ORIGINAL ARTICLE

Spider communities (Arachnida, Aranei) in the relict steppe sites in Moscow Region

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Spider communities of three neighboring grasslands (upland, lowland and steppe meadows) of Moscow Region (Prioksko-Terrasnyi Nature Reserve) were studied in 2014. Totally, 128 species from 86 genera and 18 families were collected. The taxonomic composition both epigeic and hortobiont spider communities of three meadows significantly differ from each other. In steppe meadows predominate xerophilous spider species, mesophilous species in lowland ones, and in the upland meadows highly dense hygrophilous and mesophilous species. However, the taxonomic composition of the steppe meadow was much closer to the lowland one than to upland meadow. The activity density didn't differ significantly between three meadows, but herpetobiont spider density was significantly higher in steppe and lowland meadow, than in upland one. The spider assemblage of steppe meadow stands out of other grasslands with its high specificity, and the spider assembly has distinct features of true steppe.

The 'Oka Flora' is a unique phenomenon evolved in the Oka river valley and extended northward till the south of Moscow Region. These are small steppe areas (about 1.5 ha) dominated by typical steppe plant species (feather grass, fescue, etc.) and located on the border of the subzone of European taiga and the subzone of broad-leaved forests, thus separated from their main habitats by hundreds of kilometers to the north. The steppe sites in Moscow Region are considered to be the most northern locality of steppe plants on the Central Russian Upland (Smirnov, 1958). The Oka flora area should be regarded as a relict of the xerothermic period (2500-3000 years ago) when the steppes approached the broad-leaved forests grown on this territory at that time (Malyshev, 1948). Such small plant populations within the 'alien' surroundings are extremely vulnerable, and it is not surprising that they have survived mainly in protected territories, in particular in the Prioksko-Terrasnyi Nature Reserve. It was shown that the floral composition and other features of plant associations of the steppe sites in the Oka valley are more similar to those of the zonal meadow steppes e.g. of Kursk Region (Danilov et al., 1981). The contrasting hydrothermic conditions in the local steppe sites generate 'a thermal trap' producing favorable conditions for xero- and thermophilic flora (Zelenskaya et al., 2016). However, the arthropod fauna and communities of this relatively small steppe localities among forest landscapes are still poorly investigated, and especially araneofauna and spider community structure, that have never been investigated here before. We addressed the question of whether spider communities are different between the Oka Flora area and two typical local grasslands (upland and lowland meadows). We hypothesized that spider communities of steppe meadows should differ from neighboring typical grasslands due to specific climatic conditions.

Materials and methods

Sampling sites
The study was carried out in the Prioksko-Terrasnyi Nature Reserve (southern part of Moscow Region) located on the left-bank terraces of the Oka river valley. The relief of territory is determined by the location on the south-oriented river slopes, which lead to the floodplain with terrace-like steps, boarded by ledges. The samples were collected within three different biotope types in 2014: upland, lowland and steppe meadows. The steppe meadow is located in 1.2 km distance from Oka river on the second terrace in the highly protected area named the Doly Tract (N 54°51,3' E 37°36,2'). Vegetation is represented by *Stipa pennata*, *Festuca valesiaca*, *Phleum phleoides*, *Fritillaria ruthenica* and other steppe species including legumes and steppe motley grasses. It is totally surrounded with the green moss pine forest. The lowland meadow is situated

on the second terrace of Oka river in 240 m from the water edge (N 54°51,3' E 37°39,1') and in 3 km from the steppe site. The examined part of flood-lands have not been inundated for last fifteen years. The meadow contains rich motley grass and borders with pine forest (with considerable deciduous admixture) from three sides. The upland meadow is located on the top (forth) river terrace in 4.5 km distance from the river bank and lowland meadow and in 5 km from the steppe one (N 54°53,7' E 37°38,6'). This plot is occupied by motley and gramineous grass with predominance of the latter. Mixed birch and spruce forest joins to the grassland from two directions.

