



## Distribution of earthworms in the north-west of the Iberian Peninsula

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### Abstract

A province of Galicia, Lugo, was sampled by collecting the earthworm fauna with the aim of completing the distribution maps of the north-west of the Iberian Peninsula. Qualitative samples of earthworms were made in U.T.M. grids of  $10 \times 10$  km using the “formalin-hand sorting method”. The data obtained allow us to know the distribution of the species in all the west of the Iberian Peninsula, completing the studies carried out in the provinces of A Coruña and Pontevedra (west of our study area), Portugal (in the south) and the provinces of Asturias, León and Zamora (in the east). The interest in this area is due to its particular position at the limit of the so-called Galaico-Lusitanian Province, inside of the Eurosiberian Region. This geographical place is characterised by the presence of *Allolobophora caliginosa*, *A. oliveirae*, *Dendrobaena madeirensis* and *D. octaedra*, the last two species being exclusives to this area. We have used the data to complete the distribution area of some species, e.g. *Criodrilus lacuum* and *Lumbricus castaneus*. Also we relate some geological characteristics that could explain their distribution. We also include some data about the biodiversity of the 25 earthworm species found in this area, and the ratio of dominance among them. © 2003 Éditions scientifiques et médicales Elsevier SAS. All rights reserved.

*Keywords:* Earthworms distribution; Iberian peninsula; Eurosiberian region

### 1. Introduction

Alvarez [1,2], to establish the biogeographical zonation of the Iberian Peninsula, used the presence or absence of certain earthworm species. He recognised three regions: Central-European, affecting the peninsular north; Mediterranean, including almost all the territory; and Atlantic, comprising Portugal and adjacent southern territories. Rivas Martínez [20] divided the Iberian Peninsula into two large biogeographical regions on the basis of the type of vegetation: Eurosiberian Region and Mediterranean Region (Fig. 1a). Further studies on earthworms [9,21,29] and terrestrial gastropod distribution [14] may have to include the north of Portugal inside the Eurosiberian Region. However, the north-west of the Iberian Peninsula constitutes a discrete and characteristic area of this region, with an earthworm

fauna characterised by species of the genus *Lumbricus* and *Allolobophora* (predominately *A. caliginosa caliginosa*) and with *Dendrobaena madeirensis* and *Dendrobaena octaedra* also frequent. The area studied in this work (province of Lugo, NW of Spain) is included in this zone, called Galaico-Lusitanian Province [29].

Although there are various studies on the earthworm fauna of the Iberian Peninsula [1,3–5,11], and the western half is better studied [8,16,23–25,30], in this work, we try to complete the patterns of distribution of the characteristic species of the peninsular north-west.

### 2. Materials and methods

The area of study was divided into U.T.M. grids ( $10 \times 10$  km) and each grid was sampled. The samples were taken from pastures, forests, borders of rivers and manure heaps.

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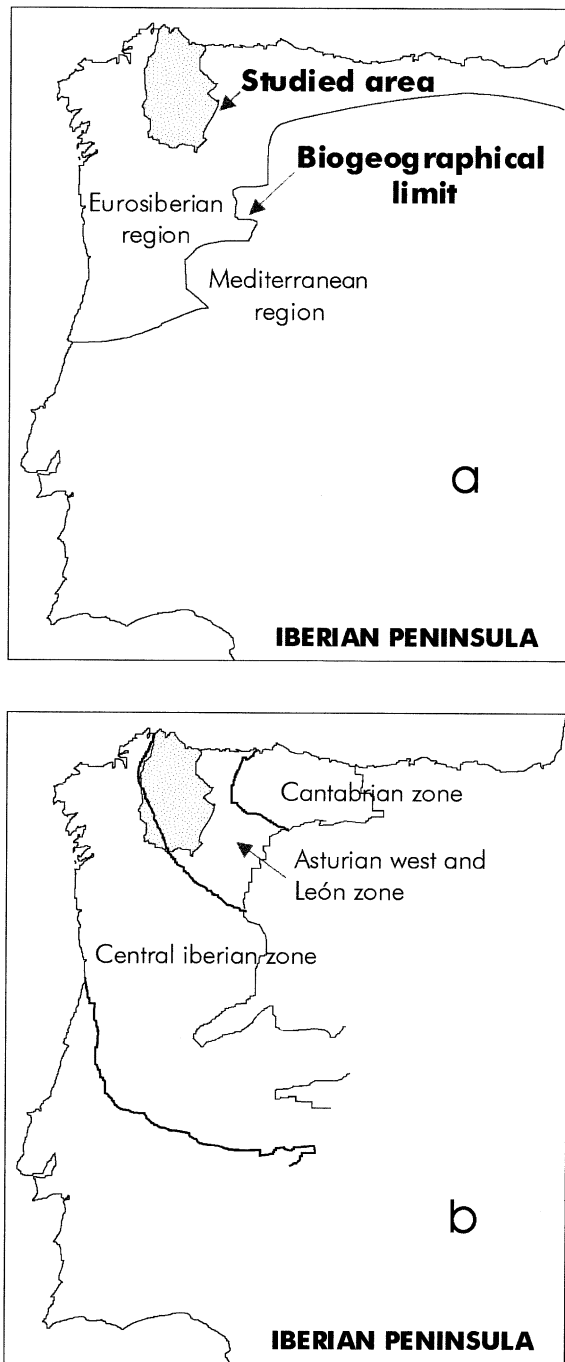


