

PERIPHYLLUS CALIFORNIENSIS (SHINJI, 1917) AND *TINOCALLIS SALTANS* (NEVSKY, 1929) (HEMIPTERA: APHIDIDAE), TWO ALIEN APHID SPECIES NEW TO THE FAUNA OF SERBIA

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Abstract

This paper presents two alien species of aphids new to the fauna of Serbia with details on their morphology and biology, with original photographs. *Periphyllus californiensis* (Shinji, 1917) is an invasive species that belongs to the subfamily Chaitophorinae and was found for the first time in 2021 on *Acer palmatum* Thunb. *Tinocallis saltans* (Nevsky, 1929) belongs to the subfamily Calaphidinae and was found on *Ulmus pumila* L. in 2020 and 2021. Both species were registered in Belgrade. There is now a total of 393 registered species of aphids in Serbia.

KEY WORDS: alien species, Serbia, fauna, first record, Japanese maple, elm, *Acer*, *Ulmus*

Introduction

Alien species have a negative economic and ecological impact, sometimes causing the decline or extinction of native species occupying the same ecological niche. In general, it has been calculated that the costs of damage deriving from the invasion of alien species have exceeded €100 billion between 1960 and 2020 (Haubrock *et al.*, 2021). Some of these species are pests of agricultural crops and ornamental plants. Aphids are sap-sucking insects that cause direct and indirect damage to plants. They cause the desiccation and deformation of plant tissue, and they deposit honeydew, which generates the emergence of sooty molds and also transmits plant viruses. Globalization and climate change have facilitated the movement of aphid species outside their natural habitats. Aphids and their eggs are easily introduced with their host plants. There are well-documented cases of long-distance travel by air currents, which are summarized by Loxdale *et al.* (1993). Alien aphid species are increasingly more often found in Serbia (Petrović-Obradović *et al.*,

2010; Vučetić *et al.*, 2014; Petrović-Obradović *et al.*, 2018; Petrović-Obradović *et al.*, 2021, Petrović-Obradović, 2021).

The subfamily Chaitophorinae comprises 181 species belonging to 13 genera divided into two tribes: Chaitophorini (8 genera) and Siphini (5 genera) (Favret, 2022). Members of the tribe Chaitophorini are monoecious on deciduous Salicaceae and Sapindaceae trees and shrubs, while Siphini are monoecious on monocotyledons. The genus *Periphyllus* van der Hoeven belongs to the tribe Chaitophorini and comprises 48 species, mainly Palearctic (Blackman & Eastop, 2022; Favret, 2022). There are 14 species in Europe (Blackman & Eastop, 2022). In a monograph on aphids of Serbia (Petrović-Obradović, 2003), 5 species are listed: *Periphyllus acericola* (Walker, 1848), *P. aceris* (Linnaeus, 1761), *P. hirticornis* (Walker, 1848), *P. lyropictus* (Kessler, 1886) and *P. testudinaceus* (Ferne, 1852). The species of this genus are elongate oval (pear-shaped) medium- to large-sized aphids with conspicuously long hairs. The siphunculi are stump shaped with polygonal reticulation and well-developed flange. Most of them are monoecious on *Acer*, but a few species live on *Aesculus* and one on *Koelreuteria*.

Despite its name, *P. californiensis* (Shinji, 1917) is native to East Asia. The species has been introduced to Europe, North America, Australia and New Zealand (Blackman & Eastop, 2022). In Europe, it has been recorded in England, Netherlands, Italy, Denmark, Croatia, Germany, Switzerland, Poland and Bulgaria (Stroyan, 1955, as cited in Junkiert *et al.*, 2011; Blackman & Eastop, 1994; as cited in Junkiert *et al.*, 2011; Colombo *et al.*, 1996; Heie, 1999; Gotlin *et al.*, 2002; Thieme and Eggers-Schumacher, 2003; Lampel & Meier, 2003; Junkiert & Wiczorek, 2011; Yovkova *et al.*, 2013). It is most commonly found on ornamental Asian maples, but it can also colonize native species (Blackman & Eastop, 2022).

