

Scientific Note

Records about the alien millipede *Oxidus gracilis* (C. L. Koch, 1847) (Diplopoda: Polydesmida: Paradoxosomatidae) in continental Chile

Registros acerca del milpiés exótico *Oxidus gracilis* (C. L. Koch, 1847) (Diplopoda: Polydesmida: Paradoxosomatidae) en Chile continental

Antonio Parra-Gómez¹

¹Facultad de Ciencias, Universidad Austral de Chile, Av. Rector Eduardo Morales Miranda 23, Valdivia, Región de Los Ríos. ✉ pg.antonio@hotmail.com

ZooBank: urn:lsid:zoobank.org:pub:9FE1BC5D-6228-48F9-93CF-E867E041709F
<https://doi.org/10.35249/rche.48.1.22.06>

Abstract. The alien polydesmid millipede *Oxidus gracilis* is recorded from continental Chile based on new material revised. The distribution in the country was mapped by combination of records from new material collected, preserved specimens and observations from the Global Biodiversity Information Facility (GBIF).

Key words: Neotropical; South America.

Resumen. El milpiés polidésmido exótico *Oxidus gracilis* es registrado en Chile continental a partir de nuevo material revisado. La distribución en el país se mapeó a partir de una combinación de registros de nuevo material recolectado, especímenes preservados y observaciones de la Global Biodiversity Information Facility (GBIF).

Palabras clave: América de Sur; Neotropical.

Diplopods are usually small detritivore invertebrates found in soil, characterized by having two pairs of legs on most of their body segments. Although most of them live near water sources, they have managed to colonize different habitats, including some extreme environments such as deserts and high mountains (Adis 2002; David 2015).

Chile has 70+ species of millipedes, with most of the species native to the country (Parra-Gómez unpublished), but some exotic species have also been recorded, the earliest record is for *Nopoiulus kochii* (Gervais, 1847) (Julida: Blaniulidae) from Iquique, port city in northern Chile, by Attems (1903). Posteriorly, Verhoeff (1924) reported 5 species such as *Cylindroiulus latestriatus* (Curtis, 1845) (Julida: Julidae) and *Brachyiulus pusillus* (Leach, 1814) (Julida: Julidae), most of them from insular territories. Later, Schubart (1964) reported *Blaniulus guttulatus* (Bosc, 1791) (Julida: Blaniulidae) and *Cylindroiulus britannicus* (Verhoeff, 1891) (Julida: Julidae) from continental Chile, citing them as “Chile in general”, without exact locality. After these publications, there are only new locality records of already known exotic millipedes in Chile by Golovatch (2014), but no further studies expanding on the effects caused by their presence in natural habitats or new exotic species has been recorded.

Oxidus gracilis is a well-known invasive species with a high adaptative potential

Received 10 December 2021 / Accepted 10 January 2022 / Published online 31 January 2022

Responsible Editor: José Mondaca E.

(Agnolin *et al.* 2019), common in urban zones and greenhouses all over Europe, Asia and some parts of temperate North and South America (Blower 1985). It is suggested that its original habitat is located in Japan and nearby islands (Nguyen *et al.* 2017) and that the species was spread through international commerce (Iniesta *et al.* 2020). This species has been constantly monitored by the myriapodological community and, in South America, it was recently reported from Uruguay (Rojas-Buffet *et al.* 2020), while an ecological niche predicting model about the potential invasion of *O. gracilis* in Atlantic Forest was also performed (Iniesta *et al.* 2020).

In Chile, *O. gracilis* was first reported from an insular territory by Verhoeff (1924), Rapa Nui (Easter Island). Later, Chamberlin (1957) incorrectly mentioned the record by Verhoeff (1924) as from Juan Fernández Islands, probably due to a misunderstanding of the aggregated species list presented for both islands by Verhoeff (1924: 417), but stated that *O. gracilis* will undoubtedly be found in continental Chile. In the present work, new records of the millipede *O. gracilis* are given from continental Chile, and former ones are reviewed.

