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New Parasitoids of Longhorn Beetles (Coleoptera: Cerambycidae) in Bulgaria

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Abstract: During the period 2005-2017, nine new hymenopteran and dipteran larval parasitoids of longhorn beetles (Coleoptera: Cerambycidae) were recorded in Bulgaria: *Ontsira antica* (Wollaston), *Doryctes leucogaster* (Nees), *Spathius umbratus* (F.), *Helcon angustator* Nees (Hymenoptera: Braconidae), *Helcostizus restaurator* (F.), *Ischnoceros rusticus* (Geoffroy), *Rhimphoctona xoridiformis* (Holmgren) (Hymenoptera: Ichneumonidae), *Billaea triangulifera* (Zetterstedt) and *Billaea adelpha* (Loew) (Diptera: Tachinidae). *Doryctes leucogaster*, *S. umbratus* and *H. angustator* were reared from *Phymatodes testaceus* (L.), *O. antica* – from *Rhagium inquisitor inquisitor* (L.), *H. restaurator* – from *Molorchus minor* (L.), *I. rusticus* – from *Morimus asper funereus* Mulsant, *R. xoridiformis* – from *Tetropium castaneum* (L.), *Billaea adelpha* and *Billaea triangulifera* (Diptera: Tachinidae) – from *Prionus coriarius* (L.). *Rhimphoctona xoridiformis* is a new for the Bulgarian fauna. Three new host-parasitoid relationships were recorded for the first time: *Rhagium inquisitor inquisitor – Ontsira antica*, *Morimus asper funereus – Ischnoceros rusticus* and *Prionus coriarius – Billaea triangulifera*.

Key words: Cerambycidae, parasitoids, Braconidae, Ichneumonidae, Tachinidae, Bulgaria

Introduction

The longhorn beetles (Coleoptera: Cerambycidae) is one of the best studied taxonomic groups in Bulgaria. The results of numerous faunistic data are summarised in two publications (Georgiev & Hubenov 2006, Migliaccio et al. 2007). The ecology of the species, however, is relatively poorly studied. Recently, investigations on host plants of xylophagous species have been conducted, in which new trophic relationships were established in Bulgaria (Doychev et al. 2017). It should be noted, that the collection of preimaginal cerambycid stages in tissues of the host plants usually is related to parasitoid findings.

This paper reports information on new larval parasitoids of longhorn beetles in Bulgaria.

Materials and Methods

The parasitoids were established during studies of xylophagous host plants of longhorn beetles (Coleoptera: Cerambycidae) in Bulgaria. The biological material (stem parts colonised by longhorn beetles and parasitised or dead cerambycid larvae with parasitoid cocoons) was collected at seven sites of the country during 2005-2017 (Table 1).

Doryctes leucogaster (Nees), *Spathius umbratus* (F.) and *Helcon angustator* Nees were reared from a stem part of *Quercus frainetto* Ten., massively infested by larvae of *Phymatodes testaceus* (L.). The cuttings were collected in the Western Rhodopes Mts. in the outskirts of the Lenovo Village. They were transported to the Entomological laboratory of the University of Forestry and were kept in photoec-

Table 1. Main characteristics of the study areas and biological materials

Locality	Coordinates	Altitude, m a.s.l.	Host plants	Cerambycid hosts			Parasitoids		
				Species	Studied larvae, N	Date of sample collection	Species	Reared specimens	Date of emergence
Pirin Mts.	41°40'22.2"N 23°16'50.8"E	880	*Pinus nigra*	*Rhagium inquisitor inquisitor*	1	13 August 2005	*Ontsira antica*	1♂, 11♀♀	25-31 August 2005
West Rhodopes Mts., near Lenovo Villilage	41°56'31.8"N 25°04'44.7"E	305	*Quercus frainetto*	*Phymatodes testaceus*	6	19 September 2005	*Doryctes leucogaster*	2♂♂, 4♀♀	17-20 March 2006
					7	19 September 2005	*Spathius umbratus*	1♂, 6♀♀	14-17 March 2006
					4	19 September 2005	*Helcon angustator*	2♂, 2♀♀	03 April 2006
West Rhodopes Mts., near Trigrad Village	41°32'52.0"N 24°24'03.2"E	1500	*Picea abies*	*Tetropium castaneum*	2	18 May 2014	*Rhimphoctona xoridiformis*	1♂, 1♀	09 June 2014
Lyulin Mt.	42°38'55.5"N 23°10'59.6"E	1060	*Fagus sylvatica*	*Morimus asper funereus*	1	25 March 2017	*Ischnoceros rusticus*	3♂♂, 1♀	10 April 2017
Vitosha Mt., Zlatni mostove loc.	42°36'51.2"N 23°14'19.1"E	1420	*Picea abies*	*Molorchus minor*	1	29 May 2016	*Helcostizus restaurator*	1♀	29 May 2016
Vitosha Mt., near Tihiat kat	42°38'10.4"N 23°13'21.2"E	1090	*Quercus dalechampii*	*Prionus coriarius*	2	23 April 2016	*Billaea triangulifera*	1♂	09 June 2016
Sofia	42°40'33.0"N 23°20'35.5"E	620	*Quercus rubra*	*Prionus coriarius*	11	20-27 March 2017	*Billaea adelpha*	1♂, 1♀	15 May 2017

