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NEW DATA OF BULGARIAN PARASITOID ENTOMOFAUNA AND CONTRIBUTIONS TO HOST-PARASITOID INTERACTIONS

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Abstract

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Fifteen parasitoid species of order Hymenoptera were collected in eight habitats in Bulgaria. Six species belong to family Ichneumonidae, respectively 5 – to Braconidae, 2 – to Eulophidae and 1 respectively to Perilampidae and Pteromalidae. *Microplitis naenia* and *Phthorima compressa* are new species for Bulgarian fauna. Four new primary host-parasitoid trophic interactions were established and eight plant associates are new for the parasitoids *Teliutaea striata – Rubus idaeus*.

Key words: parasioid; trophic interaction; Ichneumonidae; Braconidae; Eulophidae; Perilampidae; Pteromalidae

Introduction

The study is an extension of previous investigation on the parasitoid diversity on harmful insects and plants-pests-parasitoids trophic interactions. Fifty six parasitoids species were reared in period of 2008-2012, more of them reported in our previous works (Peeva et al., 2009; Velcheva et al., 2010, 2012, 2016).

The aim of the present work is to add new data connected with parasitoid species of five families of the order Hymenoptera.

Materials and Methods

Experimental material was collected from different crops in various regions of Bulgaria. The sampling localities and dates are presented in Table 1.

Specimens were reared individually on their native foods in the laboratory till emergence of parasitoids or moths (Velcheva et al., 2010).

The parasitoid species were identified after systematic keys of Kasparyan et al. (1981) and Tobias et al. (1986). The taxonomic status and nomenclature of parasitoids and moths follow Fauna Europaea database (Van Achterberg, 2013; Mitroiu, 2013; Karsholt and De Prins, 2013). Distribution of the species is after Yu et al. (2012), Zerova et al. (1989), Kolarov (2008) and Noyes (2016).

The new species for Bulgarian fauna are marked by *.

Results and Discussion

Fifteen parasitoid species of five families of Hymenoptera were recorded in 8 different localities in Bulgaria.

► Family Braconidae
Subfamily Microgastrinae
Apanteles ater (Ratzburg, 1852)

The V-thinstar larva of the host *Pandemis cerasana* (Hub) (Lepidoptera, Tortricidae) was found in locality 1 on 2.05.2011. White parasitoid cocoons were formed on the body of the host on 9.05.2011. Emergence of 19 males and 25 females occurred on 17.05.2011. *A. ater* is a primary gregarious larval endoparasitoid, common in orchards. *P. cerasana* is announced for the first time as a host of the parasitoid for our country.

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Table 1
Sampling localities and habitats

No	Locality	Latitude/ Longitude	Altitude (m a.s.l.)	Habitat
1	Experimental field in Kostinbrod town of the Institute of Soil Science, Agrotechnologies and Plant Protection "N. Pushkarov" (ISSAPP) (Ex Plant Protection Institute)	42°81′N 23°23′E	548	Apple orchard
2	Experimental field in Sofia of the ISSAPP "N. Pushkarov"	42°45′N 25°14′E	550	Plum trees
3	Experimental field in Kostinbrod town of the Institute of Agriculture – Kyustendil – (Ex Experimental Station of Small Fruit Crops)	42°81′N 23°23′E	42°81′N 23°23′E	Raspberry plantation
4	Experimental field in Institute of Agriculture – Kyustendil town	42°28′N 22°69′E	512	Organic apple orchard
5	Agricultural University, Plovdiv city	42°15′N 24°75′E	164	Organic plum orchard
6	Pancharevo village, Sofia region	42°60′N 23°38′E	703	Abandoned orchard
7	Ahtopol town	42°60′N 27°56′E	19	Private park
8	Kaval Tepe locality, Rhodope mountain	41°45′N 24°10′E	1530	Urtica dioica
9	Park"Borisovata gradina"	42°68′N 23°34′E	550	Quercus spp.

Distribution: Europe, North America, Asia.

Apanteles xanthostigma (Haliday, 1834)

The larva of the host *Ancylis achatana* (Den. et Schiff.) (Lepidoptera, Tortricidae) was found during the first observation of the level infestation by pests of plum buds of *Prunus domestica* in locality 2 on 3.02. 2009. The parasitoid cocoon was formed under laboratory conditions on 13. 03. 2009. One female braconid wasp emerged on 23. 03. 2009.

