

UDC 595.792(477)

## A REVIEW OF THE SUBFAMILY RHYSSINAE (HYMENOPTERA, ICHNEUMONIDAE) FROM THE UKRAINIAN CARPATHIANS

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**A Review of the Subfamily Rhyssinae (Hymenoptera, Ichneumonidae) from the Ukrainian Carpathians. Varga A.** — The subfamily Rhyssinae is recorded from the Ukrainian Carpathians for the first time. *Rhyssa kriechbaumeri* Ozols, 1973 is a new record for Ukraine. A key to species of the Ukrainian Carpathians is provided. Seasonal dynamics and high-altitude zone distribution of the Rhyssinae are discussed.

**Key words:** parasitoids, Hymenoptera, Ichneumonidae, Rhyssinae, Ukrainian Carpathians, Ukraine, new records.

**Обзор подсемейства Rhyssinae (Hymenoptera, Ichneumonidae) Украинских Карпат. Варга А.** — Подсемейство Rhyssinae впервые указано для Украинских Карпат, а *Rhyssa kriechbaumeri* Ozols, 1973 — впервые для Украины. Также приведена таблица для определения видов риссин в Украинских Карпатах, обсуждается их сезонная динамика и высотно-поясное распределение в Украинских Карпатах.

**Ключевые слова:** паразитоиды, Hymenoptera, Ichneumonidae, Rhyssinae, Украинские Карпаты, Украина, новые находки.

### Introduction

The Rhyssinae Morley, 1913 is a small cosmopolitan subfamily; it includes 243 described species of 8 genera, only 3 genera and 11 species of which are found in the Western Palaearctic (Yu et al., 2012). The subfamily Rhyssinae includes some of the most spectacular of all Ichneumonidae. These large conspicuous wasps, the females of which have very long ovipositors and may exceed 150 mm in length, are quite commonly encountered in the Carpathian forests.

Rhyssines are idiobiont ectoparasitoids of the wood-boring larvae of Siricoidea and rhyssines females aggregate around siricoid-infested coniferous trees (*Megarhyssa* and *Rhyssa*) or cerambycid-infested leaf trees (*Rhyssella*) where they may spend long periods boring into the wood to gain ovipositional access to their hosts (fig. 1). Males aggregate around logs of coniferous trees from which females are emerging. Males of *Megarhyssa rixator* have remarkably elongate metasomas that are inserted into the female's emergence tunnel enabling the male to copulate with the female prior to her emergence from the log. Females of some temperate species locate



Fig. 1. Female of *Megarhyssa rixator* boring into the wood of dead *Picea abies*.

Рис. 1. Самка *Megarhyssa rixator*, которая сверлит отверстие в стволе мертвой *Picea abies*.



Fig. 2. Tereshkin's trap in coniferous forest.

Рис. 2. Ловушка Терешкина в хвойном лесу.

their hosts by responding to the presence of the siricid hosts fungal symbiont and this may result in a fairly large number of rhyssines being present on a single tree. Having located a host, the rhyssine female apparently stings and paralyzes it before laying a fully-yolked, large egg on it (Chrystal, 1937). The eggs of rhyssines are extremely elongate (Iwata, 1958) to allow them to pass down the lumen of the ovipositor.

Rhyssines are amongst the easiest of ichneumonids to recognize on account of the prominent transverse rugae on the mesoscutum and the horn-like projection on the end of the metasoma of females. The only other ichneumonid with similar mesoscutal sculpture in Ukraine is *Pseudorhyssa* (Poemeniinae), which has impressed oblique grooves anteriorly on tergite II and dorsal carinae on the propodeum (none are present in rhyssines).