lector at room temperature (18-22°C). At the end of the observation period, the cuttings were opened and their content was analysed in detail.

The cocoons of *Ontsira antica* (Wollaston) were found on dead larva in the pupal chamber of *Rhagium inquisitor inquisitor* (L.) under bark of fallen stem of *Pinus nigra* Arn. in the Pirin Mt., 4.7 km north-east of the Ilindentsi Village.

The cocoons of *Ischnoceros rusticus* (Geoffroy) were collected under bark of *Fagus sylvatica* L. stump in the Lyulin Mt., 220 m south-west of the St. Cyril and Methodius Monastery beside remains of *Morimus asper funereus* Mulsant.

The cocoon of *Helcostizus restaurator* (F.) was collected under bark of standing dry stem of *Picea abies* in a larval gallery of *Molorchus minor* (L.) with its dead larva in the Vitosha Mt., Zlatni mostove locality (Fig. 1A).

The cocoons of *Rhimphoctona xoridiformis* (Holmgren) were collected under bark of *Picea abies* (L.) H. Karst. in larval galleries of *Tetropium castaneum* (L.) with their remains in the Western Rhodopes Mts., 6 km S of Trigrad Village (Fig. 1B).

The tachinids *Billaea triangulifera* (Zetterstedt) and *Billaea adelpha* (Loew) were reared from *Prionus coriarius* (L.) larvae collected in semi-decayed wood of dry stem of *Quercus dalechampii* Ten. in the Vitosha Mt., 430 m south-east of the Tihiat kat Restaurant and *Quercus rubra* L. in Sofia, Borisova gradina Park.

After collection, the cerambycid larvae and cocoons of parasitoids were put separately in Petri dishes and were reared in laboratory conditions at room temperature (18-22°C). They were observed daily for emerging parasitoid adults.

The cerambycid larvae were identified using the keys of Švácha & Danilevsky (1986, 1987, 1988) and Mamaev & Danilevsky (1975). For the parasitoid species, the following keys were used: Belokobylskij & Tobias (1986), Achterberg (1987), Belokobylskij et al. (2013) (Braconidae), Ionaitis (1981), Kasparian (1981a), Kolarov (1997), Sawoniewicz (2003), Varga (2017) (Ichneumonidae), Tschorsnig & Herting (1994), Zhang et al. (2015) (Tachinidae).

Results

In this study, nine hymenopteran and dipteran species were recorded for the first time as parasitoids of longhorn beetles in Bulgaria: *Ontsira antica* (Wollaston, 1858), *Doryctes leucogaster* (Nees, 1834), *Spathius umbratus* (Fabricius, 1798), *Helcon angustator* Nees, 1812 (Hymenoptera: Braconidae), *Helcostizus restaurator* (Fabricius, 1775), *Ischnoceros rusticus* (Geoffroy, 1785), *Rhimphoctona xoridiformis* (Holmgren, 1860) (Hymenoptera: Ichneumonidae), *Billaea triangulifera* (Zetterstedt, 1844) and *Billaea adelpha* (Loew, 1873) (Diptera: Tachinidae) (Table 1).

Ontsira antica was reared from *Rhagium inquisitor inquisitor* (L., 1758), *D. leucogaster*, *S. umbratus* and *H. angustator* – from *Phymatodes testaceus* (L., 1758), *H. restaurator* – from *Molorchus minor* (L., 1758), *I. rusticus* – from *Morimus asper funereus* Mulsant, 1863, *R. xoridiformis* – from *Tetropium castaneum* (L., 1758), *B. triangulifera* and *B. adelpha* – from *Prionus coriarius* (L., 1758).

Rhimphoctona xoridiformis is a new species for the fauna of Bulgaria. Three new host-parasitoid relationships (*Rhagium inquisitor inquisitor – Ontsira antica*, *Morimus asper funereus – Ischnoceros rusticus* and *Prionus coriarius – Billaea triangulifera*) were recorded for the first time.

