

## Redescription of two species of Aphidiinae (Hymenoptera: Braconidae) from high mountain areas of south-eastern Europe, with biological and biogeographical notes on co-occurring guild members

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*Praon spinosum* Mackauer, 1959 reared from *Thripsaphis verrucosa* Gillette, 1917 on *Carex nigra* and *Diaeretellus macrocarpus* Mackauer, 1961 reared from the conspecific aphid on *Carex rostrata* association from Mt. Durmitor Biosphere Reserve in Serbia and Montenegro are redescribed, diagnosed and illustrated with photographs from SEM and line drawings. The taxonomic position of *P. spinosum* within the genus *Praon* is discussed. Furthermore, some rare and endemic aphid – aphid-parasitoid associations from high-montane areas of south-eastern Europe are reviewed and their distribution and origin is discussed.

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## 1. Introduction

During the research on aphid parasitoid guilds in swampy habitats on Mt. Durmitor in Serbia and Montenegro, specimens of *Thripsaphis verrucosa* Gillette, 1917/*Carex* spp. associations were sampled and two parasitoid species, *Praon spinosum* Mackauer, 1959 and *Diaeretellus macrocarpus* Mackauer, 1961, were reared. These species represent an isolated parasitoid guild associated with *Carex* spp. in high-montane areas (Mackauer 1959, 1961, Mackauer & Starý 1967). *D. macrocarpus* and *P. spinosum* have rarely been collected in the Palaearctic, but are widely spread from Finland to Serbia and Montenegro (Mackauer 1961, Starý 1966, Achterberg 2004). Furthermore, the original description of *D. macrocarpus* by Mackauer (1961) has become out-dated and it is not illustrated. Similarly, the description of *P. spinosum* was based only on one female specimen reared from *Thripsaphis* sp. by Börner in Germany in 1942.

*P. spinosum* and *D. macrocarpus* are re-described here, and some rare and endemic aphid – aphid parasitoid associations from high-montane areas of south-eastern Europe are reviewed with particular reference to their distributions and origins.

## 2. Material and methods

Samples from *Carex rostrata* (L.) and *Carex nigra* (L.) with both live and mummified aphids were collected from Valovito Jezero (1700m) and Modro Jezero (1600m) on Mt. Durmitor Biosphere Reserve (Serbia and Montenegro). Each sample was placed separately in a plastic bag, which was next brought to the laboratory where aphids were identified. Live aphids were preserved in 2:1 90% ethyl alcohol and 75% lactic acid (Eastop & van Emden 1972). Mummies, each still attached to a small piece of leaf, were placed separately in small plastic boxes, which were put inside a growth cabinet. There was a circular opening covered with muslin for ventilation on the lid of each box in order to maintain inside the boxes conditions similar to those existing in the growth cabinet (22.5 °C, 65% relative humidity, 16:8 L:D photoperiod) (Kavallieratos *et al.*

2001, Trdan 2002). External structure of the emerged parasitoids was studied using an OLYMPUS SZX 9 stereomicroscope. Females of *P. spinosum* and *D. macrocarpus* were gold coated and examined using a Jeol JSM – 6460LV scanning electron microscope. The terminology used in this paper follows Huber and Sharkey (1993) and Kavallieratos *et al.* (2001).

We re-described *P. spinosum* and *D. macrocarpus* on the basis of our specimens reared from *Thripsaphis verrucosa* on *C. nigra* and *C. rostrata*.

## 3. Results

### 3.1. Redescription of *Praon spinosum* Mackauer, 1959 (Figs. 1, 2a, b)

*Holotype* ♀. Germany, Tschdf., 11.VIII.1942, reared from *Thripsaphis* sp., leg. C. Börner. Deposition: Deutsches Entomol. Institut, ex Coll. Börner.

*Additional material*. Five females and four males, Serbia and Montenegro, Mt Durmitor – Modro Jezero, 21.VII.2004, reared from *T. verrucosa* on *C. nigra*, leg. Ž. Tomanović and V. Žikić (hereafter ŽT and VŽ).

*Female*. Head. Eyes oval, sparsely haired (Fig. 1a). Malar space equal to about 0.20 times the longitudinal eye diameter. Clypeus oval, with 19–22 long setae. Face with sparse setae. Tentorial index (tentoriocular line/ intertentorial line) 0.17–0.20. Head almost 1.2 times wider than mesoscutum. Maxillary palp 4-segmented, labial palp 3-segmented. Antennae 15–16-segmented, filiform, with semi-erect and adpressed setae which are shorter than the diameter of the segments. Flagellomere 1 (Fig. 1b) 4.0–4.5 times as long as median width.  $F_2$  (Fig. 1b) about 3.0 times as long as median width.  $F_1$  without longitudinal placodes and  $F_2$  without or with one longitudinal placode (Fig. 1b).

