MITTEILUNGEN DER SCHWEIZERISCHEN ENTOMOLOGISCHEN GESELLSCHAFT
BULLETIN DE LA SOCIETE ENTOMOLOGIQUE SUISSE
89: 51–68, 2016 doi:10.5281/zenodo.51888

First records of *Chlamydatus saltitans* (Fallén, 1807) and *Tupiocoris rhododendri* (Dolling, 1972) (Heteroptera, Miridae) and notes on other rare and alien true bugs in Switzerland

David Frey[1,2], Andrea Zanetta[1,3], Marco Moretti[1] & Ralf Heckmann[4]

[1] Swiss Federal Research Institute WSL, Biodiversity and Conservation Biology, Zürcherstrasse 111, CH-8903 Birmensdorf, Switzerland
[2] Institute for Terrestrial Ecosystems, Department of Environmental Systems Science, ETH Zurich, Universitätstrasse 16, CH-8092 Zürich, Switzerland
[3] Department of Biology, Ecology & Evolution, Chemin du Musée 10, CH-1700 Fribourg, Switzerland
[4] Schillerstrasse 13, D-78467 Konstanz, Germany
Corresponding author: ralf.p.heckmann@t-online.de

An extensive arthropod survey of 85 urban gardens in the city of Zurich revealed the presence of two new true bug species for Switzerland, the European *Chlamydatus saltitans* (Fallén, 1807) and the North American *Tupiocoris rhododendri* (Dolling, 1972). Furthermore, we confirm a formerly doubted Swiss record of the Mediterranean *Orius laevigatus laevigatus* (Fieber, 1860) and record the Mediterranean *Macrolophus glaucescens* (Fieber, 1858) and *M. melanotoma* (A. Costa, 1853) for the first time north of the Western Alps. We also report new records north of the Alps of the thermophiles *Nezara viridula* (Linnaeus, 1758) and *Liorhyssus hyalinus* (Fabricius, 1794), and give new records of the alien *Halyomorpha halys* (Stål, 1855), *Leptoglossus occidentalis* (Heidemann, 1910) and *Stephanitis takeyai* (Drake & Maa, 1955) and the rare native *Ceratocombus coleoptratus* (Zetterstedt, 1819).

Keywords: distribution, first record, garden, Heteroptera, invasive, urban, Switzerland, Zurich

INTRODUCTION

Rapid floral and faunal turnover is occurring worldwide due to human mediated environmental change (Sala *et al*. 2000). Hence, reporting species occurrences is important for evaluating extinction risks of threatened species and for early detection of potentially invasive organisms (Nichols & Williams 2006; Simberloff *et al*. 2013).

Cities are hotspots of species turnover. On the one hand, anthropogenic habitat disturbance, modification, loss and fragmentation lead to changes in richness and abundance of native species (McKinney 2008; Faeth *et al*. 2011; Turrini & Knop 2015). On the other hand, the increased movement of persons and exchange of goods favour the introduction of non-native species (Rebele 1994; Kowarik 2011).

Gardens are a major component of urban green space and may therefore play an important role in shaping urban biodiversity (Gaston 2005; Goddard *et al*. 2010). Whereas their importance as sources of alien plant species is recognized (Hodkinson & Thompson 1997; Smith *et al*. 2006a), fewer studies have focused on garden arthropods (Owen 1991; Smith *et al*. 2006b, 2006c; Goddard *et al*. 2010; Sattler *et*

al. 2010; Germann *et al*. 2015). This contrasts with their key role as both pests and beneficial organisms. There have been particularly few in-depth studies on true bugs (Heteroptera) in gardens and in urban areas in general (McKinney 2008; Raupp *et al*. 2010; but see Smith *et al*. 2006b, 2006c; Turrini & Knop 2015).

The lack of data on the diversity and distribution of Heteroptera in anthropogenic ecosystems is all the more surprising since several true bug species are considered to be agricultural and horticultural pests (Kenis 2005; Rabitsch 2010). Their close association with plants favours their accidental introduction, in particular with the readily available ornamental plants and non-native forest trees (Rabitsch 2010). In consequence, alien true bugs have been increasingly reported across Europe (Rabitsch 2010). In Switzerland, however, data on both native and alien bug species remain incomplete (Kenis 2005).

The aim of this paper is to report first records of species of true bugs in Switzerland and to report first records north of the Western Alps of rare and alien species, as well as true bugs, that had previously only been found in other parts of Switzerland.

MATERIAL AND METHODS

An arthropod survey was conducted within the framework of the Sinergia SNF (Swiss National Foundation) project BetterGardens (www.bettergardens.ch) led by the Research Institute of Organic Agriculture (FiBL) in collaboration with the Swiss Federal Research Institute for Forest Snow and Landscape (WSL). The survey was carried out in 43 private gardens, 41 allotment garden lots and one school garden, which were located across the entire city of Zurich, Switzerland. Garden lots were chosen along a) a management intensity and structural complexity gradient, ranging from extensive and structurally rich to intensive and structurally poor; and b) along an urbanization gradient, ranging from the city centre to the urban fringe. Within each garden, surface dwelling arthropods were caught using six 70 mm diameter pitfall traps covered with transparent roofs as rain protection. Traps were placed in two of the most abundant garden habitats, i.e. lawn, flower- or vegetable-beds and berry cultivations. Within each habitat, traps were arranged in an equilateral triangle with a side length of one meter. Alternatively, traps were placed in a single row of one-metre length, where the arrangement in triangles was not possible. In addition, flying arthropods were sampled with three one-litre bowl traps fixed on a triangular wooden pole (Buri *et al*. 2014), which was placed in a central and unshaded position in each garden. Each bowl was sprayed with either UV-bright blue, white or yellow paint (Sparvar Leuchtfarbe, Spray-Color GmbH, Merzenich, Germany, details in Westphal et al. 2008) and three quarters filled with 0.2 % Rocima solution (bactericide and fungicide from Acima, Buchs, Switzerland). The traps were continuously open between May 18th and August 19th 2015 and emptied weekly. Arthropods were sorted into specific taxa and sent to specialists for further determination. Heteroptera were identified by Ralf Heckmann. Vouchers of the species new to Switzerland are deposited temporarily in his reference collection.

In the following section, garden type, geographical coordinates, altitude, date of collection, number of individuals, sex, trap type and, for pitfall traps, the trap location are given. Finally, the existing literature is reviewed and the probable native or alien status is discussed.

RESULTS AND DISCUSSION

CERATOCOMBIDAE

Ceratocombus coleoptratus (Zetterstedt, 1819)

1. private garden; N 47°23'09.5", E 8°28'43.6"; 414 m; 1st June 2015; 1 ♂; pitfall trap in lawn.
2. private garden; N 47°23'02.6", E 8°29'55.7"; 405 m; 8th June 2015; 1 ♂; pitfall trap in lawn.

Ceratocombus coleoptratus is considered to be relatively rare in Switzerland and has previously been recorded in eight Cantons. Here we present the second and third records of this species in the Canton of Zurich (Hollier *et al*. 2014). *C. coleoptratus* lives on the soil surface among mosses and litter and is found at forest margins, in heaths and in swamps (Wachmann *et al*. 2006). Thus, recording it in intensively managed garden lawns situated in residential areas of the city of Zurich is surprising. While this observation shows that the species can disperse into urban areas, it remains unclear whether it is able to naturalize there. Furthermore, this inconspicuous species may be considered to be rare due to observer bias rather than natural rarity (Heckmann & Rieger 2001; Hollier *et al*. 2014).

