Fauna and distribution of spiders at Randu meadows, Baltic Sea coast of the Gulf of Riga, Latvia

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Abstract: Coastal habitats, especially coastal meadows are rare and endangered habitat in need of conservation in Europe. In Latvia, spiders of the coastal habitats are investigated incompletely. The ground-dwelling spiders in this study were collected by pitfall traps in nature reserve "*Randu pļavas*" [Randu meadows] between May 9 and June 6, 2009, and the grass-dwelling spiders were collected by sweep-netting – from 1997 until 2010 four times per season. 199 species (27 morphospecies) of 18 families with dominance of Lycosidae and Linyphiidae were recorded. Almost all dominant species were found in all studied habitats: xerophytic, xeromesophytic and mesohygrophytic meadows and fore dunes. Majority of species (109) were captured only by pitfall traps, 58 species were captured only by entomological sweep net, and 59 species were captured by both methods. The highest number of species was recorded in mesohygrophytic meadow due to large amount of sampling plots. Ten species of spiders were recorded for the first time in Latvia.

Key words: Araneae, species composition, habitat preference, coastal meadows.

Introduction

Coastal habitats are always changing - some areas disappear under water, in other - sand accumulates and the land area is increasing (Eberhards et al. 2009). Vegetation of coastal meadows is adapted for saline soils and exposure to irregular overflow by marine water. Moreover – some plant species e.g. *Centaurium littorale, Puccinellia maritima, Triglochin maritimum* are specialised on growing on mesosaline soils near the sea and form unique habitats – Boreal Baltic Coastal meadows (EU habitat code 1630, Rūsiņa 2010). Additionally, dune relief forms mosaic of habitats – dry on the top of dunes and wet in depressions where groundwater table may reach soil surface. Influence of anthropogenic factors (grazing, cutting of the grass and recreation) can often be observed at coastal meadows.

Fauna and ecology of spiders in grey dunes and coastal dune grasslands have been investigated in Europe by many authors (Gajdoš, Toft 2000, 2002; Merrett 1967; Duffey 1968; Almquist 1969, 1970, 1973; Bonte, Maelfait 2001; Bonte et al. 2002, 2003, 2004, 2006; Cera, Spuņģis 2010). More emphasis has been put on grazing impact on spiders in dune habitats (Bonte et al. 2000) and on management of such habitats (Cosyns et al. 2001; Bonte et al. 2004b; Maes, Bonte 2006). The influence of changes on spider distribution in meadow habitats, managed by cattle grazing or mowing have been discussed by several authors (e.g. Cattin at al. 2003, Humbert et al. 2009). Zahn et al. (2007) stated that low density cattle grazing could

give positive effect on arthropod diversity in different wetland habitats. Unmanaged territories usually overgrow by reed and studies of effects of reed management on wildlife are important problem in the whole territory of Europe (Valkama et al. 2008).

In the Baltic region, coastal meadows cover wide areas in Estonia, but only a few studies have been done to identify spider species occurring at coastal (flood-plain) meadows (Vilbaste 1973, Meriste 2003).

In Latvia studies of spiders in the coastal habitats have started only recently (Cera et al. 2010; Cera, Spuņģis 2010). Melecis et al. (1999) initiated long-term ecological research of coastal habitats and grass-dwelling invertebrate communities in Latvia. The present paper describes spider fauna and habitat selection of spiders at one of the Latvian long-term ecological research sites – Randu meadows.

Materials and methods

Study site

A study was performed in particularly protected territory – nature reserve Randu meadows, NATURA 2000 site (LV0509100). The study site is situated at the North-Eastern coast of the Gulf of Riga (Figure 1; central coordinates of the nature reserve Randu meadows: 24°20'N, 57°15'E). Randu meadows are 100–300 m wide and about 4.5 km long band of coastal meadows in Latvia and further meadow band along the coast in Estonia. Landscape in this site has a mosaic of habitats, including wet meadows in the relief depressions and dry meadows on the top of old dunes. Historically the meadows were maintained by cattle grazing and hay harvesting, but during the last decades the management intensity decreased and the majority of meadows have been overgrown by common reed (*Phragmites australis*) with an increasing tendency, thus the meadow habitats are threatened (Melecis et al. 1997; Laime 2010).

Collecting of spiders

20 sample plots were selected irregularly to cover the territory of Randu meadows to include most of the characteristic habitats (figure 1). The investigated habitats might be divided into four groups depending on soil moisture: xerophytic meadows (4 plots), mesohygrophytic meadows (10 plots) and xeromesophytic meadows (4 plots) and fore dunes (2 plots). Every sample plot was 25 m long x 2 m wide, where vegetation was described and insects and spiders were collected. Spiders were collected using two methods: (1) entomological sweep-net and (2) pitfall traps.

