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SPIDER COMMUNITY ON THE HORSE-CHESTNUT *AESCULUS HIPPOCASTANUM* L. – PRELIMINARY RESULTS

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It is known that invasive species *Cameraria ohridella* L. is a dangerous pest of horse-chestnut *Aesculus hippocastanum* L., and great efforts have been put in all European areas, containing horse-chestnut *Aesculus hippocastanum* stands, into finding effective control measures against *C. ohridella*. Araneae species are important and effective predators to control Lepidoptera pests. Therefore it is necessary to study perspective spider species to reduce *C. ohridella* population density. Preliminary studies of the spider community have been carried out in Latvia (Riga and Jelgava regions) on horse-chestnut trees in the streets of Salaspils in 2010, 2012 and Jelgava in 2012. The spiders were captured using methods of branch beating and manual collection. A total of 15 spider species were identified to species level. Twelve genera from 12 families (Theridiidae, Dictynidae, Thomisidae, Philodromidae, Linyphidae, Tetragnathidae, Araneidae, Clubionidae, Corinnidae, Anyphaenidae, Liocranidae, Salticidae) were represented in the herbaceous layer of horse-chestnut trees. The majority of spider specimens found in 2010 were from families Philodromidae (29.49%), Linyphiidae (19.36%), Theridiidae (15.67%) and Araneidae (16.13%). The total abundance of spider specimens in these families in 2012 was also quite similar.

Key words: Araneae, *Aesculus hippocastanum,* Latvia.

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INTRODUCTION

About 500 spider species (Araneae) are known to occur in Latvia (Relys & Spuņģis 2003). The first data source on Latvian spiders was a publication by A.Grube (1859). The widest researches of spiders were carried out in 1960-1964 and 1968-1990 (Šternbergs 1998 a,b). In Latvia, studies of spiders were performed in forests (including ground cover), permanent grasslands and apple gardens. The amount of spiders varied significantly in different habitats.

The richest-in-specimens habitat was the ground cover of Latvia's forests: on the average, more than 250-300 spiders were counted per 1 m^2; occasionally the number reached 500. Many spiders were found also in the canopies of apple-trees, the number depending on the age of the trees. Up to 200-600 spiders may be found on a 25-30 years old apple-tree (Prieditis & Šternbergs 1981). Spiders are desirable in each ecosystem: they prey on a vast range of potential pest species; they are predators during each stage of their development; they rapidly colonize fields, are

resistant to starvation and dehydration and they do not migrate during low density prey period (Agnew & Smith 1989). Most spiders begin to feed already at a temperature of 6-10˚C, therefore, in Latvia's climate, they are important as the only control agent of plant pests in spring and autumn (in total 1.5 months) (Šternbergs 1984).

It is known that invasive species *Cameraria ohridella* Deschka and Dimic (Lepidoptera, Gracillariidae) is a dangerous pest of the horse-chestnut *Aesculus hippocastanum* L. (Hippocastanaceae), found in Latvia in 2002 (Savenkov & Šulcs 2010). *C. ohridella* appeared in Europe in the late seventies (Simova-Tošić & Filev 1985). *C. ohridella* is a pest of unknown origin that causes premature defoliation of white flowering horse-chestnut trees (Šefrova & Lastuvka 2001). Great efforts have been put in all European areas in finding effective control measures against *C. ohridella* (www.cameraria.de/index.php).

Initially parasitoids were thought to be the most promising *C. ohridella* population controllers, but after several studies in different European countries it became clear, that death rates of *C. ohridella*, caused by parasitism, invariably remained low (under 10%). Therefore, nowadays a common agreement exists, that parasitoid role is negligible (Girardoz et al. 2007). G.Grabenweger et al. (2005) performed a research about *C. ohridella* predator complex. Initially they assumed ants, birds and spiders to be the most important predators of leaf miner, but after completion of research the results suggested, that leaf miner predation rates of birds ranged only from 2 to 4%, but ants were not able to detect leaf miners larvae in the mines. Despite spiders being found in samples, they were not included in leaf cage experiments in semi-field conditions, like other collected arthropods. In Switzerland and Germany 28 species of *C. ohridella* natural predators and parasites were recorded. Spiders and lacewings (*Chrysopidae*) were the most efficient among them. Spiders defeated moth imago (Grabenweger 2001).

D.Lupi (2004) also carried out a three years long survey on the natural enemies of *C. ohridella* in Italy, but spiders were not inspected at all.

There is no particular information about predators feeding with leaf miner imagines. During spider specimen collecting in the spider webs, several imagines of leaf miner were observed, showing the presence of active spider feeding with this invasive species (http://www.forestry.gov.uk/pdf/horsechestnut.pdf/$FILE/horsechestnut.pdf).