The material examined was collected by hand in Linderos, Santiago Metropolitan Region and in Parque Nacional Fray Jorge and Salamanca, Coquimbo Region. The specimens were preserved in 70% ethanol and examined under dissecting and compound microscopes. Some materials were dissected for detailed study. The specimens were identified according to information given by Nguyen *et al.* (2017) and deposited in the collection of the Museo Nacional de Historia Natural de Chile (MNH) and personal collection of Antonio Parra-Gómez [APG]. The Database of the Zoological Collections of the Museum of Comparative Zoology, Harvard University, and records from the Global Biodiversity Information Facility (GBIF), were consulted to obtain additional records from Chile. Observations indexed from Inaturalist into GBIF was manually curated using keys provided by Recuero & García-París (2016), bad quality pictures were discarded.

Pictures were taken using a digital camera adapted to microscopes. All images were stacked using CombineZP stacking software. A distribution map with the records of *O. gracilis* taken from MCZBASE, Global Biodiversity Information Facility (GBIF 2021) and this work was created using the ecoregions shapefile disposed by Olson *et al.* (2001). Only literature regarding *O. gracilis* in Chile was used for species synonymies, with the exception of the original description. A complete list of synonymies are provided by Nguyen *et al.* (2017).

Order Polydesmida Pocock, 1887

Family Paradoxosomatidae Daday, 1889

Genus *Oxidus* Cook, 1911

Type species. *Fontaria gracilis* Koch C. L., 1847 accepted as *Oxidus gracilis* (C.L. Koch, 1847) by original designation.

Oxidus gracilis (C.L. Koch, 1847)

(Figs. 1-4)

Fontaria gracilis C.L. Koch 1847: 142.

Oxidus gracilis: Verhoeff 1924: 416, fig. 18; Chamberlin 1957: 12.

Orthomorpha gracilis: Skottsberg 1956: 418.

Material examined. *Oxidus gracilis*. 1 male. **CHILE.** Coquimbo, Choapa, Salamanca, in a water fountain MLP (sic.), 17-V-2011, col. P. Baéz, B. Collado and S. Letieler [MHNH]. 5

females, 5 males. Limarí, Bosque Fray Jorge National Park, under a log close to reedbed, park administration, 30°40'31.12" S - 71°38'9.57" W, 5-X-2017, col. Jorge Pérez Schultheiss [MHNH]. 9 females, 5 males. Santiago, Linderos, Buin, under ornamental stones in a house garden, 33°45'09" S - 70°44'16" W, 16-I-2019, e-13 (field code), col. Patricio Farah [APG]. **Additional records: CHILE.** >10 specimens (sic.). Valparaíso, Quillota, La Cruz, 18-I-1973, Col. Walter C. Sedgwick. Det. Herbert W. Levi (presumably) (Coordinates incorrectly given as "34°30'30.6720" S - 71°53'45.7404" W") (MCZBASE 2021).



Figures 1-2. *Oxidus gracilis*. 1. Lateral view, female. 2. Dorsal view, male, *collum* broken. Scale: 1 mm. / *Oxidus gracilis*. 1. Vista lateral, hembra. 2. Vista dorsal, macho, *collum* roto. Escala: 1 mm.

Descriptive notes. Length ca 18-19 mm in males, ca 20-21 in females. Width of midbody pro- and metazonae in males and females ca 1.3-1.4 and ca 1.9-2 mm respectively. General coloration dark brown with yellowish paranota; legs also yellowish. Body with 20 segments. Antennae long, extending back behind 2nd segment when stretched dorsally (a little shorter on females). Terga with transversal sulcus. Paraterga developed, anterolateral margin rounded, posterolateral margin dentiform. Epiproct tip bilobulated. Gonopods as Nguyen *et al.* (2017) and Rojas-Buffet *et al.* (2020): Femorite (fe) expanded distally; postfemoral lamina (l) with a rectangular shape; postfemoral spine (z) tubercular and spiniform; postfemoral process (h) thin and serrated at the distolateral part; basal part of process (h) and spine (z) noticeably separated; solenophore (sph) with a lamelliform mesal lobule; tips of mesal lobule and solenophore circular (Fig. 3).

Remarks. The species differs from *Ologonosoma* Silvestri, 1897 congeners, by the presence of prominent paranota with yellowish lateral margin (Figs. 1-2).