Sampling

Sampling was performed using the sweeping method with an entomological net and a pitfall trapping. Within each biotope type, spiders were collected twice a month for each smpling method at randomly selected two sampling plots. At each sampling plot, a series of 5 pitfall traps were set up and 5 samples with 20 single sweeps in randomly selected microsites were performed. Sweeping was provided twice in May and twice in July and pitfall traps were exposed for 10 days twice in May and twice in September of 2014. The total time of trap exposure was 1200 trap-days, and 2400 sweeps were performed. 2216 and 1343 spiders were collected using these two methods respectively. The pitfall traps were made of two 0.5 plastic cups with a diameter of 9 cm fitted one inside the other. The inner cup was filled to 1/4 capacity with 10% solution of acetic acid. Above each trap a 20 × 20 cm tin cover was installed to protect it from precipitation and evaporation of the fixative. It should be noted that the adopted sampling methods does not provide absolute values of arthropod abundance, but allow to estimate species richness, activity density of aboveground and density of hortobiont spiders (Gilyarov, 1987; Topping & Sunderland, 1992). Activity density of epigeic spiders is expressed as individuals per 100 trap-days (ind. / 100 trap-days) and hortobiont density is shown as individuals per 100 sweeps (ind. / 100 sweeps).

Data analysis

Data from four monthly sampling sites were used to calculate mean value for each biotope type in two sampling periods. For each value, the mean and standard error are provided. To compare activity of aboveground spiders and density of hortobiontic spiders between biotopes nested-design ANOVA (sampling site nested in biotope type or month) were used. All variables were log-transformed prior to the analysis to homogenize the variance.

All the adult spiders were identified to species level. According to the commonly accepted system, a spider species (or a family) was considered dominant if it represented more than 5% of the total, viz. subdominants (5.1–10%), dominants (10.1–25%), and superdominants (>25%) (Southwood, 1978).

The taxonomic composition of spider communities of the three biotope types was compared using the ordination method (Palmer, 2018). Species with occurrence lower than 3 were excluded from the analysis. We calculated the matrix of all sites (24 sites = 2 biotope types x 4 sampling periods) based on the relative densities of spider species. The similarity matrix was processed by multidimensional scaling (MDS). The optimum number of basic canonical axes was determined by the comparison of the actual and theoretical stress values. The obtained coordinates of points in the multidimensional space were used to assess the value and significance of differences between samples taken from different plots using a discriminant factor analysis (DFA). The significance of results was estimated by Wilks' Lambda. When the DFA confirmed significant differences between the sites, the Spearman correlation between the ratio of the contribution to the total density (%) of separate species and the coordinates of these samples on the significant canonical axes were calculated. All statistical hypotheses were tested at the 0.05 significance p-level.

Results

In total, 3559 individuals of spiders belonging to 128 species from 86 genera and 18 families were collected and identified (Tab. 1). The highest number of species (86) was collected in upland meadow and the lowest was noted in steppe meadow (69). In all studied biotope types the families Lycosidae (60-70% of total epigeic spider activity density) and Araneidae (29-47% of the total hortobiont spider density) were superdominant among herpetobionts and hortobionts respectively. Gnaphosidae (25% of epigeic spiders) and Thomisidae (35% of hortobionts) were considered as dominants in the lowland and steppe biotopes. Other numerous families were: Philodromidae (making up 5-11% of hortobionts in all biotope types); Linyphiidae (8-12% of epigeic spiders in all sites besides steppe meadow); Dictynidae and Salticidae (8-12% and 5-7% of epigeic and hortobiont spiders respectively in the lowland and steppe meadows), Oxyopidae (13% of hortobiont spiders in steppe meadow), Tetragnathidae (9% of hortobiont spiders in upland meadow).

The dominance structure on the species level shown that *Pardosa palustris* and *Alopecosa cuneata* co-dominated among lycosids in the steppe plots. The same positions are occupied by *A. pulverulenta* and *P. riparia* in lowland meadows. In upland meadow, *Piratula hygrophila* and *Pardosa fulvipes* were a superdominant and a dominant respectively. Among araneids, both

Mangora acalypha and *Hypsosinga pygmaea* prevailed in all habitats, but the ratio between these two species changed from one biotope to another.

