

Taxonomy and systematics

Review of the Elmidae (Coleoptera: Dryopoidea) of Chile

Revisión de los Elmidae (Coleoptera: Dryopoidea) de Chile

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Abstract

The family Elmidae is one of several families of aquatic beetles in the superfamily Dryopoidea. The Elmidae occur throughout the world (except Antarctica), with approximately 150 genera and 1,500 species. Elmidae have been studied as part of the taxa used to assess water quality. There are no keys to identify larvae of Chilean species, and to identify adults it is necessary to remove the male genitalia. Research carried out in Chile has included Elmidae in descriptions, lists and reviews of aquatic beetles in general. Until now, there has been no review dedicated entirely to Chilean Elmidae. In Chile, after this review there are 2 subfamilies, 7 genera and 18 species currently recognized. The species *Austrelmis woytowskii* (Hinton), which has been cited in error for Chile, is eliminated from the Chilean list and the species *Austrelmis* sp. 1 is included, as is *Austrolimnius elatus* Hinton. Expanded distributions of some species are included.

Keywords: Elmidae; Elminae; Larainae; Diversity; Distribution

Resumen

La familia Elmidae es una de varias familias de escarabajos acuáticos perteneciente a la superfamilia Dryopoidea. Los Elmidae se encuentran en todo el mundo (excepto en la Antártida), con aproximadamente 150 géneros y 1,500 especies. Los Elmidae han sido estudiados como parte de los taxones utilizados para evaluar la calidad del agua. No existen claves para identificar larvas de las especies chilenas y para identificar adultos es necesario extraer los genitales de los machos. Investigaciones realizadas en Chile han incluido a los Elmidae en descripciones, listas y revisiones de escarabajos acuáticos en general. Hasta ahora, no había una revisión dedicada completamente a

los Elmidae chilenos. En Chile, después de esta revisión hay 2 subfamilias, 7 géneros y 18 especies actualmente reconocidas. La especie *Austrelmis woytkowskii* (Hinton), que ha sido citada por error para Chile se elimina de la lista chilena y se incluye la especie *Austrelmis* sp. 1, al igual que *Austrolimnius elatus* Hinton. Se incluyen la ampliación de distribuciones de algunas especies.

Palabras clave: Elmidae; Elminae; Larainae; Diversidad; Distribución

Introduction

The family Elmidae (Coleoptera: Dryopoidea) colloquially known as riffle beetles is a group of globally distributed beetles (except for Antarctica) found in clean, permanent waters. Elmidae is divided into 2 subfamilies (Elminae and Larainae), with approximately 150 genera and 1,500 species Jäch et al. (2016) and more taxa are described every year. In Chile, the Elmidae have 2 large faunal divisions. This is a fauna with continental characteristics that shares genera, such as *Heterelmis* Sharp and *Microcyloepus* Hinton, with other South American countries. The other faunal area is the Southern Cone, which contains genera shared with New Zealand and Australia, or has genera only shared with Argentina, as is the case of the genera *Hydora* Anon. [Broun], *Luchoelmis* Spangler and Staines and *Stethelmis* Hinton.

The different species of Elmidae have similar life cycles. Eggs are laid on submerged substrates such as stones or wood, with hatching occurring in approximately 2 weeks. Pupation lasts about 2 weeks. After about 2 weeks of pupation, the adults emerge, some fly to find new habitats before re-entering the water, while others just re-enter the stream from which they came. Adults can live approximately 10 years (Brown, 1974).

Larvae and adults of Elmidae often co-occur in appropriate microhabitats, such as sand, gravel, leaf bundles, aquatic macrophytes, wood, and rocks in clear water, etc. The main requirement for Elmidae is uncontaminated water with high levels of dissolved oxygen, up to moderately polluted environments González-Córdoba et al. (2020). Most Elmidae consume fine particulate organic matter that they browse from the surface or find in the interstitial spaces between gravel particles. This material is usually algae, fungal hyphae, and crushed leaves or wood. The few species that feed on decaying and submerged wood take several years to develop due to the low levels of nutrients wood presents. Reviews of elmid biology are in Brown (1987) and Elliott (2008).

Elmidae breathe with tracheal gills (larvae) or plastrons (adults). Both systems require relatively high levels of dissolved oxygen (Brown, 1987; Kodada et al., 2016). Elmidae have been found to be very susceptible to contaminants such as surfactants in soap, petroleum

products, according to Brown (1984), Elliott (2008), Lafuente et al. (2019) and anything that removes oxygen from the water. Therefore, their presence in a stream is a sign of uncontaminated water during the lifespan of the Elmidae. Thus, Elmidae are often targeted during water quality assessment programs, along with Ephemeroptera, Plecoptera and Trichoptera, all of which are also susceptible to contaminants (Fierro et al., 2012). When these studies are carried out, it is very important that the sampling considers the microhabitat requirements of the different species.

The new global catalog of Elmidae has helped to understand generic and species distributions (Jäch et al., 2016). An identification key for adult genera of South American Elmidae has been developed by Manzo (2005) and an identification key for most larvae of South American Elmidae genera has been developed by Manzo and Archangelsky (2008), Pasos et al. (2018). These have been important scientific advances since Elmidae are an integral part of the ecology of streams and rivers and are often collected during sampling (Fierro et al., 2012). None the less despite its importance there are no keys to identify the larvae to species, and generally to identify the adults it is necessary to extract the male genitalia.

The first Elmidae described in Chile are found in 2 articles by Germain (1854, 1892). This was followed by articles published by Champion (1918), Hinton (1941, 1945), Janssens (1957), Spangler and Brown (1981) and Spangler and Staines (2002). Some of the species described in these papers are now found in different genera. Other papers dealing with Chilean dryopoid beetles include authors like Lataste (1897 a, b), Dajos (1974), Solervicens (1974), Shepard (2016) and Shepard and Barr (2023). Nonetheless, the information is scattered and Elmidae continues to be a relatively unknown group. This study will facilitate further efforts on Chilean Elmidae by bringing together information and providing new distribution data.

Materials and methods

The collection of elmid larvae and adults usually involves aquatic nets that are placed downstream of the sampling area where the substrates are disturbed. Elmidae then drifts in the current and into the net. The specimens

are collected from the net and preserved in 70% or 95% ethyl alcohol. Some of the net contents collected by WDS were entirely preserved in 95% alcohol bottles and then processed in the laboratory. This makes it easier to collect smaller adults (such as *Austrolimnius*) and younger larvae. After collecting at each site, ecological characteristics were recorded on field data sheets. Collection locality maps were produced with QGIS and used all known localities, published and new.

Locality data are presented primarily as they occur on the specimen labels. A forward slash “/” indicates separate lines in a label and a double forward slash “//” indicates separate labels. Information included by “()” is below the locality labels. Additional data provided here, but not in the labels, is indicated by brackets “[]”. The “WDS-A- _____” numbers refer to WDS data sheets. Collection locality maps were made using ArcGIS and used all known localities, published and new.