TINGIDAE

Stephanitis takeyai (Drake & Maa, 1955) (Fig. 1)

1. allotment «Wehrenbach»; N 47°21'19.6", E 8°34'40.4"; 480 m; 9th June 2015; 1 ♂; bowl trap.
2. private garden; N 47°22'01.2", E 8°32'03.7"; 409 m; 9th June 2015; 1 ♂; bowl trap.

These are, to our knowledge, only the second and third records of *Stephanitis takeyai* in Switzerland, where the species was first found in the Canton of St. Gallen (Megróz 2008). It is native to Japan and feeds on Ericaceae; especially *Pieris japonica*, which is a widespread ornamental plant in Europe (Rabitsch 2008). Thus it is considered to be a horticultural pest and probably disperses with the commercial sale of garden plants. In Europe, *S. takeyai* was first recorded in the Netherlands in 1994 (Aukema 1996) and has subsequently expanded to become established in Austria, Belgium, the Czech Republic, France, Germany, Great Britain, Italy, the Netherlands, Poland and Switzerland (Aukema *et al*. 2013). The occurrence in Hungary was supplemented by Vétek *et al*. (2012). Although few records currently exist in Switzerland, it is likely that the species is naturalizing due to the widespread horticultural use of exotic Ericaceae.

MIRIDAE

Macrolophus glaucescens (Fieber, 1858)

1. allotment «Stotzstrasse»; N 47°19'50.7", E 8°30'36.1"; 510 m; 27th July 2015; 1 ♀; bowl trap.

This is the first record of *Macrolophus glaucescens* north of the Western Alps. This Mediterranean species reaches the northern edge of its distribution range in southern Switzerland (Canton Ticino), eastern Austria, and Hungary (Göllner-Scheiding & Rezbanyai-Reser 1992). In the Czech Republic, the species is considered to have been introduced, probably together with its host plants (Šefrová & Laštùvka 2005; Kment 2006). *M. glaucescens* differs morphologically from the Mediterranean

Fig. 1. A male *Stephanitis takeyai* (Drake & Maa, 1955) from Zurich sampled during the BetterGardens arthropod survey. The body-length is slightly below 4 mm. The main difference to European species of the genus is the larger and more rounded neck bubble. Photograph by C. Rieger.

M. melanotoma and the native *M. pygmaeus* by having a much broader black spot behind the eye and a shorter 2nd antennal segment with respect to the width of the pronotum. In its native area, *M. glaucescens* is associated with *Echinops sphaerocephalus* (Asteraceae), a ruderal and thermophilous plant native to Eurasia (Wachmann *et al*. 2004). This plant species has a great ornamental value and is therefore frequently cultivated in gardens (D. Frey, personal observation). In Zurich, it is likely that *M. glaucescens* has been introduced accidentally, with its presence favoured by the frequent cultivation of Echinops. Yet it remains unclear whether *M. glaucescens* is currently naturalized north of the Swiss Alps.

Macrolophus melanotoma (A. Costa, 1853)

1. allotment «Stotzstrasse»; N 47°19'50.7", E 8°30'35.9"; 510 m; 20th July 2015; 1 ♂ and 1 nymph; pitfall trap in vegetable bed.
2. allotment «Wehrenbach»; N 47°21'23.6", E 8°34'38.0"; 492 m; 21st July 2015; 1 ♂; pitfall trap in vegetable bed.
3. allotment «Susenberg»; N 47°23'02.0", E 8°33'44.6"; 623 m; 18th August 2015; 2 ♀♀; bowl trap.
4. private garden; N 47°21'11.9", E 8°34'41.3", 494 m; 18th August 2015; 1 ♀; bowl trap.
5. allotment «Wydäckerring»; N 47°22'14.9", E 8°29'45.5"; 431 m; 10th August 2015; 1 ♀; bowl trap.
6. allotment «Hagenbuchrain»; N 47°22'13.1", E 8°29'02.0"; 478 m; 17th August 2015; 1 ♀, bowl trap.
7. allotment «Käferberg»; N 47°24'02.9", E 8°31'25.9"; 520 m; 10th August 2015; 1 ♀; bowl trap.
8. allotment «Steinkluppe»; N 47°24'09.0", E 8°32'17.8"; 460 m; 13th July 2015; 1 ♀; bowl trap.

These are the first records of the Mediterranean bug *Macrolophus melanotoma* north of the Alps in Switzerland. In our investigation the species was found even more frequently than its native congener *M. pygmaeus*. In Switzerland, *M. melanotoma* has been recurrently recorded in the Southern Alpine Canton Ticino, where it occurs sporadically (Göllner-Scheiding & Rezbanyai-Reser 1992; Otto & Rezbanyai-Reser 1996; Göllner-Scheiding & Rezbanyai-Reser 2000). The distribution records given in DAISIE (Delivering Alien Invasive Species Inventories for Europe, 2016) for North and Central Europe (including the arctic island of Svalbard) are doubtful and may pertain to glasshouse observations or may be due to a confusion with *M. pygmaeus* or to a software-error. No peer reviewed publications reporting *M. melanotoma* from one of these countries exist to our knowledge. *M. melanotoma* differs morphologically from *M. pygmaeus* by having a narrower black spot behind the eye, shorter 2nd antennal segments (Wagner 1970-71) and shorter middle-tibiae (R. Heckmann, personal observation). However, *M. melanotoma* remains difficult to distinguish from *M. pygmaeus*, and the two species are often confused (Castañé *et al*. 2013). Both *M. pygmaeus* and *M. melanotoma* are used as biocontrol agents in greenhouse cultures in Europe (Rabitsch 2008). Although, in Switzerland, only the use of the native *M. pygmaeus* is approved (Bundesamt für Landwirtschaft 2016), a mistaken use of *M. melanotoma* in cultures could have led to its introduction. Alternatively, the species could have been accidentally introduced with the international trade of plants or with the intensive movement of people and goods between Switzerland and Italy. The numerous records of *M. melanotoma* across the entire city of Zurich suggest that the species is naturalizing, probably favoured by the warmer climatic conditions of the urban ecosystem. Hence, to our knowledge, this is the first reported established population of *M. melanotoma* north of the Alps.

