

Betula species as host plants for various insects parasitized by braconids (Hymenoptera: Braconidae) in Serbia

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Abstract:

Stanković, S., Žikić, V., Ilić, M.: *Betula species as host plants for various insects parasitized by braconids (Hymenoptera: Braconidae) in Serbia. Biologica Nyssana, 1 (1-2), December 2010: 117-122.*

This work presents braconid wasps which can be found on insects attacking birches, especially *Betula alba* and *B. pubescens* (Betulaceae) which are autochthonous in Serbia. We have found 49 braconid species from 26 genera on 40 phytophagous insects; one from the hemimetabolous order: Homoptera: Homoptera and three from the holometabolous orders: Coleoptera, Hymenoptera and Lepidoptera. Registered braconid species belong to the subfamilies: Aphidiinae, Braconinae, Doryctinae, Euphorinae, Exothecinae, Microgastrinae, Orgilinae, Rhysipolinae and Rogadinae. Although most of the registered phytophagous insects pose a significant threat to *Betula* species, the two species: *Epirrita autumnata* (Geometridae) and *Lymantria dispar* (Noctuidae) are the most important, because they can defoliate entire forests when their populations are in gradation. Also, there are two buprestid pests *Agilus anxius* native to North America and *A. planipennis* (Buprestidae) from Central Asia which are considered as potentially invasive species.

Key words: *Betula*, Braconidae, hosts, tritrophic associations, Serbia

Introduction

Braconidae wasps comprise at least 50.000 species of solitary or gregarious ecto- and endoparasitoids that parasitize larvae of their hosts, as well as eggs and very rarely recorded, the adult stage. The body size of braconid wasps is in range from 0.5 mm to over 20 cm including the “fake ovipositor” (Starý, 1970, 1988; Shaw & Huddleston, 1991). There are two strategies among Braconidae wasps: idiobionts that permanently parasitize their host before laying eggs and konobionts that allow the host to continue developing while the larvae feed within the host's body. The great majority of Braconidae are cosmopolitan and polyphagous insects. Some species show different degrees of host specificity. There are programs of utilization of braconid wasps and other insects as biological control agents

starting from Baird (1958), Mathews (1974), Lewis *et al.* (1977, 1990), over the fieldworks such as biocontrol of olive fruit flies (Sime *et al.*, 2006; Yokoyama *et al.*, 2008), to brand-new, Kula *et al.* (2010).

Not much data exists about the insect pests feeding on birch and their parasitoids from the family Braconidae in Europe, especially in Serbia. Some sporadically records exist in the following journals: (Tomanović & Kavallieratos, 2002; Kavallieratos *et al.*, 2002, 2004). World fauna of Braconidae which attack pests in the birch communities is poorly investigated as well. Birches are autochthones for the greater part of Europe, as well as for the territory of Serbia. We have chosen to present this work in this journal because the first issue is dedicated to Vlasina Lake, which is the place full of native birches: *Betula alba* and *B. pubescens* (Betulaceae). Most important parasitoids

in biological control of the species from the genus *Agrilus* (Coleoptera: Buprestidae), could be *Spathius agrili* Yang 2005, (Braconidae) found in the USA on European birch *Betula alba* (Yang *et al.* 2008). The host range of *S. agrili* is presented by 18 wood boring insects belonging to the genus *Agrilus*, who are present on the other host plants such as *Fraxinus*, *Prunus* and *Alnus*.

Material and methods

The examined parasitoid wasps for this study were collected from the hosts feeding on *Betula alba* and *B. pubescens* all over Serbia. In the tritrophic associations: parasitoid-host-plant include all hosts found in Europe. One part of specimens is deposited at the Faculty of Sciences and Mathematics, Department of Biology and Ecology, University of Niš, Serbia while the rest of specimens are at the Faculty of Biology, University of Belgrade, Serbia. Identification of birch species was done according to Vukićević (1970).