Fig. 1. Maps of north-western Iberian Peninsula. (a) Biogeographical areas, (b) Geological zones.

The earthworm samples were collected in areas of 0.5 m<sup>2</sup> through formaldehyde-hand sorting method. Samples were collected over a period of a year and a half (July 1997–April 1999), avoiding periods of hot weather.

Sampled earthworms were fixed in a solution of 1:1 of 90% ethanol and 4% formaldehyde, and preserved in 4%

formaldehyde. Identification of species was made following the works of Alvarez [3–5], Bouché [7] and some descriptions made by Trigo et al. [30], and Briones [10]. Species checklist was made following the guide of valid names of Easton [13].

Data from several authors were used to complete the distribution maps of some species (*Allolobophora molleri*, *A. oliveirae*, *Criodrilus lacuum* and *Lumbricus castaneus*) in the whole peninsular north-west.

### 3. Results

#### 3.1. List of species

A total of 25 species belonging to three families (Lumbricidae, Acanthodrilidae and Criodrilidae) were collected:

Class Oligochaeta

Family Lumbricidae:

*Allolobophora caliginosa* (Savigny, 1826)

*Allolobophora chlorotica* (Savigny, 1826)

*Allolobophora georgii* Michaelsen, 1890

*Allolobophora molleri* Rosa, 1889

*Allolobophora oliveirae* Rosa, 1894

*Allolobophora rosea* (Savigny, 1826)

*Dendrobaena attemsi* Michaelsen, 1901

*Dendrobaena cognettii* (Michaelsen, 1903)

*Dendrobaena madeirensis* Michaelsen, 1891

*Dendrobaena mammalis* (Savigny, 1826)

*Dendrobaena octaedra* (Savigny, 1826)

*Dendrobaena pantaleonis* (Chinaglia, 1913)

*Dendrobaena rubida* (Savigny, 1826)

*Eisenia andrei* Bouché, 1972

*Eisenia eiseni* (Levinsen, 1884)

*Eisenia fetida* (Savigny, 1826)

*Eiseniella tetraedra* (Savigny, 1826)

*Lumbricus castaneus* (Savigny, 1826)

*Lumbricus friendi* Cognetti, 1904

*Lumbricus rubellus* Hoffmeister, 1843

*Lumbricus terrestris* Linnaeus, 1758

*Octolasion cyaneum* (Savigny, 1826)

*Octolasion lacteum* (Oerley, 1881)

Family Acanthodrilidae:

*Microscolex dubius* (Fletcher, 1887)

Family Criodrilidae:

*Criodrilus lacuum* (Hoffmeister, 1845)

#### 3.2. Distribution

The distribution of the species is shown in maps (Fig. 2) in all the sampled areas. Dark circles denote the references of this study and blank circles indicate the places where the species were cited by other authors previous to this work [17].

