Vestnik zoologii, **36**(2): 63–67, 2002

UDC 595.7

THE FAUNA OF SPRINGTAILS (COLLEMBOLA) IN LVIV

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Accepted 12 November 2001

The Fauna of Springtails (Collembola) in Lviv. Shrubovych J. — 119 species of Collembola have been recorded in various ecosystems of Lviv, differing by degree of the urban pressure. Successful coexistence of great number of springtail species with different ecological preferences (forest, meadow, meadow-steppe, eurytopic, compost, ruderal, synanthropic, troglophilous forms) is the most characteristic peculiarity of faunal communities in urban conditions.

Key words: Collembola, springtails, urban ecosystems, fauna.

Фауна ногохвосток (Collembola) Львова. Шрубович Ю. — 119 видов ногохвосток зарегистрированы в различающихся степенью урбопресса экосистемах города Львова. Успешное сосуществование большого числа видов коллембол с разными экологическими преферендумами (лесных, луговых, лугостепных, эвритопных, компостных, рудеральных, синантропных, троглофильных форм) является наиболее характерной особенностью фаунистических комплексов в условиях урбосреды.

Ключевые слова: Collembola, ногохвостки, урбоэкосистемы, фауна.

Introduction

Urban ecosystems are geterogenous formations with considerably transformed soil, flora and fauna under the effect of anthropogenic pressure. Nowadays the scientific interest in studying the urban ecosystems has much increased, the analysis of urban fauna allowing to expand the list of new species, which do not occur in natural biotopes of the region. Hitherto there are only some data on springtail fauna from two park and one orchard ecosystems, where 79 species were recorded (Kaprus, 1998).

The objective of this paper is to study the species structure of springtail communities in various ecosystems of Lviv with different degree of urban pressure.

Material and methods

The material was collected between 1997 and 1999 in the following habitats, which were selected in different types of ecosystems along the gradient of urban pressure:

№ 1 — beech forest-park "Iron Water";
№ 2 — I. Franko Park in the centre city;
№ 3 and № 4 — roadside boulevards in the city centre;
№ 5 — soil near single trees surrounded by asfalt, along the road with intensive traffic;
№ 6 — flower-beds;
№ 7 — desert sandy quarry in the Park "Znesinja";
№ 8 — waste industrial dump in the Park "Znesinja";
№ 9 — the building site in the Park "Znesinja";
№ 10 — cellars;
№ 11 — hothouses;
№ 12 — flower-pots.

Soil samples (5×5×10 cm), each in series of 20 repetitions, as a rule, were taken during the whole year. Springtails were extracted by means of Tullgren apparatus and fixed in 80% ethyl alcohol. A total of 1,000 samples were collected and more than 20,000 specimens of Collembola were identified.

Data on collembolan fauna in beech forest-park "Pohulianka" (№ 13) and in orchard near the centre of the City (№ 14) follow Kaprus (1998) (tabl. 1).

Results and discussion

As a result of our research, 119 springtail species have been found in Lviv, 58 of them being recorded for the first time. Thus, altogether with literature data, the collembolan fauna in Lviv includes 137 species belonging to 63 genera and 15 families (tabl. 1). The most representative families are Entomobryidae (29 species) and Isotomidae (26 species). The families Onychiuridae and Hypogastruridae are less rich in species (23 and 19 species respectively), and the remaining families are represented by 1–10 species each. Most species of Isotomidae and Onychiuridae are eurytopic ones, while representatives of the families Entomobryidae, Katiannidae, Sminthuridae and Bourletiellidae prefer the arid areas and are surface dwellers. The strong aridity of the urban environment promotes the increase of species number of four latter families and favours expansion of ranges of meadow-steppe collembolan species belonging to other families, namely *Axenyllodes baueri, Neonaphorura adulta, Cryptopygus orientalis, Cryptopygus thermophilus* and *Folsomides marchicus.*

Table 1. List of springtails (Collembola) of Lviv (numbering of examined habitats corresponds to that in "Material and methods" section)

Таблица 1. Список видов ногохвосток (Collembola) Львова (нумерация исследованных местообитаний соответствует таковой в разделе "Material and methods")

