

Campodeidae (Hexapoda, Diplura) from caves of the Grand Duchy of Luxembourg

Alberto Sendra

Asociación para el Estudio del Medio Subterráneo
Avenida Contitución, 83-12
460019 Valencia (Spain)
alberto.sendra@uv.es

Yolanda García

Asociación para el Estudio del Medio Subterráneo
Avenida Contitución, 83-12
460019 Valencia (Spain)
garmaryo@alumni.uv.es.

Dieter Weber

Kirchgasse 124
D-67454 Haßloch
dieter.weber124@gmx.de

Zusammenfassung

Von 2007 bis 2011 wurden in 82 Höhlen und künstlichen Hohlräumen des Großherzogtums Luxemburg Tiere gesammelt. Unter rund 90.000 gesammelten Tieren waren 37 Doppelschwänze. Sie teilen sich in 7 Arten auf, von denen die folgenden cavernicol sind: *Campodea (Campodea) lankesteri*, *Campodea (Campodea) wallacei*, *Litocampa humilis humilis*.

Neu für Luxemburg sind alle 7 Arten: *Campodea (Campodea) lankesteri*, *Campodea (Campodea) lubbocki*, *Campodea (Campodea) plusiochaeta*, *Campodea (Campodea) remyi*, *Campodea (Campodea) subdives*, *Campodea (Campodea) wallacei*, *Litocampa humilis humilis*.

Abstract

From 2007 to 2011, animals were collected from 82 caves in the Grand Duchy of Luxembourg. Within 90,000 individuals, 37 were diplurans representing 7 species. The following species are classified as cavernicolous: *Campodea (Campodea) lankesteri*, *Campodea (Campodea) wallacei*, and *Litocampa humilis humilis*.

All 7 species are new for Luxembourg: *Campodea (Campodea) lankesteri*, *Campodea (Campodea) lubbocki*, *Campodea (Campodea) plusiochaeta*, *Campodea (Campodea) remyi*, *Campodea (Campodea) subdives*, *Campodea (Campodea) wallacei*, and *Litocampa humilis humilis*.

Résumé

Entre 2007 et 2011, 90 000 spécimens d' animaux ont été récoltés dans 82 cavités naturelles et artificielles du Grand-Duché de Luxembourg, dont eux 37 diploures représentant 7 espèces. Les espèces suivantes sont considérées comme cavernicoles: *Campodea (Campodea) lankesteri*, *Campodea (Campodea) wallacei*, *Litocampa humilis humilis*.

Toutes les espèces sont signalées pour la première fois dans ce pays: *Campodea (Campodea) lankesteri*, *Campodea (Campodea) lubbocki*, *Campodea (Campodea) plusiochaeta*, *Campodea (Campodea) remyi*, *Campodea (Campodea) subdives*, *Campodea (Campodea) wallacei*, *Litocampa humilis humilis*.

1 Introduction

References about Diplurans in the Grand Duchy of Luxembourg do not exist so far, but we can find some Dipluran bibliography from the Campodeidae family in countries close by (see as example Arevad 1957; Bareth 2006; Condé 1947a, 1954; Condé & Bareth 1998; Paclt 1961, 1965). Very few information exist from caves and subterranean environment in all areas of Europe north of the Alps: North of France, Belgium, Ireland, Great Britain, Denmark, Germany, Benelux and Scandinavian countries (Bareth 1999, 2000). The greater part of the summarizing publications on cave fauna in Central Europe (Belgium: Leruth 1939; Switzerland: Strinati 1965; Germany: Dobat 1975, 1978; Weber 1988, 1989, 1991, 2001, 2012; Zaenker 2001) do not list diplurans to species level. Recently Weber (unpublished) collected diplurans in caves from Rhenish Palatinate and Saarland (South West Germany) with 8 species, 5 of them identical to those found in Luxembourg.

Out of 90,000 collected animals in the years from 2007 to 2011 in Luxembourg caves, 37 specimens were Diplurans. Diplurans are therefore a rare group. All collected Diplurans are determined.

2 Results

Campodea (Campodea) lankesteri Silvestri 1912

Diagnosis: Body length (excluding cerci) 5-7 mm. Epicuticle with thick microdenticles. Clothing setae thin and glabrous. Antennae with 26 to 28 antennomeres, cupuliform organ with 4 bare sensilla, sensillum of third antennomere in sternal position. Notal macrochaetae thick with few barbs: 1, 1, 1 ma, 1, 1, 0 la, 1, 1, 1 lp; marginal setae with barbs. Calcars robust with thick barbs. Urotergites macrochaetae: 1, 1, 1, 1, 1, 1, 1, 1 ma; 0, 0, 0, 1, 1, 1, 1, 0 la; 0, 0, 0, 1, 1, 1, 1, 3, 5 lp. Urosternite I male with glandular g1-setae in several continuous rows, trapezoidal appendages with glandular a2-setae. Cerci shorter than the body worn long macrochaetae with distal barbs and clothing setae scarcity. Spermatozoid fascicles 60 mm in diameter, 30 mm wide; filament 100 mm long in 8 to 9 spiral turns.

Distribution: Wide distribution range through septentrional Europe: Austria, Belgium, Denmark, France, Great Britain, Ireland and Sweden (Agrell 1944; Arevad 1957; Bagnall 1915, 1918a; Christian 1992; Condé 1947a; Condé & Barbier 1957; Good, Blackith & Higgins 1989; Leleup 1948; Marten 1939; Silvestri 1912; Womersley 1927; Wygodzinsky 1941a).

