Title: Stictocephala bisonia Kopp et Yonke, 1977 (Hemiptera: Cicadomorpha, Membracidae) in Poland

Author: Marcin Walczak, Jolanta Brożek, Łukasz Junkiert, Małgorzata Kalandyk-Kołodziejczyk, Natalia Kaszyca, Anna Łazuka i in.

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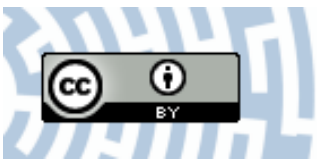

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Marcin Walczak[1,4], Jolanta Brożek[1], Łukasz Junkiert[1], Małgorzata Kalandyk-Kołodziejczyk[1], Krzysztof Musik[2], Natalia Kaszyca[1], Anna Łazuka[1], Grzegorz Gierlasiński[3]

Stictocephala bisonia Kopp *et* Yonke, 1977 (Hemiptera: Cicadomorpha, Membracidae) in Poland

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[1] University of Silesia in Katowice, Faculty of Biology and Environmental Protection, Department of Zoology, Bankowa 9, 40-007 Katowice, Poland

[2] Upper Silesian Nature Heritage Centre, Graniczna 29, 40-543 Katowice, Poland

[3] Doliny Miętusiej 27/44, 43-316 Bielsko-Biała, Poland

e-mail: [4] marcin.walczak@us.edu.pl

Abstract: The aim of this paper is to provide new data on a distribution of alien and invasive species *Stictocephala bisonia* Kopp *et* Yonke, 1977 in Poland. This species has rapidly spread across Europe and other parts of the world in the last 100 years and has colonized new territories. *S. bisonia* belongs to the group of leafhopper species of Nearctic origin.

Key words: buffalo treehopper, Poland, invasive species, biological invasion, ecology, agriculture, crop losses, economic importance of insects.

INTRODUCTION

Stictocephala bisonia Kopp *et* Yonke, 1977 is an invasive leafhopper species that is native to the central and eastern part of North America (Arzone *et al.* 1986, Mifsud *et al.* 2010). Apart from *Gargara genistae* (Fabricius, 1775) and *Centrotus cornutus* (Linnaeus, 1758) it is one of three species of the family Membracidae in Poland at the moment (Świerczewski & Stroiński 2011). Before the taxonomic position has changed it was classified as *Ceresa bubalus* (Fabricius, 1794) (Kopp & Yonke 1977).

During last 100 years *S. bisonia* has expanded its range in many regions of the world and invaded new territories. Since then, this species has been introduced to the western part of USA, Hawaii, Europe, North Africa, even to the Caucasus region and Central Asia (Świerczewski & Stroiński 2011). In Europe it was recorded for the first time in Kovin (Serbia) before 1912 (Horvath 1912) and just after that time in St-Guilhem-le-Désert and Lattes near Montpellier (France) in 1918 (Lallemand 1920), resulting in the further colonization of the continent and currently it has been found in Albania, Austria, Belgium, Bulgaria, Czech Republic, Germany, Greece, Italy, Macedonia, Moldavia, Poland, Portugal, Romania, Slovakia, Spain, Switzerland, Ukraine, Turkey and former countries

of Yugoslavia: Bosnia, Herzegovina, Croatia and Slovenia (Uvarov 1939, Hoffrichter & Tröger 1973, Okali 1974, Drosopoulos 1980, Gunthart 1980, Arzone *et al.* 1986, Nast 1987, Janský *et al.* 1988, D'Urso 1995, Lauterer 1996, Seljak 2002, Holzinger *et al.* 2003, Gjonov & Shishiniova 2014, Hoch 2018). It has been observed, that *S. bisonia* has colonized almost the whole continent excluding the northern areas. First time *S. bisonia* was noticed in Poland in 2007 from Rzeszów and next from Stara Miłosna and Zagorzyce (Świerczewski & Stroiński 2011). Since that time it has gradually spread all over the country.

