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The structure of anthophilous longhorn beetles (Col.: Cerambycidae) visiting hawthorns (*Crataegus* spp.) in the Western Palearctic

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The structure of anthophilous longhorn beetles (Col.: Cerambycidae) visiting blossoming hawthorns (*Crataegus* spp.) in various part of the Western Palearctic was analysed. Field inventories were carried out in Poland, Bulgaria, Italy, Greece, and Georgia. The study started in 2005 and continued with varying intensity until 2014. In total, 458 specimens representing 33 taxa of the Cerambycidae family were collected or observed in the study plots. On blossoming hawthorn shrubs, members of Cerambycinae and Lepturinae subfamilies were most frequently observed. Species diversity of long-horned beetles depends largely on the geographic location and the composition of host plants surrounding the hawthorn shrubs. Some very rare species, e.g. *Leptorhabdium caucasicum, Alosterna pauli, A. tabacicolor subvittata, Calchaenesthes oblongomaculatus,* and *Anaglyptus luteofasciatus* have been recorded during the study.

Key words: anthophilous Cerambycidae, *Crataegus*, Western Palearctic, species diversity, endemic species

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INTRODUCTION

The family of longhorn beetles (Cerambycidae) is one of the most speciose and well-known group of beetles with approximately 35,000 described species (Švácha & Lawrence 2014). More than 600 species (especially of the subfamilies Lepturinae and Cerambycinae) occur in Europe. The number of species of invertebrates in sundry regions of the Europe varies. For instance, the Mediterranean basin is the richest biogeographic region for invertebrates; 75% of the total European insect fauna are found there (Balletto & Casale 1991). In addition, the number of Cerambycidae in countries of the Mediterranean basin is higher than in countries situated farther to the north. For example, the number of cerambycids of Italy equals 296 (Sama & Rapuzzi 2011), of Greece about 330 (Danilevsky 2014), whereas in Poland there are only 192 species (Gutowski et al. 2012).

The representatives of the subfamilies Lepturinae and Cerambycinae are mainly anthophilous and feed as adults on flowers, pollen, and nectar. One of the most attractive plants for these beetles is hawthorn (*Crataegus*) – a large genus of shrubs and trees in the Rosaceae family, native to temperate regions of the northern hemisphere in Europe, Asia, and North America. Systematics in this genus is one of the most complicated; 50 – 100 species could be distinguished in the territory of the Old World (Christensen 1992).

There are very many publications about this group of beetles. However, the literature is dominated by taxonomic and faunistic papers. Among all publications only a few deal with the abundance structure of Cerambycidae in plant communities and on selected plants which the imagines feed on (i.e. Gutowski 1995, Michalcewicz 2004, Starzyk 1981, Zieliński 2004). So far, there were no studies on the dominance structure of Cerambycidae associated with blossoming hawthorns. This is especially interesting, because – based on the available literature (Bense 1995, Bily & Mehl 1989, Gutowski 1995, Sama 2002) and inter alia on the authors' own field observations – it is known that this plant is one of the preferred food bases for Cerambycidae.

The main aim of the study was to identify species communities of longhorn beetles associated with hawthorn flowers in different parts of the Western Palearctic. Moreover, an attempt to determine the dominance structure and level of Cerambycidae's associations to hawthorns was made. The collected material was also analysed based on different indices and statistics which help to draw conclusions about the species diversity of Cerambycidae in the studied areas depending on various factors, e.g. on their geographic location.

MATERIAL AND METHODS

Study area

The study started in 2005 and continued with varying intensity until 2014. The longhorn beetles were collected in 9 areas which are located in various parts of the Western Palearctic: two sites each in Poland, Greece, Italy, and Georgia and one in Bulgaria. The study plots are listed below with the following characteristics: abbreviation of site, country, locality, coordinates, research date, name of researchers, and a short description of the particular area. In the text the following abbreviations are used: AW - Adam Woźniak, DH - Dariusz Hofmański, LK - Lech Karpiński, MW - Marcin Walczak, SAC - Special Area of Conservation, WTS - Wojciech T. Szczepański.

P1 - Poland (Silesia), Żywocice, SAC Żywocickie Łęgi (50°27'53"N 17°59'24"E), 18.05.2013, WTS.

