Review of the world Monoctonina Mackauer 1961 (Hymenoptera, Braconidae, Aphidiinae): key for their identification and descriptions of five new species

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Abstract

The subtribe Monoctonina has long been overlooked when it comes to morphological studies, probably due to the low economic importance of its members. Mainly distributed in high montane areas and forest ecosystems, species of Monoctonina are not often found in large populations and do not parasitize pests of cultivated plants. Our research uncovered five new species belonging to this subtribe (Monoctonus brachyradius sp. n., M. canadensis sp. n., M. inexpectatus sp. n., M. luteus sp. n., and M. parvipalpus sp. n.). We also redescribe species originally described over a century ago, and discuss the utility of certain morphological characters, as well as status of some species within Monoctonina.

Key words: Monoctonus, Falciconus, Harkeria, Monoctonia, morphology, parasitoid wasps

Introduction

The genera Falciconus Mackauer 1959, Harkeria Cameron 1900, Monoctonia Starý 1962, Monoctonus Haliday 1833, and Quadrictonus Starý & Remaudiere 1982 are traditionally classified in the subtribe Monoctonina Mackauer 1961 and tribe Trioxini, on the basis of morphology (Mackauer 1961a). The main morphological character used to distinguish members of Monoctonina is the ovipositor shape, which ranges from slightly widened ventrally to distinctly ploughshare shaped, depending on the species. Currently, there are 26 species within the Monoctonina worldwide, with fourteen recorded in Europe. Eleven species are only known from their type material, while two are known only from a few specimens (Table 1).

Like other members of the subfamily Aphidiinae, species of Monoctonina are solitary endoparasitoids of aphids. Most species of Monoctonus parasitize aphids from the tribe Macrosiphini (Hemiptera, Aphididae, Aphidiinae). Exceptions are one Calaphidinae species (Therioaphis riehmi Börner) parasitized by M. gallicus (Starý et al. 1977) and four Aphidini species parasitized by five species of Monoctonus. Species of Monoctonus that parasitize Aphidini aphids also parasitize some Macrosiphini aphids, and host plants are similar ecologically (M. carici on S. tobianum sp./Triticum sp. and R. padi (L.)/Zea mays; M. malis on R. padi sp./Insertum Walker/Malus domestica and Pyrus communis and Dysaphis sp./Malus domestica and Pyrus communis; M. campbellianus on B. helichrysi (Kaltenbach), Phorodon humuli (Schrank) and Hyalopterus pruni (Geoffroy)/Prunus sp.; M. washingtonensis on R. padi, Aphis oenotherae Wilson/Epilobium sp. and D. noxia (Mordvillox ex Kurdumov)/Triticum sp.; M. paulensis usually attacks S. fragariae (Walker) and Amphorophora rubitoxica Knowlton, but it has also been reared from R. padi) (Van Achterberg 1989; Calvert 1973; Pike et al. 2000; Pike & Starý 1995). Falciconus pseudoplatani parasitizes Drepanosiphinae aphids, while species of Monoctonia parasitize Eriosomatinae aphids, with a clear division between species on Pemphigini (Monoctonia vesicarii, M. japonica) and Fordini (M. pistaciaecola) (Rakhshani et al. 2015; Tomanović et al. 2007a).
While there have been morphological studies on the Monoctonina (van Achterberg 1989; Starý 1959, 1974; Starý & Smith 1976; Tomanović et al. 2002, 2007a), data are still lacking for some of described species. Here we present a comprehensive morphological study on members of the Monoctonina with a description of five new species, and an identification key for almost all known species in this subtribe. Some species known only from type material were not available for analysis. In addition to the description of new species, we provide detailed redescriptions for species described over a century ago, adding morphological characters now commonly included in descriptions of Aphidiinae.

**Table 1.** Currently known species of Monoctonina and their distribution. Species denoted with * are known only from type material; species denoted with ** are known from a small number of specimens.

<table>
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<tr>
<th>Species</th>
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<td><strong>Harkeria rufa</strong> Cameron 1900</td>
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<td>Western Palaearctic</td>
<td>Starý et al. 1977</td>
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<td>Pike et al. 2003</td>
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<tr>
<td>Monoctonus crepis (Haliday 1834)</td>
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<td>van Achterberg 1989</td>
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<tr>
<td><em>Monoctonus fotedari</em> Bhagat 1981</td>
<td>India</td>
<td>Bhagat 1981</td>
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<tr>
<td><em>Monoctonus gallicus</em> Starý 1977</td>
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<td><em>Monoctonus hispanicus</em> Tizado 1992</td>
<td>Western Palaearctic</td>
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<td><em>Monoctonus longiradius</em> Takada 1966</td>
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<td>van Achterberg 1989</td>
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<td>Monoctonus nervosus (Haliday 1833)</td>
<td>Palaearctic</td>
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<td>Monoctonus paulensis (Ashmead 1902)</td>
<td>Nearctic</td>
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<td><em>Monoctonus similis</em> Starý &amp; Schlinger 1967</td>
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<td>Starý &amp; Schlinger 1967</td>
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<td><strong>Monoctonus tianshanensis</strong> Starý 1978</td>
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<td><em>Monoctonus woodwardiae</em> Starý &amp; Schlinger 1967</td>
<td>Far East</td>
<td>Starý &amp; Schlinger 1967</td>
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<tr>
<td>Monoctonus washingtonensis Pike &amp; Starý 1995</td>
<td>Nearctic</td>
<td>Pike &amp; Starý 1995</td>
</tr>
<tr>
<td>Monoctonia japonica Rakshani &amp; Tomanović 2015</td>
<td>Far East</td>
<td>Rakshani et al. 2015</td>
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<tr>
<td>Monoctonia pistaciaecola Starý 1962</td>
<td>Mediterranean, Asia Minor, Central Asia</td>
<td>Rakshani et al. 2015</td>
</tr>
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<td>Monoctonia vesicarii Tremblay 1991</td>
<td>Mediterranean, Asia Minor, Central Asia, Central and Western Europe</td>
<td>Rakshani et al. 2015</td>
</tr>
<tr>
<td><em>Quadrictonus luteolus</em> Starý &amp; Remaudière 1982</td>
<td>Nearctic</td>
<td>Starý &amp; Remaudière 1982</td>
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Material and methods

Specimens of Monoctonina were collected by Malaise trap or by collecting parasitized aphids at sites across the Holarctic (Belgium, Canada, Czech Republic, France, Japan, Montenegro, Russia, Serbia, Slovenia, Spain, UK (Wales), and USA) during 1995-2017. Plant leaves with parasitized aphids were collected from various host plants and kept in plastic boxes covered in nylon mesh for 3–4 weeks or until parasitoid emergence under laboratory conditions (22.5°C, light regime 16L:8D). Emerged parasitoids and host aphids were immersed in 96% ethanol and kept for later examination. Adult parasitoids were dissected and slide-mounted for detailed examination. External morphology was studied using a ZEISS Discovery V8 stereomicroscope (Carl Zeiss MicroImaging GmbH, Göttingen, Germany). Measurements are based on slide-mounted specimens and were made using the ImageJ software (Schneider et al. 2012), while photographs of specimens were obtained with a Leica DM LS phase contrast microscope (Leica Microsystems GmbH, Wetzlar, Germany). Morphological terminology follows Sharkey & Wharton (1997). For morphological analysis, 25 characters (8 meristic and 17 morphometric) were measured and examined (Figure 1). Morphometric characters were analysed as ratios (F1 length/width, F2 length/width, F1 length/F2 length, tentorial index (tentoriocular line/intertentorial line), malar space/longitudinal eye diameter, head width/mesoscutum width, fore wing pterostigma length/width, fore wing pterostigma length/R1 length, petiole length/width, ovipositor sheath length/width). Specimens used in this study are deposited in the collection of Institute of Zoology, Faculty of Biology, University of Belgrade (FBUB) and the Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa (CNC).

Results

Using diagnostic characters on available insect material we revealed five new species which are described below.

Description of species

Monoctonus brachyradius Čkrkić, Petrović & Tomanović, sp. n.

Holotype. Female. Canada, Quebec, Mingan Archipelago National Park Reserve, Quarry Island, 12 IX 2013, coll. Park staff, Malaise trap. Holotype slide mounted and deposited in CNC. Paratypes. Canada, Quebec, Mingan Archipelago National Park Reserve, Quarry Island, 20 VIII 2013, 1 female; 18 IX 2013, 3 males. Paratypes slide mounted and deposited in FBUB. (Fig. 2a–h)

Diagnosis. Monoctonus brachyradius resembles M. nervosus based on the number of flagellomeres, fore wing venation, and shape of ovipositor sheath, but it can be differentiated by a distinctly shorter distal abscissa of R1 (length of pterostigma/R1 length is 4.8–5.1 in M. brachyradius and 1.8–2.3 in M. nervosus).

Female. Head (Fig. 2a). Eyes oval, medium sized, sparsely setose. Malar space equal to 0.14 of longitudinal eye diameter. Tentorial index 0.13. Clypeus oval with 6 long setae. Maxillary palps with four palpomeres, labial palps with three palpomeres. Antenna with 15 antennomeres, filiform, setae on flagellomeres semierect, subequal to flagellomere diameter (Fig. 2b). Flagellomere 1 (F1) 4.5× as long as wide, without longitudinal placodes. F2 3.3× as long as wide, with 1–2 longitudinal placodes (Fig. 2c). F3, F4 and F5 with 2, 3–4 and 1–3 longitudinal placodes, respectively. F1 1.1× longer than F2.