With 14 specimens, it is the mostly found Diplura species in Luxembourg caves. However, it is found

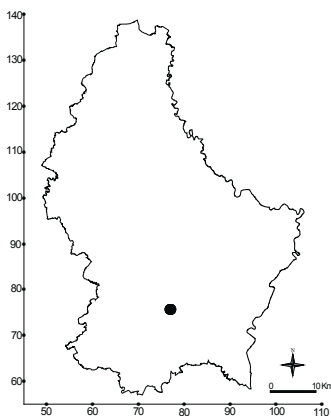


Fig. 1: Caves with *Campodea (C.) lankesteri* in Luxembourg.

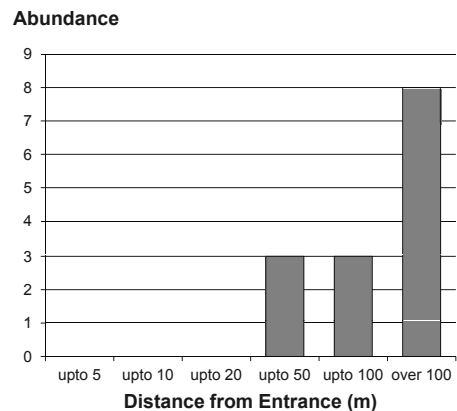


Fig. 2: Numbers of *Campodea (C.) lankesteri* caught at different distances from the entrance in Luxembourg caves.

only in one casemate in Luxembourg City. Even another casemate very close by contains another species. *C. lankesteri* was found only in traps, over the whole year and only deep inside the artificial cave (Fig. 2). We assume that it generates stable subterranean populations and is therefore eutroglophile. To prove that we know some references of *C. lankesteri* in subterranean habitats, such as Leleup (1948) (confused with *Campodea giardi* Silvestri, 1912) in the Grotte de Goyet (Belgium) (Condé 1947a) and also Bareth (2000) reported this species as very abundant in a MSS (Mesovoid shallow stratum or Superficial underground compartment) location in Liège, a province of Belgium.

Campodea (Campodea) lubbocki Silvestri 1912

Diagnosis: Body length (excluding cerci) 3.5 mm. Epicuticle without ornamentation. Clothing setae short. Antennae with 19 to 23 antennomeres, cupuliform organ with 4 bare sensilla, sensillum of third antennomere in sternal position. Notal macrochaetae small: 1, 1, 1 ma, 1, 1, 0 la, 1, 1, 1 lp; marginal setae with few barbs. One trochanteral sensillum; calcars with few barbs. Urotergites macrochaetae: 1, 1, 1, 1, 1, 1, 1, 1, 1 ma (short and small), 0, 0, 0, 0, 1, 1, 1, 0, 0 la, 0, 0, 0, 0, 1, 1, 3, 5 lp. Urosternite I male with glandular g1-setae in some continuous rows, subtrapezoidal appendages with seasonal glandular a2-setae. Cerci as long as the body with 9 to 15 articles worn short macrochaeta and abundant clothing setae. Spermatozoid fascicles 30 mm in diameter, 10-12

mm wide; filament 180-200 mm long, 1,5-2 mm in wide, in 2,5 to 3 spiral turns.

We found it in 1 specimen in a casemate in Luxembourg City, 75 m distant from the entrance. Due to the limited findings in caves so far, we classify it as eutrogloxene.

Distribution: The species has a wide distribution through northwest of Europe: Austria, Belgium, France, Great Britain, Italy, Norway, Sweden and Switzerland (Agrell 1944; Bagnall 1918a; Bareth 2007; Christian 1992; Condé 1947a, 1947b, 1961; Condé & Barbier 1957; Condé & Bareth 1998; Condé & Mathieu 1958; Denis 1924, 1930; Husson 1946; Olsen 1996; Orelli 1956; Pagés 1951; Ramanelli 1990; Silvestri 1912; Womersley 1927). Outside Europe it is located in USA (Condé 1973) and also cited in Santa Helena Island (Azores) where it could be considered as invasive species (Condé & Bareth 1970) due to it is frequent in urban gardens. Bareth (2000) refers this species in a location from the MSS in Liège province (Belgium) and in Husson (1946) it is cited inside of humid cave in Nancy (France).

Campodea (Campodea) plusiochaeta Silvestri 1912

Diagnosis: Body length (excluding cerci) 2-4 mm. Epicuticle with thin microdenticles and rosette formations. Clothing setae short and glabrous. Antennae with 19 to 23 antennomeres (until 27 antennomeres in some Greece population (Condé

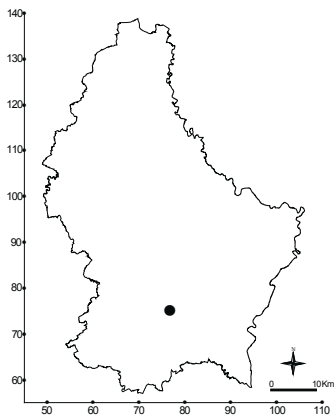


Fig. 3: Caves with *Campodea (C.) lubbocki* in Luxembourg.

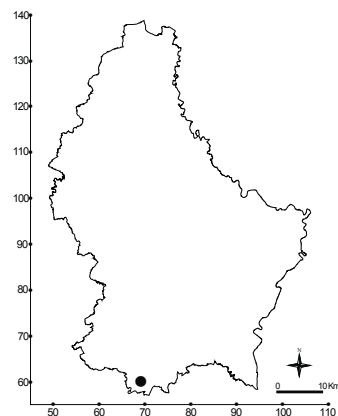


Fig. 4: Caves with *Campodea (C.) plusiochaeta* in Luxembourg.