Hawthorns were situated in riparian forest along the Odra river, mostly on the edge of the forest.

P2 - Poland (Silesia), Chałupki, SAC Graniczny Meander Odry (49°55'55"N 18°20'23"E), 29.05.2013, WTS & LK.

Site similar to the previous. Fragmentary riparian forest complex located in the Moravian gate.

B1 - Bulgaria, near Kitten (42°13'54"N 27°45'45"E), 19.05.2005, AW.

The site was located in the middle of an overexposed deciduous forest.

I1 - Italy (Sicily), Portella dell Obolo (37°53' 35"N 14°30' 5"E), 07.06.2010, AW & MW.

Beetles were collected on a meadow with many hawthorn shrubs, in the environs of the Nebrodi mountains with beech and oak forests.

I2 - Italy (Sicily), Santa Maria del Bosco (37°53’28”N 14°39’6”E), 04.06.2010, AW & MW.

Site quite similar to the previous.

Gr1 - Greece (Peloponnesus), near Aghios Petros (37°20’56”N 22°35’34”E), 15.05.2008, AW.

Maquis shrubland with many hawthorn shrubs.

Gr2 - Greece (Peloponnesus), near Vytina (37°37’41”N 22°12’56”E), 20.05.2009, MW & AW.

Plot is located in a primeval fir forest on the Menalo mountain, which is one of the most valuable forest area on Peloponnesus. Many hawthorn shrubs were found on meadows in the valleys of the mountain.

Ge1 - Georgia, Leninovka (41°27’48"N 46°00’51"E), 07.06.2014, AW & MW.

This was a wayside, lightly slanted, sunexposed slope of Mt. Takht with deciduous forest and many hawthorns growing on the edges and inside the forest stand.

Ge2 - Georgia, Norio (41°48’43"N 44°57’58"E), 10.06.2014, AW & DH.

Site is located at the foot of the Saguramo mountain. Hawthorns were situated near the road in the middle of a deciduous forest.

Field methods

There are many effective methods of collecting long-horned beetles, e.g. “sighting the imagines”, shaking down into an entomological umbrella, sweep-netting, or attracting with an artificial source of light. In the case of Cerambycidae which are visiting the flowers of shrubs the best way to detect their presence is shaking them down into an entomological umbrella. Due to the thorny branches of hawthorns it is difficult to penetrate large shrubs and therefore this method is one of the best to collect beetles on hawthorn in a proper way. The standard entomological umbrella (a square of cloth 1m x 1m) was used for the study. The cerambycids were collected in May and July at the time of hawthorn blossom. On each area about 50 hawthorns were selected for shaking down the longhorn beetles. The shrubs were being shaken for a period of about 5 hours (~200 hits/5h). Sometimes the “sighting the imagines” method was used, too. Because of the diversity of sites various factors could have affected the efficiency of catching longicorns, e.g. the size and age of the hawthorns. Therefore, the results of the research may contain some minor

Fig. 1. Blossoming hawthorn *Crataegus* sp. Vytina environs - Greece (Peloponnesus). Photo: A. Woźniak

statistical error. The collected specimens were counted and determined to the species or subspecies level. During the field research about 1,000 specimens representing 44 taxa of Cerambycidae were collected or observed on hawthorns of all areas. Due to the fact that in a few locations specimens were collected during several days as compared to one day in other plots, in order to keep the results comparable, only the specimens collected during one day were analysed, resulting in 458 specimens representing 33 taxa. For mathematical calculation of results only the number of species and individuals collected per plot and day were used.

Data analysis

The nomenclature of Cerambycidae in this paper is based on the Catalogue of Palearctic Coleoptera (Löbl & Smetana 2010) including subsequent amendments and additions (Danilevsky 2014). The collected material was identified to the species or subspecies level according to the keys provided by Bense (1995) and Heyrovsky & Slama (1992).

Besides species composition, the cerambycids were analysed with respect to the number of individuals and dominance structure.

Based on the values received by applying the dominance index by Kasprzak & Niedbała (1981) the following six classes of dominance were distinguished: superdominants (>40% of the individuals), eudominants (30.01-40%), dominants (20.01-30%), subdominants (7.51-20%), recedents (2.51-7.5%), and subrecendents (<2.51%) (Klimaszewski et al. 1980a, 1980b).

