

ARTHROPOD DIVERSITY (ARTHROPODA) ON ABANDONED APPLE TREES

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Received: February 28, 2013

Abstract

ŠŤASTNÁ PAVLA, PSOTA VÁCLAV: *Arthropod diversity (Arthropoda) on abandoned apple trees*. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 2013, LXI, No. 5, pp. 1405–1422

In 2010 and 2011, the occurrence of arthropods on apple trees without management was monitored near the village of Velké Bílovice, South Moravia, in two selected localities (an abandoned apple tree orchard and a road apple tree alley). Arthropods in tree tops were killed using deltamethrin applied with a fogger (Puls Fog). Each collection always contained the material from 5 trees in each site. In 2010, three collections were performed (28/4, 20/5, and 9/7), two in 2011 (11/5 and 23/6). Representatives of eleven orders were captured. Of all the orders trapped, Coleoptera was represented most frequently, the Hymenoptera and Diptera followed. In the alley, individuals of the Coleoptera (34%) were caught most frequently, the Hymenoptera (19.6%) and Hemiptera (17.4%) followed. In the orchard, the Coleoptera (41.4%) was represented most frequently, followed by the Hymenoptera (21.9%) and Diptera (15%). In both the environments, species with negative economic impact were recorded (e.g. *Anthonomus pyri*, *Tatianaerhynchites aequatus*, *Cydia pomonella*, *Rhynchites bacchus*). However, a greater number of pest antagonists were also found (*Scambus pomorum*, *Coccinella septempunctata*, *Episyrphus balteatus*, *Pentatoma rufipes*, *Orius* spp.). Some species were important in faunistic terms, as some critically endangered species were recorded (e.g. *Dipoea erythropus*, *Cryptocephalus schaefferi*), and the *Plectochorus iwatensis* species was recorded for the first time in the Czech Republic.

Arthropoda, *Malus domestica*, fogger, pest, natural enemies, diversity

Apple tree (*Malus domestica*) was brought to Europe with merchant expeditions from Asia to the Danube basin 5500 years ago (Prance & Nesbitt, 2005). In the territory of the Czech Republic, this fruit tree started to be widely grown during the reign of Charles IV (Stehlík, 1968). In 1752, during the reign of Maria-Theresa, a decree ordering to plant fruit trees (often apple trees) along all new roads was issued (Švédová, 2012). This means that the apple tree is a traditional tree that has occurred in the European landscape for hundreds of years. Nowadays, besides production apple tree orchards also those left for many years without any management can be found in the landscape. These include trees planted traditionally along roads, forming alleys. Apple trees without management in alleys and abandoned orchards can then represent a suitable environment for many species of insects. Some of these species are pests which can spread from these

abandoned apple trees to gardens and orchards. On the other hand, many of these species can belong to pest antagonists with rather a positive significance for agricultural practice. In terms of biodiversity protection, trees provide a suitable hide and feed for some insect species that otherwise could not occur in the intensively agriculturally used landscape. Generally, we presume that hundreds of arthropod species occur on apple trees. For example, Oatman *et al.* (1964) in their study conducted in 1959–1962 observed 763 species.

In this paper, we present partial results from an extensive study focused on the complex research of arthropod diversity on apple trees without management.

MATERIAL AND METHODS

The arthropod occurrence was monitored in South Moravia, near the village of Velké Bílovice

(Břeclav district), faunistic square 7167 over the period of 2010 and 2011. Two sites with apple trees grown without management were selected. The first site, for more than 10 years abandoned apple tree orchard, was situated 1.2 km north-east from the village outskirts (N 48°52'8.430", E 16°55'7.752"). Many trees in this site were heavily attacked by *Synanthedon myopaeformis*, some of the trees died due to this pest attack. Apparent succession processes led to the heavy occurrence of *Rosa canina* and *Sambucus nigra*. This orchard was surrounded by an irrigation reservoir from one side, a road and field from the other. The other site was an apple alley along the road surrounded by a field. This alley was situated approximately 1.6 km to the east from the outskirts of the village of Velké Bílovice (N 48°50'5.020", E 16°52'18.732"). The beeline distance between both the places is 5.2 km.

The arthropods were always captured during morning with the agent containing pyrethroid deltamethrin (50 g/l). Deltamethrin was added to the polyglycol aqueous solution containing 915.12 g/l of diethyleneglycol in ratio of 1:3 in favor of water. Concentration of the effective substance deltamethrin in the application liquid was 0.0025 g/l. The aerosol was dispersed in the tops of selected trees using a fogger device (Puls Fog).

Stunned and killed arthropods fell on a plastic sheet placed under the selected tree. Further, 15 minutes after the application, we shook the tree and collected the killed arthropods. The material obtained was then kept in 70% alcohol and subsequently assessed in the entomological laboratory.

Each collection always contained the material from 5 trees in each site. In 2010, three collections were performed (28/4, 20/5, and 9/7), two in 2011 (11/5 and 23/6). In each collection were selected other trees (total 50 trees).

RESULTS AND DISCUSSION

In the orchard, in both studied years, 28 species of the Araneae including 10 families in the total number of 153 individuals were detected (4.5%). In addition, 1408 individuals of the Coleoptera including 29 families (41.4%), 44 individuals of the Dermaptera including 1 family (1.3%), 510 individuals of the Diptera including 36 families (15%), 321 individuals of the Hemiptera (12 families, 9.4%), 745 individuals of the Hymenoptera of 15 families (21.9%), 128 individuals of the Lepidoptera of 6 families (3.8%), 3 individuals of the Mecoptera of 1 family (0.09%), 3 individuals of the Neuroptera of 2 families (0.09%), 6 individuals of the Orthoptera of 3 families (0.18%) and 81 individuals of the Psocoptera of 4 families (2.4%) were detected. The survey of all species captured is given in Tab. I.

In the alley, in both studied years, 176 individuals of the Araneae including 11 families (4.4%), 1350 individuals of the Coleoptera of 29 families (34%), 2 individuals of the Dermaptera of 1 family

(0.05%), 334 individuals of the Diptera including 30 families (8.4%), 691 individuals of the Hemiptera of 14 families (17.4%), 779 individuals of the Hymenoptera of 13 families (19.6%), 459 individuals of the Lepidoptera including 15 families (11.5%), 2 individuals of the Mecoptera of 1 family (0.05%), 17 individuals of the Neuroptera of 3 families (0.4%), 13 individuals of the Orthoptera of 2 families (0.3%), 151 individuals of the Psocoptera of 6 families (3.8%) and 2 families of the Raphidioptera of 1 family (0.05%) were detected. The survey of all species trapped is given in Tab. II. The size of the individual orders in the alley and orchard in both the followed years is given in Fig. 1.

Of the spiders one critically threatened species (*Dipoena erythropus*) and one threatened species (*Tmarus stellio*) were detected (Farkač *et al.*, 2005). Buchar (1993) developed a classification into three categories: RI – relic species of type 1 (species preferring climax and otherwise valuable habitat); R – relic species (abundant species with a clear link to the biotope), E – expansive species (species with non-specific binding to the habitat, often inhabiting biotopes strongly influenced by humans). Of the RI group, following species occurred in the orchard: *Gibbaranea bituberculata*, *Heliophanus aeneus*, *Pseudeuophrys obsoleta*, and *Ebrechtella tricuspidata*. The RI group in the alley included following species: *Gibbaranea bituberculata*, *Zilla diodia*, *Clubiona brevipes*, *C. compta*, *Ero aphana*, *Philodromus buchari*, *P. praedatus*, *Macaroesis nidicolens*, *Ebrechtella tricuspidata*, and *Synema globosum*.

More individuals of the Coleoptera were captured in the orchard, number of the detected families in the alley and orchard was the same. The captured families included namely predators (Cantharidae, Carabidae, Coccinellidae). *Scolytus rugulosus* and *S. mali* of the Coleoptera belong to pests of fruit trees, they damage in wood of dying trees (Rudinsky, 1962; Alford, 2007). In the orchard, both the species occurred and in the alley only *S. mali* was recorded. Buds of apple and pear trees are damaged by *Anthonomus pyri* (Stamenkovic & Pesic, 1998) which occurred abundantly in the alley, while in the orchard it was recorded only sporadically. *Tatianaerhynchites aequatus* was the most important pest of fruits of apple trees and other fruit trees captured in both sites and *Phyllobius oblongus* occurred frequently in the orchard. This phytophagous species can be a sporadic pest in fruit tree nurseries (Hluchý *et al.*, 2008). Other detected apple tree pests were *Rhynchites bacchus*, *Otiiorhynchus raucus*, *Neocoenorhinus minutus*, *Involvulus cupreus*. *Otiiorhynchus fullo* was found in the orchard abundantly (231 individuals), while its occurrence in the alley was only sporadic. Near threatened (NT) *Adrastus rachifer* of the Elateridae was found both in the orchard and alley, in the orchard its occurrence was relatively high (74 individuals), in the alley it occurred sporadically (9 individuals). In addition, a critically endangered (CR) *Dircaea australis* species (1 individual) of the Melandryidae was found in the