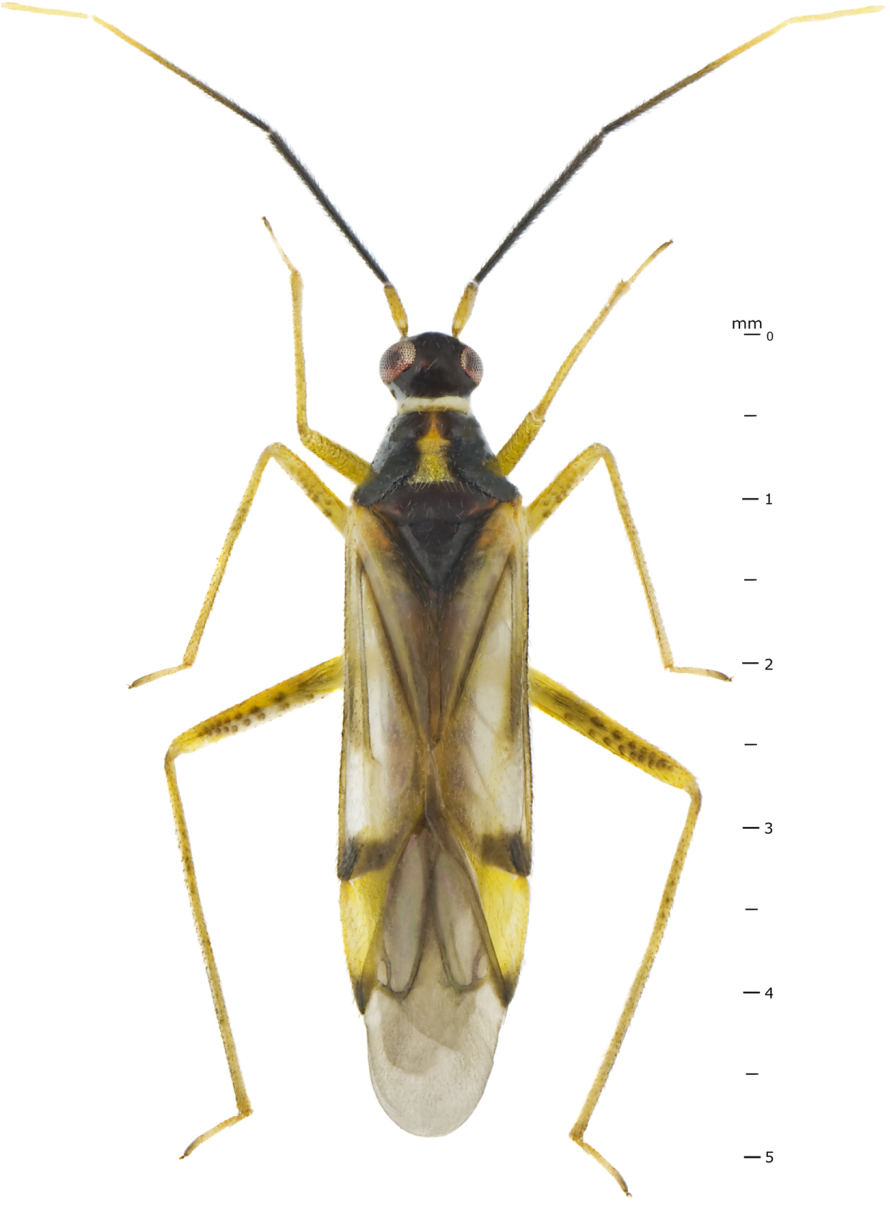

Fig. 2. A female *Tupiocoris rhododendri* (Dolling, 1972) from the Island of Mainau (Baden-Württemberg). Collected by R. Heckmann, photograph by G. Strauß.

Tupiocoris rhododendri (Dolling, 1972) (Fig. 2)

1. private garden; N 47°24'56.6", E 8°31'31.9"; 446 m; 22nd June 2015; 1 ♂; bowl trap.

This is the first record of the North American *Tupiocoris rhododendri* in Switzerland. Although native to the eastern coast of North America, the taxon was first described based on animals collected in Great Britain, where it was accidentally introduced (Dolling 1972). The species subsequently appeared in the Netherlands (Aukema *et al*. 2005), Germany (Schrameyer 2004), Belgium (Aukema *et al*. 2007) and Denmark (Aukema *et al*. 2013). The presence of *T. rhododendri* in Switzerland is not surprising because it is already naturalized in southern Germany (Baden-Württemberg) (Aukema *et al*. 2005; R. Heckmann personal observations). As with *Stephanitis takeyai*, it is found on *Rhododendron* cultivars, where it feeds on aphids. Due to the widespread cultivation of *Rhododendron* in gardens, its apparently great dispersal capacity and the frequent occurrence in adjacent Germany, it is likely that *T. rhododendri* is also naturalizing in Switzerland.

Chlamydatus saltitans (Fallén, 1807) (Fig. 3)

1. allotment «Dreiwiesen»; N 47°22'47.5", E 8°34'21.0"; 604 m; 21st July 2015; 1 ♂; pitfall trap in lawn.
2. private garden; N 47°24'43.0", E 8°33'00.0"; 430 m; 25th May, 8th June, 3rd August 2015; 10 ♂♂; pitfall trap in lawn.
3. private garden; N 47°24'43.1", E 8°33'00.4"; 430 m; 29th June 2015; 1 ♀ and 1 ♂; pitfall trap in flowerbed.

These are the first published records of *Chlamydatus saltitans* in Switzerland. Note that the species was already found in 2003 in the Canton of Basel-Land during another WSL-arthropod survey (WSL, unpublished data). These findings are, however, not unexpected because the species is native to Europe and present in all surrounding countries, with the exception of Liechtenstein (Aukema & Rieger 1999). *C. saltitans* lives in open vegetation on dry, sandy and gravelly soils. Unusually for Miridae, the species is able to cover considerable distances by jumping and thus can be easily spotted (Wachmann *et al*. 2004). In Baden-Württemberg (southern Germany), the species was found among *Achillea* sp. (Asteraceae) plants as well as on green roofs dominated by *Sedum* (Crassulaceae) and *Saxifraga* (Saxifragaceae) (R. Heckmann, personal observations). Urban areas are rich in dry and open habitats so it is likely that *C. saltitans* has been overlooked in the City of Zurich.

ANTHOCORIDAE

Orius laevigatus laevigatus (Fieber, 1860) (Fig. 4)

1. allotment «Juchhof»; N 47°24'04.5", E 8°28'24.0"; 395 m; 14th July; 1 ♂; bowl trap.

This is the first confirmed record of *Orius laevigatus* in Switzerland. Even though females of the species have previously been found in the Canton Basel-Stadt, this record remained doubtful (Wyniger & Burckhardt 2003). A further Swiss record of the species, of which a specimen was deposited in the Zoological Museum of the University of Helsinki, Finland, lacks information about the location (Péricart 1972). It is notable that this record of *O. laevigatus* is one of 4425 *Orius* specimens determined during the BetterGardens arthropod survey. The taxonomic assignment

Fig. 3. A male *Chlamydatus saltitans* (Fallén, 1807) from Zurich sampled during the BetterGardens arthropod survey. The species can easily be distinguished from the other three Central European *Chlamydatus* species with its mat hemelytra, having parts of lighter colour and only a narrow rest of the membrane. Photograph by S. Mangili.

was confirmed by the careful control of the paramere, revealing the unique character of having two long parallel flagellums as shown in Péricart (1972). *Orius laevigatus* has an Atlanto-circummediterranean distribution, extending as far as northern Great Britain. It was not found in Northern Italy, Austria or Germany (Péricart 1972) but has recently been recorded for the first time in the Netherlands (Aukema & Loomans 2005). Since this inconspicuous taxon is difficult to identify, data deficiency currently hinders any assessment of its naturalization status in Switzerland.

RHOPALIDAE

Liorhyssus hyalinus (Fabricius, 1794»

