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Dataset of the Baetidae (Ephemeroptera) and Elmidae (Coleoptera) families from the Yungas of Argentina

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Conjunto de datos de las familias Baetidae (Ephemeroptera) y Elmidae (Coleoptera) de las Yungas argentinas

RESUMEN. Las Yungas o Bosques Subtropicales de Montaña representan una de las ecorregiones más biodiversas de Argentina. Su distribución sobre las cadenas montañosas andinas ayuda a retener el agua, generando los ecosistemas lóticos. El objetivo de este trabajo es dar a conocer y describir un conjunto de datos de las familias Baetidae y Elmidae. Estos datos contienen 1.183 registros, 828 pertenecen a la familia Baetidae (15 géneros y 27 especies) y 355 registros a la familia Elmidae (10 géneros y 16 especies). Se muestrearon 10 de las 24 áreas protegidas, existiendo sectores de Yungas que no poseen registros, como el noreste de la provincia de Salta y el este de la provincia de Jujuy. Este trabajo tiene la intención de exponer vacíos de información y direccionar futuros proyectos de investigación.

PALABRAS CLAVE. Colección. Instituto de Biodiversidad Neotropical (IBN).

ABSTRACT. The Yungas or the Subtropical Mountain Forests represent one of the most biodiverse ecoregions in Argentina. Its distribution over the Andean mountain ranges helps retain water, generating the lotic ecosystems. The aim of this work is to describe a dataset of the Baetidae and Elmidae families. This dataset contains 1,183 records, 828 belong to Baetidae (15 genera and 27 species) and 355 to Elmidae (10 genera and 16 species). Ten out of the 24 protected areas were sampled, without records in some of them, such as northeastern Salta province and eastern Jujuy province. This work is intended to expose information gaps in order to contribute to future research projects.

KEYWORDS. Collection. Instituto de Biodiversidad Neotropical (IBN).

INTRODUCTION

Biodiversity collection data plays a fundamental role in documenting environmental changes (Schmitt et al., 2018). Natural history institutions and the collections are positioned to benefit conservation biology in the future (Drew, 2011). The expansion of collections represents a valuable resource for conservation biologists. Because collections represent precise data, both spatially and temporally, they can be used to reconstruct historical species ranges, provide historical data on community composition and may be used to help understand which species have been lost from an ecosystem (Hoeksema et al., 2011). In many cases, the greatest value of a dataset lies in sharing it, not necessarily in providing interpretation or analysis.

The Institute of Neotropical Biodiversity (IBN) has been working for more than 25 years on the systematics and taxonomy of several orders of insects (Domínguez, 1987; Cuezzo, 1990, Domínguez et al., 1994; Molineri,

2001; Nieto & Domínguez, 2001; Domínguez & Molineri, 2002; Manzo, 2005; Molineri et al., 2019). Most of them inhabit the mountains rivers of the Northwest of Argentina, such as Ephemeroptera, Trichoptera, Odonata and Coleoptera (especially the family Elmidae). These insects are deposited in the Institute's collection, which also holds other important taxa such as Acarina, Gastropoda (terrestrial and aquatic), and reptiles. This allowed the organization and maintenance of a large collection of specimens that in the last few years began to be digitized. As a first step, we propose here to ensure accessibility to data associated with mayflies of the family Baetidae and aquatic beetles of the family Elmidae from Northwestern Argentina.

Baetidae is one of the most diverse and abundant families of Ephemeroptera, it prefers rocky substrates and it has high sensitivity to degradation processes and anthropogenic impact (Domínguez et al., 2006). Elmidae or rifle beetles are a moderately large cosmopolitan family of water beetles. Elmids are very common, especially in lotic habitats as streams and rivers with high level of oxygen, for this reason they are used as indicators of environmental conditions (Ribera & Foster, 1997; Miserendino & Archangelsky, 2006; Buss & Salles, 2007; Souza et al., 2011). Larvae and adults are found together all year long. Despite being so widely distributed and commonly found, riffle beetles are poorly studied in South America. However, in recent years taxonomic and systematic studies of elmids have increased (Manzo, 2005; Manzo & Archangelsky, 2008, 2014). This allowed to reliably determining the specimens of the collection. At present, occurrence data of Baetidae and Elmidae in Argentina at GBIF and *Portal Nacional de Datos Biológicos, Ministerio de Educación Cultura Ciencia y Tecnología* (SNDB) are scarce.