I: Individual species captured in the orchard in 2010–2011

order	family/subfamily/superfamily	species	frequency
Araneae	Anyphaenidae	<i>Anyphaena accentuata</i> (Walckenaer, 1802)	13
Araneae	Araneidae	<i>Araniella cucurbitina</i> (Clerck, 1758)	3
Araneae	Araneidae	<i>Gibbaranea bituberculata</i> (Walckenaer, 1802)	2
Araneae	Araneidae	<i>Larinioides patagiatus</i> (Clerck, 1758)	1
Araneae	Clubionidae	<i>Clubiona lutescens</i> Westring, 1851	2
Araneae	Dictynidae	<i>Dictyna pusilla</i> Thorell, 1856	29
Araneae	Dictynidae	<i>Dictyna uncinata</i> Thorell, 1856	24
Araneae	Linyphiidae	<i>Diplostyla concolor</i> (Wider, 1834)	1
Araneae	Linyphiidae	<i>Entelecara acuminata</i> (Wider, 1834)	2
Araneae	Linyphiidae	<i>Erigone dentipalpis</i> (Wider, 1834)	1
Araneae	Linyphiidae	<i>Meioneta rurestris</i> (C. L. Koch, 1836)	1
Araneae	Linyphiidae	<i>Oedothorax apicatus</i> (Blackwall, 1850)	3
Araneae	Linyphiidae	<i>Porrhomma pygmaeum</i> (Blackwall, 1834)	1
Araneae	Linyphiidae	<i>Trematocephalus cristatus</i> (Wider, 1834)	3
Araneae	Philodromidae	<i>Philodromus cespitum</i> (Walckenaer, 1802)	17
Araneae	Salticidae	<i>Ballus chalybeius</i> (Walckenaer, 1802)	2
Araneae	Salticidae	<i>Heliophanus aeneus</i> (Hahn, 1832)	2
Araneae	Salticidae	<i>Heliophanus auratus</i> C. L. Koch, 1835	7
Araneae	Salticidae	<i>Pseudeophrys obsoleta</i> (Simon, 1868)	1
Araneae	Salticidae	<i>Pseudicius encarpatus</i> (Walckenaer, 1802)	3
Araneae	Salticidae	<i>Salticus zebraneus</i> (C. L. Koch, 1837)	9
Araneae	Tetragnathidae	<i>Tetragnatha obtusa</i> C. L. Koch, 1837	2
Araneae	Theridiidae	<i>Diplocephalus erythropus</i> (Simon, 1881)	1
Araneae	Theridiidae	<i>Theridion mystaceum</i> L. Koch, 1870	1
Araneae	Thomisidae	<i>Ebrechtella tricuspidata</i> (Fabricius, 1775)	17
Araneae	Thomisidae	<i>Tmarus stellio</i> Simon, 1875	1
Araneae	Thomisidae	<i>Xysticus kochi</i> Thorell, 1872	1
Araneae	Thomisidae	<i>Xysticus ulmi</i> (Hahn, 1831)	3
Coleoptera	Anobiidae		1
Coleoptera	Anobiidae	<i>Ptinomorphus regalis</i> (Duftschmid, 1825)	2
Coleoptera	Anthribidae	<i>Bruchela suturalis</i> (Fabricius, 1792)	1
Coleoptera	Anthribidae	<i>Rhaphitropis marchica</i> (Herbst, 1797)	6
Coleoptera	Apionidae	<i>Exapion fuscirostre</i> (Fabricius, 1775)	1
Coleoptera	Apionidae		3
Coleoptera	Apionidae	<i>Protapion</i> spp.	1
Coleoptera	Attelabidae	<i>Involvulus cupreus</i> (Linnaeus, 1758)	1
Coleoptera	Attelabidae	<i>Nelasiornychites olivaceus</i> (Gyllenhal, 1833)	3
Coleoptera	Attelabidae	<i>Neocoenorhinus minutus</i> (Herbst, 1797)	6
Coleoptera	Attelabidae	<i>Rhynchites bacchus</i> (Linnaeus, 1758)	5
Coleoptera	Attelabidae	<i>Tatianaerhynchites aequatus</i> (Linnaeus, 1767)	5
Coleoptera	Cantharidae	<i>Cantharis fusca</i> Linnaeus, 1758	3
Coleoptera	Cantharidae	<i>Cantharis livida</i> ssp. <i>rufipes</i> Herbst, 1784	26
Coleoptera	Cantharidae	<i>Cantharis rustica</i> Fallén, 1807	13
Coleoptera	Cantharidae	<i>Metacantharis clypeata</i> (Illiger, 1798)	10
Coleoptera	Carabidae	<i>Amara aulica</i> (Panzer, 1796)	1
Coleoptera	Carabidae	<i>Dromius quadrimaculatus</i> (Linnaeus, 1758)	1
Coleoptera	Carabidae	<i>Microlestes fissuralis</i> Reitter, 1901	1
Coleoptera	Carabidae	<i>Paradromius linearis</i> (Olivier, 1795)	6

order	family/subfamily/superfamily	species	frequency
Coleoptera	Carabidae	<i>Paradromius longiceps</i> (Dejean, 1826)	1
Coleoptera	Cerambycidae	<i>Cerambyx scopoli</i> Füssli, 1775	2
Coleoptera	Cerambycidae	<i>Dinoptera collaris</i> (Linnaeus, 1758)	5
Coleoptera	Cerambycidae	<i>Leiopus nebulosus</i> (Linnaeus, 1758)	6
Coleoptera	Cerambycidae	<i>Pogonocherus hispidus</i> (Linnaeus, 1758)	22
Coleoptera	Cerambycidae	<i>Tetrops praeustus</i> (Linnaeus, 1758)	16
Coleoptera	Cleridae	<i>Clerus mutillarius</i> Fabricius, 1775	1
Coleoptera	Coccinellidae	<i>Adalia decempunctata</i> (Linnaeus, 1758)	4
Coleoptera	Coccinellidae	<i>Coccinella septempunctata</i> Linnaeus, 1758	9
Coleoptera	Coccinellidae	<i>Exochomus quadripustulatus</i> (Linnaeus, 1758)	1
Coleoptera	Coccinellidae	<i>Harmonia axyridis</i> (Pallas, 1773)	4
Coleoptera	Coccinellidae	<i>Harmonia quadripunctata</i> (Pontoppidan, 1763)	1
Coleoptera	Coccinellidae	<i>Chilocorus renipustulatus</i> (L.G. Scriba, 1791)	4
Coleoptera	Coccinellidae	<i>Oenopia conglobata</i> (Linnaeus, 1758)	1
Coleoptera	Coccinellidae	<i>Propylea quatuordecimpunctata</i> (Linnaeus, 1758)	2
Coleoptera	Coccinellidae	<i>Scymnus</i> spp.	5
Coleoptera	Cryptophagidae		27
Coleoptera	Curculionidae	<i>Anthonomus pyri</i> Kollar, 1837	4
Coleoptera	Curculionidae	<i>Ceutorhynchus</i> spp.	7
Coleoptera	Curculionidae	<i>Magdalis</i> spp.	3
Coleoptera	Curculionidae	<i>Otiorhynchus fullo</i> (Schrank, 1781)	231
Coleoptera	Curculionidae	<i>Otiorhynchus raucus</i> (Fabricius, 1777)	6
Coleoptera	Curculionidae	<i>Phyllobius oblongus</i> (Linnaeus, 1758)	461
Coleoptera	Curculionidae	<i>Phyllobius</i> spp.	53
Coleoptera	Curculionidae	<i>Scolytus mali</i> (Bechstein, 1805)	4
Coleoptera	Curculionidae	<i>Scolytus rugulosus</i> (P.W. J. Müller, 1818)	3
Coleoptera	Curculionidae	<i>Sitona</i> spp.	4
Coleoptera	Curculionidae	<i>Tanymecus palliatus</i> (Fabricius, 1787)	1
Coleoptera	Dasytidae	<i>Dasytes aeratus</i> Stephens, 1829	2
Coleoptera	Dasytidae	<i>Dasytes plumbeus</i> (O.F. Müller, 1776)	1
Coleoptera	Dasytidae	<i>Dasytes virens</i> (Marshall, 1802)	1
Coleoptera	Elateridae	<i>Adrastus rachifer</i> (Fourcroy, 1785)	74
Coleoptera	Erotylidae	<i>Triplax russica</i> (Linnaeus, 1758)	3
Coleoptera	Cholevidae	<i>Ptomaphagus sericatus</i> (Chaudoir, 1845)	1
Coleoptera	Chrysomelidae	<i>Aphthona euphorbiae</i> (Schrank, 1781)	3
Coleoptera	Chrysomelidae	<i>Crepidodera aurea</i> (Geoffroy, 1785)	2
Coleoptera	Chrysomelidae	<i>Epitrix pubescens</i> (Koch, 1803)	14
Coleoptera	Chrysomelidae	<i>Chaetocnema picipes</i> Stephens, 1831	1
Coleoptera	Chrysomelidae	<i>Leptinotarsa decemlineata</i> (Say, 1824)	1
Coleoptera	Chrysomelidae	<i>Longitarsus</i> spp.	1
Coleoptera	Chrysomelidae	<i>Oulema melanopus</i> (Linnaeus, 1758)	1
Coleoptera	Chrysomelidae	<i>Phaedon cochleariae</i> (Fabricius, 1792)	1
Coleoptera	Chrysomelidae	<i>Phyllotreta cruciferae</i> (Goeze, 1777)	12
Coleoptera	Chrysomelidae	<i>Phyllotreta vittula</i> (L. Redtenbacher, 1849)	2
Coleoptera	Chrysomelidae	<i>Psylliodes dulcamarae</i> (Koch, 1803)	2
Coleoptera	Chrysomelidae	<i>Psylliodes picinus</i> (Marshall, 1802)	1
Coleoptera	Latridiidae		149
Coleoptera	Malachiidae	<i>Anthocomus equestris</i> (Fabricius, 1781)	1
Coleoptera	Malachiidae	<i>Malachius bipustulatus</i> (Linnaeus, 1758)	1