Results and discussion

The parasitoid subfamilies, genera and species and their hosts are arranged in four tables as trophic associations connected by (X). The total number of 49 braconids species from 26 genera belong to the following subfamilies: Aphidiinae, Braconinae, Doryctinae, Euphorinae, Exothecinae, Microgastrinae, Orgilinae, Rhysipolinae and Rogadinae. We have found 42 host species belonging to four insect orders: Coleoptera, Homoptera, Hymenoptera and Lepidoptera (**Tab. 1**). All registered host species are phytophagous insects feeding on leaves or they are xylophagous on birches. The trophic relations between Aphidiinae and aphid hosts (Homoptera: Aphididae) are presented in the **table 2**. The species *Callaphis flava* (Aphididae) is registered as the host of four Aphidiinae wasps: *Aphidius aquilus* Mackauer, 1961, *Praon flavinode* (Haliday, 1833), *Trioxys betulae* (Marshall, 1896) and *T. cirsii* (Curtis, 1831). Parasitoid wasp *Aphidius aquilus* attack three of four recorded aphids.

The ectoparasitoid groups of Braconidae which parasitize coleopteran and hymenopteran host larvae are shown in the **table 3**. The subfamily Braconinae is presented by five parasitoids of Coleoptera species coming from Curculionidae and Cerambycidae. *Bracon obscurator* Nees 1811 was found as parasitoid of the genus *Trypodendron*: *T. domesticum* and *T. signatum* (Curculionidae). For buprestid *Chrysobothris affinis* (Buprestidae) we noted four natural enemies: *Glyptomorpha*

pectoralis (Brullé 1832), *Pseudovipio castrator* (Fabricius 1798), *Vipio appellator* (Nees 1834) from the subfamily Braconinae and *Doryctes leucogaster* (Nees 1834) from the subfamily Doryctinae. The species *Iphiaulax impostor* (Scopoli 1763) parasitizes *Aegomorphus clavipes* and *Leiopus nebulosus* from the family of longhorned beetles (Cerambycidae). Braconidae attacking the caterpillars of various lepidopteran families found on birches belong to the genus *Bracon* are *B. abbreviator* Nees 1834, *B. discoideus* Wesmael 1838, *B. hebetor* Say 1836, *B. intercessor* Nees 1834, *B. romani* Fahringer 1927 and *B. variegator* Spinola 1808 (**Tab. 4**). Among *Bracon* species the most important is polyphagous *B. intercessor* which attacks various insects from coleopteran families, especially Curculionidae and Lepidoptera, Sessidae - *Synanthedon culiciformis*, *Paranthrene tabaniformis*. Another important species is *Bracon hebetor* recorded from many larvae of Crambidae, Gelechiidae, Noctuidae and Tortricidae (Milonas, 2005); an important natural enemy of Indian meal moth *Plodia interpunctella*, (Pyralidae), common as pest of stored products.

Subfamily Doryctinae is presented by six species from four genera attacking different hosts from the order Coleoptera: *Dendrosoter protuberans* (Nees 1834), *Doryctes leucogaster* (Nees 1834), *Ontsira ignea* (Ratzeburg 1852), *O. imperator* (Haliday 1836), *Spathius curvicaudis* Ratzeburg 1844 and *S. rubidus* (Rossi 1794), **Tab. 3**, and from Lepidoptera, only one but the most important and extremely polyphagous species, *Lymantria dispar* from the family Noctuidae. It is interesting that the presence of any *Spathius* parasitoid of *Agrylus cynaescens* –species group (Buprestidae), native in Europe, but an invasive alien pest in North America is not reported in Europe (Jendek & Grebennikov, 2009). One of the candidates for the biological control of *A. cynaescens* is *Spathius rubidus* known as polyphagous on various coleopteran families: Buprestidae, Cerambycidae, Curculionidae, and Rhizophagidae as well as Xiphidriidae from the order of Hymenoptera. In addition to this species, we report it as parasitoid of two species of *Agrylus*: *A. angustulus* and *A. hastulifer* (Buprestidae) and *Leiopus nebulosus* and *Rhagium mordax* from the family of Cerambycidae. Diversity and some parasitoid-host data are the best known for this subfamily among ectoparasitic (Belokobylskij & Žikić, 2009).