Mesosoma. Mesonotum (Fig. 1c) with central lobe densely covered with long setae. Lateral lobes of mesonotum sparsely setaceous (Fig. 1c). Notaulices deep and distinct throughout. Propodeum smooth, densely setaceous except in the small central area (Fig. 1d).

Forewing. Pterostigma elongated, about 4.5

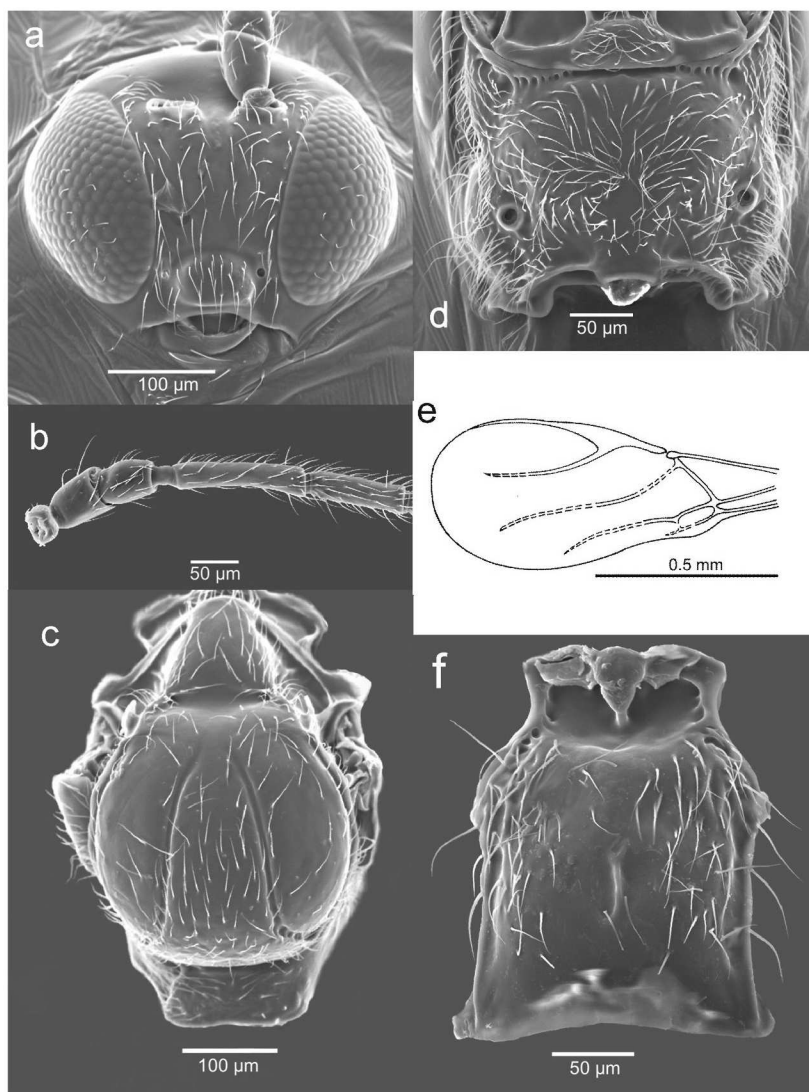


Fig. 1. *Praon spinosum* Mackauer, 1959, female. – a. Head, anterior aspect. – b. Antennae, basal part ( $F_1$  and  $F_2$ ). – c. Mesonotum, dorsal aspect. – d. Propodeum, dorsal aspect. – e. Forewing. – f. Petiole, dorsal aspect.

times as long as wide and subequal to distal abscissa of R1 (=metacarpus) (Pterostigma length / R1 length = 0.90–1.00) (Fig. 1e). Vein Rs about 0.85 times as long as pterostigma and about 0.80 times as long as distal abscissa of R1. Vein m-cu is completely effaced. Rs + M vein colourless in basal part and coloured in distal part (Fig. 1e).

**Metasoma.** Petiole (= tergite 1) about 1.4 times as long as wide at level of spiracles with long setae at both sides (Fig. 1f). Ovipositor sheath moderately elongate with slightly concave dorsal part. Apex round, with two conical apical spines (Figs 2a, b).

**Colouration.** Head black to brown. Scape,

pedicel and  $F_1$  yellowish, except distal part of  $F_1$  brownish, remaining part of antenna black to brown. Mouthparts brownish. Petiole brown to black. Legs yellow with dark apices. Metasomal tergum 2 and 3 brown to black. Remaining body parts black. Cocoon whitish.

