


Catalogue of terrestrial isopods (Isopoda, Oniscidea) from Peru, with new records of *Circoniscus ornatus* (Scleropactidae) and *Ethelum americanum* (Eubelidae)

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ABSTRACT

This work aims to list all known species of terrestrial isopods from Peru until September, 2020. Also, *Circoniscus ornatus* (Verhoeff, 1941) (Scleropactidae) and *Ethelum americanum* (Dollfus, 1896) (Eubelidae) are recorded for the first time from Nueva Alianza and Nuevo Sucre, Contamana, Loreto department, Peruvian Amazon rainforest.

KEYWORDS

Neotropics, New records, Nueva Alianza, Nuevo Sucre, Oniscidea

INTRODUCTION

Terrestrial isopods (Oniscidea) are one of the most diverse groups within Isopoda due to their morphophysiological, ecological, and behavioral adaptations, which allowed a successful colonization of almost all terrestrial habitats since ancient geological periods (for a more comprehensive overview, see Schmalfuss, 1984; Hornung, 2011; Broly *et al.*, 2013; Richardson and Araujo, 2015; Sfenthourakis and Hornung, 2018; Taiti, 2018). The Oniscidea comprise more than 3,700 species in more than 500 genera and 38 families (Schmalfuss, 2003; Javidkar *et al.*, 2015; Sfenthourakis and Taiti, 2015).

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The group has a worldwide distribution (Schmalfuss, 2003), conditioned by biotic (*e.g.*, vegetation heterogeneity and available food sources), abiotic (*e.g.*, temperature and humidity), and anthropogenic factors (*e.g.*, uses and fragmentation of land and urbanization) at different spatial scales (Warburg, 1984; Fraj *et al.*, 2010; Sfenthourakis and Hornung, 2018). This diversity is reduced or completely absent in places with very harsh conditions and in extreme latitudes (Arctic habitats) and altitudes with elevation above 4800 m a.s.l. in both hemispheres (Van Klinken and Green, 1991; Beron, 1997).

Oniscidean ecological importance relies on their contribution as “key regulators” in ecosystem processes, specifically in decomposing organic matter (*e.g.*, leaf litter, decayed wood and other organisms), nutrient recycling, and the trophic chain. Their outstanding biology also has led them to be used in environmental monitoring as bioindicators and bioaccumulators (Paoletti and Hassall, 1999; Zimmer, 2002; Quadros and Araujo, 2008; David and Handa, 2010).

Among Neotropical countries, Peru exhibits a wide range of ecosystems in its four natural regions (Coast, Andean, Yunga, and Rainforest) (MINAM, 2015), in which forests dominate, in particular: coastal dry forest, western montane forest, inter-Andean forest, high Andean forest, montane cloud forest, premontane forest, and lowland forest (MINAM, 2014). However, information about oniscidean diversity from Peru is very scarce (Del Solar *et al.*, 1970; Leistikow and Wägele, 1999; Schmalfuss, 2003) even though they are often mentioned vaguely and collectively as a group (Isopoda) in a few types of studies on soil macrofauna (*e.g.*, Lavelle and Pashanasi, 1989; Pashanasi, 2001; Tapia-Coral *et al.*, 2002; 2012; 2014; Burgos and Huamani, 2021), as well as in gray literature.

This work lists all known species of terrestrial isopods from Peru until September, 2020. Moreover, *Ethelium americanum* (Dollfus, 1896) (Eubelidae) and *Circoniscus ornatus* (Verhoeff, 1941) (Scleropactidae) are recorded for the first time from the department of Loreto.

MATERIAL AND METHODS

The checklist is based on an extensive bibliographic survey on Oniscidea from Peru. The list includes

publications with original descriptions and synonyms mentioning species occurring in Peru. Geographic distribution and some ecological remarks are also considered.

All new material was preserved in 70 % alcohol and deposited in the Museum of Natural History Collection in San Agustín National University, Arequipa, Peru (MUSA). The images were obtained using a NIKON binocular stereomicroscope model SMZ745T and a mounted TOUPCAM camera E3ISPM. New records have been incorporated into the checklist.

Regarding nomenclature and taxonomy, we follow Schmalfuss (2003) and Schmidt (2007) and the updated database in the World Register of Marine Species (WoRMS) (<https://www.marinespecies.org/>).

Study area for new records

The area included two localities in the department of Loreto, south of the city of Contamana. Nueva Alianza is located in the buffer zone of Cordillera Azul National Park (Fig. 1) and comprises a floodplain forest with a predominance of *Cecropia* sp. (cetico), palms and patches of yucca, banana, and papaya crops (Fig. 2A). The locality of Nuevo Sucre (Fig. 1) includes a low hill forest with vegetation mainly composed of *Apeiba* sp. (monkey comb), *Astrocaryum* sp., *Phytelephas* sp. (yarina) and also patches of cocoa, cob, yucca, and banana crops (MINAM, 2015) (Fig. 2B).

For new reports, specimens of *E. americanum* and *C. ornatus* were collected in November 2019, at the beginning of the rainy season. Manual sampling was performed in four microhabitats: a marsupial's skull (*Philander* sp.) (Fig. 2C), decayed termite nests (Fig. 2D), rotten logs (Fig. 2E, F), under the bark of trees and decayed pseudostem of banana plants.

RESULTS

Checklist

A total of 24 species of terrestrial isopods have been reported from Peru, classified in the genera: *Ligia* (Ligiidae, one sp.), *Andenoniscus* (Philosciidae, one sp.), *Androdeloscia* (Philosciidae, eight spp.), *Benthanoides* (Philosciidae, two spp.), *Erophiloscia* (Philosciidae, two spp.), *Ischioscia* (Philosciidae, four spp.), *Scleropactes* (Scleropactidae, one sp.),