From the ectoparasitoid subfamily Exothecinae we registered only two species: *Colastes braconius* Haliday 1833 parasitizes on *Heterarthrus vagans* sawfly (Tenthredinidae) and on another extremely polyphagous species *Epirrita autumnata* Geometridae,

Table 1. The list of pests on *Betula alba* and *B. pubescens*

Order	Family	Species	
Homoptera	Aphididae	<i>Callaphis flava</i> Mordvilko, 1928	
		<i>Euceraphis betulae</i> (Koch 1855).	
		<i>Euceraphis punctipennis</i> (Zetterstedt 1828)	
		<i>Symydobius oblongus</i> (von Heyden, 1837).	
Coleoptera	Buprestidae	<i>Agrilus angustulus</i> (Illiger 1803)	
		<i>Agrilus cyanescens</i> Ratzeburg 1837	
		<i>Agrilus hastulifer</i> Ratzeburg 1837	
		<i>Chrysobothris affinis</i> (Fabricius 1794)	
		<i>Dicerca berlinensis</i> (Herbst 1779)	
Coleoptera	Curculionidae	<i>Scolytus ratzeburgi</i> Janson 1856	
		<i>Trypodendron domesticum</i> (Linnaeus 1758)	
		<i>Trypodendron signatum</i> (Fabricius, 1787)	
Coleoptera	Cerambycidae	<i>Aegomorphus clavipes</i> (Schrank 1781)	
		<i>Leiopus nebulosus</i> (Linnaeus 1758)	
		<i>Rhagium mordax</i> (De Geer 1775)	
Hymenoptera	Tenthredinidae	<i>Fenusa pumila</i> Leach 1817	
		<i>Fenusella nana</i> (Klug 1816)	
		<i>Heterarthrus vagans</i> (Fallen 1808)	
		<i>Scolioneura betuleti</i> (Klug 1816)	
Hymenoptera	Xiphydriidae	<i>Xiphydria prolongata</i> (Geoffroy 1785)	
	Geometridae	<i>Cyclophora pendularia</i> (Clerck 1759)	
		<i>Epirrita autumnata</i> (Borkhausen 1794)	
		<i>Hypagyrtis unipunctata</i> (Haworth 1809)	
	Gracillariidae	<i>Caloptilia betulicola</i> (Hering 1928)	
	Heliozelidae	<i>Heliozela betulae</i> Stainton 1890	
	Lepidoptera	Noctuidae	<i>Euproctis chrysorrhoea</i> (Linnaeus 1758)
			<i>Hyphantria cunea</i> (Drury 1773)
			<i>Lymantria dispar</i> (Linnaeus 1758)
			<i>Orthosia gothica</i> (Linnaeus 1758)
<i>Orthosia incerta</i> (Hufnagel 1766)			
Lepidoptera	Lasiocampidae	<i>Malacosoma neustria</i> (Linnaeus 1758)	
	Psychidae	<i>Megalophanes viciella</i> (Denis & Schiffermuller 1775)	
	Sesiidae	<i>Synanthedon culiciformis</i> (Linnaeus 1758)	
Lepidoptera	Tortricidae	<i>Acleris hastiana</i> (Linnaeus 1758)	
		<i>Adoxophyes orana</i> Fischer von Rösslerstamm 1834)	
		<i>Apotomis sororculana</i> (Zetterstedt 1839)	
		<i>Archips rosana</i> (Linnaeus 1758)	
		<i>Pandemis cerasana</i> (Hubner 1786)	
Lepidoptera	Geometridae	<i>Cyclophora pendularia</i> (Clerck 1759)	
		<i>Hypagyrtis unipunctata</i> (Haworth 1809)	
		Coleophoridae	<i>Coleophora serratella</i> (Linnaeus 1761)

and *Shawiana catenator* (Haliday 1836) on caterpillars of *Caloptilia betulicola* (Gracillariidae).