order	family/subfamily/superfamily	species	frequency
Coleoptera	Melandryidae	<i>Dircaea australis</i> Fairmaire, 1856	1
Coleoptera	Mordellidae		2
Coleoptera	Nitidulidae	<i>Meligethes</i> spp.	32
Coleoptera	Phalacridae		1
Coleoptera	Salpingidae	<i>Vincenzellus ruficollis</i> (Panzer, 1794)	2
Coleoptera	Salpingidae		18
Coleoptera	Scaphidiidae		1
Coleoptera	Scarabaeidae	<i>Valgus hemipterus</i> (Linnaeus, 1758)	1
Coleoptera	Scirtidae		3
Coleoptera	Scraptiidae	<i>Anaspis</i> spp.	75
Coleoptera	Staphylinidae		13
Coleoptera	Tenebrionidae	<i>Mycetochara humeralis</i> (Fabricius, 1787)	1
Dermaptera	Forficulidae	<i>Apterygida albipennis</i> (Megerle, 1825)	41
Dermaptera	Forficulidae	<i>Forficula auricularia</i> Linnaeus, 1758	3
Diptera	Agromyzidae		5
Diptera	Anthomyiidae		4
Diptera	Asteiidae		1
Diptera	Bibionidae		2
Diptera	Calliphoridae		1
Diptera	Cecidomyiidae		3
Diptera	Ceratopogonidae		13
Diptera	Culicidae		1
Diptera	Dolichopodidae		8
Diptera	Drosophilidae		12
Diptera	Empididae		5
Diptera	Heleomyzidae		1
Diptera	Hybotidae		164
Diptera	Chaoboridae		2
Diptera	Chironomidae		117
Diptera	Chloropidae		20
Diptera	Lauxaniidae		42
Diptera	Limoniidae		4
Diptera	Lonchaeidae		1
Diptera	Megamerinidae		1
Diptera	Muscidae		17
Diptera	Opomyzidae		1
Diptera	Pallopteridae	<i>Palloptera umbellatarum</i> (Fabricius, 1775)	2
Diptera	Phoridae		7
Diptera	Piophilidae		1
Diptera	Pipunculidae		1
Diptera	Platystomatidae	<i>Platystoma seminationis</i> (Fabricius, 1775)	5
Diptera	Psilidae		6
Diptera	Sciaridae		48
Diptera	Sciomyzidae	<i>Trypetoptera punctulata</i> (Scopoli, 1763)	1
Diptera	Sepsidae		2
Diptera	Simuliidae		3
Diptera	Stratiomyiidae		2
Diptera	Tephritidae	<i>Oxyna parietina</i> (Linnaeus, 1758)	2
Diptera	Trichoceridae		3

order	family/subfamily/superfamily	species	frequency
Diptera	Ulidiidae	<i>Otites centralis</i> (Fabricius, 1805)	2
Hemiptera	Anthocoridae	<i>Anthocoris nemoralis</i> (Fabricius, 1794)	3
Hemiptera	Anthocoridae	<i>Orius</i> spp.	12
Hemiptera	Anthocoridae		17
Hemiptera	Aphidoidea		92
Hemiptera	Aradidae	<i>Aneurus avenius</i> (Dufour, 1833)	2
Hemiptera	Cicadellidae	<i>Edwardsiana crataegi</i> (Douglas, 1876)	1
Hemiptera	Cicadellidae	<i>Edwardsiana</i> spp.	4
Hemiptera	Cicadellidae	<i>Empoasca vitis</i> (Göthe, 1875)	23
Hemiptera	Cicadellidae	<i>Errastunus ocellaris</i> (Fallén, 1806)	1
Hemiptera	Cicadellidae	<i>Evacanthus interruptus</i> (Linnaeus, 1758)	3
Hemiptera	Coreidae	<i>Coreus marginatus</i> (Linnaeus, 1758)	1
Hemiptera	Lygaeidae	<i>Kleidocerys resedae</i> (Panzer, 1797)	1
Hemiptera	Miridae	<i>Apolygus lucorum</i> (Meyer-Dür, 1843)	1
Hemiptera	Miridae	<i>Atractotomus</i> spp.	2
Hemiptera	Miridae	<i>Deraeocoris ruber</i> (Linnaeus, 1758)	3
Hemiptera	Miridae	<i>Halticus saltator</i> (Geoffroy, 1785)	1
Hemiptera	Miridae	<i>Heterotoma planicornis</i> (Pallas, 1772)	1
Hemiptera	Miridae	<i>Heterotoma</i> spp.	8
Hemiptera	Miridae	<i>Megaloceroea recticornis</i> (Geoffroy, 1785)	1
Hemiptera	Miridae	<i>Orthotylus prasinus</i> (Fallén, 1829)	2
Hemiptera	Miridae	<i>Orthotylus</i> spp.	1
Hemiptera	Miridae	<i>Phytocoris</i> spp.	12
Hemiptera	Miridae	<i>Phytocoris ulmi</i> (Linnaeus, 1758)	1
Hemiptera	Miridae	<i>Pilophorus</i> spp.	4
Hemiptera	Miridae	<i>Stenodema calcarata</i> (Fallén, 1807)	1
Hemiptera	Miridae	<i>Stenotus binotatus</i> (Fabricius, 1794)	1
Hemiptera	Miridae		6
Hemiptera	Nabidae	<i>Himacerus apterus</i> (Fabricius, 1798)	36
Hemiptera	Nabidae	<i>Himacerus mirmicoides</i> (O. Costa, 1834)	1
Hemiptera	Nabidae	<i>Nabis</i> spp.	1
Hemiptera	Pentatomidae	<i>Graphosoma lineatum</i> (Linnaeus, 1758)	2
Hemiptera	Pentatomidae	<i>Pentatoma rufipes</i> (Linnaeus, 1758)	8
Hemiptera	Psyllidae	<i>Cacopsylla mali</i> (Schmidberger, 1836)	48
Hemiptera	Psyllidae	<i>Cacopsylla melanoneura</i> (Förster, 1848)	6
Hemiptera	Psyllidae	<i>Cacopsylla picta</i> (Foerster, 1848)	8
Hemiptera	Psyllidae	<i>Cacopsylla pyrisuga</i> (Förster, 1848)	1
Hemiptera	Psyllidae	<i>Cacopsylla saliceti</i> (Förster, 1848)	2
Hemiptera	Rhyparochromidae		1
Hemiptera	Tingidae	<i>Stephanitis pyri</i> (Fabricius, 1775)	1
Hemiptera	Tingidae	<i>Tingis crispata</i> (Herrich-Schäffer, 1838)	1
Hymenoptera	Braconidae	<i>Ascogaster</i> spp.	4
Hymenoptera	Braconidae		60
Hymenoptera	Cephidae	<i>Janus compressus</i> (Fabricius, 1793)	1
Hymenoptera	Crabronidae	<i>Crabro</i> spp.	3
Hymenoptera	Crabronidae	<i>Passaloecus</i> spp.	4
Hymenoptera	Crabronidae	<i>Pemphredon</i> spp.	1
Hymenoptera	Crabronidae	<i>Spilomena troglodytes</i> (Van der Linden, 1829)	5
Hymenoptera	Crabronidae	<i>Trypoxylon</i> spp.	3

order	family/subfamily/superfamily	species	frequency
Hymenoptera	Diapriidae		2
Hymenoptera	Ichneumonidae/Diplazontinae		1
Hymenoptera	Eupelmidae		1
Hymenoptera	Eurytomidae		13
Hymenoptera	Formicidae	<i>Camponotus fallax</i> (Nylander, 1856)	2
Hymenoptera	Formicidae	<i>Dolichoderus quadripunctatus</i> (Linnaeus, 1771)	36
Hymenoptera	Formicidae	<i>Formica cunicularia</i> Latreille, 1798	69
Hymenoptera	Formicidae	<i>Formica rufibarbis</i> Fabricius, 1793	32
Hymenoptera	Formicidae	<i>Lasius brunneus</i> (Latreille, 1798)	51
Hymenoptera	Formicidae	<i>Lasius niger</i> (Linnaeus, 1758)	302
Hymenoptera	Formicidae	<i>Myrmica sabuleti</i> Meinert, 1860	1
Hymenoptera	Formicidae	<i>Temnothorax affinis</i> (Mayr, 1855)	27
Hymenoptera	Formicidae	<i>Tetramorium</i> spp.	2
Hymenoptera	Halictidae		1
Hymenoptera	Chalcidoidea		88
Hymenoptera	Chrysidae		1
Hymenoptera	Cynipidae		1
Hymenoptera	Ichneumonidae	<i>Clistopyga incitator</i> (Fabricius, 1793)	1
Hymenoptera	Ichneumonidae	<i>Gelis areator</i> (Panzer, 1804)	5
Hymenoptera	Ichneumonidae	<i>Gelis</i> spp.	1
Hymenoptera	Ichneumonidae	<i>Itopectis maculator</i> (Fabricius, 1775)	2
Hymenoptera	Ichneumonidae	<i>Xorides gravenhorstii</i> (Curtis, 1831)	2
Hymenoptera	Ichneumonidae		2
Hymenoptera	Ichneumonidae/Campopleginae		3
Hymenoptera	Ichneumonidae/Cryptinae		3
Hymenoptera	Ichneumonidae/Ctenopelmatinae		1
Hymenoptera	Ichneumonidae/Diplazontinae		1
Hymenoptera	Ichneumonidae/Orthocentrinae		2
Hymenoptera	Ichneumonidae/Pimplinae		1
Hymenoptera	Pompilidae		1
Hymenoptera	Tenthredinidae	<i>Cladius pectinicornis</i> (Geoffroy in Fourcroy, 1785)	1
Hymenoptera	Tenthredinidae	<i>Dolerus</i> spp.	1
Hymenoptera	Tenthredinidae		3
Hymenoptera	Torymidae		4
Lepidoptera	Geometridae	<i>Operophtera brumata</i> (Linnaeus, 1758)	20
Lepidoptera	Geometridae		5
Lepidoptera	Lymantriidae	<i>Euproctis chrysorrhoea</i> (Linnaeus, 1758)	35
Lepidoptera	Noctuidae	<i>Amphipyra pyramidea</i> (Linnaeus, 1758)	1
Lepidoptera	Noctuidae	<i>Cosmia trapezina</i> (Linnaeus, 1758)	23
Lepidoptera	Noctuidae		26
Lepidoptera	Oecophoridae	<i>Crassa unitella</i> (Hübner, 1796)	1
Lepidoptera	Pyalidae		6
Lepidoptera	Tortricidae	<i>Cnephasia pasiuana</i> (Hübner, 1799)	1
Lepidoptera	Tortricidae		10
Mecoptera	Panorpidae	<i>Panorpa communis</i> Linnaeus, 1758	1
Mecoptera	Panorpidae	<i>Panorpa vulgaris</i> Imhoff & Labram, 1845	2
Neuroptera	Chrysopidae	<i>Chrysoperla carnea</i> (Stephens, 1836)	1
Neuroptera	Coniopterygidae		2