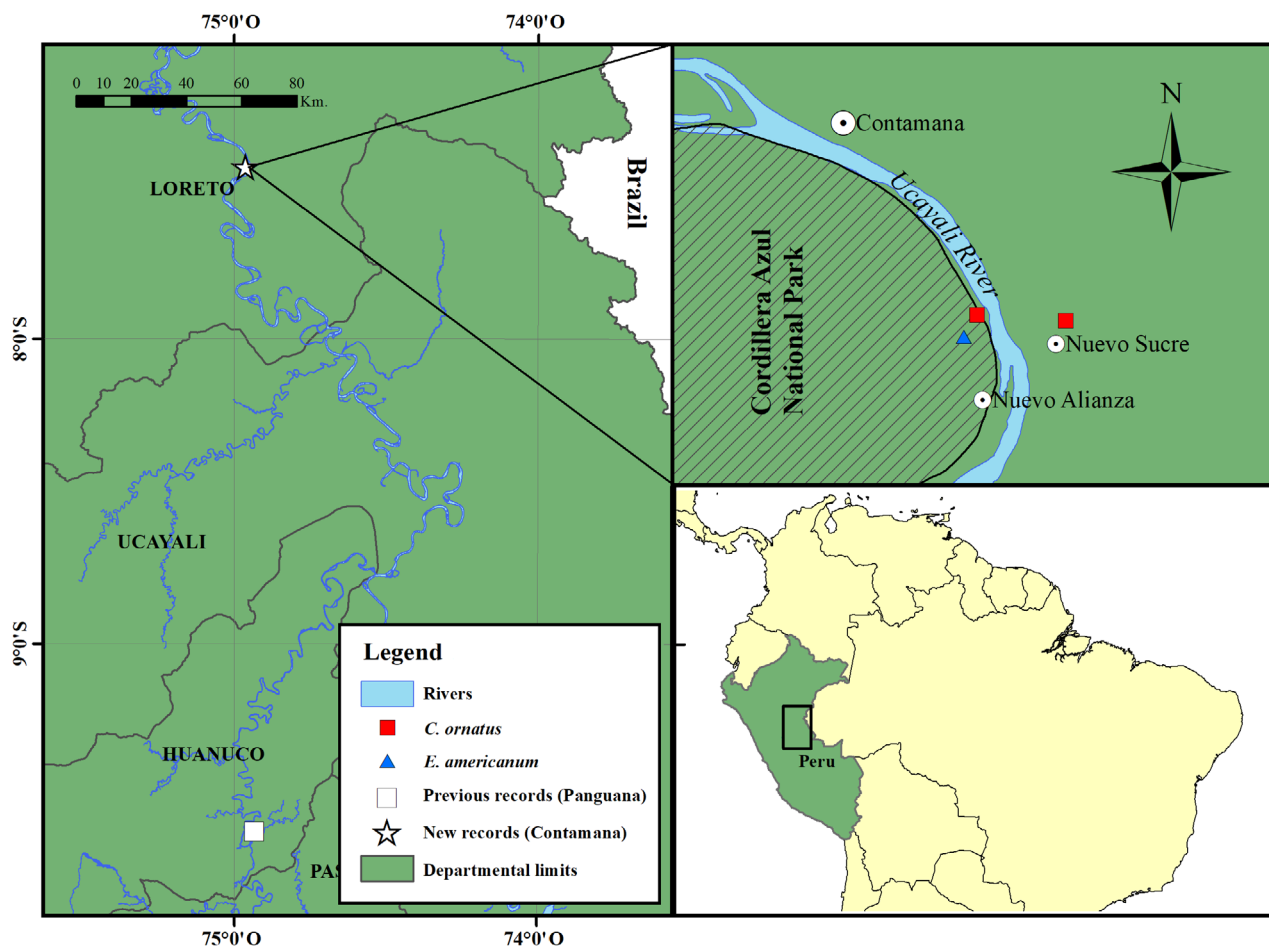


Figure 1. Map of the study area showing the collection sites of Nueva Alianza and Nuevo Sucre, Contamana, province of Ucayali, department of Loreto, Peru. The white square indicates previous records of *Circoniscus ornatus*, and the white star indicates the new records of *Circoniscus ornatus* and *Ethelum americanum*.

Circoniscus (Scleropactidae, one sp.), *Rhyscotoides* (Rhyscotidae, one sp.), *Ethelum* (Eubelidae, one sp.), *Porcellio* (Porcellionidae, one sp.) and *Porcellionides* (Porcellionidae, one sp.). To date, terrestrial isopod species have been recorded from eight of the 24 departments in the country: Huánuco, Lambayeque, La Libertad, Cajamarca, Ayacucho, Lima, Ica, and Loreto. Eighteen species have a restricted distribution in the country, two species are cosmopolitan, four species have an American distribution and two species recorded from Peru are considered as *nomina dubia*: *Ischioscia nitida* = *Philougria nitida* (Miers, 1877) and *Scleropactes peruvianus* = *Sphaeroniscus peruvianus* (Budde-Lund, 1885) (Schmalzfuss, 2003; Schmidt, 2007).

Systematic Account

Family Ligiidae Leach, 1814

Genus *Ligia* Fabricius, 1798

1. *Ligia* (*Nesoligia*) *novizealandiae* (Dana, 1853)

Lygia novi-zealandiae Dana, 1853: 739, pl. XLIX, fig. 2a–d.

Ligia (*Nesoligia*) *novae-zelandiae* — Van Name, 1936: 54–56, fig. 5h–12. — Strouhal, 1961: 187–189, figs. 1–9. — Del Solar *et al.*, 1970: 15.

Ligia novaezealandiae — Pastor *et al.*, 2017: 330. — Ramírez *et al.*, 2015: 30.