Species	Habitats													
	№1	№2	№3	№4	№5	№6	№7	№8	№9	№10	№11	№12	№13[1]	№14[1]
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Hypogastruridae														
**Hypogastrura* (*Ceratophysella*) *succinea* Gisin, 1949	-	-	+	+	+	+	-	-	-	+	-	-	-	-
H. (*C.*) *denticulata* Bagnall, 1941	-	+	+	+	+	-	-	-	-	+	-	-	+	+
**H.* (*C.*) *armata* Nicolet, 1842	-	+	-	-	-	-	-	-	-	-	-	-	-	-
H. (*C.*) *bengtssoni* Egren, 1904	-	-	-	-	-	-	-	-	-	+	-	-	-	+
H. (*C.*) *silvatica* Rusek, 1964	+	-	-	-	-	-	-	-	-	-	-	-	+	+
Hypogastrura (*Hypogastrura.*) *vernalis* Arle, 1901	+	-	+	+	+	-	+	+	+	+	-	-	-	+
H. (*H.*) *purpurescens* Lubbock, 1867	-	-	-	-	+	-	-	+	-	-	+	-	-	+
H. (*H.*) *viatica* Tullberg, 1872	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Willemia anophthalma Bцrner, 1901	+	+	-	-	+	-	-	-	-	-	-	-	+	+
Willemia denisi Mills, 1932	-	-	-	-	-	-	-	-	-	-	-	-	-	+
**Willemia scandinavica* Stach, 1949	-	-	+	-	-	-	-	-	-	+	-	-	-	-
**Willemia intermedia* Mills, 1934	-	-	-	-	-	-	-	-	+	-	-	-	-	-
**Xenylla brevisimilis* Stach, 1949	-	+	-	+	+	-	-	-	-	-	-	-	-	-
Xenylla maritima Tullberg, 1859	-	-	+	-	-	-	+	+	-	-	-	+	-	+
Xenylla boerneri Axelson, 1905	+	-	-	-	-	-	-	-	-	-	-	-	+	+
**Acherontiella cassagnaui* Thibaud, 1967	-	-	-	-	-	-	+	+	+	+	-	-	-	-
**Mesogastrura libyca* Caroli, 1914	-	-	-	-	-	-	-	-	-	+	+	-	-	-
**Schoettella ununguiculata* Tullberg, 1869	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Odontellidae														
**Odontella pseudolamellifera* Stach, 1949	+	-	-	-	-	-	-	-	-	-	-	-	-	-
**Axenyllodes baueri* Kseneman, 1935	-	-	+	-	-	-	+	-	-	-	-	-	-	-
Neanuridae														
Friesea mirabilis Tullberg, 1869	+	+	-	-	+	-	-	-	-	+	-	-	+	-
Friesea claviseta Axelson, 1900	+	+	-	-	-	-	-	-	-	-	-	-	-	+
**Friesea duodecimoculata* Denis, 1936	-	-	+	-	-	-	-	-	-	-	-	-	-	-
**Brachystomella parvula* Schäffer, 1896	+	+	+	-	-	-	+	-	-	-	-	-	-	-
**Pseudachorutes subcrassus* Tullberg, 1871	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudachorutes parvulus Börner, 1901	-	-	-	-	-	-	-	-	-	-	-	-	-	+
**Pseudachorutes corticicolus* Schäffer, 1896	-	+	-	-	-	-	-	-	-	-	-	-	-	-
**Pseudachorutella asigillata* Börner, 1901	+	-	-	-	-	-	-	-	-	-	-	-	-	-
**Micranurida pygmaea* Börner, 1901	+	-	-	-	-	-	+	-	-	-	-	-	-	-
**Thaumanura carolii* Stach, 1920	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Neanura muscorum Templeton, 1835	+	-	-	-	-	-	+	-	-	-	-	-	-	+
Onychiuridae														
**Tetrodontophora bielanensis* Waga, 1842	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Micraphorura absoloni Bцrner, 1901	+	+	+	+	-	-	+	-	-	-	-	-	-	+
**Hymenaphorura polonica* Pomorski, 1990	-	-	+	-	-	-	-	-	-	-	-		-	-
**Thalassaphorura encarpata* Denis, 1931	-	-	+	-	-	-	-	-	-	-	+	+	-	-
Protaphorura armata Tullberg, 1849	+	+	+	+	+	+	+	-	-	+	-	+	+	+
**Protaphorura subarmata* Gisin, 1957	+	+	+	-	-	-	-	-	-	+	+	+	-	-
Protaphorura pannonica Haybach, 1960	+	+	+	-	-	-	+	-	-	-	-	-	+	-
Protaphorura campata Gisin, 1952	-	-	-	-	-	-	+	-	-	-	-	-	+	-
**Onychiurus* sp.	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Onychiurus ambulans (L.) sensu Stach, 1758	-	-	-	-	-	-	-	-	-	-	-	-	-	+