The taxonomic composition of epigeic and hortobiont spider communities from different biotope types significantly differed in the multidimensional space of the canonical analysis (Wilks' Lambda=0.04, F=17.0, p < 0.0001 and Wilks' Lambda=0.12, F=8.4, p < 0.0001 respectively) along two significant axes (fig. 1). The first axis (86.8% and 81.4 of explained varience respectively) defined the difference between lowland and steppe meadows and upland meadow, the second one (13.2% and 18.6% of explained variance) differentiated the first two biotopes from each other. For both epigeic and hortobiont spider communities, Squared Machalanobis distances between group centroids indicates that the spider communities of steppe meadow were taxonomically closer to that of lowland meadows, despite significant differences (F=6.7, p=0.002 and F=4.0, p=0.018) between them. Moreover, the communities of lowland meadow were more than three times closer to steppe one, than communities of upland meadow.

The discrimination of epigeic spider communities on the first axis was determined (Spearman correlation: R<-0.5, p<0.01) by the high relative activity density of *Dicymbium nigrum*, *Piratula hygrophila*, *Pardosa lugubris*, *Trochosa spinipalpis*, *Dolomedes* spp., *Liocranoeca striata*, *Hahnia pusilla* in upland meadow, but low values or absence (R>0.5, p<0.01) of *Zelotes azsheganovae*, *Haplodrassus umbratilis*, *Tapinocyboides pygmaeus*, *Pardosa riparia*, *Haplodrassus signifier*, *Micaria pulicaria* relatively dense in other two meadows. The differences between steppe and lowland meadows were determined (R<-0.5, p<0.01) by higher activity density of *Alopecosa trabalis*, *Thanatus formicinus*, *Alopecosa sulzeri*, *Drassyllus* spp., *Asagena phalerata* in steppe meadows, but low values of *Micaria pulicaria*, *Pachygnatha listeri*, *Ceratinella brevis*, *Pardosa riparia*, *Trochosa terricola* highly dense in lowland meadows (R>0.5, p<0.01).

The differences of hortobiont spider communities of upland meadow from other two biotope types were caused by high relative density of *Misumena vatia*, *Tetragnatha pinicola*, *Pardosa fulvipes* and *Microlinyphia pusilla* (R>0.4, p<0.05), but low values or the lack of *Agalenatea redii*, *Cheiracanthium erraticum*, *Hypsosinga sanguinea*, *Argiope bruennichi*, *Dictyna arundinacea* (R<-0.4, p<0.03). The discrimination of hortobiont spider communities by second axis was determined by higher values of *Oxyopes ramosus*, *Cheiracanthium erraticum*, *Philodromus* spp. in steppe meadow (R>0.4, p<0.05) compared to lowland one, but vice versa low density of *Heliophanus* spp., *Xysticus cristatus*, *X. ulmi* and *Hypsosinga pygmaea* (R<-0.5, p<0.03).

The activity density of epigeic spiders was insignificantly (F=3.5, *p*=0.051) lower in steppe meadow, than in other two biotope types (fig. 2 A). The maximum spider activity density values were recorded in May (fig. 2 C) and significantly decreased (F=305.3; *p*<0.0001) in September within all biotopes.

The hortobiont spider density was significantly affected (F=9.1, *p*=0.0018) by factor 'Biotope type' (fig.2 B). The lowest values were recorded in upland meadow. The spider density in steppe and lowland meadow didn't significantly differ from each other (fig.2 B). Also hortobiont spider density didn't significantly depend on the month of sampling (fig. 2 D).
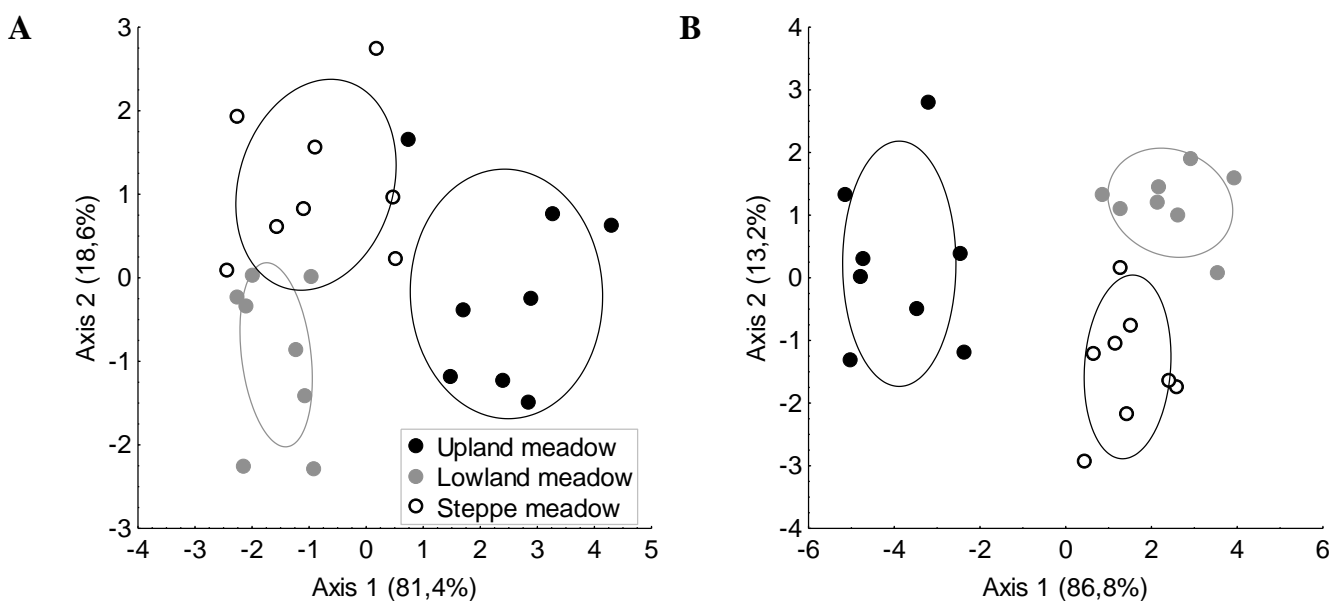

