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Size spectra of the edaphic fauna of typical Argiudol soils of the Rolling Pampa region, Argentina

Víctor N. Velazco[‡], Rosana V Sandler[‡], Maria Cynthia Valeria Sanabria[‡], Liliana B Falco[‡], Carlos E Coviella[‡], Leonardo A. Saravia[§]

‡ Instituto de Ecología y Desarrollo Sustentable (INEDES) - Dept. of Basic Sciences, Universidad Nacional de Luján, Luján, Argentina
§ Centro Austral de Investigaciones Científicas (CADIC - CONICET), Ushuaia, Argentina

Corresponding author: Víctor N. Velazco (velazcon951@gmail.com)

Abstract

Background

Soil-dwelling organisms populate the spaces—referred to as interstices—between the litter on the soil surface and the pores in the soil's organo-mineral matrix. These organisms have pivotal roles in soil ecosystem functions, such as the breakdown and decomposition of organic matter, the dispersal of bacterial and fungal spores, and biological habitat transformation. These functions, in turn, contribute to broader ecosystem services like carbon and nutrient cycling, soil organic matter regulation, and both chemical and physical soil fertility.

This study provides morphological data pertaining to a range of soil organism sizes, specifically in Argiudol soils subjected to varying levels of agricultural activity in the Rolling Pampas region, one of the world's most extensive and fertile plains.

The primary focus is on soil microarthropods—namely, Acari (mites) and Collembola (springtails)—with a body width of less than 2mm. These organisms constitute the majority of life in the intricate soil pore network. Additionally, the study documents species of earthworms (Oligochaeta: Crassiclitelata), recognized as ecosystem engineers for their ability to create physical channels in the soil matrix and to distribute organic matter. Moreover, the study includes measurements of morphological traits of soil-dwelling "macrofauna" (organisms with a body width greater than 2mm), which are also implicated in various soil ecosystem functions. These include population regulation by apex predators, organic matter decomposition, biogenic structure formation, nutrient mobilization, and herbivory.

New information

In this paper, we report both the geographical locations and individual measurements of key morphological traits for over 7,000 specimens, covering a range of soil-dwelling organisms. These include springtails (Entognatha: Collembola), mites (Arachnida: Acari), earthworms (Oligochaeta: Crassiclitellata), and additional soil macrofauna. All specimens were collected from typical Argiudol soils located in three distinct agricultural systems characterized by varying levels of land-use intensity. To our knowledge, no other dataset exists providing this information for the Argentinian Pampas.

Keywords

Soil fauna, soil invertebrates, Acari, Collembola, earthworms, body mass, body length, body width, Rolling Pampas, morphological traits, intensities of land use, occurrence, specimen

Introduction

Soil-dwelling organisms are commonly classified by body size, using body width as the distinguishing morphological trait (Swift et al. 1979), These organisms fall into three categories: microfauna (width < 200 *μm*), mesofauna (width < 2mm), and macrofauna (width > 2mm). These categories are essential for understanding the roles different organisms play in soil ecosystems. All these organisms inhabit the spaces, or interstices, formed between surface litter (Wallwork 1958, Ritz and van der Putten 2012) and the porous network within the soil (Lavelle 2012, Kampichler 1995).

Within the mesofauna, mites (Arachnida: Acari) and springtails (Entognatha: Collembola) are the most abundant and diverse edaphic microarthropods, although, due to their body weights, they do not represent an important component of total edaphic metabolism (Hale et al. 2004). That being said, in the soil (Brussaard 2012) they are key actors in the functioning of the ecosystem, since they participate in the carbon and nutrient cycle through the consumption of organic matter, the transport of propagules, the control of microflora populations and of the microfauna, and are the food resource for other edaphic organisms (Butcher and Snider 1971, Wurst et al. 2012).

Earthworms (Oligochaeta: Crassiclitellata) stand out within the macrofauna, since their presence contributes to the formation and maintenance of the physical structure of the soil, promoting aeration and permeability, which in turn provides optimal conditions for plant growth and the circulation of air, water, and nutrients in the soil. In addition, due to their feeding mechanism, earthworms take the organic matter that accumulates in the soil, engulf it and deposit it as fecal pellets that are colonized by microorganisms, thus contributing to the humification processes and the release of nutrients (Paoletti 1999, Phillips et al. 2021, Persson and Lohm 1977).