For processing the results we used the Shannon-Weaver index of species diversity (H'), Brillouin diversity index (H), and Simpson's species richness (I'). Differences between the communities of Cerambycidae in each study plot were illustrated by principal component analysis (PCA). Two principal component analyses were performed, without data transformation, on a matrix composed of 33 lines (species) and 9 columns (plots). Prior to PCA each character was converted to zero mean and unit standard deviation, so the same weight was applied to all of them. The first PCA supplies information on the species, using present/absence data as a basis. The second PCA gives information on the specimens on the basis of abundance data as presented in Table 1. All statistical calculations and their graphic interpretations were performed with the MVSP software packages (Kovach 2007).

RESULTS

In total, 458 specimens representing 33 taxa of the Cerambycidae family were collected or observed in the study plots (Tab. 1). During the study, 4 species have been caught on hawthorn shrubs in Bulgaria, 6 in Poland, 9 in Sicily, 11 in Greece, and 13 in Georgia. All collected species divide into subfamilies as follows: Lepturinae – 16, Cerambycinae – 16, and Lamiinae – 1. The ratio between the two dominant subfamilies is 1. The most numerous species were *Callimus angulatus angulatus* (108 specimens) and *Callimoxys gracilis* (56). Moreover, these species were found in 3 different countries, as well as *Alosterna tabacicolor tabacicolor* and *Tetrops praeustus praeustus*.

The highest number of specimens of Cerambycidae was obtained in Italy and Greece. On site I2 (Italy, Santa Maria del Bosco) the number of individuals reached up to 126. The number of species collected on the different study sites ranged from 3 to 11. The highest number was found on site Ge1 (Georgia, Leniovka), where the longhorn beetles had both a diversified development and food base for anthophilous species. The Shannon-Weaver index (H') of species diversity scored values from 1.099 up to 2.398, the Brillouin diversity index (H) ranged from 0.597 to 1.591, and the Simpson index (I') from 0.667 to 0.909 (Tab. 1). All three indices reached the highest values in Georgia (Ge1) and lowest in Poland (P2).

The dominance structure of Cerambycidae assemblages is very different between the research plots. In our study, the dominance structure re-

Table 1. Systematic list of species collected in each plot (numbers of individuals of the species/ subspecies, total number of individuals, total number of taxa)

