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The first records of the Nearctic treehopper *Stictocephala bisonia* in Poland (Hemiptera: Cicadomorpha: Membracidae) with some comments on this potential pest

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ABSTRACT. *Stictocephala bisonia* KOPP et YONKE, 1977 has been recorded for the first time in three localities in Poland. This is a Nearctic species introduced into Europe at the beginning of the 20th century and has expanded its range ever since. We briefly characterize this new treehopper and provide a key to the identification of the Polish species of Membracidae.

KEY WORDS: Hemiptera, Cicadomorpha, Membracidae, *Stictocephala bisonia*, alien species, Poland.

INTRODUCTION

Treehoppers or membracids are a diverse group of leafhoppers (Cicadomorpha) with around 3200 species described in over 600 genera (DIETRICH 2000). Currently, these herbivorous hemipterans are classified into three separate families: Melizoderidae, Aetalionidae and Membracidae. The last is the largest and most widespread worldwide, with more than 1600 species known from the New World, of which Smiliinae and Membracinae share the highest percentage ratio (44 and 28%, respectively) (WOOD 1993).

With a body size ranging from 2 to 24 mm, these insects are easy to distinguish from other hemipterans owing to the enlarged and ornate pronotum, possessing differently

shaped extensions and elongations. Some explanations of this phenomenon were reviewed by DIETRICH (2002). Earlier it had been suggested that these insects mimic various structures of their host plants such as buds, leaves and thorns or venomous insects (ants, wasps). Later, some researchers claimed that the spiny pronotal processes of many species deter vertebrate predators, and this hypothesis has received some scientific support. At the same time, some were convinced that the expanded pronotum lacked adaptive significance and had evolved independently of natural selection. The most important point was the discovery of the presence of numerous sensory pits on the membracid pronotum, which would suggest selection supporting increased sensory surfaces or evaporative surfaces for dispersal of pheromones. Taking into account recent physiological studies of thermoregulation in cicadas, it is possible that pronota with larger, pitted surface areas are more effective in heat transfer (DIETRICH 2002 and publications cited there).

Treehoppers are interesting not only for their bizarre forms but also for their unusual behaviour. Many species are gregarious, forming large and often conspicuous nymphal or adult aggregations. Additionally, some membracids reveal mutualistic association with their ant attendees, which may also be beneficial for plants (MORALES 2000). STYRSKY & EUBANKS (2007) suggested that predaceous ants may discourage outbreaks of pest herbivores on the plants they inhabit. Furthermore, being fairly common in many ecosystems, treehoppers are food for vertebrate and invertebrate predators. In general, they are not considered to be serious agricultural or forest pests, even though some mechanically injure plant stems during oviposition.

Only four membracids are native to Europe: *Centrotus chloroticus* FAIRMAIRE, 1851, *Centrotus cornutus* (LINNAEUS, 1758) and *Gargara genistae* (FABRICIUS, 1775), which are representatives of the subfamily Centrotinae, and *Oxyrhachis capeneri* IZZARD, 1953, belonging to the subfamily Oxyrhachinae (NAST 1972, 1987). Two of the above – *Centrotus cornutus* and *Gargara genistae* – are widely distributed in Europe, including Poland. The former is usually associated with low-growing woody plants (*Populus*, *Quercus*, *Rubus*, *Prunus* and others), while the latter prefers woody species of Fabaceae, mainly *Cytisus scoparius* and *Genista tinctoria*, on heaths, roadside embankments and along forest margins (NICKEL 2003). Recently, we have discovered the presence of another membracid species in Poland, *Stictocephala bisonia* KOPP et YONKE, 1977, which can be easily distinguished from the other two native species by the characteristic shape of the pronotum (see the key).

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Distribution, taxonomy and biology of *Stictocephala bisonia* KOPP et YONKE, 1977

(Figs 1-2)

Stictocephala bisonia, or the buffalo treehopper, is a membracid species belonging to the subfamily Smiliinae with its original, native range restricted in the past to Eastern and Midwestern North America; with the growing trade in nursery stock, however, the species has been accidentally introduced into the Western USA, Hawaii and Europe (ARZONE et al. 2007). It appeared in Europe for the first time in Hungary before 1912 (HORVATH 1912) and from that time on the species has gradually spread over the whole continent, apart from the northern- and easternmost parts, and reached North Africa, the Near East and Transcaucasia. There are also records from Central Asia (EMELJANOV 1994).