BIOLOGY, DISTRIBUTION AND ECONOMIC IMPORTANCE

In the first half of the 20th century *S. bisonia* was treated as widespread, but rather rare species in North America (Yothers 1934), although it was recorded in Europe at that time (Horváth 1912). Several features are decisive for the adaptation and speed of spreading of *S. bisonia*. The most important of which are related to the fact this species is polyphagous and eurythermic. Krištín *et al.* (1987) observed individuals of this species in Slovakia between August and November, which were alive regardless of the wide range of the ambient temperatures between -1 and +36°C. Most of all specimens were recorded in September. Those insects laid eggs in rather high temperature, about 22°C. *S. bisonia* is able to colonize new areas also due to the condition of being polyphagous species with a wide range of potential food-plants. This species feeds on a several dozen plant species and it has been collected from: *Acer* spp., *Alcea rosea*, *Alnus glutinosa*, *Armeniaca vulgaris*, *Aristolochia* spp., *Artemisia vulgaris*, *Carpinus betulus*, *Castanea sativa*, *Cerasus vulgaris, Chrysanthemum indicum*, *Cirsium arvense*, *Clematis vitalba*, *Convolvulus arvensis*, *Cornus sanguinea, Crataegus laevigata*, *Erigeron annuus*, *Fraxinus excelsior*, *F. ornus*, *Humulus lupulus*, *Juglans regia*, *Galega officinalis*, *Gossypium* spp., *Ligustrum vulgare*, *Malus pumila*, *Medicago sativa*, *Melilotus alba*, *Morus alba*, *M. nigra*, *M. rubra*, *Onobrychis viciifolia*, *Padus avium*, *Plantago major*, *Persica vulgaris*, *Polygonum aviculare*, *P. persicaria*, *Populus alba*, *P. nigra*, *P. tremula*, *Prunus amygdalus*, *P. domestica*, *P. spinosa*, *Pyrus* spp., *Quercus* spp., *Ribes nigrum*, *R. rubrum*, *Rhamnus* spp., *Robinia pseudacacia*, *Rosa canina*, *Rubus caesius*, *R. idaeus*, *Rumex acetosa*, *R. acetosella*, *R. crispus*, *Salix alba*, *S. caprea*, *S. fragilis*, *S. purpurea*, *Solanum tuberosum, Solidago canadensis*, *S. gigantea*, *Tanacetum vulgare*, *Taraxacum officinale*, *Tilia* spp., *Trifolium repens*, *Ulmus minor*, *Urtica dioica*, *Vicia faba*, *V. sativa*, *V. labrusca* and *Vitis vinifera* (Yothers 1934, Saas 1979, Krištín *et al.* 1987, Janský *et al.* 1988, Lauterer *et al.* 2011). Among these species there are many plants of economic importance. According to Yothers (1934), *S. bisonia* was considered as serious pest in USA in the first half of the 20th century. It is generally recognized as perhaps the most injurious of all the Membracidae. This species has caused yield losses in orchards and vineyeards in the southern part of Europe over a period of several decades, mainly during more and more frequent gradation phases.

It is an occasional pest of fruit trees, causing injuries to young twigs by cutting the bark and phloem during the oviposition, frequently resulting in their dieback and facilitating a transmission of fungal and bacterial diseases (Lauterer & Zacha 1984, Lauterer 1995, Arzone *et al*. 1986, Seljak 2002). Occurrence of *S. bisonia* is manifested by the presence of easily detectable puncture spots and the discoloration of the leaves apexes. These symptoms were observed e.g. in plantations of grape-bearing vines in the area of Tyrol. Damage due to the feeding of adults and larvae has been also reported on grapevine and alfalfa (Vidano 1963, 1964). The most serious damages to fruit trees and grapevine are caused by this insect pest during its gradation years (Seljak 2002, Lauterer *et al.* 2011). These symptoms are

often confused with those caused by Grapevine yellows phytoplasmas (Kunz *et al.* 2010). It is supposed, that this species does not transmit phytoplasmas astests for ESCA syndrome and grapevine leaf-roll gave negative results (Starý *et al.* 2013). However, the monitoring programme of *S. bisonia* is needed because of plant damage and crop losses caused by this species. The attributes like protective coloration and shape, which enable it to blend with its surroundings and afford it protection from observation by its predators, are undoubtedly important in the colonization of new areas by *S. bisonia*.