The percentage of presence of the different species is shown in Table 1. The species more common were *Lumbrici-*

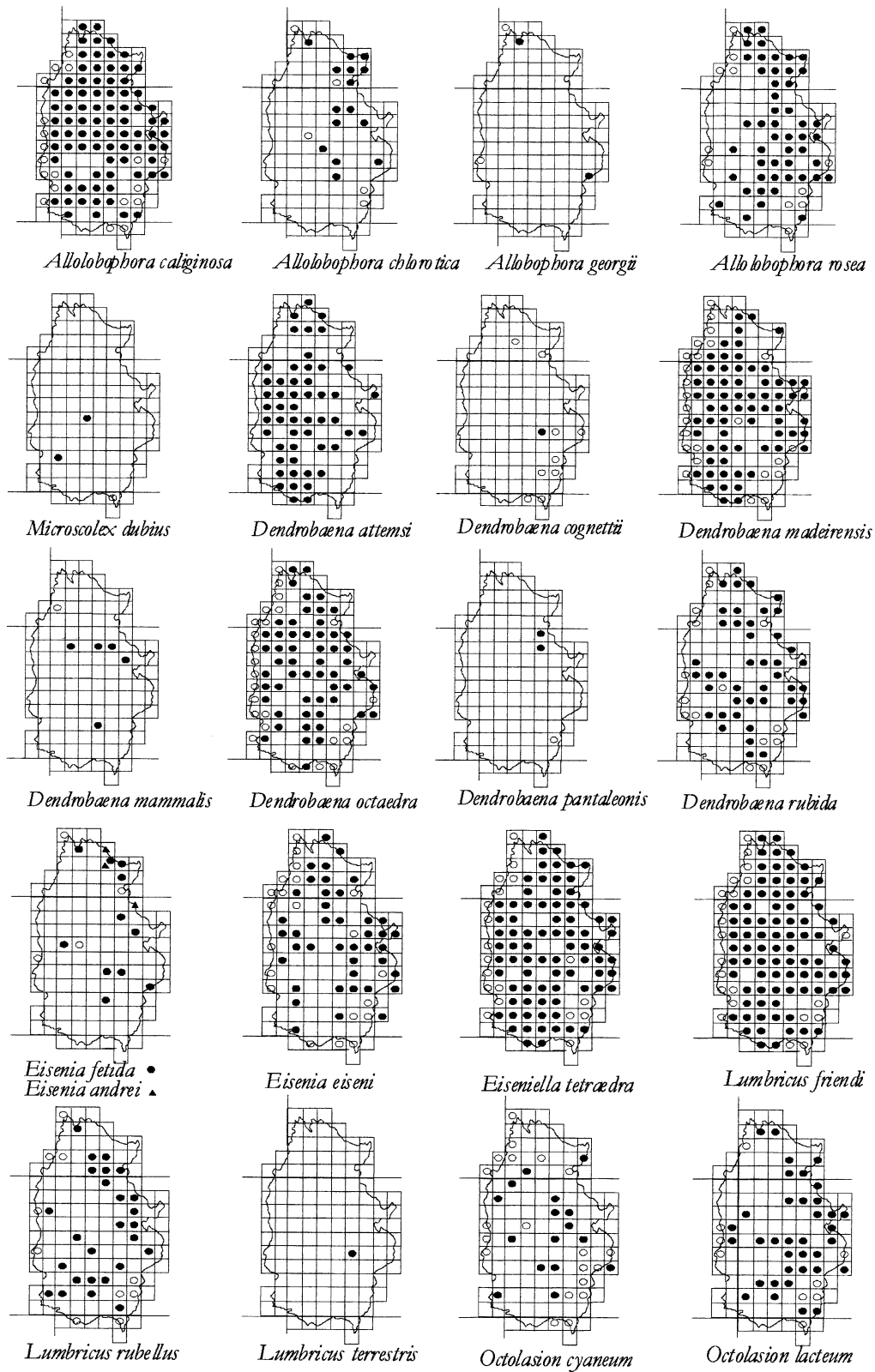


Fig. 2. Distribution maps of found species.

