

## Overwintering of ladybird beetles (Coleoptera: Coccinellidae) in the suburban zone of Warsaw

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**ABSTRACT:** The species richness and densities of overwintering ladybird beetles (Coleoptera: Coccinellidae) were studied in the municipality of Łomianki in the suburban zone of Warsaw (Central Poland). In total, 274 specimens of 25 species were found, of which the most common was *Psyllobora vigintiduopunctata* (41.9% of all specimens). Other frequently recorded ladybirds were *Exochomus quadripustulatus*, *Propylea quatuordecimpunctata* and *Vibidia duodecimguttata*. Several of the species registered in this study (*Rhyzobius litura*, *Hyperaspis concolor*, *Scymnus femoralis*, *Scymnus interruptus*, *Adalia conglomerata*) have rarely been reported in Poland.

**KEY WORDS:** Coccinellidae, overwintering, Mazovian Lowland, central Poland

The majority of studies concerning the ecology and fauna of Coccinellidae has been conducted during the growing season, and little attention is devoted to the overwintering of ladybirds (CERYNGIER 2015). Relatively numerous studies on Coccinellidae of Mazovia also include predominantly their periods of activity, reproduction, and growth (GALECKA 1980, CZECHOWSKA 1989, PANKANIN-FRANCZYK & CERYNGIER 1995, JĘDRYCZKOWSKI 2006, BLOCK & all. 2011); however, some studies pertain also to the winter period. Fragmentary data on the subject of the overwintering of different species of ladybirds in Mazovia can be found in BIELAWSKI's (1961) publications. Other two studies conducted near Warsaw (GODEAU & CERYNGIER 2011, CERYNGIER & GODEAU 2013) are entirely devoted to the matters of overwintering of Coccinellidae.

The aim of the following article is to present the structures of a group of Coccinellidae that overwinter in the suburban zone of Warsaw. Winter specimens of Coccinellidae were collected from different kinds of anthropogenic environments: around suburban building area, agriculturally used areas, and along a highway.

### Area and methods

The research was conducted within the area of the municipality of Łomianki. It is situated to the northwest off Warsaw, between Warsaw's municipality of Bielany, the Kampinos National Park, the municipality of Czosnów, and the Vistula valley. The central part of the Łomianki municipality is covered with buildings (mainly detached houses), with a well-developed road network, including the national route no. E7. The eastern part of the Łomianki municipality – the Łomiankowska Valley – is adjacent to Vistula and constitutes an area of considerable natural qualities (ROMANOWSKI & all. 2013). The Łomianki municipality is situated entirely in the buffer zone of the Kampinos National Park.

In this paper, the quantity and the species composition of ladybirds overwintering in litter and at ground surface. Litter samples and the exterior layer of the ground were collected from the same area with the aid of a metal circle with 41 cm in diameter (the area of 0,13 m<sup>2</sup>), and were sifted through an entomological sieve. The sifted material was then placed to tightly sealed foil bags and taken to the laboratory, where the samples were sorted.

The samples were collected from 20 localities in Dziekanów Leśny (UTM: DD90), Dąbrów (DC99), Łomianki (DC99), and the Łomiankowska Valley (DD90) in the period from 11 XII 2014 to 16 III 2015. In total, during 17 visits in the field research, 310 litter samples were collected, including 60 from the roadsides of the national route no. E7. The majority of the samples (275) was collected from different tree species, whereas the remaining part (35 samples) from open grass areas, mainly grassy roadsides of the route E7 (32 samples). The nomenclature and systematic arrangement of Coccinellidae was adopted after KOVÁŘ (2007).

### Results

During the research, 274 Coccinellidae specimens were reported and they belong to 25 species (Fig. 1). The most abundant was *Psyllobora vigintiduopunctata* (LINNAEUS, 1758) – 115 specimens, that is 41.9% of all

collected ladybirds – as well as *Propylea quatuordecimpunctata* (LINNAEUS, 1758) – 67 specimens, that is 24.5% of all collected ladybirds – and *Propylea quatuordecimpunctata* (LINNAEUS, 1758) (15 specimens, that is 5,5% of all collected ladybirds. Worth noting is the record of a living specimen of an invasive species *Harmonia axyridis* (PALLAS, 1773) in the litter gathered under an alder *Alnus glutinosa* (L.) GAERTNER by the Kiełpińskie Lake on 18th February 2015.

