

Range Expansion of Metcalfa pruinosa (Homoptera: Fulgoroidea) in Southeastern Europe

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Abstract. The citrus flatid planthopper *Metcalfa pruinosa*, a Nearctic species of Fulgoroidea: Flatidae, was accidentally introduced in Europe, first in Italy in the late 1970's. In a few decades, *Metcalfa pruinosa* has spread over most of Europe, finally reaching the Black Sea coast in 2009. Hundreds of individuals of different life stages were observed for the first time in the south-eastern part of Romania throughout the summer of 2009 on several host plants: *Hibiscus syriacus*, *Ligustrum vulgare*, *Robinia pseudoacacia*, *Evonymus japonicus*, *Spirea x vanhouttei*, *Aesculus hippocastanum*, *Philadelphus coronarius*, *Ficus carica*, *Vitis vinifera*, *Fraxinus pennsylvanica*. The number of individuals observed and the area covered increased dramatically in 2010 as well as the number of host plants (110 species in 49 families), suggesting the planthopper is in the expansion phase of the invasion process.

Key words: alien species, *Metcalfa pruinosa*, Flatidae, Romania.

Introduction

Human-driven biotic invasions have caused major alteration of the Earth's biota, representing a major threat to global biodiversity and habitat loss (MACK *et al.*, 2000). Globalization and increasing trade leads to higher risks of alien species arriving accidentally to new areas (MOONEY, 2005). Many studies exist concerning the economic value of the damage produced by invasive species, their impact on agriculture, forestry and fisheries is considerable; several billions of dollars are spent each year on prevention, eradication, or control of such species (e.g. PERRINGS *et al.*, 2010).

The citrus flatid planthopper *Metcalfa pruinosa*, Say 1830 is a North-American species that was accidentally introduced in Italy, near Treviso in 1979 (ZANGHERI & DONADINI, 1980). From northern Italy,

Metcalfa pruinosa has rapidly spread throughout Europe (Table 1). The possible ways of spreading were accidental by passive transport of adults or eggs with infested plant material, or by beekeepers that deliberately introduce it for the secretion of honeydew (MIHAJLOVIĆ, 2007). Active flight of adults seems to be an important way of dispersal only at small spatial scales; for example estimated rate of natural spread of *Metcalfa pruinosa* in Vienna is of 0.2-0.5 km/year (KAHRER *et al.*, 2009).

Metcalfa pruinosa is gregarious, univoltine, overwinters in egg stage and has five larval instages. The body of adults is brown to grey in color and is covered by a waxy powder. In their native range, adults of *Metcalfa pruinosa* measure 5.5 to 8 mm in length (MEAD, 2004). However dimensions vary and may even reach 15 mm (COLOMBO,

2009). Its presence is easily observed due to the white waxy filaments that cover the plants and to their characteristic display on branches.

In 2009 juvenile specimens were observed on *Fraxinus pennsylvanica* leaves in Constanța Harbor enclosure and later on,

adults were observed and identified as *Metcalfa pruinosa* using MEAD (2004) (PREDA & SKOLKA, 2009). The aim of this study was to investigate and quantify the range expansion of *Metcalfa pruinosa*, Say 1830 in this newly colonized area.

Table 1. Reports of *Metcalfa pruinosa* in Europe since 1979.

Country	Year of first report	Status	Source
Italy	1979	established	ZANGHERI & DONADINI, 1980
France	1986	established	DELLA GIUSTINA, 1987
Spain	1988	established	PONS <i>et al.</i> , 2002
Slovenia	1990	established	SIVIC, 1991
Great Britain	1994	eradicated	MALUMPHY <i>et al.</i> , 1994
Switzerland	1993	established	JERMINI <i>et al.</i> , 1995
Croatia	1993	established	MACELJSKI <i>et al.</i> , 1995
Austria	1996	established	HOLZINGER <i>et al.</i> , 1996
Czech Republic	2001	eradicated	LAUTERER, 2002
Greece	2002	established	DROSOPOULOS <i>et al.</i> , 2004
Turkey	2003	established	KARSAVURAN & GÜÇLÜ, 2004
Hungary	2004	established	PÉNZES <i>et al.</i> , 2005
Bulgaria	2004	established	TRENCH <i>et al.</i> , 2007
Serbia	2006	established	MIHAJLOVIĆ, 2007
Bosnia and Herzegovina	2006	established	GOTLIN ČULJAK <i>et al.</i> , 2007
Netherlands	2006?	unclear	STRAUSS, 2009
Romania	2009	established	PREDA & SKOLKA, 2009