Considering this scenario, the dataset presented here constitutes a significant contribution to the knowledge of the biodiversity of northwestern Argentina. This dataset contains more than 1,000 records for families Baetidae (15 genera and 27 species) and Elmidae (10 genera and 16 species). Ten of the 24 Yungas protected areas were sampled. We also expose information gaps which could lead to wildlife, ecological, biogeographic and conservation studies.

MATERIAL AND METHODS

Study area

All records of this work are located within the Yungas, a mountain rain forest. The Yungas are known as a phytogeographical province, extending from the south of Venezuela into Northwestern Argentina along the Andean mountain range (Cabrera, 1976; Legname, 1982). In Argentina they are distributed discontinuously within the provinces of Salta, Jujuy, Tucumán and Catamarca, along part of the subandean chains, and together with Misiones forest they shelter more than 50% of the present biodiversity of Argentina (Brown & Grau, 1993). Four types of forests can be differentiated along the altitudinal gradient according to the vegetation physiognomy and species composition (Brown et al., 2001). The Premontane Forest (*Selva Pedemontana*), with high diversity of tree species, characterizes the lowest altitudinal level (between 400 and 700 m) of the Yungas. On the east side of this formation transitional forests are in contact with and give way to another ecoregion, the dry Chaco. To the west and up the mountains, the Premontane Forest gives rise to the Montane Humid Forest (*Selva Montana*), rich in tree species, which expands between 700 and 1,500 m.a.s.l. Above the Montane Humid Forest start the Upper Montane Forests and Open Woodlands (*Bosque Montano*), which expand up to 2,500-3,000 m. Above this altitude the high altitude Foggy Montane Grasslands (*Pastizales de Neblina*) arise. To the west of the Yungas, the high Andes are characterized by arid mountain tops and plateaus with bare ground and scarce vegetation (the High Andean Grasslands and rocky outcrops).

Sampling description

Larvae and adults were collected using standardized methods with kicknet, D- frame net, Surber sampler (300 µm mesh) and light traps. The specimens were fixed in 4% formalin or 96% ethyl alcohol and conserved in 70% or 96% ethyl alcohol. Taxonomic identifications were made to genus level using available keys for Baetidae (Domínguez et al., 2006; Salles et al., 2018) and Elmidae (Manzo, 2005; Manzo & Archangelsky, 2014).

Data collection

The dataset is part of the database of Entomological Collection of *Instituto de Biodiversidad Neotropical* (IBN) (CONICET – UNT), Argentina. The dataset was made with LibreOffice and data was cleaned with the OpenRefine 3.2 program, both open access software. This dataset is composed of three related tables: a) the location, which includes: country, province, county, municipality, locality, name of the station or river name, decimal latitude, decimal longitude and altitude (m); b) the taxonomic data, which includes: kingdom, phylum, class, order, family, genus, specific epithet, scientific name, author and year of scientific name, collector, event time, sampling protocol, identified by, individual count, life stage, catalog number, type status sex and preparations if it corresponds; c) the physical, chemical and environmental variables, which include: water and air temperature, pH, sample time, vegetation strata, biogeographic region and habitat. All the data on the sample labels were transcribed in the database. The samples are preserved in 70% or 96% ethyl alcohol (Levi, 1966; Simmons & Muñoz-Saba, 2015), inside glass vials. If the genitalia of some specimen were studied, they were conserved into different eppendorf tubes. For subsequent DNA studies, some of the samples were stored in a freezer. Each vial was designated a unique collection code, consisting of three parts:

abbreviated name of the institution, taxonomic order category and vial number (*e.g*. IBN-E-300). Each vial may contain more than one specimen and, in some case, more than one species. All vials are deposited in a metal cabinet, in a room without windows with constant humidity and temperature of 50% and 23 °C (air conditioning and dehumidifier). The strong point of our collection is that most of the collectors are actively working on the collection, so the georeferences as well as any potential missing data were efficiently supplied and verified using digital cartography (satellite images; Quantum GIS v1.7; Google Earth Pro).

The dataset was exported on DarwinCore v.1.4 (http://www.gbif.es/Recursos2.php), postvalidation was applied using DARWINTEST software (http://www.gbif.es/darwin_test/Darwin_Test_in.php), and the metadata was integrated to the dataset in DarwinCore Archive format. Finally, the dataset was provided to *Sistema Nacional de Datos Biológicos, Ministerio de Educación, Cultura, Ciencia y Tecnología* (SNDB, Argentina) and the Global Biodiversity Information Facility (GBIF), by means of their Integrated Publishing Toolkit (IPT).

The data were analyzed in a GIS (QGIS Development Team, 2018). The georeferenced points were overlapped on the protected areas of national and provincial jurisdiction (Administration of National Parks, Federal System of Protected Areas) and the reference maps were constructed from QGIS. In addition, digital elevation model GDEM-Aster V2 (global digital elevation model, version 2, Satellite Aster) was used to delineate altitude ranges that are related to the different altitude floors of the Yungas.

This dataset is also available on GBIF and *Sistema Nacional de Datos Biológicos* (SNDB): https://doi.org/10.15468/3yegl2 (https://www.gbif.org/dataset/59e256fe-2444-479c-b754-7e94d1cefcef); https://datos.sndb.mincyt.gob.ar/collectory/public/showDataResource/dr9878

RESULTS

A total of 1,183 records are contained in this dataset including Baetidae and Elmidae families from the ecoregion of the Yungas of Argentina, of which 570 (48.2%) belong to Tucumán, 349 (29.5%) from Salta, 218 (18.4%) from Jujuy and 46 (3.9%) from Catamarca. Baetidae was represented by 15 genera and 27 species (828 records), while Elmidae was represented by 10 genera and 16 species (355 records). The most abundant genera of Baetidae were *Baetodes* Needham & Murphy with 194 records (23.4% of the family) followed by *Camelobaetidius* Demoulin with 144 records (17.4%), while in Elmidae was *Austrelmis* Brown with 113 records (31.8%) followed by *Macrelmis* Motschulsky with 79 records (22.3%) (Fig. 1)

The dataset covered a time span of 49 years between 1970 and 2019. The highest percentage of records (92.6%) was concentrated between 1990 and 2009. At both sides of the time scale records were scarce, reaching 7.4% (Fig. 2).

The highest concentration of sampled rivers was in the province of Tucumán; in addition, the largest number of stations with repeated visits were obtained (three stations with visiting, ranges from 7 to 15). Within these stations, the most visited was the Artaza river, located in Burruyacú department, Tucumán. Conversely, there are areas of Yungas that had not records and were not visited such as northeast of Salta and east of Jujuy (Fig. 3).

Related to protected areas, the Yungas have 24 protected areas placed in different categories, 10 of which were sampled in this dataset, with 383 records. The recently created "Parque Nacional Aconquija" in Tucumán is the protected area with most records, representing 38.6% (148) of the total (Fig. 4).