Characteristic larval breathing holes of *Billaea adelpha* were observed in pleural membranes of tho-

Fig. 1. Parasitoid cocoons: A – *Helcostizus restaurator* (♀) in larval gallery of *Molorchus minor* few hours before parasitoid emergence; B – *Rhimphoctona xoridiformis* (♀) in larval gallery of *Tetropium castaneum*

racic and abdominal segments of parasitised late-instar larvae of *Prionus coriarius* in the Borisova gradina Park in Sofia (Figs. 2A, B). The tachinid larvae pierced the host's integument near their breathing holes (Fig. 2C).

Doryctes leucogaster, *H. angustator, H. restaurator*, *R. xoridiformis* and *B. triangulifera* were observed as solitary parasitoids. The remaining species were detected as gregarious parasitoids. Two larvae of *P. coriarius* from the Vitosha Mt. were studied and one larva of *B. triangulifera* appeared from each host. They formed puparia (Fig. 2E), from which only one adult emerged later. Concerning *B. adelpha*, nine of the 11 studied larvae of *P. coriarius* were parasitised and 1-8 parasitoid larvae developed in one host (Fig. 2D). The majority of the individuals died during the pupal stage, despite the successful adult development in some puparia (Fig. 2F).

The degree of parasitism caused by *B. adelpha* was quite high – 81.8%. Concerning the remaining species, single samples were predominantly studied, thus it is not correct to comment the rates of parasitism in them.