These insects are considered to be good flyers, so the ability to fly long distances can facilitate invasion of this species. It was observed that specimens of *S. bisonia* covered a distance up to 50 m during 1 hour and about 300 m during twenty four hours (Janský *et al.* 1988). It spreads most efficiently through watercourses, cultivations of fruit trees, grapevine, lucerne and arteries of traffic (Schedl 1991). *S. bisonia* is succesful in spreading to new areas, which is confirmed by its presence in over 20 European countries (Mifsud *et al.* 2010). This species range includes large part of Europe with almost whole southern, western and central part, an also southern part of Turkey, Ukraine and Caucasus (Arzone *et al*. 1986, Seljak 2002, Świerczewski & Stroiński 2011). Until nineties of 20th century it has been noticed to 50 latitude of north (Schedl 1991), the last information from Poland confirm that *S. bisonia* extended its range up to 54 latitude (Brysz & Szwedo 2015). The determination of seasonal fluctuations of these insects abundance is of great importance as this species becomes more and more common. Finding these data are not easy, because the majority of the articles focuses on crop losses caused by *S. bisonia* and information about the single specimens observed are not given. However, there are some articles on localities of this species and data have been published mainly by authors from Austria, Czech Republic, Poland (Fig. 1.), Germany and Bulgaria.

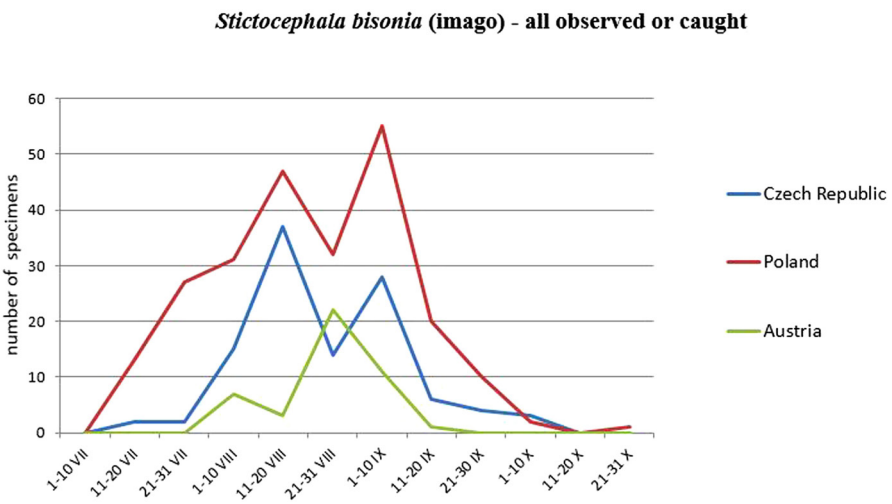

Fig. 1. Seasonal changes in abundance of *Stictocephala bisonia* in central Europe – all observed and caught imago specimens in the territory of Poland (based on new and previously published data: Świerczewski & Stroiński 2011, Kolak & Taszakowski 2013, Musik & Taszakowski 2013, Brysz & Szwedo 2015, Dobosz & Szwedo 2015, Taszakowski *et al*. 2015, Walczak *et al.* 2016, 2018, Musik *et al.* 2018), Czech Republic (on the base: Lauterer *et al*. 2011) and Austria (Schedl 1991). Some data contained approximate number of specimens, therefore the graph may contain a small measurement error (no more than 10% for the presented areas).

It was observed, that adult specimens of this species emerged in July and the earliest observations were recorded in Czech Republic on July 12th and in Germany on July 14th, while the latest in Czech Republic on October 10th, in Germany October 27th and in Slovakia on November 11th (Krištín *et al.* 1987, Landeck 2011, Lauterer *et al.* 2011). In Poland the adult insects were observed between July 18th an October 26th (see in: New records). To summarize, in the central part of Europe adult specimens of *S. bisonia* are most abundant between second decade of August and first decade of September (Fig. 1.). This conclusion is confirmed by comprehensive information about its occurrence in Poland and Czech Republic and also by observations made in Austria, Bulgaria and Germany, where adults were the most abundant in August and September (Schedl 1991, Landeck 2011, Gjonov & Shishiniova 2014). Information about immature stages of *S. bisonia* is unavailable. According to Schedl (1991) first nymphs were found in Austria on May 26th, whereas immatures were collected in Beskid Wschodni (Poland) on May 10th (Taszakowski *et al.* 2015).

MATERIAL AND METHODS

Specimens of *S. bisonia* were collected between 2011 and 2018. Common collecting methods were used, including a sweep net (Ø = 30 cm) and visual examination of host plants (Walczak *et al.* 2016). Specimens were killed with ethyl acetate or ethanol. In this latter case they were preserved in vials containing solution of ethanol in water. Specimens were identified on the basis of their morphology using the identification keys by Biedermann & Niedringhaus (2004) and Świerczewski & Stroiński (2011). The division into zoogeographical region was adopted from „*Katalog Fauny Polski*" (Burakowski *et al.* 1973) and the names of regions from Gębicki *et al.* (2013).