Mesosoma. Mesoscutum with incomplete notaulices, visible only in anterior part. Dorsal surface of mesoscutum smooth, without setae (Fig. 2d). Head width/mesonotum width ratio 1.45. Propodeum areolated with clearly defined narrow central pentagonal areola (Fig. 2e).

Fore wing (Fig. 2h). Wing length 2 mm, width 0.8 mm. Stigma narrow, 7.5× as long as wide and 4.9× as long as distal abscissa of R1. Vein m-cu distinct, 2RS effaced near m-cu. Veins r and 3RS distinct.

Metasoma. Petiole 2.1× as long as wide at spiracles. Spiracular tubercles prominent. Dorsal disc of petiole moderately rugose in basal third, with one irregular carina in upper two thirds medially and with 9–10 long setae on each side (Fig. 2f). Ovipositor sheath ploughshare shaped. Ovipositor sheath length/width ratio 3 (Fig. 2g).
FIGURE 1. Characters used in morphological analysis. a—head width; b—longitudinal eye diameter; c—malar space; d—intertentorial line; e—tentoriocular line; f—F1 length; g—F1 width; h—F2 length; i—F2 width; j—width of mesoscutum; k—oblique carina; l—postmedian carina; m—petiole length; n—petiole width; o—ovipositor sheath length; p—ovipositor sheath width; q—pterostigma length; r—radial vein; s—pterostigma width; t—R1 length; u—wing length; v—wing width.
FIGURE 2. *Monoctonus brachyradius* sp.n., female. a—head; b—antenna; c—F1 and F2; d—mesoscutum; e—propodeum; f—petiole; g—ovipositor; h—fore wing.
Colour. Head brownish-black, eyes black. Face with mouthparts and clypeus yellowish-brown. F1 yellow, except for the apical ¼ which is brown, remainder of antenna brown. Mesonotum and propodeum brown, legs light brown. Wings hyaline with brown venation. Petiole and rest of metasoma brown, ovipositor sheath yellowish-brown. Body length 2.3 mm.

Male. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to 0.42 of longitudinal eye diameter. Tentorial index 0.4. Clypeus oval with 6–7 long setae. Maxillary palps with four palpomeres, labial palps with three palpomeres. Antenna with 18 antennomeres, filiform, setae on flagellomeres semierect, subequal to flagellomere diameter. Flagellomere 1 (F1) 2.2× as long as wide, with 6 longitudinal placodes. F2 2.2× as long as wide, with 5 longitudinal placodes. F3, F4 and F5 with 5, 6 and 5 longitudinal placodes, respectively. F1 length equal to F2.

Mesosoma. Mesoscutum without notaulices, with two longitudinal rows of setae on dorsal surface. Head width/mesoscutum width ratio 1. Propodeum areolated with clearly defined narrow central pentagonal areola.

Fore wing. Wing length 2.1 mm, width 0.9 mm. Stigma narrow, 5.8× as long as wide and 4.7× as long as distal abscissa of R1. Vein m-cu distinct, 2RS effaced near m-cu. Veins r and 3RS distinct.

Metasoma. Petiole 1.7× as long as wide at spiracles. Spiracular tubercles prominent. Dorsal disc of petiole moderately rugose in basal third, with one irregular carina in upper two thirds medially and with 4–5 long setae on each side.


Host: unknown.

Distribution. Eastern Canada.

Etymology: The name of the new species refers to the very short distal abscissa of R1.

**Monoctonus canadensis Čkrkić, Petrović & Tomanović, sp. n.**

**Holotype.** Female. Canada, Alberta, Banff National Park, Baker Creek picnic area, 15 VI 2012, coll. BIOBus 2012, Malaise trap. Holotype slide mounted and deposited in CNC. Paratypes: Canada, British Columbia, Gulf Islands National Park Reserve, North Pender Island, 22 VI 2014, 1 female, 1 male; 27 VI 2014, 1 male. Paratypes slide mounted and deposited in FBUB. (Fig. 3a–h)

**Diagnosis.** This species most resembles *M. nervosus* and *M. brachyradius*, but can be differentiated from both by more elongated ovipositor sheath (ovipositor length/width ratio: 3.5 in *M. canadensis*, 3 in *M. brachyradius* and 2.7 in *M. nervosus*) and the length of R1 (length of pterostigma/R1 is 3.9–4.4), longer than in *M. brachyradius* (4.8–5.1) and shorter than in *M. nervosus* (1.8–2.3).

Female. Head (Fig. 3a). Eyes oval, medium sized, sparsely setose. Malar space equal to 0.14 of longitudinal eye diameter. Tentorial index 0.3. Clypeus oval with 9 setae. Maxillary palps with four palpomeres, labial palps with three palpomeres. Antenna with 16 antennomeres, filiform, setae on flagellomeres semierect, subequal to flagellomere diameter (Fig. 3b). Flagellomere 1 (F1) 4× as long as wide, without longitudinal placodes. F2 3.6× as long as wide, with 1 longitudinal placode (Fig. 3c). F3, F4 and F5 with 3–4, 3–4 and 2 longitudinal placodes, respectively. F1 length equal to F2.

Mesosoma. Mesoscutum without notaulices, setose in lower half (Fig. 3d). Head width/mesoscutum width ratio 1.3. Propodeum areolated, with irregular oblique carinae (Fig. 3e).

Fore wing (Fig. 3h). Wing length 2.4 mm, width 1 mm. Stigma narrow, 6.5× as long as wide and 4.2× as long as distal abscissa of R1. Vein m-cu distinct, colourless in the middle, 2RS effaced near m-cu. Veins r and 3RS distinct.

Metasoma. Petiole 2.5× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with one irregular median carina in middle third and with 5–6 long setae on each side (Fig. 3f). Ovipositor sheath moderately plough-share shaped. Ovipositor sheath length/width ratio about 3.5 (Fig. 3g).

**FIGURE 3.** *Monoctonus canadensis* sp.n., female. a—head; b—antenna; c—F1 and F2; d—mesoscutum; e—propodeum; f—petiole; g—ovipositor; h—fore wing.
Male. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to 0.3 of longitudinal eye diameter. Tentorial index 0.5. Clypeus oval with 5–6 setae. Maxillary palps with four palpomeres, labial palps with three palpomeres. Antenna with 18 antennomeres, filiform, setae on flagellomeres semierect, subequal to flagellomere diameter. Flagellomere 1 (F1) 2.8× as long as wide, with 7 longitudinal placodes. F2 2.6× as long as wide, with 6 longitudinal placodes. F3, F4 and F5 with 6, 5 and 5 longitudinal placodes, respectively. F1 length equal to F2.

Mesosoma. Mesoscutum without notaulices, with scattered long setae on dorsal surface. Head width/mesoscutum width ratio 1.3. Propodeum areolated, with irregular oblique carinae.

Fore wing. Wing length 2 mm, width 0.8 mm. Stigma narrow, 6.5× as long as wide and 3.9× as long as distal abscissa of R1. Vein m-cu distinct, colourless in the middle, 2RS effaced near m-cu. Veins r and 3RS distinct.

Metasoma. Petiole 2.5× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with one irregular median carina in middle third and with 5–6 long setae on each side.


Host: unknown.

Distribution. Western Canada.

Etymology: The name of the new species refers to its known distribution.

Monoctonus inexpectatus Čkrkić, Petrović & Tomanović, sp. n.

Holotype. Female. Canada, Ontario, Wellington County, Guelph, Biodiversity Institute of Ontario, 13 VI 2013, coll. BIO Collections Staff, Malaise trap. Holotype slide mounted and deposited in CNC. Paratype: Canada, Manitoba, Riding Mountain National Park, Arrowhead Trail, 26 VI 2012, 1 female. Paratype slide mounted and deposited in FBUB. (Fig. 4a–h)

Diagnosis. This species most resembles M. nervosus based on number of flagellomere, fore wing venation and shape of ovipositor sheath, but it can be easily distinguished based on labial palps which have 2 palpomeres (3 in M. nervosus) and shorter R1 (pterostigma length/R1 length is 3.2–3.8 in M. inexpectatus, 1.8–2.3 in M. nervosus).

Female. Head (Fig. 4a). Eyes oval, medium sized, sparsely setose. Malar space equal to 0.15 of longitudinal eye diameter. Tentorial index 0.2. Clypeus oval with 6 setae. Maxillary palps with four palpomeres, labial palps with two palpomeres. Antenna with 16 antennomeres, filiform, setae on flagellomeres semierect subequal to flagellomere diameter (Fig. 4b). Flagellomere 1 (F1) 3.7× as long as wide, without longitudinal placodes. F2 3.7× as long as wide, with 1–2 longitudinal placodes (Fig. 4c). F3, F4 and F5 with 3, 3–4 and 3–4 longitudinal placodes, respectively. F1 length equal to F2.

Mesosoma. Mesoscutum with incomplete notaulices, visible only in anterior part. Dorsal surface of mesoscutum sparsely setose in the middle (Fig. 4d). Head width/mesoscutum width ratio 1.3. Propodeum areolated, with moderately narrow central pentagonal areola (Fig. 4e).

Fore wing (Fig. 4h). Wing length 2 mm, width 0.7 mm. Stigma narrow, 6.7× as long as wide and 3.2–3.8× as long as distal abscissa of R1. Vein m-cu distinct, 2RS effaced or visible only in first half. Veins r and 3RS distinct.