The macrofauna does not present a high taxa diversity, but it does encompass a wide range of taxonomic ranks, differing at the level of orders, and it plays a large number of functions in the edaphic ecosystem, such as herbivory, litter fractionation, control of populations by predators, transport of phoretic organisms and propagules of microorganisms, and the formation of pores and habitats in the soil (Burges and Raw 1967, Lavelle and Allister 2001).

The taxonomic identification of the species that make up the community that inhabits the intricate network of pores and interstices of the soil is complex, and due to the great taxonomic diversity, its taxonomy is in constant revision and, furthermore, this identification becomes more difficult as the body size of the organisms decrease (Briones 2014).

All organisms respond to environmental pressures with individual changes in morphological, physiological, phenological, or behavioral traits. The pressures that modify the characteristics of the environment are also reflected as changes in the population structure of the taxa under study (Mittelbach and McGill 2019, Sechi et al. 2017). Therefore, the effect of the interactions of organisms with their environment is reflected in the population variations and in the variations of the traits that can be used as indicators of ecological processes on a community level (Brussaard 2012, Petchey and Belgrano 2010).

Considering the above, the understanding of cryptic soil communities at the local level becomes necessary, and it can be addressed, through the use of individual traits without considering their identification to the species level. This would make it possible to understand the processes that occur in ecological communities and improve the analysis capacity of cryptic communities (Le Guillarme et al. 2023). The magnitude of the changes that occur in the edaphic fauna community could have a significant impact on the ecological and biogeochemical processes in the soil, and in turn, the ecosystem services they provide.

The edaphic fauna is sensitive to the disturbances that occur to the soil, because human activities alter the habitat and the source of the resources that these organisms use (Lavelle et al. 2006). For example, the pulses derived from the application of fertilizers and pesticides can alter the inputs and outputs of organic matter and nutrients; or when the soil is exposed to environmental factors during the fallow period, this can alter the conditions of the porous microclimate when the vegetation cover is not present; or in livestock systems in which soil compaction affects the physical structure, distribution and pore size distribution.

Variations in body size in ecological communities due to changes in the environment are analyzed using the size spectrum (Pey et al. 2014), using the distribution of body weights and its relation to density (Turnbull et al. 2014). Analizing their relative abundance allows the description of the importance of different taxa in the community and can be related to functional redundancy and linked to ecosystem functioning (Briones 2014). Changes in the distribution of body weights in a community reflect variations in the environment or in the network of biological interactions (Pey et al. 2014, White et al. 2007). In turn, both relative abundance and body size distribution are closely related to the metabolism and the flow of energy that crosses the nodes in the network of interactions in the community (Potapov et al. 2019) of the soil system.

As described above, the changes in the size spectrum and in the biomass are linked to the response of the community to environmental pressures (Sechi et al. 2017), with the structure and dynamics of the communities (Jonsson et al. 2005), and with the functioning of the ecosystem (Lavelle 2012, Peters 1999), and they can show the effects of disturbance intensity on the soil ecosystem.

In this work we present the dataset from GBIF data of Velazco et al. (2023), and the location of taxa of springtails (Entognatha: Colembolla), mites (Aracnida: Acari), earthworms (Oligochaeta: Crassiclitellata) and other macrofauna that occur in typical Argiudol soils under three different use systems, located in the Rolling Pampas region in Argentina. This dataset contains the individual measurements of over 7000 individuals of the main morphological traits of each of the mentioned taxa: body length, body width and estimated body weight for each organism.

Project description

Title: Soil Biodiversity 2023: Size Spectra of the edaphic fauna of Argiudol soils typical of the Rolling Pampa region, Argentina.

The project focuses on the characterization of edaphic fauna on Argiudol soils of the Rolling Pampas, one of the most fertile and extensive agricultiural plains in the world, under three intensities of human impact. By measuring the individuals found over a two year sampling period, and calculating their biomass, we strive to estimate energy flux through different parts of the edaphic fauna, and to estimate community stability. In this work, we present the complete dataset collected for the project. To the best of our knowledge, there is no other dataset for the Rolling Pampas that shows the spectrum of sizes and biomass of edaphic fauna for the different taxons found.