Additional records of the specimens were obtained from the collections: National Museum of History of Chile (Santiago) and the Museum of the Department of Zoology of the University of Concepción, as well as from published literature on the Elmidae. Abbreviations cited in the text include the following: National Museum of Natural History, Washington, DC, USA (USNM); Natural History Museum, London, England (NHML); Royal Belgian Institute of Natural Sciences, Brussels, Belgium (RBINS); William D. Shepard (WDS).

Results

As a result of this work, we can consider the diversity of Elmidae to include 18 species, 7 genera and 2 subfamilies. The species *Austrelmis woytkowskii* (Hinton, 1937) is eliminated because the analysis of samples collected from various streams in northern Chile shows no evidence of its presence.

The species *Heterelmis trivialis* (Germain, 1892) is also eliminated. One of the reasons for this decision is the loss of the type material. Another reason is the fragility of the stream where it was cited; this stream is small and urbanized and tends to have a considerable decrease in its water flow in summer. This species was searched for at the type locality on 2 occasions, thus corroborating its presence in Chile, but it has not been found or reported since its description. In these samplings, the other species described by Germain and cited for the area were found.

In this work, the species *Austrolimnius elatus*, eliminated by Elgueta and Arriagada (1989), is re-established; this is supported by the type material found. Finally, it is important to mention that despite the limited progress in species richness shown in this work, there are numerous new localities for the different species present in Chile. A list of the Elmidae known from Chile is provided (Table 1).

Key to the genera of adult Elmidae known from Chile extracted from Manzo and Archangelsky (2008) and Passos et al. (2018).

- 1 Body densely pubescent, without plastron; transverse procoxae, with exposed trochantins; adults fly easily from water or net..... Larinae *Hydora* (Fig. 19)
- 1' Body not pubescent, with plastron; procoxa globosa, with unexposed trochantins; adults do not fly from water or net Elminae..... 2
- 2 Thorax without sublateral carinae (Figs. 27, 30, 32) 3
- 2' Thorax with sublateral carinae..... 4
- 3 Tarsal claws with basal teeth (Fig. 31) *Stethelmis*
- 3' Tarsal claws without basal teeth..... *Luchoelmis*
- 4 Epipleura with 1 or 2 longitudinal lines of granules..... *Austrolimnius*
- 4' Epipleura without longitudinal lines of granules..... 4
- 5 Pronotum with complete deep transverse groove (Fig. 29) *Neoelmis*
- 5' Pronotum without deep transverse groove complete..... 6
- 6 Pronotum with circular anterior depression, with V-shaped carina in ½ basal, with sublateral elevation (Fig. 28)..... *Microcylloepus*
- 6' Pronotum without depressions; sublateral carina restricted to anterior half (Figs. 25, 26)..... *Austrelmis*

Table 1
 Elmidae of Chile and endemicity status.

Species	Original generic placement	Author	Endemic	
Subfamily Elminae Curtis, 1830				
1	<i>Austrelmis anthracina</i>	<i>Elmis</i>	(Germain, 1892)	Yes
2	<i>Austrelmis chilensis</i>	<i>Elmis</i>	(Germain, 1854)	Yes
3	<i>Austrelmis costulata</i>	<i>Macrelmis</i>	(Janssens, 1957)	Yes
4	<i>Austrelmis elegans</i>	<i>Macrelmis</i>	(Hinton, 1937)	No
5	<i>Austrelmis</i> sp.	<i>Macrelmis</i>	(Janssens, 1957)	Yes
6	<i>Austrolimnius chiloensis</i>	<i>Elmis</i>	(Champion, 1918)	Yes
7	<i>Austrolimnius elatus</i>	<i>Austrolimnius</i>	Hinton, 1941	No
8	<i>Austrolimnius nycteloides</i>	<i>Elmis</i>	(Germain, 1854)	No
9	<i>Luchoelmis aequalis</i>	<i>Luchoelmis</i>	Spangler & Staines 2002	Yes
10	<i>Luchoelmis cekalovici</i>	<i>Luchoelmis</i>	Spangler & Staines 2002	No
11	<i>Luchoelmis magallanensis</i>	<i>Luchoelmis</i>	Spangler & Staines 2002	Yes
12	<i>Luchoelmis penai</i>	<i>Luchoelmis</i>	Spangler & Staines 2002	Yes
13	<i>Microcylloepus chilensis</i>	<i>Microcylloepus</i>	Janssens, 1957	Yes
14	<i>Neoelmis scissicollis</i>	<i>Elmis</i>	(Germain, 1892)	Yes
15	<i>Stethelmis chilensis</i>	<i>Stethelmis</i>	Hinton 1945	Yes
16	<i>Stethelmis kaszabi</i>	<i>Stethelmis</i>	Hinton, 1970	No
Subfamily Larainae LeConte, 1861				
17	<i>Hydora annectens</i>	<i>Hydora</i>	Spangler & Brown, 1981	No
18	<i>Hydora lenta</i>	<i>Hydora</i>	Spangler & Brown, 1981	Yes

Generic reviews

Larainae LeConte, 1861

Hydora Anon. [Broun, 1882] (Figs. 1, 2, 19)

Currently, *Hydora* has 10 described species Jäch et al. (2016), Lambert et al. (2015). This genus is an element of the Southern Cone with most of its species in New Zealand. Two species are described from South America and they are distributed only in southern Chile and Argentina (Spangler & Brown, 1981). A key to species of adults is in Spangler and Brown (1981). Archangelsky and Manzo (2006) have described the larva.

New distributional data. Hydora annectens (Fig. 1) - Chile: Ñuble Region / Termas de Chillan [Pte. Torrealba] / 10-I-2002; 1,762 m asl / Estero Renegado (WDS-A-1431) [36°54'59" S, 71°25'52" W] // William D. / Shepard, leg. / SW of Termas de Chillan [Pte. Atacalco] / 10-I-2002; 914 m asl / Río Diguillín (WDS-A-1436) [36°53'30" S, 71°37'38" W] // William D. / Shepard, leg.; Biobío Region / 37 km NW Nacimiento [Pte. San Jorge] / 11-I-2002; 543 m asl /

Río Culenco (WDS-A-1438) [37°15'30" S, 72°56'00" W] // William D. / Shepard, leg.; La Araucanía Region / P. N. Nahuelbuta [3 km WSW park gate] / 12-I-2002; 424 m asl / Estero Pehuenco (WDS-A-1439) [37°49'47" S, 73°00'32" W] // William D. / Shepard, leg. / 12 m SW Lonquimay [Pte. La Puntilla] / 13-I-2002; 1,189 m asl / Río Lonquimay (WDS-A-1447) [38°33'19" S, 71°25'54" W] // William D. / Shepard, leg. / 5 km E Manzanar / 14-I-2002 / Río Cautín (WDS-A-1451) [38°28'19" S, 71°38'37" W] // William D. / Shepard, leg. / 3-4 km S Paillaco [Pte. Huepil] / 15-I-2002; 744 m asl (WDS-A-1454) [39°13'57" S, 71°45'20" W] // William D. / Shepard, leg. / 7.8 km N Malacahuello / 17-I-2007; 1,173 m asl / Río Cautín (WDS-A-1736) [38°26.847' S, 71°31.047' W] // William D. / Shepard, leg; Los Lagos Region / just W P. N. Puyehue [Pte. Anticura] / 17-I-2001; 658 m asl / Río Anticura (WDS-A-1458) [40°39'57" S, 72°10'09" W] // William D. / Shepard, leg. / P. N. Perez Rosales / 18-I-2002; 518 m asl / Río Petrohue [41°09'17" S, 72°25'41" W] // Cheryl B. / Barr / 3 km SW Ensenada /