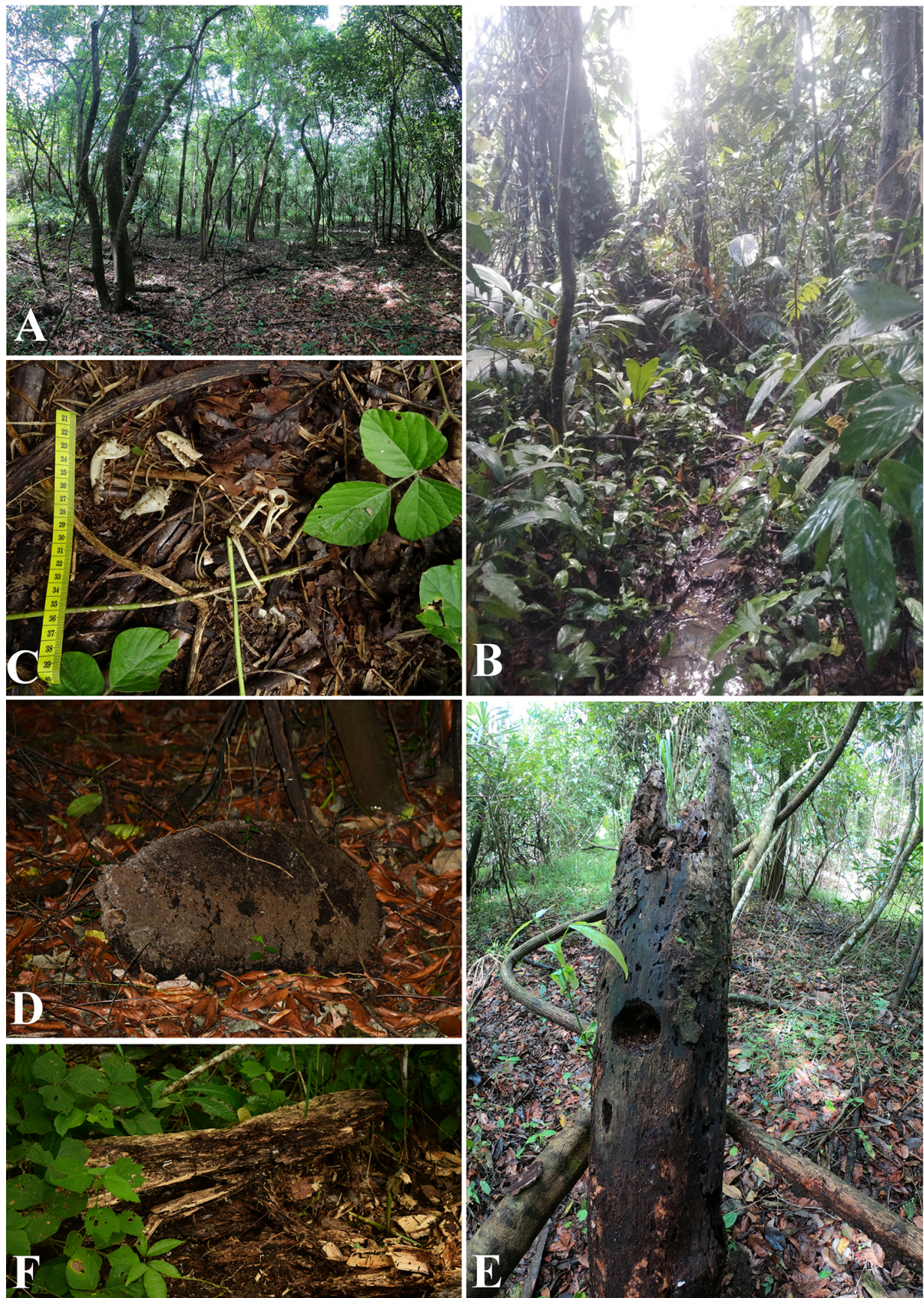


Figure 2. Photos of the habitats in the collection sites: **A**, Meandering floodplain (Nueva Alianza); **B**, low hill forest (Nuevo Sucre). Microhabitats: **C**, *Philander* sp. skull; **D**, decayed termite nests; **E**, **F**, rotten logs.

Ligia litigiosa — Schmalzfuss, 2003: 144. — Pérez-Schultheiss, 2009: 54.

Distribution. Coasts of New Zealand, Kermadec islands, and Chile (Juan Fernández Islands, Tierra del Fuego, Bahía “Carumhilla”, Bahía La Herradura and Bahía de Concepcion and Coquimbo) (Schmalzfuss, 2003; Pérez-Schultheiss, 2009). In Peru, it is recorded from the department of Ica, Chincha Islands and Ballestas Islands; department of Lima, Salto del Frayle near Chorrillos, “Galapago Island” beach in front of Pucusana district (Strouhal, 1961; Del Solar *et al.*, 1970; Pastor *et al.*, 2017); and department of Lambayeque, Lobos de Tierra Island (Ramírez *et al.*, 2015).

Family Philosciidae Kinahan, 1857

Genus *Andenoniscus* Verhoeff, 1941

2. *Andenoniscus silvaticus* Verhoeff, 1941

Andenoniscus silvaticus Verhoeff, 1941a: 71–75, Abb. 1–7. — Del Solar *et al.*, 1970: 15. — Leistikow, 1998: 216, figs. 1, 2. — Schmalzfuss, 2003: 20.

Distribution. To date, this species is recorded only from the department of Ayacucho, districts of Sivia and Ayna (Del Solar *et al.*, 1970; Leistikow, 1998; Schmalzfuss, 2003).

Genus *Androdeloscia* Leistikow, 1999

3. *Androdeloscia conipus* Leistikow, 1999

Androdeloscia conipus Leistikow, 1999: 818, figs. 4–7. — Schmalzfuss, 2003: 20.

Distribution. To date, this species is recorded only from the department of Huánuco, Panguana Biological Station, Peru (Leistikow, 1999; Schmalzfuss, 2003).

4. *Androdeloscia feistae* Leistikow, 1999

Androdeloscia feistae Leistikow, 1999: 819, figs. 8–11. — Schmalzfuss, 2003: 21. — Schmidt and Leistikow, 2005: 128.

Androdeloscia plicatipus Leistikow, 1999: 821, figs. 12–15. — Schmalzfuss, 2003: 21.

Distribution. To date, this species is recorded only from the department of Huánuco, Panguana Biological Station, Peru (Leistikow, 1999; Schmalzfuss, 2003; Schmidt and Leistikow, 2005).

5. *Androdeloscia ferrarai* Leistikow, 1999

Androdeloscia ferrarai Leistikow, 1999: 826, figs. 30–34. — Schmalzfuss, 2003: 21.

Distribution. To date, this species is recorded only from the department of Huánuco, Panguana Biological Station, Peru (Leistikow, 1999; Schmalzfuss, 2003).

6. *Androdeloscia longiunguis* Leistikow, 1999

Androdeloscia longiunguis Leistikow, 1999: 825, figs. 26–29. — Schmalzfuss, 2003: 21.

Distribution. To date, this species is recorded only from the department of Huánuco, Panguana Biological Station, Peru (Leistikow, 1999; Schmalzfuss, 2003).

7. *Androdeloscia malleus* Leistikow, 1999

Androdeloscia malleus Leistikow, 1999: 829, figs. 39–43. — Schmalzfuss, 2003: 21.

Distribution. To date, this species is recorded only from the department of Huánuco, Panguana Biological Station, Peru (Leistikow, 1999; Schmalzfuss, 2003).

8. *Androdeloscia merolobata* Leistikow, 1999

Androdeloscia merolobata Leistikow, 1999: 823, figs. 21–25. — Schmalzfuss, 2003: 21.

Distribution. To date, this species is recorded only from the department of Huánuco, Panguana Biological Station, Peru (Leistikow, 1999; Schmalzfuss, 2003).

9. *Androdeloscia poeppigi* Leistikow, 1999

Androdeloscia poeppigi Leistikow, 1999: 828, figs. 35–38. — Schmalzfuss, 2003: 21.

Distribution. To date, this species is recorded only from the department of Huánuco, Panguana Biological Station, Peru (Leistikow, 1999; Schmalfuss, 2003).

10. *Androdeloscia taitii* Leistikow, 1999

Androdeloscia taitii Leistikow, 1999: 822, figs. 16–20. — Schmalfuss, 2003: 21. — Schmidt and Leistikow, 2005: 128.

Distribution. To date, this species is recorded only from the department of Huánuco, Panguana Biological Station, Peru (Leistikow, 1999; Schmalfuss, 2003).

Genus *Benthanoides* Lemos de Castro, 1958

11. *Benthanoides peruensis* (Gruner, 1955)

Benthana peruensis Gruner, 1955: 449, Abb. 1–4, 18–24. — Leistikow and Wägele, 1999: 14.

Benthanoides peruensis — Lemos de Castro, 1958: 85. — Schmalfuss, 2003: 62.

Distribution. To date, this species is recorded only from the department of Lima, western Andes near Matucana City, Peru (Gruner, 1955; Lemos de Castro, 1958; Leistikow and Wägele, 1999; Schmalfuss, 2003).

12. *Benthanoides villosus* (Jackson, 1926)

Philoscia (Benthana) villosa Jackson, 1926: 195, pl. VII, figs. 145–151. — Van Name, 1936: 133, fig. 64.

Benthana villosa — Gruner, 1955: 451. — Ellis and Lincoln, 1975. — Leistikow and Wägele, 1999: 14.