In this document we present the list of taxa of springtails (Entognatha: Colembolla), mites (Aracnida: Acari), earthworms (Oligochaeta: Crassiclitellata) and other macrofauna that occur in typical Argiudol soils under three systems with different anthropic impact, located in the argentinian Rolling Pampas region. This list has individual measurements of the main morphological traits of each of the mentioned taxa, such as measurements of body length, body width and estimated body weight for each organism.

Personnel: Victor Nicolás Velazco, Rosana V Sandler, Cynthia Sanabria, Carlos E Coviella, Lilliana B Falco, Leonardo A Saravia, Gabriel Tolosa, Anabela Plos

Study area description: Samples were collected from fields located in the districts of Chivilcoy and Navarro in the province of Buenos Aires, Argentina. The sampling sites were fields with three different intensities of land use: 1) Naturalized grasslands (N): abandoned grasslands without significant direct anthropic influence for at least 50 years, whose predominant vegetation is *Festuca pratensis*, *Stipa sp.*, *Cirsium vulgare*, and *Solanum laucophylumm*, 2) Mixed livestock system (G): fields under continuous grazing with high animal load for 25 years, with a change towards forage production (bales of oats, corn and sorghum) for fattening two years prior to starting the study, and 3) Agricultural system (A): fields under continuous intensive agriculture for 50 years and under no-tillage for the 18 years prior to the start of samplings.

Design description: For each land use system, 3 different sites in separate fields were selected as replicates. In each replica, 3 sampling points were randomly located and then georeferenced to return to the same site on each sampling date.

Funding: This project has been partially funded by a Doctoral Scholarship to Víctor Nicolás Velazco from the Concejo Nacional de Investigaciones Científicas (CONICET-Argentina), by the research program in Terrestrial Ecology of the Universidad Nacional de Luján, with the support of the Instituto de Ecología y Desarrollo Sustentable (INEDES-UNLu-CONICET), and by Universidad Nacional de Lujan. There is also logistical support from the GBIF Argentina node, which is in charge of standards control, review and hosting of data and metadata.

Sampling methods

Description: The samples were taken from fields located in the districts of Chivilcoy and Navarro in Buenos Aires Province, Argentina.

The sampling sites were fields with three different intensities of land use: 1) Naturalized grasslands (N): abandoned grasslands without significant direct anthropic influence for at least 50 years, whose predominant vegetation is *Festuca pratensis, Stipa sp., Cirsium vulgare*, and *Solanum laucophylumm,* 2) Mixed livestock system (G): fields under continuous grazing with high animal load for 25 years, with a change towards forage production (bales of oats, corn and sorghum) two years prior to starting the study, and 3) Agricultural system (A): fields under continuous intensive agriculture for 50 years and under no-tillage for the 18 years prior to the start of the samplings.

Sampling description: The samplings were carried out once a season for 2 years. Soil subsamples with cores of 5cm in diameter and 10cm deep were taken at each sampling point. Subsequently, the sample was homogenized and taken to the laboratory for the extraction of edaphic microarthropods using the flotation technique. In addition, at each sampling point, a 25x25x25cm monolith was taken for the manual extraction of earthworms and other macrofauna organisms. The collected organisms were stored in 70% alcohol until their identification under a binocular microscope (Moreira et al. 2012Vargas and Recamier 2007, Newton and Proctor 2013, Moretti et al. 2017).

Step description: The edaphic microarthropods were extracted using the flotation technique, for which the homogenized sample was disaggregated and placed under water flow so that they pass through sieves with a 4mm and 2mm mesh opening, the soil that passed through the meshes was mixed in 2:1 ratio with a 1.2% magnesium sulfate solution.

The solution is allowed to settle for a few minutes until the mineral fraction of the soil settles and the supernatant in which the arthropods float is collected with a 98um diameter sieve and stored in 70% alcohol until observation.

The collected supernatant was observed using a Leica S8P0 binocular microscope, and with the help of fine brushes and thin needles, the microarthropods were extracted and stored in 70% alcohol until their identification.