#### Material and methods

This study is mainly based on specimens (72 ♀, 185 ♂) collected by sweep netting and using Tereshkin's traps (TT) by the author in various locations in the Ukrainian Carpathians in 2009–2013. The so-called Tereshkin's trap, a conical trap that hangs on a dead tree trunk and proved to be an effective method of collecting xylobionts and their parasites (fig. 2) (Tereshkin, 1990). The material deposited in the collections of the Vasyl Stefanyk Precarpathian National University (Ivano-Frankivsk) and Schmalhausen Institute of Zoology (Kyiv) was also studied. Ovipositor-hind tibia index (in text OTI), which is the length of the ovipositor projecting beyond the apex of the metasoma divided by the length of the hind tibia was used. Specimens were identified using the keys compiled by Kasparyan (1981) and Horstmann (1998, 2002).

#### Key to species of the Rhyssinae in Ukrainian Carpathians

1. Clypeus with apical tubercle (fig. 3, 1). Metasoma always with white coloration. OTI 4.5–5.0. *Rhyssa*. .... 4
- Clypeus without apical tubercle, weakly concave (fig. 3, 2). If metasoma with white coloration, than OTI at least 8.0. .... 2
2. Paramere without a groove paralleling its inner edge. Tergites 3–6 of male moderately concave apically, without a median longitudinal submembranous area. Metasoma entirely black. Tergites 3–5 of female transversely aciculate *Rhyssella*. .... 3
- Paramere with a strong groove close to and paralleling the apical 0.7 of its lower inner edge. Tergites 3–6 of male strongly concave apically and with a median apical longitudinal submembranous area. Mesosoma always with, metasoma with (female) or without (male) white coloration. Tergites 3–5 of female smooth...  
..... *Megarhyssa rixator*
3. Scutellum black. .... *Rhyssella approximator*
- Scutellum yellow. .... *Rhyssella obliterated*
4. Females. .... 5
- Males (male of *Rhyssa kriechbaumeri* is unknown). .... 7
5. Face black, at most with two central white spots (fig. 4, 1). Propodeum black (fig. 4, 2). ....  
..... *Rhyssa kriechbaumeri*
- Face black centrally, at least with two white stripes on eye orbits (fig. 5, 1). Propodeum at least with two lateral white spots (fig. 5, 2). .... 6
6. Central flagellomeres whitish. Clypeus yellow. .... *Rhyssa amoena*
- Antennal flagellum without a pale band. Clypeus from reddish-brown to black. .... *Rhyssa persuasoria*
7. Clypeus, scape and pedicel (fig. 6, 2), fore and mid coxae, trochanters and trochantelli yellow. ....  
..... *Rhyssa amoena*
- Clypeus from reddish-brown to black. Scape and pedicel black (fig. 6, 1). At least mid coxa and trochanter with red and/or black spots. .... *Rhyssa persuasoria*

***Megarhyssa rixator*** (Schellenberg, 1802) (fig. 1; 3, 2)

**Material.** Ukraine: Ivano-Frankivsk Region: Bogorodchany District, Mochary, 48°50'51.17" N, 24°35'26.91" E, 300–350 m, mixed forest, 5 km NE of Bogorodchany, 5.05.2012, 4 ♂, 1 ♀, 6.05.2012, 5 ♂, 3 ♀, 12.05.2011, 1 ♂, 12.05.2012, 1 ♂, 2 ♀, 31.05.2011, 3 ♀, 31.05.2012, 1 ♀; Dibrova, 48°46'10.35" N, 24°30'20.28" E, 310 m, oak forest, 5 km SW of Bogorodchany, 19.05.2011, 1 ♀, 10–11.05.2012, 1 ♂, 1 ♀; Zhbyr, 48°47'4.92" N, 24°28'46.45" E, 400 m, mixed forest, 7–8 km SW of Bogorodchany, 26.05.2012, 1 ♂, 19.05.2013, 2 ♂, TT, 15–31.05.2013, 2 ♂; Gorgany, 48°36'54.56" N, 24°09'54.27" E, 1050–1100 m, 4 km SW of Stara Guta, 4.06.2012, 4 ♂, 8–9.06.2012, 30 ♂, 1.07.2012, 1 ♀; Nadvirna District, Gorgany, Elmy, 48°24'39.50" N, 24°24'50.28" E, 800–900 m, coniferous forest, 15 km SW of Yaremche, 14.07.2011, 1 ♀, 20–23.06.2012, 1 ♀, 8.06.2013, 2 ♂; Chornogora, 48°08'09.63" N, 24°32'32.14" E, 1600 m, coniferous forest, 11.07.2013, 3 ♂ (Varga).