Benthanoides villosa — Lemos de Castro, 1958: 85.

Benthanoides villosus — Schmalfuss, 2003: 62.

Distribution. To date, this species is recorded only from the department of Lima, western Andes near Matucana City, Peru (Jackson, 1926; Van Name, 1936; Gruner, 1955; Lemos de Castro, 1958; Leistikow and Wägele, 1999; Schmalfuss, 2003).

Genus *Erophiloscia* Vandel, 1972

13. *Erophiloscia acanthifera* Leistikow, 2001

Erophiloscia acanthifera Leistikow, 2001a: 44, figs. 12–16.

Distribution. To date, this species is recorded only from the department of Huánuco, Panguana Biological Station, Peru (Leistikow, 2001a).

14. *Erophiloscia recurvata* Leistikow, 2001

Erophiloscia recurvata Leistikow, 2001a: 39, figs. 8–11.

Distribution. To date, this species is recorded only from the department of Huánuco, Panguana Biological Station, Peru (Leistikow, 2001a).

Genus *Ischioscia* Verhoeff, 1928

15. *Ischioscia hanagarthi* Schmalfuss, 1980

Ischioscia hanagarthi Schmalfuss, 1980a: 134, figs. 15–20. — Leistikow and Wägele, 1999: 17. — Schmalfuss, 2003: 132. — Leistikow and Schmidt, 2002: 175.

Distribution. To date, this species is recorded only from the department of Huánuco, Panguana Biological Station, Peru (Schmalfuss, 1980a; 2003).

16. *Ischioscia longicauda* Schmalfuss, 1980

Ischioscia longicauda Schmalfuss, 1980a: 135, figs. 21–26. — Leistikow and Wägele, 1999: 17. — Schmalfuss, 2003: 132. — Leistikow and Schmidt, 2002: 175.

Distribution. To date, this species is recorded only from the department of Huánuco, Panguana Biological Station, Peru (Schmalfuss, 1980a; 2003).

17. *Ischioscia stenocarpa* Schmalfuss, 1980

Ischioscia stenocarpa Schmalfuss, 1980a: 132, figs. 9–14. — Leistikow and Wägele, 1999: 17. — Schmalfuss, 2003: 133. — Leistikow and Schmidt, 2002: 175.

Distribution. To date, this species is recorded only from the department of Huánuco, Panguana Biological Station, Peru (Schmalfuss, 1980a; 2003).

18. *Ischioscia variegata* (Dollfus, 1893)

Philoscia variegata Dollfus, 1893: 343, pl. X, fig. 10a–d.

Philoscia (Ischioscia) variegata — Van Name, 1936: 118-123, figs. 54-56 — Del Solar *et al.*, 1970: 15.

Distribution. Panama, Venezuela, French Guiana?, Lesser Antilles: Dominica? (Schmalzfuss, 2003). In Peru, it is recorded from department of Cajamarca (Van Name, 1936); department of Lima, Salto del Frayle near district of Chorrillos (Del Solar *et al.*, 1970).

Family Scleropactidae Verhoeff, 1938

Genus *Circoniscus* Pearse, 1917

19. *Circoniscus ornatus* (Verhoeff, 1941)

Fig. 3A

Parcirconiscus ornatus Verhoeff, 1941b, 169, figs. 1–9.

Circoniscus gagei — Schmalzfuss, 1980b: 4. — Leistikow and Wägele, 1999: 38. — Schmalzfuss, 2003: 81.

Circoniscus ornatus — Schmidt, 2007: 68, figs. 209–216.

Material examined. 24♀, 9♂, 39 manca (MUSA-ENT-ISO 001), Nueva Alianza, Contamana, Loreto, 7°24'49.95"S 74°57'43.44"W, November 2019, leg. A. Ocampo and C. Ruelas; 65♀, 13♂, 12 manca (MUSA-ENT-ISO 002), 7°24'37.81"S 74°57'42.69"W, same data as previous; 6♀, 6♂, 2 manca (MUSA-ENT-ISO 003), 7°24'38.52"S 74°57'54.92"W, same data as previous; 24♀, 12♂, 8 manca (MUSA-ENT-ISO 004), 7°24'52.53"S 74°58'1.68"W, same data as previous; 12♀, 8♂, 4 manca (MUSA-ENT-ISO 005), 7°24'47.90"S 74°57'52.70"W, same data as previous;

14 ♀, 1♂ (MUSA-ENT-ISO 006), 7°24'31.72"S 74°57'46.08"W, same data as previous; 18♀, 1♂ (MUSA-ENT-ISO 007), Nuevo Sucre, Contamana, Loreto, 7°24'47.21"S 74°56'8.51"W, same data as previous; 91♀, 29♂, 34 manca (MUSA-ENT-ISO 008), 7°25'1.24"S 74°56'5.76"W, same data as previous; 2♀, 1 manca (MUSA-ENT-ISO 009), 7°25'18.21"S 74°56'19.50"W, same data as previous.

Distribution. Guyana, Surinam, and Brazil (Amapá, Amazonas, and Pará States) (Schmidt, 2007; Boyko *et al.*, 2008a; Campos-Filho *et al.*, 2018). It is recorded in Peru from the department of Huánuco, Panguana Biological Station (Schmalzfuss, 1980b; Leistikow and Wägele, 1999; Schmalzfuss, 2003; Schmidt, 2007; Boyko *et al.*, 2008a). The present article extends the knowledge of its distribution to the department of Loreto, in the buffer zone of the Cordillera Azul National Park (Nueva Alianza) and the locality of Nuevo Sucre.

Ecological remarks. Specimens were collected from inside a marsupial's skull (*Philander* sp.); decayed termite nests on the leaf litter, a few of them with some termites present; in cavities inside rotten logs and also under the bark of trees, all located in Nueva Alianza (Fig. 2C–E.). In Nuevo Sucre locality, *C. ornatus* was observed under pseudostem of decayed banana plants and inside rotten logs (Fig. 2F). The isopods shared the microhabitats with ants, termites, roaches, millipedes, centipedes, spiders, mosquitoes, and frogs.

