Bibliographie

BRAKMAN P.J., 1966. - Lijst van Coleoptera uit Nederland en het omliggend gebied. *Monographieën van de Nederlandsche Entomologische Vereeniging*, 2 : 40-83.

BRUGE H., DRUGMAND D. & HAGHEBAERT G., 1999, sous presse. - Catalogue commenté des Coleoptera Staphylinidae de Belgique. *Bulletin de la Société royale belge d'Entomologie.*

DRUGMAND D. & GEREND R., 1999, sous presse. - Catalogue commenté des Coleoptera Staphylinidae du Grand-Duché de Luxembourg. *Travaux scientifiques du Muséum national d'Histoire naturelle de Luxembourg.*

HANSEN M., 1996. - Catalogue of the Coleoptera of Denmark. *Entomologiske Meddelelser*, 64 (1-2) : 1-231.

JOHNSON C., 1967. - *Aleochara stichai* LIKOVSKY (Col. Staphylinidae) new to Britain. *The Entomologist*, 100 : 64-65.

KÖHLER F. & KLAUSNITZER B., 1998. - Entomofauna Germanica. Verzichnis der Käfer Deutschlands. *Entomologische Nachrichten Berichte*, 4 : 1-185.

LANGER V., 1996. - Insect-crop interactions in a diversified cropping system: parasitism by *Aleochara bilineata* and *Trybliographa rapae* of the cabbage root fly, Delia radicum, on cabbage in the presence of white clover. *Entomologia Experimentalis et Applicata*, 80 : 365-374.

LIKOVSKY Z., 1974. - 237. Gattung *Aleochara* GRAVENHORST, 1802. *In* : FREUDE H., HARDE K.W. & LOHSE G.A. *Die Käfer Mitteleuropas*, Bd. 5. Staphylinidae II (Hypocypthtinae und Aleocharinae). Pselaphidae. Goecke & Evers. Krefeld. 293-304.

LUCHT W.H., 1987. - *Die Käfer Mitteleuropas*. Katalog. Goecke & Evers. Krefeld. 342 pp.

MAUS Ch., MITTMANN B. & PECHSKE K., 1998. - Hosts Records of Parasitoid *Aleochara* GRAVENHORST Species (Coleoptera, Staphylinidae) Attacking Puparia of Cyclorrhapheous Diptera. *Deutsche Entomologische Zeitschrift*, 45 : 231-254.

SAINTE-CLAIRE DEVILLE J., 1935. - Catalogue raisonné des Coléoptères de France (1ère livraison). *L'Abeille. Journal d'Entomologie*, 36 : 1-160

SILFVERBERG H., 1992. - *Enumeratio Coleopterorum Fennoscandiae, Daniae et Baltiae*. Helsingfors Entomologiska Bytesförening. Helsinki. 1-94.

WELCH R.C., 1997. - The British species of the genus *Aleochara* Gravenhorst (Staphylinidae). *The Coleopterist*, 6 (1) : 1-45.

Collembola (Hexapoda) of poplar forests in Ranst : faunistics

Wim JACOBS[1], Luc DE BRUYN[1,2] & Noël LUST[3]

[1] Department Biology, Evolutionary Biology Group, University of Antwerp (RUCA), Groenenborgerlaan 171, 2020 Antwerp, Belgium. [2] Corresponding author : e-mail : debruyn@ruca.ua.ac.be

[3] Faculty of Agricultural and Applied Biological Sciences, Laboratory of Forestry, University of Ghent (RUG), Geraardsbergse steenweg 267, 9090 Gontrode, Belgium.

Abstract

The aim of this study was to make an inventory of the soil living Collembola on afforested agricultural land planted with poplar trees. Soil living Collembola were collected in the spring of 1996 in two poplar forests by means of 100 soil core samples. Altogether, 26 species were found of which 9 are new to the fauna of Belgium. Each species is briefly discussed.

Keywords : Collembola, faunistics, Belgium.

Samenvatting

Het doel van deze studie was een inventarisatie te maken van de bodemlevende Collembola in met populieren beboste landbouwgronden. Hiervoor werden in de lente van 1996 Collembola verzameld in twee populierenbossen. Hiervoor werden 100 bodemstalen genomen. Er werden 26 soorten gevonden waarvan 9 nieuw zijn voor de fauna van België. Elke soort wordt kort besproken.