order	family/subfamily/superfamily	species	frequency
Orthoptera	Acrididae	<i>Chorthippus</i> spp.	1
Orthoptera	Tetrigidae	<i>Tetrix tenuicornis</i> (Sahlberg, 1891)	1
Orthoptera	Tettigoniidae	<i>Phaneroptera falcata</i> (Poda, 1761)	3
Orthoptera	Tettigoniidae	<i>Tettigonia viridissima</i> Linnaeus, 1758	1
Psocoptera	Caeciliusidae	<i>Valenzuela flavidus</i> (Stephens, 1836)	2
Psocoptera	Peripsocidae	<i>Peripsocus alboguttatus</i> (Dalman, 1823)	1
Psocoptera	Peripsocidae	<i>Peripsocus subfasciatus</i> (Rambur, 1842)	1
Psocoptera	Philotarsidae	<i>Philotarsus parviceps</i> Roesler, 1954	1
Psocoptera	Psocidae	<i>Blaste quadrimaculata</i> (Latreille, 1794)	36
Psocoptera	Psocidae	<i>Metlyphorus nebulosus</i> (Stephens, 1836)	27
Psocoptera	Psocidae	<i>Psococerastis gibbosa</i> (Sulzer, 1776)	12
Psocoptera	Psocidae	<i>Trichadenotecnum majus</i> (Kolbe, 1880)	1

II: Individual species captured in the alley in 2010–2011

order	family/subfamily/superfamily	species	frequency
Araneae	Anyphaenidae	<i>Anyphaena accentuata</i> (Walckenaer, 1802)	1
Araneae	Araneidae	<i>Araneus sturmi</i> (Hahn, 1831)	4
Araneae	Araneidae	<i>Araneus triguttatus</i> (Fabricius, 1775)	2
Araneae	Araneidae	<i>Araniella cucurbitina</i> (Clerck, 1758)	27
Araneae	Araneidae	<i>Gibbaranea bituberculata</i> (Walckenaer, 1802)	1
Araneae	Araneidae	<i>Larinioides patagiatus</i> (Clerck, 1758)	8
Araneae	Araneidae	<i>Mangora acalypha</i> (Walckenaer, 1802)	3
Araneae	Araneidae	<i>Nuctenea umbratica</i> (Clerck, 1758)	1
Araneae	Araneidae	<i>Zilla diodia</i> (Walckenaer, 1802)	2
Araneae	Clubionidae	<i>Clubiona brevipes</i> Blackwall, 1841	16
Araneae	Clubionidae	<i>Clubiona comta</i> C. L. Koch, 1839	2
Araneae	Clubionidae	<i>Clubiona pallidula</i> (Clerck, 1758)	1
Araneae	Dictynidae	<i>Dictyna civica</i> (Lucas, 1850)	1
Araneae	Dictynidae	<i>Dictyna uncinata</i> Thorell, 1856	3
Araneae	Linyphiidae	<i>Erigone atra</i> Blackwall, 1833	2
Araneae	Linyphiidae	<i>Erigone dentipalpis</i> (Wider, 1834)	2
Araneae	Linyphiidae	<i>Meioneta rurestris</i> (C. L. Koch, 1836)	2
Araneae	Linyphiidae	<i>Oedothorax apicatus</i> (Blackwall, 1850)	2
Araneae	Linyphiidae	<i>Porrhomma microphthalmum</i> (O. P.-Cambridge, 1871)	1
Araneae	Linyphiidae	<i>Porrhomma pygmaeum</i> (Blackwall, 1834)	1
Araneae	Linyphiidae	<i>Tenuiphantes tenuis</i> (Blackwall, 1852)	1
Araneae	Mimetidae	<i>Ero aphana</i> (Walckenaer, 1802)	2
Araneae	Philodromidae	<i>Philodromus albidus</i> Kulczyński, 1911	1
Araneae	Philodromidae	<i>Philodromus buchari</i> Kubcová, 2004	1
Araneae	Philodromidae	<i>Philodromus cespitum</i> (Walckenaer, 1802)	12
Araneae	Philodromidae	<i>Philodromus praedatus</i> O. P.-Cambridge, 1871	1
Araneae	Salticidae	<i>Ballus chalybeius</i> (Walckenaer, 1802)	3
Araneae	Salticidae	<i>Evarcha arcuata</i> (Clerck, 1758)	1
Araneae	Salticidae	<i>Macaroeris nidicolens</i> (Walckenaer, 1802)	6
Araneae	Salticidae	<i>Pseudicius encarpatus</i> (Walckenaer, 1802)	2
Araneae	Salticidae	<i>Salticus zebraneus</i> (C. L. Koch, 1837)	6
Araneae	Tetragnathidae	<i>Tetragnatha nigrita</i> Lendl, 1886	1
Araneae	Theridiidae	<i>Anelosimus vittatus</i> (C. L. Koch, 1836)	2

order	family/subfamily/superfamily	species	frequency
Araneae	Theridiidae	<i>Phylloneta impressa</i> (L. Koch, 1881)	14
Araneae	Theridiidae	<i>Robertus arundineti</i> (O. P.-Cambridge, 1871)	1
Araneae	Theridiidae	<i>Simitidion simile</i> (C. L. Koch, 1836)	4
Araneae	Theridiidae	<i>Theridion mystaceum</i> L. Koch, 1870	10
Araneae	Theridiidae	<i>Theridion pinastri</i> L. Koch, 1872	3
Araneae	Thomisidae	<i>Ebrechtella tricuspidata</i> (Fabricius, 1775)	17
Araneae	Thomisidae	<i>Misumena vatia</i> (Clerck, 1758)	1
Araneae	Thomisidae	<i>Pistius truncatus</i> (Pallas, 1772)	1
Araneae	Thomisidae	<i>Synema globosum</i> (Fabricius, 1775)	2
Araneae	Thomisidae	<i>Xysticus lanio</i> C. L. Koch, 1835	1
Araneae	Thomisidae	<i>Xysticus ulmi</i> (Hahn, 1831)	1
Coleoptera	Aderidae		1
Coleoptera	Anobiidae	<i>Ptinomorphus regalis</i> (Duftschmid, 1825)	1
Coleoptera	Anobiidae		1
Coleoptera	Anthicidae	<i>Anthicus antherinus</i> (Linnaeus, 1761)	1
Coleoptera	Anthicidae	<i>Notoxus monoceros</i> (Linnaeus, 1761)	5
Coleoptera	Anthicidae		1
Coleoptera	Anthribidae	<i>Dissoleucas niveirostris</i> (Fabricius, 1798)	40
Coleoptera	Anthribidae	<i>Rhaphitropis marchica</i> (Herbst, 1797)	4
Coleoptera	Apionidae	<i>Protapion</i> spp.	3
Coleoptera	Apionidae		5
Coleoptera	Attelabidae	<i>Neocoenorhinus minutus</i> (Herbst, 1797)	218
Coleoptera	Attelabidae	<i>Rhynchites bacchus</i> (Linnaeus, 1758)	33
Coleoptera	Attelabidae	<i>Tatianaerhynchites aequatus</i> (Linnaeus, 1767)	41
Coleoptera	Cantharidae	<i>Cantharis fusca</i> Linnaeus, 1758	5
Coleoptera	Cantharidae	<i>Cantharis lateralis</i> Linnaeus, 1758	1
Coleoptera	Cantharidae	<i>Cantharis livida</i> ssp. <i>rufipes</i> Herbst, 1784	40
Coleoptera	Cantharidae	<i>Cantharis rustica</i> Fallén, 1807	8
Coleoptera	Cantharidae	<i>Metacantharis clypeata</i> (Illiger, 1798)	39
Coleoptera	Cantharidae	<i>Rhagonycha fulva</i> (Scopoli, 1763)	4
Coleoptera	Cantharidae	<i>Rhagonycha</i> spp.	1
Coleoptera	Carabidae	<i>Acupalpus meridianus</i> (Linnaeus, 1761)	1
Coleoptera	Carabidae	<i>Anchomenus dorsalis</i> (Pontoppidan, 1763)	2
Coleoptera	Carabidae	<i>Calodromius spilotus</i> (Illiger, 1798)	4
Coleoptera	Carabidae	<i>Dromius quadrimaculatus</i> (Linnaeus, 1758)	10
Coleoptera	Carabidae	<i>Philorhizus notatus</i> (Stephens, 1827)	1
Coleoptera	Cerambycidae	<i>Dinoptera collaris</i> (Linnaeus, 1758)	1
Coleoptera	Cerambycidae	<i>Exocentrus adpersus</i> Mulsant, 1846	1
Coleoptera	Cerambycidae	<i>Pogonocherus hispidus</i> (Linnaeus, 1758)	9
Coleoptera	Coccinellidae	<i>Adalia decempunctata</i> (Linnaeus, 1758)	19
Coleoptera	Coccinellidae	<i>Anatis ocellata</i> (Linnaeus, 1758)	2
Coleoptera	Coccinellidae	<i>Coccinella septempunctata</i> Linnaeus, 1758	13
Coleoptera	Coccinellidae	<i>Exochomus quadripustulatus</i> (Linnaeus, 1758)	1
Coleoptera	Coccinellidae	<i>Halysia sedecimpunctata</i> (Linnaeus, 1758)	1
Coleoptera	Coccinellidae	<i>Harmonia axyridis</i> (Pallas, 1773)	20
Coleoptera	Coccinellidae	<i>Chilocorus renipustulatus</i> (L.G. Scriba, 1791)	3
Coleoptera	Coccinellidae	<i>Oenopia conglobata</i> (Linnaeus, 1758)	2
Coleoptera	Coccinellidae	<i>Propylea quatuordecimpunctata</i> (Linnaeus, 1758)	28
Coleoptera	Coccinellidae	<i>Psyllobora vigintiduopunctata</i> (Linnaeus, 1758)	3