**Body length.** 2.6–2.8 mm.

**Male.** Antenna 18–19-segmented.  $F_1$  about 3.0 times as long as wide. Petiole subquadrate. Head black. Mouthparts brownish. Scape and pedicel brownish. Basal ring of  $F_1$  yellow, remaining part of antenna brown.

**Body length.** 2.3–2.5 mm.

**Hyperparasitoids.** *Dendrocercus bifoveatus*

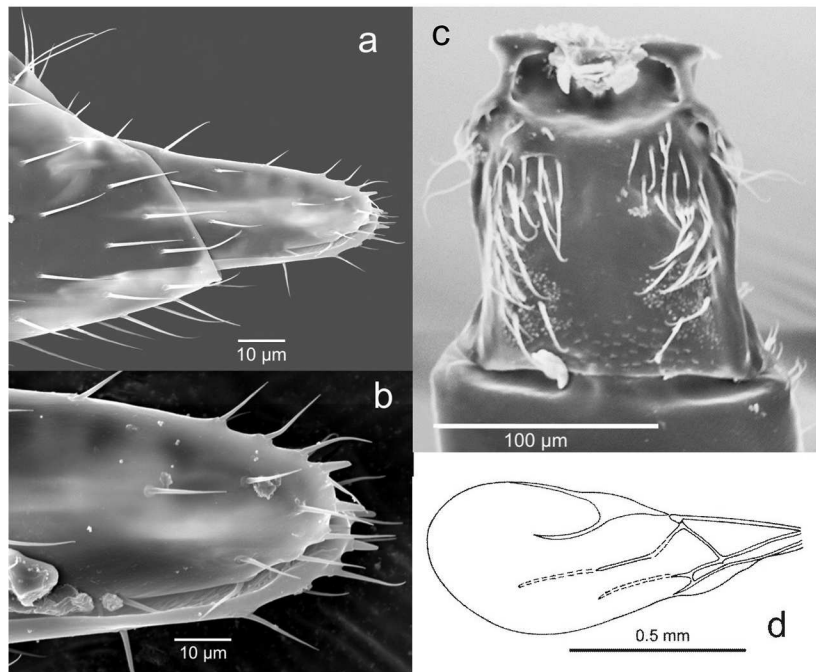


Fig. 2. *P. spinosum*, female. – a. Ovipositor sheath, lateral aspect. – b. Ovipositor sheath, lateral aspect (enlarged); *Praon necans* Mackauer, 1959, female. – c. Petiole, dorsal aspect. – d. Forewing.

(Kieffer, 1907) (4 specimens) (Hymenoptera: Megaspilidae), *Asaphes suspensus* (11 specimens) (Nees, 1834) (Hymenoptera: Pteromalidae), *Syrphophagus* sp. (2 specimens) (Hymenoptera: Encyrtidae) – Serbia and Montenegro, Mt Durmitor – Modro Jezero, 21.VII.2004, reared from *T. verrucosa* on *C. nigra*, leg. ŽT and VŽ. Specimens are deposited in collection of Institute of Zoology, Faculty of Biology, University of Belgrade, Serbia.

**Diagnosis.** *P. spinosum* belongs to the “*Para-praon*” species group which is characterized by the absence of vein m-cu in the forewing. *P. spinosum* resembles *Praon necans* (Mackauer 1959) but it is immediately distinguished from it by the ratio of length to width at the level of the spiracles of the petiole (= tergite I) [approximately 1.4 in *P. spinosum* (Fig. 1f) compared with 1.0–1.1 in *P. necans* (Fig. 2c)] and the length and width of the pterostigma [approximately 4.5 as long as wide in *P. spinosum* (Fig. 1e) compared with 3.2–3.9 in *P. necans* (Fig. 2d)]. For the above comparisons three series of *P. necans* reared from *Rhopalosiphum nymphaeae* (L., 1761) in France, Czech Republic and Serbia and Montenegro were used. Furthermore, *P. spinosum* appears to be a specialized parasitoid of *T. verrucosa* whereas *P. necans*

parasitizes *R. nymphaeae* in the Palaearctic (Mackauer 1959, Starý 1966).

### 3.2. Redescription *Diaeretellus macrocarpus* Mackauer, 1961 (Figs. 3–4)

**Holotype** ♀. Germany, Wildseemoor, 26.VII.1960, reared from *Bacillaphis* sp. on *Carex* sp., leg. R. Van den Bosch, M. Mackauer and F. Stroman. Deposited in coll. Mackauer (Vancouver, Canada).