A. xanthostigma is primary, solitary endoparasitoid isolated from 68 lepidopteran and 3 dipteran species (Yu et al., 2012; Fernandez-Triana et al., 2014). The parasitoid developes 2-3 generations per year (Zerova et al., 1989).

Distribution: Europe, Asia, Africa. Species is established in North America after introduction from Europe (Fernandez-Trianaet al., 2014).

This is the first rearing of *A. xanthostigma* of this host for Bulgaria.

Cotesia tibialis (Curtis, 1830)

The host *Orthosia gracilis* (Den. et Schiff.) (Lepidoptera, Noctuidae) was collected on the leaves of raspberry *Rubus idaeus* L. in locality 3. Twenty two male and 23 female braconid wasps emerged on 5.06. 2008. *C. tibialis* is primary and secondary gregarious endoparasitoid, reported on 104 hosts of Microlepidoptera, Macrolepidoptera, Ichneumonoidea and Chalcidoidea (Yu et al., 2012). Raspberry is a new plant associate for the parasitoid.

Distribution: Europe, Asia.

****Microplitis naenia*** (Nixon, 1970)

Forty noctuids larvae of host *Orthosia cruda* (Den. et Schif.) (Lepidoptera, Noctuidae) were found on leaves of apple trees on 10.05.2010 (Locality 1). Parasitoids formed cocoons on 15.05.2010, 17.05.2010, and 19.05.2010. One male emerged on the 27.05.2010 and from the others, two males on the 25.03.2011 Data of our observation demonstrated that *M. naenia* is a primary solitary larval endoparasitoid and develops at least two generations per year. According Yu et al. (2012) the parasitoid has been reared only on noctuid larvae. *M. naenia* is new for the Bulgarian fauna and apple is a new plant associate.

Distribution: Britain, Russia, Slovakia, Hungary and Turkey.

Subfamily Euphorinae

Meteorus ictericus (Nees, 1812)

Larvae of the host *Ancylis achatana* (Den. et Schiff.) (Lepidoptera, Tortricidae) were collected on the leaves of *Prunus domestica* L., variety Stenley on 3.05.2012, in locality 2. One parasitoid female emerged on 15.05. 2012. The species is primary and secondary solitary endoparasitoid and is known as polyphagous. *M. ictericus* is recovered of many hosts of lepidopteran families – Tortricidae, Yponomeutidae, Lasiocampidae, Gelechiidae, Geometridae, Pyralidae, Pyraustidae, Noctuidae, Momphidae and Thaumetipoeidae. The parasitoid develops 2-3 generations in temperate regions and 4 in the Southern parts (Zerova et al., 1989). This is the first finding of the parasitoid in plum biocenose.

Distribution: Palearctic and Nearctic regions, Asia, Australia.

► Family Ichneumonidae

Subfamily Banchinae

Apophua bipunctoria (Thunberg, 1824)

Larvae of the host *Argyrotaenia ljungiana* (Thunberg) (Lepidoptera, Tortricidae) were found on the leaves of apple trees in the locality 1 on 10.05.2010. Emergence of a male took place on 31.05.2010. *A. bipunctoria* is primary, solitary

endoparasitoid, develops 2 generations per year, preferably in larvae of the family Tortricidae. Females lay eggs in larvae second instar, but endoparasitoid begins feed on the fully developed larva (Zerova et al., 1989). Rearing of *A. bipunctata* of *A. ljungiana* is a new trophic parasitoid host relation for our country.

Distribution: Palearctic and Neoarctic regions.

Teleutaea striata (Gravenhorst, 1829)

Firstly, the host *Pandemis* sp. (Lepidoptera, Tortricidae) was collected of leaves of raspberry *Rubus idaeus* L in locality 3 on 2.06.2008, and the wasp emerged on 18.06.2008. In the second case larvae of *P. heparana* (Den. et Schiff.) were found on apple leaves in organic orchard in locality 4 on the 20.05. 2011. The wasp emerged on 9.06.2011. *T. striata* is primary, solitary, larval endoparasitoid developing two generations per year. It is well known parasitoid of Tortricidae in orchards (Bichina and Gontarenko, 1981; Evenhuis and Vlug, 1983; Kienzle et al., 1997), especially often reared of *Adoxophyes orana* (Fischer von Röslerstamm). *Rubus idaeus* is a new plant associate of the parasitoid.