Metasoma. Petiole 2.3× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, especially in basal third, with 8–9 long setae on each side (Fig. 4f). Ovipositor sheath ploughshare shaped. Ovipositor sheath length/width ratio 3.15 (Fig. 4g).


Male. Unknown.

Host: unknown.

Distribution. Central Canada.

Etymology: The name of this species is derived from Latin inexpectatus for unexpected and refers to the surprisingly large number of new species discovered within the analysed Monoctonina material.
FIGURE 4. Monoctonus inexpectatus sp.n., female. a—head; b—antenna; c—F1 and F2; d—mesoscutum; e—propodeum; f—petiole; g—ovipositor; h—fore wing.
**Monoctonus luteus** Čkrkić, Petrović & Tomanović, sp. n.

**Holotype.** Female. Canada, British Columbia, Kootenay National Park, Kootenay Crossing, 10 VI 2014, coll. P. Langan, Malaise trap. Holotype slide mounted and deposited in CNC. Paratypes: Alberta, Banff National Park, Baker Creek picnic area, 16 VI 2012, 1 male; 19 VI 2012, 1 male. Paratypes slide mounted and deposited in FBUB. (Fig. 5a–h)

**Diagnosis.** This species morphologically resembles *M. caricis* based on fore wing venation and labial palps with 2 palpomeres, but has a distinctly elongated F1 (F1 length/width ratio: 5.6 in *M. luteus*, and 3.6 in *M. caricis*), and only moderately widened ovipositor sheath (length/width ratio 4.2 in *M. luteus*, and 3 in *M. caricis*).

Female. Head (Fig. 5a). Eyes oval, medium sized, sparsely setose. Malar space equal to 0.14 of longitudinal eye diameter. Tentorial index 0.12. Clypeus oval with 5 setae. Maxillary palps with four palpomeres, labial palps with two palpomeres. Antenna with 16 antennomeres, filiform, setae on flagellomeres semiferect, subequal to flagellomere diameter (Fig. 5b). Flagellomere 1 (F1) 5.6× as long as wide, without longitudinal placodes. F2 4.2× as long as wide, without longitudinal placodes (Fig. 5c). F3, F4 and F5 with 1, 2 and 2 longitudinal placodes, respectively. F1 1.3× longer than F2.

Mesosoma. Mesoscutum without notaulices, dorsal surface smooth, scarcely setose in lower half (Fig. 5d). Head width/mesoscutum width ratio 1.3. Propodeum areolated, with narrow central pentagonal areola and slightly irregular oblique carinae (Fig. 5e).

Fore wing (Fig. 5h). Wing length 2.4 mm, width 1 mm. Stigma narrow, 7.2× as long as wide and 3.3× as long as distal abscissa of R1. Vein m-cu visible in first third, second third colourless, last third effaced. 2RS absent. Veins r and 3RS distinct.

Metasoma. Petiole 2× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with one irregular carina medially and with 4–5 long setae on each side (Fig. 5f). Ovipositor sheath only slightly widened ventrally. Ovipositor sheath length/width ratio 4.2 (Fig. 5g).


**Monoctonus parvipalpus** Čkrkić, Petrović & Tomanović, sp. n.

**Holotype.** Female. Canada, British Columbia, Vancouver, Stanley Park, 8 VII 2014, coll. J. Sibbald, Malaise trap. Holotype slide mounted and deposited in CNC. (Fig. 6a–h)

**Diagnosis.** This species morphologically resembles *M. caricis* based on fore wing venation and labial palps with 2 palpomeres, but has a distinctly elongated F1 (F1 length/width ratio: 5.6 in *M. luteus*, and 3.6 in *M. caricis*), and only moderately widened ovipositor sheath (length/width ratio 4.2 in *M. luteus*, and 3 in *M. caricis*).

Female. Head (Fig. 5a). Eyes oval, medium sized, sparsely setose. Malar space equal to 0.14 of longitudinal eye diameter. Tentorial index 0.12. Clypeus oval with 5 setae. Maxillary palps with four palpomeres, labial palps with two palpomeres. Antenna with 16 antennomeres, filiform, setae on flagellomeres semiferect, subequal to flagellomere diameter (Fig. 5b). Flagellomere 1 (F1) 5.6× as long as wide, without longitudinal placodes. F2 4.2× as long as wide, without longitudinal placodes (Fig. 5c). F3, F4 and F5 with 1, 2 and 2 longitudinal placodes, respectively. F1 1.3× longer than F2.

Mesosoma. Mesoscutum without notaulices, dorsal surface smooth, scarcely setose in lower half (Fig. 5d). Head width/mesoscutum width ratio 1.3. Propodeum areolated, with narrow central pentagonal areola and slightly irregular oblique carinae (Fig. 5e).

Fore wing (Fig. 5h). Wing length 2.1 mm, width 0.9 mm. Stigma narrow, 7.1× as long as wide and 2.7× as long as distal abscissa of R1. Vein m-cu visible in first third, second third colourless, last third effaced. 2RS absent. Veins r and 3RS distinct.

Metasoma. Petiole 1.8× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with one irregular carina medially and with 4–5 long setae on each side.


Host: unknown.

**Distribution.** Western Canada.

**Etymology:** The name of this species refers to its yellow color.
FIGURE 5. Monoctonus luteus sp.n., female. a—head; b—antenna; c—F1 and F2; d—mesoscutum; e—propodeum; f—petiole; g—ovipositor; h—fore wing.
FIGURE 6. Monoctonus parvipalpus sp.n., female. a—head; b—antenna; c—F1 and F2; d—mesoscutum; e—propodeum; f—petiole; g—ovipositor; h—fore wing.
Diagnosis. Based on wing venation, this species resembles *M. nervosus*. It can be easily differentiated by antennae with 18 antennomeres, elongated F1 (length/width ratio is 4.9–5, 4 in *M. nervosus*), labial palps with 1 palpomere and moderately widened ovipositer sheaths (length/width ratio 3.6 in *M. parvipalpus*; 2.7 in *M. nervosus*).

Female. Head (Fig. 6a). Eyes oval, medium sized, sparsely setose. Malar space equal to 0.12 of longitudinal eye diameter. Tentorial index 0.17. Clypeus oval with 8 setae. Maxillary palps with four palpomeres, labial palps with one palpomere. Antenna with 18 antennomeres, filiform, setae on flagellomeres semierect, subequal to flagellomere diameter (Fig. 6b). Flagellomere 1 (F1) 5× as long as wide, without longitudinal placodes. F2 4.3× as long as wide, with 0–1 longitudinal placode (Fig. 6c). F3, F4 and F5 with 2–3, 3–4 and 2–3 longitudinal placodes, respectively. F1 1.2× longer than F2.

Mesosoma. Mesoscutum without notaulices, with scattered setae on dorsal surface (Fig. 6d). Head width/mesoscutum width ratio 1.3. Propodeum areolated, with moderately narrow central pentagonal areola (Fig. 6e).

Fore wing (Fig. 6h). Wing length 2.6 mm, width 1 mm. Stigma narrow, 6.9× as long as wide and 3.3× as long as distal abscissa of R1. Vein m-cu distinct, 2RS visible in first half, effaced near m-cu. Veins r and 3RS distinct.

Metasoma. Petiole 2× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with 6–7 long setae on each side (Fig. 6f). Ovipositor sheath moderately ploughshare shaped. Ovipositor sheath length/width ratio 3.6 (Fig. 6g).


Male. Unknown.

Host: unknown.

Distribution. Western Canada.

Etymology: The name of this species is derived from Latin *parvus* for small and *palpus* and refers to its number of labial palpomeres (1) which is less than in any other known *Monoctonus* species.

Redescriptions

*Falciconus pseudoplataani* (Marshall 1896)

(Figs 7a, 8a, 9a)

*Aphidius pseudoplataani* Marshall 1896: 582

**Material examined.** Serbia, New Belgrade, 5 VI 2007, 3 females reared from *Drepanosiphum platanoidis* (Schrank) on *Acer pseudoplataani*; Kopaonik, Jelak, 7 VIII 2011, 1 female, 1 male, collected from *Acer heldreichii*; Belgrade, VI 2012, 3 females reared from *Drepanosiphum platanoidis* on *Acer* sp.; Montenegro, Durmitor, Komarnica, 21 VII 2004, 1 male reared from *Drepanosiphum* sp. on *Acer* sp.; Czech Republic, Češké Budějovice, 20 VI 2008, 1 female reared from *Drepanosiphum platanoidis* on *Acer pseudoplataani*; Buchlovice, Mor. m., 16 VII 2011, 2 females reared from *Drepanosiphum* sp. on *Acer pseudoplataani*; Belgium, Jodoigne, 7 VI 2015, 2 females, 1 male, reared from *Drepanosiphum platanoidis* on *Acer pseudoplataani*; 8 VI 2015, 8 females, 8 males, reared from *Drepanosiphum platanoidis* on *Acer pseudoplataani*.

Female. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to 0.2 of longitudinal eye diameter. Tentorial index 0.2. Clypeus oval with 5–6 setae. Maxillary palps with four palpomeres, labial palps with two palpomeres. Antenna with 16 antennomeres, filiform, setae on flagellomeres semierect, subequal to half of flagellomere diameter. Flagellomere 1 (F1) about 5 (4.7–5.1)× as long as wide, without longitudinal placodes. F2 about 3.8 (3.2–4.4)× as long as wide, with 0–1 longitudinal placodes. F3, F4 and F5 with 3–5, 4–5 and 4–5 longitudinal placodes, respectively. F1 1.3× longer than F2.