(1) Grass-dwelling spiders were collected using entomological sweep-net (diameter 30 cm) during the period of 1997–2010. Spiders were considered as by-catch, since the entomological sweep-net method was initially used to capture insects in this long-term ecological study. The plots were sampled four times per season in May, June, July and August, approximately at the same dates every year. One sample includes captures of 50 sweeps by entomological net along the sample plot. Insects and spiders were gathered in a small nylon gauze bag attached to a metal ring fastened at the bottom of the entomological net. The bag was removed after sweeping, tied, labelled, and placed in a plastic bag with ethyl-acetate vapour (killing agent for arthropods). The sampling was always performed by two persons: A. Karpa and K. Vilks.

(2) Ground-dwelling spider samples were collected using simple pitfall traps with diameter of opening 7 cm and volume 250 ml, filled with 100 ml 4% formaldehyde solution with addition of some

drops of detergent. Trap exposition period was from May 9 to June 6, 2009. Ten pitfall traps were placed on transect line in each of 20 sample plots (200 traps in total). The distance between traps was 2.5 m.

The arthropods were sorted in laboratory. Spiders were placed in the vials and stored in 70% ethanol. Spider species were identified using identification keys (Locket, Millidge 1953, Nentwig et al. 2011, Almquist 2005, 2006). Taxonomy of spiders in this article follows Platnick (2011). All samples collected during the study are deposited at the Laboratory of Bioindication, Institute of Biology, University of Latvia. Vegetation on transects were described by Solvita Rūsiņa (Univeristy of Latvia, Faculty of Geography and Earch Science, unpublished data) in accordance with Brown-Blanquet method.

Data analysis

Only adult spiders were used for the data analysis, since juvenile spiders are often impossible to identify to the species-level by using external morphology. Data obtained in every sample plot were pooled according to the habitat type and method used. Content of 10 pitfall traps in every sample plot gave one replicate per season. Further, one replicate for every sample plot using sweep-netting was formed by pooling four seasonal samples during 14 years (1997–2010). Thus, 20 replicates were obtained for both methods. Dominance structure analysis follows Engelmann's (1987) classification. Dominance classes were calculated separately for every meadow type and capture method and are used to characterise species' relative abundance. Each class was assigned a number according to Engelmann (1987): 1 – subrecedent (<1.2% of total number of individuals collected); 2 – recedent (1.2–3.9%); 3 – subdominant (4.0–12.4%); 4 – dominant (12.5–39.9%); 5 – eudominant (>40.0%). Further only dominant and subdominant species were analysed, because eudominant species were absent, while recedent and subrecedent species had insufficient number of individuals for statistical analysis.

Results

In total, 15162 adult spiders were recorded. Altogether 18 families with 199 species and 27 morfospecies (11.5% of the total number of species) were represented in the samples (Table 2). 58 spider species were captured exclusively by sweep-netting, 109 species – exclusively by pitfall trapping, while 59 taxa were captured using both methods. Spiders inhabiting upper vegetation level were collected by sweep netting, while ground dwelling spiders were gathered by pitfall traps. Thus, the number of spider specimens and the number of identified species could not be compared between both methods. additionally study periods varied in duration, and species living in different microhabitats have specific ecological characteristics.

Ten new spider species for the Latvian fauna were found in the Randu meadows during this study: *Glyphesis servulus*, *Hypomma fulvum*, *Hypselistes jacksoni*, *Oedothorax agrestis*, *Tapynociba affinis*, *Trichopterna cito*, *Pardosa fulvipes*, *Agroeca dentigera*, *A. lusatica*, and *Liocranoeca striata.* Four specimens of fore dune species *Arctosa cinerea* were recorded. This species is included in special protected list of animals in Latvia (Anonymous 2000).

The number of species recorded in each studied habitats was different – in the xerophytic meadow only by sweep-net 46 taxa were found and 64 – by pitfall traps, in the xeromesophytic meadows – 46 and

74 respectively, in the mesohygrophytic meadows – 51 and 103 respectively, and in the fore dunes 15 and 57 taxa respectively. The highest number of taxa in the mesohygrophytic meadow could be explained by the highest trapping effort in this habitat – ten sample plots were located there in comparison to four sample plots in xerophytic and xeromesophytic meadows and two sample plots in fore dunes. Additionally, the vegetation cover and structure in the mesohygrophytic meadows are more structurally diverse (higher, denser) in comparison to the other studied habitats.