18-I-2002 124; m asl / Unnamed tributary (WDS-A-1462) [41°14'03" S, 72°36'03" W] // William D. / Shepard, leg. / 14 km SE Corral / 22-I-2002; 120 m asl / Estero Los Llanos (WDS-A-1472) [39°57'21" S, 73°22'21" W] // William D. / Shepard, leg. / 3 km W Nueva Braunau / 30-XII-2002; 6 m asl / Río Colequal (WDS-A-1502) [41°19'04" S, 73°07'53" W] // William D. / Shepard, leg. / 8 km SW Correntoso [Pte. Hondo] / 31-XII-2002; 128 m asl (WDS-A-1504) [41°28.83' S, 72°48.20' W] // William D. / Shepard, leg. / 5 km NE Chamiza / 31-XII-2002; 110 m asl / Río Chamiza (WDS-A-1506) [41°26.57' S, 72°49.19' W] // William D. / Shepard, leg. / 8 km W Puerto Austral [Pte. Queche] / 1-I-2003; 195 m asl (WDS-A-1510) [41°58.58' S, 72°39.72' W] // William D. / Shepard, leg. / 6 km E Contaco [Pte. Contaco] / 9-I-2003; 158 m asl / Río Contaco (WDS-A-1521) [40°35.91' S, 73°29.67' W] // William D. / Shepard, leg. / 13 km E Bahía Mansa [Pte. El Avion] / 9-I-2003; 143 m asl / Unnamed tributary (WDS-A-1522) [40°35.04' S, 73°37.52' W] // William D. / Shepard, leg. / P. N. Villarica / 16-I-2007; 873 m asl / Río Puesco (WDS-A-1735) [39°32.008' S, 71°33.321' W] // William D. / Shepard, leg.

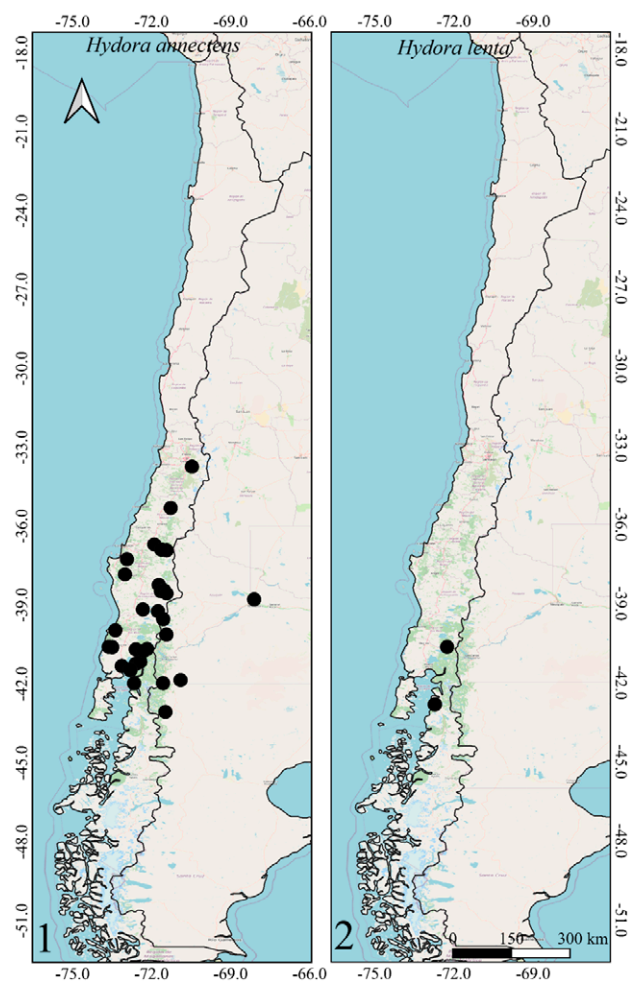
Hydora lenta - Chile: Region X / 12 km S Caleta Gonzalo / 3-I-2003; 158 m asl (WDS-A -1511) [42°49.34' S, 72°42.73' W] // William D. / Shepard, leg. / 13 km S Caleta Gonzalo [Pte. Camahueto No. 1] (WDS-A-1512) [42°49.55' S, 72°43.44' W] / 3-I-2003; 183 m asl // William D. / Shepard, leg.

Elminae Curtis, 1830

Austrelmis Brown, 1984 (Figs. 3-6, 20-24)

Austrelmis. Five species have been cited for Chile (Elgueta & Arriagada, 1989): *A. anthracina* Germain (1892), *A. chilensis* Germain, (1854), *A. costulata* Janssens (1957), *A. elegans* Janssens (1957) and *A. woytkowskii* Hinton (1937). Jerez and Moroni (2006) cited 8 species, however, they cite *A. nyctelioides* as belonging to *Austrelmis*, but it belongs in *Austrolimnius* Germain (1892); Manzo (2007); Jäch et al. (2016). We removed *A. woytkowskii* Hinton (1937) from the Chilean list since the specimens identified as such for northern Chile appear to be a distinct species, which we identified as *Austrelmis* sp. 1. This species is very similar to *A. consors* Hinton (1940) (Figs. 1-3). In addition, there are many other species in the altiplano that do not correspond to species described or cited for Chile (see Hinton, 1940: 130, Figs. 28, 29).