Material and methods

Between April and October 2009 and 2010, we monitored every fortnight alien insect species in Constanța County, in 15 localities along the Black Sea coast (Fig. 1a). In 2009, 32 sites covered by semi natural vegetation and ornamental plants such as city parks, etc. were surveyed in the city of Constanța and surroundings, to assess the presence of *M. pruinosa* and identify host plants (Fig. 1a). We considered the planthopper's preference for shaded areas with dense vegetation (PONS *et al.*, 2002) and focused our surveys on these types of potential habitats. Host plant species were identified using CIOCĂRLAN (2000). We considered a plant species as "host" when several individuals (juveniles and/or adults) were present and signs of their activity were evident on the plant (white waxy filaments, exuviae and honeydew secretions as traces of feeding). In 2010, we

repeated the survey performed in the city of Constanța and made additional observations in similar areas south of Constanța city, along the Romanian Black Sea coast. We investigated in total 81 sites represented by green urban areas in 15 localities, 50.6% located in Constanța city (including Mamaia) and 49.4% south of Constanța city, up to the last Romanian locality next to the Bulgarian border (Fig. 1a). We recorded the presence or absence of *Metcalfa pruinosa*, the host plants and the level of infestation of the investigated site. The level of infestation was assigned considering the abundance of individuals (juveniles and adults), which was visually estimated using a scale from 1 to 5 as follows: level 1 – fewer than 10 individuals; level 2 – between 11 and 20; level 3 – between 21 and 50; level 4 – between 51 and 100; level 5 – over 101 individuals. Geographic coordinates were measured with a Garmin eTrex Summit GPS

receiver; the maps were realized with Garmin MapSource Version 6.15.6.

Results

In 2009 *Metcalfa pruinosa* was observed in three localities from Constanța County along the Romanian Black Sea coast (Constanța, Eforie and Tuzla). Its presence was noticed in 81% of the 32 surveyed sites, in parks, public gardens and on vegetation along the roads. The host plants on which *Metcalfa pruinosa* was encountered were *Aesculus hippocastanum* L., *Fraxinus pennsylvanica* Marsh., *Robinia pseudoacacia* L., *Hibiscus syriacus* L., *Philadelphus coronarius* L., *Evonymus japonicus* L. f., *Spirea x vanhouttei* (Briot) Zabel, *Ligustrum vulgare* L., *Ficus carica* L., *Vitis vinifera* L. We did not record its presence on a number of common species in Constanța like *Tilia cordata* Mill., *Acer negundo* L., *Thuja orientalis* L., *Thuja occidentalis* L., *Juniperus communis* L., *Ailanthus altissima* Mill., *Eleagnus angustifolia* L., *Populus x canadensis* Moench although more than 200 species are mentioned in the literature as host plants (BAGNOLI & LUCCHI, 2000; PONS *et al.*, 2002). The highest abundance of individuals of different life stages was observed on *Hibiscus syriacus* hedges in sheltered green spaces.

The next year, we noticed the presence of *Metcalfa pruinosa* in several other localities along the Black Sea coast. If we compare the average levels of infestation estimated for the same period in 2010 in the surveyed localities, the highest abundance of planthoppers can be observed south of Constanța city, in Comorova forest (Fig. 1b). In Constanța city, the extent of the area covered increased compared to 2009, as well as the abundance of the individuals (Fig. 2). The number of recently infested sites multiplied in the second year (Fig. 3). In total, *Metcalfa pruinosa* was present in 76 sites along the Romanian Black Sea coast, about 94% of the surveyed sites. Not surprisingly, the number of host plants increased as well, including among others the common plant species previously mentioned as not infested in 2009. In 2010, we identified 110 host plants belonging to 49 families. Rosaceae and Asteraceae

comprised almost 26% of the species; again the most frequented species was *Hibiscus syriacus* (Fig. 4). Analyzing the native ranges of the host plants identified, only 14% are north-American, while most of them are originated in Eurasia (Fig. 5).