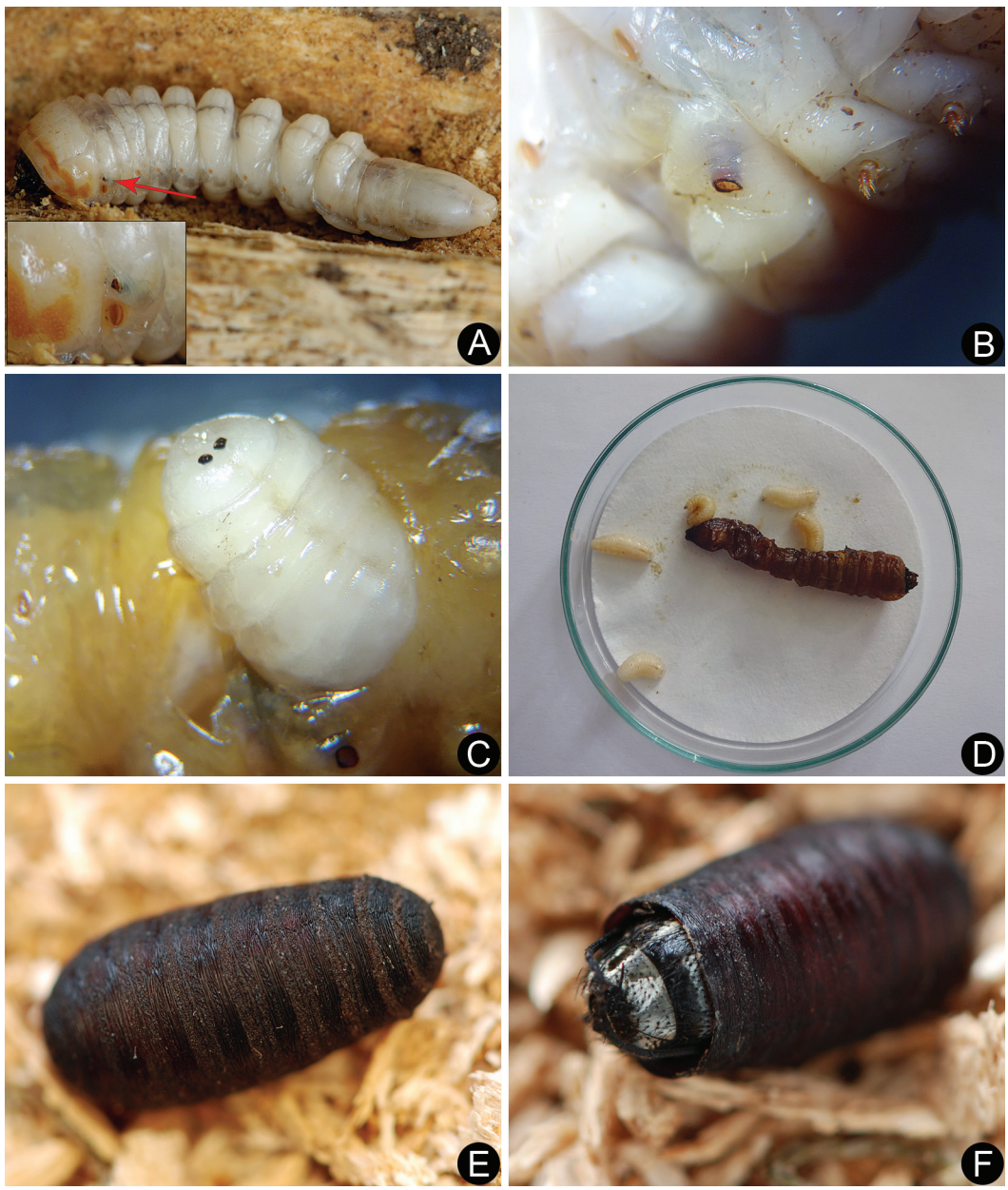

Fig. 2. *Billaea* parasitoids on *Prionus coriarius*: A – host larva parasitised by *B. adelpha* (on pleural membrane of the cerambycid mesothorax, the breathing hole of the parasitoid larva is pointed); B – breathing hole of *B. adelpha*; C – *B. adelpha* larva piercing host's integument; D – *B. adelpha* larvae near the host; E – *B. triangulifera* puparium; F – dead imago of *B. adelpha* in puparium

Discussion

According to the key of Belokobylskij & Tobias (1986), all reared adults of *Spathius umbratus* were previously identified as S. *curvicaudis* Ratzeburg, 1844, new for the Bulgarian fauna. Recently, Achterberg (2014) synonymised three *Spathius* species (*S. curvicaudis*, *S. erythrocephalus* Wesmael and *S. radzayanus* Ratz.) as junior synonyms of *Spathius umbratus* (F.). This resulted into relatively large host range – the species is a parasitoid of Coleoptera (Anobiidae, Buprestidae, Cerambycidae, Curculionidae), Lepidoptera (Tineidae, Sesiidae) and Hymenoptera (Xiphydriidae). Among longhorn beetles, it is associated with *Anoplophora glabripennis* (Motschulsky), *A. chinensis* (Förster), *Callidiellum rufipenne* (Motschulsky), *Lamia textor* (L.), *Pogonocherus hispidus* (L.) (syn. *S. erythrocephalus*), *Callidium aeneum* (De Geer), *Clytus* sp., *Obrium cantharinum* (L.), *Phymatodes pusillus* F., *P. testaceus*, *Xylotrechus pantherinus* (Savenius) (syn. *S. curvicaudis*), *Exocentrus lusitanus* (L.), *Monochamus alternatus* Hope, *Rhagium inquisitor*, *R. sycophanta* (Schrank) (syn. *S. radzayanus*) and *Saperda populnea* (L.) (syn. *S. umbratus*) (Belokobylskij & Tobias 1986, Sláma 1998, Kenis & Hilszczanski 2004, Hérard et al. 2013, Shimazu 2008, Gima 2013, Beyarslan 2017).

The Palaearctic and Oriental species *Doryctes leucogaster* is known as a parasitoid of a wide range of coleopteran and lepidopteran hosts, including many cerambycids: *Acanthocinus aedilis* (L.), *Anaesthetis testacea* (F.), *Chlorophorus pilosus* (Forster), *Exocentrus lusitanus*, *Hylotrupes bajulus* (L.), *Isotomus speciosus* (Schneider), *Leioderes kollari* Redtenbacher, *Penichroa fasciata* (Stephens), *Phymatodes testaceus*, *P. variabilis* L., *Plagionotus arcuatus* (L.), *Purpuricenus kaehleri* (L.), *Rhagium bifasciatum* F., *R. inquisitor*, *R. mordax* (De Geer), *Tetropium castaneum* (L.), *Trichoferus griseus* (F.), *T. holosericeus* (Rossi) and *Xylotrechus arvicola* (Olivier) (Fischer 1965, Hellrigl 1997, Gima 2013, Samin et al. 2014, Beyarslan 2017). In Bulgaria, it was reported as a parasitoid of *Lymantria dispar* (L.) (Lepidoptera: Erebidae) (Balevski 1999).

The Holarctic *Ontsira antica* is a parasitoid of Coleoptera and the list of its hosts includes the following longhorn beetles: *Clytus arietis* (L.), *Exocentrus punctipennis* Mulsant & Guillebeau, *Phymatodes testaceus*, *Plagionotus arcuatus*, *P. floralis* (Pallas), *Poecilium glabratum* (Charpentier), *Pogonocherus hispidulus* (Piller & Mitterpacher), *P. hispidus*, *Purpuricenus kaehleri*, *Pyrrhidium sanguineum*, *Tetropium castaneum* and *T. fuscum* (F.) (Belokobylskij & Tobias 1986, Hellrigl 1997, Sláma 1998, Kenis & Hilszczanski 2004, Gima 2013, Beyarslan 2017).