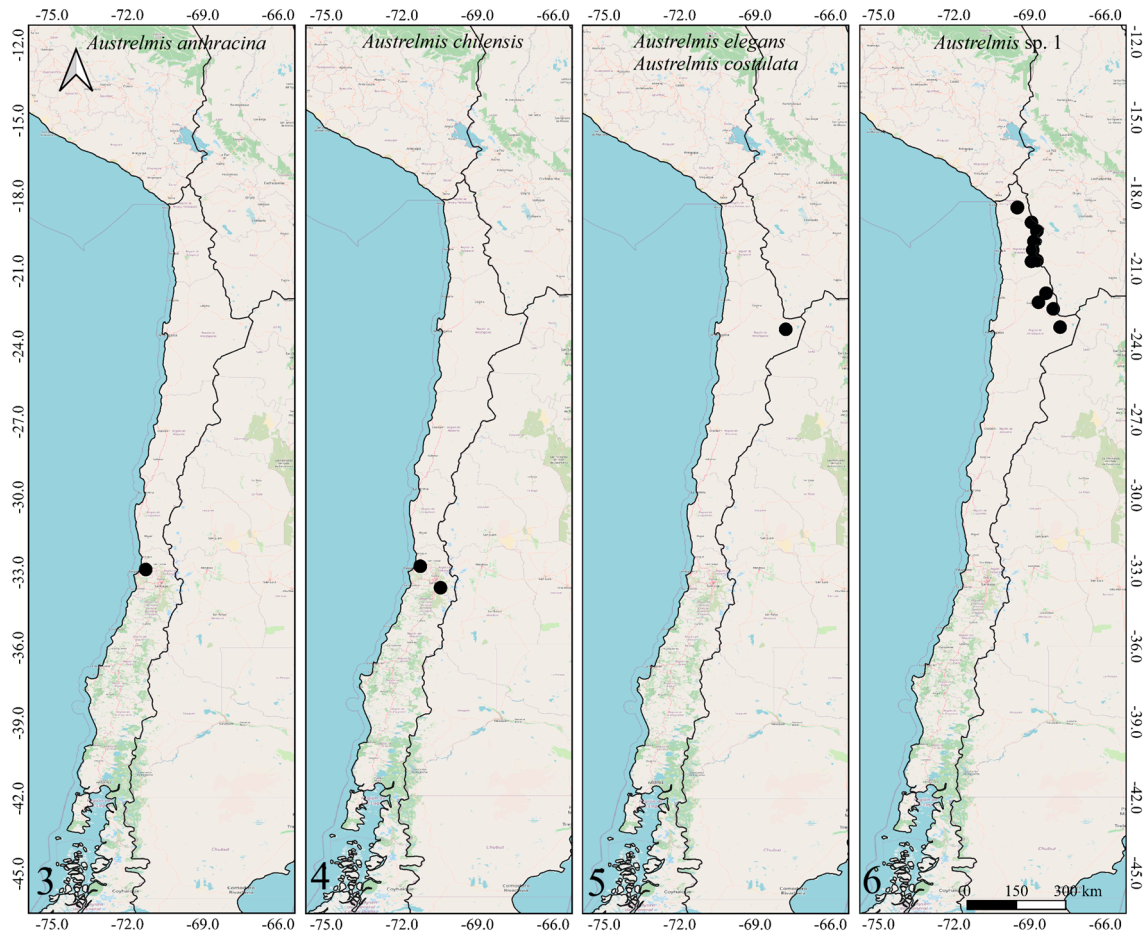
Austrelmis is closely associated with the Andes, with species known from southern Ecuador, Peru, Chile, Bolivia and Argentina. Previously, *Austrelmis* was considered to be associated with high elevations and low temperatures,



Figures 1-2. Distributions of the species belonging to the genera *Hydora* in Chile and neighboring countries.

but new collections made by us and new descriptions have expanded its altitudinal distribution and temperature ranges (Manzo, 2007; Ferrú & Elgueta, 2011; Fierro et al., 2020). In many streams it is the dominant taxon (Hinton, 1940). In almost all the small streams of the highlands, *Austrelmis* is often found in dense populations, which can reach 200 specimens per m² (Hinton, 1940). There is no key to species for adults or larvae. However, larvae of several species have been described by Archangelsky et al. (2016), Martínez-Román et al. (2017) and Martínez-Román et al. (2025).

New distributional data. Austrelmis sp. 1 - Chile: Arica y Parinacota Region / Parinacota / Putre / Ticnamar / 01-V-2008; 3,200 m asl / M. Ferrú, leg. / [18°34'50"



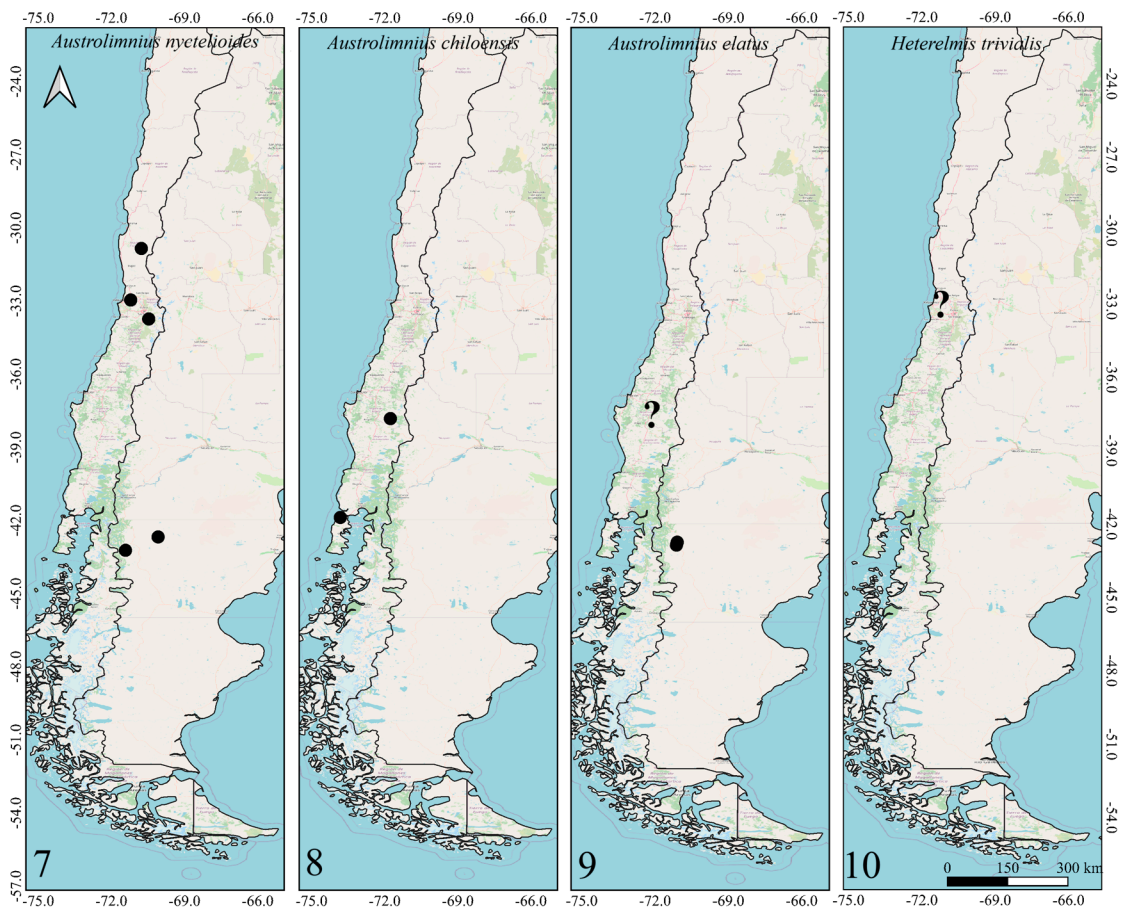
Figures 3-6. Distributions of *Austrelmis* and species in Chile.