Specimens are deposited in the Insect Collection of the Department of Zoology (DZUS) (Faculty of Biology and Environmental Protection, University of Silesia, Katowice, Poland). Katarzyna Strzelczyk, who is a student of the Faculty of Biology and Environmental Protection, University of Silesia, was given a permission to legally collect leafhoppers in "Łężczok" Nature Reserve by the Regional Director for Environmental Protection in Katowice (permission number RDOŚ PN 6205.30.2015 MM).

DISTRIBUTION IN POLAND

Published records.

S. bisonia were recorded from 19 localities (in 8 zoogeographical regions) in Poland to date (Fig. 2.):

Baltic Coast: Gdańsk-Oliwa [CF43] (Brysz & Szwedo 2015); **Wielkopolsko-Kujawskia Lowland:** "Łęgi koło Słubic'' Nature Reserve [VU60, VT79] (Brysz & Szwedo 2015); **Mazovian Lowland:** Stara Miłosna [EC18] (Świerczewski & Stroiński 2011); **Upper Silesia** : Wodzisław Śląski [CA14] (Kolak & Taszakowski 2013), Rudziniec [CA18] (Dobosz & Szwedo 2015), Piekary Śląskie [CA58], Bukowno [CA86] (Musik *et al.* 2018); **Krakowsko-Wieluńska Upland:** Częstochowa-Dźbów [CB62] and Częstochowa-Lisiniec [CB63] (Walczak *et al.* 2016); **Małopolska Upland:** Łódź: Widzew, Młynek and Botanic Garden [CC93] (Brysz & Szwedo 2015); **Sandomierska Lowland:** Rzeszów [EA63], Zagorzyce [EA44] (Świerczewski & Stroiński 2011); **Eastern Beskidy Mountains:** Libusza [EA10], Dobrynia [EV39], Lisów [EA21], Ożenna [EV37], Zdynia [EV28] (Musik & Taszakowski 2013, Taszakowski *et al.* 2015), Bartne [EV29] (Walczak *et al.* 2018).

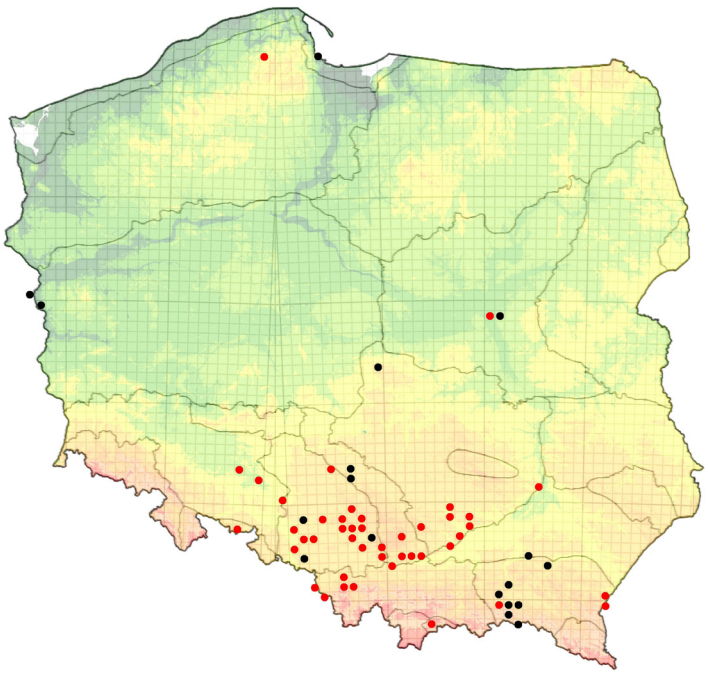

Fig. 2. Distribution of *Stictocephala bisonia* in Poland: ● – published records from Poland, ● – new localities in Poland.

New records.

This paper presents information about 68 new localities of *S. bisonia* situated in 11 zoogeographical regions in Poland (Fig. 2). *S. bisonia* is a species new to 5 regions: Pomeranian Lake District, Lower Silesia, Eastern Sudetes Mountains, Western Beskidy Mountains and Pieniny Mountains. Data were collected by many researchers, so they may be presented in different ways.

Pomeranian Lake District (reported here as new to this region):

Kaszubski PK, Kamienica Królewska [54º23'32"N, 17º53'19"E; XA83], 24.07.2018, 1 ex., observ. R. Kaźmierczak.