Six dominant or subdominant species were found in all habitat types (Table 1): *Phylloneta impressa*, *Araneus quadratus*, *Larinioides cornutus*, *Pardosa pullata*, *Pachygnatha listeri* and *Alopecosa pulverulenta*. Xerophytic and xeromesophytic meadows had five subdominant species: *Hypsosinga pygmaea*, *Singa hamata*, *Tibellus oblongus*, *Xysticus cristatus* and *Pardosa palustris*. The latter species dominated in the xerophytic meadows. *Pardosa prativaga* was subdominant in fore dunes, xeromesophytic and mesohygrophytic meadows. *Microlinyphia pusilla*, *Metellina segmentata*, *Hahnia nava* and *Argenna subnigra* was subdominant in the xerophytic meadows. The subdominant *Neoscona adianta* and *Clubiona diversa* were characteristic for xeromesophytic meadows, and subdominant *Ceratinella brevipes*, *Tetragnatha* spp. and *Pardosa* spp. was characteristic for mesohygrophytic meadows. The dominant *Xerolycosa miniata* was characteristic for fore dunes. Insufficient number of individuals did not allow us to perform analyses of the following taxa: *Hypomma bituberculatum*, *Tibellus oblongus*, *Ozyptila trux, Xysticus ulmi* and *Heliophanus auratus*.

Discussion

In total, we recorded 199 spider and 27 morphospecies in the fore dunes and coastal meadow habitats. Similar studies in Estonia have yielded much less species in the same habitat types: e. g. Meriste (2003) reported only 13 species in Matsalu Häädemeeste coastal meadows using sweep-netting, while Vilbaste (1982) mentioned 30 species (Vilbaste used also litter sieving additionally to sweep-netting). This might be explained by the sweep-netting use of Meriste (2003), which generally yields less species (Churchill, Arthur 1999) and the duration of the study – it lasted only one season – April to October 2000. Vilbaste (1982) summarised spider data collected irregularly during the period of 1960–1976, and relatively low number of species is explained by the fact that spiders in her study is by-catch rather than target species. The latest species list of Estonian coastal meadows of Matsalu Nature park (Meriste pers.com.) consists of 72 species (collected by the pitfall trap method). We do share 30 species with the Matsalu and Randu meadows study.

Collecting of spiders by different methods is essential to describe complete fauna of the site. In comparison with the sweep-netting, pitfall traps usually yields more spiders, also in this study. During the study period of 14 years of grass-dwelling spiders at Randu meadows in stationary sample plots, sweep-netting yielded only 113 taxa and 1 022 adult individuals, while 163 taxa and more than 13 000 individuals were captured by using pitfall traps. Churchill & Arthur (1999) showed that pitfall traps in heath land yield more spider species than sweep-netting or visual search methods. Biodiversity might be evaluated also by using only one of these methods, but the difference it might require much more time for spider biodiversity assessment. Long

term ecological research requires application of standardized methods for spider collection kept unchanged for the whole study period and, preferably, also between various studies. Indicator species for every studied dune habitat type might be assessed by several methods used simultaneously (Bonte et al. 2002). The methods used are dependent on the main goal of the study (Bonte et al. 2002). Different collecting methods should be used to find complete number of spider species living in Randu meadows, e.g. application of litter sieving, branch-beating and vacuum suction might increase the number of recorded species.

The dominant and subdominant species prefer various coastal habitats in the previous studies (Hänggi et al. 1995, Almquist 2005, 2006) and this study (Table 2). The species might be divided into two groups: (1) species of families Araneidae, Linyphiidae, Philodromidae, Theridiidae and Thomisidae inhabiting the grass layer and are tightly connected with vegetation height and cover, while (2) species of families Lycosidae, Tetragnathidae – inhabiting ground layer and tightly connected with the litter cover. The genera *Tetragnatha* and *Pardosa* were subdominant in mesohygrophytic meadows (not included in Table 2). According to Almquist (2005) about a half of *Tetragnatha* species in Latvia are living in the vegetation layer and prefer wetland habitats (*T. dearmata*, *T. extensa*, *T. montana*, *T. striata*). Several species of genus *Pardosa* also preferes moist habitats (Almquist 2005).

By comparison of species habitat preferences among the literature data and data obtained in this study (Table 1) the species *Phylonetta impressa* and *Pachygnatha listeri* could be characterised as coastal habitat generalists. Species *Alopecosa pulverulenta*, *Araneus quadratus*, *Larinioides cornutus* and *Pardosa pullata* inhabit wet meadows with various moisture levels. This is confirmed by the literature data and results of this study. *Pardosa prativaga*, *Hypsosinga pygmaea*, *Singa hamata*, *Pardosa palustris*, *Tibellus oblongus* and *Xysticus cristatus* are the species preferring dry meadows. But species which were dominant or subdominant only in one habitat type could be characterised as habitat indicators: *Xerolycosa miniata* indicate fore dunes; *Argenna subnigra*, *Hahnia nava*, *Metellina mengei*, *Microlinyphia pusilla* indicate xerophytic meadows; *Neoscona adianta, Clubiona diversa* indicate xeromesophytic meadows and *Ceratinella brevipes* indicate mesohygrophytic meadows.