Figure 1. Multidimensional scaling with a subsequent canonical analysis of epigeic (A) and hortobiotic (B) spider communities of three biotope types. The dots indicate individual sampling plots (n=8 for each biotope type), the ellipses indicate the 95% confidence interval of the centroid position of the group. Samples with occurrence lower than 2 individuals were excluded from the analysis.

Discussion

The studied spider communities although have the undoubted common features at the same time demonstrate the clear differences. The biotopes of the lower terraces are inhabited mostly by the xerophilous spider species (steppe site) or mesoxerophilous and mesophilous species (lowland). Whereas on the upper terrace, hygrophilous and mesophilous species are predominated (upland). And vice versa hygrophilous groups are almost absent in the steppe site, xerophilous ones are scarce in the upland plot. The lowland meadow occupied the intermediate position. In particular, *Alopecosa cuneata* is typical species in true meadow steppes (Nentwig et al., 2017) and also common in studied steppe sites. However in the lowland site, *A.cuneata* was replaced by *A. pulverulenta*, which is common in dry habitats of Moscow Region. In turn, both species are replaced in the upland meadow by the usual spiders of grasslands and forest complex (*Pardosa fulvipes* and *Piratula hygrophila*).
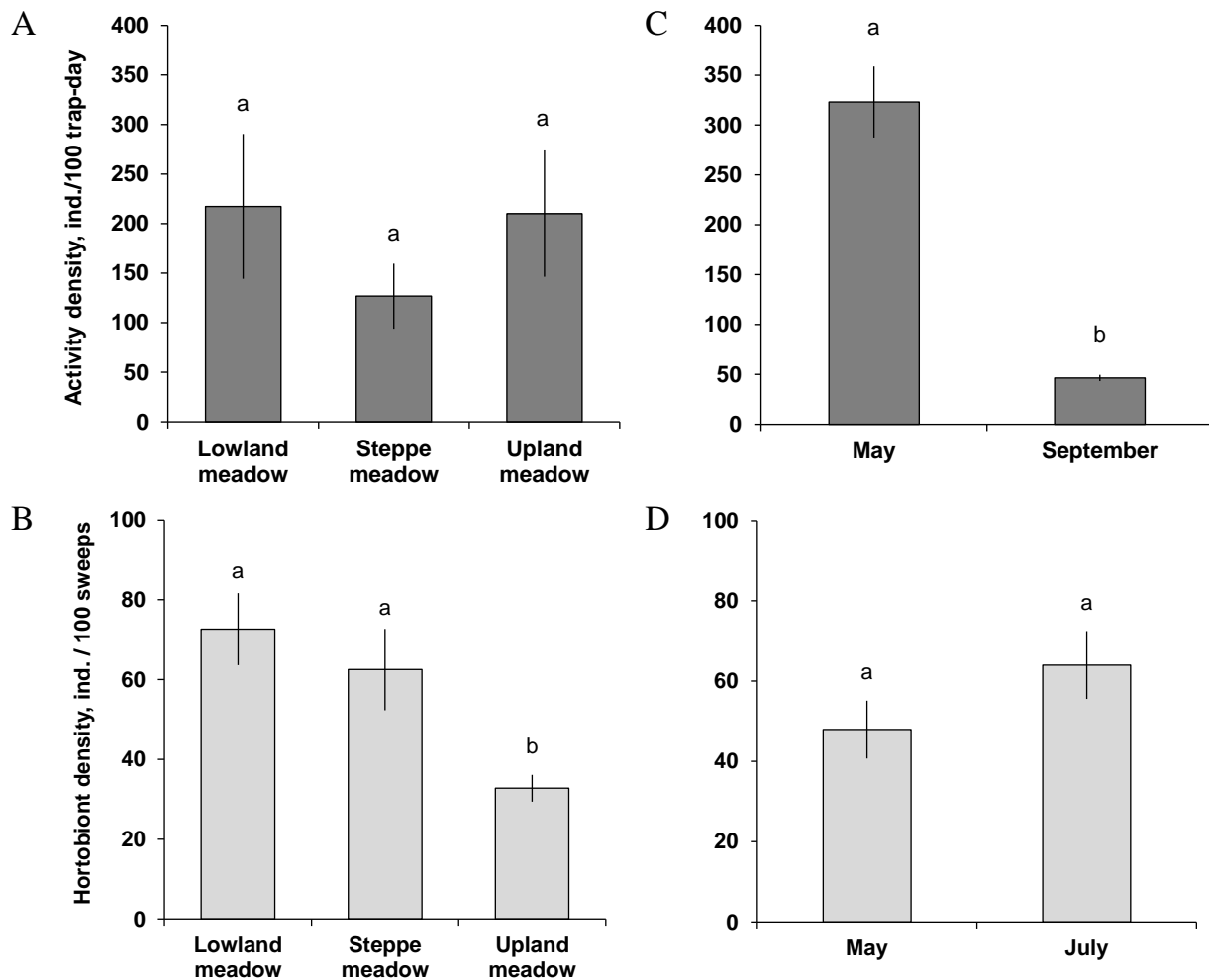