S, 7°29'37" W]; Chile: Region I Tarapacá / Tamarugal / Colchane / Río Isluga / 21-X-2007; 4,207 m asl / M. Ferrú, leg / [19°9'54" S, 68°55'50" W]; Tarapacá Region / Tamarugal / Pica / Caya / 30-XII-2008; 3,717 m asl / M. Ferrú, leg / [20°42'41" S, 68°55'48" W] / Tamarugal / Pica / Laguna Guantija [aguada que alimenta el salar] / 06-11-1993; 4,022 m asl / W. Sielfeld, leg / [19°55'44" S, 68°50'55" W] / Tamarugal / Pica / Salar de Coposa [aguada que alimenta el salar] / 3,758 m asl / M. Ferrú leg / [20°40'45" S, 68°42'30" W]; Antofagasta Region / El Loa / San Pedro de Atacama / 20-II-2015; 3,747 m asl / Río San Pedro / [21°58'37" S, 68°21'16" W] / El Loa / San Pedro de Atacama / Machuca / 19-IV-2018; 4,234 m asl / [22°35'59" S, 68°3'58" W] / El Loa / San Pedro de Atacama / Chiu Chiu / 30-IV-2019; 2,541 m asl / [22°20'15" S, 68°39'6"

W] / El Loa / San Pedro de Atacama / Tumbres / 17 -II-2015; 3,866 m asl / [23°19'27" S, 67°47'38" W].

Austrolimnius Carter and Zeck, 1929 (Figs. 7-9, 25, 26)

Austrolimnius with 104 species worldwide (Jäch et al., 2016; Polizei et al., 2020) and 22 species described in South America (González-Córdoba et al., 2020). Currently only 3 species are described from Chile: *A. chiloensis* (Champion, 1918), *A. nyctelioides* (Germain, 1892), and *A. elatus* (Hinton, 1941). The Chilean species show a distribution restricted to the Southern Cone. Adults are very small and often associated with substrates with fine gravel and sand. There is no key for adult but the larvae of *A. elatus* and *A. nyctelioides* are described in Martínez-Roman and Archangelsky (2017).



Figures 7-10. 7-9, Distribution of the species of *Austrolimnius*; 10, *Heterelmis* in Chile and neighboring countries.

Heterelmis Sharp, 1882 (Fig. 10)

Heterelmis is a genus of moderate size with 22 described species (Polizei, 2018). However, many more species await description. *Heterelmis* is a continental element that is distributed from the southern United States of America, and throughout Central and South America. The differences between species are very fine, making identification difficult. Molecular work may be required to separate species with greater certainty. *Heterelmis* survives well in desert areas, often living in small springs and oases. Currently only 1 species is recorded from Chile, *Heterelmis trivialis* (Germain, 1892). However, we were not able to relocate specimens in 2 searches of the type locality. There is no key to species for adults or larvae.

Luchoelmis Spangler and Staines, 2004 (Figs. 11-14, 27)

Luchoelmis is an element of the Southern Cone, where it is currently known from the southern parts of Chile and

Argentina. Five species have been described, but more are recognized and await description (Shepard, personal communication). *Luchoelmis* is generally associated with aquatic bryophytes and macrophytes. *Luchoelmis* was the only elmid found in streams as far south as Tierra del Fuego (53°27.54' S, 68°44.26' W). There is a key to 4 species of adults in Spangler and Staines (2004). Archangelsky and Manzo (2014) described another species.

Microcylloepus Hinton, 1935 (Figs. 15, 28)

Microcylloepus is a genus of moderate size, with 29 described species distributed from the USA and throughout Central and South America (Hemmerich et al., 2025). This genus is a continental element. Currently only 1 species is known from Chile, *Microcylloepus chilensis* Janssens, 1957. *Microcylloepus* survives well in desert areas, often surviving in small springs or oases.

New distributional data. Microcylopeus chilensis - Chile: Tarapacá Region / El tamarugal / Huara / Quebrada de Tana William D. / M. Ferrú, leg / [19°27'45.32" S, 69°59'28.80" W].

Neelmis Musgrave, 1935 (Figs. 11, 16)

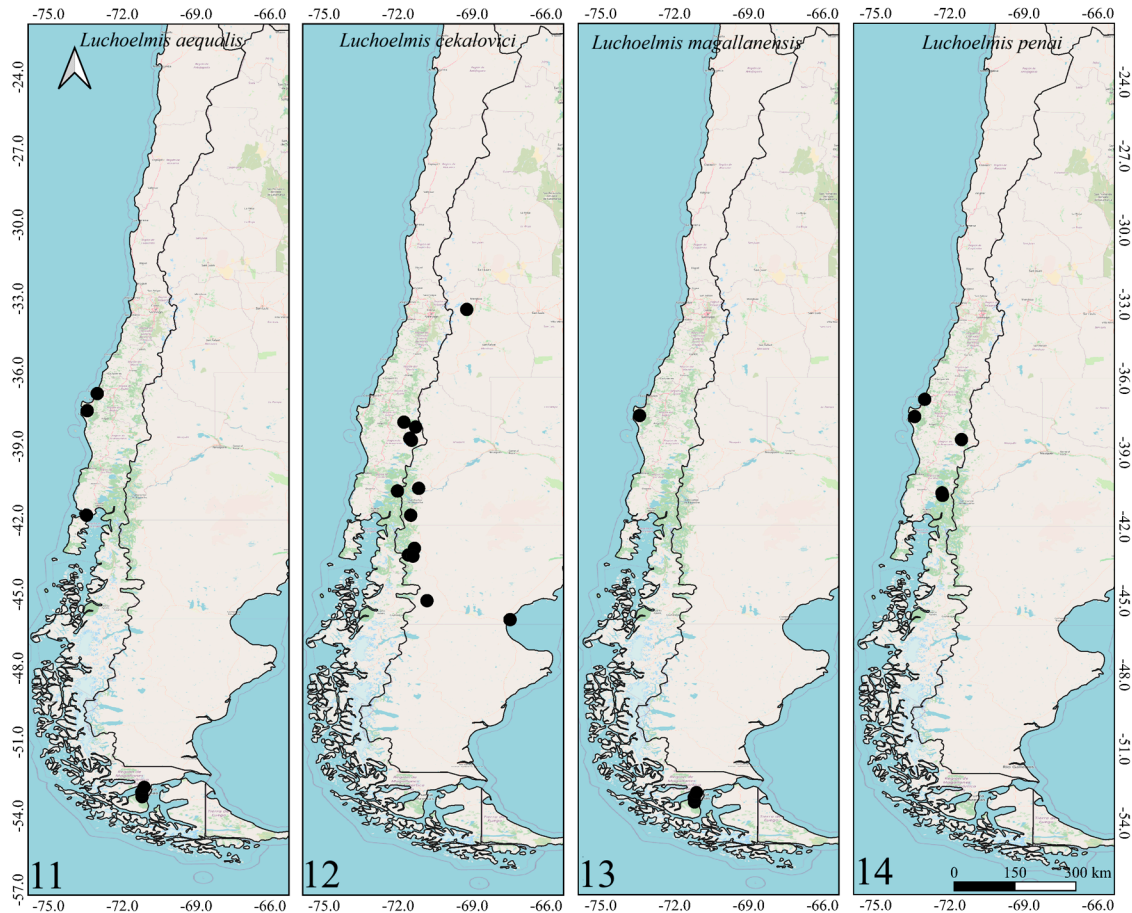
Neelmis is one of the larger and widely distributed genera here included, with 50 described species going from the southern USA, to southern South America (Jäch et al., 2016). The only species in Chile is *N. scissicollis* (Germain, 1892), which has a wide southern distribution.