1. allotment «Freilager West"; N 47°22'46.5", E 8°29'03.1"; 418 m; 1st, 8th June 2015; 2 ♀♀, 1 ♂; bowl trap.
2. allotment «Burgwies»; N 47°21'30.9", E 8°34'23.0"; 461 m; 2nd June 2015; 1♀; bowl trap.
3. private garden; N 47°24'42.6", E 8°31'13.8"; 498 m; 9th June 2015; 1 ♀; bowl trap.
4. allotment «Steinkluppe»; N 47°24'09.0", E 8°32'17.8"; 460 m; 15th, 22nd June 2015; 1 ♀, 1 ♂; bowl trap.
5. allotment «Wydäckerring»; N 47°22'14.9", E 8°29'45.5"; 431 m; 15th June 2015; 1 ♂; bowl trap.
6. allotment «Köschenrütistrasse»; N 47°25'35.1", E 8°32'12.4"; 434 m; 23rd June, 11th & 18th August 2015; 1 ♀ & 2 ♂♂; bowl trap.
7. allotment «Käferberg»; N 47°23'59.8", E 8°31'22.6"; 505 m; 6th July 2015; 1 ♀; bowl trap.
8. allotment «Herrenbergli»; N 47°23'38.3", E 8°28'06.0"; 525 m; 20th July 2015; 1 ♂; bowl trap.
9. allotment «Oberes Paradis»; N 47°19'57.2", E 8°31'28.1"; 485 m; 20th July 2015; 1 ♂; bowl trap.
10. allotment «Moos"; N 47°19'45.2", E 8°32'03.9"; 475 m; 20th July 2015; 2 ♂♂; bowl trap.
11. allotment «Stotzstrasse»; N 47°19'50.7", E 8°30'36.1"; 510 m; 20th July 2015; 1 ♂; bowl trap.
12. private garden; N 47°24'56.6", E 8°31'31.9"; 446 m; 20th, 27th July, 3rd August 2015; 2 ♀♀, 1 ♂; bowl trap.
13. private garden; N 47°20'07.4", E 8°30'58.6"; 454 m; 20th July 2015; 1 ♀; bowl trap.
14. allotment «Juchhof»; N 47°24'04.5", E 8°28'24.0"; 395 m; 21st July 2015; 1 ♀; bowl trap.
15. allotment «Susenberg»; N 47°23'02.0", E 8°33'44.6"; 623 m; 21st July 2015; 1 ♀; bowl trap.
16. allotment «Friedhof Ost»; N 47°22'19.4", E 8°30'32.4"; 418m; 27th July 2015; 1 ♂; bowl trap.
17. school garden «Schulhaus Wengi"» N 47°22'31.2", E 8°31'22.1"; 411 m; 28th July 2015; 1 ♀; bowl trap.
18. private garden; N 47°24'05.7", E 8°30'14.1"; 473 m; 28th July 2015; 1 ♀; bowl trap.
19. allotment «Allmend»; N 47°24'37.4", E 8°29'34.5"; 526 m; 3rd August 2015; 1 ♂; bowl trap.
20. allotment «Breitenstein»; N 47°23'38.7", E 8°30'57.4"; 401 m; 4th August 2015; 1 ♂; bowl trap.
21. private garden; N 47°24'41.0", E 8°32'54.9"; 433 m; 10th August 2015; 1 ♀; bowl trap.
22. allotment «Probstei»; N 47°23'59.9", E 8°34'46.3"; 449 m; 11th August 2015; 1 ♀; bowl trap.
23. private garden; N 47°24'24.6", E 8°34'36.3"; 427 m; 11th August 2015; 1 ♀; bowl trap.
24. private garden; N 47°21'08.9", E 8°34'55.8"; 511 m; 11th August 2015; 1 ♀; bowl trap.
25. allotment «Friesenbergstrasse»; N 47°21'43.4", E 8°29'56.1"; 495 m; 17th August 2015; 1 ♀; bowl trap.
26. allotment «Juchhof»; N 47°23'54.0", E 8°28'39.1"; 395 m; 18th August 2015; 1 ♂; bowl trap.

Liorhyssus hyalinus has a cosmopolitan distribution in tropical and subtropical regions (Wachmann *et al*. 2007). In Europe, and probably favoured by global warming, *L. hyalinus* is becoming more frequent in Baden-Württemberg in southern Germany (Wachmann *et al*. 2007; R. Heckmann, personal observation) and its range is currently expanding as far north as Scandinavia (Hradil *et al*. 2007; Wachmann *et al*. 2007). In Switzerland, although historical records exist from the Cantons Bern, Vaud and Geneva (Frey-Gessner 1866a, 1866b), *L. hyalinus* has previously only been recorded in the southern and central Alpine Cantons Valais and Ticino, both of which are characterised by the abundance of xeric and warm habitats (Frey-Gessner 1866a, 1866b; Delarze & Dethier 1988; Giacalone *et al*. 2002; Göllner-Scheiding & Rezbanyai-Reser 2000; Witschi & Zettel 2002). Its frequency suggests that

Fig. 4. A male *Orius laevigatus laevigatus* (Fieber, 1860) from Zurich sampled during the Better-Gardens arthropod survey. The species can be morphologically distinguished from species of the *Heterorius* subgenus by the presence of black setae on the edges of the pronotum, and from *Orius niger* by the pale middle-legs and the slightly obscured hind-legs, which are all black in *O. niger*. Photograph by S. Mangili.

L. hyalinus is naturalized in Zurich, which is probably favoured by the heat island effect of the city and by the abundance of xeric habitats.

COREIDAE

Leptoglossus occidentalis (Heidemann, 1910)

1. allotment «Freilager West»; N 47°22'46.5", E 8°29'03.1"; 418 m; 17th August 2015; 1 nymph; bowl trap.

The North American «western conifer seed bug» *Leptoglossus occidentalis* was accidentally introduced to Europe in 1999 and was recorded for the first time in Switzerland in the Canton Ticino in 2001, where it is naturalized today (Colombi & Brunetti 2002; Wyniger 2007). The species further naturalized in the Canton Valais, and single individuals have also been found in the Cantons Basel-Stadt, Nidwalden, Zurich and Thurgau (Wyniger 2007; Schmidt *et al*. 2010; Heckmann & Blöchlinger 2013). The species has spread across Europe and is currently present in almost all countries (Aukema & Rieger 1999; Aukema *et al*. 2013). *L. occidentalis* can be easily identified by the conspicuous, partly leaf shaped hind legs. It is phytophagous and feeds on immature seeds and flowers of conifers. The species has a preference for Pinaceae, especially the genus *Pinus* and *Pseudotsuga menziesii*, but it has also been observed on *Abies*, *Cedrus*, *Juniperus* and *Picea* (Villa *et al*. 2001). Adults overwinter in wood crevices and under bark or similar structures. In autumn, they may enter buildings in large numbers and can become a nuisance pest (Wheeler 1992). In its native range, *L. occidentalis* is regarded as a pest and recent observations in southern European conifer forests show that there is also a serious potential threat in Europe (Luchi *et al*. 2012; Tamburini *et al*. 2012; Lesieur *et al*. 2014).

PENTATOMIDAE

Halyomorpha halys (Stål, 1855)

This East Asian bug was among the abundant and frequent bug species caught during the BetterGardens arthropod survey: 171 individuals (approx. 2 % of all true bugs captured) were caught in 55 gardens (approx. 65 % of all gardens surveyed) across the entire city (Fig. 5). This is notable because the species was first recorded in Switzerland only recently, which was also the first record in Europe (Wermelinger *et al*. 2008). *H. halys* was first discovered in the City of Zurich and has subsequently expanded (Wyniger & Kment 2010), mainly in Liechtenstein (Arnold 2009) and northern Switzerland (Haye *et al*. 2014; www.halyomorphahalys.com). It has since been found in Germany (Heckmann 2012), France (Callot & Brua 2013), Italy (Maistrello *et al*. 2014), Hungary (Vétek *et al*. 2014), Greece (Milonas & Partsinevelos 2014), Austria (Rabitsch & Friebe 2015), Romania (Macavei *et al*. 2015) and Serbia (Šeat 2015). Taken together, these observations suggest that *H. halys* has a high potential for spreading and that it readily adapts to urban environments.

Nezara viridula (Linnaeus, 1758)

1. private garden; N 47°22'53.1", E 8°30'05.3"; 408 m; 17th August 2015; 1 ♂; bowl trap.