Discussion

Preliminary data suggest that *Metcalfa pruinosa* has a similar life cycle in the south eastern part of Romania, as in the southern part of Europe (PONS *et al.*, 2002; SOULIOTIS *et al.*, 2008). The planthopper develops one generation per year, adults can be observed from late June until late September. The increase in the abundance of individuals, of the area covered and of the number of host plants observed in the two successive years suggest that *Metcalfa pruinosa* is in the expansion phase of the invasion process. The successful range expansion of *M. pruinosa* can be related to its great polyphagy and to the lack of specialized predators in the newly colonized areas (STRAUSS, 2009). In Europe, *Metcalfa pruinosa* reaches higher densities than in the United States and the number of host plants is also higher (BAGNOLI & LUCCHI, 2000; WILSON & LUCCHI, 2001). We assume that the expansion of *Metcalfa pruinosa* in our study area is also favored by its great polyphagy thus the geographical origins of the available plant species should not have a negative influence on their potential use as hosts. We noticed that the planthopper is capable of living on plants that originate in its native area as well as on a high number of plant species native to Europe and/or Asia (Fig. 5). *Hibiscus syriacus* L., a species of Asian origin, was the most frequented plant by juveniles and adults of *Metcalfa pruinosa* (Fig. 4). A high number of individuals of different life stages were observed on *Campsis radicans* (L.) Seemann, a species of North-American origin, but also on two Mediterranean species, *Aesculus hippocastanum* L. and *Ligustrum vulgare* L. Its wide range of host plants and gregarious behavior gives it a competitive advantage enabling it to successfully reproduce and spread.