1984); cupuliform organ with 4 bare sensilla; sensillum of third antennomere in tergal position (or in sternal position in the septentrional populations -form *gardneri* by Bagnall 1918a). Notal macrochaetae with thin barbs: 1, 1, 1 ma, 1, 1, 0 la, 1, 1, 1 lp. Sedas marginales with some few thin barbs. Calcars with 2-3 thick barbs. Urotergites macrochaetae: 0, 0, 0, 0, 1, 1, 1, 0, 0 la, 0, 0, 0, 0, 1, 1, 1, 3, 5 lp. Urosternite I male with glandular g1-setae in several continuous rows, subtrapezoidal appendages with glandular a2-setae. Cerci shorter than the body with 6-7 articles worn long macrochaeta and clothing setae scarcity, latero-internal macrochaetae with 1-2 thin barbs. Spermatozoid fascicles 45-50 mm diameter, 20-23 mm wide, filament 550-600 mm long, 5-6 mm diameter, in 5-6 spiral turn.

Distribution in Luxemburg + map.

Only one specimen was found in an iron mine in South Luxemburg, surprisingly more than 100 m distant from the entrance. Due to the lack of findings in other caves, we classify *C. plusiochaeta* as eutrogloxene.

Distribution: It is widespread in the Holarctic region, but it may be a complex of mix of several species. In Euro-Mediterranean area it occupies several countries: Algeria, Austria, Croatia, Czech Republic, Denmark, Finland, France, Great Britain, Germany, Greece, Hungary, Italy, Macedonia, Morocco, Montenegro, Norway, Poland, Serbia, Slovakia, Spain, Switzerland and Turkey (Arevad 1957; Bareth 1963, 1986; Blesic 1996, 1998a, 2001; Borset 1968; Christian 1992; Condé 1947a, 1947c, 1947d, 1948a, 1948b, 1950, 1951a, 1953, 1961, 1984; Condé & Mathieu 1957; Condé & Poivre 1982; Denis 1930; Husson 1946; Olsen 1996; Paclt 1956, 1961, 1965; Pagés 1951; Ramellini 1995, 2000; Rusek 1963; Sendra & al. 2010; Sendra & Jiménez 1983, 1986; Sendra & Moreno 2004; Silvestri 1912, 1932a; Stach 1928, 1964; Wygodzinsky 1941b) by reaching Ukraine (Tarashchuk 1979) and Russia (Silvestri 1912). It is also well spread in USA (Allen 1994; Condé 1973) and known in Saint Helena Island (Condé & Bareth 1970).

***Campodea (Campodea) remyi* Denis 1930**

Diagnosis: Body length (excluding cerci) 4-5 mm. Epicuticle with thin microdenticles and rosette formations. Clothing setae short and glabrous. Antennae with 27 to 30 antennomeres; cupuliform organ with 4 bare sensilla; sensillum of third

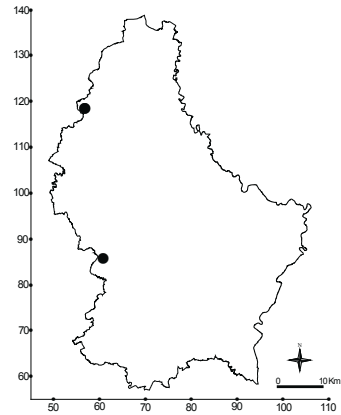


Fig. 5: Caves with *Campodea (C.) remyi* in Luxemburg.

antennomere in tergal position. Notal macrochaetae with few barbs: 1, 0, 0 ma, 1, 1, 0 la, 1, 1, 0 lp; marginal setae thick and with plenty of barbs almost spiny. One small trocanteral sensillum; calcars with 1-2 barbs. Urotergites macrochaetae: 0, 0, 0, 0, 1, 1, 0, 0 la, 0, 0, 0, 0, 1, 1, 3, 5 lp. Urosternite I male with seasonal glandular g1-setae continuous rows, appendages widened distal with seasonal glandular a2-setae. Cerci longer than the body with 11-12 articles worn thin and glabrous macrochaetae and shorter and thin clothing setae. Spermatozoid fascicles 40-50 mm diameter, 15-20 mm wide; filament 550-750 mm long in 6 to 8 spiral turns.

Five specimens were found in two abandoned railway tunnels. It counts as eutrogloxene.

Distribution: Widespread in Central Europe: Bosnia-Herzegovina, France, Germany, Romania, Slovenia and Switzerland (Bareth 1974; Bareth & Juberthie 1996; Blesic 1981, 1996; Bockemühl 1956; Condé 1947a; Denis 1930; Ionescu 1955, 1951, Orelli 1956; Paclt 1961, 1965; Wygodzinsky 1940, 1941b).

***Campodea (Campodea) subdives* Silvestri 1932**

Diagnosis: Body length (excluding cerci) 3 mm. Epicuticle without ornamentation. Clothing setae short and glabrous. Antennae with 20 to 24 antennomeres (28-29 in a female from a cave of Mallorca Island); cupuliform organ with 4 bare sensilla; sensillum of third antennomere in sternal position. Notal macrochaetae with thin barbs: 1, 1, 1 ma, 1, 1, 0 la, 1, 1, 1 lp; marginal setae with distal

thin barbs. Calcars with short barbs. Urotergites macrochaetae 0, 0, 0, 1, 1, 1, 1, 0, 0 la, 0, 0, 0, 1, 1, 1, 1, 3, 5 lp. Urosternite I male with glandular g1-setae continuous rows. Cerci (in Anatolian specimens) with 7-8 articles, basal articles with long macrochaetae, medial and distal articles with short macrochaetae and clothing setae numerous almost as long as macrochaetae.

We found this species only in one schist mine near Perlé, but in two traps and 6 specimen 40 and 50 m distant from the entrance. As these are the only cave findings so far, we assume the species is eutrogloxene.