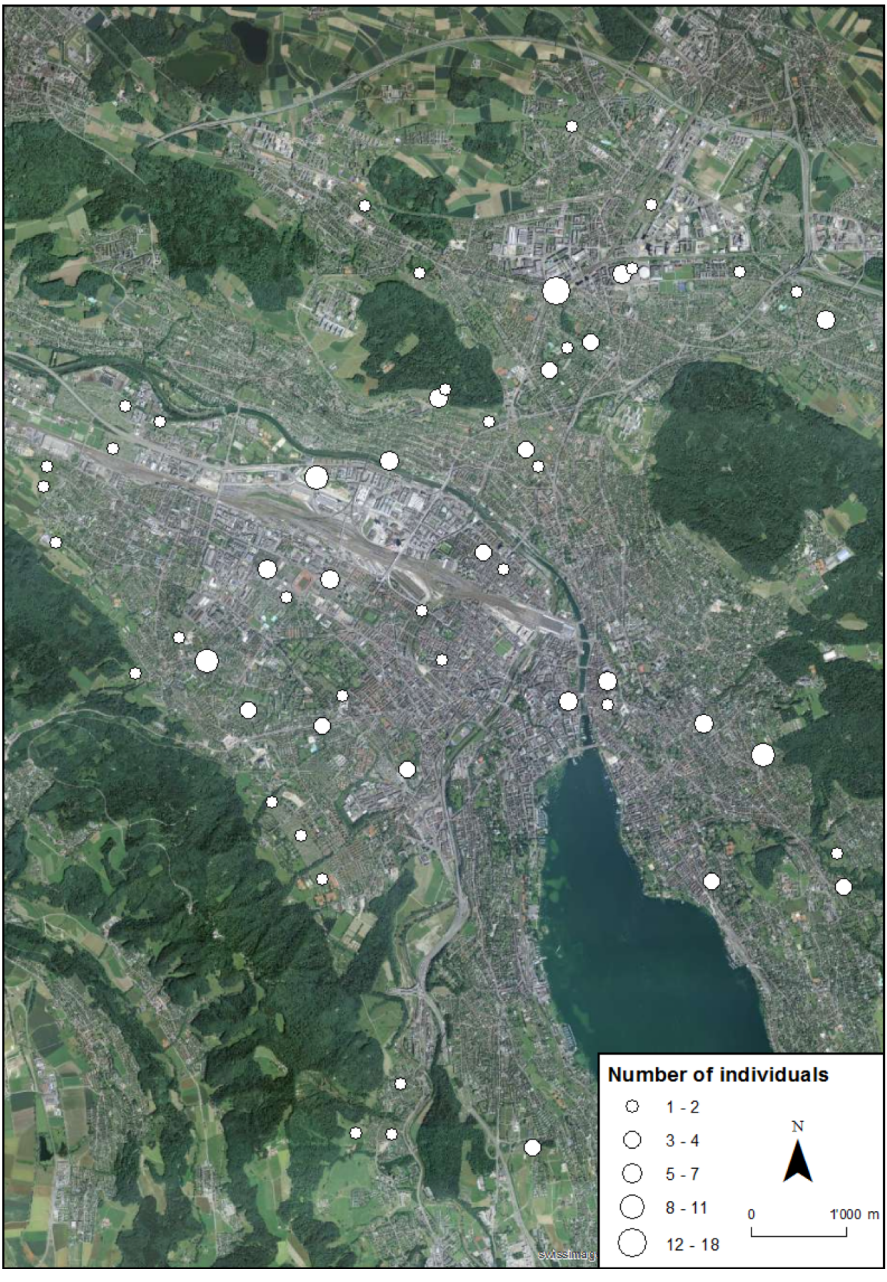

Fig. 5. Occurrences and abundance of the alien true bug *Halyomorpha halys* (Stål, 1855) in the City of Zurich sampled during the BetterGardens arthropod survey between May 18th and August 19th 2015.

This is the first record of *Nezara viridula* in the Canton of Zurich. North of the Swiss Alps, this thermophilous species has been reported only in the Cantons of Basel-Stadt (Wyniger & Burckhardt 2003) and Basel-Land (Werner 2005), with numerous individuals and/or nymphs observed at these locations. Similar observations have been made in adjacent Germany (Baden-Württemberg), where the species has been reported, among others, from the goods station of Lörrach (R. Heckmann, personal observation). After the first accidental records in Baden-Württemberg (Rieger 1994; Voigt 1998), the later observations may indicate the beginning of a naturalization of the species in southern Germany and northern Switzerland. An historical designation as «*Nezara* Am. *S. prasina* L.» exists from the Canton of Graubünden (Killias 1874), but this record is probably due to a wrong synonymisation (Wyniger & Burckhardt 2003), since the taxon was not included in subsequent publications (Killias 1879). It is also possible that the individual was confused with the morphologically similar, and later reported, *Palomena prasina* (Killias 1879). South of the Swiss Alps, in the Canton Ticino, *N. viridula* has been reported frequently since the 19th century and is considered to be native there (Frey-Gessner 1863, 1866a, 1866b; De Carlini 1887; Göllner-Scheiding & Rezbanyai-Reser 1992, 2000; Otto 1992, 1996; Otto & Rezbanyai-Reser 1996; Giacalone *et al*. 2002). *N. viridula* has a cosmopolitan distribution in tropical and subtropical regions, where it is considered to be an agricultural pest because it feeds on immature fruits and seeds of crop plants (Panizzi 1997; Panizzi *et al*. 2000). In Europe *N. viridula* occurs in all Mediterranean countries and it is also established as an alien species in Great Britain, Belgium and northern Hungary (Aukema & Rieger 2009; Aukema *et al*. 2013). It is clearly shifting its range northwards in Europe, probably as a sign of climate change.

CONCLUSION

The BetterGardens arthropod survey revealed the presence of two true bug species that are new to Switzerland and recorded several Mediterranean species for the first time in Northern Switzerland. These results are in line with the observation that urban areas are «ports of entry» for alien species (Rebele 1994; Kowarik 2011). Our results suggest that one important vector of such introductions may be the trade with ornamental plants (see also Trivellone *et al*. 2015 for leafhoppers). If so, urban gardens may represent a source of alien arthropods in urban ecosystems. The predominance of dry habitats in cities and the warmer climatic conditions with respect to the rural or natural surroundings, the «urban heat island effect» (Pickett *et al*. 2011), may subsequently favour the naturalization of such species. Whereas the introduction of alien species in cities is often perceived as a driver of biotic homogenization and associated loss of biodiversity (Knop 2016), we argue that the appearance of neobiota is an intrinsic property of urban ecosystems (Rebele 1994) and should not be interpreted as negative per se (Kowarik 2011; Marris 2011). In particular since there is increasing evidence that alien species also can deliver ecosystem functions and underlying ecosystem services in anthropogenic ecosystems (Ewel & Putz 2004; Hobbs *et al*. 2009; Kueffer & Kaiser-Bunbury 2014). Investigations should thus aim at studying possible impacts of such species, such as their roles and functions in urban trophic networks and community assemblages as well as their effects on city dwellers (Kowarik 2011).

ACKNOWLEDGEMENTS

The BetterGardens project is financed by the Swiss national Science foundation (Sinergia) (no. 154416). We thank Simon Tresch, Giulia Benazzi and Sofia Mangili for the data sampling, sorting work and the help in the field; the garden owners and the Swiss allotment garden association (Schweizer Familiengärtner-Verband) and their local sections for providing access to their properties; and Grün Stadt Zürich for their support. We thank Christian Rieger (Nürtingen) for the photograph of *Stephantis takeyai*, Gerhard Strauß (Biberach) for the photograph of *Tupiocoris rhododendri*, and Sofia Mangili and Michele Abderhalden for the photographs of *Chlamydatus saltitans* and *Orius laevigatus*; Marco D'Alessandro and Martin Obrist for advice and data bank extractions; Robert Home for correcting the English text; and Wolfgang Rabitsch for the helpful comments on the manuscript.