Introduction

The classis Collembola is amongst the poorest studied Arthropod groups of Belgium. Nevertheless, many representatives belong to the most common Arthropods. They are mainly found in soils because of their sensitivity to desiccation (JOOSSE, 1973). Until now, 138 species were recorded for Belgium (JANSSENS, 1997). Many recent studies however revealed new species (e.g., BERBIERS & SEGERS, 1991). Therefore, the number of species found is likely to increase in future. In Austria, e.g., 500 species have been recorded (CHRISTIAN, pers. comm.). HOPKIN (pers. comm.) who is presently revising the Collembola in the UK and Ireland estimates that the total fauna comprises more than 200 species. Until recently, little attention was paid to forests planted on agricultural land. Therefore, our goal was to make an inventory of species of pasture-lands that were afforested with poplar (*Populus* x *euramericana* GUINIER).

Material and methods

The research was carried out in two forests located in Ranst, Belgium; the 'Muizenbos' (UTM : 31UFS096732) and the 'Tussen Maas en Moor' forest (UTM : 31UFS110740). Before afforestation (between 120 and 20 years ago), the lots were used as pasture. In the 'Muizenbos', 8 stations were sampled. One station was sampled in the 'Tussen Maas en Moor' forest. The soils of above mentioned forests belong to the 'Antwerp sandy loam region' and have a perched water table (DE KEERSMAEKER, 1993). In all stations an active mull humus was present. This humus profile is characterised in winter by a thin litter layer that disappears nearly completely in summer time.

In each station 5-6 samples (depth : 5 cm; ∅ 48 mm) were taken on two dates (12th and 21st of May) resulting in a total sample size of 100. The soil core samples were extracted in a modified High Gradient Canister extractor (e.g. VAN STRAALEN & RIJNINKS, 1982; VANNIER, 1970). By gradually increasing the temperature at the top of the soil core, the animals flee downwards where they are collected in a recipient (DUNGER & FIEDLER, 1989). The presence of members of the order Pauropoda among the extracted animals indicates that the extraction was sufficiently efficient (RUSEK, 1995). To avoid a negative impact of the odour of the recipient liquid, an aqueous saturated solution of the odourless picric acid was used (DUNGER & FIEDLER, 1989). Afterwards, the animals were sorted out by hand. The identification was based on the keys of GISIN (1960) and FJELLBERG (1980) and additional publications.

Results & discussion

Altogether, 1,602 individuals were identified to species level. We distinguished 26 species (Table 1). The community was largely dominated by *Mesaphorura macrochaeta* with almost one third of the animals caught. Six other species were also represented with more than 100 individuals : *Protaphorura armata*, *Folsomia quadrioculata*, *Sminthurinus aureus*, *Isotomurus palustris* and *Isotomiella minor*. Eight species were collected with more than 10 individuals and less than 100 individuals. The largest group, comprising twelve species, were represented with less than 10 individuals. Based on the Collembola checklist for Belgium (JANSSENS, 1997) it was concluded that 9 species were new to the fauna of Belgium. Each species is discussed below with ecological aspects such as biogeography, vertical distribution, habitat preferences and reproduction.

Arrhopalites microphthalmus is a new species for Belgium. It was formerly found in forests in southern France (GISIN, 1960). The ecology of the species is unknown but it was found in the mineral soil of an oak wood in northern Spain (POZO *et al.*., 1986). *A. microphthalmus* is widely distributed in Europe (CHRISTIANSEN & BELLINGER, pers. comm.).

Caprainea marginata, also a new species for Belgium, occurs from Scandinavia to Central Europe. KOPESZKI & MEYER (1996) described the species as xerothermophilic in Austria. This contradicts our observations and those of PONGE (1993) for western Europe. We found the species mainly under tree cover. According to PONGE *et al.* (1993) it is an epigeic species in forests, but POZO *et al.* (1986) only found it in the litter layer of a meadow.

Ceratophysella denticulata is a Cosmopolitan species (FJELLBERG, 1998), preferring detritus as a habitat. It is mainly found in moist habitats (PONGE, 1993) where it lives epigeic (PONGE *et al.*, 1993).

Folsomia fimetarioides is a new species for Belgium. It prefers moist habitats (STERZYNSKA, 1995). It was previously found in Scandinavia,

Table 1. Species collected from soil core samples of the two Poplar forests in Ranst (species new to the Belgian fauna are printed in bold) (Muizenbos = 84 samples; Maas & Moor = 12 samples).