In Germany, this species was recorded for the first time in 1966 in the far southwestern corner of the country (Istein am Rhein) (HOFFRICHTER & TRÖGER 1973) and over the intervening forty years has colonized the Southwestern Länder (Rhineland-Palatinate, Saarland, Hesse, Baden-Württemberg). It is apparently moving northeast as new localities have been discovered in Thuringia (WORSCHECH 2008), southern Saxony-Anhalt (KLAUS et al. 2007) and Berlin (H. NICKEL, pers. comm.) in the last few years. The first record from the Czech Republic, dating from 1994, is from Southeastern Moravia (the village of Vlkoš) (LAUTERER 1996). While most localities are still within the above-mentioned area, this treehopper was also found in Northern Moravia, near the border with Poland – at Stará Ves nad Ondřejnicí in ruderal vegetation along a river in 2003 (KURAS 2005) and at Karvina in vegetation on the shore of a pool in 2004 (KOCAREK 2005). Additionally, in 2010 there were reports from Northeastern Bohemia (LAUTERER et al., in prep.). In Slovakia, the buffalo treehopper appeared for the first time in 1972 (OKALI 1974), in the southwestern part of the country (the village of Klúčovec, in the shore vegetation (*Salix*, *Solidago*) of a reservoir on the River Danube), and for more than 15 years it has colonized mainly the lowlands of Western and Eastern Slovakia (JANSKÝ et al. 1988). The nearest localities to the east of Poland are in Southern and Eastern Ukraine (Crimea, the Kharkov region). Although provisionally cited for Poland (HOCH 2004 and updates), the species is not listed in the most recent checklist of planthoppers and leafhoppers of Poland (CHUDZICKA 2004).

Fig. 1. *Stictocephala bisonia* KOPP et YONKE – lateral view (Photo by A. Kuźma).

Fig. 2. *Stictocephala bisonia* KOPP et YONKE – antero-lateral view (Photo by A. Kuźma).

From a historical point of view, the species was known in European entomological literature until the mid-1970s under the names *Ceresa bubalus* (FABRICIUS, 1794) listed by NAST (1972) and *Stictocephala bubalus* (FABRICIUS, 1794) cited by EMELJANOV (1964). However, after examining FABRICIUS' type KOPP & YONKE (1977) discovered that it was not conspecific with the species introduced into Palaearctic and, accordingly, established the new name of *Stictocephala bisonia* for the latter.

Knowledge of the biology of the buffalo treehopper is important in understanding it as a potential pest. The insect requires at least two host plant species: a woody plant for oviposition and a herbaceous one for larval development (ARZONE et al. 1987). For oviposition 1-3 years old branches of broad-leaved trees and shrubs are preferred, including apple, peach, poplar and willow. Cultivations of lucerne (*Medicago sativa*) and red clover (*Trifolium pratense*) serve as the best food for nymphs, but in moist habitats, they may develop on many other herbaceous plants with glabrous or not very hairy stems. The adults are polyphagous and in Slovakia (JANSKÝ et al. 1988) the list of utilized food-plants is quite long and covers: *Artemisia vulgaris*, *Carpinus betulus*, *Castanea sativa*, *Chrysanthemum indicum*, *Clematis vitalba*; *Convolvulus arvensis*, *Cornus sanguinea*, *Crataegus oxycantha*, *Fraxinus excelsior*, *F. ornus*, *Humulus lupulus*, *Juglans regia*, *Ligustrum vulgare*, *Malus pumila*, *Medicago sativa*, *Melilotus albus*, *Morus alba*, *M. nigra*, *M. rubra*, *Onobrychis sativa*, *Polygonum aviculare*, *P. persicaria*, *Populus alba*, *P. nigra*, *P. tremula*, *Prunus amygdalus*, *P. armeniaca*, *P. avium*, *P. cerasus*, *P. domestica*, *P. persica*, *P. spinosa*, *Ribes nigrum*, *R. rubrum*, *Robinia pseudoacacia*, *Rosa canina*, *Rubus caesius*, *R. idaeus*, *Rumex acetosa*, *Salix alba*, *S. caprea*, *S. fragilis*, *S. purpurea*, *Solidago canadensis*, *S. gigantea*, *Tanacetum vulgare*, *Urtica dioica*, *Vicia faba*, *V. sativa*, *V. labrusca*, *Vitis vinifera*.

The species has one generation per year and overwinters in the egg stage. In Central Europe, the nymphs hatch at the turn of April and May (STOIAN & SAVIN 1976), and the adults are usually found from the middle of July until the end of October (NICKEL 2003).