REFERENCES

Arnold, K. 2009. *Halyomorpha halys* (Stål, 1855), eine für die europäische Fauna neu nachgewiesene Wanzenart (Insecta: Heteroptera: Pentatomidae: Cappaeini). — Mitteilungen des Thüringer Entomologenverbandes e.V. 16: 19.

Aukema, B. 1996. *Stephanitis takeyai* on *Pieris japonica*. — Mededelingen van de Plantenziektenkundige Dienst 179: 46–47.

Aukema, B. & Loomans, A. 2005: De wants *Orius laevigatus* in Nederland (Heteroptera: Anthocoridae). — Nederlandse Faunistische Mededelingen 23: 125–127.

Aukema, B., Bos, F., Hermes, D. & Zeinstra, P. 2005. Nieuwe en interessante nederlandse wantsen II, met een geactualiseerde naamlijst (Hemiptera: Heteroptera). — Nederlandse Faunistische Mededelingen: 23, 37–76.

Aukema, B., Bruers, J.M. & Viskens, G.M. 2007. Nieuwe en zeldzame Belgische wantsen II (Hemiptera: Heteroptera). — Bulletin van de Koninklijke Belgische Vereniging voor Entomologie, 143: 83–91.

Aukema, B. & Rieger, Ch. (eds) 1999. Catalogue of the Heteroptera of the Palaearctic Region. Vol. 3. Cimicomorpha II. — The Netherlands Entomological Society, xiii + 577 pp.

Aukema, B. & Rieger, Ch. (eds) 2006. Catalogue of the Heteroptera of the Palaearctic Region. Vol. 5. Pentatomorpha II. — The Netherlands Entomological Society, xiii + 550 pp.

Aukema, B., Rieger, Ch. & Rabitsch, W. (eds) 2013. Catalogue of the Heteroptera of the Palaearctic Region. Supplement. — The Netherlands Entomological Society, Amsterdam. xxiv + 629 pp.

Bundesamt für Landwirtschaft 2016. Pflanzenschutzmittelverzeichnis (Stand: 03.03.2016). http://www.blw.admin.ch/psm/produkte/index.html?lang=de [Accessed 4th April 2015].

Buri, P., Humbert, J.-Y. & Arlettaz, R. 2014. Promoting pollinating insects in intensive agricultural matrices: field–scale experimental manipulation of hay–meadow mowing regimes and its effects on bees. — PLoS ONE 9 (1): e85635.

Callot, H. & Brua, C. 2013. *Halyomorpha halys* (Stål, 1855), the marmorated stink bug, new species for the fauna of France (Heteroptera Pentatomidae). — L'Entomologiste 69: 69–71.

Castañé, C., Agustí, N., Arnó, J., Gabarra, R., Riudavets, J., Comas, J. & Alomar, O. 2013. Taxonomic identification of *Macrolophus pygmaeus* and *Macrolophus melanotoma* based on morphometry and molecular markers. — Bulletin of Entomological Research, 103 (2): 204–215.

Colombi, L. & Brunetti, R. 2002. Rapporto del Servizio fitosanitario del Cantone Ticino. — Servizio fitosanitario, Bellinzona, 36 pp.

DAISIE European Invasive Alien Species Gateway, 2016. *Macrolophus melanotoma*. http://www.europe-aliens.org/speciesFactsheet.do?speciesId= 51597 [Accessed 4th April 2015].

De Carlini, A. 1887. Rincoti del Sottoceneri. — Bullettino della Società entomologica Italiana Anno 19: 258–277.

Delarze, R. & Dethier, M. 1988. La faune des pelouses steppiques valaisannes et ses relations avec le tapis végétal. III. Les Hétéroptères. — Bulletin de la Société Vaudoise des Sciences Naturelle 79 (1): 49–59.

Dolling, W.R. 1972. A new species of *Dicyphus* Fieber (Hem., Miridae) from southern England. — Entomologist's Monthly Magazine 107: 244–245.

Ewel, J.J., & Putz, F.E. 2004. A place for alien species in ecosystem restoration. — Frontiers in Ecology and the Environment 2 (7): 354–360.

Faeth, S.H., Bang, C. & Saari, S. 2011. Urban biodiversity: patterns and mechanisms. — Annals of the New York Academy of Sciences 1223 (1): 69–81.

Frey-Gessner, E. 1863. Zusammenstellung der durch Meyer–Dür im Frühling im Tessin und Anfang Sommer 1863 im Ober–Engadin beobachteten und gesammelten Hemipteren und Orthopteren. — Mitteilungen der Schweizerischen Entomologischen Gesellschaft 1 (5): 150–154.