Mesosoma. Mesoscutum without notaulices. Dorsal surface of mesoscutum sparsely setose. Head width/mesoscutum width ratio 1.2. Propodeum areolated, with central pentagonal areola wide in the middle (Fig. 7a).

Fore wing (Fig. 8a). Wing length 2.3 mm, width about 0.9 (0.8–1) mm. Stigma about 3.7 (3.4–4)× as long as wide and about 2 (1.8–2.2)× as long as distal abscissa of R1. Veins m-cu, 2RS, r and 3RS distinct. 3RS almost as twice as long as r.

Metasoma. Petiole 2.5× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with 3–5 long setae on each side. Ovipositor sheath narrow, needle shaped. Ovipositor sheath length/width ratio 4.6 (Fig. 9a).

Male. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to about 0.3 of longitudinal eye diameter. Tentorial index 0.4. Clypeus oval with 11–12 setae. Maxillary palps with four palpomeres, labial palps with two palpomeres. Antenna with 18 antennomeres, filiform, setae on flagellomeres semierect, subequal to half of flagellomere diameter. Flagellomere 1 (F1) 2.5× as long as wide, with 11–14 longitudinal placodes. F2 1.8× as long as wide, with 11–12 longitudinal placodes. F3, F4 and F5 with 13–14, 10–12 and 9–10 longitudinal placodes, respectively. F1 length equal to F2.


Fore wing. Wing length 1.9 mm, width 0.7 mm. Stigma about 5.1 (5–5.2)× as long as wide and 1.6× as long as distal abscissa of R1. Veins m-cu, 2RS, r and 3RS distinct. 3RS almost as twice as long as r.

Metasoma. Petiole 2.3× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with 3–4 long setae on each side.


Hosts: Drepanosiphum spp. on Acer spp.

Distribution. West Palaearctic

Harkeria angustivalva (Starý 1959)
(Figs 7b, 8b, 9b)

Monoctonus (Paramonoctonus) angustivalvus Starý 1959: 239

Material examined. Serbia, Kopaonik, 2 VII 2000, 1 female reared from Nasonovia sp. on Hieracium sp., 5 VII 2000, 1 female reared from Nasonovia sp. on Hieracium sp.; 17 VII 2013, 1 female, 1 male, reared from Nasonovia pilosellae on Hieracium aurantiacum; 6 females, 2 males, reared from Nasonovia sp. on Hieracium pilosella; 2 females reared from Nasonovia ribisnigri on Hieracium sp.; Czech Republic, 2005, 2 females reared from Nasonovia sp. on Hieracium sp.; 2 females reared from Nasonovia sp. on Hieracium sp.; Montenegro, Pljevlja, Dragaši, 21 VII 2017, 1 female reared from Nasonovia sp. on Hieracium pilosella; Slovenia, Vogel, 17 VII 2014, 41 females, 14 males, reared from Nasonovia sp. on Hieracium murorum.

Female. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to 0.2 of longitudinal eye diameter. Tentorial index 0.3. Clypeus oval with 5 setae. Maxillary palps with four palpomeres, labial palps with two palpomeres. Antenna with 14–15 antennomeres, filiform, setae on flagellomeres semierect, subequal to half of flagellomere diameter. Flagellomere 1 (F1) about 4.7 (4.3–5.1)× as long as wide, without longitudinal placodes. F2 3.4× as long as wide, without longitudinal placodes. F3, F4 and F5 with 1, 1–4 and 4–5 longitudinal placodes, respectively. F1 1.3× longer than F2.

Mesosoma. Notaulices incomplete, visible in anterior part of mesoscutum. Dorsal surface of mesoscutum sparsely setose. Head width/mesoscutum width ratio 1.3. Propodeum without a central areola, with two postmedian carinae at the base (Fig. 7b).

Fore wing (Fig. 8b). Wing length about 1.8 (1.7–1.9) mm, width 0.7 mm. Stigma narrow, about 4.8 (4.4–5.4)× as long as wide and about 3.3 (2.9–4)× as long as distal abscissa of R1. Vein m-cu visible only in first third, remainder colourless or completely absent. Vein 2RS visible only in first half. Veins r and 3RS distinct, 3RS short.

Metasoma. Petiole 1.8× as long as wide at spiracles. Dorsal disc of petiole smooth, with 2–4 long setae on each side. Ovipositor sheath needle shaped, only slightly widened ventrally. Ovipositor sheath length/width ratio 4.8 (Fig. 9b).


Male. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to 0.3 of longitudinal eye diameter.
Tentorial index 0.5. Clypeus oval with 5–6 setae. Maxillary palps with four palpomeres, labial palps with two palpomeres. Antenna with 17 antennomeres, filiform, setae on flagellomeres semierect, subequal to half of flagellomere diameter. Flagellomere 1 (F1) about 2.2 (2.1–2.3)× as long as wide, with 7 longitudinal placodes. F2 1.9× as long as wide, with 7 longitudinal placodes. F3, F4 and F5 with 7, 6 and 5 longitudinal placodes, respectively. F1 1.1× longer than F2.

Mesosoma. Notaulices incomplete, visible only in anterior part of mesoscutum. Dorsal surface of mesoscutum sparsely setose. Head width/mesoscutum width ratio 1.3. Propodeum without a central areola, with two postmedian carinae at the base.

Fore wing. Wing length 2 mm, width 0.8 mm. Stigma narrow, 4.4× as long as wide and 2.6× as long as distal abscissa of R1. Vein m-cu visible only in first third, remainder colourless or completely absent. Vein 2RS visible only in first half, sometimes completely absent. Veins r and 3RS distinct, 3RS short.

Metasoma. Petiole 1.6× as long as wide at spiracles. Dorsal disc of petiole smooth, with 1–3 long setae on each side.


Host: *Nasonovia* spp. on *Hieracium* spp.

**Distribution.** West Palaearctic

### Monoctonus caricis (Haliday 1833)
(Figs 7c, 8c, 9c)

*Aphidius* (*Monoctonus*) *caricis* Haliday 1833: 261, 488.

**Material examined.** Canada, British Columbia, Gulf Islands National Park Reserve, 23 VII 2012, 2 females, 1 male; Langley, James Kennedy Elementary, 2 X 2015, 1 male; Victoria, Pacific Forestry Centre, 11 VIII 2014, 1 female.

Female. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to 0.2 of longitudinal eye diameter. Tentorial index 0.3. Clypeus oval with 7 setae. Maxillary palps with four palpomeres, labial palps with two palpomeres. Antenna with 13 antennomeres, filiform, setae on flagellomeres semierect, subequal to half of flagellomere diameter. Flagellomere 1 (F1) about 3.6 (3.3–3.7)× as long as wide, without longitudinal placodes. F2 about 3 (2.6–3.3)× as long as wide, without longitudinal placodes. F3, F4 and F5 with 1–3, 1 and 1–2 longitudinal placodes, respectively. F1 length equal to F2.

Mesosoma. Notaulices incomplete, visible in anterior third of mesoscutum. Dorsal surface of mesoscutum sparsely setose. Head width/mesoscutum width ratio 1.5. Propodeum areolated, with narrow central pentagonal areola (Fig. 7c).

Fore wing (Fig. 8c). Wing length 1.4 mm, width 0.5 mm. Stigma narrow, about 7.6 (7.3–7.8)× as long as wide and about 3.2 (3–3.4)× as long as distal abscissa of R1. Vein m-cu visible only in first third, vein 2RS not visible. Veins r and 3RS distinct, 3RS sometimes colourless.

Metasoma. Petiole 2× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with 4–5 long setae on each side. Ovipositor sheath ploughshare shaped. Ovipositor sheath length/width ratio 3 (Fig. 9c).

Colour. Head brown, eyes black, mouthparts light brown. Scapus, pedicel, F1, and F2 yellow, remainder of antenna brown. Mesonotum, propodeum and legs brown. Wings hyaline with brown venation. Petiole and rest of metasoma brown, ovipositor sheath light brown to brown. Body length 1.7 mm.

Male. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to 0.2 of longitudinal eye diameter. Tentorial index 0.4. Clypeus oval with 6 setae. Maxillary palps with four palpomeres, labial palps with two palpomeres. Antenna with 16–17 antennomeres, filiform, setae on flagellomeres semierect, subequal to half of flagellomere diameter. Flagellomere 1 (F1) 2.6× as long as wide, with 4 longitudinal placodes. F2 2.2× as long as wide, with 4 longitudinal placodes. F3, F4 and F5 all with 6 longitudinal placodes. F1 length equal to F2.

Mesosoma. Notaulices incomplete, visible only in anterior part of mesoscutum. Dorsal surface of mesoscutum sparsely setose. Head width/mesoscutum width ratio 1.3. Propodeum areolated, with narrow central pentagonal areola.
Fore wing. Wing length 1.7 mm, width 0.6 mm. Stigma narrow, about 8.4 (7.9–8.9)× as long as wide and about 2.6 (2.5–2.7)× as long as distal abscissa of R1. Vein m-cu visible in first third, second third colourless, last third effaced. 2RS absent. Veins r and 3RS distinct.

Metasoma. Petiole 1.8× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with 3–4 long setae on each side.


Hosts: *Rhopalosiphum padi* on *Zea mays*; *Sitobion fragariae* on *Holcus mollis*; *Sitobion* sp. on *Triticum* sp.; *Hyalopteroides humilis* (Walker) on *Dactylis glomerata*; *Macrosiphum equiseti* (Holman) on *Equisetum sylvaticum*.