**Allotype** ♂. Germany, Wildseemoor, 26.VII.1960, reared from *Bacillaphis* sp. on *Carex* sp., leg. R. Van den Bosch, M. Mackauer and F. Stroman. Deposited in coll. Mackauer (Vancouver, Canada).

**Paratypes.** 1♀ and 3♂♂, same data as holotype.

**Additional material.** 4♀♀, Germany, Windgefäll-Weiher, Schwarzwald, 28.VII.1960, reared from *Bacillaphis* sp. on *Carex* sp., leg. R. Van den Bosch, M. Mackauer and F. Stroman; 3♀♀, Germany, Tieringen, Schwäbische Alb, 31.VII.1960, reared from *Thripsaphis* sp. on *Carex* sp., leg. R. Van den Bosch; 1♀, Sweden, Vrml. Karlskoga, 13.VII.1954, reared from

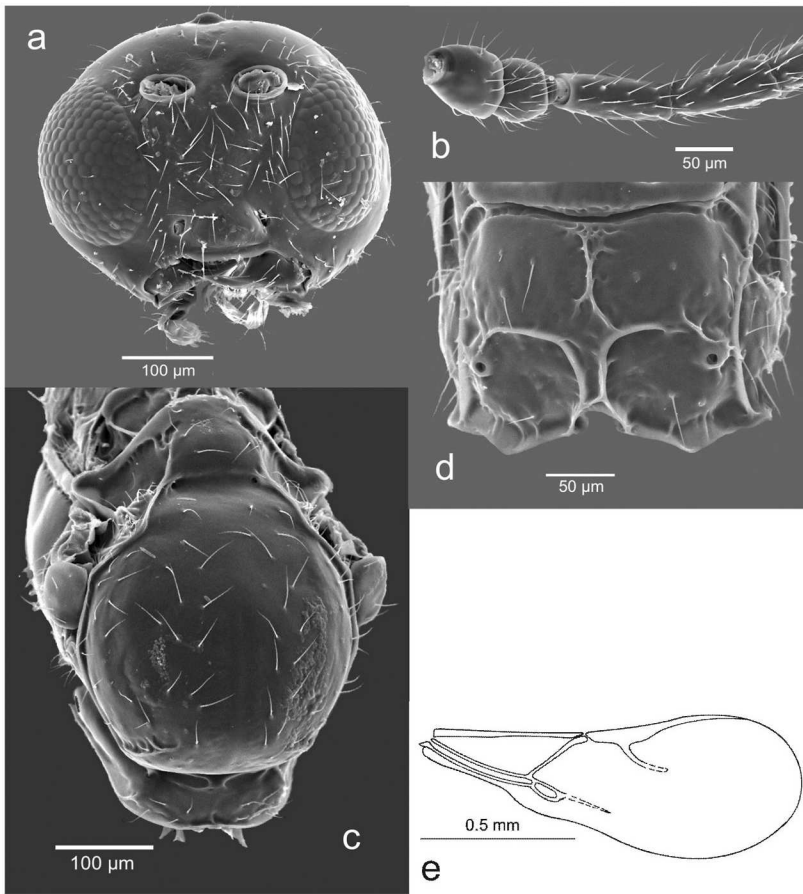


Fig. 3. *Diaeretellus macrocarpus*, Mackauer, 1961, female. – a. Head, anterior aspect. – b. Antennae, basal part ( $F_1$  and  $F_2$ ). – c. Mesonotum, dorsal aspect. – d. Propodeum, dorsal aspect. – e. Forewing.

*Iziphya ingegardae* Hille Ris Lambers on *Carex* sp., leg. F. Ossiannilsson; 1♀ and 1♂, Serbia and Montenegro, Mt Durmitor – Valovito Jezero, 3.VII.2002, reared from *T. verrucosa* on *C. rostrata*, leg. N. G. Kavallieratos (hereafter NK) and ŽT; 1♂, Serbia and Montenegro, Mt Durmitor – Valovito Jezero, 20.VII.2004, reared from *T. verrucosa* on *C. rostrata*, leg. ŽT and VŽ; 2♀♀ and 3♂♂, Serbia and Montenegro, Mt Durmitor-Modro Jezero, 21.VII.2004, reared from *T. verrucosa* on *C. nigra*, leg. ŽT and VŽ.

**Female.** Head. Eyes oval (Fig. 3a). Malar space equal to 0.25 longitudinal eye diameter. Clypeus oval, with 5–8 long setae (Fig. 3a). Tentorial index about 0.55. Maxillary palp 3-segmented, labial palp 1-segmented. Head 1.2–1.3 times wider than mesoscutum. Antennae 14-segmented, moderately thickened at apex, with semierect and adpressed setae which are shorter than the diameter of the segments.  $F_1$  and  $F_2$  3.3–

3.4 times as long as wide, without longitudinal placodes.  $F_1$  equal to  $F_2$  (Fig. 3b).