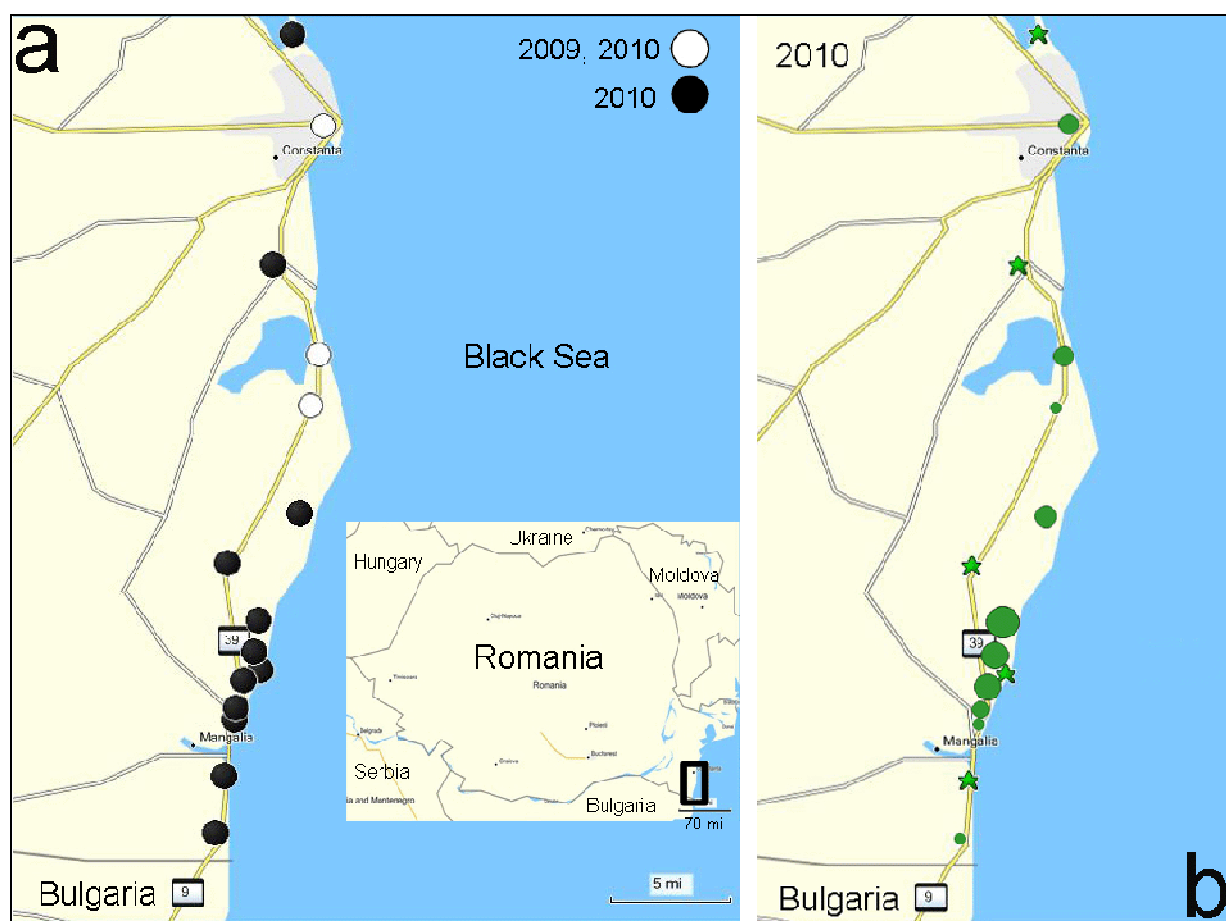


Fig. 1. The study area along the Romanian Black Sea coast (mini map) (a.) indicates time of investigation, dark circles represent new localities surveyed only in 2010 (b.) average levels of infestation estimated for the surveyed localities; values are ascending from 1 (smallest circle) to 4.2 (biggest circle), stars represent value 0.