Frey-Gessner, E. 1866a. Verzeichnis der schweizerischen Insekten. 1. Hemiptera. — Mitteilungen der Schweizerischen Entomologischen Gesellschaft 2 (1): 7–30.
Frey-Gessner, E. 1866b. Verzeichnis der schweizerischen Insekten. 1. Hemiptera. — Mitteilungen der Schweizerischen Entomologischen Gesellschaft 2 (3): 115–133.
Gaston, K.J., Warren, P.H., Thompson, K. & Smith, R.M. 2005. Urban domestic gardens (IV): the extent of the resource and its associated features. — Biodiversity and Conservation 14 (14): 3327–3349.
Giacalone, I., Dioli, P. & Patocchi, N. 2002. Monitoraggi faunistici alle Bolle di Magadino (Svizzera meridionale) eterotteri acquatici e terrestri (Insecta, Heteroptera: Gerromorpha, Nepomorpha e Geocorisae). — Bollettino del Società ticinese di Scienze naturali 90: 81–92.
Germann, C., Frey, D., Zanetta, A. & Moretti, M. 2015. First record of *Euophryum confine* (Broun, 1881) (Coleoptera, Curculionidae: Cossoninae) in Switzerland. — Mitteilungen der Schweizerischen Entomologischen Gesellschaft 88: 337–340.
Goddard, M.A., Dougill, A.J. & Benton, T.G. 2010. Scaling up from gardens: biodiversity conservation in urban environments. — Trends in Ecology and Evolution 25 (2): 90–98.
Göllner-Scheiding, U. & Rezbanyai-Reser, L. 1992. Zur Wanzenfauna des Monte Generoso, Kanton Tessin, Südschweiz (Heteroptera). — Entomologische Berichte Luzern 28: 15–36.
Göllner-Scheiding, U. & Rezbanyai-Reser, L. 2000. Weitere Angaben zur Wanzenfauna des Monte Generoso, Kanton Tessin, Südschweiz (Heteroptera). — Entomologische Berichte Luzern 44: 123–150.
Heckmann, R. 2012. Erster Nachweis von *Halyomorpha halys* (Stål, 1855) (Heteroptera: Pentatomidae) für Deutschland. — Heteropteron 36: 17–18.
Heckmann, R. & Rieger, Ch. 2001. Wanzen aus Baden-Württemberg – Ein Beitrag zur Faunistik und Ökologie der Wanzen in Baden–Württemberg (Insecta, Heteroptera). — Carolinea 59, Karlsruhe: 81–98.
Heckmann, R. & Blöchlinger, H. 2013. Bemerkungen zur Wanzenfauna des Kantons Thurgau (Hemiptera, Heteroptera). — Mitteilungen der Schweizerischen Entomologischen Gesellschaft 86: 122.
Hobbs, R.J., Higgs, E., & Harris, J.A. 2009. Novel ecosystems: implications for conservation and restoration. — Trends in Ecology & Evolution 24 (11): 599–605.
Hodkinson, D.J. & Thompson, K. 1997. Plant dispersal: the role of man. — Journal of Applied Ecology 34: 1484–1496.
Hollier, J., Heckmann, R. & Strauss, G. 2014. The Dipsocoromorpha (Heteroptera) of Switzerland. — Mitteilungen der Schweizerischen Entomologischen Gesellschaft 87: 95–101.
Hradil, K., Kment, P. & Roháčová, M. 2007. New records of *Liorhyssus hyalinus* (Heteroptera: Rhopalidae) in the Czech Republic, with a review of its worldwide distribution and biology. — Acta Musei Moraviae, Scientiae biologicae 92: 53–107.
Kenis, M. 2005. Insects-Insecta. *In*: Wittenberg, R. (ed.), An inventory of alien species and their threat to biodiversity and economy in Switzerland, pp. 131–212 — CABI Bioscience Switzerland, Delémont.
Killias, E. 1874. 2. Insekten – Hemiptera heteroptera. — Graubünden, Naturforschende Gesellschaft: – Naturgeschichtliche Beiträge zur Kenntnis der Umgebung von Chur (Festschrift), Chur, pp. 110–116.
Killias, E. 1879. I. Verzeichnis der Bündner Hemipteren (Hemiptera Heteroptera Schnabelkerfe, Halbdecker). — Jahresbericht der naturforschenden Gesellschaft Graubündens 12: 57–94.
Kment, P. 2006. Heteroptera – Plostice. *In*: Mlíkovský, J. & Stýblo, P. (eds), Nepuvodní druhy fauny a flory Ceske Republiky, pp. 255–266 — Èeský svaz ochráncù pøírody, Praha.
Knop, E. 2016. Biotic homogenization of three insect groups due to urbanization. — Global Change Biology 22 (1): 228–236.
Kowarik, I. 2011. Novel urban ecosystems, biodiversity, and conservation. — Environmental Pollution 159 (8): 1974–1983.
Kueffer, C. & Kaiser-Bunbury, C.N. 2014. Reconciling conflicting perspectives for biodiversity conservation in the Anthropocene. — Frontiers in Ecology and the Environment 12 (2): 131–137.
Lesieur, V., Yart, A., Guilbon, S., Lorme, P., Auger-Rozenberg, M.-A. & Roques, A. 2014. The invasive *Leptoglossus* seed bug, a threat for commercial seed crops, but for conifer diversity? — Biological Invasions 16: 1833–1849.
Luchi, N., Mancini, V., Feducci, M., Santini, A. & Capretti, P. 2012. *Leptoglossus occidentalis* and *Diplodia pinea*: a new insect-fungus association in Mediterranean forests. — Forest Pathology 42: 246–251.

Macavei, L.I., Bâeţan, R., Oltean, I., Florian, T., Varga, M., Costi, E., & Maisrello, L. 2015. First detection of *Halyomorpha halys* Stål, a new invasive species with a high potential of damage on agricultural crops in Romania — Lucrări Ştiinţifice Seria Agronomie 58 (1): 105–108.

Marris, E. 2013. Rambunctious garden: saving nature in a post-wild world. — Bloomsbury Publishing USA, New York, 210pp.

McKinney, M.L. 2008. Effects of urbanization on species richness: a review of plants and animals. — Urban ecosystems 11 (2): 161–176.

Maistrello, L., Dioli, P., Vaccari, G., Nannini, R., Bortolotti, P., Caruso, S., Costi, E., Montermini, A., Casoli, L. & Bariselli, M. 2014. Primi rinvenimenti in Italia della cimice esotica *Halyomorpha halys*, una nuova minaccia per la frutticoltura. — ATTI Giornate Fitopatologiche 1: 283–288.

Megróz, A. 2008. Ein weiterer neuer Schädling. Die Andromeda–Netzwanze neu auch in der Schweiz. — Der Gartenbau 42 (8): 2–3.

Milonas, P.G. & Partsinevelos, G.K. 2014. First report of brown marmorated stink bug *Halyomorpha halys* Stål (Hemiptera: Pentatomidae) in Greece. — Bulletin OEPP/EPPO Bulletin 44 (2): 183–186.

Nichols, J.D. & Williams, B.K. 2006. Monitoring for conservation. — Trends in Ecology & Evolution 21 (12): 668–673.

Otto, A. 1992. Zur Landwanzenfauna der Magadino–Ebene, Kanton Tessin (Heteroptera: Geocorisae). — Entomologische Berichte Luzern 28: 37–44.

Otto, A. 1996. Die Wanzenfauna montaner Magerwiesen und Grünbrachen im Kanton Tessin (Insecta: Heteroptera). Eine faunistisch–ökologische Untersuchung. — Diss. ETH Nr. 11457, 211 pp.

Otto, A. & Rezbanyai–Reser, L. 1996: Zur Wanzenfauna der Insel Brissago, Kanton Tessin (Heteroptera). — Entomologische Berichte Luzern 35: 49–58.

Owen, J. 1991. The Ecology of a Garden: the first fifteen years. — Cambridge University Press, Cambridge, 403 pp.

Panizzi, A.R. 1997. Wild hosts of Pentatomids: Ecological Significance and Role in Their Pest Status on Crops. — Annual Revue of Entomology 42: 99–122.

Panizzi, A.R., McPherson, J.E., James, D.G., Javahery, M. & McPherson, R.M. 2000. Stink Bugs (Pentatomidae). *In*: Schaefer, C.W. & Panizzi, A.R. (eds), Heteroptera of Economic Importance, pp. 421–474. — CRC Press, Boca Raton, FL.

Péricart, J. 1972. Hémiptères Anthocoridae, Cimicidae et Microphysidae de l'Ouest–Paléarctique. — Masson, Paris, 402 pp.

Pickett, S.T.A., Cadenasso, M.L., Grove, J.M., Boone, C.G., Groffman, P.M., Irwin, E., Kaushal, S.S., Marshall, V., McGrath, B.P., Nilon, C.H., Pouyat, R.V., Szlavecz, K., Troy, A. & Warren, P. 2011. Urban ecological systems: Scientific foundations and a decade of progress. — Journal of Environmental Management 92 (3): 331–362.

Rabitsch, W. 2008. Alien true bugs of Europe (Insecta: Hemiptera: Heteroptera). — Zootaxa 1827: 1–44.

Rabitsch, W. 2010. True Bugs (Hemiptera, Heteroptera). Chapter 9.1. — BioRisk 4: 407–433.

Rabitsch, W. & Friebe, G. 2015. From the west and from the east? First records of *Halyomorpha halys* (Stål, 1855) (Hemiptera: Heteroptera: Pentatomidae) in Vorarlberg and Vienna, Austria. – Beiträge zur Entomofaunistik 16: 115–139.

Raupp, M.J., Shrewsbury, P.M. & Herms, D.A. 2010. Ecology of herbivorous arthropods in urban landscapes. — Annual Review of Entomology 55: 19–38.

Rebele, F. 1994. Urban ecology and special features of urban ecosystems. — Global Ecology and Biogeography Letters 4: 173–187

Rieger, C. 1994. Ein Fund von *Nezara viridula* (Linnaeus, 1758) in Süddeutschland (Heteroptera: Pentatomidae). — Entomologische Zeitschrift 104 (24): 469–472.