**Coloration.** Female. Generally body colour as in *Rhyssa persuasoria*, but white marks also on mesoscutum. Legs generally red, all coxae and hind femora varying from red to brown, sometimes with yellow spots, hind tibiae and tarsi fuscous. Propodeum and metasoma entirely smooth and polished. OTI 8.0–9.0

**Male.** Body colour as in female, but metasoma usually entirely black, with at most two white spots on tergite I.

**Remark.** From other species of the genus, *M. rixator* differs in the black clypeus, mesosoma and metasoma and in the structure of the male parameres (see Horstmann, 1998).

**Distribution.** Palaearctic: Austria, Czech Republic, Germany, Poland, Switzerland, Russia (Chita, Tula and Yaroslavl Regs); Ukraine.

***Rhyssa amoena*** Gravenhorst, 1829 (fig. 3, 1; 5, 1; 6, 2)

**Material.** Ukraine: Ivano-Frankivsk Region: Bogorodchany District, Mochary, 48°50'51.17" N, 24°35'26.91" E, 300–350 m, mixed forest, 5 km NE of Bogorodchany, 21.05.2011, 1 ♂, 30.05.2011, 4 ♂, 10.06.2012, 1 ♂, 10.07.2012, 2 ♀, 24.07.2012, 1 ♀, 27.05.2013, 2 ♂, 4.06.2013, 1 ♂; Dibrova, 48°46'10.35" N, 24°30'20.28" E, 310 m, oak forest, 5 km SW of Bogorodchany, 10.06.2011, 1 ♂; Gorgany, 48°33'7.45" N, 24°11'55.33" E, 1200–1300 m, 10–12 km S of Stara Guta, 17–19.08.2011, 1 ♀; 48°36'54.56" N, 24°09'54.27" E, 1050–1100 m, 4 km SW of Stara Guta, 8–9.06.2012, 5 ♂, 1.07.2012, 1 ♀, 20.06.2013, 4 ♂, 1 ♀; Nadvirna District, Gorgany, Elmy, 48°24'39.50" N, 24°24'50.28" E, 800–900 m, coniferous forest, 15 km SW of Yaremche, 14.07.2011, 2 ♂, 1 ♀, 8.06.2013, 1 ♂; Yavirnuik, 48°24'53.86" N, 24°29'01.78" E, 1300–1350 m, 7–8 km SW of Yaremche, 14.07.2009, 1 ♂; 48°20'48.49" N, 24°29'44.51" E, 900–1000 m, 3–4 km W of Polyanytsa, 16.08.2009, 1 ♀ (Varga).

**Coloration.** Female. Generally body colour as in *Rhyssa persuasoria* but white marks more abundant: face sometimes almost white, with only a black central spot, band on flagellum (central flagellomeres) white. Clypeus, coxae partly, trochanters and trochantelli usually yellow. Head and propodeum often with red coloration in the dark areas.

**Male.** Body colour as in female, but face entirely, fore and mid coxae, trochanters and trochantelli entirely, scape and pedicel dorsally yellow.