Subfamily Rogadinae assembles eight species of *Aleiodes*: *A. circumscriptus* (Nees 1834), *A. gastritor* (Thunberg 1822), *A. nigricornis* Wesmael 1838, *A. pallidator* (Thunberg 1822), *A. rossicus* (Kokujev 1898) and *A. sanctihyacinthi* (Provancher 1880), distributed mostly in whole Europe (Aydogdu & Beyarslan, 2006) and *Petalodes compressor* (Herrich-Schäffer 1838). The species *A. pallidator* has been recorded as parasitoid of four lepidopteran larvae: *Cyclophora pendularia* (Geo-

Table 2. Subfamily Aphidiinae and the aphid hosts

	<i>Callaphis flava</i>	<i>Euceraphis betulae</i>	<i>Euceraphis punctipennis</i>	<i>Symydobius oblongus</i>
<i>Aphidius aquilus</i>	X	X	X	
<i>Betuloxys compressicornis</i>		X	X	
<i>Praon flavinode</i>	X			
<i>Trioxys betulae</i>	X			X
<i>Trioxys cirsii</i>	X			

metridae), *Lymantria dispar*, *Megalophanes viciella* (Psychidae) and *Apotomis sororculana* (Tortricidae) (Tab. 4).

The last registered ectoparasitic Braconidae subfamily is Rhysipolinae, with only one species, *Rhysipolis mediator* (Haliday 1836) on *Caloptilia betulicola* (Gracillariidae).

Table 3. Subfamilies of ectoparasitoid Braconidae on coleopteran and hymenopteran hosts.

		<i>Trypodendron domesticum</i>	<i>Trypodendron signatum</i>	<i>Scolytus ratzeburgi</i>	<i>Agrilus cyanescens</i>	<i>Agrilus angustulus</i>	<i>Agrilus nastulifer</i>	<i>Chrysobothris affinis</i>	<i>Dicerca berolinensis</i>	<i>Aegomorphus clavipes</i>	<i>Leioptus nebulosus</i>	<i>Rhagium mordax</i>	<i>Fenusa pumila</i>	<i>Fenusella nana</i>	<i>Heterarthrus vagans</i>	<i>Scolioneura betuleti</i>	<i>Xiphydria prolongata</i>
Braconinae	<i>Bracon obscurator</i>	X	X														
	<i>Glyptomorpha pectoralis</i>							X									
	<i>Iphiaulax impostor</i>									X	X						
	<i>Pseudovipio castrator</i>							X									
	<i>Vipio appellator</i>							X									
Doryctinae	<i>Dendrosoter protuberans</i>			X													X
	<i>Doryctes leucogaster</i>							X									
	<i>Ontsira ignea</i>								X								
	<i>Ontsira imperator</i>								X			X					
	<i>Spathius curvicaudis</i>						X										
Exothecinae	<i>Spathius rubidus</i>				X	X					X	X					X
	<i>Colastes braconius</i>														X		
	<i>Shawiana catenator</i>												X	X	X	X	

Table 4. Subfamilies of ectoparasitoid Braconidae on lepidopteran hosts

		<i>Cyclophora pendularia</i>	<i>Hypagyrtis unipunctata</i>	<i>Calliphila betulicola</i>	<i>Heliozela betulae</i>	<i>Epirrita autumnata</i>	<i>Lymantria dispar</i>	<i>Euproctis similis</i>	<i>Hyphantria cunea</i>	<i>Orthosia gothica</i>	<i>Orthosia incerta</i>	<i>Malacosoma neustria</i>	<i>Megalophanes viciella</i>	<i>Synanthedon culiciformis</i>	<i>Acleris hastiana</i>	<i>Adoxophyes orana</i>	<i>Apotomis sororculana</i>	<i>Archips rosana</i>	<i>Pandemis cerasana</i>	<i>Pandemis heparana</i>
Braconinae	<i>Bracon abbreviator</i>																			X
	<i>Bracon discoideus</i>															X				
	<i>Bracon hebetor</i>															X				
	<i>Bracon intercessor</i>													X						
	<i>Bracon romani</i>													X						
	<i>Bracon variegator</i>																	X	X	
Doryctinae	<i>Doryctes leucogaster</i>						X													
Exothecinae	<i>Colastes braconius</i>				X															
Rogadinae	<i>Aleiodes circumscriptus</i>										X									
	<i>Aleiodes gastritor</i>		X			X														
	<i>Aleiodes nigricornis</i>									X	X									
	<i>Aleiodes pallidator</i>	X					X						X				X			
	<i>Aleiodes rossicus</i>							X				X						X		
	<i>Aleiodes sanctihyacinthi</i>								X											
	<i>Aleiodes signatus</i>							X												
	<i>Aleiodes testaceus</i>					X														
	<i>Petalodes compressor</i>														X					
Rhysipolinae	<i>Rhysipolis mediator</i>			X																