Species	Muizenbos	Maas & Moor	Total
***Arrhopalites microphtalmus* CASSAGNEAU & DELAMARE, 1953**	1		1
***Caprainea marginata* (SCHÖTT, 1893)**	3	1	4
Ceratophysella denticulata (BAGNALL, 1941)	17	8	25
***Folsomia fimetarioides* (AXELSON, 1903)**	4	1	5
Folsomia quadrioculata (TULLBERG, 1871)	152	29	181
***Folsomia spinosa* KSENEMAN, 1936**	3	5	8
Friesea mirabilis TULLBERG, 1871	57	2	59
Heteromurus nitidus TEMPLETON, 1835	1		1
***Isotoma agrelli* DELAMARE, 1950**	3		3
Isotomiella minor (SCHÄFFER, 1896)	86	24	110
Isotomurus palustris (MÜLLER, 1776)	97	21	118
Isotoma viridis BOURLET, 1839	3	1	4
***Lepidocyrtus lignorum* FABRICIUS, 1783**	7	4	11
Lepidocyrtus lanuginosus (GMELIN, 1788)	7	1	8
Megalothorax minimus WILLEM, 1900	9	8	17
***Mesaphorura macrochaeta* (RUSEK, 1976)**	551	14	565
Neanura muscorum ABSOLON, 1901	2	1	3
***Neotullbergia crassicuspis* GISIN, 1944**	15		15
Paratullbergia callipygos (BÖRNER, 1902)	47		47
Protaphorura armata (TULLBERG, 1869)	177	5	182
***Protaphorura subuliginata* GISIN, 1956**	1		1
Pseudosinella alba (PACKARD, 1873)	26		26
Sminthurinus aureus (LUBBOCK, 1862)	138	2	140
Tomocerus minor (LUBBOCK, 1862)	4	1	5
Stenaphorura quadrispina (BÖRNER, 1901)	6		6
Xenyllodes armata AXELSON, 1903	57		57
Total species	26	17	26
Individuals	1474	128	1602

eastern Europe, England and Austria (GISIN, 1960). Depth preference nor reproductive modes are known.

Folsomia quadrioculata is a common hemiedaphic species, that can be found up to a height of 1700 m. It is a Holarctic species (KOPESZKI & MEYER, 1996). STERZYNSKA (1995) ascertained that this species reaches the highest abundance in the thickening phase of secondary succession of forests. It prefers moist habitats (ARPIN *et al.*, 1984).

Folsomia spinosa is a new species for Belgium, mainly found from central Europe to central France (GISIN, 1960). Depth preference nor reproductive modes are known.

Friesea mirabilis is found in soils with little or no calcium (KOPESZKI & MEYER, 1996). It is a typical species for mull-humus with a pH lower than 5 (PONGE, 1983). The species' abundance was correlated with the carbon content of the soil (HÅGVAR & ABRAHAMSEN, 1984). It is a zoophagous species that eats Rotifera and eggs of Collembola. It is found throughout Europe (GISIN, 1960; KOPESZKI & MEYER, 1996).

Heteromurus nitidus is mainly found in wet meadows (GISIN, 1960) and mull-humus profiles with pH-values higher than 5 (PONGE, 1983). It is found throughout Europe (GISIN, 1960).

Isotoma agrelli is a new species for Belgium, previously only recorded from France (Brittany) (GISIN, 1960). Depth preference nor reproductive modes are known.

Isotomiella minor is a species that avoids acid soils. Its vertical distribution is uncertain. According to KOPESZKI & MEYER (1996) it varies between euedaphic to hemiedaphic. On the other hand, PONGE *et al.* (1993) consider it as epigeic. This species was found to be positively correlated with the total nitrogen content of the soil (HÅGVAR & ABRAHAMSEN, 1984).

The taxon *Isotomurus palustris* comprises a group of species that was recently subdivided into several species by using DNA-analysing methods. Species identification is not possible using morphological characters only. All *Isotomurus* species live in moist to wet habitats (CARAPELLI *et al.*, 1995).

Isotoma viridis and *Lepidocyrtus lignorum* are found throughout Europe. While the first prefers open habitats, the second is a species that prefers forests (PONGE, 1993). It can be found in high numbers (JACOBS, unpublished data).