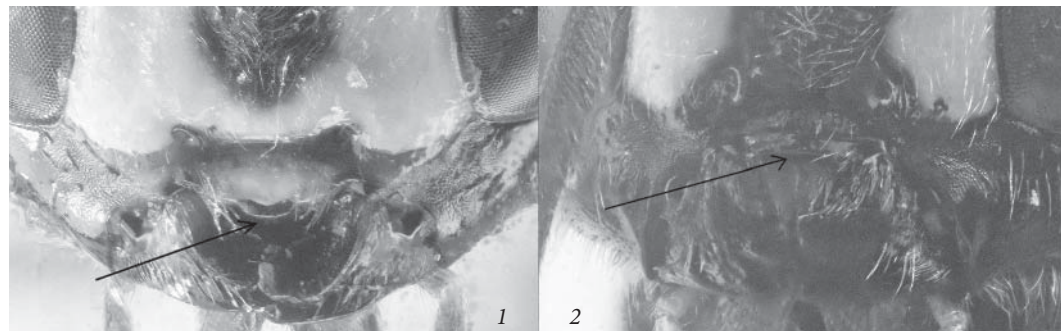


Fig. 3. The clypeus: 1 — *Rhyssa amoena*; 2 — *Megarhyssa rixator*.

Рис. 3. Наличник: 1 — *Rhyssa amoena*; 2 — *Megarhyssa rixator*.

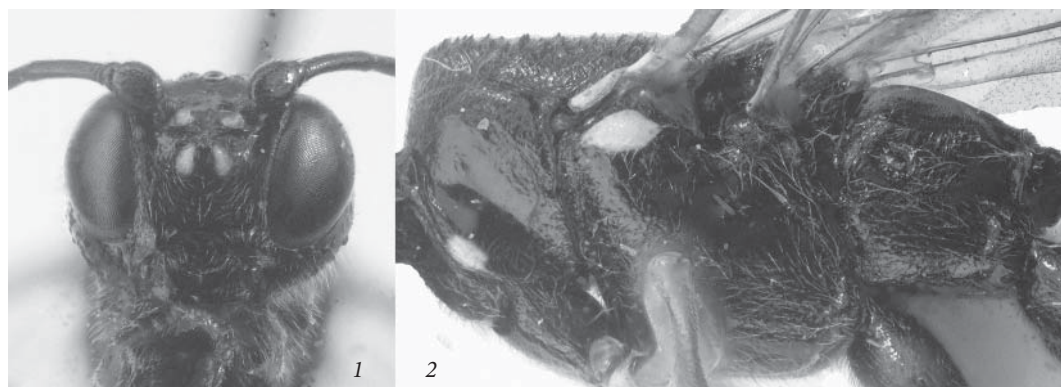


Fig. 4. *Rhyssa kriechbaumeri*, female: 1 — head (frontal view); 2 — mesosoma (lateral view).

Рис. 4. *Rhyssa kriechbaumeri*, самка: 1 — голова (вид спереди); 2 — грудь (вид сбоку).

**Variation.** Propodeum sometimes with only two faint white lateral spots. Central (14–16) flagellomeres usually white, but sometimes white band can be absent. Flagellum is generally lighter than in *Rhyssa persuasoria*.

**Distribution.** Palaearctic: Austria, Belarus, Bulgaria, Czech Republic, Finland, France, Germany, Hungary, Iran, Italy, Latvia, Poland, Romania, Russia (Bryansk, Chita, Irkutsk, Khabarovsk, Primorye, Sakhalin, Leningrad Regs), Slovakia, former Yugoslavia; Ukraine.

#### *Rhyssa kriechbaumeri* Ozols, 1973 (fig. 4)

**Material.** Ukraine: Ivano-Frankivsk Region: Bogorodchany District, Mochary, 48°50'51.17" N, 24°35'26.91" E, 300–350 m, mixed forest, 5 km NE of Bogorodchany, 1.05.2011, 3 ♀, 31.05.2011, 1 ♀; Zhbyr, 48°47'4.92" N, 24°28'46.45" E, 400 m, mixed forest, 7–8 km SW of Bogorodchany, 26.05.2012, 1 ♀; Gorgany, 48°36'54.56" N, 24°09'54.27" E, 1050–1100 m, 4 km SW of Stara Guta, 8–9.06.2012, 2 ♀; 48°33'32.30" N, 24°07'41.34" E, 1250–1300 m, 11–12 km SW of Stara Guta, 20–22.05.2012, 1 ♀; Nadvirna District, Gorgany, Elmy, 48°24'39.50" N, 24°24'50.28" E, 800–900 m, coniferous forest, 15 km SW of Yaremche, 8.06.2013, 6 ♀ (Varga).