	Abbreviation	P1	P2	B	I1	I2	Gr1	Gr2	Ge1	Ge2	Sum
Lepturinae											
Leptorhabdium caucasicum	*Lc*	-	-	-	-	-	-	-	-	4	4
Anisorus quercus aureopubens	*Aqa*	-	-	-	-	-	-	-	6	-	6
Dinoptera collaris	*Dc*	3	-	-	-	-	-	-	2	2	7
Fallacia elegans	*Fe*	-	-	-	-	-	-	-	7	-	7
Cortodera humeralis aspromontana	*Cha*	-	-	-	-	-	38	-	-	-	38
Pidonia lurida	*Pl*	-	11	-	-	-	-	-	-	-	11
Grammoptera auricollis bipustulata	*Gab*	-	-	-	-	-	10	-	-	-	10
Grammoptera ruficornis flavipes	*Grf*	-	-	-	-	15	-	-	-	-	15
Grammoptera ruficornis ruficornis	*Grr*	11	13	-	-	-	-	-	-	-	24
Grammoptera ustulata ustulata	*Guu*	4	-	-	2	3	-	-	-	-	9
Grammoptera viridipennis	*Gv*	-	-	-	20	9	-	-	-	-	29
Alosterna pauli	*Ap*	-	-	-	-	-	9	-	-	-	9
Alosterna tabacicolor subvittata (Fig. 7)	*Ats*	-	-	-	-	-	-	-	4	-	4
Alosterna tabacicolor tabacicolor	*Att*	2	3	2	-	-	-	5	-	-	12
Pachytodes erraticus	*Pe*	-	-	-	5	-	-	-	-	-	5
Stenurella nigra maesta	*Snm*	-	-	-	-	-	-	-	4	-	4
Cerambycinae											
Callimoxys gracilis (Fig. 9)	*Cg*	-	-	26	-	-	13	13	4	-	56
Callimus angulatus angulatus	*Caa*	-	-	5	16	82	5	-	-	-	108
Molorchus minor minor	*Mmm*	-	-	-	-	-	-	4	-	-	4
Molorchus umbellatarus umbellatarus	*Muu*	-	-	-	2	-	-	-	-	-	2
Dolocerus reichii	*Dr*	-	-	-	2	4	-	-	-	-	6
Stenhomalus bicolor	*Sb*	-	-	-	-	-	5	23	-	-	28
Cerambyx scopolii scopolii	*Css*	-	-	5	-	-	-	-	-	2	7
Calchaenesthes oblongomaculatus	*Co*	-	-	-	-	-	5	-	-	-	5
Phymathodes rufipes rufipes	*Prr*	-	-	-	-	-	5	5	-	-	10
Ropalopus macropus	*Rm*	-	-	-	-	-	-	-	1	-	1
Anaglyptus danilevskii	*Ad*	-	-	-	-	-	-	-	2	2	4
Anaglyptus gibbosus	*Ag*	-	-	-	4	5	-	-	-	-	9
Anaglyptus luteofasciatus	*AI*	-	-	-	-	-	-	6	-	-	6
Anaglyptus simlicicornis	*As*	-	-	-	-	-	-	-	2	-	2
Chlorophorus figuratus	*Chf*	-	-	-	-	-	-	-	3	-	3
Clytus clavicornis	*Cc*	-	-	-	2	5	-	-	-	-	7
Laminae											
Tetrops praeustus praeustus	*Tpp*	1	-	-	1	3	-	-	1	-	6
Number of individuals		21	27	38	54	126	90	56	36	10	458
Number of species		5	3	4	9	8	8	6	11	4	33
Shannon-Weaver diversity H' (log base e)		1.609	1.099	1.386	2.197	2.079	2.079	1.792	2.398	1.386	-
Brillouin diversity H		0.957	0.597	0.795	1.422	1.326	1.326	1.097	1.591	0.795	-
Simpson's diversity I'		0.800	0.667	0.750	0.889	0.875	0.875	0.833	0.909	0.750	-

Table 2. Number of dominant and recedent species in each plot.

Dominance class	Site								
	P1	P2	B	I1	I2	Gr1	Gr2	Ge1	Ge2
superdominants (> 40.00%)	1	2	1	-	1	1	1	-	-
eudominants (30.01 - 40.00%)	-	-	-	1	-	-	-	-	-
dominants (20.01 - 30.00%)	-	-	-	1	-	-	1	-	4
subdominants (7.51 - 20.00%)	3	1	2	1	1	3	3	6	-
recedents (2.51 - 7.50%)	1	-	1	5	4	4	1	5	-
subrecendents (< 2.51%)	-	-	-	1	2	-	-	-	-

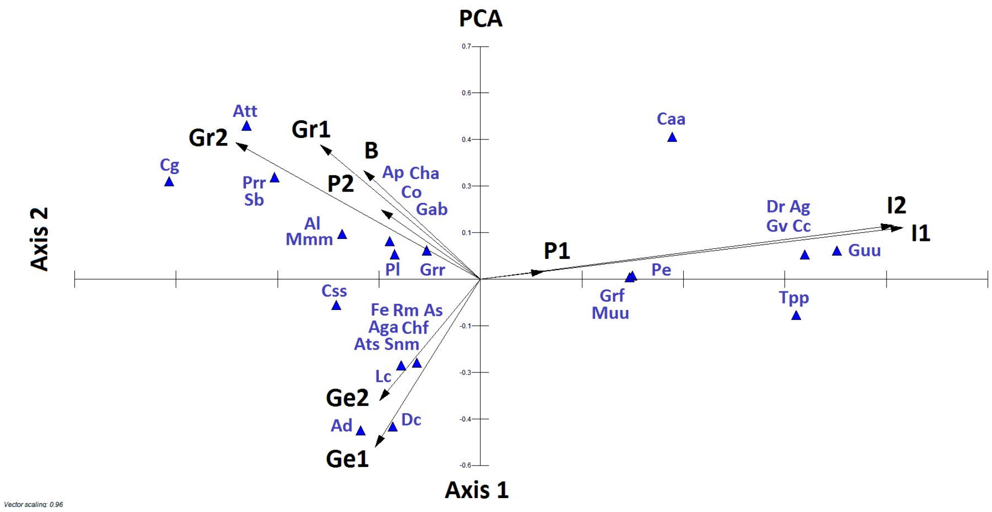

Fig. 2. PCA analysis based on the number of all species of Cerambycidae recorded in each plot (abbreviations as in Table 1). Eigenvalues of the first two axes were 2.183 and 1.732, respectively, explaining 24.2% and 19.2% of the total variation in the species dataset