Lepidocyrtus lanuginosus is also a typical forest species (PONGE, 1993). It is an epigeic species (PONGE *et al.*, 1993), occurring in high abundance in moder humus profiles. (PONGE, 1983). This species is found throughout Europe, on planes as well as on slopes (GISIN, 1960; KOPESZKI & MEYER, 1996).

Megalothorax minimus is a parthenogenetic species. It is also considered to be troglophilic (KOPESZKI & MEYER, 1996). Its vertical distribution in the soil is uncertain : according to KOPESZKI & MEYER (1996) it varies between euedaphic to hemiedaphic. PONGE *et al.* (1993) on the other hand consider it as epigeic. This species was found to be negatively correlated with the carbon content of the soil (HÅGVAR & ABRAHAMSEN, 1984). *Megalothorax minimus* is found throughout Europe and northern America (GISIN, 1960).

Mesaphorura macrochaeta is a new species for Belgium. The reproduction is mainly parthenogenetic. It is a euedaphic species, that can be found up to 40 cm deep in the soil (KOPESZKI & MEYER, 1996; PONGE *et al.*, 1993). The abundance of this species is positively correlated with the level of base saturation and the calcium content of soils in mull-humus profiles (HÅGVAR & ABRAHAMSEN, 1984). Nevertheless it reaches the highest abundance in more acid profiles (ARPIN *et al.*, 1984) and can therefore be considered as acidotolerant (PONGE, 1993).

Neanura muscorum is a cosmopolite species (KOPESZKI & MEYER, 1996). It is a typical forest species with a preference for moist habitats (PONGE, 1993). It is an euedaphic species (FABER & JOOSSE, 1993).

Neotullbergia crassicuspis is a new species for Belgium previously found in Switzerland, Germany and Scotland. It is a rather rare species occurring at low abundances (GISIN, 1960).

Paratullbergia callipygos prefers neutral acidocline soils. It is an euedaphic species (PONGE *et al.*, 1993). It occurs in western and central Europe (GISIN, 1960).

Protaphorura armata is a cosmopolitic species (KOPESZKI & MEYER, 1996). It was found that the abundance of this species was negatively correlated with the pH and the level of base saturation of the soil (HÅGVAR & ABRAHAMSEN, 1984). The reproduction is sexual (HÅGVAR, 1995). *P. armata* can be found from the Mediterranean to Scandinavia (GISIN, 1960; HÅGVAR & ABRAHAMSEN, 1984).

Protaphorura subuliginata is a new species for Belgium. It is found throughout Europe in forests and meadows. It is an euedaphic species (KOPESZKI & MEYER, 1996; GISIN, 1960).

Pseudosinella alba is an indicator species for heavy soils (KOPESZKI & MEYER, 1996) of the mull-humus type (ARPIN *et al.*, 1984). It is a mycophagous and epigeic species (PONGE *et al.*, 1993). This species is found throughout Europe with exception of the most northern part (GISIN, 1960).

Sminthurinus aureus is a cosmopolitic species (KOPESZKI & MEYER, 1996). It is an epigeic species (PONGE *et al.*, 1993) and a typical species for moist mull-humus profiles (PONGE, 1983; 1993).

Tomocerus minor is a Holarctic species. It is hygro- and troglophilic (KOPESZKI & MEYER, 1996) and typical for forests with a moist mull-humus profile (PONGE, 1983, 1993). It is a hemiedaphic species (VERHOEF & BRUSSAARD, 1990).

Stenaphorura quadrispina is found throughout Europe and in the Middle East (GISIN, 1960). According to KOPESZKI & MEYER (1996), it prefers more open habitats, like moist meadows. Because we found it in a moist forest, we can assume that soil humidity is more important than macrohabitat type.

The last species, *Xenyllodes armata* is found throughout Europe but never dominates the Collembolan community (GISIN, 1960). Depth preference nor reproductive mode is known.

Acknowledgments

We want to thank the OCMW of Antwerp for allowing us to work in the Muizenbos and Frans JANSSENS for confirming identification of the Collembola species.

References

ARPIN P., PONGE J.F., DABIN B. & MORI A., 1984. - Utilisation des nématodes et des Collemboles pour caractériser des phénomènes pédobiologiques. *Revue d'Ecologie et de Biologie du Sol*, 21 : 243-268.