Mazovian Lowland:

Warszawa, Zakole Wawerskie [52°13'47"N, 21°08'08"E; EC08], 01.08.2018, 1 ex., observ. D. Kowalczyk.

Lower Silesia (reported here as new to this region):

Brzeg [50º51'35"N, 17º28'02"E; XS73], 07.08.2014, 1 ex., observ. J. Regner;

Chróścice, gm. Dobrzeń Wielki [50º46'43"N, 17º48'44"E; XS92], 02.09.2018, 1 ex., observ. M. Lisowska;

Gogolin [50°29'31"N, 18°01'16"E; BB89], 06.09.2018, 2 exx., observ. M. Pastrykiewicz;

Gogolin [50°30'17"N, 18°01'35"E; BB89], 10.09.2018, 3 exx., closed quarry near garbage dump, observ. M. Pastrykiewicz;

Górażdże, the Limestone Quarry Górażdże [50°31'58"N, 18°01'15"E; BB90], a xerothermic grasslands, on *Prunus domestica*: 26.07.2018, 1♀, leg. M. Walczak;

Górażdże, the Limestone Quarry Górażdże [50°31’54”N, 18°01’24”E; BB90], a coast of the water reservoir, on *Alnus* sp.: 26.07.2018, 3♂♂, leg. M. Walczak;

Górażdże, the Limestone Quarry Górażdże [50°32’10”N, 18°01’01”E; BB90], a reed bed (*Phragmition*), on *Salix* sp.: 26.07.2018, 2♂♂, 1♀, leg. M. Walczak, 4♀♀, leg. A. Łazuka;

Górażdże, the Limestone Quarry Górażdże [50°31’49”N, 18°01’30”E; BB90], a mixed forest, on schrubs: 26.07.2018, 1♀, leg. A. Łazuka;

Górażdże, the Limestone Quarry Górażdże [50°32’08”N, 18°01’15”E; BB90], a ruderal community with domination *Calamagrostis epigejos*, on young seedlings *Populus nigra*: 26.07.2018, 3♀♀, leg. A. Łazuka.

Upper Silesia:

Będzin, Łagisza [50º20’58”N, 19º08’14”E; CA67], 06.09.2017, 2 ex., observ. S. Skrzypiec;

Chorzów, Wiejska Street, “Żabie Doły” [50°19’12.8”N, 18°57’33.5”E; CA57], a spoil heap: 18.07.2014, 7♂♂, 3♀♀, 04.08.2014, 3♂♂, 4♀♀, 18.08.2014, 2♂♂, 6♀♀, 04.09.2014, 4♂♂, 1♀, leg. M. Gibas;

Chorzów, Wiejska Street, “Żabie Doły” [50°19’13.5”N, 18°57’38.7”E; CA57], an initial forest community dominated by birches that overgrows an edge of a spoil heap: 18.07.2014, 2♂♂, 1♀, 04.08.2014, 6♂♂, 2♀♀, 18.08.2014, 4♂♂, 2♀♀, 04.09.2014, 4♂♂, leg. M. Gibas;

Dąbrowa Górnicza, Antoniów, close to Spacerowa Street [50°22’19”N, 19°12’47”E; CA78], a thicket: 12.08.2016, 1♂, leg. A. Potocki;

Gliwice, Łabędy, Fabryczna Street, [50°20’59”N, 18°37’13”E; CA38], garden, on *Cydonia* sp.: 14.09.2016, 2♂♂, 1♀, leg. Ł. Junkiert;

Imielin, Golcówka [50°08’53”N, 19°12’55”E; CA75], a xerothermic grasslands: 13.08.2017, 1♀, leg. N. Kaszyca;

Katowice, Dąbrówka Mała, Szwedzka Street, near Ikea [50°16’11”N, 19°03’29”E; CA67], a ruderal plant community: 17.08.2013, 1 ♀, leg. L. Kruszelnicki;

Kotlarnia [50°16’13”N, 18°22’26”E; CA07], 12.08.2018, at least 5 exx., Coal Mine, observ. M. Pastrykiewicz;

Miejsce, near Spytkowice [50°01’05”N, 19°30’33”E; CA94], 20.08.2016, 1 ex., observ. G. Kolago;