veals that the subdominants and recedents are the most numerous classes in each plot, except for sites P2 and Ge2 (Tab. 2). In most areas we can distinguish superdominants, i.e. in Poland – *Grammoptera ruficornis ruficornis* and *Pidonia lurida*, in Bulgaria – *Callimoxys gracilis*, in Italy – *Callimus angulatus angulatus*, and in Greece – *Cortodera humeralis aspromontana* and *Stenhomalus bicolor*. Only both research plots in Georgia and one in Italy did not show a species which in terms of individuals significantly outnumbered the rest of the species. This may indicate an environment relatively unaltered or only insignificantly altered by man and a well-balanced ecosystem at the place where the insects were collected.

18 out of 33 taxa appear only on one study site, which indicates a high uniqueness of localities. Six taxa recorded were Italian or Greek endemics: *Anaglyptus luteofasciatus*, *Clytus clavicornis*, *Alosterna pauli*, *Gramoptera auricollis bipustulata*, *Grammoptera ruficornis flavipes*, and *Grammoptera viridipennis*.

The principal component analysis (PCA) based on the number of species recorded in each plot shows that in the individual countries separate assemblages of Cerambycidae were formed (Fig. 2, Fig. 3). Analysing the species composition of the research plots (Fig. 2) three major groups can be distinguished by their characteristic species. The most distinct were the Italian areas – with an

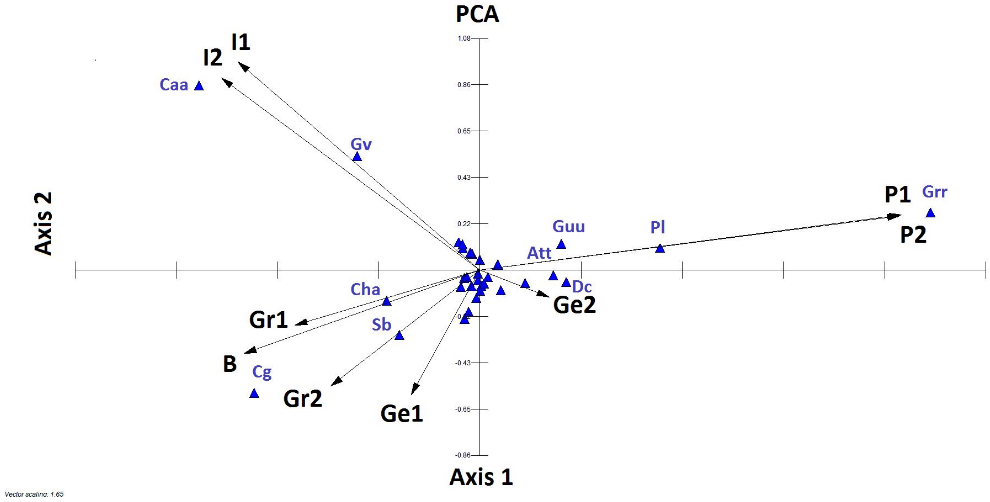

Fig. 3. PCA analysis based on the number of all individuals of Cerambycidae recorded in each plot (abbreviations as in Table 1). Eigenvalues of the first two axes were 1.904 and 1.784, respectively, explaining 21.2% and 19.8% of the total variation in the species dataset

important role of endemic species like *Clytus clavicornis* and *Grammoptera viridipennis*. Clearly isolated were also the Georgian plots, where the geographic range of many collected species does not exceed Asia. The neighboring countries Greece and Bulgaria have probably formed one group, indicated by the very similar species composition of longhorn beetles of their areas – 3 out of 4 Bulgarian species were also found in Greece. The divergent positions of the Polish sites may be explained, on the one hand, by the low number of species typical for this region. On the other hand, quantitative analysis of the species on grounds of their individual counts (Fig. 3) significantly distinguished the Polish sites, where species such as *Grammoptera ruficornis ruficornis* and *Pidonia lurida* were quite numerously collected, from those in other areas. Italian areas have been highlighted by two strongly dominant species – *Callimus angulatus angulatus* and *Grammoptera viridipennis*. Balkan countries again created a common group, mainly because of *Callimoxys gracilis*, which was observed numerously in all three sites in that region.