Distribution: Its dispersal distribution could be show that it is a rare species or perhaps a doubt species that belong to other species. It is referred in few locations along the euro-Mediterranean area. Described from Rodas Island (Greece: Silvestri 1932) and later cited from Algeria (Condé 1948a), and more recently in a cave from Mallorca Island (Spain: Condé 1955; Vandel & al. 2007) and in several endogean stations from Anatolia peninsula (Turkey: Sendra & al. 2010).

***Campodea (Campodea) wallacei* Bagnall 1908
= *C. simulatrix* Wygodzinsky 1941**

Diagnosis: Body length (excluding cerci) 3-4 mm. Epicuticle without ornamentation. Clothing setae long and thin. Antennae with 24 to 30 antennomeres (31-32 in specimens found in caves); cupuliform organ with 4 bare sensilla; sensillum of third antennomere in tergal position. Notal macrochaetae long and thin with numerous

barbs: 1, 1, 1 ma, 1, 1, 0 la, 1, 1, 1 lp; marginal setae thick and with some thin barbs. Calcars robust with thick barbs. Urotergites macrochaetae: 0, 0, 0, 1, 1, 1, 0, 0 la, 0, 0, 0, 0, 1, 1, 1, 3, 5 lp. Urosternite I male with glandular g1-setae in a continuous rows, appendages without glandular a2-setae. Cerci with 8-10 articles worn long macrochaetae and clothing setae scarcity. Spermatozoid fascicles 45-50 mm diameter, 12-15 mm wide, filament 560-600 mm long, 3-4 mm diameter, in 4-5 spiral turns.

We found this species in only one cave, the Meischtrefer Hiel which is one of the few natural limestone caves in Luxembourg. 10 specimens were found, only in traps 47 to 62 m distant from the entrance and distributed over the whole year. It builds stable subterranean populations and counts therefore as eutroglophile.

Distribution: Spread through north and central Europe: Great Britain, France, north of Italy, Sweden, Romania, Macedonia, Serbia, Montenegro, Croatia, Slovakia, Slovenia (Agrell 1944; Bagnall 1918b; Bareth 2006; Bareth & Condé 1985; Blesic 1984, 1988, 1992, 1996, 1998a, 1998b, 1998c, 2000, 2001; Condé 1947a, 1948a, 1950, 1962; Ionescu 1951, 1955; Minelli & al. 1995; Pagés 1951; Ramellini 2000; Wygodzinsky 1941a, 1941b). In few occasions it has been found in caves (Condé 1951b, 1957).

***Litocampa humilis humilis* Condé 1948**

Diagnosis: Body length (excluding cerci) 4-7 mm. Epicuticle with thin microdenticles. Clothing setae

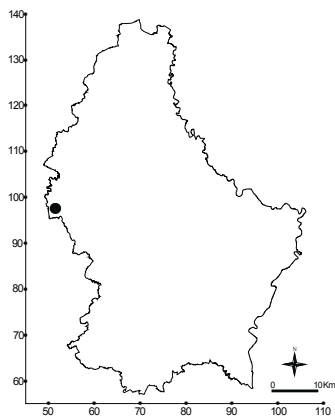


Fig. 6: Caves with *Campodea (C.) subdives* in Luxembourg.

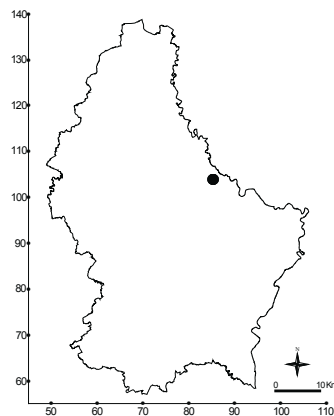


Fig. 7: Caves with *Campodea (C.) wallacei* in Luxembourg.

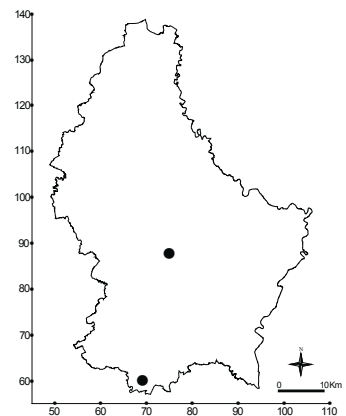


Fig. 8: Caves with *Litocampa humilis humilis* in Luxembourg.

Tab. 1: Campodeidae in Central Europe * South Germany: Caves only

Species	Luxembourg	Belgium	Denmark	North Germany	South Germany*	North France
<i>Campodea lankesteri</i> Silvestri 1912	+	+	+	+	-	+
<i>Campodea lubbocki</i> Silvestri 1912	+	+	-	-	+	+
<i>Campodea plusiochaeta</i> Silvestri 1912	+	-	+	+	+	+
<i>Campodea remyi</i> Denis 1930	+	-	-	+	+	+
<i>Campodea wallacei</i> Bagnall 1918	+	-	-	-	+	+
<i>Campodea subdives</i> Silvestri 1932	+	-	-	-	-	-
<i>Litocampa humilis</i> Condé 1948	+	+	-	-	+	+
<i>Campodea fragilis</i> Meinert 1865	-	+	+	+	+	+
<i>Campodea staphylinus</i> Westwood 1842	-	-	-	+	+	+
<i>Campodea silvestrii</i> Bagnall 1918	-	-	+	+	-	+
<i>Campodea taunica</i> Marten 1939	-	-	-	+	-	+
<i>Campodea charchardi</i> Condé 1947	-	-	-	-	-	+
<i>Campodea westwoodi</i> Bagnall 1918	-	-	-	-	-	+
<i>Campodea meinerti</i> Bagnall 1918	-	-	-	-	+	+
<i>Campoda rophalota</i> Denis 1930	-	-	-	-	-	+
<i>Litocampa hubarti</i> Bareth 1999	-	+	-	-	-	-
<i>Plusiocampa dobat</i> Condé	-	-	-	-	+	-
Total number of species	7	5	4	7	8	14