In Southern Europe (Italy, Slovenia) it has been reported to cause serious damage to fruit trees and grapevines (ARZONE et al. 1987; SELJAK 2002). The greatest damage is caused by females, which lay more than 100 eggs, inserting them with a strong ovipositor into the bark of young branches. Oviposition wounds are 2 mm deep and 3-4 mm long covering not only the phloem layer of the branch but also reaching the cambium tissue. If repeated annually, such attacks may gradually destroy the whole plant. Thus, to efficiently reduce the buffalo treehopper population in orchards, dicotyledons should first be eliminated under and between the trees by selective herbicide treatment (SCHAUB et al. 1994). Adults feeding on grapevines cause the rolling, thickening, brightening, reddening or yellowing of the leaves and ultimately economic damage to vineyards. Moreover, it is possible that *Stictocephala bisonia* can transmit phytoplasmas that cause diseases affecting fruit trees, vegetables and crops. DUDUK et al. (2008a) detected in an individual of

Stictocephala bisonia the presence of apple proliferation phytoplasmas which were reported as damaging apples in Serbia (DUDUK et al. 2008b). However, they called for further research to verify the transmissibility of these microorganisms in *S. bisonia* as a potential vector.

Polynema striaticorne GIRAULT, 1911 (Hymenoptera, Chalcidoidea, Mymaridae) is one of the chalcid species known to parasitize the eggs of the buffalo treehopper (BALDUF 1928). In 1966 the species was introduced into the Piedmont region of Italy from the United States in an attempt to the control the buffalo treehopper (VIDANO 1966). The parasitoid was successfully established, and subsequently spread to many European countries, where positive results in the control of *Stictocephala bisonia* were achieved (VIDANO et al. 1985).

To date, this alien insect has not been considered a serious pest in Central Europe. In Germany, scattered populations can be found along woody margins and in tall herb stands, usually near rivers, streams and ditches (NICKEL 2003). Anthropogenic habitats have also been invaded, as in Thuringia the species was collected from the pond bankside zone vegetation in an old, abandoned gravel pit (WORSCHECH 2008).

Localities in Poland

(Fig. 3)

Stictocephala bisonia has been recorded in the following localities in Poland so far:

1) Stara Miłosna near Warsaw [UTM EC18] – a few individuals observed by Jacek Mościcki on field bindweed (*Convolvulus arvensis* L.) climbing over a hedge alongside the Wawerski ditch, 31.07.2010 (14:00 hrs) and 1.08.2010 (12:30 hrs);
2) Rzeszów [UTM EA63] – a few individuals observed by Artur Kuźma on low-growing willows (*Salix* spp.) on the bank of the River Wisłok, 22.08.2007 and 10.08.2008;
3) Zagorzyce [UTM EA44] – a few individuals observed by Witek Ochał in a moist meadow near a forest edge, 10.08.2010.

Key to the membracid species occurring in Poland (after EMELJANOV 1964 and OSSIANNILSSON 1981, modified; size data from BIEDERMANN & NIEDRINGHAUS 2004)

1(4) Caudal prolongation of pronotum narrow, not covering lateral margins of scutum (Fig. 4a, b). Dark brown species…….……...…….…… Centrotinae
2(3) Pronotum strongly convex, on each side with a triangular pointed process and caudally with a slender, weakly curved, dorsally sharply carinate process extending almost to the apex of the abdomen. Overall length ♂♀ 7.0-9.6 mm.…..….... *Centrotus cornutus* (LINNAEUS, 1758)
3(2) Pronotum anteriorly strongly convex, without lateral processes, caudally with a spine-like carinate prolongation extending to the apex of the clavus or a little longer. Smaller species. Overall length ♂: 4.4-4.8, ♀: 4.9-5.5 mm…….. *Gargara genistae* (FABRICIUS, 1775)
4(1) Base of caudal prolongation of pronotum wide, covering lateral margins of scutum

(Fig. 4c) Overall length ♂: 7.9-8.3, ♀: 8.5-10.2 mm Green species (when alive) ……..… *Stictocephala bisonia* KOPP et YONKE, 1977 **(**Smiliinae**)**

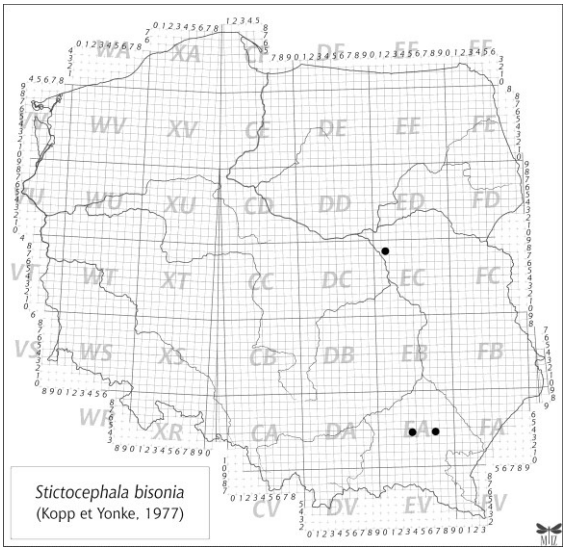

Fig. 3. Distribution of *Stictocephala bisonia* KOPP et YONKE in Poland.