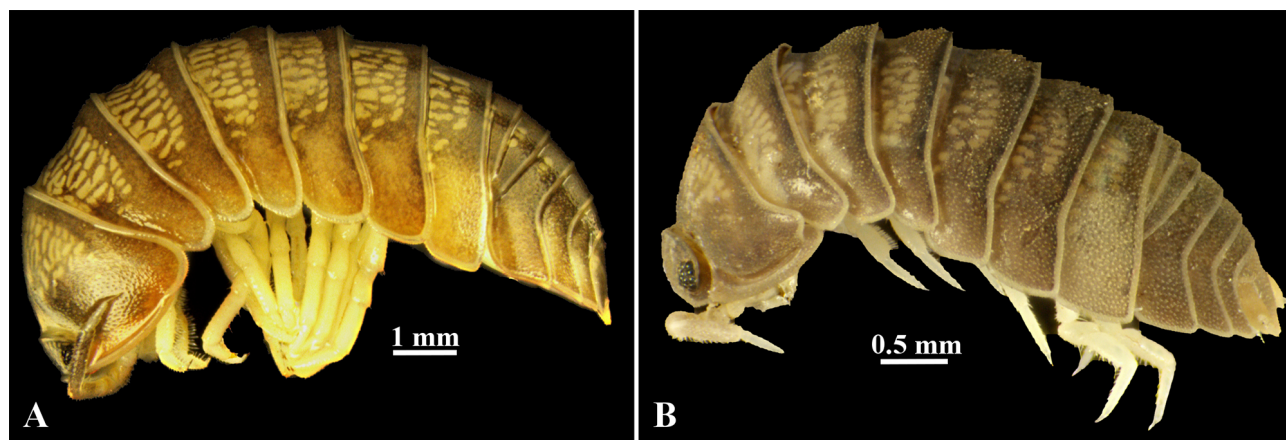


Figure 3. Habitus in lateral view of: A, *Circoniscus ornatus* (Verhoeff, 1941); B, *Ethelum americanum* (Dollfus, 1896).

Genus *Scleropactes* Budde-Lund, 1885**20. *Scleropactes incicus* Budde-Lund, 1885**

Scleropactes incicus Budde-Lund, 1885: 241. — Jeppesen, 2000: 243. — Schmidt, 2007:46. — Leistikow and Wägele, 1999: 40. — Schmalfuss, 2003: 267.

Distribution. Peru (Budde-Lund, 1885; Schmalfuss, 2003; Schmidt, 2007).

Family Rhyscotidae Budde-Lund, 1904**Genus *Rhyscotoides* Schmalfuss and Ferrara, 1978****21. *Rhyscotoides ortonedae* (Budde-Lund, 1908)**

Rhyscotus ortonedae Budde-Lund, 1908: 299–300, figs. 11–31.

Rhyscotus ortonedae — Del Solar *et al.*, 1970: 15.

Distribution. Samoa, Ecuador, Province of Guayas (Schmalfuss, 2003). In Peru, it is recorded from department La Libertad, province of Trujillo (Del Solar *et al.*, 1970).

Family Eubelidae Budde-Lund, 1899**Genus *Ethelum* Budde-Lund, 1899****22. *Ethelum americanum* (Dollfus, 1896)**

Fig. 3B

Mesarmadillo americanus Dollfus, 1896: 397–398, fig. 11.

Material examined. 6♀, 2♂ (MUSA-ENT-ISO 010), Nueva Alianza, Contamana, Loreto, 7°24'49.95"S 74°57'43.44"W, November 2019, leg. A. Ocampo and C. Ruelas; 14♀, 4♂ (MUSA-ENT-ISO 011), 7°24'37.81"S 74°57'42.69"W, same data as previous; 37♀, 22♂, 3 manca (MUSA-ENT-ISO 012), 7°24'38.52"S 74°57'54.92"W, same data as previous; 20♀, 4♂ (MUSA-ENT-ISO 013), 7°24'52.53"S 74°58'1.68"W, same data as previous; 15♀, 7♂, 6 manca (MUSA-

ENT-ISO 014), 7°24'47.90"S 74°57'52.70"W, same data as previous.

Distribution. Lesser Antillas, French Guiana, Guyana, northern Venezuela and Brazil (Pará State: Apeú, Castanhal) (Schmidt, 2003; Schmalfuss, 2003; Boyko *et al.*, 2008b; Campos-Filho *et al.*, 2018). In Peru it is recorded from the department of Loreto, in the buffer zone of the Cordillera Azul National Park (Nueva Alianza). This work provides the first record of this species for Peru and considerably extends its distribution.

Ecological remarks. The specimens were collected in a floodplain forest at Nueva Alianza, sharing the same microhabitats with *C. ornatus* except for the marsupial's skull.

Family Porcellionidae Brandt, 1831**Genus *Porcellio* Latreille, 1804****23. *Porcellio laevis* Latreille, 1804**

Porcellio laevis Latreille, 1804: 46.

Porcellio (*Porcellionides*) *aztecus* — Miers, 1877: 669.

Porcellio laevis — Verhoeff, 1941a: 76. — Del Solar *et al.*, 1970: 15. — Aguilar, 1976: 67. — Aguilar, 1981: 131. — Iannacone *et al.*, 2001.

Distribution. Species of European and Mediterranean original distribution, now cosmopolitan due to introductions through human activities (Leistikow and Wägele, 1999; Schmalfuss, 2003). It is recorded in Peru from the departments of Lima (Miers, 1877), La Libertad, province of Trujillo; and Ayacucho, near the Yucaes River (Verhoeff, 1941a; Del Solar *et al.*, 1970; Aguilar, 1976; 1981; Iannacone *et al.*, 2001).

24. *Porcellionides pruinosus* (Brandt, 1833)

Porcellio pruinosus Brandt, 1833:181.

Porcellio (*Porcellionides*) *jelskii* — Miers, 1877: 668, pl. LXVIII fig. 3.

Metoponorthus pruinosus — Verhoeff, 1941a: 76.

Porcellionides pruinosus — Del Solar *et al.*, 1970: 15.

Distribution. Species of Mediterranean origin, now with a synanthropic cosmopolitan distribution (Schmalfuss, 2003). In Peru, it is recorded from the department of Lima, department La Libertad, province of Trujillo; and department of Ayacucho, province of Cangallo and province of Lucanas, district of San Pedro de Palco, in southern Peru (Del Solar *et al.*, 1970).

DISCUSSION

The first descriptions and records of Peruvian terrestrial isopods date back to the second half of the 19th century (Miers, 1877; Budde-Lund, 1885), based on study material collected by foreign scientific expeditions. The richness of this group of crustaceans had a gradual increase in the last two centuries until reaching a total of 24 species, a figure that in turn is very low compared to other countries in South America, such as Brazil, whose species register approximately 192 (Campos-Filho *et al.*, 2020).

The records of terrestrial isopods of Peru come from the departments of Lambayeque, Cajamarca, La Libertad (North of Peru); Lima, Huánuco (Center of Peru); Ica, Ayacucho (South of Peru); and Loreto (Northeast of Peru). The species are mostly present in low and medium altitudinal ranges (0 to 2,615 m a.s.l.). According to bibliographic references, some occurrence habitats are: supralittoral zones in the rocky intertidal shores to amphibious species like *Ligia* sp. (Carefoot and Taylor, 1995), coastal hills (Aguilar, 1976; López *et al.*, 1978; Burgos and Huamaní, 2021), gardens in urban areas, orchards, and cultivated areas (*e.g.*, commonly synanthropic species) (Aguilar, 1981; Iannacone *et al.*, 2001), valleys from the western Andes (*e.g.*, *Benthonoides* spp.) (Lemos de Castro, 1958), and tropical amazon rainforest (*e.g.*, *Androdeloscia* spp., *Erophiloscia* spp., *Ischioscia* spp., and *Circoniscus*) (Schmalfuss, 1980b; Leistikow, 1998, 1999, 2001a; Schmalfuss, 2003). For the species *S. incicus* habitat data in Peru is not known.