New distributional data. Neelmis scissicollis - Chile: Biobío Region / 37 km NW Nacimiento [Pte. San Jorge] / 11-I-2002; 543 m asl / Río Culenco (WDS-A-1438) [37°15'30" S, 72°56'00" W] // William D. / Shepard, leg.; Los Ríos region / Chiahuin [Reserva Costera Valdiviana] / 26-II-2008; 15 m asl / Unnamed tributary (WDS-A-1780) [39°58'11" S, 73°34'14" W] // William D. / Shepard, leg.; Araucanía Region / P. N. Nahuelbuta [3 km SO puerta de parque] / 12-I-2002; 1,390 m asl / Estero Pehuenco (WDS-A-1439) [37°49'47" S, 73°00'32" W] // William D. / Shepard, leg. / 14 km E P. N. Nahuelbuta [Pte. El Manza] / 12-I-2002; 869 m asl / Río Piculquén (on reverse WDS-A-1441) [37°48'42" S, 72°52'41" W] // William D. / Shepard, leg. / 15 km E P. N. Nahuelbuta / 12-I-2002; 902 m asl / unnamed stream (WDS-A-1442) [37°47'51" S, 72°51'20" W] // William D. / Shepard, leg.; CHILE: / 19 km E Victoria [Pte. Quino] / 13-I-2002; 634 m asl / Unnamed tributary (WDS-A-1443) [38°17'21" S, 72°10'00" W] // William D. / Shepard, leg. / 11 km NW Curacautín [Pte. Rari Puca] / 13-I-2002; 835 m asl / Unnamed tributary (WDS-A-1445) [38°20'13" S, 71°58'15" W] // William D. / Shepard, leg. / 7 km SE Lolen [Pte. Pedregoso] / 14-I-2002; 1,216 m asl / Unnamed tributary (WDS-A-1449) [38°31'53" S, 71°12'03" W] // William D. / Shepard, leg. / P. N. Huerquehue [1 km N gate] / 15-I-2002; 1,109 m asl / Unnamed tributary (WDS-A-1452) [39°09'27" S, 71°42'52" W] // William D. / Shepard, leg. / Lago Tinquilco [Pte. Tinquilco, desague del lago / 15-I-2002; 1,119 m asl / Río Tinquilco (WDS-A-1453) [39°10'44" S, 71°44'13" W] // William D. / Shepard, leg. / 3-4 km S Paillaco [Pte. Huepil] / 15-I-2002; 744 m asl / Río Liucura (WDS-A-1454) [39°13'57" S, 71°45'20" W] // William D. / Shepard, leg.; CHILE: Region X / 3 km SW Ensenada / 18-I-2002; 408 m asl / Unnamed tributary (WDS-A-1462) [41°14'03" S, 72°36'03" W] // William D. / Shepard, leg.; Los Lagos Region / 13 km W Puerto Varas [Pte. Colequal] / 18-I-2002; 366 m asl / Río Colequal (on reverse WDS-A-1463) [41°19'36" S, 73°06'50" W] // William D. / Shepard, leg. / 8 km W Loncotoro / 19-I-2002; 387 m asl / Unnamed tributary (WDS-A-1464)

[41°18'01" S, 73°18'27" W] // William D. / Shepard, leg. / 9 km E Loncotoro [Pte. Colequal 2] / 19-I-2002; 366 m asl / Río Colequal (WDS-A-1465) [41°16'39" S, 73°06'28" W] // William D. / Shepard, leg. / Isla Chiloé / 5 km N Lago Tarahuín [Pte. Trainel] / 20-I-2002; 55 m asl / Unnamed tributary (on reverse 1467) [42°40'30" S, 73°47'46" W] // William D. / Shepard, leg. / Isla Chiloé / 20 km S Castro [Pte. Notúco] / 20-I-2002; 58 m asl / Unnamed tributary // Cheryl B. / Barr / Isla Chiloé / 5 km NE Huillenco / 21-I-2002; 55 m asl / Unnamed tributary (WDS-A-1470) [42°39'19" S, 73°50'43" W] // William D. / Shepard, leg. / 14 km SE Corral / 22-I-2002; 37 m asl / Estero Los Llanos (WDS-A-1472) [39°57'21" S, 73°22'28" W] // William D. / Shepard, leg. / 20 km SE Corral [Pte. Las Romanzas] / 22-I-2002; 18 m asl / Estero de la Romanza (on reverse WDS-A-1473) [39°57'41" S, 73°19'33" W] // William D. / Shepard, leg. / 10 km NE Chamiza / 31-XII-2002; 128 m asl / Unnamed tributary (WDS-A-1504) [41°28'83" S, 72°48'20" W] // William D. / Shepard, leg. / 5 km NE Chamiza / 31-XII-2002; 110 m asl / Río Chamiza (on reverse WDS-A-1506) [41°26.57' S, 72°49.19' W] // William D. / Shepard, leg. / 1 km N Contao [Pte. Zambo] / 1-I-2003; 134 m asl (WDS-A-1507) [41°48'18" S, 72°42'43" W] // William D. / Shepard, leg. / 4 km S Contao [Pte. Puñon] / 1-I-2003; 259 m asl (WDS-A-1508) [41°49'50" S, 72°41'57" W] // William D. / Shepard, leg. / 8 km W Puerto Austral [Pte. Queche] / 1-I-2003; 195 m asl (WDS-A-1510) [41°58'35" S, 72°39'43" W] // William D. / Shepard, leg. / 6 km E Contao [Pte. Contao] / 9-I-2003; 158 m asl (WDS-A-1521) [40°35'55" S, 73°29'40" W] // William D. / Shepard, leg. / P. N. Nahuelbuta [area de picnic] / 5-I-2007; 1,102 m asl / Unnamed tributary (WDS-A-1732) [37°49'42" S, 73°0'37" W] // William D. / Shepard, leg. / P. N. Villarica / 16-I-2007; 873 m asl / Río Puesco (WDS-A-1735) [39°32'1" S, 71°33'19" W] // William D. / Shepard, leg.

Stethelmis Hinton, 1945 (Figs. 17-18, 30-32)

Stethelmis was described from Chile without a precise locality. This genus has 3 species described from South America, *Stethelmis chilensis*, *S. kaszabi*, and *S. shepardi* Martínez-Román, Manzo and Archangelsky (2019). Until now, the distributions of the first 2 species were considered from the central zone of Chile to the south of Chile and Argentina (Archangelsky & Manzo 2007; Martínez-Román et al., 2019; Solervicens, 2014). However, *Stethelmis* has been collected as far south as Isla Navarino (Chile: Region XII / Isla Navarino / Marzo 2004 / Río Robalo / Adrian Mill, leg.). There is a key to adults and a larval description in Martínez-Román et al. (2019).