Figure 2. Activity density (ind./100 trap-day) of epigeic spiders (A and C) and density (ind./100 sweeps) of hortobiont spiders (B and D) in different biotope types (A, B) and month (C, D). The same letters above the columns indicate the absence of significant differences between mean values. Comparisons were recognized as significant at the <0.05 p-level.

In terms of diversity and taxonomic composition, the spider community of steppe meadow is rather close to that in the lowland meadow. The main reason of this seems to be the location in the same landscape of second terrace the Oka river. The southern exposition on the river sandy slopes having good drainage capacity causes the low soil moisture which leads to the formation of xero- and thermophilic habitats. Due to 'a thermal trap' (Zelenskaya et al., 2016), these conditions are more prominent in the Doly Tract, where the steppe plot is located. This fact results in some dissimilarity in various parameters, in particular in the dominance structure of communities. Besides that, the upland meadow is apparently more affected by the adjacent forest (mixed birch and coniferous) than other two grasslands by the pine forest. In other words, the ecotone effect is more pronounced in upland meadow, which leads to higher number of species. Also two meadow types of floodplain are

located closer to each other than upland meadow. This is most likely the reason for the lack of statistically significant differences in activity density of epigeic mobile spiders.

The significant differences between density of hortobiont spiders is most likely effected by difference of the plant density and spatial structure of plant community. The higher values of herpetobiont spider density were evolved in meadows characterized by quite dense motley grass association (lowland meadow). Conversely minimum of spider density was collected in upland meadow with the dominance of gramineous grass in plant community. We did not observed the significant differences in density of hortobiont spiders during summer, but the activity of epigeic spiders decreased drastically to the end of the vegetation season, that reflects the phenology of mass species, namely lycosids.

The floral composition and other features of plant associations of the steppe sites in the Doly Tract are more similar to those of the zonal meadow steppes of Kursk Region (Danilov et al., 1981). It is interesting that based on our data the spider steppe assemblages of those regions also have similarities with each other. For example, the wolf spider *Pardosa palustris* dominated among epigeic spiders in the late May, as well as numbers and richness of the linyphiids were reduced (Polchaninova, 2009). Theridiid spider *Asagena phalerata*, which is common in Kursk steppes (Polchaninova, 2012), did not found in any other grassland apart from the steppe one.