Distribution. West Palaearctic and Nearctic

### Monoctonus crepidis (Haliday 1834)

(Figs 7d, 8d, 9d)

*Aphidius crepidis* Haliday 1834: 94

**Material examined.** Serbia, Vlasina, 11 VIII 2006, 3 females, 2 males, unknown aphid from *Hieracium* sp.; Vlasina-Cemernik, 12 VIII 2006, 2 females, 2 males, reared from *Nasonovia* sp. on *Hieracium* sp.; 4 VIII 2011, 25 females, 10 males, unknown aphid on *Hieracium pilosella*; Stara planina-Babin zub, 4 IV 2010, 19 females, 16 males, unknown aphid from *Hieracium* sp., 7 VII 2010, 84 females, 28 males, reared from *Nasonovia ribisnigri* (Mosley) on *Crepis* sp.; Kopaonik, 14 VII 1988, 1 female, unknown aphid host and plant; 27 VII 2010, 24 females, 18 males, reared from *Nasonovia* sp. on *Crepis* sp.; 42 females, 11 males, reared from *Nasonovia* sp. on *Hieracium* sp.; 17 VII 2013, 17 females, 9 males, reared from *Nasonovia ribisnigri* on *Hieracium pilosella*; 9 females, 1 male, reared from *Nasonovia ribisnigri* on *Hieracium* sp.; 41 females and males, reared from *Nasonovia pilosella* (Börner) on *Hieracium aurantiacum*; 5 females, 4 males, reared from *Nasonovia* sp. on *Hieracium pilosella*; 6 females reared from *Nasonovia* sp. on *Lapsana communis*; Kopaonik-Kriva reka, 7 VIII 2011, 2 females, 2 males, reared from *Nasonovia ribisnigri* on *Hieracium pilosella*; Kras-Adžine livade, 1 VI 2011, 152 females, 38 males, reared from *Nasonovia* sp. on *Hieracium murorum*; Golija, Jankov kamen, 11 VII 2011, 7 females, 4 males, reared from *Nasonovia* sp. on *Hieracium pilosella*; 6 females reared from *Nasonovia* sp. on *Hieracium pilosella*; 17 VII 2013, 17 females, 9 males, reared from *Nasonovia ribisnigri* on *Hieracium pilosella*; 9 females, 1 male, reared from *Nasonovia ribisnigri* on *Hieracium* sp.; 41 females and males, reared from *Nasonovia pilosella* (Börner) on *Hieracium aurantiacum*; 5 females, 4 males, reared from *Nasonovia* sp. on *Hieracium pilosella*; 6 females reared from *Nasonovia* sp. on *Hieracium pilosella*; 1 female, unknown aphid from *Hieracium* sp., 7 VII 2010, 19 females, 16 males, reared from *Nasonovia ribisnigri* on *Hieracium pilosella*; 6 females reared from *Nasonovia* sp. on *Hieracium pilosella*; 100 females and males reared from *Nasonovia ribisnigri* on *Hieracium pilosella*; 5 females, 4 males, reared from *Nasonovia* sp. on *Hieracium pilosella*; 6 females reared from *Nasonovia* sp. on *Hieracium pilosella*; Nova Varoš, 7 VII 2013, 200 females and males, reared from mixed colony of *Hyperomyzus picridis* (Börner & Blunck) and *Nasonovia* sp. on *Picris hieracioides*; Montenegro, Škrka, 7 VIII 2005, 2 females reared from *Nasonovia* sp. on *Hieracium* sp.; Andrijevica, 22 VII 2012, 10 females, 3 males, reared from *Nasonovia* sp. on *Hieracium* sp.; Durmitor-Crnj jezero, 10 VII 2013, 100 females and males reared from *Nasonovia ribisnigri* on *Hieracium* sp.; Komovi, 9 VII 2013, 5 females, 2 males, reared from *Nasonovia* sp. on *Hieracium* sp.; Pljevlja, Dragaši, 21 VII 2017, 27 females, 26 males, reared from *Nasonovia* sp. on *Hieracium pilosella*; 6 females reared from *Nasonovia* sp. on *Hieracium pilosella*; Ljubišnja, Jabučno, 22 VII 2017, 2 females, 1 male, reared from *Nasonovia* sp. on *Hieracium pilosella*.

**Female.** Head. Eyes oval, medium sized, sparsely setose. Malar space equal to 0.2 of longitudinal eye diameter. Tentorial index 0.2. Clypeus oval with 4–5 setae. Maxillary palps with four palpomeres, labial palps with three palpomeres. Antenna with 13 antennomeres, filiform, setae on flagellomeres semierect, subequal to flagellomere diameter. Flagellomere 1 (F1) about 3.2 (2.4–4.1)× as long as wide, with 0–2 longitudinal placodes. F2 about 2.6 (2.2–3.8)× as long as wide, with 1–4 longitudinal placodes. F3, F4 and F5 with 2–5, 1–4 and 2–4 longitudinal placodes, respectively. F1 about 1.2 (1.1–1.4)× longer than F2.

Mesosoma. Mesocutum without notaulices, dorsal surface sometimes with two irregular longitudinal rows of setae. Head width/mesocutum width ratio 1.3. Propodeum areolated, with wide central pentagonal areola (Fig. 7d).

Fore wing (Fig. 8d). Wing length about 2 (1.7–2.1) mm, width about 0.8 (0.7–0.9) mm. Stigma narrow, about 5.3 (4.8–6)× as long as wide and about 3.2 (2.2–4.6)× as long as distal abscissa of R1. Veins m-cu and 2RS visible, second half of both veins sometimes colourless. Veins r and 3RS distinct.

Metasoma. Petiole about 1.9 (1.7–2.1)× as long as wide at spiracles. Dorsal disc of petiole rugose, with 3–6 long setae on each side. Ovipositor sheath distinctly ploughshare shaped. Ovipositor sheath length/width ratio about 2.4 (2.3–2.5) (Fig. 9d).
Colour. Head brown, eyes black, mouthparts yellow. Scapus and pedicel brown, F1 brown with a yellow narrow ring at the base, remainder of antenna brown. Mesonotum brown, propodeum and legs light brown. Wings hyaline with brown venation. Petiole and rest of metasoma brown, ovipositor sheath yellow to light brown. Body length 2.3 mm.

Male. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to about 0.3 of longitudinal eye diameter. Tentorial index 0.4. Clypeus oval with 9–10 setae. Maxillary palps with four palpomeres, labial palps with three palpomeres. Antenna with 15–16 antennomeres, filiform, setae on flagellomeres semierect, subequal to flagellomere diameter. Flagellomere 1 (F1) about 2.2 (1.9–2.3)× as long as wide, with 4–9 longitudinal placodes. F2 about 1.9 (1.7–2)× as long as wide, with 5–8 longitudinal placodes. F3, F4 and F5 with 4–7, 3–7 and 3–8 longitudinal placodes, respectively. F1 1.1× longer than F2.

Mesosoma. Mesoscutum mostly without notaulices (if present, notaulices incomplete and visible only in anterior part), scarcely setose in lower half. Head width/mesoscutum width ratio 1.2. Propodeum areolated, with wide central pentagonal areola.

Fore wing. Wing length about 1.9 (1.8–2) mm, width about 0.8 (0.78–0.9) mm. Stigma narrow, about 4.5 (4–5)× as long as wide and about 2.9 (2.5–3.3)× as long as distal abscissa of R1. Veins m-cu and 2RS visible, second half of 2RS sometimes colourless, in rare cases 2RS completely absent. Veins r and 3RS distinct.

Metasoma. Petiole about 1.9 (1.7–1.9)× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with 4–6 long setae on each side.


Hosts: Hyperomyzus hieracii (Börner) on Hieracium sp.; Nasonovia pilosellae on Hieracium pilosella; Nasonovia ribisnigri on Hieracium hoppeanum, H. pilosella; Nasonovia sp. on Cichorium alpine, C. intybus, Hieracium guentheri-becki, H. murorum, H. pilosella, H. pseudobifidum, Lapsana communis.

Distribution. Holarctic.

**Monoctonus cerasi** group
(Figs 7e, f, 8e, f, 9e, f)

*Aphidius cerasi* Marshall 1896: 607–608

**Note:** Specimens identified as *M. ligustri* and *M. mali* correspond to the original description of *M. cerasi* morphologically and do not differ from each other. However, since we have not examined holotypes of those species, we refrain from synonymising them at this time and provide a redescription of the *M. cerasi* group s.s., based on specimens identified as *M. ligustri* and *M. mali*.