**Mesosoma.** Mesonotum with notaulices distinct in the fore part, slightly crenulated, with two rows of setae. Notaulices effaced on the disc (Fig. 3c). Propodeum areolated, with 5–6 setae on its upper and 4–5 setae on its lower areola. Areola narrow and pentagonal (Fig. 3d).

**Forewing.** Pterotigma 4.3–4.5 times as long as wide. Distal abscissa of R1 (=metacarpus) equal to pterostigma (Fig. 3e).

**Metasoma.** Petiole 2.7–2.8 times as long as wide at spiracles, with 7–8 costulae on its anterolateral area, with rugose mediodorsal part and weakly prominent mediodorsal carina (Fig. 4a). Ovipositor sheath linear in its dorsal margin (Figs. 4b, c).

**Colouration.** Head black. Mouthparts brownish. Scape and pedicel brownish.  $F_1$  with narrow yellow ring at the base, remaining part of anten-

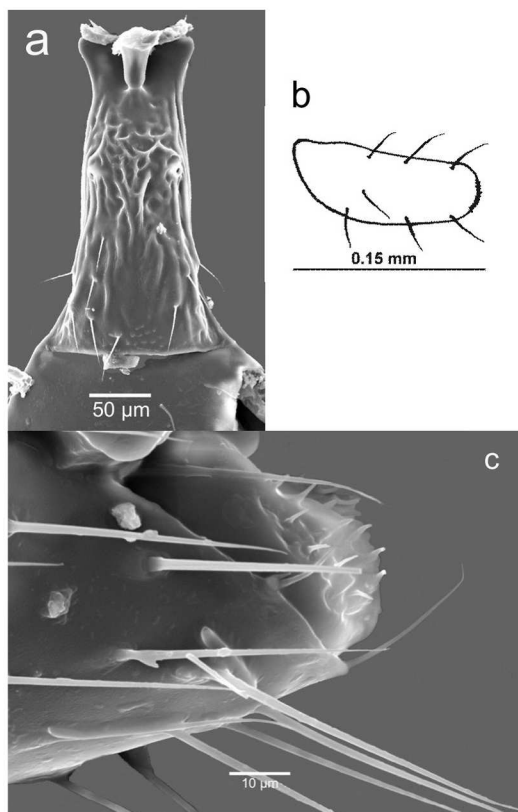


Fig. 4. *D. macrocarpus*, female. – a. Petiole, dorsal aspect. – b. Ovipositor sheath, lateral aspect. – c. Ovipositor sheath, lateral aspect (enlarged).

nae brown. Petiole and metasomal tergum 2 brown to black. Legs brownish with dark apices. Rest of body black.

Body length. 2.5–2.8 mm.

*Male*. Antennae 16-segmented, moderately thickened at apex, with semierect and adpressed setae which are shorter than the diameter of the segments. Body generally black except brown mouthparts and legs.

*Hyperparasitoids*. *Dendrocerus bifoveatus* (2 specimens) (Kieffer, 1907) (Hymenoptera: Mechaspilidae) – Serbia and Montenegro, Mt Durmitor – Valovito Jezero, 3.VII.2002, reared from *T. verrucosa* on *C. rostrata*, leg. NK and ŽT; *Asaphes vulgaris* (Walker, 1834) (5 specimens) (Hymenoptera: Pteromalidae) – Serbia and Montenegro, Mt Durmitor-Modro Jezero, 21.VII.2004, reared from *T. verrucosa* on *C. nigra*, leg. ŽT and VŽ. Specimens are deposited in collection of Institute of Zoology, Faculty of

Biology, University of Belgrade, Serbia.

*Remarks*. *D. macrocarpus* specimens reared from *T. verrucosa* had longer  $F_1$  than the type specimens [3.3–3.4 times as long as median width, compared with ‘Segment 3 mindestens 2.5-mal so lang wie dick...’ (Mackauer 1961)]. Males with 16-segmented antennae instead of the 17–18 in the type specimens.

### 3.3. Some rare high montane aphid parasitoid species in south-eastern Europe

All specimens collected in Serbia and Montenegro are deposited in the collection of Institute of Zoology, Faculty of Biology, University of Belgrade, Serbia. Specimens collected in Greece are deposited in the collection of Laboratory of Agricultural Zoology and Entomology, Agricultural University of Athens (Greece).