Within Baetidae, the genera *Americabaetis, Baetodes, Camelobaetidius, Cloeodes* and *Nanomis* Lugo-Ortiz & McCafferty were recorded in all altitudinal ranges of the Yungas, while *Guajirolus* Flowers were recorded only between 0-600 m.a.s.l. In the case of Elmidae, the genera *Austrelmis, Heterelmis* Sharp and *Neoelmis* Musgrave were recorded within all altitudinal ranges, while *Hexacylloepus* Hinton was recorded between 0-600 m.a.s.l, and *Hexanchorus* Sharp only between 1500-2100 m.a.s.l. (Fig. 5).

DISCUSSION

The *Instituto de Biodiversidad Neotropical* has a great experience working on taxonomy and the use of bioindicators of the quality of the Yungas mountain streams (Domínguez, 1987; Cuezzo, 1990, Domínguez et al., 1994; Nieto & Domínguez, 2001; Domínguez & Molineri, 2002; Manzo, 2005; Molineri et al., 2019, between others), in this work a set of data that are scarce in the digital portals are given and discussed filling the information gap in the area.

Although Baetidae is a common and abundant family in almost all lotic habitats, clearly the great number of records in the IBN collection is due to the contributions of three researchers working and collecting Ephemeroptera. This highlights the importance of collecting several taxonomic groups on each field trip. Related to the altitude, genera such as *Apobaetis* Day, *Rhopyscelis* Cruz, Salles & Hamada and *Guajirolus* were recorded restricted to specific range of altitude, relating to warm weather and sandy substrate (Nieto, 2004, 2006), these habitats are very common in lowlands or piedmonts of the Yungas. *Andesiops* Lugo-Ortiz & McCafferty, appears above the 600 m.a.s.l., this genus has been reported always at high altitude. Moreover, it is the genus of Baetidae in South America with the highest record reported (4,300 m.a.s.l.; Nieto et al., 2016). On the other hand, other genera that are very common between 0-2,100 m.a.s.l. are not to be found above