short and glabrous. Antennae with 27 to 33 antennomeres; cupuliform organ with 4 bare sensilla; sensillum of third antennomere in sternal position. Notal macrochaetae with thin barbs along 2/3 distal: 1, 1, 1 ma, 1, 1, 0 la, 1, 1, 1 lp; marginal setae with some thin barbs. Calcars with 4-6 barbs; tarsal claws with small lateral crests. Urotergites 0, 0, 0, 0, 1, 1, 1, 0, 0 la, 0, 0, 0, 0, 1, 1, 1, 3, 5 lp. Urosternite I male with glandular g1-setae in several continuous rows, appendages widened distal with glandular a2-setae. Cerci shorter than the body with 10 to 12 articles worn macrochaetae with few distal thin barbs and thin clothing setae scarcity. Sperma-

tozoid fascicles 65-70 mm diameter, 14-15 mm wide, filament 1200-1600 mm, 5.7 mm de diameter in 10 spiral turns.

Distribution: *L. humilis* is a frequent species in the subterranean domain. It is known in caves from East of France (Pagés 1951; Condé 1948c, 1951b, 1962), Germany (Condé 1949) and also found in a cave from the north-west of Ireland. Recently, Bareth (2000) localized it in Belgian caves. In any of the specimens found in caves, *L. humilis* shows troglomorphic adaptations to the subterranean domain, but there is only one exception in a cave near Cluj (Romania) where a population of this species

shows 14 sensilla with fingerlike expansions in their cupuliform organ, due to Condé (1991) proposed a new subspecies: *Litocampa humilis comasi*.

In Luxembourg caves, *L. humilis humilis* seems to be a rare species. We found one specimen in the Millesteng, although 24 traps were stationed in this cave and another specimen in the Minière Hainaut II, where we positioned 72 traps over the whole year. Both specimens were found in the downright darkness. We could consider *L. humilis humilis* as eutroglobiont species, but without obvious troglomorphic adaptations.

3 Discussion

Although there was not any knowledge of Diplurans in Luxembourg, the result of this extensive sampling has shown a high diversity, a total of seven species (Table 1) from only 37 specimens collected. Firstly we want to point out the logical absence of any species of Japygidae family due to the dry environment preference of their species, not usual in caves (subterranean environments in general). Secondly the high diversity found if we compare with the Campodeids fauna of the nearest countries (Table 1), that it is lower in Belgium and Denmark, and it is similar in North of Germany but higher in North of France where the Diplurans has been well prospected (Bareth 2006).

By karstic and biospeleological features Luxembourg is included in Europe north of the Alps, a region which includes (Gunn 2006) North of France, Germany, the British Islands, Belgium, the Netherlands, Luxembourg, Denmark, Norway and Sweden. This region has a relatively small number of hypogean taxa compared to Southern Europe. This fact reflects the glacial history and post-glacial colonization of taxa. It is north of the boundary of the highest subterranean endemic zone defined by Juberthie & Decu (1994). Only a couple of eutroglobiont Diplura taxa inhabit this region (*L. humilis* and *L. hubarti*), one of them, *L. humilis*, in the subterranean environment of Luxembourg. Further two more species, *C. lankesteri* and *C. wallacei-simulatrix* could be considered eutroglobiont.

4 Acknowledgments

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5 References

- Allen R.T. 1994. - An annotated checklist and distribution records of the subfamily Campodeiinae in North America (Insecta: Diplura: Rhabdura: Campodeidae). Transactions of the American Entomological Society, 120(3): 181-208.
- Agrell I. 1944. - Die schwedischen Thysanuren. Opuscula entomologica, IX: 23-36.
- Arevad K. 1957. - Danske Diplura (Insecta, Apterygota). Entomologiske Meddelelser XXVIII: 127-144.
- Bagnall R.S. 1915. - Preliminary notes on British Campodeidae (Thysanura) and a plea for material. The Entomologist's monthly magazine (1915): 261-263.
- Bagnall R.S. 1918a. - Records and descriptions of some British Campodeidae. Ent.month. Mag., 54: 109-113.
- Bagnall R.S. 1918b. - On two new species of Campodea. Ent.month. Mag., 54: 157-159.
- Bareth C. 1963. - Etude morphologique et histologique de quelques formations tégumentaires des Diploures Campodéidés. Bulletin du Muséum National d' Histoire naturelle 2 série 35(4): 370-380.
- Bareth C. 1968. - Biologie sexuelle et formations endocrines de Campodea remyi Denis (Diploures Campodéidés). Rev.Écol.Biol.Sol., V (3): 303-426.
- Bareth C. 1974. - Le tractus génital de Campodea (C.) remyi (Diploures, Campodéidés) structure et évolution en fonction du cycle annuel et du cycle de ponte. Bulletin Société Zoologique de France, 98(3): 361-373.
- Bareth C. 1986. - Acquisitions récentes sur l'écologie et la biologie des Diploures Campodéidés (Insectes Apterygota). 2e International Séminari on Apterygota, Sienna, Italy 1986: 99-103.