Table 1  
Earthworm presence in the studied area (percentage of sampled squares)

Species	Presence (%)	Species	Presence (%)
<i>A. caliginosa</i>	80.31	<i>E. andrei</i>	2.36
<i>A. chlorotic</i>	15.75	<i>E. eiseni</i>	48.03
<i>A. georgii</i>	3.15	<i>E. fetida</i>	11.81
<i>A. moller</i>	20.47	<i>E. tetraedra</i>	77.17
<i>A. oliveirae</i>	2.36	<i>L. castaneus</i>	9.45
<i>A. rosea</i>	46.46	<i>L. friendi</i>	82.68
<i>D. attemsi</i>	41.73	<i>L. rubellus</i>	28.35
<i>D. cagnettii</i>	7.87	<i>L. terrestris</i>	0.79
<i>D. madeirensis</i>	72.44	<i>O. cyaneum</i>	27.56
<i>D. mammalis</i>	4.72	<i>O. lacteum</i>	35.43
<i>D. octaedra</i>	62.99	<i>M. dubius</i>	1.57
<i>D. pantaleonis</i>	2.36	<i>C. lacuum</i>	10.24
<i>D. rubida</i>	45.67		

*cus friendi*, *Allolobophora caliginosa* and *Dendrobaena madeirensis*, with a widespread distribution in the studied area.

#### 4. Discussion

The Eurosiberian Region in the Iberian Peninsula is characterised by the presence of species such as *Allolobophora caliginosa*, *Dendrobaena madeirensis* and *D. octaedra*, together with other species also frequent such as *Allolobophora chlorotica*, *A. rosea*, *Lumbricus terrestris*, *L. friendi*, *L. rubellus*, *Dendrobaena rubida*, *Octolasion cyaneum* and *O. lacteum* [9]. All these species except *Lumbricus terrestris* are well represented in our study area. *L. terrestris* is a very common species in Europe and appears in the north-east of the Iberian Peninsula, being substituted by *Lumbricus friendi*, which is more abundant and more broadly distributed in the Peninsula [11,12].

*Dendrobaena madeirensis* and *D. octaedra* are characteristic species of the peninsular north-west, typical of the so-called Galaico-Lusitanian Province [9,21,29]. The area studied is located in the limit between this province and the rest of the Eurosiberian Region. In this area, we found the limits of the distribution areas of some of the species collected.

The *Allolobophora molleri* complex is extensively distributed in the western part of the Peninsula [6]. The species of this complex appears near flooded zones and river banks, and prefers low clay and silt values in soils with high moisture content [27]. These species are very common in the peninsular south-west [2] diminishing their presence towards the north and east [12]. We did not find *A. molleri* in the north of the area studied, which seems to point to its distribution limits. Nowadays this complex is not associated with the two large biogeographical regions of the Iberian Peninsula [21].

*Lumbricus castaneus* is another characteristic species of the north of the Iberian Peninsula. Bouché [7] considered that its distribution is North-Atlantic. This species is extended

throughout the north of the Peninsula reaching Asturias province [9] and its distribution limits are in our studied area. Under geological criteria (Fig. 1b), this limit coincides with the Astur-leonesa zone of the Macizo Ibérico defined by Julivert et al. [15] (Fig. 3).

*Criodrilus lacuum* is not very frequent in the studied area, but its distribution pattern is especially interesting. As a species from the *A. molleri* complex, *C. lacuum* occurs in river banks and soils with high moisture content. Its distribution is holarctic, but its presence in western Europe is very limited [19]. It is found just in some disperse points of Portugal and in the Atlantic part of Galicia (Fig. 3); its distribution coincides with the Centroibérica zone of the Macizo Ibérico [15]. It should be considered, together with *Dendrobaena madeirensis* and *D. octaedra*, a characteristic species of the Galaico-Lusitanian Province. The presence of *C. lacuum* in this area indicates the existence of a little centre of distribution that modifies the western boundary of the species. Its presence in the north-west of the Peninsula agrees with the proposed holarctic distribution of Criodrilidae, including several holarctic genera of aquatic oligochaetes with representatives in Europe, Mediterranean lands, and North and Central America [18].

*Allolobophora oliveirae* is considered a characteristic species of this province [29]. *A. oliveirae* was initially found in Portugal [22]. Trigo et al. [30], based on anatomical criteria, differentiated the subspecies *A. oliveirae limicola* from the original one described as *A. oliveirae typica*. Souto [28] confirmed the separation of both subspecies and stated that ecological differences also exist. *A. oliveirae limicola* differs from *A. oliveirae typica* in preferences for high soil porosity, aeration and moisture content, and is considered a hydrophile species similar to *Criodrilus lacuum* and *Allolobophora molleri* [26]. In the present study, the collected individuals were not divided into subspecies, with the aim of showing the whole distribution of *A. oliveirae* using data from several authors. In the studied area, *A. oliveirae* is few. As in the case of *Criodrilus lacuum*, there seems to be a clear relationship between its distribution area and the nature of the geological substrate (Fig. 3).