The subfamily Calaphidinae comprises 76 genera with 411 described species and is divided into 8 tribes: Calaphidini (64 species within 17 genera), Myzocallidini (139 species within 14 genera), Panaphidini (37 species within 11 genera), Pseudochromaphidini (2 species within 2 genera), Pterocallidini (29 species within 4 genera), Saltusaphidini (60 species within 13 genera), Shivaphidini (8 species within 1 genus) and Therioaphidini (72 species within 14 genera) (Favret, 2022). They are monoecious (i.e., there is no host alternation) and are monophagous or oligophagous on trees, shrubs and herbaceous plants (Stroyan, 1977). The genus *Tinocallis* (Matsumura, 1919) belongs to the tribe Therioaphidini and comprises 20 species native to the Palearctic (Blackman & Eastop, 2022; Favret, 2022). There are 6 species in Europe (Blackman & Eastop, 2022): *Tinocallis nevskyi* Remaudière, Quednau & Heie, 1988, *T. platani* (Kaltenbach, 1843), *T. saltans* (Nevsky, 1929), *T. takachihoensis* Higuchi, 1972, *T. ulmiparvifoliae* Matsumura, 1919 and *T. zekowae* (Takahashi, 1919). In Serbia, 2 species have been found and published so far: *T. platani* (Kaltenbach, 1843) (Vučetić *et al.*, 2014) and *T. takachihoensis* (Higuchi, 1972) (Petrović-Obradović *et al.*, 2018). All viviparous females are alatae. The species are mainly associated with Ulmaceae. Members of this genus can be recognized by their narrow, slit-like secondary rhinaria and spinal finger-like tubercles on the abdomen and in some species also on the head, pronotum and mesonotum. *T. saltans* (Nevsky, 1929) is native to Central and East Asia (Blackman & Eastop, 2022) and has been introduced to North America (Halbert & Pike, 1990), South America (La Rossa *et al.*, 1990 and Naumann-Etienne & Remaudière, 1995, as cited in Blackman & Eastop, 2022) and Europe, where it is mainly found in Central and Eastern Europe (Kanturski *et al.*, 2018), and also in Spain (Perez *et al.*, 1991) and Italy (Patti & Barbagallo, 1998).

Materials and Methods

Aphids were collected with the leaves and twigs of their host plants at several different locations in Belgrade during 2018, 2020 and 2021. The aphids were fixated in 70% ethanol and kept in small plastic tubes until slide-mounting in Canada balsam. The specimens were examined using a stereomicroscope (Leica, Type:

DMLS2) and the measurements were done according to Blackman and Eastop (2021). The keys provided by Blackman & Eastop (2021); Stroyan, (1977) and Kanturski *et al.* (2018) were used for identification. The classification of Remaudière & Remaudière (1997) is followed here.

Microscopic slides were deposited in the collection of the Faculty of Agriculture, University of Belgrade, and in the private collection of the first author.

Results

The first discovery of *Periphyllus californiensis* (Shinji, 1919) occurred in New Belgrade in 2021, while *Tinocallis saltans* (Nevsky, 1929) was first found in Zemun in 2018.

***Periphyllus californiensis* (Shinji, 1917) – Californian maple aphid**

Material examined: Belgrade, New Belgrade, 15.04.2021, fundatrices and alate viviparous females on *Acer palmatum*; Belgrade, New Belgrade, 25.04.2021, fundatrices and alate viviparous females on *Acer palmatum*; Belgrade, New Belgrade, 08.05.2021, apterous viviparous females and dimorphs on *Acer palmatum*. Belgrade, New Belgrade; 23.11.2021; oviparous females.

Morphology: Fundatrices (Fig.1) (2 specimens) are oval, brown. Body length: 2.5-2.6 mm. The head and pronotum are black, sclerotized. The antennae are 5-segmented, approximately 1/3 the length of the body (0.29-0.35 x body length) and are dark except for antennal segment III. The terminal process is subequal to the base of antennal segment VI. Mesonotum, metanotum and abdominal tergites I-VII have paired dark spinal and marginal sclerites and pleural sclerites between them. The legs are dark. The siphunculi are dark, truncate with a flange, shorter than in apterous viviparous female. The cauda is broadly rounded.



Figure 1. *Periphyllus californiensis* (Shinji, 1917): fundatrix, on *Acer palmatum* in April 2021, New Belgrade. Photo by M. Tomić.

Apterous viviparous females (Fig.2) (2 specimens) are elongate oval, brown. Body length: 1.9-2.7 mm. The head and pronotum are black, sclerotized. Antennae are dark except for the base of antennal segment III and are slightly more than $\frac{1}{2}$ the length of body. The terminal process is 2.1-3.4 times as long as the base of antennal segment VI. The longer hair on the base of antennal segment VI is 50-63 μm long and 0.4-0.63-times as long as the base of that segment. Secondary rhinaria are absent, except in alatform specimens. Abdominal tergites I-VII with paired dark spinal and marginal sclerites, between which there are small pleural sclerites and abdominal tergite VIII with a dark cross band. The spinal sclerites on tergites I-VII are sometimes fused into cross-bands. The siphunculi are dark, stump-shaped with polygonal reticulation and a well-developed flange. The cauda is short, broadly rounded with 10-12 hairs. The femora are mostly dark except at bases. The fore and middle tibiae are dark at bases and apices, with brown middle sections. The hind tibiae are uniformly dark. First tarsal segments with 5 ventral hairs (2 pairs of lateral hairs and 1 median sense peg).