order	family/subfamily/superfamily	species	frequency
Coleoptera	Coccinellidae	<i>Scymnus</i> spp.	12
Coleoptera	Coccinellidae	<i>Tytthaspis sedecimpunctata</i> (Linnaeus, 1761)	1
Coleoptera	Coccinellidae	<i>Vibidia duodecimguttata</i> (Poda, 1761)	3
Coleoptera	Coccinellidae		3
Coleoptera	Cryptophagidae		5
Coleoptera	Curculionidae	<i>Anthonomus pomorum</i> (Linnaeus, 1758)	5
Coleoptera	Curculionidae	<i>Anthonomus pyri</i> Kollar, 1837	74
Coleoptera	Curculionidae	<i>Ceutorhynchus</i> spp.	3
Coleoptera	Curculionidae	<i>Curculio</i> spp.	1
Coleoptera	Curculionidae	<i>Eusomus ovulum</i> Germar, 1824	1
Coleoptera	Curculionidae	<i>Larinus turbinatus</i> Gyllenhal, 1835	1
Coleoptera	Curculionidae	<i>Magdalis</i> spp.	22
Coleoptera	Curculionidae	<i>Mecinus</i> spp.	2
Coleoptera	Curculionidae	<i>Orchestes</i> spp.	29
Coleoptera	Curculionidae	<i>Otiorhynchus fullo</i> (Schrank, 1781)	5
Coleoptera	Curculionidae	<i>Otiorhynchus raucus</i> (Fabricius, 1777)	1
Coleoptera	Curculionidae	<i>Phyllobius oblongus</i> (Linnaeus, 1758)	13
Coleoptera	Curculionidae	<i>Phyllobius</i> spp.	58
Coleoptera	Curculionidae	<i>Polydrusus picus</i> (Fabricius, 1792)	8
Coleoptera	Curculionidae	<i>Scolytus mali</i> (Bechstein, 1805)	5
Coleoptera	Curculionidae	<i>Scolytus rugulosus</i> (P.W. J. Müller, 1818)	14
Coleoptera	Curculionidae	<i>Sitona</i> spp.	23
Coleoptera	Dasytidae	<i>Dasytes aeratus</i> Stephens, 1829	5
Coleoptera	Dasytidae	<i>Dasytes plumbeus</i> (O.F. Müller, 1776)	3
Coleoptera	Dytiscidae		1
Coleoptera	Elateridae	<i>Adrastus rachifer</i> (Fourcroy, 1785)	9
Coleoptera	Elateridae	<i>Agriotes sputator</i> (Linnaeus, 1758)	3
Coleoptera	Elateridae	<i>Agrypnus murinus</i> (Linnaeus, 1758)	2
Coleoptera	Elateridae	<i>Athous haemorrhoidalis</i> (Fabricius, 1801)	2
Coleoptera	Elateridae	<i>Hemicrepidius hirtus</i> (Herbst, 1784)	1
Coleoptera	Elateridae	<i>Limonius minutus</i> (Linnaeus, 1758)	3
Coleoptera	Elateridae	<i>Melanotus castanipes</i> (Paykull, 1800)	1
Coleoptera	Elateridae	<i>Sericus brunneus</i> (Linnaeus, 1758)	1
Coleoptera	Hydrophilidae	<i>Helophorus</i> spp.	1
Coleoptera	Hydrophilidae		1
Coleoptera	Chrysomelidae	<i>Altica</i> spp.	3
Coleoptera	Chrysomelidae	<i>Bruchidius</i> spp.	1
Coleoptera	Chrysomelidae	<i>Crepidodera aurata</i> (Marsham, 1802)	1
Coleoptera	Chrysomelidae	<i>Cryptocephalus schaefferi</i> Schrank, 1789	1
Coleoptera	Chrysomelidae	<i>Epitrix pubescens</i> (Koch, 1803)	23
Coleoptera	Chrysomelidae	<i>Chaetocnema aridula</i> (Gyllenhal, 1827)	1
Coleoptera	Chrysomelidae	<i>Chaetocnema hortensis</i> (Geoffroy, 1785)	1
Coleoptera	Chrysomelidae	<i>Chaetocnema picipes</i> Stephens, 1831	4
Coleoptera	Chrysomelidae	<i>Luperus luperus</i> (Sulzer, 1776)	65
Coleoptera	Chrysomelidae	<i>Luperus xanthopoda</i> (Schrank, 1781)	4
Coleoptera	Chrysomelidae	<i>Orsodacne cerasi</i> (Linnaeus, 1758)	2
Coleoptera	Chrysomelidae	<i>Oulema gallaeciana</i> (Heyden, 1870)	2
Coleoptera	Chrysomelidae	<i>Oulema melanopus</i> (Linnaeus, 1758)	4
Coleoptera	Chrysomelidae	<i>Phyllotreta cruciferae</i> (Goeze, 1777)	6

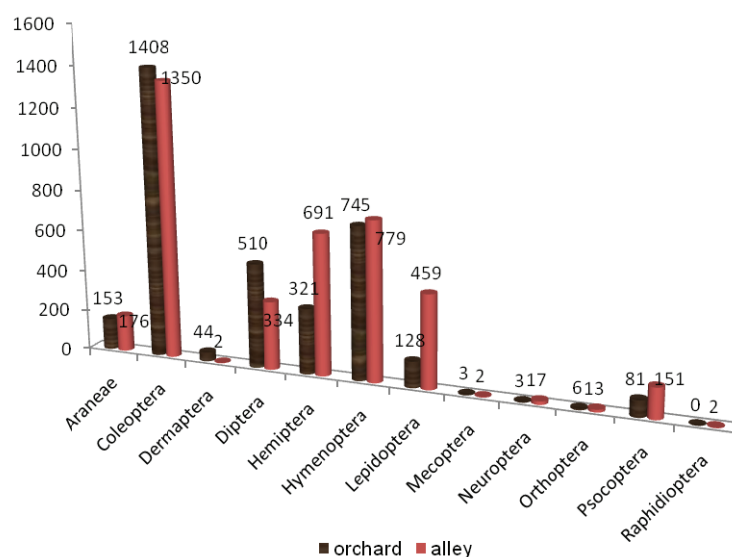
order	family/subfamily/superfamily	species	frequency
Coleoptera	Chrysomelidae	<i>Phyllotreta undulata</i> (Kutschera, 1860)	1
Coleoptera	Chrysomelidae	<i>Phyllotreta vittula</i> (L. Redtenbacher, 1849)	7
Coleoptera	Chrysomelidae	<i>Psylliodes chrysocephalus</i> (Linnaeus, 1758)	21
Coleoptera	Latridiidae		77
Coleoptera	Malachiidae	<i>Anthocomus equestris</i> (Fabricius, 1781)	6
Coleoptera	Malachiidae	<i>Malachius bipustulatus</i> (Linnaeus, 1758)	2
Coleoptera	Mordellidae		1
Coleoptera	Nitidulidae	<i>Glischrochilus hortensis</i> (Fourcroy, 1775)	6
Coleoptera	Nitidulidae	<i>Meligethes</i> spp.	95
Coleoptera	Oedemeridae	<i>Oedemera femorata</i> (Scopoli, 1763)	2
Coleoptera	Phalacridae		9
Coleoptera	Salpingidae		2
Coleoptera	Scarabaeidae	<i>Calamosternus granarius</i> (Linnaeus, 1767)	1
Coleoptera	Scarabaeidae	<i>Chilo thorax distinctus</i> (O.F. Müller, 1776)	1
Coleoptera	Scarabaeidae	<i>Pleurophorus caesus</i> (Creutzer in Panzer, 1796)	2
Coleoptera	Scarabaeidae	<i>Protaetia cuprea</i> (Fabricius, 1775)	1
Coleoptera	Scarabaeidae	<i>Tropinota hirta</i> (Poda, 1761)	1
Coleoptera	Scirtidae		6
Coleoptera	Scraptiidae	<i>Anaspis</i> spp.	79
Coleoptera	Staphylinidae	<i>Metopsia similis</i> Zerche, 1998	1
Coleoptera	Staphylinidae		12
Coleoptera	Tenebrionidae	<i>Lagria atripes</i> Mulsant, 1855	4
Dermaptera	Forficulidae	<i>Forficula auricularia</i> Linnaeus, 1758	2
Diptera	Agromyzidae		1
Diptera	Anisopodidae		1
Diptera	Anthomyiidae		12
Diptera	Bibionidae		22
Diptera	Calliphoridae		4
Diptera	Cecidomyiidae		5
Diptera	Ceratopogonidae		12
Diptera	Culicidae		3
Diptera	Dolichopodidae		40
Diptera	Drosophilidae		4
Diptera	Fanniidae		4
Diptera	Heleomyzidae		5
Diptera	Hybotidae		18
Diptera	Chironomidae		5
Diptera	Chloropidae		18
Diptera	Lauxaniidae		34
Diptera	Limoniidae		2
Diptera	Muscidae		37
Diptera	Opomyzidae		2
Diptera	Phoridae		6
Diptera	Piophilidae		1
Diptera	Pipunculidae		1
Diptera	Psychodidae		1
Diptera	Rhagionidae		1
Diptera	Scatopsidae		2
Diptera	Sciaridae		36