The *nomina dubia* mentioned in this manuscript as *Scleropactes peruvianus* = *Sphaeroniscus peruvianus* (Budde-Lund, 1885) was described from an incomplete specimen which was then destroyed (Schmidt, 2007) and *Ischioscia nitida* = *Philougria nitida* described

by Miers (1877) does not mention if the original description is based on a male or female holotype and actually the specimen is not available. Nevertheless six females syntypes are stored in the British Museum collection's (Ellis and Lincoln, 1975; Leistikow, 2001b). Both species do not have a specific type locality in Peru (Leistikow, 2001b; Schmidt, 2007).

The department with the largest number of records is Huánuco (district of Puerto Inca, Yuyapichis River, Panguana Biological Station), with 14 sympatric species (Leistikow, 1999; Schmalfuss, 2003) belonging to one of the most diverse families in genera and species (Philosciidae) (Schmidt, 2003; López-Orozco *et al.*, 2017). Leistikow (2001b) considers such a large number of species found in one location as an interesting finding that could go beyond the "sampling artifact" produced by a systematic collection and more due to speciation processes in one of the many centers of endemism (hot-spot) in the country (Rodríguez and Young, 2000; MINAM, 2008; Brack and Mendiola, 2010).

At the same place, Dr. Werner Hanagarth, between 1975 and 1976, collected the first specimens (364 individuals) of *C. ornatus* (see Schmalfuss, 1980a; Schmidt, 2007). In 1981, Dr. Michael Von Tschirnhaus collected the same species in the same locality mentioned above, at 260 m a.s.l. (Schmidt, 2007). In this latter work, the occurrence of this species is extended to northern Peru on a floodplain (Nueva Alianza) and in a hill forest (Nuevo Sucre). These localities are situated on both sides of the Ucayali River (Fig. 1). The type locality of *E. americanum* is the Caribbean island of Saint Vincent and the Grenadines (Lesser Antilles) in the Caribbean Sea and specimens were first procured by Mr. Herbert H. Smith between the years 1889–1891 as part of the investigation of the Fauna of the West-India Island carried out by the Joint Committee of the Royal Society and the British Association (Dollfus, 1896; Pearse, 1917; Van Name, 1936; Jass and Klausmeier, 2006). Our specimens were collected at an altitude range of 128 to 153 m a.s.l. in Nueva Alianza, and 136 to 194 m a.s.l. in Nuevo Sucre. *Ethelum americanum* and *Circoniscus ornatus* were found in areas modified by man (Schmidt, 2002), preferring saproxilic microhabitats (Marmaneu *et al.*, 2019) and decayed termite nests (termitariophilous) (Lisboa *et al.*, 2013).

The scarcity of studies on Oniscidea taxonomy, ecology and, even in areas such as conservation biology (*e.g.*, population status), in addition to the lack of specialists in the group, results in insufficient documentation of the Peruvian terrestrial oniscifauna. Faced with a scenario that has become less favorable to biodiversity in general, it is not possible to establish an approximation of the response that terrestrial isopods may have to the threats of anthropogenic pressure, climate change, loss of habitats, fragmentation of land, pollution, among other factors (Voy May *et al.*, 2012). This catalogue is the first attempt to provide a starting point for future research on these organisms at the national level, recognizing their importance in ecosystems.

Finally, much of the Peruvian territory still remains unexplored as far as Oniscidea are concerned, and in a similar way to other invertebrate taxa, more research support will be needed to enrich the checklist, clarify some taxonomic problems and fill information gaps.

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REFERENCES

- Aguilar, P. 1976. Fauna desértico-costera peruana. I. Invertebrados más frecuentes en las Lomas. *Revista Peruana de Entomología*, 19: 67–70.
- Aguilar, P. 1981. Fauna desértico-costera peruana. VII: Apreciaciones sobre diversidad de invertebrados en la costa central. *Revista Peruana de Entomología*, 24: 127–132.
- Beron, P. 1997. On the High Mountain Isopoda Oniscidea in the Old World. *Historia Naturalis Bulgarica*, 8: 85–100.
- Boyko, C.B.; Bruce, N.L.; Hadfield, K.A.; Merrin, K.L.; Ota, Y.; Poore, G.C.B.; Taiti, S.; Schotte, M. and Wilson, G.D.F. 2008a. [*Circoniscus ornatus* (Verhoeff, 1941)]. World Marine, Freshwater and Terrestrial Isopod Crustaceans database. Available from: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=883273>. Accessed on 18 April 2020.
- Boyko, C.B.; Bruce, N.L.; Hadfield, K.A.; Merrin, K.L.; Ota, Y.; Poore, G.C.B.; Taiti, S.; Schotte, M. and Wilson, G.D.F. 2008b. [*Ethelum americanum* (Dollfus, 1896)]. World Marine, Freshwater and Terrestrial Isopod Crustaceans database. Available from: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=260279>. Accessed on 18 April 2020.
- Brack, A. and Mendiola, C. 2010. Ecología del Perú. Parte III. Los Recursos Naturales y su uso sostenible. Lima, Perú, Bruño, 371p.
- Brandt, I.F. 1833. Conspectus monographiae crustaceorum oniscodorum Latreillii. *Bulletin de la Societe Imperiale des Naturalistes de Moscou*, 4: 171–193.
- Broly, P.; Deville, P. and Maillet, S. 2013. The origin of terrestrial isopods (Crustacea: Isopoda: Oniscidea). *Evolutionary Ecology*, 27: 461–476.
- Budde-Lund, G. 1885. Crustacea Isopoda Terrestria per Familias et Genera et Species Descripta. Copenhagen, Nielsen & Lydiche, 319p.
- Budde-Lund, G. 1908. Isopoda von Madagaskar und Ostafrika mit Diagnosen verwandter Arten. p. 265–308 In: A. Voeltzkow (ed), *Reise in Ostafrika in dem Jahren 1903-1905. Vol 2.* Stuttgart, Wissenschaftliche Ergebnisse.
- Burgos, A. and Huamaní, C. 2021. Diversity of Terrestrial Arthropods in Asia Hills, Lima, Peru. *The Biologist (Lima)*, 19: 141–153.
- Campos-Filho, I.S.; Cardoso, G.M. and Aguiar, J.O. 2018. Catalogue of terrestrial isopods (Crustacea, Isopoda, Oniscidea) from Brazil: an update with some considerations. *Nauplius*, 26: e2018038.
- Campos-Filho, I.S.; Gadelha, I.M.; da Costa, E.; de Lima, A.; Coelho, D. and Otávio, J. 2020. Two new records of terrestrial isopods (Isopoda, Oniscidea) from the state of Paraíba, Brazil. *Nauplius* 28: e2020006.
- Carefoot, T.H. and Taylor, B.E. 1995. *Ligia*: A prototypal terrestrial isopod. p. 47–60. In: M.A. Alikhan (ed), *Terrestrial Isopod Biology. Crustacean issues 9.* Rotterdam, The Netherlands, A.A. Balkema Publishers.