The Transpalaearctic *Helcon angustator* is known as a parasitoid of *Agrilus sulcicollis* Boisduval & Lacordaire (Coleoptera: Buprestidae), *Callidium violaceum* (L.), *Monochamus* sp., *Oberea pupillata* (Gyllenhal), *Phymatodes testaceus*, *Poecilium pusillum* (F.), *Pyrrhidium sanguineum*, *Ropalopus clavipes* (F.), *Ropalopus macropus* (Germar), *Tetropium gabrieli* Weise and *T. fuscum* (Coleoptera: Cerambycidae) (Tobias et al. 1986, Achterberg 1987, Kenis & Hilszczanski 2004).

European host list of the Holarctic *Helcostizus restaurator* includes *Callidium aeneum*, *Cerambyx scopolii* Fuessly, *Evodinus borealis* (Gyllenhal), *Molorchus minor*, *Pedestredorcadion pedestre* (Poda), *Poecilium glabratum*, *P. pusillum*, *P. rufipes* (F.), *Rhagium inquisitor*, *Ropalopus clavipes*, *Saperda populnea*, *Stenostola ferrea* (Schrank), *Tetropium* sp. (Cerambycidae) and *Pissodes harcyniae* (Herbst) (Curculionidae) (Torka 1818, Erichson 1848, Rondani 1873, Kleine 1909, Scheidter 1917, Schimitschek 1944, Uhthoff-Kaufmann 1990, Gutowski & Karas 1991, Kolarov 1995, Sláma 1998, Kenis & Hilszczanski 2004, Schwarz & Shaw 2010). The inclusion of *Pedestredorcadion pedestre*, which develops in soil, seems too doubtful and this old record (since 1909) needs confirmation. In North America, *H. restaurator* (= *H. ablator* (Thunberg), junior synonym) was reported as a parasitoid of *Dicentrus bluthneri* LeConte, *Holopleura marginata* LeConte, *Phymatodes aeneus* LeConte, *P. maculicollis* LeConte, *P. nitidus* LeConte, *Saperda calcarata* Say (Cerambycidae) and *Pissodes fasciatus* LeConte (Curculionidae) (Deyrup 1975, 1977). *Helcostizus restaurator* is known in Bulgaria from some localities up to 1200 m a.s.l. (Kolarov & Bordera 2007).

The European-Central Asian *Ischnoceros rusticus* was reported as parasitoid of *Acanthocinus aedilis*, *Aegomorphus clavipes* (Schrank), *Aromia moschata* (L.), *Leiopus nebulosus* (L.), *Morimus asper* (Sulzer), *Rhagium bifasciatum*, *R. inquisitor*, *R. mordax*, *Saperda carcharias* (L.), *S. punctata*, *S. scalaris* (L.), *Stenocorus* sp. (Coleoptera: Cerambycidae) and *Buprestis haemorrhoidalis araratica* Marseul (Coleoptera: Buprestidae) (Kleine 1909, Kasparian 1981b, Campadelli & Scaramozzino 1994, Hilszczanski 2002, Sheng & Sun 2010, Varga 2014).

The present finding of *Rhimphoctona xoridiformis* extends its known geographical range. Until now, this European species was recorded in Austria, the Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Norway, Poland, Romania, Russia, Sweden, Switzerland and United Kingdom (Anonymous 2006, Yu et al. 2012). It has been reported mainly as a parasitoid of species of *Tetropium* (*T. castaneum*, *T. fuscum* and *T. gabrieli*) but also of *Arhopalus rusticus* (L.), *Pogonocherus fasciculatus* DeGeer, *Pyrrhidium sanguineum*, *Stictoleptura rubra* (L.) (Cerambycidae) and *Pissodes harcyniae* (Curculionidae) (Schimitschek 1929, Thompson 1957, Sláma 1998, Kenis & Hilszczanski 2004, Yu et al. 2012, Gima 2013).

The Holoeurosiberian *Billaea triangulifera* is associated with many longhorn beetles: *Acanthocinus aedilis*, *A. griseus* (F.), *A. xanthoneurus* (Mulsant & Rey), *Leiopus nebulosus*, *Monochamus sutor* (L.), *M. urussovi* (Fischer von Waldheim), *Morimus asper*, *Oplosia cinerea* (Mulsant), *Pyrrhidium sanguineum*, *Rhagium inquisitor*, *Saperda octopunctata* (Scopoli), *S. populnea* (L.), *S. scalaris*, *Saphanus piceus* (Laicharting), *Stenostola dubia* (Laicharting), *S. ferrea*, *Tetropium castaneum*, *T. fuscum*, *T. gabrieli* and *Xylotrechus altaicus* (Gebler) (Zhang et al. 2015, Tschorsnig 2017). In Bulgaria, it has been reported as a parasitoid of *A. griseus* only (Hubenov et al. 2001).