Table 1 (*continued*)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
**Onyshiurus rectospinatus* Stach, 1922	-	+	-	-	-	-	-	-	-	+	-	-	-	-
**Ortonyshiurus rectopapillatus* Stach, 1933	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Deuteraphorura insubraria Gisin, 1952	-	+	+	-	+	+	-	-	-	-	-	-	-	+
**Deuteraphorura cebennaria* Gisin, 1956	-	-	+	-	-	-	-	-	-	-	-	-	-	-
**Deuteraphorura silesiaca* Dunger, 1977	+	-	-	-	-	-	-	-	-	-	-	-	-	-
**Agronychiurus naglitshi* Gisin, 1960	-	-	+	-	-	-	-	-	-	+	-	-	-	-
Mesaphorura macrochaeta Rusek, 1976	+	+	+	+	+	+	+	+	+	-	+	+	-	+
Mesaphorura krausbaueri Börner, 1901	-	-	-	-	-	-	-	-	-	-	-	-	+	+
**Mesaphorura critica* Ellis, 1976	-	+	+	-	+	-	+	+	-	+	-	+	-	-
**Metaphorura affinis* Börner, 1902	+	+	+	+	-	-	+	-	-	-	-	+	-	-
**Stenaphorurella quadrispina* Börner, 1901	+	+	+	-	-	-	+	-	-	-	-	-	-	-
**Paratullbergia callipygos* Börner, 1902	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Neonaphorura adulta Gisin, 1944	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Isotomidae														
**Paranurophorus simplex* Denis, 1929	-	-	-	-	-	-	-	-	-	+	+	-	-	-
**Isotomodes productus* Axelson, 1906	-	+	+	+	+	-	+	+	+	-	-	-	-	-
Folsomides parvulus Stach, 1922	+	-	-	-	-	+	+	+	-	-	-	-	+	-
**Folsomides marchicus* Frenzel, 1941	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Folsomia manolacei Bagnall, 1932	+	+	+	+	+	-	-	-	-	+	-	+	+	+
Folsomia penicula Bagnall, 1939	+	-	+	-	+	-	-	+	-	-	+	-	-	+
*Folsomia quadrioculata*Tullberg, 1971	+	-	-	-	-	-	-	-	-	-	-	-	+	-
**Folsomia similis* Bagnall, 1939	-	-	+	-	-	-	-	-	-	+	+	-	-	-
Folsomia fimetaria Linnaeus, 1758	+	+	+	-	+	-	-	-	-	+	+	-	-	+
**Folsomia* cf. *fimetarioides* Axelson, 1903	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Folsomia candida Willem, 1902	+	+	+	-	+	-	-	-	+	-	+	+	+	+
Folsomia strenzkei Nosek, 1963	-	-	-	-	-	-	-	-	-	-	-	-	+	-
Cryptopygus bipunctatus Axelson, 1903	+	-	+	+	-	+	-	+	+	+	-	+	+	-
**Cryptopygus orientalis* Stach, 1947	-	-	+	-	-	-	-	-	+	-	-	-	-	-
**Cryptopygus thermophilus* Axelson, 1900	-	-	-	-	-	-	+	-	+	-	-	-	-	-
Proisotoma minima Axelson, 1901	+	-	-	-	+	-	-	-	-	-	-	-	+	-
Proisotoma minuta Tullberg, 1871	+	+	-	+	+	+	-	+	-	+	-	+	+	-
Isotomiella minor Schäffer, 1896	+	+	-	+	+	+	-	+	+	+	+	+	+	+
Isotoma notabilis Schäffer, 1896	+	+	+	+	+	-	+	+	+	+	+	+	+	+
Isotoma tigrina Nicolet, 1942	+	-	+	-	-	-	-	+	+	-	-	+	-	+
Isotoma anglicana Lubbock, 1862	+	+	+	+	+	-	+	-	-	-	-	-	-	+
Isotoma viridis Bourlet, 1839	+	+	+	-	-	-	-	+	+	-	-	-	-	+