Remarks on selected species

***Alosterna pauli* Pesarini, Rapuzzi et Sabbadini, 2004 (Fig. 8)**

Very rare species, newly described in 2004. An endemic species to South Greece – Peloponnesus. Ecologically associated with the kermes oak (*Quercus coccifera*) and hawthorn (*Crataegus* spp.), whose pollen it feeds on (Pesarini, Sabbadini 2004). According to the authors' observations, imagines visit flowering oaks and hawthorns during sunny weather in the afternoon for copulating and feeding. Fifteen specimens of *A. pauli* have been caught during the study.

***Anaglyptus gibbosus* (Fabricius, 1787) (Fig. 10)**

Thermophilous species known from Southern Europe (Spain, France, Italy, Slovenia, Croatia) and North Africa (Tunisia, Algeria). Polyphagous in broadleaf trees, e.g. *Acer*, *Quercus*, *Sorbus*, and *Crataegus*. Adults are found on flowers from April to June (Bense 1995, Sama 2002). Larvae feed in dry, hard wood with no signs of decay.

They overwinter as an imago in pupal cells. Life cycle of at least 2 years.

***Anaglyptus luteofasciatus* Pic, 1905**

An endemic species to South Greece – Peloponnesus (Löbl & Smetana 2010). Placed on the IUCN Red List of Threatened Species as Endangered (EN). Range of this species covers only a few, severely fragmented localities with a spatial extent of less than 5,000 km² and an area of occupancy of less than 500 km² (Nardi & Mico 2010). Larvae develop in dry wood of broadleafed trees and overwinter as imago. Life cycle of at least 2 years. Adults are found from May to June on flowers, especially on blossoming hawthorns. This species behaves similar to *A. mysticus* – imagines are most active in the afternoon, but usually they are hardly observable, moving among the twigs and leaves of hawthorns, rarely visiting the inflorescences.

***Calchaenesthes oblongomaculatus* (Guérin-Méneville, 1844)**

Species occurring in Europe (Greece, Bulgaria, and Romania) and Asia (Cyprus, Turkey, and Jordan) (Löbl & Smetana 2010). Imagines are observed from May to June. Develops in oak (*Quercus* sp.). Life cycle of 2 – 3 years. Authors' observations show high activity of imagines starting at 20 °C, especially in the environment of flowering oaks and hawthorns.

***Clytus clavicornis* Reiche, 1860 (Fig. 11)**

An endemic species to Sicily. Known from eight sites in Northern Sicily (Sama 2006). Placed on the IUCN Red List of Threatened Species as Vulnerable (VU). It is an obligate saproxylic species, occupying oak (*Quercus* sp.) woodland in the mountains (Nardi & Mico 2010). Development is known insufficiently, but larvae feed in dead wood of deciduous trees (e.g. *Castanea*, *Acer*) (Bense 1995).

***Grammoptera auricollis bipustulata* Steiner, 1975**

An endemic subspecies to South Greece - Peloponnesus. Adult beetles occur from May to June. Imagines are found on flowering bushes of *Q. coccifera* and *Crataegus* (Bense 1995). Details of the development are unknown, but it probably develops in *Quercus* branches as other species of this genus. Adult beetles may occur on flowering hawthorns in large numbers.

***Grammoptera ruficornis flavipes* (Pic, 1892) (Fig. 5)**

An endemic subspecies to Sicily. Larvae are polyphagous on broadleaved trees and shrubs (La Mantia et al. 2010). Imagines were found on flowers, especially on blossoming *Crataegus*.