The European-Turanian *B. adelpha* is known as a parasitoid of *Capnodis tenebrionis* (L.) (Coleoptera: Buprestidae), *Aromia moschata*, *Cerambyx welensii* (Kuster), *Lamia textor* (L.), *Pedostrangalia ariadne* (Daniel), *Prinobius myardi* Mulsant, *Prionus coriarius*, *Rhaesus serricollis* (Motschulsky), *Tetropium fuscum* (Coleoptera: Cerambycidae) and *Cetonia aurata* (L.) (Coleoptera: Cetoniidae) (Tschorsnig 2017).

Finally, it should be noted that the established records increase the data on the richness of the Bulgarian entomofauna and extend the knowledge of host ranges of parasitoid species studied.

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References

Achterberg C. van 1987. Revision of the European Helconinini (Hymenoptera: Braconidae: Helconinae). Zoologische Mededelingen 61 (18): 263-285.

Achterberg C. van 2014. Notes on the checklist of Braconidae (Hymenoptera) from Switzerland. Mitteilungen der Schweizerichen Entomologischen Gesellschaft 87 (3-4): 191-213.

Anonymous. 2006. Collection inventory of the Hymenoptera collection of the Zoological Museum, University of Copenhagen (ZMUC). Available at: http://www.zmuc.dk/EntoWeb/collections-databaser/Hymenoptera/Hymenoptera.htm. Last update: 24 October 2006.

Belokobylskij S. & Tobias V. 1986. Family Braconidae, subfam. Doryctinae [21-72]. In: Medvedev G. (ed.): Keys to the insects of the European part of the USSR. Vol. 3: Hymenoptera. Part 4. Nauka, Leningrad, 509 pp. (In Russian).

Belokobylskij S. A., Tang P. & Chen X. 2013. The Chinese species of the genus *Ontsira* Cameron (Hymenoptera, Braconidae, Doryctinae). ZooKeys 345: 73-96.

Beyarslan A. 2017. Checklist of Turkish Doryctinae (Hymenoptera, Braconidae). Linzer Biologische Beiträge 49/1: 415-440.

Campadelli G. & Scaramozzino P. L. 1994. Imenotteri parassitoidi di insetti xilofagi in Romagna. Bollettino dell'Istituto di Entomologia della Universita degli Studi di Bologna 48: 115-121.

Deyrup M. A. 1975. The insect community of dead and dying Douglas-fir: I. The Hymenoptera. Coniferous Forest Biome. Ecosystem Analysis Studies, Bulletin № 6, University of Washington, Seattle, 111 p.

Deyrup M. 1977. Notes on habitats and parasitoids of some Cerambycidae of Western Washington. Coleopterists Bulletin 31 (2): 181-182.

Doychev D., Topalov P., Zaemdjikova G., Sakalian V. & Georgiev G. 2017. Host plants of xylophagous longhorn beetles (Coleoptera: Cerambycidae) in Bulgaria. Acta zoologica bulgarica 69 (4): 511-528.

Erichson W. F. 1848. Insekten. In: Bericht über die wissenschaftlichen Leistungen in der Naturgeschicte der Insekten, Arachniden, Crustaceen, und Entomostraceen während des Jahres 1847. Archiv für Naturgeschichte 14 (2): 27-140.

Fischer M. 1965. Die Braconidae des Steiermärkischen Landesmuseums "Joanneum" in Graz (Hymenoptera, Braconidae). Mitteilungen der Abteilung für Zoologie und Botanik am Landesmuseum Joanneum Graz 21: 1-29.

Georgiev G. & Hubenov Z. 2006. Vertical distribution and zoogeographical characteristics of Cerambycidae (Coleoptera) family in Bulgaria. Acta Zoologica Bulgarica 58 (3): 315-343.

Gima L. 2013. Contributions to the knowledge of research on beetle parasite fauna (Insects). Note 1. Muzeul Olteniei Craiova, Oltenia, Studii şi comunicări, Ştiinţele Naturii 29 (2): 172-183.

Gutowski J. M., Karas M. 1991. *Evodinus borealis* (Gyllenhal, 1827) (Coleoptera, Cerambycidae) in Poland. Wiadomości Entomologiczne 10 (4): 221-226 (In Polish, English abstract).

Hellrigl K. 1997. Parasitische Hautflügler und Zweiflügler in Waldgebieten Südtirols (Hym., Apocrita: Chalcidoidea, Ichneumonoidea), (Diptera, Brachycera: Tachinidae). Vorkommen, Bedeutung, Perspektiven. Schriftenreihe für wissenschaftliche Studien 4: 1-116.