In this study we have found the data of three endoparasitic braconid subfamilies: Euphorinae, Microgastrinae and Orgilinae (Tab. 5). As *Bracon obscurator*, *Cosmophorus regius* Niezabitowski 1910 (Euphorinae) shows the same affinity to the species of *Trypodendron* (Tab. 2). Two species of *Meteorus*, *M. pulchricornis* (Wesmael 1835) and *M. meteorus*, *M. pulchricornis* (Wesmael 1835) and *M. versicolor* (Wesmael 1835) attack the most common pest *Lymantria dispar*. Polyphagous *Epirrita autumnata* is the host of solitary endoparasitoid *Zele deceptor* (Wesmael 1835). Mostly gregarious, Microgastrinae are presented by nine members on *Betula* species that eight of them attack *Lymantria dispar*: three species of *Apanteles*: *A. lacteicolor* Viereck 1911, *A. melanoscelus* (Ratzeburg 1844) and *A. xanthostigma* (Haliday 1834), one species of *Cotesia*: *C. lomerata* (Linnaeus 1758), *Microgaster hospes* Marshall 1885, and three species of *Protapanteles*: *P. fulvipes* (Haliday 1834), *P. liparidis* (Bouche 1834) and *P. immunis* (Haliday 1834). Larvae of *Epirrita autumnata* is parasitized by *Cotesia jucunda* (Marshall 1885).

There is only one species of Orgilinae, *Orgilus punctulator* (Nees 1811) has been found as pest of *Coleophora serratella* (Coleophoridae).

Table 5. Subfamilies of Euphorinae, Microgastrinae and Orgilinae and their hosts.

		<i>Trypodendron domesticum</i>	<i>Trypodendron signatum</i>	<i>Epirrita autumnata</i>	<i>Lymantria dispar</i>	<i>Coleophora serratella</i>
Euphorinae	<i>Cosmophorus regius</i>	X	X			
	<i>Meteorus pulchricornis</i>				X	
	<i>Meteorus versicolor</i>				X	
	<i>Zele deceptor</i>			X		
Microgastrinae	<i>Apanteles lacteicolor</i>				X	
	<i>Apanteles melanoscelus</i>				X	
	<i>Apanteles xanthostigma</i>				X	
	<i>Cotesia glomerata</i>				X	
	<i>Cotesia jucunda</i>			X		
	<i>Microgaster hospes</i>				X	
	<i>Protapanteles fulvipes</i>				X	
	<i>Protapanteles liparidis</i>				X	
	<i>Protapanteles immunis</i>			X		
Orgilinae	<i>Orgilus punctulator</i>					X

Conclusion

We noted that pest insects make no difference on which *Betula* species they feed. The most important pests on *Betula* as well as other trees are polyphagous species *Lymantria dispar* and *Epirrita autumnata*, because they can defoliate entire forests when their populations are in gradation. We have found that larvae of *Lymantria dispar* on birches are attacked by 11 parasitoid species from the subfamilies Braconinae, Rogadinae, Euphorinae and Microgastrinae. The moth *Epirrita autumnata* can be very dangerous in birch forests. The example from northern Sweden shows that this pest's caterpillars can defoliate birch forests, causing death of stems of the polycormic trees as a result (Tenow, et al., 2004). There are three buprestid pests of the genus *Agrilus* found on *Betula alba* and *B. pubescens*: *A. angustulus*, *A. cyanescens*, *A. hastulifer*. They are extremely polyphagous wood borers. For now there is no data of the natural enemies of *A. cyanescens*. *Agrilus anxius*, which is native to North America and *A. planipennis* from Central Asia are considered as potentially invasive species.

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