*Aphidius galii* Tomanović & Kavallieratos, 2002

*Linosophon* sp. on *Galium lucidum* (6♀♀, 533), Mt Durmitor-Crno jezero, 30.VI.2001, leg. ŽT, (Montenegro); *Galium schultesii* (18♀♀, 8♂♂), Mt Durmitor-Crno jezero, 30.VI.2002, Mt Durmitor-Jezerska gora, 1.VII.2002, leg. ŽT, (Montenegro).

*Aphidius linosophonis* Tomanović & Starý, 2001

*Linosophon galiophagum* (Wimshurst) on *Galium sylvaticum* (5♀♀, 11♂♂), Mt Tara-Derventa Canyon, 31.V.1998, leg. ŽT, (Serbia).

*Aphidius montenegrinus* Tomanović & Kavallieratos, 2004

*Acyrtosiphon daphnidis* Ilharco, 1994 on *Daphne alpina* (5♀♀, 6♂♂), Mt Durmitor-Zabojsko jezero, 1.VIII.2002, leg. NK and ŽT, (Montenegro).

*Aphidius sussi* Pennacchio & Tremblay, 1988

*Delphiniobium junackianum* Karsch. on *Aconitum firmum* (87♀♀, 28♂♂), Mt Kopaonik-Metode, 03.VII.2000, 7.VIII.2000, Mt Kopaonik-Samokovka, 9.VII.2000, 6.VIII.2000, 25.VIII.2000, Mt Kopaonik-Marine vode, 6.VIII.2000, Mt Kopaonik-Konaci, 23.VIII.2000, leg. ŽT, (Serbia); *A. toxicum* ssp. *bosniacum* (61♀♀, 35♂♂), Mt Durmitor-Crno jezero,



2.VII.1998, 15.VIII.1998, 13.VII.2000, 19.VII.2000, 30.VI.2002, 4.VII.2002, leg. ŽT, (Serbia), Mt Kopaonik-Metode, 18.VIII.1998, 20.VII.1999, leg. O.Petrović-Obradović, (Serbia), Biogradska gora, 26.VII.2001, Mt Durmitor-Sušica, 2.VII.2002, leg. ŽT, (Montenegro); *Aconitum napellus* (4♀♀), Central Macedonia, 21.VI.2002, leg. N. Emmanouel, (Greece); Italy – Pennacchio and Tremblay (1988).

*Aphidius* sp.

*Macrosiphum daphnidis* Börner on *Daphne oleoides* (12♀♀, 1♂), Mt. Tymphi, Ioannina, Western Greece, 17. VII. 2003, 3.VII. 2004, 18.VII. 2004, leg. NK and ŽT (Greece).

*Ephedrus blattnyi* Starý, 1973

*Pterocomma rufipes* (Hartig) on *Salix retusa* (1♀, 1♂), Durmitor-Mali Međed, 14.VII. 2000, leg. O. Petrović Obradović, Durmitor-Mali Međed, 18.VII.2000, leg. S. Tomanović, (Montenegro); Slovakia – Starý and Leclant (1973).

*Diaeretellus palustris* Starý, 1971

*Rhopalosiphum nymphaeae* Linnaeus on *Ranunculus aquatilis* (2♂♂), Mt Vlasina, 22.VII.1990, leg. O. Petrović Obradović, (Serbia); Germany – Starý (1971).

*Lysiphlebus balcanicus* Starý, 1998

*Aphis psammophila* Scelejewicz on *Jasione heldreichii* (6♀♀), Mt Vlasina, 21.VII.1990, leg. O. Petrović Obradović, 30.VII.1996, leg. ŽT, (Serbia); Spain – Sanchis et al. (1999).

*Monoctonus leclanti* Tomanović & Starý, 2002

*Delphiniobium junackianum* Karsch. on *Aconitum pentheri* (1♀), Mt Kopaonik-Metode, 7.VIII.2000, leg. ŽT, (Serbia); *A. toxicum* ssp. *bosniacum* (6♀♀, 1♂), Mt Kopaonik-Metode, 18.VIII.1998, 20.VII.1999, leg. O. Petrović Obradović, (Serbia), Mt Durmitor-Crno jezero, 15.VIII.1997, leg. O. Petrović Obradović, 19.VII.2000, Mt Durmitor-Sušica Canyon, 2.VII.2002, leg. ŽT, (Montenegro).

*Praon retusae* Tomanović & Kavallieratos, 2002

*Acyrtosiphon* cf. *malvae* (Mosley) on *Salix retusa* (1♀, 1♂), Mt Durmitor-Mali Međed, 6.VII.1998, 14.VII.2000, (Montenegro).

*Trioxys chaetosiphonis* Starý, 1971

*Longicaudus trirhodus* (Walker) on *Thalictrum aquilegifolium* (2♀♀), Mt Kopaonik-Samokovska reka, 8.VII.2000 leg. ŽT, (Serbia); France – Starý et al. (1971).