**Material examined.** Serbia, Surčin, 6 V 2006, 1 male reared from *Myzus ligustri* (Mosley) on *Ligustrum vulgare*; Slanci, 8 V 2007, 2 females reared from *Myzus ligustri* on *Ligustrum vulgare*; Kragujevac, 2 V 2017, 1 female reared from *Myzus ligustri* on *Ligustrum vulgare*; Gornji Milanovac, Savinac, 9 IV 2017, 1 female, 1 male, reared from *Myzus ligustri* on *Ligustrum vulgare*; Ljig, Ivanovci, 1 male reared from *Myzus ligustri* on *Ligustrum vulgare*; Surčin, 11 V 2017, 38 females, 12 males reared from *Myzus ligustri* on *Ligustrum vulgare*; Šar planina, Brezovica, 20 VII 1995, 1 female reared from *Dysaphis* sp. on *Malus domestica*; Zemun, 22 IV 2014, 2 males reared from *Dysaphis devecta* (Walker) on *Malus* sp; Serbija, Surčin, 6 X 2011, 5 females, 2 males, reared from *Rhopalosiphum insertum* on *Crataegus sp*; Serbia, Surčin, 11 V 2017, 38 females, 12 males reared from *Myzus ligustri* on *Ligustrum vulgare*; Šar planina, Brezovica, 20 VII 1995, 1 female reared from *Dysaphis* sp. on *Malus domestica*; Zemun, 22 IV 2014, 2 males reared from *Dysaphis devecta* (Walker) on *Malus* sp; Prokuplje, Gornja Konjuša, 1 female, 1 male, reared from *Aphis pomi* De Geer on *Malus domestica*; Lebane, Konjino, 1 female, unknown aphid from *Pyrus communis*; Slovenia, Ljubljana, 10 IV 2012, 14 females, 7 males, reared from unknown aphid on *Crataegus nigra*; 1 male reared from *Dysaphis* sp. on *Pyrus communis*; Russia, St. Petersburg, 6 X 2011, 5 females, 2 males, reared from *Rhopalosiphum insertum* on *Crataegus sp*; Wales, Cardiff Bay, April 2011, 1 female reared from *Rhopalosiphum padi* on *Prunus padus*.

Female. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to 0.2 of longitudinal eye diameter. Tentorial index about 0.5 (ranging from 0.4–0.6). Clypeus oval with 7–10 setae. Maxillary palps with four palpomeres, labial palps with three palpomeres. Antenna with 13 antennomeres, filiform, setae on flagellomeres semierect, subequal to flagellomere diameter. Flagellomere 1 (F1) about 3.5 (2.9–4.2)× as long as wide, without longitudinal placodes. F2 about 2.6 (2.4–3)× as long as wide, with 0–5 longitudinal placodes. F3, F4 and F5 with 1–5, 3–7 and 2–4 longitudinal placodes, respectively. F1 length equal to F2.
Mesosoma. Mesoscutum without notaulices, dorsal surface scarcely setose. Head width/mesoscutum width ratio 1.4. Propodeum areolated, with narrow central pentagonal areola (Fig. 7g).

Fore wing (Fig. 8g). Wing length about 1.8 (1.7–1.9) mm, width about 0.8 (0.7–0.9) mm. Stigma about 4.8 (4.3–5.2)× as long as wide and about 2.7 (2.5–3.1)× as long as distal abscissa of R1. Veins m-cu and 2RS absent. Veins r and 3RS distinct.

Metasoma. Petiole about 2.1× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with 3–5 long setae on each side. Ovipositor sheath distinctly ploughshare shaped. Ovipositor sheath length/width ratio about 1.3. Propodeum areolated, with narrow central pentagonal areola.

Material examined. Montenegro, Durmitor, Mali Meded, 16 VII 2000, 6 VII 1998, 2 females, 1 male, reared from Acyrthosiphon malvae (Mosley) on Salix retusa; 17 VII 2000, 1 female, 2 males reared from Acyrthosiphon malvae on Salix retusa; Czech Republic, Bohemia, Jablonec, 28 VIII 1959, 1 female reared from unknown plant and aphid host; Techobuz, 5 IX 2013, 1 female and 1 male reared from Impatiens balsamines (Kaltenbach) on Impatiens noli tangere.

Female. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to 0.2 of longitudinal eye diameter. Tentorial index 0.2. Clypeus oval with 9–10 setae. Maxillary palps with four palpomeres, labial palps with three palpomeres. Antenna with 15–17 antennomeres, filiform, setae on flagellomeres semierect, subequal to segment diameter. Flagellomere 1 (F1) about 4 (3.4–4.3)× as long as wide, without longitudinal placodes. F2 about 3.4 (2.5–3.7)× as long as wide, with 1 longitudinal placode. F3, F4 and F5 with 2, 2–3 and 2–3 longitudinal placodes, respectively. F1 length equal to F2.

Mesosoma. Notaulices on mesoscutum sometimes absent, sometimes barely visible in anterior part. Dorsal surface of mesoscutum sparsely setose; sometimes with two longitudinal rows of setae. Head width/mesoscutum width ratio 1.3. Propodeum areolated, with moderately narrow central pentagonal areola (Fig. 7g).

Fore wing (Fig. 8g). Wing length about 2.1× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with one irregular median carina and with 3–5 long setae on each side. Ovipositor sheath distinctly ploughshare shaped. Ovipositor sheath length/width ratio about 2.4 (2.1–2.9) (Fig. 9e, f).


Monoctonus nervosus (Haliday 1833)
(Figs 7g, 8g, 9g)

Aphidius (Monoctonus) nervosus Haliday 1833: 488

Material examined. Montenegro, Durmitor, Mali Meded, 16 VII 2000, 6 VII 1998, 2 females, 1 male, reared from Acyrthosiphon malvae (Mosley) on Salix retusa; 17 VII 2000, 1 female, 2 males reared from Acyrthosiphon malvae on Salix retusa; Czech Republic, Bohemia, Jablonec, 28 VIII 1959, 1 female reared from unknown plant and aphid host; Techobuz, 5 IX 2013, 1 female and 1 male reared from Impatiens balsamines (Kaltenbach) on Impatiens noli tangere.

Hosts: Myzus cerasi (Fabricius) on Prunus avium; Myzus ligustri on Ligustrum sp.; Rhopalosiphum insertum on Crataegus sp., Malus domestica, Pyrus communis; Rhopalosiphum padi on Prunus padus; Dysaphis sp. on Malus domestica, Pyrus communis.

Distribution. West Palaearctic
6.4 (6.1–6.7)× as long as wide and about 2 (1.8–2.3)× as long as distal abscissa of R1. Veins m-cu and 2RS visible. Veins r and 3RS distinct.

Metasoma. Petiole 2.2× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with 8–9 long setae on each side. Ovipositor sheath distinctly ploughshare shaped. Ovipositor sheath length/width ratio about 2.7 (2.6–2.8) (Fig. 9g).


Male. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to 0.3 of longitudinal eye diameter. Tentorial index 0.4. Clypeus oval with 6–10 setae. Maxillary palps with four palpomeres, labial palps with three palpomeres. Antenna with 17–19 antennomeres, filiform, setae on flagellomeres semierect, subequal to flagellomere diameter. Flagellomere 1 (F1) about 2.4 (2.3–2.5)× as long as wide, with 6–7 longitudinal placodes. F2 about 2.3 (2.1–2.5)× as long as wide, with 4–7 longitudinal placodes. F3, F4 and F5 with 4–5, 4–8 and 5–6 longitudinal placodes, respectively. F1 length equal to F2.


Fore wing. Wing length about 2.4 (2.1–2.5) mm, width about 0.9 (0.8–1) mm. Stigma narrow, about 6 (5.8–6.2)× as long as wide and about 2.4 (2.2–2.7)× as long as distal abscissa of R1. Veins m-cu and 2RS visible. Veins r and 3RS distinct.

Metasoma. Petiole 2.2× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with 6–7 long setae on each side.


Hosts: Impatientinum balsamines on Impatiens noli-tangere; Acrystosiphon malvae on Salix retusa, Geranium caeruleatum.

Distribution. Palaearctic

Monoctonus paulensis (Ashmead, 1902)
(Figs 7h, 8h, 9h)

Aphidius paulensis Ashmead 1902: 246

Material examined. Canada, Alberta, Jasper National Park, 21 VII 2012, 1 female, Malaise trap; Waterton Lakes National Park, 27 VI 2012, 1 male, Malaise trap; British Columbia, Abbotsford, 9 VI 2005, 1 female reared from Myzus persicae (Sulzer) on Capsicum annuum; 10 VI 2005, 1 female reared from Myzus persicae on Capsicum annuum; 12 VI 2005, 3 females reared from Myzus persicae on Capsicum annuum; 13 VI 2005, 1 female reared from Myzus persicae on Capsicum annuum; 12 VII 2005, 2 females reared from Aulacorthum solani (Kaltenbach) on Capsicum annuum; Gulf Islands National Park Reserve, 6 VII 2012, 1 male, Malaise trap; Glacier National Park, 6 VIII 2014, 1 female, Malaise trap; Manson Landing, 30 IX 2016, 1 female, Malaise trap; Newfoundland and Labrador, Gros Morne National Park, 17 IX 2013, 1 female, Malaise trap; Northwest Territories, 13 VIII 2014, 1 male, Malaise trap; USA, Alaska, Amatignak, 10 VI—1 IX 2008, 1 female from Malaise trap on Leymus sp.; Little Sitkin, 9 VI—1 IX 2008, 1 female from Malaise trap on Leymus sp.

Female. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to 0.3 of longitudinal eye diameter. Tentorial index 0.3. Clypeus oval with 8–9 setae. Maxillary palps with four palpomeres, labial palps with three palpomeres. Antenna with 15–16 antennomeres, filiform, setae on flagellomeres semierect, subequal to flagellomere diameter. Flagellomere 1 (F1) about 4 (3.6–4.7)× as long as wide, without longitudinal placodes. F2 about 3.3 (2.7–3.7)× as long as wide, with 0–1 longitudinal placode. F3, F4 and F5 with 0–2, 1–3 and 0–2 longitudinal placodes, respectively. F1 length equal to F2.
FIGURE 7. Propodeum, females. a—F. pseudoplatani; b—H. angustivalva; c—M. caricis; d—M. crepidis; e—M. ligustri; f—M. mali; g—M. nervosus; h—M. paulensis.