**Isotoma violacea* Tullberg, 1876	-	-	-	-	-	-	-	+	-	-	-	-	-	-
**Isotoma propinqua* Axelson, 1902	-	-	-	-	-	-	-	-	-	+	-	-	-	-
Isotomurus palustris Börner, 1923	+	+	+	-	-	-	-	+	-	-	+	-	+	+
Vertagopus cinereus Nicolet, 1842	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Cyphoderidae														
**Cyphoderus albinus* Nicolet, 1842	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Tomoceridae														
Tomocerus minor Lubbock, 1862	+	+*	-	-	-	-	-	-	-	-	-	-	+	+
**Tomocerus minutus* Tullberg, 1876	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Tomocerus vulgaris Tullberg, 1871	+	+	+	-	-	-	+	+	+	-	+	—	-	+
Pogonognathelus flavescens Tullberg, 1871	+	-	-	-	-	-	-	-	-	+	-	-	-	+
Entomobryidae														
Orchesella flavescens Bourlet, 1839	+	-	-	-	-	-	+	-	-	-	-	-	-	+
Orchesella cincta Linnaeus, 1758	+	+	-	-	-	-	+	+	+	-	-	-	-	+
Orchesella bifasciata Nicolet, 1842	+	+	-	-	-	-	-	-	-	-	-	-	+	+
Orchesella pseudobifasciata Stach, 1960	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Orchesella spectabilis Tullberg, 1871	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Orchesella xerothermica Stach, 1960	-	-	-	-	-	-	-	-	-	-	-	-	-	+
**Entomobrya* sp.	+	-	-	-	-	-	-	-	-	-	-	-	-	-
**Entomobrya marginata* Tullberg, 1871	+	+	+	-	+	-	+	+	+	+	+	+	-	-
**Entomobrya muscorum* Nicolet, 1842	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Entomobrya multifasciata Tullberg, 1871	-	+	-	-	-	-	-	-	-	-	-	-	-	+
Entomobrya nivalis Linnaeus, 1758	-	-	-	-	-	-	-	-	+	-	-	-	-	+
Entomobrya arborea Tullberg, 1871	-	-	-	-	-	-	-	-	-	-	-	-	-	+
**Entomobrya quinquelineata* Börner, 1901	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Entomobrya puncteola Uzel, 1891	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Lepidocyrtus lignorum Fabricius, 1775	+	+	+	-	+	-	+	-	+	-	+	-	+	+
Lepidocyrtus lanuginosus Gmelin, 1788	+	+	+	-	+	-	+	+	+	-	+	-	+	+
Lepidocyrtus cyaneus Tullberg, 1871	-	+	+	+	-	-	-	+	+	+	-	-	-	+
Lepidocyrtus violaceus Fourcrou, 1775	+	-	+	-	-	-	+	-	+	-	-	-	-	+
Lepidocyrtus curvicollis Bourlet, 1839	-	-	-	-	-	-	-	-	-	+	+	-	-	+
Lepidocyrtus paradoxus Uzel, 1891	+	-	-	-	-	-	-	+	+	-	-	-	-	+
**Lepidocyrtus nigrecscens* Sheptycki, 1967	-	-	-	-	-	-	-	-	+	-	-	-	-	
Pseudosinella alba Packard, 1873	+	+	+	-	+	+	+	+	-	-	-	+	-	+
Pseudosinella zygophora Schille, 1908	+	+	-	-	-	-	-	-	-	-	-	-	+	-
**Pseudosinella* sp. 1	-	+	+	-	-	-	-	-	-	-	-	-	-	-
**Pseudosinella* sp. 2	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Sinella caeca Schött, 1897	-	-	+	+	-	+	-	-	-	-	-	+	-	+