Table 1. List of Coccinellidae overwintering in litter in the municipality of Łomianki with numbers of specimens recorded in areas of different land use

Systematic position	Land use		
	urban fabric	farmland	roadsides
1	2	3	4
<b>Coccidulinae, Coccidulini</b>			
<i>Rhyzobius chrysomeloides</i> (HERBST, 1783)	2	9	-
<i>Rhyzobius litura</i> (FABRICIUS, 1787)	1	3	-
<b>Scymninae, Hyperaspidini</b>			
<i>Hyperaspis concolor</i> (SUFFRIAN, 1843)	-	1	-
<b>Scymninae, Scymnini</b>			
<i>Scymnus (Pullus) ferrugatus</i> (MOLL, 1785)	1	1	-
<i>Scymnus (Scymnus) femoralis</i> (GYLLENHAL, 1827)	-	-	-
<i>Scymnus (Scymnus) gr. frontalis</i> (FABRICIUS, 1787)	-	-	2
<i>Scymnus (Scymnus) interruptus</i> (GOEZE, 1777)	-	-	1
<b>Scymninae, Stethorini</b>	2	-	1
<i>Stethorus pusillus</i> (HERBST, 1797)			
<b>Chilocorinae, Chilacorini</b>			
<i>Chilocorus bipustulatus</i> (LINNAEUS, 1758)	5	-	-
<i>Exochomus quadripustulatus</i> (LINNAEUS, 1758)	65	2	-
<b>Chilocorinae, Platynaspidini</b>			
<i>Platynaspis luteorubra</i> (GOEZE, 1777)	-	-	1
<b>Coccinellinae, Halyziini</b>			
<i>Halyzia sedecimguttata</i> (LINNAEUS, 1758)	2	-	-
<i>Psyllobora vigintiduopunctata</i> (LINNAEUS, 1758)	25	88	2
<i>Vibidia duodecimguttata</i> (PODA, 1761)	11	4	-
<b>Coccinellinae, Tyththaspidini</b>			
<i>Coccinula quatuordecimpustulata</i> (Linnaeus, 1758)	-	1	-
<i>Tyththaspis sedecimpunctata</i> (Linnaeus, 1761)	-	1	2

continued table 1

1	2	3	4
<b>Coccinellinae, Coccinellini</b>			
<i>Adalia conglomerata</i> (LINNAEUS, 1758)	5	-	-
<i>Adalia decempunctata</i> (LINNAEUS, 1758)	1	1	-
<i>Aphidecta oblitterata</i> (LINNAEUS, 1758)	3	-	-
<i>Calvia quaturdecimguttata</i> (LINNAEUS, 1758)	3	-	-
<i>Coccinella septempunctata</i> LINNAEUS, 1758	5	-	1
<i>Harmonia axyridis</i> (PALLAS, 1773)	-	1	-
<i>Myzia oblongoguttata</i> (LINNAEUS, 1758)	1	-	-
<i>Propylea quatuordecimpunctata</i> (LINNAEUS, 1758)	12	3	-
<b>Epilachninae, Epilachnini</b>			
<i>Subcoccinella vigintiquatuorpunctata</i> (LINNAEUS, 1758)	-	5	-
Total	<b>144</b>	<b>120</b>	<b>10</b>

From the studied samples, an average density of ladybird beetles overwintering in litter amounted to 6.7 specimen/m<sup>2</sup>. The highest density was reported from the samples collected from agricultural areas (an average of 10.2 specimen/m<sup>2</sup>), and the lowest from the samples from the sides of highway passes (an average of 1.3 specimen/m<sup>2</sup>). A moderate density of ladybird beetles in litter found underneath different kinds of trees oscillated within a broad spectrum (from 0 to 44 specimens/m<sup>2</sup>), with the highest underneath box alders (*Acer negundo* LINNAEUS) and European larches (*Larix decidua* MILLER). The density of the samples of overwintering ladybird beetles collected from grassy roadsides was distinctly lower than underneath the trees (Table 2). The highest number of ladybird beetles was recorded from the litter underneath pedunculate oaks (*Quercus robur* LINNAEUS) (9 species) and box alders (8 species) (Table 2).