Oxidus gracilis is widely distributed over the world primarily in warm temperate areas (Nguyen *et al.* 2017). The material from Chile has been collected in Rapa Nui (Easter Island) (Verhoeff 1924) and also in continental Chile in 1973 by Walter C. Sedgwick, as other invertebrates were collected in the same date and locality by this author and possibly identified by Herbert W. Levi as he worked with spiders from the same batch (MCZBASE 2021, 2022), no subsequent publication has been issue citing this last sample. Although records from GBIF show *O. gracilis* to be a very common species in central Chile (GBIF

2021), especially in urban environments, it is worth noting that some of our specimens were collected in the park administration zone of the Bosque Fray Jorge National Park, near man-made structures (Fig. 4).

Apart from *Oxidus*, only one Paradoxosomatidae genus from Chile is known: *Ologonosoma* (Fig. 5). Species from this genus have been recorded from Bosque Fray Jorge National Park and Valparaíso in the case of *Ologonosoma robustum* (Attems, 1898) and Valdivia and nearby places for *Ologonosoma ecarinatum* (Attems, 1898) and *Ologonosoma primum* (Chamberlin, 1957), all 3 of them endemic to the Chilean territory (Attems 1898, 1903; Chamberlin 1957; Silva & Sáiz 1975; Parra-Gómez unpublished). Only *O. robustum* seems to overlap its known distribution with the records of *O. gracilis*. Impacts of exotic diplopods on native species in Chile is still unknown as no study has ever been conducted in the country.



Figure 3. Male right gonopod view under compound microscope, lateral view. Nomenclature by Nguyen *et al.* (2017): h = postfemoral process; sph = solenophore; sl = solenomere; z = postfemoral spine; l = postfemoral lamina; fe = femorite; co = coxa; pf = prefemorite. Scale: 0.1 mm / Gonópodo derecho del macho visto bajo microscopio compuesto, vista lateral. Nomenclatura por Nguyen *et al.* (2017): h = proceso postfemoral; sph = solenóforo; sl = solenómero; z = espina postfemoral; l = lámina postfemoral; fe = femorito; co = coxa; pf = prefemorito. (nota: la translación de algunos términos al español es tentativa, debido a que en muchos casos no existe una traducción oficial). Escala: 0,1 mm.

According to the records known in the literature, the exotic milliped fauna of continental Chile contains a total of six species: *B. guttulatus* (Bosc, 1792), *B. pusillus* (Leach, 1814), *C. britannicus* (Verhoeff, 1891), *C. latestriatus* (Curtis, 1845), *N. kochii* (Gervais, 1847) (Attems 1903; Verhoeff 1924; Schubart 1964), and *O. gracilis* which extends from Caballo Muerto near Ovalle to Chillán, based on the additional records herein (Fig. 4).