This study yielded knowledge on characteristic spider species for coastal meadows of the Baltic Sea as well as ten new species to the fauna of Latvia. Further coastal meadows management and habitat conservation would benefit of an experimental study on the effects of various management practice (e.g. grazing, mowing and burning) on coastal spider species diversity. Also, for species with known biotic and abiotic requirements, distribution modelling for climatic changes in the future might be undertaken.

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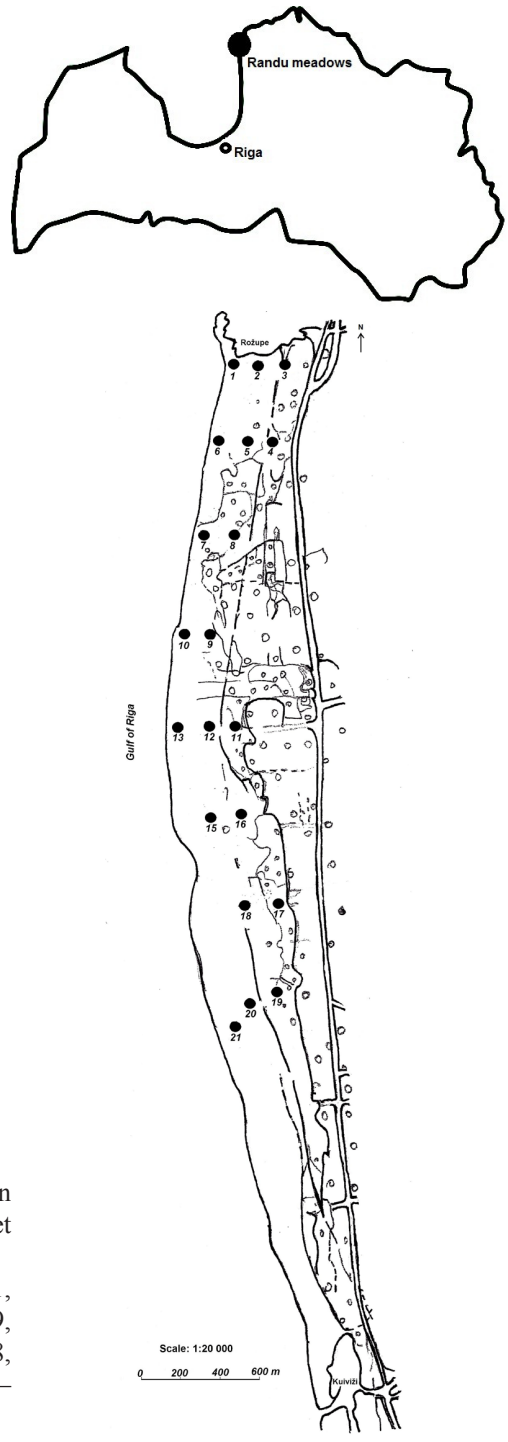

Figure 1 (right). Location of sample plots in the Randu meadows, Latvia (after Melecis et al. 1997).
Sample plot number and habitat type: 1, 13 – fore dunes; 2, 5, 6, 7, 12, 15, 18, 19, 20, 21 – mesohygrophytic meadow; 4, 8, 9, 11 – xerophytic meadows; 3, 10, 16, 17 – xeromesophytic meadows.

Table 1. Comparison of habitat preference of subdominant and dominant spider species at Randu meadows, Latvia: Almquist 2005, 2006, Hänggi et al. 1995 and our study.