Araneae species are important and effective polyphagous predators to control insect pests and are numerously found on horse-chestnut trees in Latvia. Therefore, it is a necessity to study and identify perspective spider species to reduce *C. ohridella* population density.

MATERIAL AND METHODS

The study of the spider community has been carried out in Latvia (Salaspils and Jelgava regions). Spiders were collected from horse-chestnut canopies in Salaspils and Jelgava greenery. Two different methods were used for collection of the spiders: the branch beating and manual collection. Both methods were used for collecting spiders from horse-chestnut in Salaspils city, Dienvidu street (56º 88' 67'' N, 24º 34' 70'' E) (August 2010, May-June 2012). One sample consisted of 10 hits on the branches of each tree (five sample trees in total). The spiders were collected in a nylon gauze bags and were killed in the laboratory with ethyl-acetate. The material was placed in glass vials filled with 70% ethyl alcohol for preservation. Manual collection of spiders was used for spider collection in Jelgava city along Valnu street (56º 38' 45'' N, 23º 43' 15'' E). The spiders were caught from five trees once a month from June to August 2012. The majority of spiders were immature, which is quite typical for the spider community of the herbal layer (Veselova & Mikhailov 1986).

Thus, the identification of species was not always possible. Adult spiders were identified to species by use of the identification keys by Almquist

(2005, 2006). Taxonomy follows Platnick (2013). To characterize the dominance of spider families structure, Engelmann`s classification was used (Engelmann 1978).

RESULTS

A total of 392 spiders were collected in our study. Fifteen adult specimens have been taxonomically identified to species level and 355 juveniles have been identified to family level. In total twelve genera from 12 families were encountered. Of them, seven families were represented by identified species: Linyphiidae - 4 species, Araneidae - 3, Theridiidae - 2, Dictynidae - 2, Clubionidae - 2, Thomisidae - 1, Philodromidae – 1. The rest of families: Tetragnathidae, Corinnidae, Anyphaenidae, Liocranidae, and Salticidae, were represented only by juvenile specimens (Table 1).

Ten spider families were found on the herbaceous layer of horse-chestnut in August 2010. The families Salticidae and Thomisidae were not registered in 2010, and the families Corinnidae and Liocranidae were not registered in 2012. Five spider species were registered in 2010: *Hypomma cornutum* (Blackwall, 1833), *Hylyphantes graminicola* (Sundevall, 1830), *Gongylidium rufipes* (Linnaeus, 1758) from family Linyphiidae, *Araneus diadematus* Clerck, 1757 (Araneidae) and *Dictyna uncinata* Thorell, 1856 (Dictynidae). The proportion of juveniles constituted 58-100% from total collected spider amount. The majority of spider specimens found in 2010 were belonging to dominant families Philodromidae (29.49%), Linyphiidae (19.36%), Theridiidae (15.67%) and Araneidae (16.13%). Families Dictynidae (5.53%) and Clubionidae (11.52%) were found as subdominant and other four families (Tetragnathidae (0.46%), Anyphaenidae (0.46%), Liocranidae (0.92%), and Corinnidae (0.46%) were found as subrecedent).

Ten spider families were also registered in 2012. The richest of spider specimens were four dominant families: Family Linyphiidae (28.57%) represented by 4 species: *Hypomma cornutum, Hylyphantes graminicola, Gongylidium rufipes*, *Kaestneria dorsalis* (Wider, 1834). Family Araneidae (25.14%) represented by 3 species: *Araneus diadematus*, *A. sturmi* (Hahn, 1831) and *Araniella cucurbitina* (Clerck, 1757). Family Philodromidae (15.43%) was represented by one species – *Philodromus emarginatus* (Schrank, 1803). Family Theridiidae (14.29%) - represented by 2 species: *Theridon varians* Hahn, 1833 and *Parasteatoda tepidariorum* (G.L.Koch, 1784). Family Clubionidae (7.43%) represented by two species: *Clubiona caerulescens* G.L.Koch, 1867 and *C. lutescens* Westring, 1851 and was found in 2012 as subdominant family. Three families: Dictynidae (3.43%) represented by two species: *Dictyna uncinata* and *D. arundinacea* (Linnaeus, 1758), Tetragnathidae (2.86%) (only five juvenile specimens were found) and Araneidae (2.86%) were characterized as recedent families in 2012. Only one species - *Xysticus cristatus* (Clerck, 1757) – was collected from Thomisidae family, which was tagged as subrecedent. Each of the rest four subrecedent spider families – Anyphaeinidae, Salticidae, Liocranidae and Corinnidae - were represented only by juveniles.