The general differences in taxonomical and dominance structure of spider community in studied ecosystems are related to the presence or absence of groups, which are typical or atypical for steppe zone. This is concern to both species and higher-level taxa. Thus, linyphiids being a hygrophilous family are low-abundant in arid zones and also practically lacking in studied steppe ecosystem (both herpeto- and hortobiontous). Hygrophilous tetragnathids (*Pachygnatha listeri*, *Tetragnatha* spp.) are also scarce in steppe meadow. In opposite, xerophilous lynx spiders (*Oxyopes ramosus*), which are rare in Forest Zone, are much more abundant in steppe meadow than in other two grasslands. A density of some philodromid spiders (e.g. *Thanatus formicinus* is common dweller of xerothermic forest steppes), known as a dominant in the steppe ecosystems (Prokopenko & Zhukov, 2010; Nentwig et al., 2017), was also enlarged in the steppe site. Ubiquitous in all studied biotope types wolf spiders and common for both Forest and Steppe Zones differed by ecology preferences between meadows. In the steppe meadows was dense only xerophilous species (e.g. species of *Alopecosa* genera), whereas mesophilous and hygrophilous species prevailed on other meadows were rare (e.g. *Trochosa terricola*) or totally absent (e.g. *Piratula hygrophila*).

We can conclude that both epigeic and hortobiont spider communities of steppe meadow stands out of other grass ecosystems, which confirmed our hypothesis. The spider assembly has distinct features of steppe one, although it is represented mainly by the same species as in the neighbor upland meadow. In particular, the typical steppe groups occupied the dominant position. Contrary the groups dominating in the meadow and forest ecosystems but with little occurrence in steppes are absent or presented weakly in the steppe meadow of Oka flora area. Despite its small area, the studied steppe site contains rare species (e.g. Seyfulina, 2017), making an important contribution to the local biodiversity. With some caution it can be stated that the spider community of the steppe meadow is azonal and rather correspond to the forest-steppe zone.

Acknowledgements

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Appendix

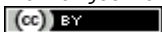**Table 1.** Presence of spider species in the studied biotopes.

No	Taxa	Upland meadow	Lowland meadow	Steppe meadow
	Fam. ANYPHAENIDAE			
1	*Anyphaena accentuata* (Walckenaer, 1802)	+	+	—
	Fam. ARANEIDAE			
2	*Aculepeira ceropegia* (Walckenaer, 1802)	+	++	+
3	*Agalenatea redii* (Scopoli, 1763)	+	+++	++
4	*Araneus sturmi* (Hahn, 1831)	+	—	—
5	*Araniella opisthographa* (Kulczyn'ski, 1905)	+	—	+
6	*Argiope bruennichi* (Scopoli, 1772)	—	+	+
7	*Cercidia prominens* (Westring, 1851)	+	—	+
8	*Cyclosa conica* (Pallas, 1772)	+	—	—
9	*Hypsosinga pygmaea* (Sundevall, 1831)	+	+++	++
10	*H. sanguinea* (C. L. Koch, 1844)	+	+	+
11	*Mangora acalypha* (Walckenaer, 1802)	++	+++	+++
12	*Singa hamata* (Clerck, 1757)	—	—	+
13	*S. nitidula* C. L. Koch, 1844	—	+	+
	Fam. CLUBIONIDAE			
14	*Clubiona diversa* O. P.-Cambridge, 1862	+	+	—
15	*. C. neglecta* O. P.-Cambridge, 1862	—	+	—
16	*C. subtilis* L. Koch, 1867	+	—	—
	Fam. DICTYNIDAE			
17	*Argenna patula* (Simon, 1874)	+	—	+
18	*A. subnigra* (O. P.-Cambridge, 1861)	+	++	+
19	*Dictyna arundinacea* (Linnaeus, 1758)	+	++	++
	Fam. EUTICHURIDAE			
20	*Cheiracanthium erraticum* (Walckenaer, 1802)	—	+	+
	Fam. GNAPHOSIDAE			
21	*Drassodes pubescens* (Thorell, 1856)	—	+	+
22	*Drassyllus lutetianus* (L. Koch, 1866)	+	+	+
23	*D. praeficus (L. Koch, 1866)*	+	+	+
24	*D. pusillus* (C. L. Koch, 1833)	++	++	++
25	*Gnaphosa bicolor* (Hahn, 1833)	—	—	+
26	*Haplodrassus signifer* (C. L. Koch, 1839)	+	++	+
27	*H. umbratilis* (L. Koch, 1866).	—	+++	++
28	*Micaria pulicaria* (Sundevall, 1831)	—	++	—
29	*Zelotes azsheganovae* Esyunin et Efimik, 1992	—	+	+
30	*Z. latreillei* (Simon, 1878)	—	+	+
	Fam. HAHNIIDAE			
31	*Antistea elegans* (Blackwall, 1841)	+	—	—
32	*Hahnia nava* (Blackwall, 1841)	+	++	+
33	*H. pusilla* C. L. Koch, 1841	++	—	—
	Fam. LINYPHIIDAE			
34	*Agyneta affinis* (Kulczyn'ski, 1898)	+	++	+
35	*Anguliphantes angulipalpis* (Westring, 1851)	+	—	—
36	*Bathyphantes gracilis* (Blackwall, 1841)	+	—	—
37	*B. nigrinus* (Westring, 1851)	+	—	—
38	*B. parvulus* (Westring, 1851)	+	—	—
39	*Centromerita concinna* (Thorell, 1875)	—	+	—
40	*Centromerus brevipalpus* (Menge, 1866)	+	—	—
41	*Ceratinella brevipes* (Westring, 1851)	—	+	—
42	*C. brevis* (Wider, 1834)	+	+	—