*Trioxys galiobii* Starý, 1974

*Myzus langei* Börner on *Galium lucidum* (1♀), Zlatarsko jezero, 11.VII.1991 leg. O. Petrović Obradović, (Serbia); Czech Republic – Starý (1974).

### 3.4. Some new high montane aphid parasitoid associations from south-eastern Europe

*Aphidius avenae* Haliday, 1834

*Acyrtosiphon malvae* (Mosley) on *Achillea tanacetifolia* (3♀♀), Mt Šara-Livadačko jezero, 24.VII.1995 leg. O. Petrović Obradović, (Serbia); *Acyrtosiphon* cf. *malvae* (Mosley) on *Salix retusa* (56♀♀, 44♂♂), Mt Durmitor-Mali Međed, 6.VII.1998, 18.VII.2000, Mt Durmitor-Ledena pećina, 17.VII.2000, leg. ŽT, (Montenegro).

*Aphidius ervi* Haliday, 1834

*Macrosiphum daphnidis* Börner on *Daphne oleoides* (4♀♀), Mt Tymphi, Ioannina, Western Greece, 3.VII.2004, leg. NK (Greece); *Macrosiphum cholodkovskyi* (Mordvilko) on *Filipendula ulmaria*, (9♀♀, 9♂♂), Mt Durmitor-Crno jezero, 30.VI.2001, leg. ŽT, (Montenegro).

*Aphidius microlophii* Pennacchio & Tremblay, 1986

*Wahlgreniella ossiannilssoni* Hille Ris Lambers on *Arctostaphylos uva ursi* (10♀♀, 6♂♂), Mt Durmitor-Škrčka jezera, 7.VIII. 2005, leg. VŽ and ŽT, (Montenegro).

*Aphidius urticae* Haliday, 1834

*Acyrtosiphon daphnidis* Ilharco on *Daphne alpina* (3♀♀), Mt Durmitor-Zabojsko jezero, 01.VII.2002, leg. ŽT, (Montenegro).

*Binodoxys acalephae* (Marshall, 1896)

*Aphis myrsinitidis* Petrović & Leclant on

*Euphorbia myrsinites* (6♀♀, 7♂♂), Mt Zlatar, 11.VII.1991, (Serbia), Mt Durmitor-Crno jezero, 27.VIII.1991, leg. O. Petrović Obradović, (Montenegro); *Uhlmania singularis* (Börner) on *Asperula cynanchica* (2♀♀), Žabljak, 09.VII.1995, leg. O. Petrović Obradović, (Montenegro).

*Binodoxys brevicornis* (Haliday, 1833)

*Uhlmania singularis* (Börner) on *Asperula longifolia*, Mt Durmitor-Crno jezero, 30.VI.2002, leg. ŽT, (Montenegro).

*Diaeretiella rapae* (M'Intosh, 1855)

*Aphis cadiva* Walker on *Silene vulgaris* (2♂♂), Mt Durmitor-Zminje jezero, 23.VIII.1990, leg. O. Petrović Obradović, (Montenegro); *Pseudobrevicoryne leclanti* Petrović and Remaudičič on *Arabis alpina* (3♀♀), Mt Durmitor-Crno jezero, 15.VIII.1997, leg. O. Petrović Obradović, (Montenegro).

*Ephedrus plagiator* (Nees, 1811)

*Aphis salicariae* Koch on *Epilobium angustifolium* (3♀♀), Kopaonik-Samokovska reka, 6.VIII.2000, leg. ŽT, (Serbia); *Macrosiphum cholodkovskyi* (Mordvilko) on *Filipendula ulmaria* (1♀, 1♂), Mt Kopaonik-Marine vode, 8.VII.2000, leg. ŽT, (Serbia).

*Lysaphidus viaticus* Sedlag, 1968

*Pleotrichophorus duponti* Hille Ris Lambers on *Achillea millefolium* (3♀♀), Mt Durmitor-Zminje jezero, 17.VIII.1997, leg. O. Petrović Obradović, (Montenegro).

*Lysiphlebus fabarum* (Marshall, 1896)

*Aphis carlinae* (Börner) on *Carlina acaulis* (2♀♀), Mt Šara-Ošljak, 4.VII.1995, leg. O. Petrović Obradović, (Serbia).

*Monoctonus crepidis* (Haliday, 1834)

*Hyperomyzus hieracii* (Börner) on *Hieracium* sp. (1♀), Mt Durmitor-Zminje jezero, 13.VII.2000, leg. ŽT, (Montenegro).