Distribution: Austria, Belarus, Central European Russia, Czech Republic, Estonia, Finland, Germany, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Slovakia, Sweden, The Netherlands and Japan.

Subfamily Campopleginae

Sinophorus xanthostomus (Gravenhorst, 1829)

Larvae of the host *Eupsilia transversa* (Hufnagel) (Lepidoptera, Noctuidae) was collected on the leaves of quince (*Cydonia oblonga* Mill.) near abandoned orchard in locality 6 on 14. 05. 2009. The cocoon of the ichneumonid wasp was formed on 18.05. 2009 and the emergence of adult was registered on 25. 05. 2009. This solitary, larval endoparasitod lays eggs in larvae of IVth-Vthinstars of *Heliothis peltigera* (Calbukov, 1978). The other known hosts of the parasitoids are of the families Pieridae (*Pieris brassicae* L., *Pieris rapae* L.), Noctuidae (e.g. *Agrotis ipsilon* Huf., *Agrotis segetum* Den & Schiff., *Helicoverpa armigera* Hub., *Heliothis peltigera* Den & Schiff., *Spodoptera exigua* Hub.), Gelechiidae (*Chionodes distinctella* Zell.), Crambidae (*Loxosteges ticticalis* L., *Ostrinia nubilalis* Hub.), Pyralidae (*Myelois circumvoluta* Fourc.) (Zeman et al., 2015).

Yu et al., (2012) reported the following associated plants *Alnus glutinosa* (L.); *Gossypium hirsutum* L.; *Heracleum sphondylium* L.; *Lotus corniculatus* L.; *Medicago sativa* L.; *Picea* spp. Dietrich and *Zea mays* L. In our country it was found also on *Salvia* sp., *Mentha* sp. and *Vitis vinifera* L. (Harizanov et al., 1977; Calbukov, 1978). A quince is a new plant associate of the parasitoid.

Distribution: Palearctic, Mediterranean, Neotropical and Oriental regions.

Subfamily Diplazontinae

Phthorima compressa (Desvignes, 1856)

Larvae of the host *Episyrphus balteatus* De Geer (Diptera, Syrphidae) were collected on the leaves of *Prunus domestica* L. heavy infested with *Hyalopterus pruni* (Geoff) (Aphididae) in locality 5 on 29.04.2008. The pupae were formed on 17.05.2008, and parasitoid emerged on 23.05.2008. According our observation the parasitoid is solitary larval-pupal endoparasitoid. Only two dipteran hosts *Neocnemodon fulvimanus* (Zett.) and *Neocnemodon vitripennis* (Meigen) were reported in work of Yu et al. (2012). *P. compressa* on *Episyrphus balteatus* is a new trophic relation and plum is a new plant habitat of the parasitoid. Parasitoid is a new for the Bulgarian fauna.

Distribution: Austria, Belguim, Cenral European Russia, Czech Republic, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Moldova, Poland, Romania, Slovakia, Spain, Sweden, Switzerland, UK and USA.

Subfamily Ichneumoninae

Tycherus fuscicornis (Wesmel, 1845)

Larvae of the host *Cacoecimorpha pronubana* Hübner (Lepidoptera, Tortricidae) were found on the leaves of *Laurus nobilis* L in locality 7. One male emerged on 5. 07. 2009 and a female on 10.06. 2011.

The ichneumon wasp was isolated of the same host in France (Greathead and Greathead, 1992). Yu et al. (2012) reported *Olethreutes hercyniana* Treit. – as a systematically closed tortricid host species and only two plant associates – *Daucus carota* L. and *Heracleum sphondylium* L. *L. nobilis* is a new plant associate for the parasitoid.

Distribution: Armenia, Austria, Belgium, Bulgaria, Czechoslovakia, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Lithuania, Netherlands, Norway, Poland,Romania, Russia, Russia, Spain, Sweden, Ukraine, United Kingdom.