***Grammoptera viridipennis* Pic, 1893 (Fig. 6)**

An endemic species to Sicily. Similar to most European species of this genus (e.g. *G. abdominalis* and G. *auricollis*) it develops in rotten wood infested by fungus. Larvae feed on dead branches of broadleaved trees such as *Acer*, *Castanea sativa*, *Prunus*, *Pyrus piraster* and *Quercus*. Adults are found on flowers and trees from May to June (La Mantia et al. 2010). Imagines copulate on sunexposed, blossoming hawthorns, sometimes in large numbers.

***Leptorhabdium caucasicum* Kraatz, 1879 (Fig. 4)**

Species distributed in the South European part of Russia, Armenia, Azerbaijan, Georgia, and Turkey (Löbl & Smetana 2010). Most of the south-eastern records of this species in the Caucasus come from the environs of Tbilisi. Beyond the Caucasus, reliable records of *L. caucasicum* are known only from Northern Anatolia, where it is distributed at least as far westwards as the area of Boyabat (Samsun prov.) (Miroshnikov 2009). According to Danilevsky (1974), larvae can develop in trunks of the horse chestnut


4


5


6


7


8


9


10


11

Figs. 4 - 11. 4 - *Leptorhabdium caucasicum* Kraatz, 1879, 5 - *Grammoptera auricollis bipustulata* Steiner, 1975, 6 - *Grammoptera viridipennis* Pic, 1893, 7 - *Alosterna tabacicolor subvittata* Reitter, 1885, 8 - *Alosterna pauli* Pesarini, Rapuzzi et Sabbadini, 2004, 9 - *Callimoxys gracilis* (Brulle, 1832), in copula, 10 - *Anaglyptus gibbosus* (Fabricius, 1787), 11 - *Clytus clavicornis* Reiche, 1860. Photos: A. Woźniak

(*Aesculus*). Imagines can be observed in May and they are most active between 6 and 7 p.m. (Lobanov 2003). Four specimens (3 males and 1 female) were shaken down from blossoming hawthorn during rainy weather.

***Phymatodes rufipes* (Fabricius, 1776)**

Species distributed in Southern Europe and the southern part of Central Europe, eastwards to Ukraine and Asia Minor (Löbl & Smetana 2010). Develops in broadleaf trees and shrubs (mostly in *Crataegus*, *Prunus*, *Rubus*, *Quercus*, *Juglans*, and *Corylus*). Larvae feed in sick and dead, sunexposed twigs and branches. Life cycle of 1 – 2 years. Adults are found on the host plants and on flowers from April to June (Bense 1995). According to Hilszczański & Plewa (2009), larvae of this species develop mainly in thin branches among the treetops of oaks.

DISCUSSION

The species composition of longhorn beetles visiting hawthorns has not been previously studied in detail. Information about Cerambycidae feeding on the pollen of flowers in Poland was already published several times (e.g. Gutowski 1995, Michalcewicz 2004, Starzyk 1981, Zielinski 2004). However, there are practically no detailed studies about this issue in Southern Europe. Only information relating to anthophilous species can be found in various publications (e.g. Bense 1995).

It can be assumed that hawthorns are an important food base for many anthophilous insects, including beetles of the Cerambycidae family. At the various research sites the numbers of species visiting the flowers of hawthorn were different. A relationship between the geographic location of the sites and hence the different climatic conditions and the species number of collected longicorns is discernible. In the countries with a warmer climate more species visited the flowers, which also to a high degree corresponds with a bigger number of species in these regions.

There also seems to be a correlation between the larval host plants growing in the neighborhood of the research area and the species composition of long-horned beetles with imagines visiting *Crataegus* spp. Many Cerambycidae fly to hawthorns, because these shrubs may constitute the most important or even the only food source in early spring. They start to bloom already at the end of April and quite quickly (within 2 – 3 weeks) begin to lose their blossoms. Naturally, the short period of blossoming has an effect on the relatively small number of cerambycid species visiting their inflorescences. Other plants, especially those belonging to the Apiaceae family (e.g. *Aegopodium podagraria*) have much longer flowering periods.