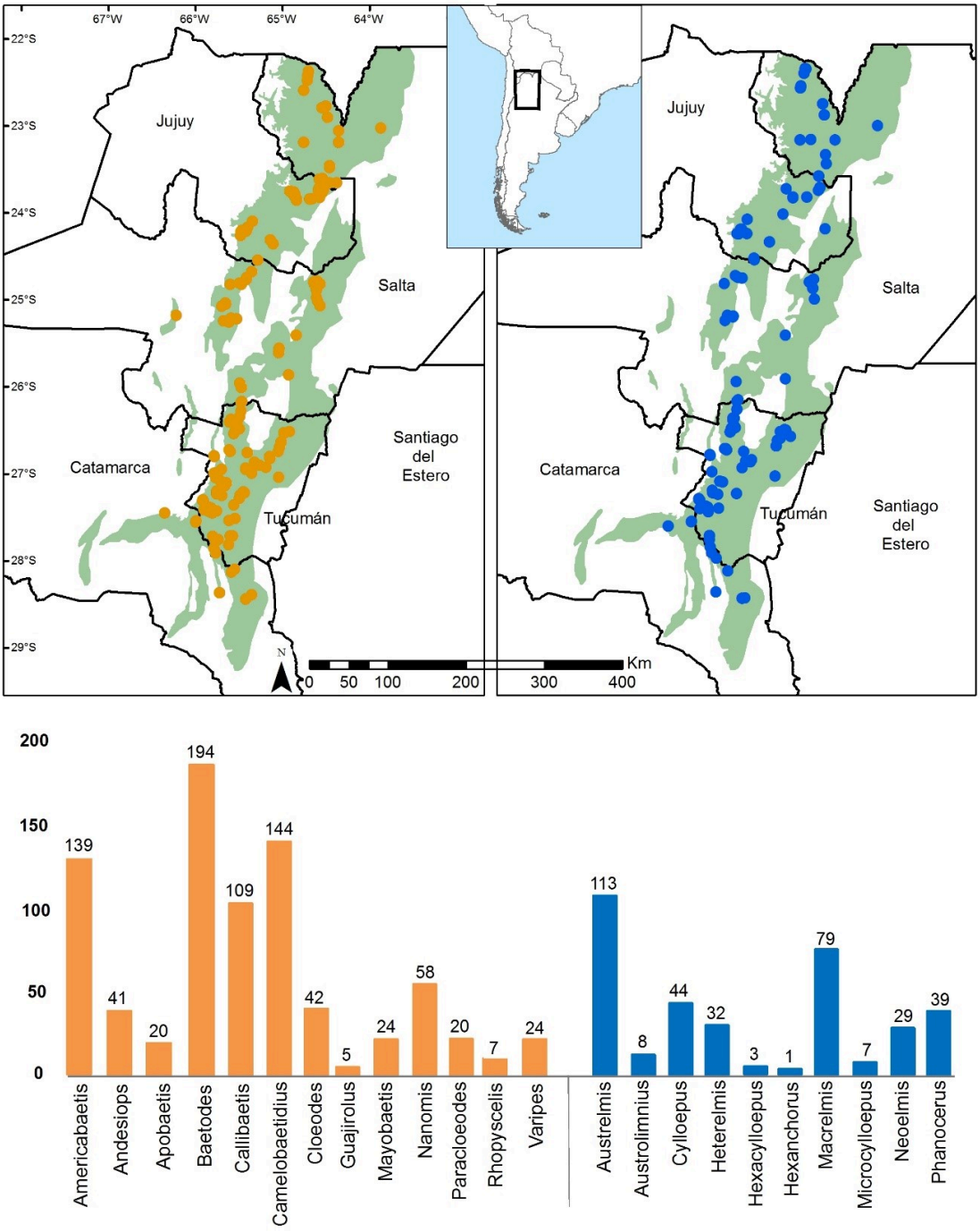

Fig. 1. Frequency of records of the different genera of the Baetidae (orange) and Elmidae (blue) families and their distribution on a map of the Yungas of Argentina (green shading), from the dataset of the collection of *Instituto de Biodiversidad Neotropical* (IBN), Tucumán, Argentina.

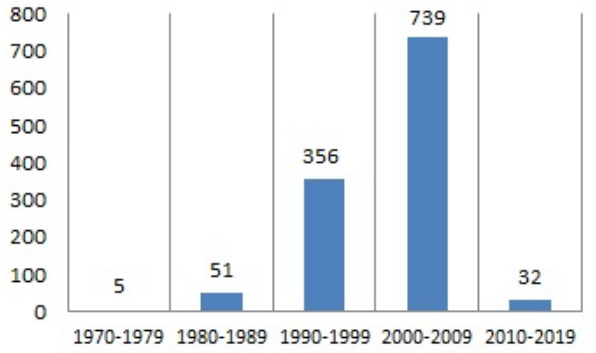

Fig. 2. Frequency of records in the ranges of decade, of the dataset of the collection of the *Instituto de Biodiversidad Neotropical* (IBN), Tucumán, Argentina [Axis X: Decades; Axis Y: Number of records)

this altitude, such as *Callibaetis* Eaton, *Paracloeodes* Day, and *Varipes* Lugo-Ortiz & McCafferty, the oxygen availability related with the altitude may act as an ecological limiting factor for the occurrence of these taxa (Dos Santos et al., 2018). Altitudinal data from the elmid species studied provide an extensive range for *Heterelmis* and moderate range for *Cylloepus* Erichson, *Macrelmis* and *Phanocerus* Sharp. This distribution is coincident with other studies from the Yungas (von Ellenrieder, 2007; Manzo 2007). Undoubtedly, the altitudinal range for *Austrelmis*, *Neoelmis*, *Hexacylloepus* and *Hexanchorus* will increase as new material is collected. *Austrelmis* and *Neoelmis* are the genera with the highest altitudinal range, reaching distribution over 3,500 m.a.s.l. (Manzo & Archangelsky, 2012). Also, many *Hexanchorus* species are distributed from 0 to 1,500 m.a.s.l. (Spangler & Santiago-Fragoso, 1992), therefore it is possible to find them in lowlands.