Subfamily Pimplinae

Endromopoda detrita (Holmgren, 1860)

The host Syricoris *lacunana* (Den. et Schiff.) was collected on *Urtica dioica* L in locality 8. The same high altitude of parasitoid habitat was found also in Turkey (Çoruh and Kolarov, 2010; Çoruh et al., 2014).

Stinging nettle *U.dioica* is a new plant associate for the parasitoid (Yu et al., 2012).

Distribution: Holarctic and Oriental region (Çoruh and Kolarov, 2010).

► Family Eulophidae

Colpoclypeus florus (Walker, 1839)

Larvae of the host *Cacoecimorpha pronubana* (Hüb.) (Lepidoptera, Tortricidae) were found to feed on leaves

of *L. nobilis* in locality 7. Eight imago specimens of the parasitoid emerged in the period 4 – 6.07.2009**.** Eggs and first instar larvae of *C. florus* develop inside the host and after second instar, they feed on the host larvae as ectoparasitoid (Zerova et al., 1989). The species is very common in orchards of Europe. *L. nobilis* is a new plant association for the parasitoid.

Distribution: Palaearctic and Nearctic regions.

***Eulophus larvarum* (L.)**

Larvae of the host *Orthosia gracilis* (Den. et Schiff.) (Lepidoptera, Noctuidae) were found on raspberry *Rubus idaeus* L and blackberry *Rubus fruticosus* L. in locality 3. The parasitoid wasps emerged on 5.06 and 15.06. 2008. *E. larvarum* is primary gregarious ectoparasitoid, wide generalist, recorded of 96 species of orders Lepidoptera, Diptera, Hymenoptera and Coleoptera (Noyes, 2016). The parasitoid species normally develops two generations per year. Isolation of *E. larvarum* of *O. gracilis* is a new trophic parasitoid host relation for our country.

Distribution: Europe, Asia.

► Family Perilampidae

Perilampus ruficornis (Fabricius, 1793)

Pupa of the host *Argyrotaenia ljungiana* Thun. (Lepidoptera, Tortricidae) found on on the leaves of apples in locality 1 on 30.08.2011. The emergence of one female of *P. ruficornis* occurred on 11.09.2011. The species is secondary solitary endoparasitoid. Twenty six hosts of the orders Hymenoptera, Diptera and Lepidoptera are listed in comprehensive Universal Chalcidoidea Database (Noyes, 2016). *Episimus argutanus* (Clem.), *Tortrix viridana* L. and *Rhyacionia buoliana* (Den. et Schiff.) were the only primary tortricid hosts recorded and our finding is addition to the list of the parasitoid primary hosts.

Distribution: Europe, Asia, Africa, USA.

► Family Pteromalidae

Dibrachis cavus (Walker, 1835)

Larvae of the host *O. gracilis* (Lepidoptera, Noctuidae) were collected on the leaves of blackberry *Rubus fruticosus* L. in locality 2. Emergence of imago was registered on 15.06.2008**.** *D. Cavus* is established as a primary, secondary and even third range parasitoid of numerous hosts of Lepidoptera, Diptera, Coleoptera, Hemiptera and some spiders. The chalcidoid develops 3–4 generations per year. The blackberry is new plant associate of the parasitoid.

Distrbution: Europe, North and South America, Asia, Australia.

Conclusion

Fifteen parasitoid species of order Hymenoptera were collected in 8 habitats in Bulgaria. Six species belong to family Ichneumonidae, 5 to Braconidae, 2 – to Eulophidae and 1 respectively to Perilampidae and Pteromalidae. *Microplitis naenia* and *Phthorima compressa* are new species for Bulgarian fauna.

Four new primary host-parasitoid trophic interactions were established (*Meteorus ictericus* ex. *Ancylis achatana; Apophua bipunctoria* ex. *Argyrotaenia jungiana; Sinophorus xanthostomus* ex. *Eupsilia transversa;* and *Perilampus ruficornis* ex. *Argyrotaenia ljungiana*). The plant associates are new respectively for the following parasitoids: *Cotesia tibialis - Rubus idaeus; Tycherus fuscicornis – Laurus nobilis, Colpoclypeus florus - Laurus nobilis; Microplitis naenia – Malus domestica; Sinophorus xanthostomus - Cydonia oblonga; Phthorima compressa - Prunus domestica; Endromopoda detrita - Urtica dioica; Dibrachys cavus - Rubus fruticosus).*

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