BERBIERS P. & SEGERS H., 1991. - Collembola of the Zonien Forest (Province Brabant, Belgium). *Bulletin et Annales de la Société royale belge d'Entomologie*, 127 : 81-85.

CARAPELLI A., FRATI F., FANCIULLI P.P. & DALLAI R., 1995. - Genetic differentiation of six sympatric species of *Isotomurus* (Collembola, Isotomidae); is there any difference in their microhabitat preference? *European Journal of Soil Biology*, 31 : 87-99.

DE KEERSMAEKER L., 1993. - *Synekologische evaluatie van de kruidlaag in populierenbossen te Ranst*. Scriptie voorgedragen tot het behalen van de graad Bio-ingenieur in het Land- en Bosbeheer, Gent.

DUNGER W. & FIEDLER H.J., 1989. - Methoden der Bodenbiologie. Gustav Fischer Verlag, Stuttgard, 415 pp.

FABER J.H. & JOOSSE E.N.G., 1993 - Vertical distribution of Collembola in a *Pinus nigra* organic soil. *Pedobiologia*, 37 : 336-350.

FJELLBERG A., 1980. - Identification keys to Norwegian Collembola. Utgitt av Norsk Entomologisk Forening, Ås, 152 pp.

FJELLBERG A., 1998. - The Collembola of Fenno-scandia and Denmark Part I. Poduromorpha.. Fauna Ent.Scand. 35 : 1-184.

GISIN H., 1960. - *Collembolen Fauna Europas*. Musée d'Histoire Naturelle, Genève, 312 pp.

HÅGVAR S., 1995. - Instability in small, isolated microarthropod communities. *PolskiePismo Entomologiczne.*, 64 : 123-133.

HÅGVAR S. & ABRAHAMSEN G., 1984. - Collembola in Norwegian coniferous forest soils III. Relations to soil chemistry. *Pedobiologia*, 27 : 331-339.

HOPKIN S.P., 1997. - Biology of Springtails - Insecta: Collembola. Oxford University Press, Oxford, 340 pp.

JANSSENS F., 1997 - Checklist of the Collembola. http://www.geocities.com/~frans.janssens/collembo.htm.

JOOSSE E.N.G., 1973. - Populatieoecologisch onderzoek aan Collembola. *Vakblad voor Biologie*, 53 : 2-7.

KOPESZKI H. & MEYER E., 1996. - Artenzusammensetzung und Abundanz von Collembolen in Waldböden der Provinzen Bozen und Trient (Italien). *Berichte der natur-medizinische Verein, Innsbruck*, 83 : 221-227.

PONGE J.F., 1983. - Les Collemboles, indicateurs du type d'humus en milieu forestier. Résultats obtenus au Sud de Paris. *Acta Oecologia-Oecologia Genereralis*, 4 : 359-374.

PONGE J.F., 1993. - Biocenoses of Collembola in atlantic temperate grass-woodland ecosystems. *Pedobiologia*, 37: 223-244.

PONGE J.F., ARPIN P. & VANNIER G., 1993. - Collembolan response to experimental perturbations of litter supply in a temperate forest ecosystem. *European Journal of Soil Biology*, 29 : 141-153.

POZO J., SELGA D. & SIMON J.C., 1986. - Studies on the Collembolan populations of several plant communities of the Basque Country (Spain). *Revue d'Ecologie et de Biologie du Sol*, 23 : 215-232.

RUSEK J., 1995. - Synecology of Collembola. *Polska Pismo Entomologiczne*, 64 : 69-75.

STERZYNSKA M., 1995. - Changes in the community structure of Collembola during secondary processes of succession in the pine forest. *Polska Pismo Entomologiczne*, 64 : 229-232.

VAN STRAALEN N.M. & RIJNINKS P.C., 1982. - The efficiency of Tullgren apparatus with respect to interpreting seasonal changes in age structure of soil arthropod populations. *Pedobiologia*, 24 : 197-209.

VANNIER G., 1970. - Réactions des Micro-Arthropodes aux Variations de l'Etat hydrique du Sol. Techniques relatives à l'extraction des Arthropodes du Sol. Editions du Centre National de la Recherche Scientifique, Paris, 189 pp.

VERHOEF H.A. & BRUSSAARD L., 1990. - Decomposition and nitrogen mineralization in natural and agro-ecosystems: the contribution of soil animals. *Biogeochemistry*, 11 : 175-211.