The identification of mites, springtails and worms and other fauna was carried out using taxonomic keys. After the identification, the body weights of the edaphic organisms were estimated, all of them expressed in micrograms of dry weight. The earthworms were weighed to obtain the fresh weight and the dry weight was taken with a factor of 0.15.

The other organisms were measured one by one through photographs taken with a Leica S8P0 microscope with a built-in digital camera and whose rasters include a measurement scale depending on the configuration of the optical system at the time of capture.

Once the images were obtained, the ImageJ tool was used and the measurements of the body length and width of each of the individuals in micrometers were obtained.

Following this, several published linear equations relating body length and width were used to estimate the body weight of the organisms.

The length-width equations are general but vary by taxonomic (Caruso and Migliorini 2009) group and also by the general shape that may exist within the taxonomic group. A total of 8662 specimens were measured individually.

Geographic coverage

Description: The Argentine pampa is a wide plain with more than 54 million hectares. Phytogeographically, it is located in the Neotropical region, Chaqueño domain, Eastern district of the Pampean province and, therefore, the dominant vegetation is the steppe or pseudo-steppe of grasses (Oyarzabal et al. 2018, Cabrera 1976). The climate is temperate and with relatively high humidity throughout the year, periodically interrupted by droughts derived from El Niño and La Niña. The so-called Rolling Pampas is the most fertile and productive zone in the region, where more than 80% of the land is dedicated to the production of agricultural crops. The soils of the Pampas have relatively few limitations for crop production and are suitable for livestock. They are deep, well-drained soils, do not offer limitations for root growth, and have a good organic matter content (Cabrera and Willink 1973).

The fields Table 1 where all the samples were taken are located in the districts of Chivilcoy (60 m.a.s.l. Lat: 35° 8'1.85"S Long: 59°44'41.37" W and Lat: 34°51'48.47" S Long: 60°13'10.51" W) and Navarro (43 m.a.s.l. Lat: 34°49'12.72" S Long: 59°10'14.00" W) in the province of Buenos Aires, Argentina. The fields with agricultural use are located within a radius of no more than 5km from each other, the mixed fields that implement livestock and pasture cultivation are within a radius of less than 7km, and two of the three pastures are contiguous while the third is about 37km. These distances in the Humid Pampa are practically irrelevant in terms of climate or elevation, the soils in all the sampled sites correspond to typical Argiudols (Natural Resources Conservation Service et al. 2010) of the Henry Bell and Lobos series (CIRN 2022).

Coordinates: -35.14 and -34.82 Latitude; -60.22 and -59.17 Longitude.

Taxonomic coverage

Description:

The edaphic fauna organisms were classified into different taxonomic categories (Table 2). The identification of organisms stored in 70% alcohol was carried out with the support of taxonomic keys.

The mites were identified up to superfamilies (Balogh and Balogh 1988, Balogh and Balogh 1972, Burges and Raw 1967, Dindal 1990, Evans and Till 1979, Krantz and Walter 2009, Momo and Falco 2009), the springtails were identified up to the family level (Claps et al. 2020, Janssens 2023, Momo and Falco 2009), the earthworms, down to species (de Michis and Moreno 1999, Reynolds 1996, Satchell 1983), and the macrofauna was identified in different taxonomic ranks, whether they are classes, orders, or families (Choate 1999, Claps et al. 2020, Dindal 1990, Klimaszewiski and Watt 1997, Vargas et al. 2014, Zhang 2011).

Traits coverage

All the organisms of the edaphic fauna extracted by the sifting and flotation technique (Vargas and Recamier 2007) were processed; in total, for each system of use, 3530 - 3111 - 2021 were processed for the agricultural (A), livestock (G) and grassland (N) systems, respectively.

The organisms were taxonomically identified and then these organisms were characterized by their morphometric features. The morphometric traits measured were body length and body width, which allow the estimation of the body weight of each organism through the use of previously documented linear regression equations (Newton and Proctor 2013, Ganihar 1997).