During the last decades the main purpose of the projects in the IBN was to improve the knowledge of the aquatic insect's biodiversity of the entire Yungas region

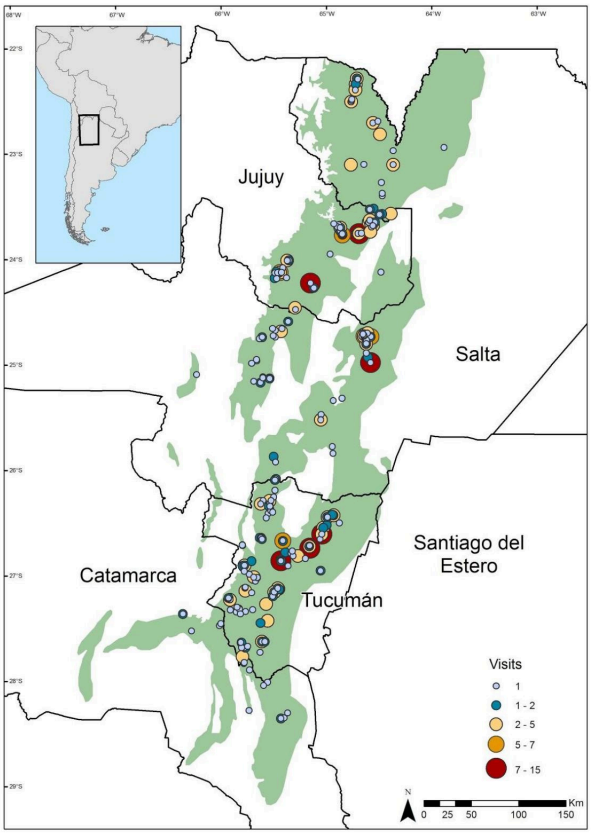

Fig. 3. Frequency of visits to the Yungas sampling stations in Argentina, from the dataset of the collection of the *Instituto de Biodiversidad Neotropical* (IBN), Tucumán, Argentina.

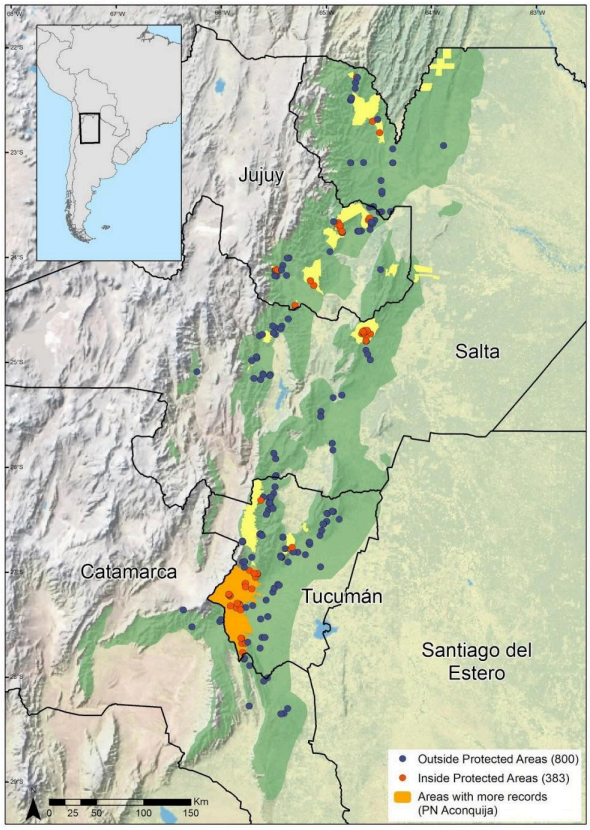

Fig. 4. Distribution of sampling points and their relationship with the Yungas protected areas, from the dataset of the *Instituto de Biodiversidad Neotropical* (IBN), Tucumán, Argentina.