Mysłowice, a vicinity of Piastów Śląskich Street [50°10’32”N, 19°05’43”E; CA66], a mining waste of “Mysłowice-Wesoła” Coal Mine: 30.08.2014, 1♂, leg. M. Pniok;

Piekary Śląskie, Lotników Street [50°21’59”N, 18°58’14”E; CA58], a post-industrial wasteland covered with a grass community dominated by *Deschampsia caespitosa*: 27.09.2011, 1♀, leg. M. Kalandyk-Kołodziejczyk;

Pilchowice, Stanicka Street [50°12’37”N, 18°32’42”E; CA26], post-agricultural wasteland: 24.09.2012, 1♀, 28.08.2013, 1♂ (Fig. 3.), 14.09.2013, 1♀, leg. Ł. Junkiert;

Puszczew [50°48’09”N, 18°51’21”E; CB43], garden, 14.08.2018, 2♂♂, 1♀, leg. M. Walczak;

Racibórz, Markowice, “Łężczok” Nature Reserve [50°07’43”N, 18°16’14”E; CA05], a thicket of *Salix* sp.: 17.07.2016 1♂, 22.07.2016 1♂, 14.09.2016 1♀, leg. K. Strzelczyk;

Rogoźnik [50º24’02”N, 18º57’36,6”E; CA58], a thicket at the lakeshore: 18.08.2012, 1♀, leg. K. Musik;

Ruda Kozielska, [50º12’N, 18º24’E; CA16], on *Salix* sp.: 30.08.2013, 1♂, leg. Ł. Junkiert;

Babice near Nędza, Rudzka Street, [50°08’47’’N, 18°17’52’’E; CA05], wayside shrubs: 17.08.2011, 1♀, leg. Ł. Junkiert;

Siemianowice, Przełajka, Rzeczna Street, [50º20’47”N, 19º03’31”E; CA67], a meadow located near Brynica River: 24.09.2016, 1♂, 6♀♀, leg. J. Brożek;

Fig. 3. Habitus of *Stictocephala bisonia*, dorsal view – male from Pilchowice (collected on 28 August 2013), leg. and det. Ł. Junkiert.

Sosnowiec, Zagórze, a vicinity of Kielecka Street [50°17'21"N, 19°10'46"E; CA77], urban greenery: 13.08.2016, 1♂, leg. M. Walczak;

Świętochłowice, "Hugona Hill", a vicinity of Śląska Street [50°16'38.8"N, 18°54'48.0"E; CA57], a forest community overgrowing a coal mine heap: 21.07.2014, 2♂♂, 1♀, 1 nymph, 06.08.2014, 2♂♂, 21.08.2014, 3♀♀, leg. M. Gibas;

Trzebinia [50°09'30"N, 19°28'10"E; CA95], 02.10.2012, 1 ex., leg. R. Celadyn, det. & coll. A. Itczak.

Krakowsko-Wieluńska Upland:

Czajowice, quarry [50º11'22"N, 19º48'23"E; DA16], 10.09.2016, 1 ex., observ. G. Kolago;

Kłokoczyn [49º59'42"N, 19º38'14"E; DA03], 17.08.2014, 1 ex., observ. G. Kolago;

Kraków-Czyżyny [50º03'50"N, 20º00'51"E; DA24], wasteland, the remains after garden plots, 05.09.2014, at least 10 exx., observ. G. Kolago;

Kraków-Dębniki, ul. Gronostajowa [50º01'38"N, 19º53'55"E; DA24], *Solidago* sp. and *Urtica dioica* shrubs near Gronostajowa Street, 50°01'42", E19°53'52", 15.09.2015, 7♂♂, 8♀♀, leg. M. Kobiałka & M. Walczak, 04.09.2017, 6♂♂, 6♀♀, leg. A. Michalik, T. Szklarzewicz & M. Walczak;

Kraków-Dębniki, osiedle Bodzów, quarry [50º02'10"N, 19º52'26"E; DA14], 27.08.2015, 1 ex., observ. G. Kolago;

Kraków, Krzemionki [50º02’22”N, 19º56’49”E; DA24], 10.09.2016, 1 ex., observ. G. Kolago;

Kraków, Łąki Nowohuckie [50º04’02”N, 20º02’07”E; DA34], 16.08.2016, 1 ex., observ. G. Kolago;

Kraków, Park Lotników Polskich [50º04’13”N, 19º59’36”E; DA24], 31.08.2016, 1 ex., observ. G. Kolago;

Kraków, Dąbski Pond [50º03’54”N, 19º59’14”E; DA24], 24.07.2017, 1 ex., observ. G. Kolago;

Kraków, Płaszowski Pond [50º02’30”N, 19º58’02”E; DA24), 20.08.2015, 1 ex., observ. G. Kolago;

Przylasek Rusiecki [50º03’33”N, 20º09’30”E; DA34], 26.10.2013, 1 ex., observ. G. Kolago;

“Bonarka” Nature Reserve, vicinity [50º01’47”N, 19º57’31”E; DA24], 04.09.2016, 1 ex., observ. G. Kolago.