In totally, the four dominant spider families, collected during total growing seasons 2010 and 2012, were: Linyphiidae (23.50%), Philodromidae (23.21%), Araneidae (20.15%) and Theridiidae (15.05%).

DISCUSSION

During our study 12 spider families and 15 species were found on the *A. hippocastanum*, eight of identified spider species are wide spread in western and central Europe, and only 4 species: *A. cucurbitina, H. graminicola, C. lutescens* and *C. caerulescens* are common in north-western and central Europe (http://srs.britishspiders.org.uk/portal.php/p/A-Z+Species+Index).

Theridiidae, Linyphiidae, Araneidae and Philodromidae families were relatively similar and the richest in specimens in 2010 and 2012. Three species from Lynyphiidae family: *H. cornutum*, *H. graminicola*, *G. rufipes*, and two

Table 1. Number of specimens and percentage of spider families collected by brunch beating from foliage and hand collection of *Aesculus hippocastanum*

Family / Species	Number of specimens			Relative abundance (%) 2010+2012
	2010	2012	Sum	
Theridiidae				15.05
Theridion varians Hahn, 1833	0	2	2	
Parasteatoda tepidariorum (G.L.Koch, 1784)	0	1	1	
Juv.	34	22	56	
Linyphiidae				23.50
Hypomma cornutum (Blackwall, 1833)	1	3	4	
Hylyphantes graminicola (Sundevall, 1830)	1	5	6	
Kaestneria dorsalis (Wider, 1834)	0	1	1	
Gongylidium rufipes (Linnaeus, 1758)	1	0	1	
Species 1	2	0	2	
Juv.	37	41	78	
Tetragnathidae				1.51
Juv.	1	5	6	
Araneidae				
Araneus diadematus Clerck, 1757	1	5	6	20.15
Araniella cucurbitina (Clerck, 1757)	0	2	2	
Araneus sturmi (Hahn, 1831)	0	1	1	
Juv.	34	36	70	
Dictynidae				4.59
Dictyna arundinacea (Linnaeus, 1758)	0	1	1	
Dictyna uncinata Thorell 1856	5	1	6	
Juv.	7	4	11	
Anyphaenidae				0.77
Juv.	1	2	3	
Liocranidae				0.5
Juv.	2	0	2	
Clubionidae				9.69
Clubiona caerulescens G.L.Koch, 1867	0	1	1	
Clubiona lutescens Westring, 1851	0	1	1	
Juv.	25	11	36	
Philodromidae				23.22
Philodromus emarginatus (Schrank, 1803)	0	1	1	
Juv.	64	26	90	
Thomisidae				0.5
Xysticus cristatus (Clerck, 1757)	0	1	1	
Juv.	0	1	1	
Salticidae				0.26
Juv.	0	1	1	
Corinnidae				0.26
Juv.	1	0	1	
sum	217	175	392	100

species from Araneidae family: *A. diadematus* and *A. cucurbitina* - are widely distributed as typical inhabitants in Latvian coniferous and deciduous forests and gardens (Priedītis 1995, 1997, Šternbergs 1977, 1981, 1983, 1986, 1988, Ančipanova 1983, 1985, Cera et al. 2010). Spiders from Linyphiidae family are essential predators of phytophagous mites (Gerson 1985). It is important, that Linyphiidae spiders occur in most biotopes in September and October, thus decreasing the number of mites present on the plants at the time, when pests begin to diapause. That is probably of the greatest importance during warm, sunny autumns. For the first time species *H. graminicola* was found by J.Ančipanova and M.Šternbergs (1987) as dominant species in apple canopy and registered on trunks of the deciduous trees in Latvian reservation "Moricsala" (Šternbergs 1983). *H. graminicola* is common species in woodlands in deciduous and pine forests of Lake Engure Nature Park in Latvia (Cera et al. 2010).

The second richest family is Philodromidae. Species *P. emarginatus* was found for the first time in Latvia by A.Grube (1859) and registered by M.Šternbergs (1983) as subdominant species on trunks of the deciduous trees in Latvian reservation "Moricsala".