Sala, O.E., Chapin, F.S., Armesto, J.J, Berlow, E., Bloomfield, J., Dirzo, R., Huber-Sanwald, E., Huenneke, L.F., Jackson, R.B., Kinzig, A., Leemans, R., Lodge, D.M., Mooney, H.A., Oesterheld, M., Poff, N.L., Sykes, M.T., Walker, B.H., Walker, M. & Wall, D.H. 2000. Global biodiversity scenarios for the year 2100. — Science 287: 1770–1774.

Sattler, T., Duelli, P., Obrist, M.K., Arlettaz, R. & Moretti, M. 2010. Response of arthropod species richness and functional groups to urban habitat structure and management. — Landscape Ecology 25 (6): 941–954.

Schmidt, M., Müller, G. & Landau-Lüscher, I. 2010. Stinkende Wanzen in Zürich. Zwei eingeschleppte Wanzenarten breiten sich in der Schweiz aus. — Fachzeitschrift für Schädlingsbekämpfung 4: 14–15.

Schrameyer, K. 2004. Funde und Foto *Tupiocoris rhododendri* (Dolling, 1972) — Nachrichten aus der Deutschen Gesellschaft für allgemeine und angewandte Entomologie 18: 82.

Šeat, J. 2015. *Halyomorpha halys* (Stål, 1855) (Heteroptera: Pentatomidae) a new invasive species in Serbia — Acta Entomologica Serbica 20: 167–171.
Šefrová, H. & Laštùvka, Z. 2005. Catalogue of alien animal species in the Czech Republic. — Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis 53: 151–170.
Simberloff, D., Martin, J.-L., Genovesi, P., Wardle, D.A., Aronson, J., Courchamp, F., Galil, B., García-Berthou, E., Pascal, M., Pyšek, P., Sousa, R., Tabacchi, E., & Vilà, M. 2013. Impacts of biological invasions: what's what and the way forward. — Trends in Ecology and Evolution 28 (1): 58–66.
Smith, R.M., Thompson, K., Hodgson, J.G., Warren, P.H. & Gaston, K.J. 2006a. Urban domestic gardens (IX): composition and richness of the vascular plant flora, and implications for native biodiversity. — Biological Conservation 129 (3): 312–322.
Smith, R.M., Warren, P.H., Thompson, K. & Gaston, K.J. 2006b. Urban domestic gardens (VI): environmental correlates of invertebrate species richness. — Biodiversity and Conservation 15 (8): 2415–2438.
Smith, R.M., Gaston, K.J., Warren, P.H. & Thompson, K. 2006c. Urban domestic gardens (VIII): environmental correlates of invertebrate abundance. — Biodiversity and Conservation 15 (8): 2515–2545.
Tamburini, M., Maresi, G., Salvador, C., Battisti, A., Zottele, F. & Pedrazzoli, F. 2012. Adaptation of the invasive western conifer seed bug *Leptoglossus occidentalis* to Trentino, an alpine region (Italy). — Bulletin of Insectology 65: 161–170.
Trivellone, V., Knop, E., Turrini, T., Andrey, A., Humbert, J.-Y. & Kunz, G. 2015. New and remarkable leafhoppers and planthoppers (Hemiptera: Auchenorrhyncha) from Switzerland. — Mitteilungen der Schweizerischen Entomologischen Gesellschaft 88: 273–284.
Turrini, T. & Knop, E. 2015. A landscape ecology approach identifies important drivers of urban biodiversity. — Global Change Biology 21 (4): 1652–1667.
Vétek, G., Kondorosy, E., Maráczi, L. 2012. First record of the andromeda lace bug (*Stephanitis takeyai* Drake et Maa) (Heteroptera: Tingidae) in Hungary. — Növényvédelem 48: 21–26.
Vétek, G., Papp,V., Haltrich, A. & Rédei, D. 2014. First record of the brown marmorated stink bug, *Halyomorpha halys* (Hemiptera: Heteroptera: Pentatomidae), in Hungary, with description of the genitalia of both sexes. — Zootaxa 3780 (1): 194–200.
Voigt, K. 1998. *Nezara viridula* erneut in Süddeutschland gefunden! (Heteroptera, Pentatomidae). — Carolinea 56: 121–122.
Villa, M., Tescari, G. & Taylor, S.J. 2001. Nuovi dati sulla presenza in Italia di *Leptoglossus occidentalis* (Heteroptera, Coreidae). — Bollettino della Società Entomologica Italiana 133: 101–112.
Wachmann, E., Melber, A. & Deckert, J. 2004. Wanzen 2 – Die Tierwelt Deutschlands, 75. — Keltern, Goecke & Evers, 294 pp.
Wachmann, E., Melber, A. & Deckert, J. 2006. Wanzen 1 – Die Tierwelt Deutschlands, 77. — Keltern, Goecke & Evers, 263 pp.
Wachmann, E., Melber, A. & Deckert, J. 2007. Wanzen 3 – Die Tierwelt Deutschlands, 78. — Keltern, Goecke & Evers, 272 pp.
Wagner, E. 1970–71. Die Miridae Hahn, 1831, des Mittelmeerraumes und der Makaronesischen Inseln (Hemiptera, Heteroptera). Teil 1. — Entomologische Abhandlungen Museum für Tierkunde, Dresden, 37: 1–484.
Wermelinger, B., Wyniger, D. & Forster, B. 2008. First records of an invasive bug in Europe: *Halyomorpha halys* Stål (Heteroptera: Pentatomidae), a new pest on ornamentals and fruit trees? — Mitteilungen der Schweizerischen Entomologischen Gesellschaft 81: 1–8.
Werner, D. 2005. *Nezara viridula* (Linnaeus, 1758) in Köln und in Deutschland (Heteroptera, Pentatomidae). — Heteropteron 21: 29–31.
Westphal, C., Bommarco, R., Carré, G., Lamborn, E., Morison, N., Petanidou, T., Potts, S.G., Roberts, S.P.M., Szentgyörgyi, H., Tscheulin, T., Vaissière, B.E., Woyciechowski, M., Biesmeijer, J.C., Kunin, W.E., Settele, J. & Steffan-Dewenter, I. 2008. Measuring bee diversity in different European habitats and biogeographical regions. — Ecological Monographs 78: 653–671.
Wheeler, A.G. Jr. 1992. *Leptoglossus occidentalis*. A new conifer pest and household nuisance in Pennsylvania. — Regulatory Horticulture 18: 29–30.
Witschi, F. & Zettel, J. 2002. Auensukzession und Zonation im Rottensand (Pfynwald, Kt. VS). V. Wiederbesiedlung einer Überschwemmungsfläche durch Wanzen (Heteroptera). — Mitteilungen der Schweizerischen Entomologischen Gesellschaft 75: 65–86.
Wyniger, D. 2007. Erstnachweise von *Leptoglossus occidentalis* (Heteroptera, Coreidae) auf der Schweizer Alpennordseite und weitere Funde aus dem Tessin. — Mitteilungen der Schweizerischen Entomologischen Gesellschaft 80: 161–165.

Wyniger, D. & Burckhardt, D. 2003. Die Landwanzenfauna (Hemiptera, Heteroptera) von Basel (Schweiz) und Umgebung. — Mitteilungen der Schweizerischen Entomologischen Gesellschaft 76: 1–136.

Wyniger, D. & Kment, P. 2010. Key for the separation of *Halyomorpha halys* (Stål) from similar-appearing pentatomids (Insecta: Heteroptera: Pentatomidae) occuring in Central Europe, with new Swiss records. — Mitteilungen der Schweizerischen Entomologischen Gesellschaft 83: 261–270.

(received April 25, 2016; accepted May 11, 2016; published June 30. 2016)