order	family/subfamily/superfamily	species	frequency
Diptera	Sepsidae		6
Diptera	Simuliidae		10
Diptera	Stratiomyiidae	<i>Pachygaster atra</i> (Panzer, 1798)	5
Diptera	Stratiomyiidae		8
Diptera	Syrphidae	<i>Episyrphus balteatus</i> (De Geer, 1776)	18
Diptera	Syrphidae		10
Hemiptera	Anthocoridae	<i>Anthocoris confusus</i> Reuter, 1884	1
Hemiptera	Anthocoridae	<i>Anthocoris nemoralis</i> (Fabricius, 1794)	12
Hemiptera	Anthocoridae	<i>Anthocoris</i> spp.	12
Hemiptera	Anthocoridae	<i>Orius minutus</i> (Linnaeus, 1758)	2
Hemiptera	Anthocoridae	<i>Orius</i> spp.	30
Hemiptera	Anthocoridae	<i>Temnostethus pusillus</i> (Herrich-Schäffer, 1835)	8
Hemiptera	Anthocoridae		50
Hemiptera	Aphidoidea		197
Hemiptera	Cicadellidae	<i>Allygidius abbreviatus</i> (Lethierry, 1878)	1
Hemiptera	Cicadellidae	<i>Allygidius atomarius</i> (Fabricius, 1794)	1
Hemiptera	Cicadellidae	<i>Allygus communis</i> (Ferrari, 1882)	2
Hemiptera	Cicadellidae	<i>Allygus modestus</i> Scott, 1876	2
Hemiptera	Cicadellidae	<i>Alnetoidia alneti</i> (Dahlbom, 1850)	1
Hemiptera	Cicadellidae	<i>Aphrodes bicinctus</i> (Schränk, 1776)	1
Hemiptera	Cicadellidae	<i>Aphrodes makarovi</i> Zachvatkin, 1948	3
Hemiptera	Cicadellidae	<i>Athysanus argentarius</i> Metcalf, 1955	1
Hemiptera	Cicadellidae	<i>Balclutha punctata</i> (Fabricius, 1775)	1
Hemiptera	Cicadellidae	<i>Edwardsiana rosae</i> (Linnaeus, 1758)	1
Hemiptera	Cicadellidae	<i>Empoasca vitis</i> (Göthe, 1875)	89
Hemiptera	Cicadellidae	<i>Errastunus ocellaris</i> (Fallén, 1806)	1
Hemiptera	Cicadellidae	<i>Evacanthus interruptus</i> (Linnaeus, 1758)	2
Hemiptera	Cicadellidae	<i>Ledra aurita</i> (Linnaeus, 1758)	1
Hemiptera	Cicadellidae	<i>Mocydia crocea</i> (Herrich-Schäffer, 1837)	1
Hemiptera	Cicadellidae	<i>Zygina flammigera</i> (Fourcroy, 1785)	1
Hemiptera	Cicadellidae	<i>Zygina schneideri</i> (Günthart, 1974)	1
Hemiptera	Cixiidae	<i>Cixius nervosus</i> (Linnaeus, 1758)	3
Hemiptera	Cixiidae	<i>Tachycixius pilosus</i> (Olivier, 1791)	1
Hemiptera	Coreidae	<i>Coreus marginatus</i> (Linnaeus, 1758)	4
Hemiptera	Coreidae		1
Hemiptera	Delphacidae	<i>Dicranotropis hamata</i> (Boheman, 1847)	2
Hemiptera	Lygaeidae	<i>Kleidocerys resedae</i> (Panzer, 1797)	1
Hemiptera	Lygaeidae	<i>Metopoplax origani</i> (Kolenati, 1845)	1
Hemiptera	Lygaeidae	<i>Platyplax salviae</i> (Schilling, 1829)	2
Hemiptera	Miridae	<i>Atractotomus mali</i> (Meyer-Dür, 1843)	7
Hemiptera	Miridae	<i>Criocoris crassicornis</i> (Hahn, 1834)	1
Hemiptera	Miridae	<i>Deraeocoris lutescens</i> (Schilling, 1836)	2
Hemiptera	Miridae	<i>Deraeocoris ruber</i> (Linnaeus, 1758)	9
Hemiptera	Miridae	<i>Harpocera hellenica</i> Reuter, 1876	8
Hemiptera	Miridae	<i>Harpocera thoracica</i> (Fallén, 1807)	1
Hemiptera	Miridae	<i>Heterotoma planicornis</i> (Pallas, 1772)	1
Hemiptera	Miridae	<i>Heterotoma</i> spp.	1
Hemiptera	Miridae	<i>Chlamydatus pullus</i> Reuter, 1870	1
Hemiptera	Miridae	<i>Isometopus intrusus</i> (Herrich-Schäffer, 1842)	1

order	family/subfamily/superfamily	species	frequency
Hemiptera	Miridae	<i>Megaloceroea recticornis</i> (Geoffroy, 1785)	1
Hemiptera	Miridae	<i>Orthonotus rufifrons</i> (Fallén, 1807)	1
Hemiptera	Miridae	<i>Orthotylus prasinus</i> (Fallén, 1829)	4
Hemiptera	Miridae	<i>Orthotylus</i> spp.	1
Hemiptera	Miridae	<i>Phytocoris reuteri</i> Saunders, 1875	1
Hemiptera	Miridae	<i>Phytocoris</i> spp.	2
Hemiptera	Miridae	<i>Pilophorus perplexus</i> Douglas & Scott, 1875	11
Hemiptera	Miridae	<i>Pilophorus</i> spp.	11
Hemiptera	Miridae	<i>Psallus perrisi</i> (Mulsant & Rey, 1852)	12
Hemiptera	Miridae	<i>Psallus</i> spp.	6
Hemiptera	Miridae	<i>Psallus wagneri</i> Ossiannilsson, 1953	9
Hemiptera	Miridae		4
Hemiptera	Nabidae	<i>Himacerus apterus</i> (Fabricius, 1798)	19
Hemiptera	Pentatomidae	<i>Palomena prasina</i> (Linnaeus, 1761)	1
Hemiptera	Pentatomidae	<i>Pentatoma rufipes</i> (Linnaeus, 1758)	62
Hemiptera	Pentatomidae	<i>Rhaphigaster nebulosa</i> (Poda, 1761)	1
Hemiptera	Pentatomidae	<i>Troilus luridus</i> (Fabricius, 1775)	1
Hemiptera	Piesmatidae	<i>Piesma maculatum</i> (Laporte, 1833)	16
Hemiptera	Psyllidae	<i>Cacopsylla mali</i> (Schmidberger, 1836)	6
Hemiptera	Psyllidae	<i>Cacopsylla melanoneura</i> (Förster, 1848)	4
Hemiptera	Psyllidae	<i>Cacopsylla picta</i> (Foerster, 1848)	14
Hemiptera	Rhopalidae	<i>Myrmus miriformis</i> (Fallén, 1807)	3
Hemiptera	Tingidae	<i>Physatocheila costata</i> (Fabricius, 1794)	1
Hemiptera	Tingidae	<i>Stephanitis pyri</i> (Fabricius, 1775)	29
Hemiptera	Tingidae		2
Hymenoptera	Aculeata		1
Hymenoptera	Aculeata/Halictinae		3
Hymenoptera	Bethylidae		1
Hymenoptera	Braconidae	<i>Ascogaster</i> spp.	8
Hymenoptera	Braconidae	<i>Chelonus</i> spp.	3
Hymenoptera	Braconidae		88
Hymenoptera	Braconidae/Aphidiinae		1
Hymenoptera	Cynipidae		4
Hymenoptera	Diapriidae		2
Hymenoptera	Eurytomidae		2
Hymenoptera	Formicidae	<i>Camponotus fallax</i> (Nylander, 1856)	2
Hymenoptera	Formicidae	<i>Dolichoderus quadripunctatus</i> (Linnaeus, 1771)	76
Hymenoptera	Formicidae	<i>Formica cunicularia</i> Latreille, 1798	23
Hymenoptera	Formicidae	<i>Formica pratensis</i> Retzius, 1783	26
Hymenoptera	Formicidae	<i>Formica rufibarbis</i> Fabricius, 1793	12
Hymenoptera	Formicidae	<i>Lasius brunneus</i> (Latreille, 1798)	1
Hymenoptera	Formicidae	<i>Lasius niger</i> (Linnaeus, 1758)	299
Hymenoptera	Formicidae	<i>Temnothorax affinis</i> (Mayr, 1855)	17
Hymenoptera	Formicidae	<i>Temnothorax crassispinus</i> (Karavaiev, 1926)	10
Hymenoptera	Chalcidoidea		79
Hymenoptera	Ichneumonidae	<i>Diplazon laetatorius</i> (Fabricius, 1781)	1
Hymenoptera	Ichneumonidae	<i>Gelis areator</i> (Panzer, 1804)	59
Hymenoptera	Ichneumonidae	<i>Gelis</i> spp.	1
Hymenoptera	Ichneumonidae	<i>Itopectis maculator</i> (Fabricius, 1775)	11