Nr.	Species	Almquist 2005, 2006	Hänggi et al. 1995	This study
1.	*Alopecosa pulverulenta*	meadows, heath with pines	dry and moist meadows	all studied meadow habitats
2.	*Araneus quadratus*	moist meadows	dry and moist meadows	all studied meadow habitats
3.	*Argenna subnigra*	dry meadows and dunes	coastal dunes, dry meadows	xerophytic meadows
4.	*Ceratinella brevipes*	no data	dry and moist meadows	mesohygrophytic meadows
5.	*Clubiona diversa*	heathlands, dunes (grass and ground level)	dry and moist meadows	xeromesophytic meadows
6.	*Hahnia nava*	meadows near shores, in litter and in grass-layer	dry and moist meadows	xerophytic meadows
7.	*Heliophanus auratus*	damp meadows	*species not described due to lack of data*	fore dunes
8.	*Hypomma bituberculatum*	no data	saline grasslands, reed beds	fore dunes
9.	*Hypsosinga pygmaea*	dry meadows	*species not described due to lack of data*	xero- and xeromesophytic meadows
10.	*Larinioides cornutus*	dry meadows	fresh grasslands, pastures	all studied meadow habitats
11.	*Metellina segmentata*	in meadows and on trees	dry and moist meadows	xerophytic meadows
12.	*Microlinyphia pusilla*	no data	dry and moist meadows	xerophytic meadows
13.	*Neoscona adianta*	heathlands, limestones	dry and moist meadows	xeromesophytic meadows
14.	*Pachygnatha listeri*	damp meadows and deciduous forests, bogs	dry and moist meadows	all studied meadow habitats
15.	*Pardosa prativaga*	dry and moist meadows	dry and moist meadows	foredunes; xeromeso-mesohygrophytic meadows
16.	*Pardosa pullata*	meadows, bogs	dry and moist meadows	all studied meadow habitats
17.	*Pardosa palustris*	bogs, dry and moist meadows	dry and moist meadows	xero- and xeromesophytic meadows
18.	*Phylloneta impressa*	heathlands, bushes	dry and moist meadows	all studied habitats
19.	*Ozyptila trux*	*Calluna*-stands, meadows near lakes	forest edges, deciduous forests	fore dunes
20.	*Singa hamata*	moist meadows	dry and moist meadows	xero- and xeromesophytic meadows
21.	*Tibellus oblongus*	dunes, damp meadows	dry and moist meadows	fore dunes, xero- and xeromesophytic meadows
22.	*Xysticus cristatus*	grass layer in damp and dry meadows	dry and moist meadows	xero- and xeromesophytic meadows
23.	*Xerolycosa miniata*	dunes, meadows	coastal dunes	fore dunes
24.	*Xysticus ulmi*	meadows, marshes	moist meadows	fore dunes

Table 2. A list and domination classes of spider species (arranged taxonomically) collected by sweep-net (s-n) and pitfall trap (p-t) in the Randu meadows, Latvia in three meadow habitats: xerophytic (x), xeromesophytic (xm), mesohygrophytic (mh) and fore dunes (fd). Explanation of domination classes: 1 – subrecedent; 2 – recedent; 3 – subdominant; 4 – dominant species. Abbreviations: * – new species to the fauna of Latvia.

Family / Species	Habitat codes, methods and domination classes								
	x		xm		mh		fd		
	s-n	p-t	s-n	p-t	s-n	p-t	s-n	p-t	Sum
Mimetidae									
Ero furcata (Villers, 1789)		1							2
Theridiidae									
Crustullina sticta (O. P.-Cambridge, 1861)						1			1
Enoplognatha ovata (Clerck, 1757)					1				2
Enoplognatha thoracica (Hahn, 1833)		1		1					26
Euryopis flavomaculata (C.L.Koch, 1836)		1		1		1			134
Neottiura bimaculata (Linnaeus, 1767)	1		1	1	1				5
Paidiscura pallens (Blackwall, 1834)	1		2		2				13
Phylloneta impressa (L.Koch, 1881)	3		3		3		3		81
Phylloneta sisyphia (Clerck, 1757)			2		1				8
Platnickina tincta (Walckenaer, 1802)			1		2				6
Robertus arundineti (O.P.-Cambridge, 1871)	1	1		1		1		1	18
Robertus lividus (Blackwall, 1836)						1			2
Robertus spp.			1		1				4
Simitidion simile (C.L.Koch, 1836)			1		1				3
Theridiidae species					1				1
Linyphiidae									
Agyneta spp.	1				1				3
Bathyphantes approximatus (O.P.-Cambridge, 1871)				1		1			30
Bathyphantes gracilis (Blackwall, 1841)	1		1	1		1		1	42
Bathyphantes nigrinus (Westring, 1851)		1		1		1			13
Bathyphantes spp.	2		2		2		2		26
Centromerita bicolor (Blackwall, 1833)						1			3
Centromerus brevivulvatus Dahl, 1912						1			1
Centromerus dilutus (O.P.-Cambridge, 1875)					1				1
Centromerus incilium (L.Koch, 1881)		1		1		1			19
Centromerus spp.		1	1	1	1	1		1	21
Centromerus sylvaticus (Blackwall, 1841)		1				1			2
Ceratinella brevipes (Westring, 1851)		1		2		3			448
Ceratinella scabrosa (O.P.-Cambridge, 1871)				1					1
Ceratinella sp.	1								1
Cnephalocotes obscurus (Blackwall, 1834)		1		1		1			13
Dicymbium nigrum (Blackwall, 1834)				1		1			99