- Bareth C. 2000. Les Diploures Campodéidés des grottes de Belgique. Bulletin des Chercheurs de la Wallonie, XL: 5-6.
- Bareth C. 2006. - Les Campodes de France (Diploures Campodéidés). Mémoires de Biospéologie, numéro hors série: 2-108.
- Bareth C. 2007. - Remarques sur les cerques de Campodea lubbocki Silvestri, 1912 (Diplura: Campodeidae). Notes faunistiques de Gembloux 60(1), Communications brèves: 53-54.
- Bareth C. & Condé, B. 1985. - Campodéidés endogés de Ligurie (Diplura). Annali del Museo Civico di Storia Naturale ' Giacomo Doria' , LXXXV: 251-258.
- Bareth C. & Juberthie, L. 1996. - Ultrastructure of the formations of the cuticle of Campodea kervillei Denis (Insecta: Diplura). Bulletin des Academie & Societe Lorraines des Sciences, 35(4): 231-241.
- Blesic B. 1984. - Fauna Diplura (Insecta) Sr Srbije. Collection of Scientific Papers of the Faculty of Science Kragujevac, 5: 91-96.
- Blesic B. 1961. - Knowledge of the faune Campodeidae (Diplura) of Yugoslavia. Collections of Scientific Papers of the Faculty of Sciences Kragujevac, 2: 55-57.
- Blesic B. 1988. - Prilog Poznavanja Faune Campodeidae (Diplura, Apterygota) Istocne Srbije. Collection of Scientific Papers of the Faculty of Science Kragujevac, 9: 39-41.
- Blesic B. 1992. - Apterygota (Diplura i Protura) u Blizini Pozarevca. Collection of Scientific Papers of the Faculty of Science Kragujevac, 13: 99-101.
- Blesic B. 1996. - Diplura of Western Balkan. BIOS (Macedonia, Grecia), 4: 23-27.
- Blesic B. 1998a. - Knowledge of Protura and Diplura of Montenegro. The Montenegrin Academy of Sciences and Arts Glasnik of the Section of Natatural Sciences, 12: 63-70.
- Blesic B. 1998b. - Investigations of Protura ad Diplura of South Serbia. Proceedings for Natural Sciences Matica Srpska 94: 87-90.
- Blesic B. 1998c. - Observations on reproduction in Kampods (Diplura: Campodeidae). Entomologist' s Records, 110: 266.
- Blesic B. 2000. - Investigation of Diplura and Protura in western Serbia. Proceedings for Natural Sciences, 99: 69-79.
- Blesic B. 2001. - Protura and Diplura (Insecta: Apterygota) of the Republic of Macedonia. 75 years Maced. Mus. Nat. Hist.: 157-162.
- Bockemühl J. 1956. - Die Apterygoten des Spitzberges bei Tübingen, eine faunistisch-ökologische Untersuchung. Zoologische Jahrbücher (Systematik, Ökologie und Geographie der Tiere), 84: 113-194.
- Borset E. 1968. - Some records of Diplura from Oslo area. Norsk Entomologisk Tidsskrift, 15(2): 141-143.
- Christian E. 1992. - Verbreitung und Habitatpräferenz von Doppel- und Zangenschwänzen in der Großstadt Wien (Diplura: Campodeidae, Japygidae). Entomol. Gener., 17(3): 195-205.
- Condé B. 1947a. - Quelques campodéidés du nord-est de la France. Bulletin du Muséum d' Histoire naturelle 2e série, 19: 185-186.
- Condé B. 1947b. - Nouvelles stations Françaises de campodéidés avec description d' une forme nouvelle. Annales des Sciences Naturelles, Zoologie, 11 série, 9: 139-144.
- Condé B. 1947c. - Deux Diploures méditerranéens a Strasbourg. Bulletin de la Société des Sciences de Nancy, n.s., VI(4): 120-121.
- Condé B. 1947d. - Quelques campodéidés des Landes et du Pays Basque (Aptérygotes, Diploures). Bulletin du Muséum d' Histoire naturelle 2 série, XIX: 185-186.
- Condé B. 1948a. - Nouvelles stations Françaises de campodéidés avec description d' une forme nouvelle. Annales Sc.nat. Zool., 11 série (9):139-144.
- Condé B. 1948b. - Campodéidés d' Algérie. Bulletin de la Société entomologique de France, LII(9): 144-146.
- Condé B. 1948c. - Contribution a la connaissance des campodéidés cavernicoles de France. Notes Biospéologiques, II: 35-48.
- Condé B. 1949. - Présence de Campodéidés cavernicoles en Lorraine et en Champagne. Bulletin de la Société des Sciences de Nancy, nouvelle série VIII (2/3): 31-34.