order	family/subfamily/superfamily	species	frequency
Hymenoptera	Ichneumonidae	<i>Lissonota</i> spp.	2
Hymenoptera	Ichneumonidae	<i>Pimpla contemplator</i> (Müller, 1776)	4
Hymenoptera	Ichneumonidae	<i>Plectochorus ivatensis</i> (Uchida, 1928)	1
Hymenoptera	Ichneumonidae	<i>Scambus pomorum</i> (Ratzeburg, 1848)	3
Hymenoptera	Ichneumonidae	<i>Tromatobia lineatoria</i> (Villers, 1789)	2
Hymenoptera	Ichneumonidae/Campopleginae		14
Hymenoptera	Ichneumonidae/Cryptinae		4
Hymenoptera	Ichneumonidae/Orthocentrinae		4
Hymenoptera	Ichneumonidae/Pimplinae		5
Hymenoptera	Ichneumonidae/Tersilochinae		8
Hymenoptera	Proctotrupidae		1
Hymenoptera	Torymidae		1
Lepidoptera	Adelidae	<i>Nematopogon swammerdamellus</i> (Linnaeus, 1758)	3
Lepidoptera	Arctiidae	<i>Hyphantria cunea</i> (Drury, 1773)	2
Lepidoptera	Coleophoridae	<i>Coleophora hemerobiella</i> (Scopoli, 1763)	9
Lepidoptera	Gelechiidae	<i>Recurvaria nanella</i> (Denis & Schiffermüller, 1775)	7
Lepidoptera	Gelechiidae		1
Lepidoptera	Geometridae	<i>Colotois pennaria</i> (Linnaeus, 1761)	4
Lepidoptera	Geometridae	<i>Ectropis crepuscularia</i> (Denis & Schiffermüller, 1775)	3
Lepidoptera	Geometridae	<i>Ematurga atomaria</i> (Linnaeus, 1758)	1
Lepidoptera	Geometridae	<i>Erannis defoliaria</i> (Clerck, 1759)	2
Lepidoptera	Geometridae	<i>Operophtera brumata</i> (Linnaeus, 1758)	133
Lepidoptera	Geometridae	<i>Selenia</i> spp.	3
Lepidoptera	Geometridae		21
Lepidoptera	Gracillariidae	<i>Callisto denticulella</i> (Thunberg, 1794)	2
Lepidoptera	Gracillariidae	<i>Parornix</i> spp.	2
Lepidoptera	Lasiocampidae	<i>Malacosoma neustria</i> (Linnaeus, 1758)	8
Lepidoptera	Lymantriidae	<i>Euproctis chrysorrhoea</i> (Linnaeus, 1758)	58
Lepidoptera	Lymantriidae	<i>Lymantria dispar</i> (Linnaeus, 1758)	6
Lepidoptera	Lymantriidae	<i>Orgyia antiqua</i> (Linnaeus, 1758)	4
Lepidoptera	Noctuidae	<i>Acronicta psi</i> (Linnaeus, 1758)	1
Lepidoptera	Noctuidae	<i>Amphipyra pyramidea</i> (Linnaeus, 1758)	1
Lepidoptera	Noctuidae	<i>Cosmia trapezina</i> (Linnaeus, 1758)	74
Lepidoptera	Noctuidae		68
Lepidoptera	Panorpidae	<i>Panorpa communis</i> Linnaeus, 1758	2
Lepidoptera	Psychidae		1
Lepidoptera	Pyalidae		6
Lepidoptera	Sesiidae	<i>Synanthedon myopaeformis</i> (Borkhausen, 1789)	2
Lepidoptera	Tortricidae	<i>Acleris holmiana</i> (Linnaeus, 1758)	4
Lepidoptera	Tortricidae	<i>Ancylis achatana</i> (Denis & Schiffermüller, 1775)	3
Lepidoptera	Tortricidae	<i>Cnephasia communana</i> (Herrich-Schäffer, 1851)	2
Lepidoptera	Tortricidae	<i>Cnephasia pasiuana</i> (Hübner, 1799)	7
Lepidoptera	Tortricidae	<i>Cydia pomonella</i> (Linnaeus, 1758)	1
Lepidoptera	Tortricidae	<i>Pandemis</i> spp.	1
Lepidoptera	Tortricidae	<i>Spilonota ocellana</i> (Denis & Schiffermüller, 1775)	1
Lepidoptera	Tortricidae		15

order	family/subfamily/superfamily	species	frequency
Lepidoptera	Ypsolophidae	<i>Ypsolopha horridella</i> (Treitschke, 1835)	1
Mecoptera	Panorpidae	<i>Panorpa vulgaris</i> Imhoff & Labram, 1845	2
Neuroptera	Coniopterygidae		4
Neuroptera	Hemerobiidae	<i>Hemerobius humulinus</i> Linnaeus, 1758	1
Neuroptera	Chrysopidae	<i>Chrysopa perla</i> (Linnaeus, 1758)	1
Neuroptera	Chrysopidae	<i>Chrysopa</i> spp.	8
Neuroptera	Chrysopidae	<i>Chrysoperla carnea</i> (Stephens, 1836)	3
Orthoptera	Acrididae	<i>Chorthippus</i> spp.	1
Orthoptera	Tettigoniidae	<i>Phaneroptera falcata</i> (Poda, 1761)	9
Orthoptera	Tettigoniidae	<i>Pholidoptera griseoptera</i> (De Geer, 1773)	2
Orthoptera	Tettigoniidae	<i>Tettigonia viridissima</i> Linnaeus, 1758	1
Psocoptera	Caeciliusidae	<i>Valenzuela flavidus</i> (Stephens, 1836)	14
Psocoptera	Elipsocidae	<i>Elipsocus annulatus</i> Roesler, 1954	1
Psocoptera	Mesopsocidae	<i>Mesopsocus laticeps</i> (Kolbe, 1880)	1
Psocoptera	Peripsocidae	<i>Peripsocus phaeopterus</i> (Stephens, 1836)	1
Psocoptera	Philotarsidae	<i>Philotarsus parviceps</i> Roesler, 1954	1
Psocoptera	Psocidae	<i>Amphigerontia contaminata</i> (Stephens, 1836)	2
Psocoptera	Psocidae	<i>Blaste conspurcata</i> (Rambur, 1842)	1
Psocoptera	Psocidae	<i>Blaste quadrimaculata</i> (Latreille, 1794)	42
Psocoptera	Psocidae	<i>Loensia pearmani</i> Kimmins, 1941	1
Psocoptera	Psocidae	<i>Metylophorus nebulosus</i> (Stephens, 1836)	49
Psocoptera	Psocidae	<i>Psococerastis gibbosa</i> (Sulzer, 1776)	37
Psocoptera	Psocidae	<i>Trichadenotecnum</i> spp.	1
Raphidioptera	Raphidiidae	<i>Dichrostigma flavipes</i> (Stein, 1863)	1
Raphidioptera	Raphidiidae	<i>Xanthostigma xanthostigma</i> (Schummel, 1832)	1



1: Quantitative distribution of the individual orders in the alley and orchard

orchard. In the alley, critically endangered species of *Cryptocephalus schaefferi* (1 individual) of the Chrysomelidae, endangered species (EN) *Luperus xanthopoda* (4 individuals) of the Chrysomelidae and *Tropinota hirta* (1 individual) of the Scarabaeidae, near

threatened (NT) *Pleurophorus casus* (2 individuals) of the Scarabaeidae occurred.

With the exception of two individuals, the Dermaptera occurred exclusively in the abandoned orchard, with the prevailing occurrence of *Apterygida albipennis*. This species seeks wetter sites;

it occurs mostly on grass stands or shrubs (Kočárek, 1998). *Forficula auricularia* occurred less frequently (3 individuals in the abandoned orchard and 2 individuals in the alley). Species of the Dermaptera are omnivorous; they mainly feed on small insects but can also cause damage to ripe fruit (Šefrová, 2006). *Forficula auricularia* is an effective predator of harmful aphids on apple trees (Carroll & Hoyt, 1984).

The Diptera was the third most frequently occurring in the abandoned orchard and the fifth one in the alley. Despite this quite high occurrence, it is not probable that the presence of this order would be of principal importance for apple trees both in terms of harmfulness or regulation of pests with the exception of the Syrphidae, namely *Episyrphus balteatus*. This species is a very efficient predator of aphids on apple trees (Dib *et al.*, 2010). Some species of the Cecidomyiidae can also do harm on apple tree (Carl, 1980). On the other side, some Cecidomyiidae have predatory larvae that feed on aphids on apple trees (Tracewski *et al.*, 1984).