43	*Dicymbium nigrum* (Blackwall, 1834)	++	—	—
44	*Diplocephalus dentatus* Tullgren, 1955	++	—	—
45	*Diplostyla concolor* (Wider, 1834)	+	++	+
46	*Entelecara acuminata* (Wider, 1834)	—	+	—
47	*Erigone dentipalpis* (Wider, 1834)	++	—	—
48	*Gongylidiellum murcidum* Simon, 1884	+	—	—
49	*Hypomma cornutum* (Blackwall, 1833)	—	+	—
50	*Kaestneria pullata* (O. P.-Cambridge, 1863)	+	+	—
51	*Linyphia hortensis* Sundevall, 1830			
52	*Microlinyphia pusilla* (Sundevall, 1830)	+	+	+
53	*Neriene clathrata* (Sundevall, 1830)	+	—	—
54	*Pocadicnemis pumila* (Blackwall, 1841)	+	—	—
55	*Panamomops inconspicuus* (Miller et Valesova, 1964)	—	—	+
56	*Stemonyphantes lineatus* (Linnaeus, 1758)	—	+	+
57	*Tallusia experta* (O. P.-Cambridge, 1871)	+	—	—
58	*Tapinocyboides pygmaeus* (Menge, 1869)	—	+	+
59	*Tenuiphantes mengei* (Kulczyn'ski, 1887)	+	—	—
60	*Tiso vagans* (Blackwall, 1834)	+	—	—
61	*Walckenaeria alticeps* (Denis, 1952)	+	—	—
62	*W. cucullata* (C. L. Koch, 1836)	—	—	+
63	*W. dysderoides* (Wider, 1834)	—	+	—
64	*W. nudipalpis* (Westring, 1851)	+	—	—
	Fam. LIOCRANIDAE			
65	*Agroeca brunnea* (Blackwall, 1833)	+	+	+
66	*Agroeca cuprea* Menge, 1873	—	+	+
67	*A. lusatica* (L. Koch, 1875)	+	—	—
68	*A. proxima* (O. P.-Cambridge, 1871)	+	—	—
69	*Liocranoeca striata* (Kulczyn'ski, 1882)	++	—	—
	Fam. LYCOSIDAE			
70	*Alopecosa cuneata* (Clerck, 1757)	+	++	+++
71	*A. inquilina* (Clerck, 1757)	—	+	+
72	*A. pulverulenta* (Clerck, 1757)	++	+++	++
73	*A. sulzeri* (Pavesi, 1873)	—	—	++
74	*A. trabalis* (Clerck, 1757)	—	—	++
75	*Pardosa agrestis* (Westring, 1861)	—	+	+
76	*P. fulvipes* (Collett, 1876)	+++	++	++
77	*P. lugubris* (Walckenaer, 1802)	++	—	+
78	*P. paludicola* (Clerck, 1757)	—	+	++
79	*P. palustris* (Linnaeus, 1758)	+	++	+++
80	*P. proxima* (C. L. Koch, 1847)	+	+	—
81	*P. pullata* (Clerck, 1757)	+	++	++
82	*P. riparia* (C. L. Koch, 1833)	+	+++	+
83	*Pirata tenuitarsis* Simon, 1876	+	—	—
84	*Piratula hygrophila* (Thorell, 1872)	+++	+	—
85	*Trochosa ruricola* (De Geer, 1778)	+	+	—
86	*T. spinipalpis* (F. O. P.-Cambridge, 1895)	++	—	—
87	*T. terricola* Thorell, 1856	++	++	+
	Fam. MIMETIDAE			
88	*Ero cambridgei* Kulczyn'ski, 1911	+	—	+
	Fam. OXYOPIDAE			
89	*Oxyopes ramosus* (Martini & Goeze, 1778)	+	++	+++
	Fam. PHILODROMIDAE			
90	*Thanatus arenarius* L. Koch, 1872	—	+	—
91	*Th. formicinus* (Clerck, 1757)	+	+	++
92	*Th. striatus* C. L. Koch, 1845	—	+	—