- Dana, J.D. 1853. Crustacea, Part II. Isopoda. United States exploring Expedition during the Years, 1838, 1839, 1840, 1841, 1942 under the command of Charles Wilkes, U.S.N., Vol. 14. Philadelphia, C. Sherman, p. 696–805, pls. 46–53.
- David, J.F. and Handa, I.T. 2010. The ecology of saprophagous macroarthropods (millipedes, woodlice) in the context of global change. *Biological Reviews*, 85: 881–895.
- Del Solar, E.M.; Blancas, F. and Mayta, R. 1970. Catálogo de Crustáceos del Peru. Lima, Peru, privately printed, 53p.
- Dollfus, A. 1893. Voyage de M.E. Simon au Venezuela (Decembre 1887-Avril 1888) 25 mémoire. Isopodes terrestres. *Annales de la Societe Entomologique de France*, 62: 339–346.
- Dollfus, A. 1896. On West Indian terrestrial isopod crustaceans. *Proceedings of the Zoological Society of London*, 1896: 388–400.
- Ellis, J.P. and Lincoln, R.J. 1975. Catalogue of the types of terrestrial isopods (Oniscoidea) in the collections of the British Museum (Natural History). II. Excluding pseudotracheata. *Bulletin of the British Museum Natural History, Zoology*, 28: 65–100.
- Fraj, M.; Cheikhrouha, F.C. and Grosset, C.S. 2010. Terrestrial isopods diversity related to irrigation and agricultural practices in North-East of Tunisia. *Anadolu Journal of Agricultural Sciences*, 25(S-3): 217–223.
- Gruner, H.E. 1955. Die Gattung *Benthana* Budde-Lund, 1908 (Isopoda, Oniscoidea). *Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere*, 83: 441–452.
- Hornung, E. 2011. Evolutionary adaptation of oniscidean isopods to terrestrial life: Structure, physiology and behavior. *Terrestrial Arthropod Reviews*, 4: 95–130.
- Iannacone, J.; Alayo, M.; Abanto, M.; Sánchez, J. and Zapata, E. 2001. *Porcellio laevis* Latreille, 1804 (Isopoda: Porcellionidae) como bioindicador para la evaluación de plomo. *Revista Peruana de Entomología*, 42: 175–183.
- Jackson, H.G. 1926. Woodlice from Spain and Portugal, with an account of *Benthana*, a subgenus of *Philoscia*. *Proceedings of the Zoological Society of London*, 1926: 183–201.
- Javidkar, M.; Cooper, S.J.B.; King, R.A.; Humphreys, W.F. and Austin, A. 2015. Molecular phylogenetic analyses reveal a new southern hemisphere oniscidean family (Crustacea: Isopoda) with a unique water transport system. *Invertebrate Systematics*, 29: 554–577.
- Jass, J. and Klausmeier, B. 2006. Terrestrial isopods (Crustacea: Isopoda: Oniscoidea) of the West Indies. Insight, a Milwaukee PUBLIC Museum series in natural history, No. 3. Milwaukee, Milwaukee Public Museum, 36p.
- Jeppesen, P.C. 2000. Catalogue of terrestrial isopod taxa and type material described by Gustav Budde-Lund (Crustacea: Isopoda). *Steenstrupia*, 25: 221–265.
- Latreille, P. 1804. Histoire Naturelle, Générale et Particulière des Crustacés et des Insectes. Ouvrage Faisant Suite aux Oeuvres de Leclerc de Buffon, et Partie du Cours Complet d' Histoire Naturelle Rédigé par C.S. Sonnini. Tome Septième. Paris, F. Dufart, 412 p.
- Lavelle, P. and Pashanasi, B. 1989. Soil macrofauna and land management in Peruvian Amazonia (Yurimaguas, Loreto). *Pedobiologia*, 33: 283–291.
- Lisboa, J.T.; Couto, E.C.G.; Santos, P.P.; Delabie, J.H.C. and Araujo, P.B. 2013. Terrestrial isopods (Crustacea: Isopoda: Oniscoidea) in termite nests (Blattodea: Termitidae) in a cocoa plantation in Brazil. *Biota Neotropica*, 13: 393–397.
- Leistikow, A. 1998. Redescriptions of terrestrial Isopoda from Chile and Peru (Crustacea, Isopoda, Oniscoidea). *Spixiana*, 21: 215–225.
- Leistikow, A. 1999. *Androdeloscia* gen. n., a new genus of South American terrestrial isopoda with description of 13 new species (Crustacea: Oniscoidea: "Philosciidae"). *Revue Suisse de Zoologie*, 106: 813–904.
- Leistikow, A. 2001a. The genus *Erophiloscia* Vandel, 1972 – its phylogeny and biogeography, with description of three new species (Crustacea, Isopoda, Oniscoidea). *Spixiana*, 24: 29–51.
- Leistikow, A. 2001b. Phylogeny and biogeography of South American Crinocheta, traditionally placed in the family "Philosciidae" (Crustacea: Isopoda: Oniscoidea). *Organisms, Diversity & Evolution*, Electronic Supplement, 4: 1–85.
- Leistikow, A. and Schmidt, C. 2002. The phylogeny of the genus *Ischioscia* Verhoeff, 1928, with redescriptions of three species (Crustacea: Isopoda: Oniscoidea). *Organism Diversity and Evolution*, 2: 139–178.
- Leistikow, A. and Wägele, J.W. 1999. Checklist of terrestrial isopods of the New World (Crustacea, Isopoda, Oniscoidea). *Revista brasileira de Zoologia*, 16: 1–72.
- Lemos de Castro, A. 1958. Revisão do gênero *Benthana* Budde-Lund, 1908 (Isopoda, Oniscoidea). *Arquivos do Museu Nacional*, 44: 85–118.
- López, E.L.; Núñez, J.A. and Dávila, B.J. 1978. Fauna desértico-costera peruana. – VI: Artrópodos de las Lomas de Mollendo-Matarani (Arequipa). *Revista Peruana de Entomología*, 21: 31–38.
- López-Orozco, C.; Carpio-Díaz, Y.M.; Navas, G.R. and Campos-Filho, I.S. 2017. A new species and first record of *Pulmoniscus* Leistikow, 2001 (Isopoda, Oniscoidea, Philosciidae) from Colombia. *Nauplius*, 25:e2017014.
- Marmaneu, J.; Recuero, E.; Ballester, I. and Micó, E. 2019. Diversidad de isópodos terrestres (Isopoda, Oniscoidea) asociados a diferentes microhábitats saxícolas. *Boletín de la Asociación Española de Entomología*, 43: 269–285.
- Miers, E.J. 1877. On a collection of Crustacea, Decapoda and Isopoda, chiefly from South America, with descriptions of new genera and species. *Proceedings of the Zoological Society of London*, 1877: 653–679.
- MINAM. 2008. Diagnóstico ambiental del Perú. Lima, Ministerio del Ambiente, 69p.
- MINAM. 2014. Perú, Reino de Bosques. Lima, Ministerio del Ambiente, 157p.
- MINAM. 2015. Mapa nacional de cobertura vegetal: memoria descriptiva. Lima, Ministerio del Ambiente, Dirección General de Evaluación, Valoración y Financiamiento del Patrimonio Natural, 105p.
- Paoletti, M.G. and Hassall, M. 1999. Woodlice (Isopoda: Oniscoidea): their potential for assessing sustainability and