Photographs of each member of the edaphic biota (see Fig. 1) stored in 70% alcohol were taken with a Leica stereoscope (S8AP0) with a camera included (Leica DFC 295) and with an integrated reference scale (Leica Application Suite V4.4). This allows micrometer precision to be obtained through the use of 40x eyepieces and a variable objective with a maximum magnification of up to 8x, which allowed working with magnifications of up to 320x.

To obtain the length measurements of the body length and width, each image was processed using the ImageJ software (Gonzales 2018, Rasband 2018), a program for the processing of scientific images that allows measuring lengths in the images from a reference scale; each measurement obtained was recorded in this database.

Body weight estimates were made by using morphometric linear equations (Table 3) that relate the body lengths to the length and width of the edaphic fauna. These equations are taken from the scientific literature (Coulis and Joly 2017, Greiner et al. 2010, Hale et al. 2004, Hawkins et al. 1997, Lebrum 1971a, Lebrum 1971b, Persson and Lohm 1977, Tanaka 1970) and in Fig. 2 the distribution of body weight of the different taxa involved is observed, which is the size spectrum of the fauna that inhabits the soil in the different management systems.

Data coverage of traits

The dataset is then left with values of the following morphological traits: the body length and width in micrometers of the edaphic fauna, with the exception of earthworms,and the body weight in micrograms of dry weight of each organism of the edaphic fauna found in the different sampling events.

Temporal coverage

Data range: 2008-8-15 - 2010-12-15.

Notes: The sampling design covered seasonal variability with bimonthly sampling over two years.

Collection data

Collection name: Size Spectra of the Edaphic Fauna from Rolling Pampas

Parent collection identifier: Not applicable

Specimen preservation method: Alcohol

Usage licence

Usage licence: Open Data Commons Attribution License

Data resources

Data package title: Size Spectra of the edaphic fauna of typical Argiudol soils of the Rolling Pampas region, Argentina.

Resource link: https://doi.org/10.15468/cmp3ma

Alternative identifiers: https://www.gbif.org/dataset/6c685c4f-021a-40e2-a8a0-ac0ffc84c215

Number of data sets: 2

Data set name: Occurrence

Download URL: https://www.gbif.org/occurrence/download?dataset_key=6c685c4f-021a-40e2-a8a0-ac0ffc84c215

Data format: Darwin Core

Description: These datasets present the invertebrates of the edaphic fauna whose specimens belong to different taxa of Collembola: Entognatha (springtiails), Acari: Arachnida (mites), Crassiclitellata: Oligochaeta (earthworms) and other invertebrates of the edaphic fauna (Mollusca and Artrhopoda) that are part of the macrofauna.

Each row records the presence of soil organisms and these were validated according to the Darwin Core Standard (DWC).

These soils are found in the Rolling Pampas region, Argentina, one of the most extense and fertile plains in the world. The data geographically references the sampling sites and also includes the date on which the samplings were taken.

Column label	Column description
occurrenceID	An unique identifier for the occurrence event
institutionCode	The name in use by the institution
collectionCode	The code identifying the collection
catalogNumber	A unique identifier for the record within the data set
basisOfRecord	The specific nature of the data record:"Occurrence"
type	The nature or genre of the resource: "PhysicalObjet"
datasetName	The name identifying the data set
habitat	A category for the habitat
day	The integer day of the month on which the event occurred

eventTime	The interval during which an event occurred
otherCatalogNumbers	A list (concatenated and separated) of previous catalog numbers
higherGeography	A list (concatenated and separated) of geographic names less specific than the information captured in the country term
continent	The name of the continent in which the event occurs
country	The name of the country
countryCode	The standard code for the country
stateProvince	The name of the next smaller administrative region than country (province) in which the registry occurs
county	The name of the smaller administrative region
month	The integer month in which the event occurred
year	The four-digit year in which the event occurred
kingdom	The full scientific name of the kingdom in which the taxon is classified
phylum	The full scientific name of the phylum in which the taxon is classified.
class	The full scientific name of the class in which the taxon is classified
order	The full scientific name of the order in which the taxon is classified
family	The scientific name of the family in which the taxon is classified
genus	The genus part of the cientific name without authorship
specificEpithet	The name of species epithet of the scientific name
higherClassification	A list (concatenated and separated) of taxa names terminating at the rank immediately superior to the referenced taxon
scientificName	The full scientific name or lowest level taxonomic rank that can be determined, with authorship and date information.
taxonRank	The taxonomic rank of the most specific name in the scientificName
verbatimLatitude	The verbatim original latitude of the occurrence Location
verbatimLongitude	The verbatim original longitude of the occurrence Location
decimalLatitude	The geographic latitude, in decimal degrees
decimalLongitude	The geographic longitude, in decimal degrees
verbatimSRS	The ellipsoid, geodetic datum, or spatial reference system (SRS) upon which coordinates given in verbatimLatitude and verbatimLongitude
georeferencedBy	Names of people, who determined the georeference for the location occurrence
recordedBy	Reference to the method used to determine the spatial coordinate names of people responsible for recording the original occurrence