Table 1 (*continued*)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Heteromurus nitidus Templeton, 1935	+	+	+	+	+	+	-	-	-	-	-	+	-	+
**Heteromurus major* Moniez, 1889	-	-	-	-	-	-	+	-	-	-	-	-	-	-
**Willowsia nigromacullata* Lubbock, 1873	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Willowsia buski Lubbock, 1870	+	+	-	+	+	-	-	-	-	-	-	+	-	+
Neelidae														
Megalothorax minimus Willem, 1900	+	+	-	-	-	+	+	+	-	+	+	+	+	+
**Neelides minutus* Folsom, 1901	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Arrhopallitidae														
Arrhopallites caecus Tullberg, 1871	-	-	-	-	-	+	-	-	-	-	-	-	-	+
**Arrhopallites terricola* Gisin, 1958	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Sminthurididae														
**Sminthurides schoetti* Axelson, 1903	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Sphaeridia pumilis Krausbauer, 1898	+	+	+	+	-	-	+	+	+	-	+	-	+	+
Katianidae														
Sminthurinus aureus Lubbock, 1862	+	+	+	+	+	-	-	-	+	-	-	+	+	+
Sminthurinus elegans Fitch, 1862	+	+	+	+	-	+	+	+	+	-	+	-	-	+
**Sminthurinus trinotatus* Axelson, 1905	-	-	+	-	-	-	-	-	-	-	+	+	-	-
**Sminthurinus domesticus* Gisin, 1963	-	-	-	+	-	-	-	-	-	-	+	+	-	-
**Sminthurinus niger* Lubbock, 1867	-	+	-	-	-	-	-	-	-	-	-	-	-	-
**Gisinianus flammeolus* Gisin, 1957	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Sminthuridae														
**Sminthurus multipunctatus* Schäffer, 1896	-	+	-	-	-	-	+	+	+	-	-	-	-	-
Sminthurus viridis Linnaeus, 1758	+	-	-	-	-	-	-	-	-	-	-	-	-	+
Lipothrix lubbocki Tullberg, 1872	-	-	-	-	-	-	-	-	-	-	-	-	+	+
**Allacma fusca* Linne, 1758	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Bourletiellidae														
Deutherosminthurus bicinctus Koch, 1840	+	-	-	-	-	-	-	-	-	-	-	-	-	+
Deutherosminthurus pallipes Egren, 1903	-	-	-	-	-	-	-	-	+	-	-	-	-	+
**Bourletiella lutea* Lubbock, 1867	-	+	+	+	-	-	+	-	+	-	-	-	-	-
**Bourletiella hortensis* Fitch, 1863	-	-	+	+	-	+	-	-	-	-	-	-	-	-
**Bourletiella* sp.	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Dicyrtomidae														
Dicyrtomina ornata Nicolet, 1842	+	-	-	-	-	-	-	-	-	-	-	-	-	+
Dicyrtomina minuta Fabricius, 1783	+	-	-	-	-	-	-	-	-	-	-	-	-	+
Dicyrtoma fusca Lubbock, 1873	+	-	-	-	-	-	-	-	-	-	-	-	-	+
Total species	**70**	**56**	**51**	**25**	**28**	**17**	**39**	**29**	**29**	**27**	**23**	**24**	**29**	**66**