**Coloration.** Female. Head, mesosoma and metasoma generally black. Face entirely black or sometimes with two central white spots. Flagellum black. Pronotum at lower corner, tegula, subtegular ridge, scutellum and postscutellum white. White coloration of metasoma varies from spots to stripes on the apex of each tergite. Legs generally red, all coxae varying from red-brownish to black, hind tibia and tarsus fuscous.

Male. Unknown.

**Remark.** I collected one male with an entirely black propodeum and without white spots on the mesopleuron (except subtegular ridge), but I need to examine more material to find clear differences between this specimen and specimens of *Rhyssa persuasoria*.

**Distribution.** Germany (Horstmann, 2002), Hungary (Kiss, 1926), Russia (Magadan Reg.) (Ozols, 1973), Switzerland (Kriechbaumer, 1887), first record from Ukraine.

#### *Rhyssa persuasoria* (Linnaeus, 1758) (fig. 5, 2; 6, 1)

**Material.** Ukraine: Ivano-Frankivsk Region: Bogorodchany District, Mochary, 48°50'51.17" N, 24°35'26.91" E, 300–350 m, mixed forest, 5 km NE of Bogorodchany, 9.05.2011, 5 ♂, 10.05.2011, 1 ♂, 31.05.2011, 1 ♀, 29.04.2012, 2 ♂, 1.05.2012, 2 ♂, 5.05.2012, 5 ♂, 1 ♀, 6.05.2012, 5 ♂, 1 ♀, 12.05.2012, 7 ♂, 31.05.2012, 1 ♂, 2 ♀, 10.06.2012, 1 ♀, 10.07.2012, 1 ♀, 19.07.2012, 2 ♀, 1.05.2013, 2 ♂, 6.05.2013, 3 ♂, 12.05.2013, 1 ♂, 21.05.2013, 1 ♀, 27.05.2013, 1 ♀, 17.08.2013, 1 ♀; Dibrova, 48°46'10.35" N, 24°30'20.28" E, 310 m, oak forest, 5 km SW of Bogorodchany, 10–11.05.2012, 4 ♂; Zhbyr, 48°47'4.92" N, 24°28'46.45" E, 400 m, mixed forest, 7–8 km SW of Bogorodchany, 31.05.2013, 1 ♀, TT, 15–31.05.2013, 1 ♀; Gorgany, 48°36'54.56" N,



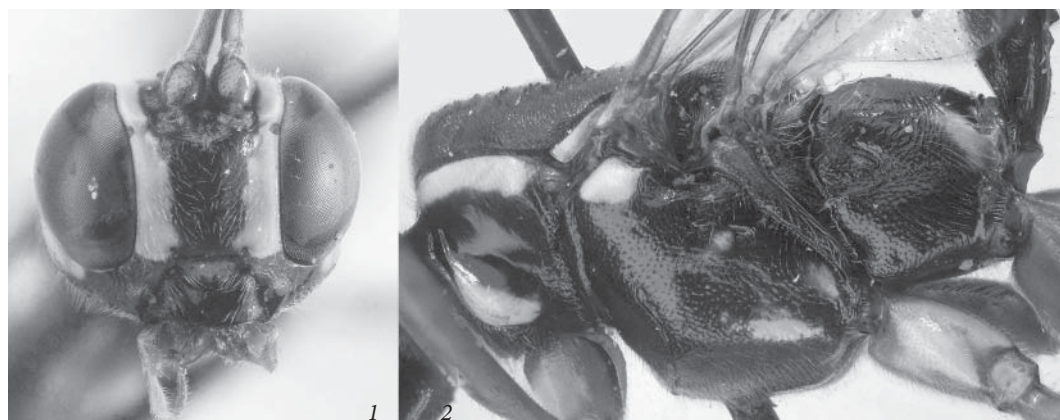


Fig. 5. Genus *Rhyssa*: 1 — *Rhyssa amoena*, head (frontal view), female; 2 — *Rhyssa persuasoria*, mesosoma (lateral view), female.