recordedByID	Globally unique identifier for the person responsible for recording the original occurrence
samplingProtocol	Descriptions of the methods used during the event sampling
sampleSizeValue	A numeric value for the size of a sample in a sampling event
samplingEffort	The unit of measurement of the size of a sample in a sampling event. The amount of effort when sampling a event
verbatimCoordinateSystem	The coordinate format for the verbatimLatitude and verbatimLongitude
occurrenceRemarks	Notes about the occurrence.
eventDate	The date-time during which an event occurred
sampleSizeUnit	The unit of measurement of the sample size of the sampling event
georeferenceProtocol	A link to the reference on the methods used to determine the coordinates

Data set name: Measurement: data set 2

Description: These datasets present the invertebrates of the edaphic fauna whose specimens belong to different taxa of Collembola: Entognatha (springtiails), Acari: Arachnida (mites), Crassiclitellata: Oligochaeta (earthworms) and other invertebrates of the edaphic fauna (Mollusca and Artrhopoda) that are part of the macrofauna.

Each row records individual measurements of morphological traits of soil organisms that are extensions of the occurrence dataset described above and validated according to the Darwin Core Standard (DWC).

Column label	Column description
occurrenceID	A unique identifier taken from the occurrence dataset and linking it to the measurements of each occurrence.
measurementValue	The value of the measurement
measurementUnit	The units associated with the measurementValue
measurementType	The nature of the measurement
measurementMethod	A description of the method used to determine the measurement
measurementDeterminedBy	Names of people who determined the value of the measurement
measurementDeterminedDate	Date range on which the measurement was taken
measurementAccuracy	The description of the estimated error associated with the measurementValue

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Author contributions

Nicolas Velazco: updated the ID of the specimens, photographed and measured all the 8662 individuals collected, built the database, and collaborated with the writting of the manuscript. Rosana Sandler: Did all the fieldwork, collected and separated the specimens, and did the first ID of the specimens. Cynthia Sanabria: database construction, and collaborated with the writting the manuscript. Carlos Coviella: project design, project development, and collaborated with the writing and revising of the manuscript. Liliana Falco: project design, project development, statistical analyses, and collaborated with the writting of the manuscript. Leonardo Saravia: Project leader, project design, statistical analyses, collaborated with the writting of the manuscript.

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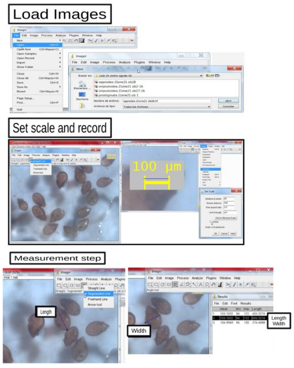

Figure 1.

Graphic summary of the steps followed to obtain the measurements of the morphological traits, that is, the length and width of the body. Step one: upload the images to ImageJ. Step two: Configure the measurement tool through the relationship of the measurement scale and the length of pixels that it represents. Step three: take measurements of the lengths of interest.