Mesosoma. Notaulices on mesoscutum sometimes absent, sometimes barely visible in anterior part. Dorsal surface of mesoscutum sparsely setose; sometimes with two longitudinal rows of setae. Head width/mesoscutum width ratio 1.5. Propodeum areolated, with moderately narrow central pentagonal areola (Fig. 7h).

Fore wing (Fig. 8h). Wing length about 1.9 (1.7–2.1) mm, width about 0.7 (0.6–0.8) mm. Stigma narrow, about 6.4 (5.5–7.9)× as long as wide and about 2.5 (2.1–3)× as long as distal abscissa of R1. Veins m-cu and 2RS visible, both sometimes colourless in second half or missing completely. Veins r and 3RS distinct.

Metasoma. Petiole about 2.1 (1.7–2.3)× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with 6–9 long setae on each side. Ovipositor sheath distinctly ploughshare shaped. Ovipositor sheath length/width ratio about 2.7 (2.1–2.9) (Fig. 9h).

Colour. Head brown, eyes black, mouthparts light brown. Scapus and pedicel brown, F1 with a narrow basal ring or first half yellow, remainder of antenna brown. Mesonotum, propodeum and legs brown. Wings hyaline with brown venation. Petiole and rest of metasoma brown, ovipositor sheath light brown to brown. Body length 2.5 mm.

Male. Head. Eyes oval, medium sized, sparsely setose. Malar space equal to 0.3 of longitudinal eye diameter. Tentorial index 0.4. Clypeus oval with 9–10 setae. Maxillary palps with four palpomeres, labial palps with three palpomeres. Antenna with 18 antennomeres, filiform, setae on flagellomeres semierect, subequal to flagellomere diameter. Flagellomere 1 (F1) about 2.4 (2.3–2.5)× as long as wide, with 4–9 longitudinal placodes. F2 about 2.5 (2.2–2.6)× as long as wide, with 4–9 longitudinal placodes. F3, F4 and F5 with 4–9, 5–8 and 4–8 longitudinal placodes, respectively. F1 length subequal to F2.

Mesosoma. Mesoscutum without notaulices, scarcely setose in lower half. Head width/mesoscutum width ratio 0.8. Propodeum areolated, with moderately narrow central pentagonal areola.

Fore wing. Wing length 2.2 mm, width about 0.9 (0.9–1) mm. Stigma narrow, about 6.6 (6.4–6.7)× as long as wide and about 2.5 (2.1–2.8)× as long as distal abscissa of R1. Veins m-cu and 2RS visible, 2RS sometimes colourless in second half. Veins r and 3RS distinct.

Metasoma. Petiole about 2.1 (2–2.3)× as long as wide at spiracles. Dorsal disc of petiole moderately rugose, with one irregular carina medially and with 5–6 long setae on each side.

**Hosts:** Acyrthosiphon pisum (Harris), Amphorophora rubitoxica, Illinoa grindeliae (Williams), I. liriodendri (Monell), Macrosiphum californicum (Clarke), M. euphorbiae (Thomas), Myzus ornatus Laing, M. persicae, Rho-palosiphum padi, Sitobion fragariae.

**Distribution.** Nearctic

Revision of the genus Monoctonia Starý with a description of a new species and redescriptions of known species is given in Rakhshani *et al.* (2015).

![FIGURE 8. Fore wing, females. a—F. pseudoplatani; b—H. angustivalva; c—M. caricis; d—M. crepidis; e—M. ligustri; f—M. mali; g—M. nervosus; h—M. paulensis.](image)

**Monoctonia pistaciaecola** Starý 1962

*Monoctonia pistaciaecola* Starý 1962: 875–877

**Material examined.** Female paratype (and allotype), Former USSR, Yalta, southern Crimea, Nikitsky Botanical...
Garden, 08 VI 1949, reared from Forda hirsuta mordwilkoi Börner on Pistacia, leg. Rubtzov; Spain, San Juan de Paluezas, 28 VII 2011, 3 females reared from Geoica utricularia (Passerini) on Pistacia terebinthus.

**FIGURE 9.** Ovipositor sheaths. a—F. pseudoplatani; b—H. angustivalva; c—M. caricis; d—M. crepidis; e—M. ligustri; f—M. mali; g—M. nervosus; h—M. paulensis.

**Monoctonia japonica** Rakhshani & Tomanović 2015

*Monoctonia vesicaria* Tremblay 1991: 137–142

Monoctonia vesicarii Tremblay 1991


Key for identification of species of Monoctonina based on females

Note: the key is based on material that has been examined by the authors. Genera Boreogalba and Quadrictonus were not available for examination and are not included in the analysis; for descriptions see Mackauer (1962) and Starý & Remaudiére (1982).

1. Propodeum without central areola, only with two postmedian carinae at the base (Fig. 7b); ovipositor sheath needle shaped (Fig. 9b). .......................... Harkeria angustivalva  
   - Propodeum with a central pentagonal areola (Figs. 2e, 3e, 4e, 5e, 6e, 7a, c–h); ovipositor sheath gradually widened ventrally or distinctly ploughshare shaped. .......................... 2
2. Pterostigma triangular, length/width ratio 2–2.7; petiole subquadrate, length/width ratio 1–1.2; parasitoids of gall-forming aphids .......................... 3
   - Pterostigma narrow, length/width ratio higher than 3; petiole elongated, length/width ratio 2 or higher; parasitoids of Aphidini, Macrosiphini and Drepanosiphinae .......................... 5
3. Antenna with 12–13 antennomeres; parasitoids of Fordini on Pistacia spp. .......................... Monoctonia pistoriaecola  
   - Antenna with 16 (17) antennomeres; parasitoids of Pemphigus spp. on Populus spp. .......................... 4
4. F1 2.10–2.30× as long as wide; F2 with 3–4 longitudinal placodes .......................... Monoctonia japonica  
   - F1 1.75–2.00× as long as wide; F2 with 1 longitudinal placode .......................... Monoctonia vesicarii  
5. Large median cell of fore wing closed basally, veins m-cu and 2RS distinct, sometimes colourless in part (Figs. 2h, 3h, 4h, 6h, 8a, d, g, h) .......................... 6
   - Large median cell of fore wing not closed basally, veins m-cu and 2RS absent (Figs. 5h, 8b, c, e, f) .......................... 15
6. Vein 3RS distinctly longer than vein r, almost twice as long (Fig. 8a); parasitoids of Drepanosiphum platanoidis on Acer spp. .......................... Faliciconus pseudoplataani  
   - Vein 3RS only slightly longer, equal to or shorter than vein r; parasitoids of Aphidini and Macrosiphini .......................... 7
7. Ovipositor sheath only slightly widened ventrally, length/width ratio 4.1 .......................... Monoctonus allisoni  
   - Ovipositor sheath moderately to distinctly ploughshare shaped (Figs. 2h, 3h, 4h, 6h, 9d, g, h), length/width ratio lower than 4 .......................... 8
8. Antenna with 18 antennomeres; labial palps with 1 palpomere .......................... Monoctonia parvipalpus sp. n.  
   - Antenna with 17 or fewer antennomeres; labial palps with 2 or 3 palpomeres .......................... 9
9. Petiole length/width ratio 2.5; ovipositor sheath length/width ratio 3.5 .......................... Monoctonus canadensis sp. n.  
   - Petiole length/width ratio 2.3 or lower; ovipositor sheath length/width ratio 3.2 or lower .......................... 10
10. Ovipositor sheath ploughshare shaped, length/width ratio 2.9–3.1 .......................... 11
   - Ovipositor sheath distinctly ploughshare shaped, length/width ratio lower than 2.7 .......................... 13
11. Labial palps with 3 palpomeres; F1 length/width ratio 4.3–4.5 .......................... 12
   - Labial palps with 2 palpomeres; F1 length/width ratio 3.6–3.8 .......................... Monoctonus ineptatus sp. n.  
12. Pterostigma length/R1 length ratio about 2.8; F1 yellow only at base, remainder of F1 brown .......................... Monoctonus leclanti  
   - Pterostigma length/R1 length ratio 4.8–5; F1 mostly yellow, only apex brown .......................... Monoctonus brachyradius sp. n.  
13. Antenna with 13 antennomeres; central pentagonal areola of propodeum wide (Fig. 7d) .......................... Monoctonus crepids  
   - Antenna with 14–16 antennomeres; central pentagonal areola of propodeum narrow (Fig. 7g, h) .......................... 14
14. Antenna with 14 antennomeres; labial palps with 2 palpomeres .......................... Monoctonus washingtonensis  
   - Antenna with 15–16 antennomeres; labial palps with 3 palpomeres .......................... Monoctonus luteus sp. n.  
15. Antenna with 16 antennomeres; ovipositor sheath only slightly widened ventrally (Fig. 4g), length/width ratio 4.2 .......................... Monoctonus paulensis  
   - Antenna with 13 antennomeres; ovipositor sheath ploughshare shaped or distinctly ploughshare shaped (Fig. 9c, e, f), length/width ratio 2–3 .......................... 16
16. Vein m-cu visible in basal third (Fig. 8c); labial palps with 2 palpomeres; ovipositor sheath ploughshare shaped (Fig. 9c), length/width ratio 3 .......................... Monoctonus caricos  
   - Vein m-cu completely absent (Fig. 8e, f); labial palps with 3 palpomeres; ovipositor sheath distinctly ploughshare shaped (Fig. 9e, f), length/width ratio 2.4 .......................... Monoctonus cerasi group (M. cerasi, M. mali, M. ligustri)
Discussion

Monoctonina is one of the least studied subtribes within the Aphidiinae. Many of its component species are known only as type material or from a small number of specimens, reflecting, at least in part, their low importance as biological control agents. Most Monoctonina species are found in high montane or cold temperate forest ecosystems where they parasitize one or a few closely related aphid species. Because most of their aphid hosts are not pests of cultivated plants, these parasitoids are rarely employed in biological control [except for failed attempts with *M. nervosus* against *S. avenae* (Fabricius) (Starý 1993)]. Additionally, species descriptions are very diverse in terms of the morphological characters used in literature. There is sole revision (Van Achterberg 1989), which mainly considered European species by using morphological characters that are not commonly analysed in other Aphidiinae. All of this, coupled with the limited availability of identification keys (Van Achterberg 1989; Tomanović *et al.* 2007a) has left members of the Monoctonina as virtually unknown and enigmatic. The first effort to clarify the species status and identification of some Monoctonina species was taken by Rakhshani *et al.* (2015) who published a revision of the genus *Monoctonina*. The current study extends this work by revising the whole subtribe based on the analysis of morphological characters which are commonly used to identify Aphidiinae (Tomanović *et al.* 2006, 2007b).