Figure 2. *Periphyllus californiensis* (Shinji, 1917): apterous viviparous female, on *Acer palmatum* in May 2021, New Belgrade. Photo by M. Tomić.

Alate viviparous female (Fig.3) (4 specimens) have a dark head and thorax and brown abdomen with spinopleural cross bars and marginal sclerites. Body length 2.5-2.9 mm. Antennae are mostly dark, except for the base of antennal segment III. The terminal process is 1.6-2.43-times as long as the base of antennal segment VI. The longer hair on the base of antennal segment VI is 55-88 μm long and 0.42-0.69-times as long as the base of that segment. Antennal segment III with 10-17 secondary rhinaria and 0 on antennal segment IV. The siphunculi are dark, stump-shaped with rows of polygonal reticulation that is more extensive than in aptera.

Dimorphs (Fig.4) (1 specimen) are specialized aestivating first instar nymphs. They are pale green and dorsoventrally flattened with foliate (leaf shaped) marginal hairs and have spinal and pleuromarginal plates. The terminal process is shorter than the base of antennal segment VI.

Oviparous females (Fig.5) (3 specimens) are brown with black head and pronotum. Body length 2.3-3 mm. Antennae and legs with the same coloration as apterous viviparous females with long pointed hairs. The

terminal process is 1.8-2 times as long as the base of antennal segment VI. The hind tibiae are swollen with about 162-195 pseudorhinaria. Abdominal tergites I-VII with paired dark spinal and marginal sclerites. Abdominal segments VII and VIII are elongated.



Figure 3. *Periphyllus californiensis* (Shinji, 1917): alate viviparous female, on *Acer palmatum* in May 2021, New Belgrade. Photo by M. Tomić.



Figure 4. *Periphyllus californiensis* (Shinji, 1917): dimorph, on *Acer palmatum* Thunb. in May 2021, New Belgrade. Photo by M. Tomić.

Biology: *Periphyllus californiensis* (Shinji, 1919) has been recorded from 15 species of maple: *Acer buergerianum* Miq., *A. campestre* L., *A. carpinifolium* Siebold & Zucc., *A. circinatum* Pursh, *A. japonicum* Thunb., *A. macrophyllum* Pursh, *A. miyabei* Maxim., *A. negundo* L., *A. oblongum* Wall. ex DC., *A. palmatum* Thunb., *A. pictum* Thunb., *A. platanooides* L., *A. pseudosieboldianum* (Pax) Komarov, *A. saccharum* Marshall, *A. trautvetteri* Medw. (Blackman & Eastop, 2022). In Serbia, it has only been found on *A. palmatum* Thunb. on which it is monoecious, holocyclic. Aestivating nymphs are produced in May and oviparous females were found in November.



Figure 5. *Periphyllus californiensis* (Shinji, 1917): oviparous female, on *Acer palmatum* in November 2021, New Belgrade. Photo by M. Tomić.

***Tinocallis saltans* (Nevsky, 1929) – Spotted elm aphid**

Material examined: Belgrade, Zemun, 09.05.2018; alate viviparous females on *Ulmus* sp.; Belgrade, New Belgrade; 02.06.2020; alate viviparous females on *U. pumila* L.; Belgrade, New Belgrade; 22.05.2021; alate viviparous females on *U. pumila* L. Belgrade, New Belgrade; 28.11.2021; oviparous female on *U. pumila* L.

Morphology: Alate viviparous females (Fig.6) (4 specimens) are yellowish orange with brown head and thorax. Body length 1.2-1.4 mm. Antennal segments pale with dark apices except I and II, which are brown. The terminal process is 0.69-1.04-times as long as the base of antennal segment VI. Antennal segment III with 8-12 narrow, slit-like secondary rhinaria. Pronotum with two pairs of finger-like tubercles. Mesonotum with one pair of conical tubercles. Abdominal tergites I and II with a pair of spinal, finger-like, pale tubercles. Abdominal tergites III-VIII with dark spinal rounded sclerites. Abdominal tergite IV with a pair of smaller, pigmented tubercles. Marginal tubercles are also present on abdominal tergites I-IV; those on tergite IV are pigmented. The spinal hairs on abdominal tergites III, V and VII are laterally displaced into pleural area. The anal plate is bilobed and cauda is knobbed. The distal area of wing veins and edge of pterostigma with fuscous pigmentation. The legs are mostly pale except apices of hind femora, which are dark.