Рис. 5. Род *Rhyssa*: 1 — *Rhyssa amoena*, голова (вид спереди), самка; 2 — *Rhyssa persuasoria*, грудь (вид сбоку), самка.

24°09'54.27" E, 1050–1100 m, 4 km SW of Stara Guta, 8–9.06.2012, 46 ♂, 5 ♀, 4.06.2012, 2 ♂, 1 ♀, 1.07.2012, 1 ♂; 48°33'32.30" N, 24°07'41.34" E, 1250–1300 m, 11–12 km SW of Stara Guta, 20–22.05.2012, 1 ♀ (Varga); Nadvirna District, Gorgany, Elmy, 48°24'39.50" N, 24°24'50.28" E, 800–900 m, coniferous forest, 15 km SW of Yaremche, 7.06.2009, 1 ♀ (Sirenko), 14.07.2011, 1 ♀, 20–23.06.2012, 2 ♂, 2 ♀, 8.06.2013, 2 ♂, 4 ♀; Transcarpathian Region: Rakhiv District, slopes of m. Sheshul, 48°09'23.13" N, 24°21'27.15" E, 1400–1500 m, subalpine zone, 6–7 km E of Kvasy, 16–18.06.2012, 7 ♂, 2 ♀, 15.06.2013, 7 ♂; Tyachiv District, Solotvyno, 280 m, 47°57'15.82" N, 23°52'13.95" E, 23.06.2013, 1 ♀ (Varga).

**Coloration.** Female. Generally body colour as in previous species, but white marks of head and mesosoma more abundant: stripes on eye orbits, frons, temples, pronotum partly, tegula, subtegular ridge, mesopleuron partly, scutellum, postscutellum and spots on propodeum white. Clypeus varying from reddish-brown to black. Legs generally red, all coxae varying from red to brown, sometimes with yellow spots, hind tibiae and tarsi fuscous.

**Male.** Body colour as in female, but face entirely yellow. Fore and mid coxae, trochanters and trochantelli yellow with red or (and) black spots.

**Variation.** In only one male, the fore and mid coxae, trochanters and trochantelli were entirely yellow and in a few males the pedicel has a small yellow spot, but the combination of these two characters were never found in the same specimen.

**Distribution.** A cosmopolitan species.

### *Rhyssella approximator* (Fabricius, 1793)

**Material.** Ukraine: Ivano-Frankivsk Region: Bogorodchany District, Mochary, 48°50'51.17" N, 24°35'26.91" E, 300–350 m, mixed forest, 5 km NE of Bogorodchany, 9.07.2009, 1 ♀, 3.05.2011, 1 ♀ (Varga).

**Coloration.** Female. Head, mesosoma and metasoma black. Face with two vertical yellow stripes. Tegula yellowish. Pterostigma fuscous. Legs red. Central tergites (III–V) of female and scutellum transversely aciculate. OTI 4.5–5.0.

**Distribution.** Palaearctic: Austria, Belarus, Belgium, Bulgaria, China, Croatia, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Japan, Latvia, Lithuania, Mongolia, Montenegro, The Netherlands, Norway, Poland, Romania, Russia (Amur, Chita, Irkutsk, Kamchatka, Karachayev-Cherkess, Khabarovsk, Orenburg, Sakhalin, and Yaroslavl Regs), Serbia, Sweden, Switzerland, United Kingdom; Ukraine.