A more pronounced occurrence of the individuals of the Hemiptera was in the alley (691) compared to the orchard (321). Predatory true bugs of the Hemiptera prevailed in apple tree tops, namely nymphs and imagoes of the Anthocoridae (*Anthocoris* spp., *Orius* spp.), nymphs of the predatory bug *Himacerus apterus* of the Nabidae and zoophytophagous bug *Pentatoma rufipes* of the Pentatomidae. *Anthocoris nemorum*, *Deraeocoris lutescens*, *Himacerus apterus*, and *Orius minutus* and also *Atractotomus mali* were the most abundant zoophagous and zoophytophagous species found by Jahn (1998) in the experimental sites. He associated a high occurrence of phytozoophagous species *Orthotylus marginalis* and zoophytophagous species *Psallus ambiguus* with the mass incidence of apple leaf suckers. Kinkorová & Kocourek (2000) found on apples a dominant occurrence of predatory true bugs of *Orius minutus*, *O. vicinus*, *O. laticollis*, *Heterotoma planicornis*, and with a higher abundance of aphids also *Himacerus apterus*. Jonsson (1983) in 1979–1981 found a number of predatory species in apple orchards, the dominant *Campylomma verbasci*, *Atractotomus mali*, *Orthotylus marginalis*, *Blepharidopterus angulatus*, *Phytocoris tiliae*, *Psallus ambiguus*, *P. perrisi*, and *Anthocoris nemorum*. Besides the predatory species, we found a number of phytophages without a closer connection to apple trees, the rarer ones were e.g. *Harpocera hellenica* and *Halticus saltator*, a new finding in the territory of Moravia (Hradil *et al.*, 2013). Other interesting findings were *Stephanitis pyri*, a rare species considered until recently extinct from our fauna. Under favorable conditions it could again become a pest at least in Moravian apple tree plantings. The results of study of true bugs living on wildy growing apple trees in South Moravia showed that abandoned trees were a suitable environment for a number of species of useful predatory true

bugs; however, to a lesser extent, they can also be a reservoir of pests for surrounding vegetation.

Species of the Hemiptera, of the Auchenorrhyncha suborder, were equally distributed among the representatives of the species living in the grass stand (*Athysanus argentarius*, *Aphrodes bicinctus*, *A. makarovi*, *Balclutha punctata*, *Dicranotropis hamata*, *Errastunus ocellaris*, *Mocytia crocea*), species living in the larval stage on plants and in the imago stage mainly on woody plants (*Allygidius abbreviatus*, *A. atomarius*, *Allygus communis*, *A. modestus*, *Cixius nervosus*, *Tachycixius pilous*) and species living through-out their life-cycles on wood plants (*Alnetoidia alneti*, *Edwardsiana crataegi*, *E. rosae*, *Empoasca vitis*, *Ledra aurita*, *Zygina flammigera*, *Z. schneideri*). Representatives of *Empoasca vitis*, a polyphagous occurring mainly on wood plants, and developing also on apple trees, were significantly more abundant. Of the Psylloidea, the species living on apple trees prevailed (*Cacopsylla mali*, *C. picta*, to a lesser extent *C. melanoneura*, rare incidence of *C. pyrisuga* and *C. saliceti*). *C. mali* widely occurs on unpruned apple trees mainly in the uplands, *C. picta* mainly in the lowlands. *C. picta* is also an important vector of the AP phytoplasma (Apple Proliferation) (bacteria *Candidatus Phytoplasma mali*), (Jarausch *et al.*, 2007), which is a quarantine disease in the EU. *C. melanoneura* lives mainly on hawthorns (*Crataegus* spp.), sporadically also on apple trees; in north-west Italy it is also a vector of the given bacteriosis (Malagnini *et al.*, 2010). Old apple tree orchards and alleys should be occasionally checked for the presence of AP. It is suggested that in South Moravia they serve as a reservoir of the *Cacopsylla picta*, which in migration during the following year being attracted by intensive concentration of volatile substances from apple trees infests mainly large orchards (Čermák & Lauterer, 2008).

The Hymenoptera was the second most frequent order occurring in the abandoned orchard and alley. It was mostly represented by Formicidae with the most abundant *Lasius niger*, a species known for searching for aphid colonies in tree tops. It defends aphids against predators and feeds on sweet honey-dew produced by them (Stewart-Jones *et al.*, 2008). Parasitoids of the Hymenoptera are an important group in terms of pest regulation. Parasitoids are very sensitive to various insecticides, so their populations can be suppressed by application of agrochemicals in production orchards (Mates *et al.*, 2012). Therefore, apple trees in abandoned orchards or alleys can be a suitable environment for the development of useful parasitoid populations. In the abandoned orchard and alley, parasitoids of the Chalcidoidea, Braconidae, and Ichneumonidae were recorded most frequently. In the alley, the occurrence of the *Scambus pomorum*, an important parasitoid of *Anthonomus pomorum*, was recorded. Parasitism in some cases can reach even tens of percents (Mody *et al.*, 2011). In the alley, species *Plectochorus ivatensis* was detected, this is a new species for the Czech Republic (Holý *et al.*, 2012).

The only more significant pest on pear and apple trees of the Hymenoptera was *Janus compressus*. It was recorded only in one piece in the abandoned orchard.

Compared to the orchard, significantly more species of the Lepidoptera (35 species of 15 families versus 10 species of 6 families) and individuals (459 versus 128) were captured in the alley. Some caterpillars of Noctuidae and Tortricidae could not be determined exactly. Presumably, most of these cases were species without a negative impact (morphology of caterpillars of harmful species is well known and their determination does not mostly create any troubles). In both sites under study, species of the Geometridae, Noctuidae, and Tortricidae prevailed, this corresponds to high numbers of species occurring in these families, with the same three dominating species: *Euproctis chrysorrhoea*, *Cosmia trapezina* and *Operophtera brumata*. In the orchard, mainly harmful species were recorded, of the indifferent species, *Amphipyra pyramidea* and *Crassa unitella* were recorded. Pests in the alley accounted just for ca 60%, i.e. indifferent species occurred more frequently, but the occurrence of the individuals of harmful

species was similar in both the sites – about 70%. With two exceptions, all detected species were phytophagous, *Crassa tinctella* captured in the orchard is a saprophagous and *Synanthedon myopaeformis* detected in the alley is a xylophagous. No faunistically or zoogeographically remarkable species were recorded. All indifferent species are widespread polyphagous (*Ancylis achatana*, *Colotois pennaria*, *Ectropis crepuscularia*, *Ematurga atomaria*, *Acronicta psi*, *Amphipyra pyramidea*) without any evident link to apple trees or shrubs of the Rosaceae with the exception of *Ypsolopha horridella*, which feeds on Rosaceae. Among the detected pests, oligophagous to polyphagous prevailed, of feed specialist, *Coleophora hemerobiella*, *Callisto denticulella*, *Synanthedon myopaeformis*, and *Cydia pomonella* were trapped, all of them in the alley.

Of the Psocoptera, 81 individuals of 8 species occurred in the orchard and 151 individuals of 11 species were recorded in the alley. Despite this relatively high occurrence, the presence of these species of this order presumably does not affect apple trees principally neither in terms of harmfulness nor pest regulation.

SUMMARY

In 2010 and 2011, the occurrence of arthropods on apple trees without management was monitored near the village of Velké Bílovice, South Moravia, in two selected localities: an abandoned apple tree orchard and an apple tree alley along the road. Arthropods in tree tops were killed using deltamethrin applied with a fogger (Puls Fog). Representatives of eleven orders were captured. In the orchard, the Coleoptera was represented most frequently, the Hymenoptera, Diptera, Hemiptera, Araneae, Lepidoptera, Psocoptera, Dermaptera Orthoptera, Mecoptera, and Neuroptera followed. In the alley, individuals of the Coleoptera were caught most frequently, the Hymenoptera and Hemiptera, Lepidoptera, Diptera, Araneae, Psocoptera, Neuroptera, Orthoptera, Dermaptera, Mecoptera, and Raphidioptera followed. Some of the detected species belonged to apple tree pests. Many antagonists of pests were also found (predators, parasitoids). However, a large set of captured species seeks in the apple tree top only a hide without any positive or negative effects on the tree. It must be noted that some of the detected species belong to the endangered and critically endangered species. We can state that apple trees are a significant refugium in the landscape. The biotope of the abandoned apple trees can also be a source of pest antagonists for prospective production apple trees plantations.

Acknowledgement

This work was supported by the Ministry of Agriculture of the Czech Republic (project No. QJ1210209). We thank especially to Lenka Frýželková, Lucie Nováková, Jiří Mrtka, Lukáš Nytra for their help in the field and laboratory and Luboš Purchart (Carabidae), Jan Bezděk (Coleoptera), Ondřej Košulič (Araneae), Kamil Holý (Hymenoptera), František Chládek (Orthoptera, Dermaptera, Blattodea, Neuroptera), Petr Heřman (Diptera), Petr Werner (Formicidae), Karel Hradil (Hemiptera), Igor Malenovský (Hemiptera), Jiří Foit (Coleoptera), Zdeněk Laštůvka (Lepidoptera), Jakub Beránek (Coleoptera), Pavel Lauterer (Hemiptera), and Otakar Holuša (Psocoptera) for help with determination. The authors thank to Zdeněk Laštůvka for his notes to the manuscript.

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