***** Species recorded in Lviv for the first time.

[1] By I. Kaprus, 1998.

The basis of springtail communities in the urban environment is formed mainly by eurytopic species, the following being the most distributed over the territory investigated: *Protaphorura armata, Mesaphorura macrochaeta, Folsomia manolachei, Isotoma notabilis, Tomocerus vulgaris, Entomobrya marginata, Lepidocyrtus lignorum, Lepidocyrtus lanuginosus, Lepidocyrtus cyaneus, Megalothorax minimus* and *Sminthurinus aureus.* The group of meadow species makes up a considerable part of collembolan species richness in urban ecosystems of parks, boulevards, flower-beds and in technotopes of the Park "Znesinja" (fig. 1). Such meadow species as *Mesaphorura critica, Isotomodes productus, Pseudosinella alba* and *Sminthurinus elegans* were recorded in the majority of investigated urban ecotsystems. As to the group of forest species, only *Isotomiella minor* was recorded almost in every site investigated, the other species of this group more often occured in the forest-park.

Synantropic (*Heteromurus nitidus, Sinella caeca* etc.), ruderal *(Cryptopygus bipunctatus* and *Isotoma anglicana)* and compost species *(Hypogastrura denticulata, Hypogastrura vernalis, Folsomia fimetaria* and *Proisotoma minuta)*, generally typical for the collembolan fauna in urban environment, form the basis of communities in ecosystems with high level of urban transformation (fig. 1). These species are constant dwellers in cellars, hothouses and flower-pots.

Very interesting from the faunistic point of view were the findings in specific urban habitats of closed ground. *Paranurophorus simplex* recorded in hothouses is adventitious in regional fauna. Its original range includes Southern China and North America (California), and in Europe it has been found in human dwellings (Определитель..., 1988). The closely related species *Paranurophorus armatus* Stach, 1947 was

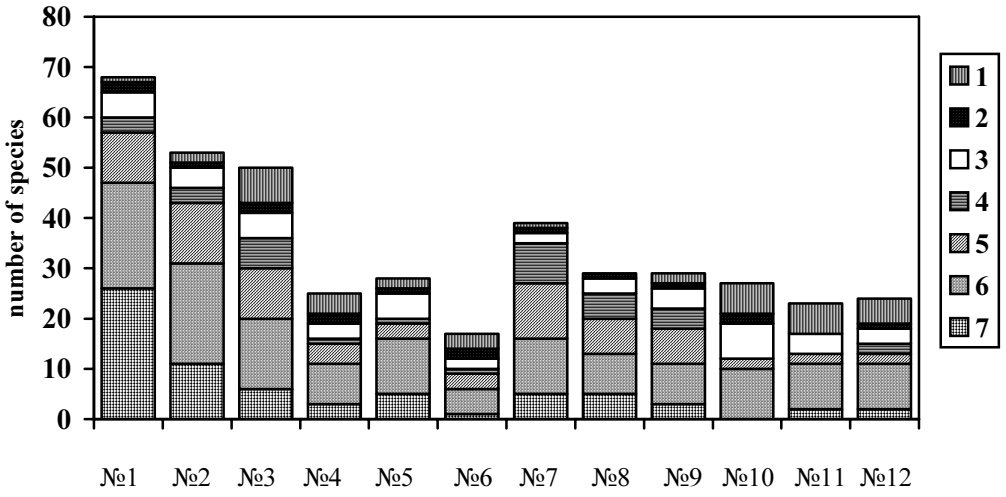

Fig. 1. Spectra of ecological groups of springtail communities in the investigated urban ecosystems (numbering of investigated habitats corresponds to that in "Material and methods" section): 1 — synantropic species; 2 — ruderal species; 3 — compost species; 4 — meadow-steppe species; 5 — meadow species; 6 — eurytopic species; 7 — forest species.

Рис. 1. Спектры экологических групп сообществ ногохвосток в исследованных урбоэкосистемах нумерация исследованных урбоэкосистем соответствует таковой в разделе "Material and methods"): 1 — синантропные виды; 2 — рудеральные виды; 3 — компостные виды; 4 — лугостепные виды; 5 — луговые виды; 6 — эвритопные виды; 7 — лесные виды.

recorded in Poland in the same habitats: hothouses and flower-pots with exotic ornamental plants (Pomorski, Skarzynski, 1996). *Acherontiella cassagnaui, Mesogastrura libyca* and *Isotoma propingua* were recorded in cellars, in natural conditions being restricted to caves (Fjellberg, 1980; Определитель..., 1988). Consequently, these troglophilous species of springtails have found favourable conditions for their existence in cellar urban habitats and have become synantropic.

Conclusions

Thus, the springtail fauna in urban environment is characterized by great species richness and a wide spectrum of ecological groups with various preferendums. The eurytopic, forest and meadow species coexist here with the meadow-steppe, compost, synantropic and ruderal ones. Forming and maintaining artificial urban ecosystems, people favor the expansion of natural ranges of springtail species with specific requirements for habitats, such as troglophilous and adventitious species. The urban formations of such a type supports the high collembolan species richness.

Acknowledgements

I am much obliged to my colleague I. B. Konovalova for English version of the paper and to I. V. Zagorodniuk for his assistance in preparing the manuscript.

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