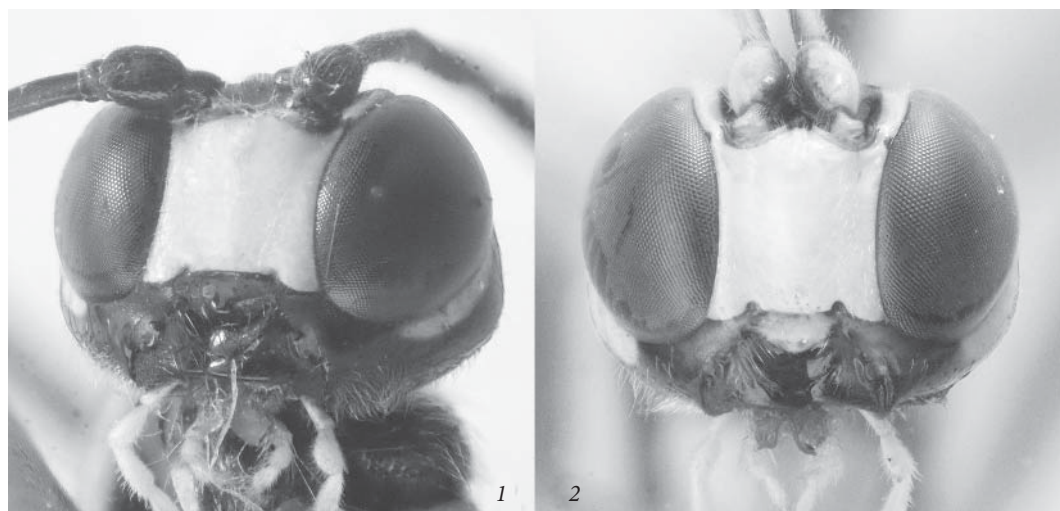


Fig. 6. Genus *Rhyssa*: 1 — *Rhyssa persuasoria*, head (frontal view), male; 2 — *Rhyssa amoena*, mesosoma head (frontal view), male.

Рис. 6. Род *Rhyssa*: 1 — *Rhyssa persuasoria*, голова (вид спереди), самец; 2 — *Rhyssa amoena*, голова (вид спереди), самец.

### ***Rhyssella obliterata* (Gravenhorst, 1829)**

Material. Ukraine: Transcarpathian Region: Mukachevo District, Ivanivtsi, 48°28'18.07" N, 22°38'43.16" E, 120 m, 23–24.09.1957, 1 ♀.

Coloration. This species differs from *Rhyssella approximator* (Fabricius, 1793) in having yellow pterostigma, scutellum, postscutellum and two stripes on mesoscutum. OTI 5.0

Distribution. Palaearctic: Armenia, Austria, Belarus, Croatia, Czech Republic, France, Germany, Hungary, Latvia, Macedonia, Montenegro, Poland, Romania, Russia (Primoskiy Kray), Serbia, Sweden; Ukraine.

### High-altitude zone distribution and seasonal dynamics of the Rhyssinae

During the investigations carried out in various locations of the Ukrainian Carpathians between 2009 and 2013 six species of the subfamily Rhyssinae, belonging to three genera, were recorded. One species was recorded for the first time from Ukraine. The most abundant rhyssine between 2009 and 2013 was *Rhyssa persuasoria* (54.76 % of the total number of specimens).

Rhyssinae species have been recorded in various high-altitude zones of the Ukrainian Carpathians (table 1). All six species are collected in the foothill oak forest zone,

Table 1. High-altitude zone distribution of the Rhyssinae in Ukrainian Carpathians

Таблица 1. Высотно-поясное распределение Rhyssinae в Украинских Карпатах

Species	Foothill oak forest zone (150–400 m)	Beech forest zone (400–1300 m)	Coniferous boreal forest zone (900–1600 m)	Subalpine zone (1400–2061 m)
<i>Megarhyssa rixator</i>	+		+	
<i>Rhyssa amoena</i>	+		+	
<i>Rhyssa kriechebaumeri</i>	+		+	
<i>Rhyssa persuasoria</i>	+		+	+
<i>Rhyssella approximator</i>	+			
<i>Rhyssella obliterata</i>	+			