In this work, the studied area gave information to complete the distribution pattern of earthworm species in the peninsular north-west, and showed how boundaries of some species are very influenced by geological factors. The work also showed the importance of the border areas as key zones to identify the main factors influencing earthworm distribution.

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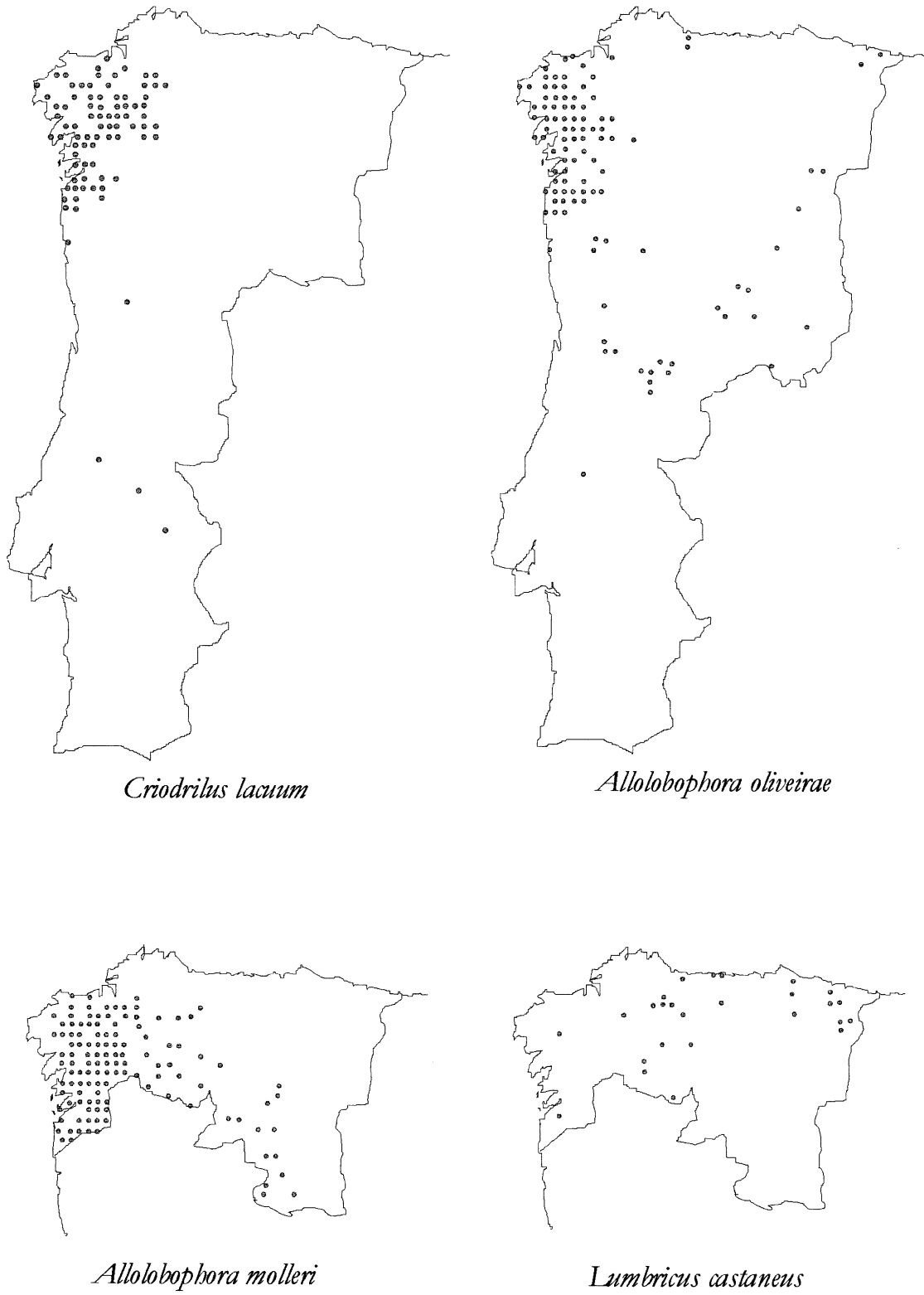


Fig. 3. Distribution areas in the peninsular north-west.

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