Hérard F., Maspero M.& Ramualde N. 2013. Potential candi-

dates for biological control of the Asian longhorned beetle (*Anoplophora glabripennis*) and the citrus longhorned beetle (*Anoplophora chinensis*) in Italy. Journal of Entomological and Acarological Research 45: 22.

Hilszczanski J. 2002. Polish xoridines and their host associations (Hymenoptera: Ichneumonidae: Xoridinae). In: Melika G. & Thuroczy C. (Eds.): Parasitic wasps: evolution, systematics, biodiversity and biological control. International Symposium: 'Parastic Hymenoptera: Taxonomy and Biological Control', 14-17 May 2001, Koszeg, Hungary, 294-298.

Hubenov Z., Georgiev G., Mirchev P. & Naidenov J. 2001. *Acanthocynus griseus* (F.) (Coleoptera: Cerambycidae) – a new host of *Billaea triangulifera* (Zett.) (Diptera: Tachinidae) in Bulgaria. Forest Science 1/2: 87-89 (In Bulgarian, English summary).

Ionaitis V. P. 1981. Family Ichneumonidae, subfam. Gelinae (Cryptinae) [175-274]. In: Medvedev G. (Ed.): Keys to the insects of the European part of the USSR. Vol. 3: Hymenoptera. Part 3. Leningrad: Nauka, 688 p. (In Russian).

Kasparian D. R. 1981a. Family Ichneumonidae, subfam. Campopleginae (Porizontinae) [383-423]. – In: Medvedev G. (Ed.): Keys to the insects of the European part of the USSR. Vol. 3: Hymenoptera. Part 3. Nauka, Leningrad, 688 p. (In Russian).

Kasparian D. 1981b. Family Ichneumonidae, subfam. Xoridinae [168-174]. In: Medvedev G. (Ed.): Keys to the insects of the European part of the USSR. Vol. 3: Hymenoptera. Part 3. Leningrad: Nauka, 688 p. (In Russian).

Kenis M. & Hilszczanski J. 2004. Natural enemies of Cerambycidae and Buprestidae infesting living trees [475-498]. In: Lieutier F., Day K. R., Battisti A., Grégoire J. C. & Evans H. F. (Eds.): Bark and wood boring insects in living trees in Europe, a synthesis. Kluwer Academic Publishers, 569 p.

Kleine R. 1909. Die Schmarotzerwespen der Cerambyciden und Buprestiden. Entomologische Blätter 5: 177-179, 207-212.

Kolarov J. 1995. A catalogue of the Turkish Ichneumonidae (Hymenoptera). Entomofauna 16 (7): 137-188.

Kolarov J. 1997. Fauna Bulgarica. Vol. 25: Hymenoptera, Ichneumonidae. Part 1 (Pimplinae, Xoridinae, Acaenitinae, Collyriinae). Sofia: Professor Marin Drinov Publishing House & Pensoft, 326 p. (In Bulgarian, English summary).

Kolarov J. & Bordera S. 2007. Fauna and distribution of Bulgarian Phygadeuontini (Hymenoptera: Ichneumonidae: Cryptinae). Boletín de la Asociación Española de Entomología 31 (1-2): 157-169.

Mamaev B. M. & Danilevsky M. L. 1975. Larvae of Longhorned Beetles. Moscow: Nauka, 282 p. (In Russian).

Migliaccio E., Georgiev G. & Gashtarov V. 2007. An annotated list of Bulgarian cerambycids with special view on the rarest species and endemics (Coleoptera: Cerambycidae). Lambillionea 107 (1), Supplément 1: 1-78.

Rondani C. 1873. Degli insetti nocivi e dei loro parassiti. Ordine dei Scarabearii – Coleoptera. Enumerazione con note. Bollettino della Società Entomologica Italiana 5: 3-30.

Samin N., Ghahari H., Gadallah N. & Davidian E. M. 2014. A study on the Braconidae (Hymenoptera: Ichneumonoidea) from West Azarbaijan Province, Northwestern Iran. Linzer Biologische Beiträge 46/2: 1447-1478.

Sawoniewicz J. 2003. Zur Systematik und Faunistik europäischer Ichneumonidae II (Hymenoptera, Ichneumonidae). Entomofauna 24 (15): 209-228.

Scheidter F. 1917. Über die Eiablage von *Saperda populnea* L. Naturwissenschaftliche Zeitschrift für Forst- und Landwirtschaft 15: 113-128.

Schimitschek E. 1929. *Tetropium gabrieli* Weise und *Tetropium fuscum* F.: Ein Beitrag zu der Lebensgeschichte und Lebensgemeinschaft. Zeitschrift für Angewandte Entomologie 15: 229-334.

Schimitschek E. 1944. Forstinsekten der Tuerkei und ihre Umwelt. Prague, 371 p.