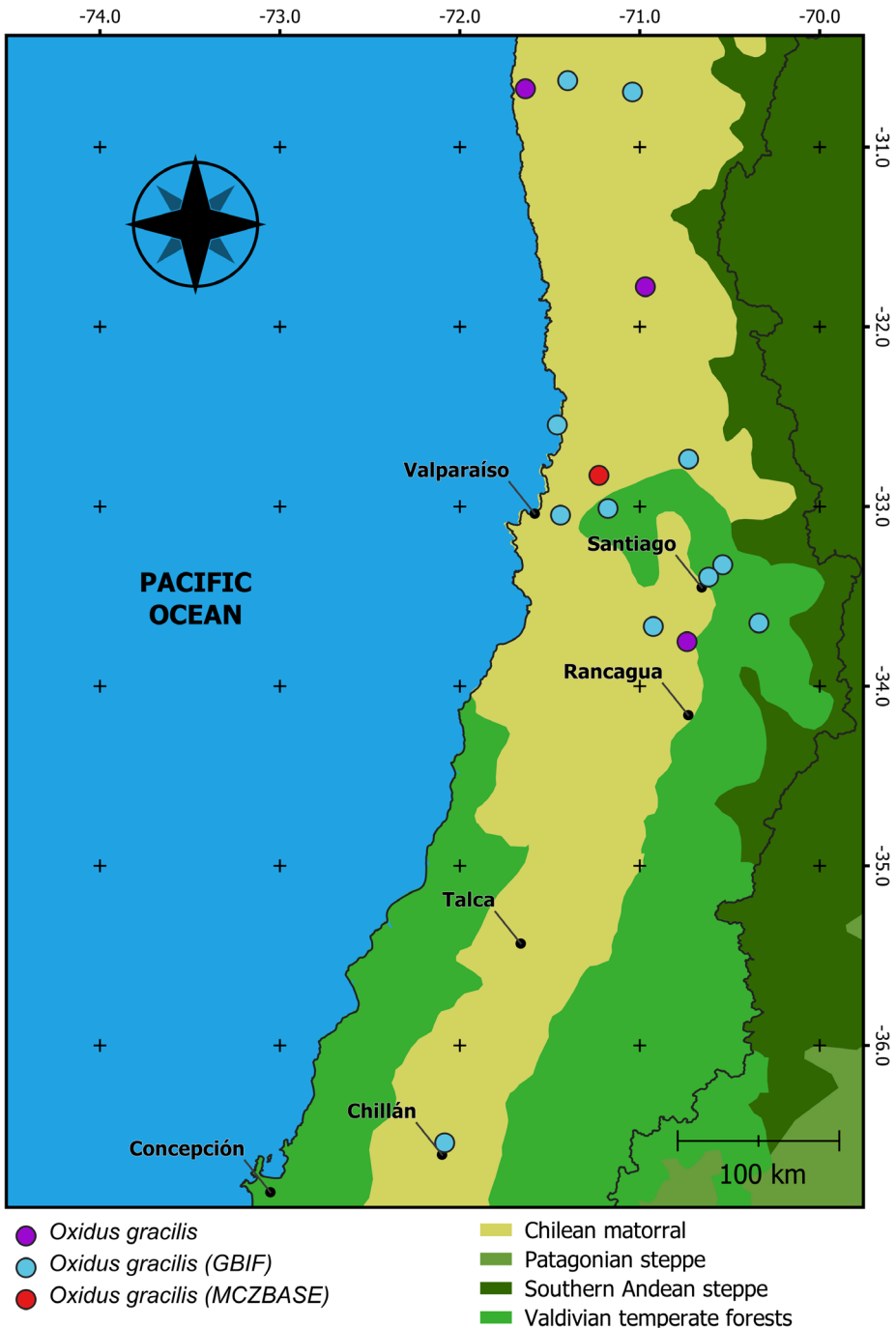


Figure 4. *Oxidus gracilis* distribution in continental Chile. / Distribución de *Oxidus gracilis* en Chile continental.



Figure 5. *Ologonosoma* sp. from Nahuelbuta locality, Chile. / *Ologonosoma* sp. de la localidad de Nahuelbuta, Chile.

Acknowledgements

Thanks to Jorge Pérez Schultheiss and Carlos Martínez for their comments who help to improve this manuscript. To Patricio Farah for collecting specimens from Linderos and Edgardo Flores for let us use his picture of *Ologonosoma* sp. To Adam Baldinger for clarifying doubts on MCZBASE database, and to Sergei Golovatch for helping with some of the literature used.

Literature Cited

- Adis, J. (2002)** Amazonian Arachnida and Myriapoda Identification keys to all classes, orders, families, some genera, and lists of know terrestrial species. Pensoft Publishers. Sofia, Bulgaria. 590 pp.
- Agnolin, F., Agnolin, A. & Guerrero, E. (2019)** Invertebrados exóticos nuevos o poco conocidos en la ciudad de Buenos Aires. *Acta Zoológica Lilloana*, 63(2): 48-67.
- Attems, C.G. (1898)** System der Polydesmiden. I. Theil. *Denkschriften Der Akademie Der Wissenschaften Wien, Mathematisch-Naturwissenschaftliche Klassen*, 67: 221-482.
- Attems, C.G. (1903)** Beiträge zur Myriopodenkunde. *Zoologische Jahrbücher*, 18: 63-154.
- Blower, G.J. (1985)** Millipedes, keys and notes for the identification of the species. Brill. Leiden, The Netherlands. 242 pp.
- Chamberlin, R.V. (1957)** The Diplopoda of the Lund University and California Academy of Sciences expeditions. *Lunds Universitets Arsskrift, Ny Följd, Avd. 2*: 1-44.
- GBIF.org (2021)** Occurrence download: <https://doi.org/10.15468/dl.vxvysu>. Accessed 4 October 2021.
- Golovatch, S.I. (2014)** On some new or poorly-known millipedes from Chile and Argentina (Diplopoda). *Russian Entomological Journal*, 23: 249-281.