Among the Coccinellidae species reported in the following studies, a few of them have been rarely recorded from Poland.

*Rhyzobius litura* (FABRICIUS, 1787)

- DC99 Łomianki: 2 I 2015, 1 ex., in litter underneath an *Acer negundo* at a built-up area; 17 I 2015, 1 ex., underneath a *Quercus robur* at an agricultural area; 10 III 2015, 2 exx., underneath a *Crataegus* sp. at an agricultural area.

Table 2. Numbers of litter samples collected under different trees and from grassy roadsides in the municipality of Łomianki, and numbers of individuals, mean densities and numbers of species of Coccinellidae recorded in these samples

Place of sampling	No. of litter samples	Coccinellidae		
		No. of individuals	density (N/m <sup>2</sup> )	No. of species
<i>Under trees:</i>				
<i>Acer negundo</i> L.	17	98	43,7	8
<i>Acer platanoides</i> L.	33	2	0,5	2
<i>Acer pseudoplatanus</i> L.	4	8	15,2	3
<i>Alnus glutinosa</i> (L.) Gaertn.	28	2	0,5	2
<i>Betula pendula</i> Roth	20	7	2,7	5
<i>Crataegus</i> sp.	2	4	15,2	3
<i>Hedera helix</i> L.	2	2	7,6	2
<i>Larix decidua</i> Mill.	12	61	38,5	3
<i>Picea abies</i> (L.) H. Karst.	32	12	2,8	6
<i>Pinus sylvestris</i> L.	21	17	6,1	6
<i>Populus</i> spp.	21	6	2,2	2
<i>Quercus robur</i> L.	21	20	7,2	9
<i>Quercus rubra</i> L.	14	18	9,7	2
<i>Salix alba</i> L.	26	5	1,5	4
<i>Sorbus aucuparia</i> L.	3	-	-	-
<i>Tilia</i> spp.	19	7	2,8	6
<i>Grassy roadsides</i>	32	5	1,2	4

A species occurring locally in Poland. In recent years, it was reported from Wrocław and a few sites in Great Poland (RUTA & all. 2009), as well as from the environs of Rogów (BOROWSKI 2015). At the area of Łomianki municipality, it maintains a relatively numerous and steady population, mainly inhabiting fields (GAŁECKA 1980, PANKANIN-FRANCZYK & CERYNGIER 1995, CERYNGIER 1997).

*Hyperaspis concolor* (SUFFRIAN, 1843)

– DD90 Dolina Łomiankowska, 11 I 2015, 1 ex., in litter underneath a *Salix alba*, within an agricultural zone.

A species with a poorly studied biology, recently recorded from the vicinity of the studied area (SZAWARYN & HAWRO 2015), and also from the environs of Poznań (RUTA & all. 2009), Wrocław (GREŃ & all. 2013), Rogów (BOROWSKI 2015) and Cedynia (CERYNGIER & all. 2016a).

*Scymnus femoralis* (GYLLENHAL, 1827)

- DD90 Dolina Łomiankowska, 11 I 2015, 1 ex., in litter underneath a *Pinus sylvestris*, within an agricultural zone.

A species very rarely reported from Poland, for example from the Kampinos National Park and the Łominaki municipality (CERYNGIER 1997, MARCZAK 2010). Apart from that, it was reported from Lower Silesia (Wrocław), Great Poland (Mokrz), the western part of Mazovia (Szumin) and the Biebrza National Park (RUTA & all. 2009), as well as from the Wigry National Park (CERYNGIER & all. 2015).

*Scymnus interruptus* (GOEZE, 1777)

- DC99 Łomianki, 17 II 2015, 1 ex., in litter underneath a lime tree (*Tilia sp.*) in the roadside zone of the national route E7.

A species rarely encountered in Poland, during the growing season connected with different deciduous trees and shrubs (BIELAWSKI 1962). Since 2000, it has been recorded from the Ojców National Park (KUŚKA 2007), Upper Silesia (GREŃ & all. 2013), Great Poland (RUTA & all. 2009), and Mazovia (RUTA & all. 2009, BOROWSKI 2015).