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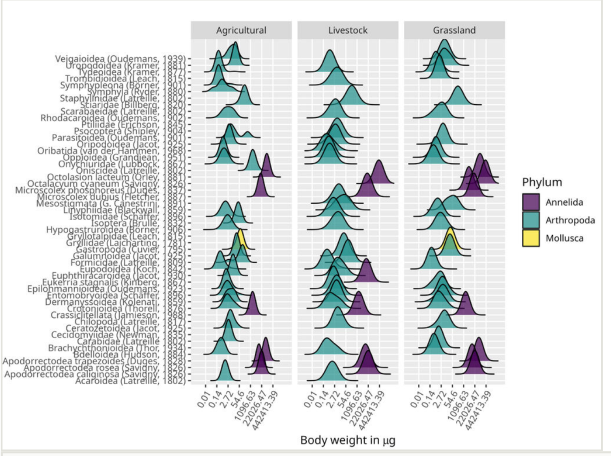

Figure 2.

Distribution of body weight in micrograms of dry weight of the taxa that make up the edaphic fauna community in the different land use systems. Horizontal axis: body weight in micrograms on a logarithmic scale. Vertical axis: taxa by their scientific name. Legend: the colors refer to the phylum to which the different taxa belong.

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Table 1.

Geographical location of the fields in which the samples were taken. Coordinates are in WGS84 sexagesimal degree systems.

System Use	Site field	Latitude	Longitude
Agricultural System	Casuarina	S 35°03'20.2"	W 59°41'18.5"
	Molino	S 35°03'15.5"	W 59°41'09.9"
	Manga	S 35°05'22.0"	W 59°38'70.9"
Livestock System	L24	S 34°17'17.1"	W 59°10'31.3"
	L25	S 34°49'25.0"	W 59°10'25.7"
	L27	S 34°49'30.2"	W 59°10'16.1"
Grassland	Romina	S 35°03'28.7"	W 59°41'03.6"
	Festuca	S 35°03'31.6 "	W 59°41'03.3"
	Triángulo	S 34°51'05.0"	W 60°01'74.0"

Table 2.

Taxonomic coverage of edaphic fauna organisms.

Phylum	**Class**	**Order**	**Family**	**Scientific Name**	**Taxon Rank**
Mollusca	Gastropoda	Gastropoda		Gastropoda (Cuvier, 1795)	Order
Arthropoda	Symphyla			Symphyla (Ryder, 1880)	Class
	Pauropoda			Parasitoidea (Oudemans, 1901)	Class
	Malacostraca	Isopoda		Oniscidea (Latreille, 1802)	Suborder
	Insecta	Psocoptera		Psocoptera (Shipley, 1904)	Order
		Ortoptera	Gryllotalpidae	Gryllotalpidae (Leach, 1815)	Family
			Gryllidae	Gryllidae (Laicharting, 1781)	Family
		Hymenoptera	Formicidae	Formicidae (Latreille, 1809)	Family
		Diptera	Sciaridae	Sciaridae (Billberg, 1820)	Family
			Ecidomyiidae	Cecidomyiidae (Newman, 1835)	Family
		Coleoptera	Scarabaeidae	Scarabaeidae (Latreille, 1802)	Family
			Ptiliidae	Ptiliidae (Erichson, 1845)	Family
			Carabidae	Carabidae (Latreille 1802)	Family
				Staphylinidae (Latreille, 1802)	Superfamily
		Blattodea		Isoptera (Brullé, 1832)	Infraorder
	Entognatha	Symphypleona		Symphypleona (Börner, 1901)	Order
		Poduromorpha	Onychiuridae	Onychiuridae (Lubbock, 1867)	Family
				Hypogastruroidea (Börner, 1906)	Superfamily
		Entomobryomorpha	Isotomidae	Isotomidae (Schäffer, 1896)	Family
				Entomobryoidea (Schäffer, 1896)	Superfamily
	Chilopoda			Chilopoda (Latreille, 1817)	Class
	Arachnida	Trombidiformes		Tydeoidea (Kramer, 1877)	Superfamily
				Trombidioidea (Leach, 1815)	Superfamily
				Eupodoidea (Koch, 1842)	Superfamily
				Bdelloidea (Hudson, 1884)	Superfamily
		Oribatida		Oripodoidea (Jacot, 1925)	Superfamily
				Oribatida (van der Hammen, 1968)	Subclase