*Monoctonus nervosus* (Haliday, 1833)

*Acyrtosiphon* cf. *malvae* (Mosley) on *Salix retusa* (3♀♀, 11♂♂), Mt Durmitor-Mali Međed, 6.VII.1998, 14.VII.2000, Mt Durmitor-Ledena pećina, 17.VII.2000, leg. ŽT, (Montenegro).

*Praon longicorne* Marshall, 1891

*Macrosiphum cholodkovskyi* (Mordvilko) on *Filipendula ulmaria* (5♀♀), Mt Durmitor-Crno jezero, 30.VI.2001, 4.VII.2002, leg. ŽT, (Montenegro).

## 4. Discussion

### 4.1. Habitats and distribution

Both *P. spinosum* and *D. macrocarpus* were collected in swampy montane habitats and reared from *T. verrucosa*/ *Carex* spp. associations. *T. verrucosa* lives on several *Carex* spp. (Heie 1982) in very specific microhabitats, between the stem and the lower leaves just at the water surface, where there is very high humidity. A comparison of the habitats of the two species indicates that they tend to be associated with montane swamps and moors in Europe (Mackauer 1961, Starý 1966).

### 4.2. Biodiversity and biogeography

High montane areas in south-eastern Europe represent a very important centre of aphidiine diversity (Kavallieratos et al. 2004). This is due to great plant and habitat diversities and dynamic historical processes (Matvejev & Puncer 1989), with the glacial and postglacial history of this region being very complex. Colder climate and glacial phenomena in south-eastern Europe were less expressed than in Central and Northern Europe. This resulted in a relative richness of flora, which was not reduced by the influence of glacial periods as it was in Central and Northern Europe. This is one of the main reasons for the significant presence of Tertiary relics and endemism of plants and associated insects in this area. We revealed many new and rare aphid parasitoid species and host associations from high mountains over the period 1996–2004 (Starý et al. 1998, Kavallieratos & Tomanović 2001, Tomanović & Kavallieratos 2002, Tomanović et al. 2002, 2003, 2004, Kavallieratos et al. 2004, 2005). Some of the aphidiines as members of new host associations have economical importance as biocontrol



agents of pest aphids [*A. ervi*, *A. avenae*, *Ephe-drus plagiator* (Nees, 1811), *Diaeretiella rapae* (M'Intosh, 1855), *Lysiphlebus fabarum* (Marshall, 1896)].

Biogeographically, high montane associations and species are characterized by an insular type of distribution. In spite of the fact that their host aphids have much broader distribution, some aphidiine species are restricted to specific high montane microhabitats. Based on the known distribution of aphidiine wasps, we recognize two patterns of their distribution: the Eastern–Western and the Southern–Northern. The Eastern–Western pattern distribution indicates an ancient Mediterranean origin of aphidiinae species and associations (*L. balcanicus*, *M. leclanti*, *A. sussi*, *P. retusae*, *Aphidius galii* Tomanović & Kavallieratos, 2002, *Aphidius linosiphonis* Tomanović & Starý, 2001, *A. montenegrinus*). The Southern–Northern distribution pattern presupposes a glacial origin of the aphidiine species and associations (*E. blatnyi* Starý, *Diaeretellus palustris* Starý, 1960, *D. macrocarpus*, *P. spinosum*, *Trioxys chaetosiphonis* Starý, 1971 and *Trioxys galiobii* Starý, 1974).

### 4.3. Taxonomy

*P. spinosum* belongs to the “*Parapraon*” species group. Starý (1983) established a new genus *Parapraon* mainly based on the lack of the recurrent (m-cu) vein in the forewing. However, Johnson (1987) pointed out the great variability of character states of m-cu vein and consequently synonymized *Parapraon* with *Praon*. Later on, molecular phylogenetic studies did not find any support for the generic status of *Parapraon* (Kambhampati et al. 2000). According to Kavallieratos et al. (2005) the “*Parapraon*” species group is monophyletic inside the genus *Praon*. All studied European “*Parapraon*” [*Praon necans*, Mackauer, 1959, *Praon gallicum* Starý, 1971, *P. retusae* and *Praon exsoletum* (Nees, 1811)] and *P. spinosum*] share the following synapomorphies: absent or significantly reduced vein m-cu, elongated ovipositor sheath, two conical apical spines on the ovipositor sheath and large hairless areas on the lateral lobes of the mesonotum.

The genus *Diaeretellus* is closely related to the *Aphidius* Nees, 1819, *Euaphidius* Mackauer, 1961, *Diaeretiella* Starý, 1960 and *Diaeretus* Förster, 1862 based on morphology, but the phylogenetic relationships and taxonomic status of these genera need further investigation.

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