*Adalia conglomerata* (LINNAEUS, 1758)

- DD90 Dziekanów Leśny, 11 XII 2014, 2 exx., in litter underneath a spruce (*Picea bies*) at a built-up area; 16 II 2015, 1 ex., in litter underneath a larch (*L. decidua*) at a built-up; DC99 Łomianki, 5 III 2015, 1 ex., underneath *P. abies* within built-up area.

A boreal-mountain species rarely recorded, associated with coniferous trees, especially the spruce. According to the published data, in the current century, it has been collected only from the Białowieża Forest (Mokrzycki 2001), the Świętokrzyskie Mountains (BYK 2007), and Upper Silesia (GREŃ & all. 2013).

## Discussion

The species richness of the ladybird beetles overwintering in the anthropogenic habitats of the Łomianki municipality (25 species) reported in this study can be assessed as relatively high. In previous studies from the environs of Warsaw with a comparable amount of samples collected from the alder and oak forests of the Kampinos National Park (303 specimens)

(GODEAU & CERYNGIER 2011) and the Vistula riparian forests (N = 269 specimens) (CERYNGIER & GODEAU 2013), 16 and 24 species, respectively, were recorded. The significantly higher richness reported in this study results probably from a higher environmental differentiation of habitats from where the samples were collected.

Three out of four species the most numerous collected (*P. vigintiduo-punctata*, *E. quadripustulatus* i *P. quatuordecimpunctata*) are the ladybird beetles that are common in the whole country, creating abundant populations. The fourth species, *V. duodecimguttata*, had been until recently considered as rare in Poland (CZECHOWSKA & BIELAWSKI 1981, BURAKOWSKI & all. 1986, RUTA & all. 2009), yet the data from recent years (CERYNGIER & GODEAU 2013, CERYNGIER & all. 2016a, CERYNGIER & all. 2016b) demonstrate that at least in Mazovia and in the region of Lower Oder (the Cedyňa National Park), it is currently being frequently encountered. Among Coccinellidae that overwinter in the litter of Vistula willow-poplar riparian forests, it is a definite dominant (CERYNGIER & GODEAU 2013).

The densities of overwintering Coccinellidae reported in this study were relatively high. On the verges of the Kampinos Forest in semi-natural habitats of barren vegetation with self-sown pines (*Pinus sylvestris*), around 3 specimens overwintering at 1 m<sup>2</sup> (J. ROMANOWSKI & M. ROMANOWSKI, unpublished) were recorded in total; thus, two times fewer than the current average density of the overwintering ladybird beetles. Few other data from Poland and Europe (CERYNGIER 2015) also report a usually lower density of ladybirds overwintering in litter than in these studies. Therefore, it can be assumed that in the environmentally divergent suburban zone of Warsaw, convenient circumstances for overwintering are found there by Coccinellidae groupings that are rich in species and specimens.

## SUMMARY

The species richness and densities of ladybird beetles overwintering in the litter and on the ground surface of various habitats were studied in the municipality of Łomianki in the suburban zone of Warsaw (central Poland) between 11 December 2014 and 16 March 2015. The samples of the litter and an upper layer of soil were collected within a round frame of 41 cm diameter (0.13 m<sup>2</sup>) and sifted with an entomological sieve. The sifted material was placed in plastic bags and then sorted in the laboratory. Altogether, 310 samples were collected, including 161 samples from built-up areas, 89 from farmland, and 60 from highway roadsides. Majority of samples (275) were collected under a canopy of various trees, and the remaining ones (35) in open, grassy habitats.

In total, 274 specimens of 25 ladybird species were found, of which the most common was *Psyllobora vigintiduopunctata* (41.9% of all specimens). Other frequently recorded ladybirds were *Exochomus quadripustulatus*, *Propylea quatuordecimpunctata* and *Vibidia duodecimguttata*. Several of the species registered (*Rhyzobius litura*, *Hyperaspis concolor*, *Scymnus femoralis*, *Scymnus interruptus*, *Adalia conglomerata*) are considered rare in Poland. The highest densities of overwintering ladybirds were recorded in the samples from the farmland (average 10.2 specimens/m<sup>2</sup>), intermediate – in the samples from the built-up areas (average 6.9 specimens/m<sup>2</sup>), and the lowest – in the samples from the highway roadsides (average 1.3 specimens/m<sup>2</sup>).

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