Małopolska Upland:

Kalina-Lisiniec, Natura 2000, buffer zone of the floristic Nature Reserve “Kalina-Lisiniec” [50°21’42”N, 20°09’22”E; DA37], 02.08.2018, 1 ex., observ. G. Kolago;

Nowy Korczyn [50°17’46”N, 20°48’19”E; DA87], a meadow near Wisła River, 07.08.2015, 1 ex., observ. G. Kolago;

Pińczów, a vicinity of Wierciszów [50°30’56”N, 20°33’07”E; DA69], a xerothermic grasslands: 22.07.2017, 3♂♂, leg. Ł. Depa & N. Kaszyca;

Piotrowice [50°11’34”N, 20°39’34”E; DA76], Wisła riverside, 09.08.2014, 1 ex., observ. G. Kolago;

Polana Polichno [50°28’46”N, 20°30’05”E; DA69], 12.08.2018, 1 ex., observ. R. Kaźmierczak;

“Góry Pieprzowe” Nature Reserve [50°41’05”N, 21°47’08”E; EB51], 07.09.2014, a few exx., 30.08.2015, 1 ex., observ. G. Kolago;

“Góry Wschodnie” Nature Reserve [50°22’18”N, 20°44’02”E; DA88], 02.09.2018, 1 ex., observ. G. Kolago

Wola Chorberska [50°23’52”N, 20°31’15”E; DA68], a xerothermic grasslands: 22.07.2017, 1♀, leg. Ł. Depa & N. Kaszyca.

Sandomierska Lowland:

Morsko (Koszycki Obszar Chronionego Krajobrazu) [50º08’34”N, 20º32’59”E; DA65], 26.07.2017, 1 ex., 24.08.2017, 1 ex., observ. G. Kolago.

Eastern Sudetes Mountains (reported here as new to this region):

Opawskie Mountains, Wierzbiec [50º19’19”N, 17º27’25”E; XR77], 30.08.2017, 2♂♂, 1♀, leg. K. Błaszczyk, D. Świerczewski & M. Walczak.

Western Beskidy Mountains (reported here as new to this region):

Bielsko-Biała, Dolina Gościnna [49º47’10”N, 19º01’04”E; CA51], 10.09.2013, 1 ex., leg. & det. G. Gierlasiński;

Bielsko-Biała, Kozia Góra [49º46’04”N, 19º02’21”E; CA51], 29.08.2015, 1 ex., leg. & det. G. Gierlasiński;

Bielsko-Biała, Trzy Lipki [49º50’05”N, 19º01’02”E; CA52], 12.09.2015, 1 ex., leg. & det. G. Gierlasiński;

Buczkowice [49º43’40”N, 19º04’09”E; CA61], 30.07.2014, 1 ex., observ. G. Gierlasiński;

Bystra [49º45’09”N, 19º01’15”E; CA51], 29.09.2017, 1 ex., leg. & det. G. Dubiel;

Cieszyn, ecological use "Łąki na Kopcach" [49º46'09"N, 18º37'00"E; CA21], 18.08.2018, 1 ex., leg. & det. G. Gierlasiński;

Leszna Górna [49º41'32"N, 18º43'49"E; CA30], 22.08.2018, 1 ex., leg. & det. G. Gierlasiński;

Meszna [49º44'46"N, 19º03'47"E; CA61], 17.08.2017, 1 ex., observ. G. Gierlasiński;

Milówka [49º33'33"N, 19º05'12"E; CA69], 09.09.2017, 1 ex., leg. & det. G. Gierlasiński.