				Oppioidea (Grandjean, 1951)	Superfamily
				Galumnoidea (Jacot, 1925)	Superfamily
				Euphthiracaroidea (Jacot, 1930)	Superfamily
				Epilohmannioidea (Oudemans, 1923)	Superfamily
				Crotonioidea (Thorell, 1876)	Superfamily
				Ceratozetoidea (Jacot, 1925)	Superfamily
				Brachychthonioidea (Thor, 1934)	Superfamily
		Mesostigmata		Veigaioidea (Oudemans, 1939)	Superfamily
				Uropodoidea (Kramer, 1881)	Superfamily
				Rhodacaroidea (Oudemans, 1902)	Superfamily
				Parasitoidea (Oudemans, 1901)	Superfamily
				Mesostigmata (G. Canestrini, 1891)	Order
				Dermanyssoidea (Kolenati, 1859)	Superfamily
		Astigmata		Acaroidea (Latreille, 1802)	Superfamily
		Araneae	Linyphiidae	Linyphiidae (Blackwall, 1859)	Family
Annelida	Clitellata	Crassiclitellata	Lumbricidae	*Octolasion lacteum* (Örley, 1881)	Species
				Octalacyum cyaneum (Savigny, 1826)	Species
			Acanthodrilidae	*Microscolex phosphoreus* (Duges, 1837)	Species
				Microscolex dubius (Fletcher, 1887)	Species
			Ocnerodrilidae	*Eukerria stagnalis* (Kinberg, 1867)	Species
			Lumbricidae	*Apodorrectodea trapezoides* (Duges, 1828)	Species
				Apodorrectodea rosea (Savigny, 1826)	Species
				Apodorrectodea caliginosa (Savigny, 1826)	Species
				Crassiclitellata (Jamieson, 1988)	Order

Table 3.

Regression length-mass relationships with reference to the authors who estimated the regression equations and the body shape to which the different taxa fit. L = length of the body; l = width of the body; W = body weight; Log = base ten logarithm; ln = natural logarithm.

Author	Body plan morphotype	Length mass relationship equations	dry weight factor
Tanaka (1970)	Hipogastruridae	b_0= 2,78 ± 0,24 ; b_1= 0,71 ± 0,025	
	Isotomidae and Onychiuridae	b_0= 2,55 ± 0,93 ; b_1= 0,99 ± 0,088	
	Onychiuridae	b_0= 2,75 ± 0,34 ; b_1= 0,63 ± 0,037	
	Entomobriidae	b_0= 2,5 ± 0,38 ; b_1= 1,07 ± 0,04	
	Symphypleona	b_0= 3,71 ; b_1= 0,689	
Persson and Lohm (1977)	Trombidiformes	$W = (0,00387 * L)^{3}$	0,4
	Mesostigmatas	$W = 0,85 * (L^{2,09} * l^{0,84} * 10^{-6,44})$	0,4
	Symphyla and Pauropoda	$W=(1,20 + L)^{3}$	0,2
Lebrum (1971a), Lebrum (1971b)	Achipteriforme oribatid’s	log W = 2,09 log L + 0,93 log l – 6,67	0,4
	Nothriforme oribatid’s	log W = 2,09 log L + 0,84 log l – 6,44	0,4
	Carabodiforme oribatid’s	log W = 1,62 log L + 1,40 log l – 6,56	0,4
	Acari	log W = 1,53 log L + 1,53 log l – 6,67	0,4
Hawkins et al. (1997)	Gastropoda	$W = 0,172 L^{1,688}$	
Ganihar (1997)	Arannae	ln W = - 3.2105 + L * 2.4681	
	Coleoptera adult	ln W = - 3.2689 + L * 2.4625	
	Coleoptera larvae	ln W = - 7,1392 + L * 0,8095	
	Diptera	ln W = -3,4294 + L * 2,5943	
	Formicidae	ln W = - 3,1415 + L * 2,3447	
	Insecta	ln W = - 3,0710 + L* 2,2968	
	Isopoda	W = - 1,1167 + L * 0,4762	
	Pauropoda and Collembola	ln W = - 1,8749 + L* 2,3002	
	Chilopoda	ln W = - 6,7041 + L * 2,8420	
	Ortoptera	ln W = - 3,5338 + L * 2,4619	

Coulis and Joly (2017)	Diplopoda Miriapoda	ln W = 2,38 * ln (L) – 2,77	0,45