- Condé B. 1950. - Campodéidés du Var et des Alpes-Maritimes. Bulletin de la Société Linneenne de Lyon, 6 (juin, 1950): 128-132.
- Condé B. 1951a. - Campodéidés de la région d'Orédon (Hautes-Pyrénées). Bulletin de la Société entomologique de France, LVI(6): 91-95.
- Condé B. 1951b. - Campodéidés de la grotte de la Balme. Bulletin de la Société Linneenne de Lyon, 1 (janvier, 1951): 6-7.
- Condé B. 1953. - Campodéidés endogés d'Afrique septentrionale. Bulletin de la Société Zoologique de France, LXXVIII (5-6): 358-377.
- Condé B. 1954. Ordnung : Entotropha (Diplura). In : H. Franz, Die Nordost im Spiegel ihrer Landtierwelt. Univ. ERSITÄTSVERLAG. Pp. 644-649.
- Condé B. 1955. - Sur la faune endogée de Majorique (Pénicillates, Protoures, Diploures Campodéidés, Palpigrades). Bulletin du Muséum d'Histoire naturelle 2e série, XXVI(6): 674-677.
- Condé B. 1957. - Un Diploure Cavernicole inédit des Alpes de Provence. Notes Biospéologiques, XII: 7-12.
- Condé B. 1961. - Sur la microfaune du sol de Grande-Bretagne. II Diploures Campodéidés. Annales and Magazine of Natural History Ser. 13, IV: 149-154.
- Condé B. 1962. - Géonémie des Diploures troglobies du Jura et du Vercors. Spelunca Mémoires, 2: 119-127.
- Condé B. 1973. - Campodéidés Endogés de l'Est des Etats-Unis. Bulletin de la Société Linneenne de Lyon, n° spécial: 17-29.
- Condé B. 1984. - Diploures Campodéidés (Insectes) de Grèce (1re note). Revue suisse Zoologie, 91(1): 173-201.
- Condé B. 1991. - Campodéidés des Grottes de Bourgogne (Insectes, Diploures). Mémoires de Biospéologie, XVIII: 243-246.
- Condé B. 1993. - Une lignée danubienne du genre *Plusiocampa* (Diploures Campodéidés). Revue suisse de Zoologie, 100 (3) : 735-745.
- Condé & Barbier, 1957. - Diploures Campodéidés des Açores et de Madère. Boletim do Museu Municipal do Funchal, XIX: 63-87.
- Condé B. & Bareth C. 1970. - La Faune Terrestre de l' Ile de Sainte-Helene (première partie). Annals of the Royal Museum of Central Africa, 8^e Zoology, 181: 149-152.
- Condé B. & Bareth C. 1998. - Diploures Campodéidés de France continentale. Revue Française d'Entomologie (nouvelle série) 20(3): 95-102.
- Condé B. & Mathieu A. 1958. - Campodéidés Endogés de la Région Pyrénéenne. Vie et Milieu, VIII(4): 439-472.
- Condé & Poivre, 1982. - *Plusiocampa bonadonai* Condé au Valais (Insecta, Diplura). Revue suisse Zoologie, 89(1): 167-176.
- Denis J. 1924. - Sur la Faune Française des Apterygotes IV. Archives de Zoologie expérimentale et générale, 62: 286-287.
- Denis J. 1930. - Sur la faune française des Aptérygotes XIe note: Diploures avec tableau de détermination des espèces françaises. Bulletin Société Zoologique de France, 55: 19-41.
- Husson R. 1946. - Sur quelques récoltes de Diploures Campodéidés -- Revue Française d'Entomologie, 13: 90-92.
- Dobat K. 1975. - Die Höhlenfauna der Schwäbischen Alb mit Einschluss des Dinkelberges, des Schwarzwaldes und des Wutachgebietes. Abhandlungen zur Karst- und Höhlenkunde, Reihe D, Paläontologie, Zoologie, 2: 260 - 381, München.
- Dobat K. 1978. - Die Höhlenfauna der Fränkischen Alb. Abhandlungen zur Karst- und Höhlenkunde, Reihe D, Paläontologie, Zoologie, 3: 11-240, München.
- Gann J. 2006. - *Encyclopedia of Caves and Karst Science*. Fitzroy Dearborn. 1940 pp. New York London.
- Good J.A., R.E. Blackit & D.G. Higgins, 1989. - *Campodea lankestri* Silvestri, a soil apterygote new to Ireland. Irish Naturalist' Journal, 23(4): 154.
- Ionescu M.A. 1951. - Contributiuni la studiul Campodeidelor din Republica Populara Romana. Buletin C̄thntific Sectiunea de Sthnte Biologice Agronomice Geologice si Geografice, III(3): 525-532.