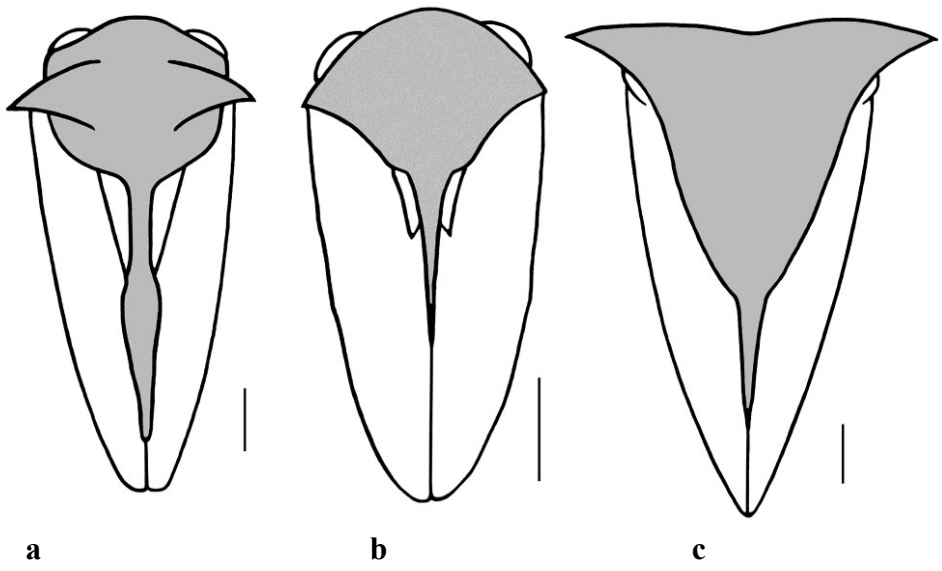

Fig. 4. Dorsal view of Membracidae – a. *Centrotus cornutus* (L.); b. *Gargara genistae* (F.); c. *Stictocephala bisonia* KOPP et YONKE. Pronotum coloured grey, scale bar 1 mm.

DISCUSSION

The membracid *Stictocephala bisonia* is one of seven alien leafhopper species introduced into Europe from the Nearctic Region, together with *Acanalonia conica* (SAY, 1830), *Prokelisia marginata* (VAN DUZEE, 1897), *Metcalfa pruinosa* (SAY, 1830), *Graphocephala fennahi* YOUNG, 1977, *Erythroneura vulnerata* (FITCH, 1851), *Kyboasca maligna* (WALSH, 1862) and *Scaphoideus titanus* BALL, 1932 (MIFSUD et al. 2010). Additionally, with *Graphocephala fennahi* (reported by ŁABANOWSKI & SOIKA 1997) and *Japananus hyalinus* (OSBORN, 1900) introduced from east Asia (recorded by MOKRZYCKA in 2007; unpublished), this species forms a group of three non-native leafhoppers occurring in Poland.

It is interesting to consider the factors that led to the establishment of this species in the country. Leafhoppers can migrate but they are more dwellers than active flyers. However, some species are able to migrate over long distances using air flows. *Stictocephala bisonia* fits into the first group, as it was observed by SCHEDL (1991) that in Northern Italy and Eastern Austria the species moves along the damp woods of rivers and the ruderal vegetation alongside roads and railway lines. Similarly, in Poland all locations are near watercourses. It is possible that the population located in Rzeszów originated as a result of migration from Slovakia (Ondava Upland) via the low mountain passes of the Beskid Niski Mts and then travelled along the valleys of streams and rivers. According to MAZUR (2001) some xerothermic species of weevils may have arrived in Southern Poland by following this route. The Ondavian route seems to have been opened quite recently (early Holocene or even historical times) as a result of extensive anthropogenic deforestation.

Alien hemipterans are certainly assisted by the worldwide trade in fruit trees, vine cuttings and ornamental plants (MISFUD et al. 2010). Especially eggs hidden in the plant tissue are well protected and can survive being transported over long distances and for long periods of time. In the new location, without their specific parasites they can establish populations viable enough to invade neighbouring areas. At present, without appropriate genetic studies, it is difficult to state whether the species arrived as a result of migration or was unintentionally introduced, and from which direction it came. However, further studies should be carried out in order to monitor the population of *Stictocephala bisonia* in the country, as it is possible that new localities will soon be found.

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