Figures 11-14. Distributions of the species belonging to the genera *Luchoelmis* in Chile and neighboring countries.

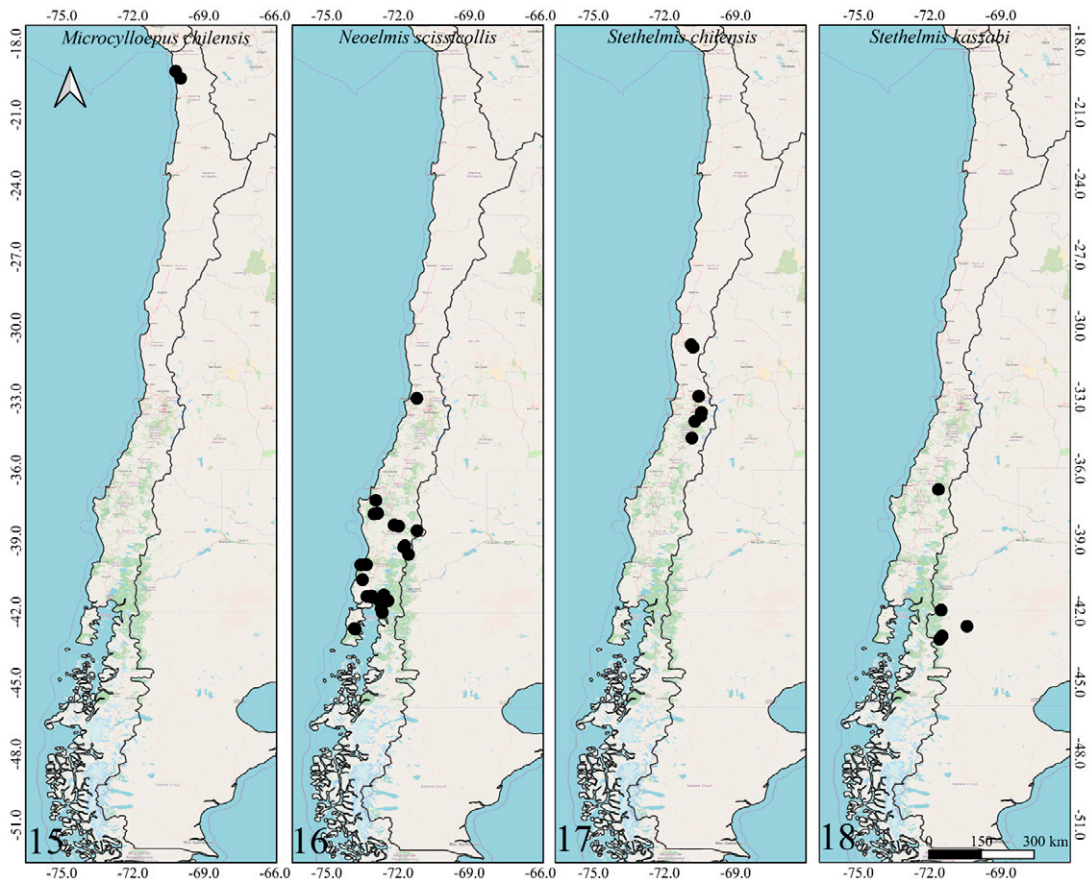
New distributional data. Stethelmis chilensis - Chile: Coquimbo Region / Limarí / Ovalle / Río Rapel / 31 III 2018 501 m asl / [30°42'42" S, 70°52'27" W] / M. Ferrú leg. / Limarí / Ovalle / Río Grande (Puente Mostazal) / 31-III-2018; 501 m asl / [30°49'31" S, 70°47'22" W] / M. Ferrú leg. ; Valparaíso Region / Los Andes / Rinconada / Río Pocuro / 16-I-2016; 975 m asl / [32°53'41" S, 70°33'12" W] / P. Fierro leg.; Metropolitana Region / Cordillera / San José de Maipo / El Canelo / 21-XII-2015; 989 m asl / [32°34'0" S, 70°26'50" W] / P. Fierro leg. ; O'Higgins Region / Rancagua / San Francisco de Mostazal / Río Peuco / 22-XII-2015; 442 m asl / [33°56'42" S, 70°42'58" W] / P. Fierro leg. / Colchagua / Chimbarongo / Agua Buena / 20-II-2016; 512 m asl / [34°38'54" S, 70°50'25" W] / P. Fierro leg.; Los Lagos Region / 9 km E Loncotoro [Pte. Colequal 2] / 19-I-2002; 366 m asl / Río Colequal

(WDS-A-1465) [41°16'39" S, 73°06'28" W] // William D. / Shepard, leg.

Stethelmis kaszabi - Araucanía Region / 16 km SE Lon / 14 I 2002 1243 m asl / Río Bio Bio // William D. / Shepard, leg.; Ñuble Region / SO de Termas de Chillan [Pte. Atacalco] / 10-I-2002; 914 metros / Río Diguillín (WDS-A-1436) [36°53'30" S, 71°37'38" W] // William D. / Shepard, leg.

Discussion

The Chilean Elmidae include 2 subfamilies, 7 genera and 17 species. However, many additional species are known but not yet described. Many geographic areas remain unexplored, so additional species are likely to be found. Endemism is relatively high in the Chilean

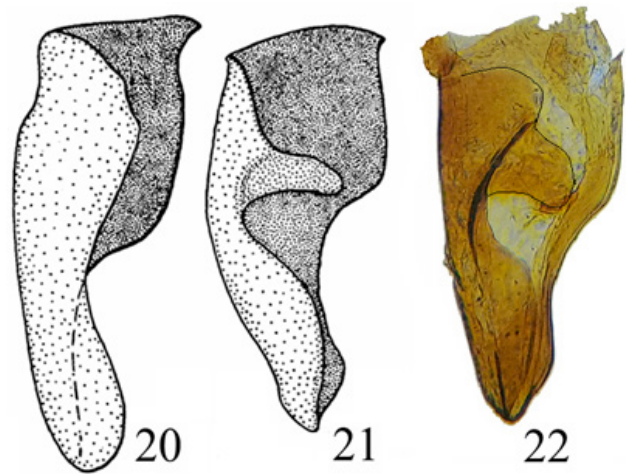


Figures 15-18. Where the distribution of the species belonging to the genus *Microcyloepus*, *Neoelmis* and *Stethelmis* in Chile and neighboring countries is shown.