- use as bioindicators. *Agriculture, Ecosystems and Environment*, 74: 157–165.
- Pashanasi, B. 2001. Estudio cuantitativo de la macrofauna del suelo en diferentes sistemas de uso de la tierra en la amazonía peruana. *Folia Amazónica*, 12: 75–97.
- Pastor, R.; Gonzáles, A. and Zavalaga, F. 2017. Benthonic communities of soft and hard bottom ecosystems in intertidal and shallow subtidal. Ballestas Islands Pilot Site. September–October 2013. *Informe Instituto del Mar del Perú*, 44: 303–331.
- Pérez-Schultheiss, J. 2009. State of knowledge on terrestrial isopods (Crustacea: Isopoda: Oniscidea) of Chile, with a species checklist. *Boletín del Museo Nacional de Historia Natural, Chile*, 58: 51–66.
- Pearse, A.S. 1917. Isopoda collected by the Bryant Walker Expedition to British Guiana, with notes on Crustacea from other localities. *Occasional Papers, Museum of Zoology, University of Michigan*, 46: 1–8.
- Quadros, A.F. and Araujo, P.B. 2008. An assemblage of terrestrial isopods (Crustacea) in southern Brazil and its contribution to leaf litter processing. *Revista Brasileira de Zoologia*, 25: 58–66.
- Ramírez, P.; De la Cruz, J. and Castro, J. 2015. Marine biodiversity in the Lobos de Tierra Island, Perú. 2011. *Informe instituto del Mar del Perú*, 42: 7–34.
- Richardson, A. and Araujo, P.B. 2015. Lifestyles of terrestrial crustaceans. p. 299–336. In: M. Thiel and L. Watling (eds), *The natural history of the Crustacea. Lifestyles and feeding biology*. Oxford University Press, Oxford, U.K.
- Rodríguez, L.O. and Young, K.R. 2000. Biological Diversity of Peru: Determining Priority Areas of Conservation. *Ambio*, 29: 329–337.
- Schmalzfuss, H. 1980a. A revision of the neotropical genus *Ischioscia* Verhoeff, with descriptions of four new species (Isopoda, Philosciidae). *Studies on Neotropical Fauna and Environment*, 15: 125–139.
- Schmalzfuss, H. 1980b. Die ersten Landasseln aus Dominikanischem Bernstein mit einer systematisch phylogenetischen Revision der Familie Sphaeroniscidae (Stuttgarter Bernsteinsammlung: Crustacea, Isopoda, Oniscoidea). *Stuttgarter Beiträge zur Naturkunde*, 61: 1–12.
- Schmalzfuss, H. 1984. Eco-morphological strategies in terrestrial isopods. *Proceeding of the Zoological Society of London* 53: 49–63.
- Schmalzfuss, H. 2003. World catalog of terrestrial isopods (Isopoda: Oniscidea). *Stuttgarter Beiträge zur Naturkunde*, 654: 1–341.
- Schmidt, C. 2002. Contribution to the phylogenetic system of the Crinocheta (Crustacea, Isopoda). Part 1. (Olibrinidae to Scyphaidae s. str.). *Zoosystematics and Evolution*, 78: 275–352.
- Schmidt, C. 2003. Contribution to the phylogenetic system of the Crinocheta (Crustacea, Isopoda). Part 2 (Oniscoidea to Armadillidiidae). *Zoosystematics and Evolution*, 79: 3–179.
- Schmidt, C. 2007. Revision of the Neotropical Scleropactidae (Crustacea: Oniscidea). *Zoological Journal of the Linnean Society*, 151: 1–339.
- Schmidt, C. and Leistikow, A. 2005. Review of the genus *Androdeloscia* Leistikow, with description of four new species (Crustacea: Isopoda: Oniscidea). *Entomologische Abhandlungen*, 62: 117–163.
- Sfenthourakis, S. and Taiti, S. 2015. Patterns of taxonomic diversity among terrestrial isopods. *ZooKeys*, 515: 13–25.
- Sfenthourakis, S. and Hornung, E. 2018. Isopod distribution and climate change. *ZooKeys*, 801: 25–61.
- Strouhal, H. 1961. Die Oniscoideen-Fauna der Juan Fernández-Inseln (Crustacea, Isopoda terrestrial). *Annalen des Naturhistorischen Museums in Wien*, 64: 185–244.
- Taiti, S. 2018. Biologia e biogeografia degli isopodi terrestri (Crustacea, Isopoda, Oniscidea). *Atti dell'Accademia nazionale italiana di Entomologia*, 65: 83–90.
- Tapia-Coral, S.; Pashanasi, B. and Del Castillo, D. 2002. Estudio preliminar de la macrofauna del suelo en áreas de varillales y chamizales de la Amazonía Peruana. *Folia Amazónica*, 13: 65–86.
- Tapia-Coral, S.C.; Luizão, F.; Pashanasi, B. and Del Castillo, D. 2012. Comunidade de macro-invertebrados do solo em plantíos florestais e sistemas naturais na Amazônia Peruana. *Folia Amazónica*, 21: 33–44.
- Tapia-Coral, S.C.; Luizão, F.; Pashanasi, B.; Del Castillo, D. and Lavelle, P. 2014. Influencia da massa e nutrientes da liteira sobre a composição dos macro-invertebrados em plantíos florestais na Amazônia Peruana. *Folia Amazónica*, 23: 171–186.
- Van Klinken, R.D. and Green, A.J.A. 1991. The first record of Oniscidea (Terrestrial Isopoda) from Macquarie Island. *Polar Records*, 28: 240–242.
- Van Name, W.G. 1936. The American Land and Fresh-Water Isopod Crustacea. *Bulletin of the American Museum of Natural History*, 71: 1–535.
- Verhoeff, K.W. 1941a. Land-Isopoden. p. 73–80. In: E. Titschak (ed), *Beiträge zur Fauna Perus*. Jena, Germany, G. Fischer.
- Verhoeff, K.W. 1941b. Über eine neue südamerikanische Gattung der Isopoda terrestria. *Zoologischer Anzeiger*, 134: 169–173.
- Von May, R.; Catenazzi, A.; Angulo, A.; Venegas, P. and Aguilar, C. 2012. Research and conservation of biodiversity in Peru: importance of using modern techniques and efficient administrative processes. *Revista Peruana de Biología*, 19: 351–358.
- Warburg, M.R. 1984. The effect of climate on the distribution and abundance of isopods. *Zoological Symposium*, 53: 339–367.
- Zimmer, M. 2002. Nutrition in terrestrial isopods (Isopoda: Oniscidea): an evolutionary-ecological approach. *Biological Reviews*, 77: 455–493.