Table 2 continued

Family / Species	x		xm		mh		fd		
	s-n	p-t	s-n	p-t	s-n	p-t	s-n	p-t	S
Dicymbium tibiale (Blackwall, 1836)						1			8
Diplocephalus latifrons (O.P.-Cambridge, 1863)				1		1			2
Diplocephalus picinus (Blackwall, 1841)						1		1	2
Diplocephalus sp.	1								1
Dismodicus bifrons (Blackwall, 1841)						1			2
Dismodicus elevatus (C.L. Koch, 1838)	1		1		1				4
Erigone atra Blackwall, 1833	1		1	1	1	1	2		68
Erigone dentipalpis (Wider, 1834)						1		1	18
Erigone longipalpis (Sundevall, 1830)						1		1	16
Erigone spp.	1		1		1		2		11
Erigonella hiemalis (Blackwall, 1841)				1	1	1			4
Glyphesis servulus (Simon, 1881)*		1		1		1			19
Gnathonarium dentatum (Wider, 1834)	1				1	1			4
Gonatium rubens (Blackwall, 1833)		1		1	1	1			4
Gongylidiellum latebricola (O.P.-Cambridge, 1871)		1				1			24
Gongylidiellum murcidum Simon, 1884	1		1	1	1	1			15
Gongylidiellum sp.					1				1
Hylyphantes graminicola (Sundevall, 1830)								1	1
Hypomma bituberculatum (Wider, 1834)	1	1	1	1	2	1	3	2	109
Hypomma cornutum (Blackwall, 1833)			1			1			8
Hypomma fulvum (Bösenberg, 1902)*					1	1			6
Hypselistes jacksoni (O.P.-Cambridge, 1902)*						1			18
Kaestneria pullata (O.P.-Cambridge, 1863)	1	1	2	1	2	1			50
Leptyphanes sp.						1			1
Linyphia spp.	2		2		2				20
Linyphia triangularis (Clerck, 1757)					1	1			2
Maso sundevalli (Westring, 1851)			1				2		2
Meioneta rurestris (C.L.Koch, 1836)		1		1		1		1	41
Micrargus herbigradus (Blackwall, 1854)						1			1
Micrargus laudatus (O.P.-Cambridge, 1881)						1		1	2
Micrargus sp.						1			1
Micrargus subaequalis (Westring, 1851)		1		1	1				14
Microlinyphia pusilla (Sundevall, 1830)	3	1	2	1	2	1		1	49
Neriene montana (Clerck, 1757)								1	1
Neriene peltata (Wider, 1834)	1				1				2
Neriene radiata (Walckenaer, 1842)		1							1
Neriene spp.	2		1			1			7
Notioscopus sarcinatus (O.P.-Cambridge, 1872)	1					1			1
Oedothorax agrestis (Blackwall, 1853)*						2			197
Oedothorax apicatus (Blackwall, 1850)		1				1		1	19
Oedothorax gibbosus (Blackwall, 1841)				1		1			44
Oedothorax retusus (Westring, 1851)	1					2		1	194
Oedothorax spp.				1		2		1	196

Table 2 continued

Family / Species	x		xm		mh		fd		
	s-n	p-t	s-n	p-t	s-n	p-t	s-n	p-t	S
Paludiphantes sp.						1			1
Pelecopsis elongata (Wider, 1834)		1		1		1			65
Pelecopsis parallela (Wider, 1834)	1	2		1		1		2	105
Pelecopsis radiciola (L.Koch, 1872)								1	3
Porrhomma microphthalmum (O. P.-Cambridge, 1871)								1	1
Porrhomma pallidum Jackson, 1913								1	1
Pocadicnemis pumila (Blackwall, 1841)		2		1		1	2	2	196
Porrhomma spp.	2	1	2	1	2	1	3		67
Savignia frontata Blackwall, 1833	1	1	1		1	1	2		14
Silometopus elegans (O.P.-Cambridge, 1872)	1	1	1		1	1		1	15
Silometopus reussi (Thorell, 1871)						1		1	9
Styloctetor stativus (Simon, 1881)		2		1		1			129
Tallusia experta (O.P.-Cambridge, 1871)				1		1			68
Tapinocyba affinis Lessert, 1907*						1			25
Tapinocyba insecta (L.Koch, 1869)		1		1		1		1	52
Tapinocyba mitis (O.P.-Cambridge, 1882)					1			1	4
Tapinocyba pallens (O.P.-Cambridge, 1872)			1		1	1			81
Tapinocyboides pygmaeus (Menge, 1869)		2		1		1		2	120
Tenuiphantes mengei (Kulczyn'ski, 1887)						1			1
Tenuiphantes spp.	1	1	1	1		1			21
Thyreosthenius biovatus (O.P.-Cambridge, 1875)		1							1
Tiso vagans (Blackwall, 1834)	1	1	2	1	1	1			62
Trichopterna cito (O.P.-Cambridge, 1872)*		1							1
Trichopternoides thorelli (Westring, 1861)						1			15
Linyphiidae indet.		3		3		2	2	4	622
Walckenaeria antica (Wider, 1834)		1		1		1			26
Walckenaeria atrotibialis (O.P.-Cambridge, 1878)				1		1			9
Walckenaeria cuspidata Blackwall, 1833				1				1	2
Walckenaeria obtusa Blackwall, 1836				1		1			5
Walckenaeria spp.			1	1		1			3
Walckenaeria unicornis O.P –Cambridge, 1861				1		1			22
Walckenaeria vigilax (Blackwall, 1853)				1	1	1			48
Tetragnathaidae									
Metellina mengei (Blackwall, 1870)	1		1						3
Metellina segmentata (Clerck, 1757)	3		2		1				43
Metellina sp.					1				1
Pachygnatha clercki Sundevall, 1832		1		1		2		2	309
Pachygnatha degeeri Sundevall, 1830					1				1
Pachygnatha listeri Sundevall, 1830	1	4		4	1	3		4	1796
Tetragnatha spp.	2		2		3		3		47