As a result of inspecting and shaking hawthorns, species different from those of the present study were found in other locations. These comprise, e.g., in Georgia *Grammoptera abdominalis*, *Cortodera pumila tournieri*, *Vadonia unipunctata unipunctata*, and *Tetrops gilvipes*, in Greece *Anoplodera rufipes*, in Bulgaria *Molorchus kiessenwetteri*, in Italy *Phymatodes alni*, and in Poland *Rhagium mordax*, *Cortodera humeralis humeralis*, *Gaurotes virginea*, *Anoplodera rufipes*, and *Anaglyptus mysticus*. These findings prove that more species visit the inflorescences of this plant and, therefore, this issue requires further studies.

The following longhorn beetle – hawthorn trophic relations can be distinguished:

1) species associated with hawthorn as imagines and as larvae,

2) species associated with hawthorn only as imagines,

3) species associated with hawthorn only as larvae,

4) species visiting hawthorn accidentally and occasionally.

The first group comprises species such as *Callimus angulatus angulatus, Stenhomalus bicolor, Phymatodes rufipes rufipes, Ropalopus macropus, Anaglyptus danilevskii, Anaglyptus gibbosus, Anaglyptus luteofasciatus, Anaglyptus simplicicornis, Chlorophorus figuratus, Grammoptera ruficornis flavipes, Grammoptera ruficornis ruficornis, Grammoptera ustulata ustulata, Grammoptera auricollis bipustulata, Pachytodes erraticus*, and *Tetrops praeustus* (Bense 1995). The authors of this work have reared from twigs of *Crataegus* spp., polyphagous species such as *Molorchus umbellatarus umbellatarus* and *Ropalopus macropus*. The high number of individuals of the dominant species *Callimus angulatus angulatus* is very characteristic. Similar observations were made by La Mantia et al. (2010), who reported a large number of individuals of this species as well as the development of the larvae in hawthorn branches. Moreover, the first group comprises species which normally appear after the blossoming of hawthorns, but under specific conditions like the delay of shrub blossoming or earlier appearance of imagines may also visit the flowers of *Crataegus* spp. Here, we can include, e.g., *Rutpela maculata* and *Stenurella melanura*, which the authors observed on hawthorn flowers.

In the second group the authors include *Molorchus minor minor, Dolocerus reichii, Cerambyx scopolii scopolii, Calchaenesthes oblongomaculatus, Clytus clavicornis, Leptorhabdium caucasicum, Anisorus quercus aureopubens, Dinoptera collaris, Fallacia elegans, Cortodera humeralis aspromontana, Pidonia lurida, Grammoptera viridipennis, Alosterna pauli, Alosterna tabacicolor subvittata, Alosterna tabacicolor tabacicolor*, and *Stenurella nigra maesta*.

According to the list above, most of the collected species can be assigned to the first two groups. However, in many cases it cannot be clearly stated if those species only visit inflorescences or if their entire development is associated with hawthorn. Probably, some of the polyphagous species like *Callimoxys gracilis* and *Stenurella nigra* can develop in hawthorn. According to literature resources, those species can develop in *Prunus, Paliurius*, and *Frangula* (Bense 1995), so it is likely that their larvae can develop also in hawthorn. During the field studies, species associated with branches of the discussed shrubs have been caught as well – primarily of the *Tetrops* genus. The swarming of *Phymatodes rufipes* overlaps with oak flowering since it is their pollen which the imagines feed on (Hilszczański & Plewa 2009). The presence of many individuals on hawthorn inflorescences and observations of their behaviour confirm that this species also feeds on hawthorn pollen. However, these observations were made only in Southern Europe while in the central part – in Poland – *Phymatodes rufipes* was not recorded on blossoming hawthorn. Similar information applies also to *Cerambyx scopolii scopolii*. Undoubtedly, *Phymatodes alni*, the presence of which on shaken hawthorns was probably accidentally, should be assigned to the fourth group.

CONCLUSIONS

It has been proven that members of the Cerambycinae and Lepturinae subfamilies most frequently occur on blossoming hawthorn shrubs.

Species diversity of longhorn beetles largely depends on the geographic location and composition of host plants surrounding the shrubs of hawthorn.

Some very rare species have been recorded during the study, e.g. *Calchaenesthes oblongomaculatus*, *Alosterna pauli*, and *Anaglyptus luteofasciatus*. They have not been caught as yet, neither on other flowering species, nor using traps.

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