- Ionescu 1955. - Diplura. in Fauna Republicii Populare Romîne, Insecta VII(2): 48 pp.
- Leleup M.N. 1948. - D0184 Thysanoures nouveaux pour la faune belge. Bulletin et Annales Société Entomologique de Belgique, 84(I-II): 12.
- Juberthie C. & Decu, V. 1994. Structure et diversité du domaine souterrain : particularités des habitats et adaptations des espèces. Pp 5-22. In : Encyclopaedia Biospeologica. C. Juberthie & V. Decu ed. Société de Biospéologie. Moulis Bucarest.
- Leruth R. 1939. - La Biologie du domaine souterrain et la Faune cavernicole de la Belgique. Memoires du Musee royal d'histoire naturelle de Belgique, 87: 1 - 506, Bruxelles.
- Marten W. 1939. - Zur Kenntnis von Campodea. -- Zeitschrift für Morphologie und Ökologie der Tiere, 36: 41-88.
- Minelli A.S., Ruffo, S. & Posta, L.A. 1995. - 33. 'Apterygota' : Collembola, Protura, Microcoryphia e Zygentoma (=Thysanura s.l.), Diplura. Checklist delle Specie della Fauna Italiana. Ed. Calderini Bologna.
- Olsen K.M. 1996. - Tohalen Campodea lubbockii Silvestri, 1912, "kransohale". Insekt-Nytt, 21(4): 7-8.
- Orelli M. 1956. - Untersuchungen zur postembryonalen Entwicklung von Campodea (Insecta, Apterygota). Verhandlungen der Naturforschenden Gesellschaft in Basel, 67(3): 501-574.
- Paclt J. 1951. - Contribution à l' étude de notre faune du domaine principalement endogé I. (Tschechisch u. Französisch). Folia Entomologica (Entomologické listy), 14: 161-164.
- Paclt J. 1956. - Diplura Slovenska a prilahlych oblasti. Biologické práce SAV, 2(6): 5-25.
- Paclt J. 1961. - Campodeidae des Senckenberg-Museums (Ins.-Diplura) -- Senckenbergiana biologica, 42(5/6): 455-458.
- Paclt J. 1965. - Neue Beiträge zur Kenntnis der Apterygoten-Sammlung des Zoologischen Staatsinstituts und Zoologischen Museums Hamburg -- Entomologische Mitteilungen aus dem Zoologischen Staatsinstitut u. Zoologischen Museum Hamburg, 3(54): 93-104.
- Pagés J. 1951. - Contribution à la connaissance des Diploures -- Supplement du Bulletin Scientifique de Bourgogne, 9: 1-97.
- Ramellini P. 1990. - I Diplura dei Monti Ausoni e Aurunci (Lazio): Fauna ed Ecologia -- Bollettino dell' Associazione Romana di Entomologia, 44(1989): 13-28.
- Ramellini P. 1995. - Materiali per un catalogo topografico dei Dipluri Italiani -- Fragmenta entomologica Roma, 27(1): 15-50.
- Ramellini P. 2000. - Note su Campodeidi del Piemonte (Diplura, Campodeidae). Rivista Piemontese di Storia Naturale, 21: 103-114.
- Rusek J. 1963. - Zweiter Beitrag zur Kenntnis der Apterygoten-Fauna der Mährisch-schlesischen Beskiden. Acta Musei Silesiar, series A, XII: 21-35.
- Stach J. 1928. - Verzeichnis der Apterygogenea Ungarns. Annales Musei Nationalis Hungarici XXVI: 269-274.
- Stach J. 1964.- Katalog Fauny Polski. XV. Apterygota -- Polska Akademia Nauk. Instytut Zoologiczny. Warszawa. 103 pp.
- Sendra A. & Jiménez R. 1983. - Contribución al conocimiento de los Campodeidae endógeos de la Península Ibérica (Campodeidae, Diplura) -- I Congreso Ibérico de Entomología, II: 749-757.
- Sendra A. & Jiménez R. 1986. - Contribución al conocimiento de los Campodéidos endogeos de España Peninsular (Insecta, Diplura) -- Eos, LXII: 277-284.
- Sendra A. & Moreno A. 2004. - El subgénero Campodea s.str. en la Península Ibérica (Hexapoda: Diplura: Campodeidae) -- Boletín Sociedad Entomológica Aragonesa, 35: 19-38.
- Sendra A., Teruel S., Satar A., Tusun S. & Özbay C. 2010. - New species, new records, and distribution of Campodeidae (Diplura) in Anatolia. Zootaxa, 2639: 40-52.
- Silvestri F. 1912. - Contribuzione alla conoscenza dei Campodeidae (Thysanura) d' Europa -- Bollettino del Laboratorio di Zoologia generale e agraria in Portici, VI: 110-147.
- Silvestri F. 1932a. - Campodeidae (Thysanura) de España (primera parte). Eos, VIII: 115-164.

- Silvestri F. 1932b. - Nuovi contributi alla conoscenza della fauna delle isole Italiane dell' Egeo -- Bolletino del Laboratorio di Zoologia generale e agraria in Portici, 27: 61-111.
- Strinati P. 1965. - Faune cavernicole de la Suisse: 1 - 484, o.O.
- Tarashchuk M. V. 1979. - New and slightly known species of Apterygota for the Ukrainian SSR fauna. Vestnik Zoologii, 1979(6): 83-84.
- Vadell M., Jordana R., Sendra A. & Moraza M.L. 2007. - Primeros datos sobre la fauna cavernícola terrestre de la Cova des Pas de Vallgornera (Llucmajor, Mallorca, Baleares). Endins, 31: 117-124.
- Weber D. 1991. - Die Evertebratenfauna der Höhlen und künstlichen Hohlräume des Katastergebietes Westfalen einschliesslich der Quellen- und Grundwasserfauna. Abhandlungen zur Karst- und Höhlenkunde, 25: 1 - 701, München.
- Weber D. 1988. - Die Höhlenfauna und -flora des Höhlenkatastergebietes Rheinland-Pfalz/Saarland. Abhandlungen zur Karst- und Höhlenkunde 22: 1-157.
- Weber D. 1989. - Die Höhlenfauna und -flora des Höhlenkatastergebietes Rheinland-Pfalz/Saarland, 2. Teil, Abhandlungen zur Karst- und Höhlenkunde 23: 1-250.
- Weber D. 2001. - Die Höhlenfauna und -flora des Höhlenkatastergebietes Rheinland-Pfalz/Saarland, 4. Teil. Abhandlungen zur Karst- und Höhlenkunde 33: 1088.
- Weber D. 2012. - Die Höhlenfauna und -flora des Höhlenkatastergebietes Rheinland-Pfalz/Saarland, 5. Teil. Abhandlungen zur Karst- und Höhlenkunde, 36: 2367 S., München.
- Wygodzinsky P. 1940. - Beiträge zur Kenntnis der Dipluren und Thysanuren der Schweiz -- Naturforschenden Gesellschaft, 1:40-46.
- Wygodzinsky P. 1941a. - Zur Kenntnis einiger europäischen Dipluren und Thysanuren -- Verhandlungen der Naturforschenden Gesellschaft in Basel, 52: 63-100.
- Wygodzinsky P. 1941b. - Beiträge zur Kenntnis der Dipluren und Thysanuren der Schweiz -- Mémoires de la Société Helvétique de Sciences Naturelles, LXXIV, mém., 2: 113-223.
- Womersley H. 1927. - The Apterygota of the South-West of England. Proc. Bris. Nat. Soc., 4 S., Vol. VI., Pt. V., for the South Western Naturalists' Union: 372-379.
- Zaenker S. 2001. - Das Biospeläologische Kataster Hessen. Die Fauna der Höhlen, künstlichen Hohlräume und Quellen. Abhandlungen zur Karst- und Höhlenkunde, 32: CD-Version, München.