Schwarz M. & Shaw M. R. 2010. Western Palaearctic Cryptinae (Hymenoptera: Ichneumonidae) in the National Museums of Scotland, with nomenclatural changes, taxonomic notes, rearing records and special reference to the British check list. Part 4. Tribe Phygadeuontini, subtribes Mastrina, Ethelurgina, Endaseina (excluding Endasys), Bathythrichina and Cremnodina. Entomologist's Gazette 61: 187-206.

Sheng M. L. & Sun S. P. 2010. Parasitic ichneumonids on woodborers in China (Hymenoptera: Ichneumonidae). Beijing: Science Press, 338 p. (In Chinese, English summary).

Shimazu M. 2008. Biological control of the Japanese pine sawyer beetle, *Monochamus alternatus* [351-370]. In: Zhao B. G., Futai K., Sutherland J. R. & Takeuchi Y. (Eds.): Pine Wilt Disease. Tokyo: Springer, 459 p.

Sláma M. 1998. Tesaříkovití – Cerambycidae České republiky a Slovenské republiky (Brouci – Coleoptera). Sláma, Krhanice. 384 p.

Švácha P. & Danilevsky M. L. 1986. Cerambycoid larvae of Europe and Soviet Union (Coleoptera, Cerambycoidea). Part I. Acta Universitatis Carolinae. Biologica 30 (1-2): 1-186.

Švácha P. & Danilevsky M. L. 1987. Cerambycoid larvae of Europe and Soviet Union (Coleoptera, Cerambycoidea). Part II. Acta Universitatis Carolinae. Biologica 31 (3-4): 121-284.

Švácha P. & Danilevsky M. L. 1988. Cerambycoid larvae of Europe and Soviet Union (Coleoptera, Cerambycoidea). Part III. Acta Universitatis Carolinae. Biologica 32 (1-2): 1-205.

Thompson W. R. 1957. A Catalogue of the Parasites and Predators of Insect Pests. Section 2, Host Parasite Catalogue. Part 4, Hosts of the Hymenoptera (Ichneumonidae). Ottawa, Ont. Canada, The Commonwealth Institute of Biological Control, pp. 333-561.

Tobias V., Belokobylskij S. & Kotenko A. 1986. Family Braconidae, subfam. Helconinae [150-158]. In: Medvedev G. (ed.): Keys to the insects of the European part of the USSR. Vol. 3: Hymenoptera. Part 4. Nauka, Leningrad, 509 p. (In Russian).

Torka V. 1918. Ichneumoniden der Provinz Posen. Entomologische Rundschau 35: 1-12, 27-28, 29, 33-34, 39-40.

Tschorsnig H.-P. & Herting B.1994. Die Raupenfliegen (Diptera: Tachinidae) Mitteleuropas: Bestimmungstabellen und Angaben zur Verbreitung und Ökologie der einzelnen Arten. Stuttgarter Beiträge zur Naturkunde (A), 506: 1-170. Online authorized version of English translation by Rayner R., Raper C.: Tschorsnig H.-P. & Herting B. 2001. The Tachinids (Diptera: Tachinidae) of Central Europe: Identification Keys for the Species and Data on Distribution and Ecology, http://tachinidae.org.uk/site/downloads.php

Tschorsnig H.-P. 2017. Preliminary host catalogue of Palaearctic Tachinidae (Diptera). First version, provided online on 28 April 2017. www.nadsdiptera.org/Tach/WorldTachs/CatPalHosts/Home.html.

Uhthoff-Kaufmann R. R. 1990. The genera *Nathrius* Brèthes and *Molorchus* F. (Col.: Cerambicidae) in Great Britain. Entomologist's Record 102: 239-242.

Varga A. 2014. Study of Xoridinae (Hymenoptera: Ichneumonidae) in the Ukrainian Carpathians. Genera *Odontocolon* Cushman and *Ischnoceros* Gravenhorst. Proceedings of the Russian Entomological Society, St. Petersburg 85 (1): 143-150.

Varga O. 2017. A review of the genus *Rhimphoctona* Förster, 1869 (Hymenoptera: Ichneumonidae: Campopleginae) from the Ukrainian Carpathians, with a key to European species. Zootaxa 4263 (2): 387-394.

Yu D. S., Achterberg C. van & Horstmann K. 2012. Taxapad 2012 - World Ichneumonidae 2011. Taxonomy, biology, morphology and distribution. USB/flash drive. Ottawa, Ontario, Canada. (www.taxapad.com).

Zhang C.-T., Shima H., Wang Q. & Tschorsnig H.-P. 2015. A review of *Billaea* Robineau-Desvoidy of the eastern Palearctic and Oriental regions (Diptera: Tachinidae). Zootaxa 3949 (1): 1-40.

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