93	*Tibellus oblongus* (Walckenaer, 1802)	++	+++	++
	Fam. PISAURIDAE			
94	*Dolomedes fimbriatus* (Clerck, 1757)	+	+	+
95	*Pisaura mirabilis* (Clerck, 1757)	+	+	+
	Fam. SALTICIDAE			
96	*Evarcha arcuata* (Clerck, 1757)	+	++	+
97	*Heliophanus cupreus* (Walckenaer, 1802)	—	+	—
98	*H. dubius* C. L. Koch, 1835	—	+	—
99	*H. flavipes* (Hahn, 1832)	+	+	+
	Fam. SPARASSIDAE			
100	*Micrommata virescens* (Clerck, 1757)	+	++	+
	Fam. TETRAGNATHIDAE			
101	*Pachygnatha degeeri* Sundevall, 1830	++	++	++
102	*P. listeri* Sundevall, 1830	++	+	—
103	*Tetragnatha extensa* (Linnaeus, 1758)	+	+	+
104	*T. montana* Simon, 1874	+	—	—
105	*T. pinicola* L. Koch, 1870	—	+	—
	Fam. THERIDIIDAE			
106	*Asagena phalerata* (Panzer, 1801)	—	—	+
107	*Episinus angulatus* (Blackwall, 1836)	+	—	—
108	*Neottiura bimaculata* (Linnaeus, 1767)	+	+	+
109	*Phylloneta impressa* (L. Koch, 1881)	—	+	+
110	*P. sisyphia* (Clerck, 1757)	+	—	—
111	*Platnickina tincta* (Walckenaer, 1802)	—	+	—
112	*Robertus arundineti* (O. P.-Cambridge, 1871)	—	+	—
113	*R. lividus* (Blackwall, 1836)	+	—	—
114	*Theridion pictum* (Walckenaer, 1802)	—	—	+
115	*Th. varians* Hahn, 1833	—	—	+
	Fam. THOMISIDAE			
116	*Heriaeus oblongus* Simon, 1918	+	—	—
117	*Misumena vatia* (Clerck, 1757)	++	++	++
118	*Ozyptila atomaria* (Panzer, 1801)	—	—	+
119	*O. brevipes* (Hahn, 1826)	+	—	—
120	*O. rauda* Simon, 1875	+	+	+
121	*O. trux* (Blackwall, 1846)	+	—	—
122	*Tmarus piger* (Walckenaer, 1802)	+	—	+
123	*Xysticus bifasciatus* C. L. Koch, 1837	+	+	+
124	*X. cristatus* (Clerck, 1757)	—	—	+
125	*X. kochi* Thorell, 1872	—	+	—
126	*X. lineatus* (Westring, 1851)	—	+	+
127	*X. striatipes* L. Koch, 1870	+	+	—
128	*X. ulmi* (Hahn, 1831)	+	+	—