Most morphological characters used to distinguish species of Aphidiinae vary to some degree in Monoctonina, so it is important to take multiple morphological characters into account when identifying species. The shape of ovipositor sheath is sufficient to differentiate members of Monoctonina from other Aphidiinae and as such is clearly an apomorphic character. However, the shape of ovipositor sheaths alone is not a clear discriminator of Monoctonina species. Our findings indicate that the subtribe can be divided into four groups, based on the shape of female genitalia (for identification purposes only, not as a reflection of their relationships). The first group includes species with very slender, only slightly widened ovipositor sheath (length/width ratio 4.2–4.8), i.e. *H. angustivalva, F. pseudoplatus* and *M. luteus*. The second group includes species with moderately widened ovipositor sheath (length/width ratio 3.5–3.6) and it contains *M. canadensis* and *M. parvipalpus*. The third group, represented with species with ploughshare-shaped ovipositor sheath (length/width ratio 2.9–3.1), consists of *M. inexpectatus, M. brachyradius, M. caricis* and *M. leclanti*. Finally, the fourth group contains species with distinctly ploughshare-shaped ovipositor sheath (length/width ratio 1.8–2.7), namely *M. nervosus, M. paulensis, M. crepisidis, M. cerasi* group, *M. washingtononis, Monoctonia pistaciaecola, M. japonica* and *M. vesicarii*. Within each group, relevant taxonomic characters (number of flagellomere, fore wing venation, number of palpomeres in maxillary and labial palps, etc.) vary to some extent. As Starý (1976) notes, when drawing conclusions about the phylogeny and evolution of Monoctonina, the shape of the ovipositor sheath is just one character among many that should be considered.

Van Achterberg (1989) gives a division of West Palaearctic species of *Monoctonus* based on different morphological and life history parameters:

- **crepisidis** group: veins m-cu and 2RS of fore wing present; 13–14 antennal segments; parasites of aphids on herbaceous plants (*M. crepisidis* and *M. gallicus*)
- **nervosus** group (identified here as *nervosus* group s.l. for clarification purposes): veins m-cu and 2RS present or partly present; most often 16–17 antennal segments; parasites of aphids on herbaceous plants and grasses [*M. nervosus, M. caricis*, with addition of *M. leclanti* and Nearctic *M. paulensis, M. pacificus* and *M. allisoni* (Tomanović *et al.* 2002)]
- **cerasi** group: veins m-cu and 2RS completely absent; parasites of aphids on trees and shrubs (*M. cerasi, M. liguistri, M. mali*).

The addition of new species revealed by this study, and some regrouping of certain species, lead to somewhat modified groups of *Monoctonus* proposed by van Achterberg (1989):

- **crepisidis** group: *M. crepisidis, M. gallicus* and *M. washingtononis*
- **nervosus** group s.l.: *M. nervosus, M. paulensis, M. leclanti, M. allisoni, M. pacificus, M. canadensis, M. inexpectatus, M. parvipalpus*, and *M. brachyradius*.
- **caricis** group: *M. caricis, M. luteus* (not included in Van Achterberg (1989); with the description of *M. luteus*, another species with similar wing venation to *M. caricis*, we place these two species in their own group)
- **cerasi** group: *M. cerasi, M. liguistri* and *M. mali*
When it comes to *Monoctonus*, by far the most species rich genus of Monoctonina, looking at the groups based on ovipositor sheath shape, it is clear that they do not coincide with the groups based on wing venation, antennal segments, and host preferences. The *nervosus* group s.l. contains most of the species and, as such, has members with different ovipositor sheath shapes. This might suggest that those morphological similarities do not reflect phylogenetic relatedness between species.

Aside from describing five new species, this study provides some new insights about the known taxa of Monoctonina.

Van Achterberg (1989) identified *M. mali* and *M. ligustri* as different species, based on specimens previously identified as *M. cerasi*. Our analysis of morphological characters suggests that *M. ligustri* and *M. mali* represent one species with a somewhat broader host range, which includes *Dysaphis* spp., *Myzus ligustri*, and *Rhopalosipham insertum*. Analysed specimens of *M. mali* and *M. ligustri* all correspond to the original description of *M. cerasi*. *Monoctonus cerasi* was described by Marshall (1896) based on a single male specimen. Since then, it has been sporadically mentioned in literature (Evenhuis 1968; Powell 1982; Starý 1966, 1972). However, the overall status of this species remains unclear, given that there is no available description of females. Mackauer (1961b) examined the holotype of *M. cerasi* and designated specimens reared from *Myzus ligustri* and *Ovatus menthae [=O. crapegarius* (Walker)] to this species. Starý (1966) reported finding *M. cerasi* on *Myzodes ligustri* (= *Myzus ligustri*) on *Ligustrum vulgare*, which is the only known host for *Monoctonus ligustri*. Furthermore, Starý et al. (1971) recorded specimens of *M. cerasi* parasitizing *M. ligustri*, *O. crapegarius*, and *R. insertum*. Literature, host data, and our morphological analysis suggest that *M. cerasi*, *M. ligustri*, and *M. mali* represent one species. However, since we have not examined the holotypes of these species, we refrain from synonymising them and refer to them as the *M. cerasi* group s.s.

Within *Monoctonus nervosus* group s.s., *M. nervosus* was described by Haliday (1833) from the Palaearctic, while *Monoctonus paulensis* was described by Ashmead (1902) from Alaska. The two species are morphologically very similar and were thought to represent one species, but described separately from Palaearctic and Nearctic (Starý 1974). However, our results suggest that, while the two are indeed morphologically indistinguishable, they represent two very closely related species. There are a few arguments for this assumption. First, the geographic separation is evident; *M. nervosus* has been recorded in Europe and Asia, while *M. paulensis* has only been found in North America (Starý 1974). One other important argument for separation is the host range. Our findings and previous studies show that *M. nervosus* parasitizes *Impatientum balsamines*, *Acythosiphon mali* and *A. pism* (Lacatusu & Panu 1967; Starý 1974; Tomanović et al. 2007a). By contrast, *M. paulensis* parasitizes *Sitobion fragariae*, *Amphorophora rubitoxica*, *Illinoia grindeliae*, *M. californicum*, *M. euphorbiae*, *M. ornatus*, *M. persicae*, *Rhopalosipham padi* and *Acythosiphon pism* (Calvert 1973; Starý 1974). Although there is an overlap in host species in the case of *A. pism*, the inability of *M. nervosus* to establish itself as a parasitoid of *Sitobion avenae* in biological control studies (Starý 1993), together with the lack of field data on *M. nervosus* parasitizing numerous hosts of *M. paulensis*, show that leaving the two species separated might be the most adequate conclusion in light of available data.

The discovery of five new Nearctic species from a relatively well studied and economically important group such as Aphidiinae shows that, even with numerous entomology studies conducted on a regular basis, there is always need for more research efforts. Considering the evident decline in insect abundances (Hallmann et al. 2017; IPBES 2019), as well as current extinction rates (Stork 2010), additional taxonomic research is necessary.

Morphological analyses of any group of organisms are a valuable starting point for taxonomic studies, which in turn should be a cornerstone for further studies on phylogeny, ecology or applied aspects of entomology. However, to advance understanding of the evolutionary relationships among species of Monoctonina, the integration of morphological, molecular, and ecological data are essential.

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M. washingtonensis and for valuable advice in the process of writing this manuscript, Dr David Gillespie (Agassiz Research and Development Centre, Agriculture and Agri-Food Canada) for the loan of M. paulensis specimens from Canada and USA, Edward Baker (Cardiff Council Tree preservation officer, Cardiff, Wales) for the loan of specimens of M. cerasi from Wales, and Dr Elena Davidian (Russian Institute of Plant Protection, Pushkin, Russia) for the loan of specimens of M. mali from Russia.

References


https://doi.org/10.1093/aesa/66.1.28

https://doi.org/10.1080/00222930008678422

https://doi.org/10.1007/BF02309501

https://doi.org/10.1371/journal.pone.0185809


https://doi.org/10.4039/Ent941107-10


https://doi.org/10.1111/j.1365-3113.1982.tb00457.x

https://doi.org/10.11646/zootaxa.3905.4.2

https://doi.org/10.1038/nmeth.2089