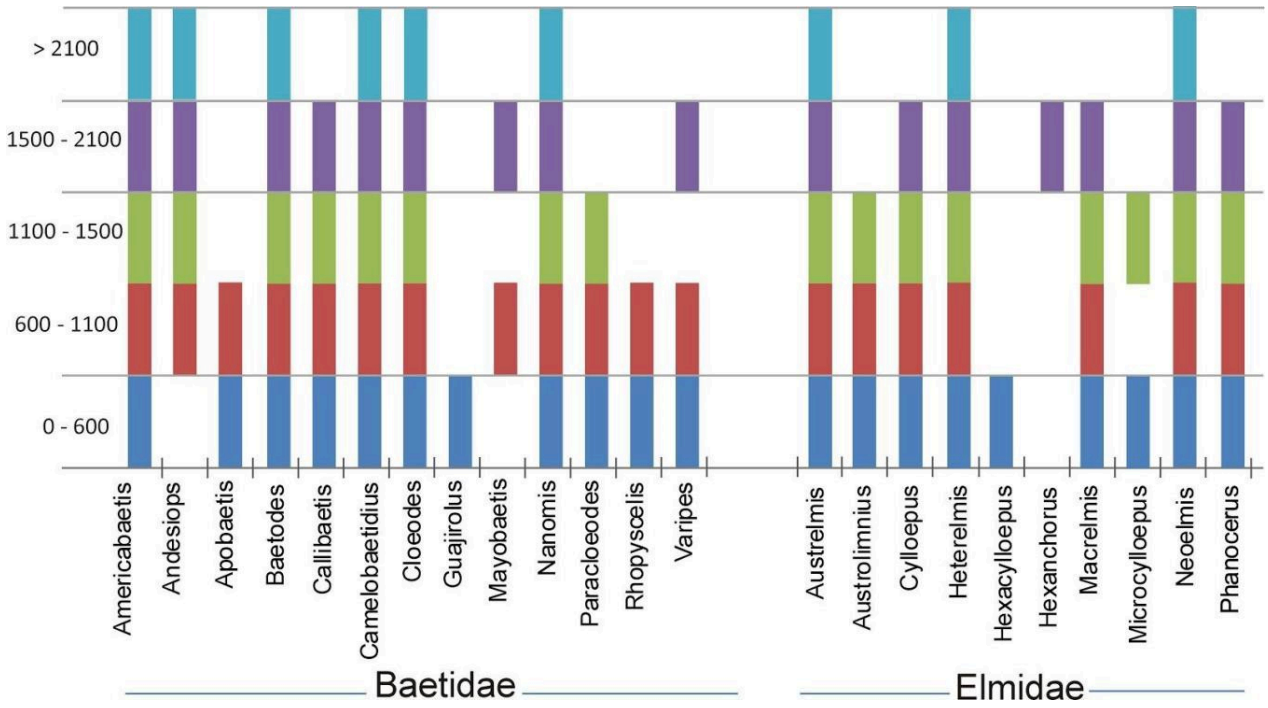

Fig. 5. Distribution of the genera of the Baetidae and Elmidae families in the altitudinal ranges of the dataset of the *Instituto de Biodiversidad Neotropical* (IBN), Tucumán, Argentina.

and not just the protected areas. On the other hand, these areas require collection permits, which discourages carrying out the process, despite the fact that currently this has improved considerably. Probably these are the reasons why protected areas have received less attention than other Yungas areas. Our work exposes some areas without data and this could be used in future research projects.

The importance of these families of aquatic macroinvertebrates as bioindicators of water quality in one of the most biodiverse forested regions of Argentina as well as the scarce records available in open access portals, make the presentation of this dataset of significant importance. Finally, free and open access to primary biodiversity data is essential to achieve better biodiversity conservation policies and sustainable development (Chavan & Penev, 2011).

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