- Iniesta, L.F.M., Bouzan, R.S., Rodrigues, P.E.S., Almeida, T.M., Ott, R. & Brescovit, A.D. (2020)** Ecological niche modeling predicting the potential invasion of the non-native millipede *Oxidus gracilis* (C. L. Koch, 1847) (Polydesmida: Paradoxosomatidae) in Brazilian Atlantic Forest. *Annales de La Société Entomologique de France (N.S.)*, 56(5): 387-394.
- Koch, C.L. (1847)** System der Myriapoden mit den Verzeichnissen und Berichtigungen zu Deutschlands Crustaceen, Myriapoden und Arachniden. pp. 1-196. In: Panzer & Herrich-Schäffer, A. (Eds.), Kritische Revision der Insectenfauna Deutschlands, III. Regensburg, Germany. 270 pp.
- MCZBASE [The Database of the Zoological Collections Museum of Comparative Zoology - Harvard University] (2021)** Invertebrate Zoology 40453 *Oxidus gracilis*. Accessed 15 November 2021. Available at: <https://mczbase.mcz.harvard.edu/guid/MCZ:IZ:40453>
- MCZBASE [The Database of the Zoological Collections Museum of Comparative Zoology - Harvard University] (2022)** Invertebrate Zoology 56069 *Achaearanea acoreensis*. Accessed on 1 January 2022. Available at: <https://mczbase.mcz.harvard.edu/guid/MCZ:IZ:56069>
- David, J-F. (2015)** Diplopoda — Ecology. pp. 303-327. In: Minelli, A. (Ed.), Treatise on Zoology—Anatomy, Taxonomy, Biology. The Myriapoda, Volume 2. Brill, The Netherlands. 482 pp.
- Nguyen, A.D., Korsós, Z., Jang, K.-H. & Hwang, U.-W. (2017)** A revision and phylogenetic analysis of the millipede genus *Oxidus* Cook, 1911 (Polydesmida, Paradoxosomatidae). *European Journal of Taxonomy*, 293: 1-22.
- Olson, D., Dinerstein, E., Wikramanayake, E., Burgess, N., Powell, G., Underwood, E., D'Amico, J., Itoua, I., Strand, H., Morrison, J., Loucks, C., Allnutt, T., Ricketts, T., Kura, Y., Lamoreux, J., Wettengel, W., Hedao, P. & Kassem, K. (2001)** Terrestrial Ecoregions of the World: A New Map of Life on Earth. *BioScience*, 51: 933-938.
- Recuero, E. & García-París, M. (2016)** A new North American region colonized by the Australian millipede *Akamptogonus novarae* (Humbert & DeSaussure, 1869) (Polydesmida, Paradoxosomatidae), with a key for the known Paradoxosomatidae species from North and Central America and the Caribbean Islands. *North-Western Journal of Zoology*, 12(2): 385-389.
- Rojas-Buffet, C., Simó, M. & Sierwald, P. (2020)** First records of *Oxidus gracilis* (C.L. Koch, 1847) for Uruguay, with notes on its natural history and distribution (Polydesmida: Paradoxosomatidae). *Boletín de La Sociedad Zoológica del Uruguay*, 29(2): 171-175.
- Schubart, O. (1964)** Diplopoda, Symphyla, Pauropoda, Chilopoda. Ergänzung—Oberklasse Progonéata / Oberklasse Opisthogoneata. pp. 1-55. In: Brohmer, P., Ehrmann, P. & Ulmer, G. (Eds.), Die Tierwelt Mitteleuropas. Band II, Lief. 3. Ergänzung. Quelle & Meyer, Germany. 55 pp.
- Silva, F. & Sáiz, F. (1975)** Investigaciones ecológicas de los diplopodos del Parque Nacional "Fray Jorge". *Anales Del Museo de Historia Natural de Valparaíso*, 8: 17-28.
- Skottsberg, C. (1956)** Derivation of the Flora and Fauna of Juan Fernandez and Easter Island. pp. 193-438. In: Skottsberg, C. (Ed.), The Natural history of Juan Fernandez and Easter Island. Almqvist & Wiksells Boktryckeri, Sweden. 438 pp.
- Verhoeff, K. (1924)** Über myriapoden von Juan Fernandez und der Osterinsel. *The Natural History of Juan Fernandez and Easter Island*, 3: 403-418.