Table 2 continued

Family / Species	x		xm		mh		fd		
	s-n	p-t	s-n	p-t	s-n	p-t	s-n	p-t	S
Araneidae									
Agalenatea redii (Scopoli, 1763)	1		1	1	1				8
Araneus diadematus Clerck, 1757	1				1				4
Araneus marmoreus Clerck, 1757	1		1		2				10
Araneus quadratus Clerck, 1757	3		3		3				72
Araneus sturmi (Hahn, 1831)			1						2
Araniella cucurbitina (Clerck, 1757)			1		1				3
Argiope bruennichi (Scopoli, 1772)	1				1				3
Cercidia prominens (Westring, 1851)						1			1
Hypsosinga pygmaea (Sundevall, 1831)	3		3		1				31
Larinioides cornutus (Clerck, 1757)	3		3		3				52
Larinioides patagiatus (Clerck, 1757)	1		1						4
Larinioides sclopetarius (Clerck, 1757)	1				1				4
Neoscona adianta (Walckenaer, 1802)	1		3		2				21
Singa hamata (Clerck ,1757)	3	1	3		1				38
Stroemiellus stroemi (Thorell, 1870)	1								1
Lycosidae									
Alopecosa cuneata (Clerck, 1757)		1		1		1			36
Alopecosa pulverulenta (Clerck, 1757)		4		4		4		2	1895
Alopecosa sp.			1						1
Arctosa cinerea (Fabricius, 1777)								1	4
Arctosa leopardus (Sundevall, 1833)						1			2
Arctosa lutetiana (Simon, 876)		1				1			2
Arctosa stigmosa (Thorell, 1875)						1			5
Hygrolycosa rubrofasciata (Ohlert, 1865)		1		1		1			25
Pardosa agrestis (Westring, 1861)				1		1		4	107
Pardosa amentata (Clerck, 1757)						1			4
Pardosa fulvipes (Collett, 1876)*						1			1
Pardosa lugubris (Walckenaer, 1802)		1		1		1			3
Pardosa nigriceps (Thorell, 1856)		1				1			2
Pardosa paludicola (Clerck, 1757)	1	1		1		1			24
Pardosa palustris (Linnaeus, 1758)	1	4		3		2		1	1148
Pardosa prativaga (L.Koch, 1870)		1	1	3	2	4		3	1258
Pardosa pullata (Clerck, 1757)	1	3	1	3	1	3		1	956
Pardosa sphagnicola (Dahl, 1908)		1		2	1	2			269
Pardosa spp.	1	1	2		3	1	2		48
Pirata hygrophilus Thorell, 1872		1		1		2			170
Pirata piraticus (Clerck, 1757)						1		1	54
Trochosa ruricola (DeGeer, 1778)		1		1		1		1	119
Trochosa spinipalpis (F.O.P.-Cambridge, 1895)		1		2		2			185
Trochosa terricola Thorell, 1856		2		2		2		1	318
Xerolycosa miniata (C.L.Koch, 1834)				1		1		4	100