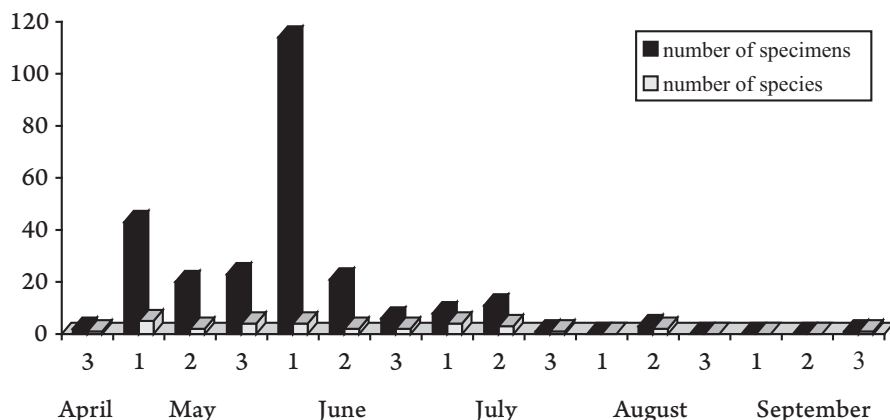


Fig. 7. The seasonal dynamics of Rhyssinae flying in Ukrainian Carpathians during 1957–2013.

Рис. 7. Сезонная динамика лёта Rhyssinae в Украинских Карпатах в 1957–2013 гг.

reaching up to 150–400 m a. s. l. in Precarpathia and Transcarpathian lowland with mixed forests, where the main tree species are *Quercus robur*, *Q. rubra*, *Caprinus*, *Fraxinus*, *Picea abies*, *Abies alba*, and *Pinus sylvestris*. No rhyssines were found in monocultural stands of *Fagus sylvatica* in the beech forest zone (400–1300 m a. s. l.) in Transcarpathia, probably because of the absence of conifers here. Despite the fact that *Rhyssella* species associate with leaf trees there are no data about association of this genus with *Fagus sylvatica*.

Rhyssines were most abundant in the coniferous boreal forest zone, situated at 900–1600 m a. s. l. in the mountainous part of the Carpathians, where the *Piceeta-abietis* community predominates. Only one species, *Rhyssa persuasoria*, was found in the subalpine zone, at 1400–2061 m a. s. l., known as polonyns, which are high altitude open grasslands, partly taken over by bush, mainly by *Pinus mugo*, *Dushekia viridis*, *Juniperus sibirica* and only single *Picea abies* trees, in which this species attacks its hosts.

The flight season of Rhyssinae adults is prolonged, lasting six months, from the last third of April to the last third of September (fig. 7). Five species (except *Rhyssella obliterated*) were collected during the first third of May. Rhyssines were most abundant during the first third of May and June. Thus Rhyssinae species are most common at the end of spring (in the foothill areas) and in the beginning of summer (in the mountainous part of the Carpathians).

Flight periods of *Rhyssa persuasoria* and *Rhyssa amoena* are from the end of spring to the end of summer; moreover, the first specimens of *Rhyssa persuasoria* emerged earlier, at the end of April, while *Rhyssa amoena* started flying later, in the latter third of May (fig. 8). *Rhyssa kriechebaumeri* was collected only in May and the beginning of June. The

Species	Apr	May			June			July			Aug			Sep		
	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<i>Megarhyssa rixator</i>																
<i>Rhyssa amoena</i>																
<i>Rhyssa kriechebaumeri</i>																
<i>Rhyssa persuasoria</i>																
<i>Rhyssella approximator</i>																
<i>Rhyssella obliterated</i>																

Fig. 8. Appearance of Rhyssinae species adults in ten-day periods of the 1957–2013 season.

Рис. 8. Появление видов Rhyssinae в десятидневные периоды в сезоны 1957–2013 гг.

flight periods of *Megarhyssa rixator* and *Rhyssella approximator* were shorter than for the two *Rhyssa* species, and lasting from May to the middle of July. *Rhyssella obliterata* was collected only in the end of September.

I wish to thank A. Gumovsky for help in the preparation of the manuscript, the anonymous referee, and two referees, A. Reshchikov and G. Broad for useful comments and correction of the English text.

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Received 15 November 2013

Accepted 4 February 2014