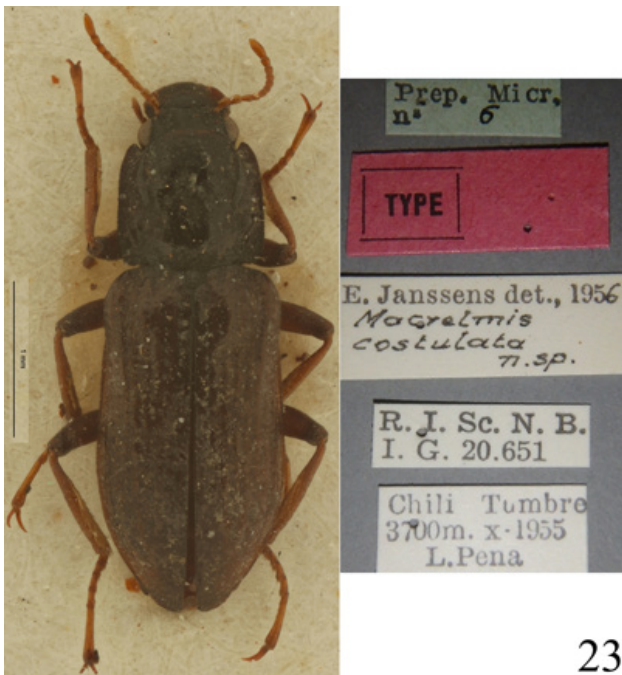


19

Figure 19. Dorsal habitus of the type specimen of *Hydora annectens* and labels.



Figures 20-22. Ventral view of paramero of *Austrelmis*. 2. *A. woytkowskii* Hinton, taken from Hinton, 1840; 3. *A. consors* Hinton, taken from Hinton, 1840; 4. *A. sp.1*, where the paramere of the species collected in the highlands of Chile can be seen.



23

Figure 23. Dorsal habitus of the type specimen of *Austrelimnis costulata* and labels.



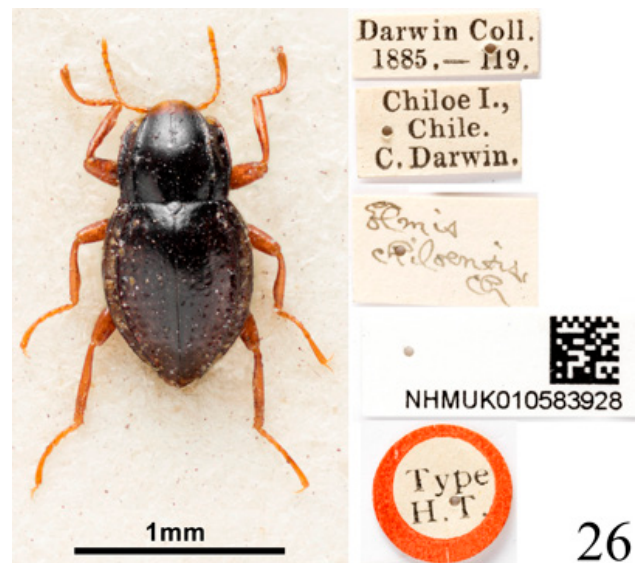
24

Figure 24. Dorsal habitus of type specimen of *Austrelimnis elegans* and labels.



25

Figure 25. Dorsal habitus of the type specimen of *Austrolimnius elatus* and labels.



26

Figure 26. Dorsal habitus of the type specimen of *Austrolimnius chiloensis* and labels.

Elmidae, 82.3% (14 of 17 species) of the species are endemic to Chile. The only Chilean Elmidae not endemic to Chile are *Austrolimnius elatus*, *A. nycteloides*, and *Hydora annectens*.

The number of genera and species present in the South American countries on the Pacific slope decreases from north to south (Ecuador to Chile) (Table 2). Partly this is because the northernmost areas are closer to the equator, where temperatures are more favorable to elmid evolution. Also, partly this is due to Ecuador and Peru

Table 2

Number of genera and species of Elmidae and the area of the countries on the Pacific slope of South America (from north to south) and Bolivia and Argentina.

Country	Area (km ²)	Number of genera and species	Reference
Colombia	916,445	31 genera and 65 especies	Hincapié-Montoya, 2023
Ecuador	276,841	19 genera and 59 especies	Monte and Mascani, 2012
Perú	1,285,216	17 genera and 51 especies	Shepard and Chaboo, 2015
Chile	756,950	7 genera and 18 especies	This review
Bolivia	1,098,581	12 genera and 33 especies	Manzo and Moya, 2010
Argentina	2,780,400	14 genera and 21 especies	Manzo and Archangelsky, 2014



Figure 27. Dorsal habitus of *Luchoelmis* sp. (Photography: William Shepard).

having areas located on the east front of the Andes near to the Amazon where the evolution of the Elmidae has gone in a different direction (Shepard unpublished data). Chile lacks an Amazonian component.

In Chile, the elmid fauna has been negatively impacted by coastal and Andean orogenies, especially in the north.



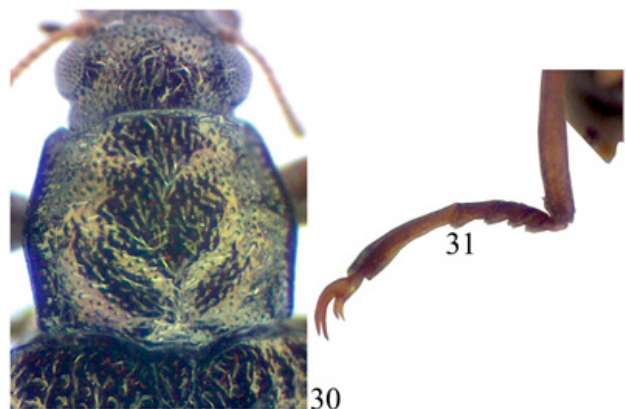
Figure 28. Dorsal habitus of the type specimen of *Microcylloepus chilensis* and labels (left). Dorsal thoracic habits delimiting the elevation in the posterior fraction of the pronotal disc depression of *Microcylloepus chilensis* (right).

This is mainly due to the isolation and desertification that characterizes this area (Shepard unpublished data). The only 2 genera present there are *Austrelmis* and *Microcylloepus*. *Microcylloepus* elsewhere has been able to maintain populations in desert environments where small springs or seeps occur, so it is not surprising that it would be found here, while *Austrelmis* is a very typical inhabitant of high mountain habitats throughout the Andes.

The Southern Cone area of Chile has genera that were thought to be restricted to this area, such as *Austrolimnius*, *Luchoelmis*, and *Stethelmis*. However, *Austrolimnius* and *Stethelmis* have now been collected somewhat farther north, Coquimbo in the case of *Austrolimnius* and Atacama in the case of *Stethelmis*, nonetheless their diversity remains in the Southern Cone area.



Figure 29. Thorax of *Neoelmis scissicollis* with carinae on pronotum (Photography: Marcos Ferrú).



Figures 30-31. A. Thorax of *Stethelmis* sp., without carinae on pronotum; 13. Posterior leg of *Stethelmis* sp. (Photography: Marcos Ferrú).

Two collection attempts in the type locality of *Heterelmis trivialis* failed to find extant populations. It is not known why this population might have disappeared. Likewise, attempts to find populations of *Austrelmis woytkowskii* were unsuccessful. These findings reinforce the necessity to amplify sampling focused on aquatic coleoptera and Elmidae specifically, in order to determine



Figure 32. Dorsal habitus of the type specimen of *Stethelmis chilensis* and labels.

if these populations are truly extinct or only minimally abundant.

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