Oviparous females (Fig.7) (1 specimen) are yellow with dark dorsal spots. Antennae are pale dark except for apices of segments. Pronotum with two pairs of anterior and posterior spinal hairs and a pair of posterior

marginal hairs. Mesonotum, metanotum and abdominal tergites with pairs of spinal and marginal hairs on wart-like, pigmented tubercles. The cauda is knobbed. The siphunculi are short, truncate and dark. The legs are pale with some pseudorhinaria.



Figure 6. *Tinocallis saltans* (Nevsky, 1929): alate viviparous female, on *Ulmus pumila* L. in May 2021, New Belgrade, lower left: *Aphis* sp. Photo by M. Tomić.



Figure 7. *Tinocallis saltans* (Nevsky, 1929): oviparous female, on *Ulmus pumila* L. in November 2021, New Belgrade. Photo by M. Tomić.

Biology: *Tinocallis saltans* has been recorded from 9 species of elms: *Ulmus androssowii* Litv., *U. glabra* Huds., *U. japonica* (Rehder), *Sarg.*, *U. laevis* Pall., *U. minor* Mill., *U. parvifolia* Jacq., *U. procera* Salisb., *U. pumila* L. and *U. villosa* Brandis. ex Gamble (Blackman & Eastop, 2022), and also from *Zelkova serrata* (Thunb.) Makino (Ripka *et al.*, 1998). In Serbia it has only been recorded on *U. pumila* L. It is not clear yet how this species overwinters in Serbia. Oviparous females were found in November and males were not found.

Discussion and Conclusion

In the last two decades, many new species have been recorded in Serbia (Petrović-Obradović, 2003; Glavendekić, 2005; Poljaković Pajnik, 2006; Petrović-Obradović *et al.*, 2007; Petrović-Obradović *et al.*, 2009; Petrović-Obradović *et al.*, 2010; Vučetić *et al.*, 2013; Vučetić *et al.*, 2014; Jevremović *et al.*, 2016; Jovičić *et al.*, 2017; Ilić-Milošević *et al.*, 2019; Petrović-Obradović *et al.* 2019; Petrović Obradović *et al.*, 2020; Petrović-Obradović *et al.*, 2021; Petrović-Obradović, 2021) and a significant number of them are alien species. Several of these recent findings are from Belgrade (Petrović-Obradović *et al.*, 2019; Petrović Obradović *et al.*, 2020, Petrović-Obradović *et al.*, 2021, Petrović-Obradović, 2021), even though it is one of the most researched areas in Serbia (Petrović-Obradović, 2003). Some of these published species were not listed as new records for Serbia. They are listed here with references: *Pachypappa warshavensis* (Nasonov, 1894) (Poljaković-Pajnik, 2006); *Hyadaphis polonica* (Szelegiewicz, 1959) and *Subsaltusaphis* sp. (Vučetić *et al.*, 2013); *Capitophorus horni* (Börner, 1931) (Jovičić *et al.* 2017); *Aphis hieracii* (Schrank, 1801) and *Hyadaphis coriandri* (George, 1928) (Ilić-Milošević *et al.*, 2019).

In Serbia, *P. californiensis* has only been found on *Acer palmatum* Thunb., one of its preferred hosts. *A. palmatum* Thunb. or Japanese maple is an East Asian species that is planted in Serbia as an ornamental tree. It is only sporadically planted in Serbia, so this is the most likely reason why *P. californiensis* (Shinji, 1917) has not been found in Serbia until now.

With the last two species described here, the total number of species of aphids recorded in Serbia reached 393. These new records indicate that it is possible that there are other species yet to be found in Serbia and further research on the Serbian aphid fauna is necessary.

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PERIPHYLLUS CALIFORNIENSIS (SHINJI, 1917) И TINOCALLIS SALTANS (NEVSKU, 1929), (HEMIPTERA: APHIDIDAE), ДВЕ СТРАНЕ ВРСТЕ БИЉНИХ ВАШИ НОВЕ ЗА ФАУНУ СРБИЈЕ

МИХАЈЛО ТОМИЋ И ОЛИВЕРА ПЕТРОВИЋ-ОБРАДОВИЋ

Извод

У овом раду су представљене две стране врсте биљних ваши нових за фауну Србије са детаљима о њиховој морфологији, биологији и са оригиналним фотографијама. *Periphyllus californiensis* (Shinji, 1917) је инвазивна врста која припада потфамилији Chaitophorinae и која је први пут нађена 2021. на *Acer palmatum* Thunb. док је *Tinocallis saltans* (Nevsky, 1929), који припада потфамилији Calaphidinae, нађен на *Ulmus pumila* L. у 2020. и 2021. Обе врсте су регистроване у Београду. У Србији су сада регистроване укупно 393 врсте биљних ваши.

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