Table 2 continued

Family / Species	x		xm		mh		fd		
	s-n	p-t	s-n	p-t	s-n	p-t	s-n	p-t	S
Pisauridae									
Dolomedes fimbriatus (Clerck, 1757)						1			1
Pisaura mirabilis (Clerck, 1757)		1	2		1				4
Hahniidae									
Antistea elegans (Blackwall, 1841)		1		1		1			14
Hahnia nava (Blackwall, 1841)		3		2		1		1	250
Hahnia ononidum Simon, 1875						1			1
Dictynidae									
Argenna subnigra (O.P.-Cambridge, 1861)	2	3	1	2	1	1		2	239
Dictyna arundinacea (Linnaeus, 1758)	1		1		1				3
Dictyna pusilla Thorell, 1856	1				1				2
Corinnidae									
Phrurolithus festivus (C.L.Koch, 1835)				1		1		1	4
Liocranidae									
Agroeca dentigera Kulczyn'ski, 1913*		1		1		1			26
Agroeca lusatica (L.Koch, 1875)		1		1		1		1	78
Liocranoeca striata (Kulczyński, 1882)*						1		1	3
Miturgidae									
Cheiracanthium erraticum (Walckenaer, 1802)		1			1				2
Cheiracanthium virescens (Sundevall, 1833)	1		1						3
Clubionidae									
Clubiona diversa O.P.-Cambridge, 1862			3		1			1	17
Clubiona lutescens Westring, 1851						1		1	2
Clubiona neglecta O.P.-Cambridge, 1862	1								1
Clubiona phragmitis C.L.Koch, 1843					1	1		1	22
Clubiona reclusa O.P.-Cambridge, 1863	1		1		1	1			17
Clubiona stagnatilis Kulczyn'ski, 1897				1		1		1	4
Clubiona subtilis L.Koch, 1867		1		1	1	1	2	1	30
Clubiona trivialis C.L.Koch, 1843	1	1		1					6
Gnaphosidae									
Drassodes lapidosus (Walckenaer, 1802)				1					2
Drassodes pubescens (Thorell, 1856)		1				1			4
Drassyllus lutetianus (L.Koch, 1866)		1		1		2		1	143
Drassyllus praeficus (L.Koch, 1866)		1		1					3
Drassyllus pusillus (C.L.Koch, 1833)		2		2		1		1	178
Gnaphosa leporina (L.Koch, 1866)		1							8

Table 2 continued

Family / Species	x		xm		mh		fd		
	s-n	p-t	s-n	p-t	s-n	p-t	s-n	p-t	S
Haplodrassus moderatus (Kulczyn'ski, 1897)		1		1		1		1	14
Haplodrassus singifer (C.L.Koch, 1839)	1	1		1		1			16
Haplodrassus umbratilis (L.Koch, 1866)		1							1
Micaria pulicaria (Sundevall, 1831)		1		1		1		1	39
Zelotes clivicola (L.Koch, 1870)		1							3
Zelotes electus (C.L.Koch, 1839)		1		1		1			12
Zelotes latreillei (Simon, 1878)		1		1		1			19
Zelotes longipes (L.Koch, 1866)				1				1	4
Zelotes suterraneus (C.L.Koch, 1833)								1	
Zoridae									
Zora armillata Simon, 1878				1		1			6
Zora nemoralis (Blackwall, 1861)						1		1	7
Zora spinimana (Sundevall, 1833)		1		1		1			12
Philodromidae									
Philodromus aureolus (Clerck, 1757)					1				1
Philodromus cespitum (Walckenaer, 1802)	2		1		1				10
Thanatus arenarius L.Koch, 1872	1	1	1						3
Thanatus formicinus (Clerck, 1757)	1								1
Thanatus spp.		1		1					4
Thanatus striatus C.L.Koch, 1845		1		1	1	1		1	17
Tibellus maritimus (Menge, 1875)	1		2		2				16
Tibellus oblongus (Walckenaer, 1802)	3	1	3		2		3		55
Thomisidae									
Diaea dorsata (Fabricius, 1777)			1		1				2
Misumena vatia (Clerck, 1757)			1		1				6
Ozyptila atomaria (Panzer, 1801)		1				1			8
Ozyptila trux (Blackwall, 1846)		1		1	1	2	3		297
Xysticus audax (Schrank, 1803)	1		1		1				3
Xysticus bifasciatus C.L.Koch, 1837		1		1	1	1			26
Xysticus cristatus (Clerck, 1757)	3	2	3	1	2	1			123
Xysticus erraticus (Blackwall, 1834)	2	2	1	1	1	1			85
Xysticus kochi Thorell, 1872		1		1		1			4
Xysticus lanio C.L.Koch, 1835			1			1			4
Xysticus lineatus (Westring, 1851)		1		1		1			7
Xysticus luctuosus (Blackwall, 1836)			1						1
Xysticus spp.				1	1				2
Xysticus ulmi (Hahn, 1831)	2	1	2	1	2	1	3		32
Salticidae									
Evarcha arcuata (Clerck, 1757)	1			1	2				14

Table 2 continued

Family / Species	x		xm		mh		fd		
	s-n	p-t	s-n	p-t	s-n	p-t	s-n	p-t	S
Heliophanus auratus C.L.Koch, 1835	1		1				3		5
Heliophanus dubius C.L.Koch, 1835					1				1
Heliophanus flavipes (Hahn, 1832)	2		1						10
Neon reticulatus (Blackwall, 1853)	1				1		2		5
Neon valentulus Falconer, 1912		1				1			2
Salticus spp.	2						3		10
Sitticus floricola (C.L.Koch, 1837)						1			1
Sitticus pubescens (Fabricius, 1775)								1	3
Synageles venator (Lucas, 1836)					1				1
Salticidae indet.		1							1
Total	**368**	**2838**	**271**	**3170**	**378**	**7443**	**35**	**659**	**15162**