Eastern Beskidy Mountains:

Męcina Wielka, close to Gorlice [49°37'20''N, 21°15'53''E; EV19], a mesotrophic grassland communities: 07.08.2018, 2♂♂, leg. N. Kaszyca;

Nowe Sady [49°38'27''N, 22°44'37''E; FA20], 19.08.2018, 1 ex., the shrubs near Wiar Riverside, leg. T. Rutkowski;

Nowosiółki Dydyńskie [49°38'10''N, 22°43'49''E; FV29], the shrubs near Wiar Riverside, 1 ex., 18.08.2018, leg. T. Rutkowski;

Pacław [49°37'31''N, 22°42'24''E; FV29], 1 ex., 22.08.2018, leg. T. Rutkowski.

Pieniny Mountains (reported here as new to this region):

Maniowy [49º27'32"N, 20º15'54"E; DV47], 11.08.2018, 1 ex., leg. & det. G. Gierlasiński.

Moreover another specimens were observed in Łódź in localities previously noticed:

Łódź (CC93), 11.08.2016, 1 ex., 02.09.2017, 1 ex., 18.08.2018, 1 ex., Łódź (DC03), 13.08.2017, 1 ex., observ. R. Kaźmierczak.

DISCUSSION

Biological invasions, which are considered as a global phenomenon that largely decreases global biodiversity, have become a serious ecological and economic problem in the recent years. They can be treated as „side effects" of dynamic development of our civilization.

Our fear of invasive species is caused by their adverse effects on the environment and negative impact on yields. These species can change habitats so the ecosystems they inhabited are supposed to loss their dynamic equilibrium. Food source availability and the lack of predators feeding on them in the new location may cause invasive species population growth. Invasive species outcompete native species for resources such as nutrients, light and water and can crowd out native animals or plants (Perrings 2001, Brown & Sax 2005, Mattson *et al*. 2007, Mifsud *et al.* 2010 Wilson *et al.* 2016), moreover they may contribute to many native species extinction (Rothschild 1907, Wilmshurst *et al.* 2008). Many species of Cicadomropha and Fulgoromorpha are considered as serious agricultural pests such as *Nilaparvata lugens* and *Sogatella furcifera*, which cause damages to rice crops in Asia and they are among the most important insect pests in the world (Ghosal *et al.* 2018, Rathee & Dalal 2018). In Europe crop losses, damages to garden plants and at nurseries caused by alien species of Cicadomropha and Fulgoromorpha are more and more noticeable. *S. bisonia* is not the only species that has negative impact on cultivated plants. There are other species, attacking plants, with non-european origin: *Erythroneura vulnerata*, *Scaphoideus titanus* and *Metcalfa pruinosa* (Arzone *et al*. 1986, Seljak 2002, Papura *et al.* 2012, Gogan *et al.* 2013, Gjonov & Shishiniova 2014, Preda & Skolka 2011). The Auchenorrhyncha species that are non-native to Europe were recently summarized by Mifsud *et al.* (2010) and, according to this review, a total of 12 species introduced from North America and East Asia have been established in Europe. At least 6 leafhopper species that have invaded Europe and have been recorded recently should be included in this list: *Ricania japonica*, *Erasmoneura vulnerata*, *Osbornellus auronitens*, *Penestragania apicalis*, *Penthimiola bella* and *Sophonia*

orientalis (Gjonov 2011, Seljak 2011, Nickel *et al.* 2013, Zina *et al.* 2013, Trivellone *et al.* 2017, Wilson *et al.* 2011). Many of them have colonized Central Europe, while 5 of them have been encountered in Poland so far: *Graphocephala fennahi*, *Eupteryx decemnotata*, *Japananus hyalinus*, *Orientus ishidae* (Soika & Łabanowski 2000, Musik 2011, Walczak *et al*. 2012, Lubiarz & Musik 2015, Klejdysz *et al*. 2017) and mentioned here *S. bisonia*. Our results presented here extend the knowledge of the distribution of *S. bisonia* in Poland and constitute a basis for the further research in Poland and other countries. The research program for this species should include: monitoring of the range expansion, measurement of population size per unit area, account for crop yield losses and gathering information on host plants – especially cultivated plants.

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NOTICES/COMMENTS

The presented work initially concerned only the occurrence of *S. bisonia* in Upper Silesia. The process of its creation was, however, long, and during the preparation in several works was quoted in a less numerous composition and under a different title [Walczak M., Brożek J., Junkiert Ł., Kalandyk-Kołodziejczyk M., Musik K. in prep. *Stictocephala bisonia* Kopp *et* Yonke, 1977 (Hemiptera: Cicadomorpha, Membracidae) in Upper Silesia]. For this reason, the earlier citation should be referred to the article presented here.

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