Araneidae family was registered in Latvian apple gardens in 1984-1985 by J.Ančipanova and M.Šernbergs (1987) as the richest-in-specimens family. Species *A. cucurbitina* most frequently occurred in Latvian nature (Šternbergs 1977). This species was dominant and eudominant in apple canopy of Latvian apple gardens, and subdominant in canopy of other deciduous trees (Prieditis & Sternbergs 1981, Šternbergs 1983, Ančipanova 1985, Priedītis 1997). On apple trees crone, *A. cucurbitina* individuals are generally eaters of pest species from order Lepidoptera, also Diptera, Hymenoptera, Coleoptera (Priedītis 1997). Spiders of Araneidae family feed on Diptera, Hymenoptera and Sternorrhyncha (Šternbergs 1984, Ančipanova 1985), and probably have an important role in diminishing the number of these insects on horse-chestnut canopy.

In Latvia, the first data on species, belonging to Theridiidae family, were presented in 1859 (6 species) (Grube 1859). Later on, five other new for Latvia species were added (Prieditis & Sternbergs 1981, Šternbergs 1985). Nowadays, the total number of species in Theridiidae family known in Latvia is 46 (Relys & Spungis 2003). Theridiidae family is the second richest family in apple agrocenoses of Latvia (Ančipanova & Šternbergs 1987). According to J.Ančipanova & M.Šternbergs (1987), *T. varians* was predominant species in apple canopy in 1987. Spider *T. varians* was found in Swedish pine and young spruce forests and in deciduous and pine forests of Lake Engure Nature Park in Latvia (Almquist 2005, Cera et al. 2010). Species belonging to Theridiidae family are essential predators of phytophagous mites and insects from Culicidae and Chironomidae families (Gerson 1985; Ančipanova & Šternbergs 1987). In nutrition of Theridiidae spiders the dominating orders were: Diptera – 19.9-39.6%, (Culicidae, Chironomidae, Syrphidae families), Homoptera – 62.8-33% (*Cacopsylla mali* (Schmb.), *Aphis pomi* (De Geer), Hymenoptera - 13.8-15.4% and Coleoptera – 2.3-8.7% (1984-1985) (Priedītis 1997).

In Latvia, spider species *D. arundinacea* from recedent family Dictynidae was mentioned for the first time in 1859 by A.Grube. Species *D. arundinacea* and *D. uncinata* were found in Latvia 1962-1979 by M.Šternbergs (1981, 1983, 1998b) on the deciduous trees in Latvian reservation "Moricsala", also in apple-tree canopies and trunks (Prieditis & Šternbergs 1981). *D. arundinacea* is common and typical species for dry wooded meadows, dry and wet pine forests in Lake Engure Nature Park in Latvia (Cera et al. 2010).

Clubionidae family was represented on horse-chestnut by two species, and this spider community consisted 9.69% from total collected spider amount. A.Grube (1859) mentioned 6 species from this family. Species *Clubiona lutescens* and *C. caerulescens* were found by A.Prieditis and M.Sternbergs (1981) in apple-tree canopies and by M.Šternbergs (1979, 1981) on trunks and canopy of the deciduous trees

in Latvian reservation "Moricsala". Spiders *C. lutescens* are more common in woodland, dry and wet pine forests in Lake Engure Nature Park of Latvia (Cera et al. 2010). Spider community of this family on *A. hippocastanum* made up 1.5% from total collected spider amount.

Species of the subrecedent family Thomisidae (0.5%) were commonly found in Latvia, most often close to the soil surface (Šternbergs 1977).

One species – *X. cristatus* - was registered on horse-chestnut canopy. It is the most widespread and common throughout Latvia from April to October (Šternbergs 1979). *X. cristatus* was found in Latvian marshland habitats and in natural and drained fens in Poland (Kajak et al. 2000, Cera et al. 2010). This species is also common in Swedish dry and damp meadows (Almquist 2006). As a consequence, its diet is extremely various and comprises flying insects, including butterflies, ants, and other soft-bodied prey (Nyffeler & Breene 1990).

CONCLUSION

We agree with the conclusions, made by M.Šternbergs (1984) and A.Priedītis (1997), concerning spiders in apple-tree canopies: when plant pests have multiplied in large quantities, they become the main food source of spiders. During cool spring and autumn periods (approximately 1.5 months) spiders are the only destroyers of plant pests in Latvia (Priedītis 1997).

Of great importance is the fact, that in general in two years time (2010 and 2012) 81.92% of the spider specimens, collected from the horse-chestnut canopies *A. hippocastanum* in Salaspils and Jelgava cities, were representing Linyphiidae, Philodromidae, Araneidae and Theridiidae families, and are essential plant pest control agents.

In our opinion, spider community of these families may be effectively decreasing population density of not only invasive pest *Cameraria ohridella*, but also of other plant feeders from orders Hemiptera, Coleoptera and Lepidoptera. Investigations on spider community on horse-chestnut trees and their effectiveness as predators of the *C. ohridella* in Latvia will be continued.

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