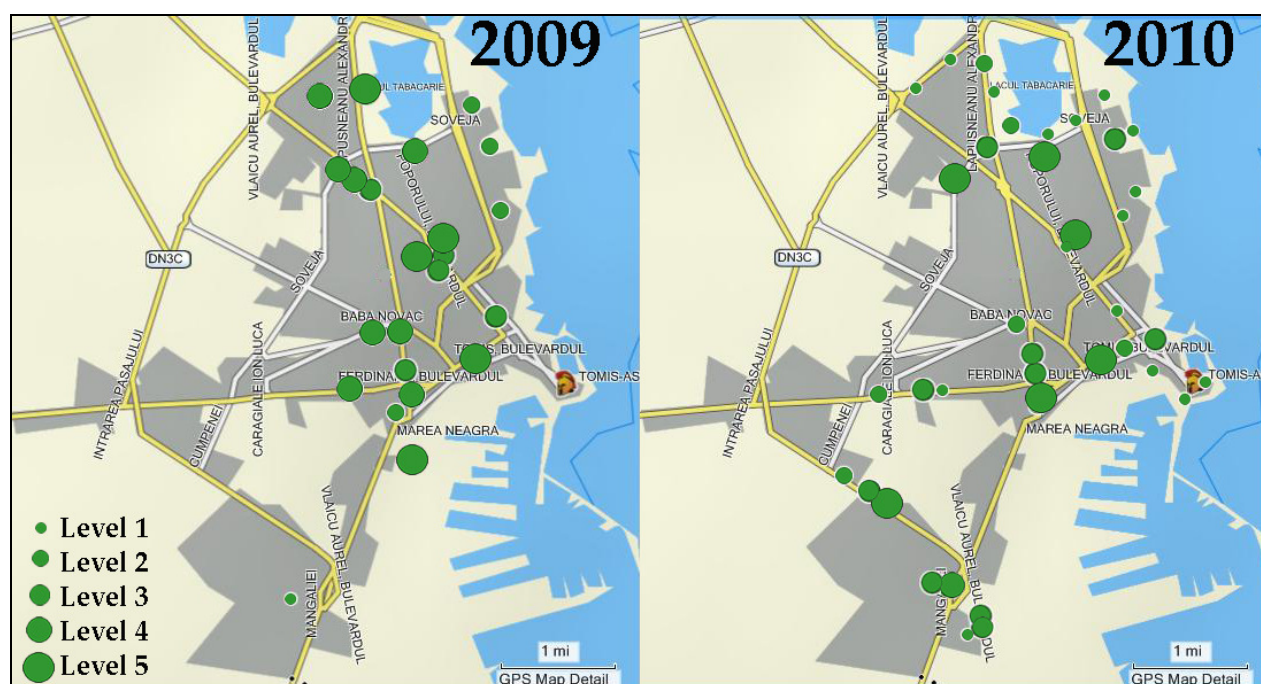


Fig. 2. Occurrence of *Metcalfa pruinosa* in Constanța city in two successive years (estimated levels of infestation are described in Methods section).

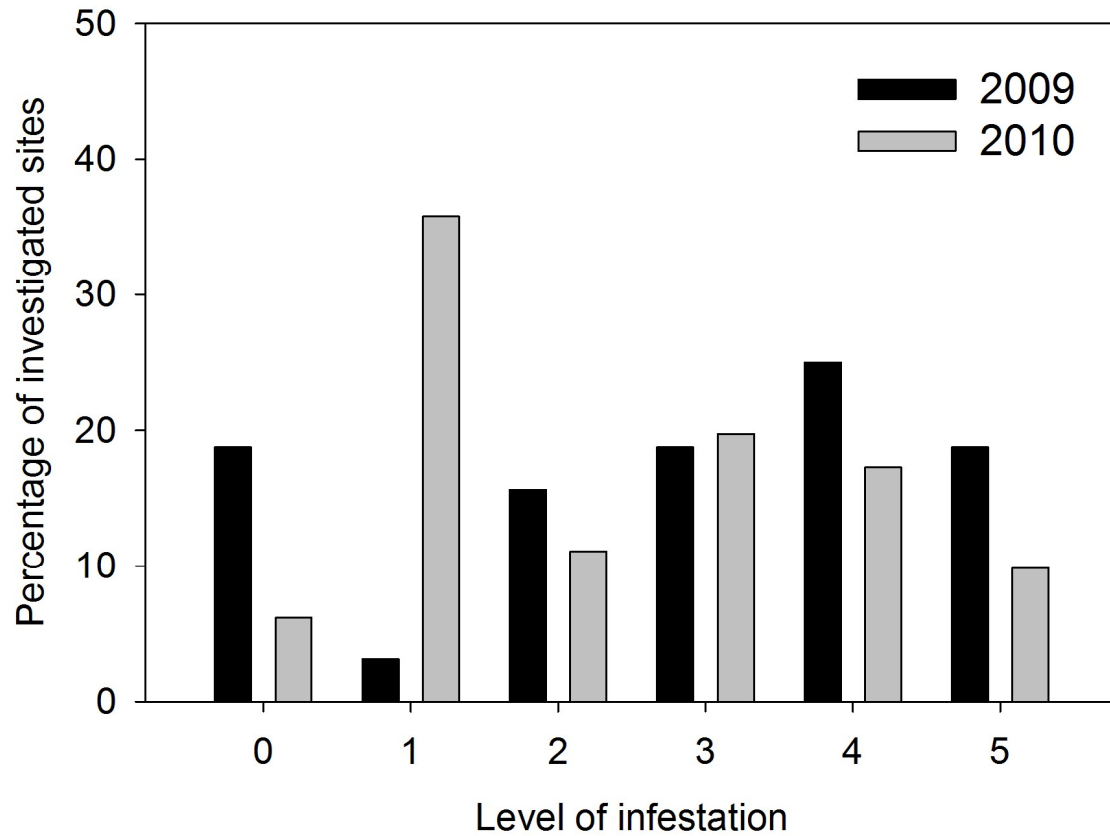


Fig. 3. Estimated levels of infestation by *Metcalfa pruinosa* in south-eastern part of Romania (n=32 for 2009; n=81 for 2010).

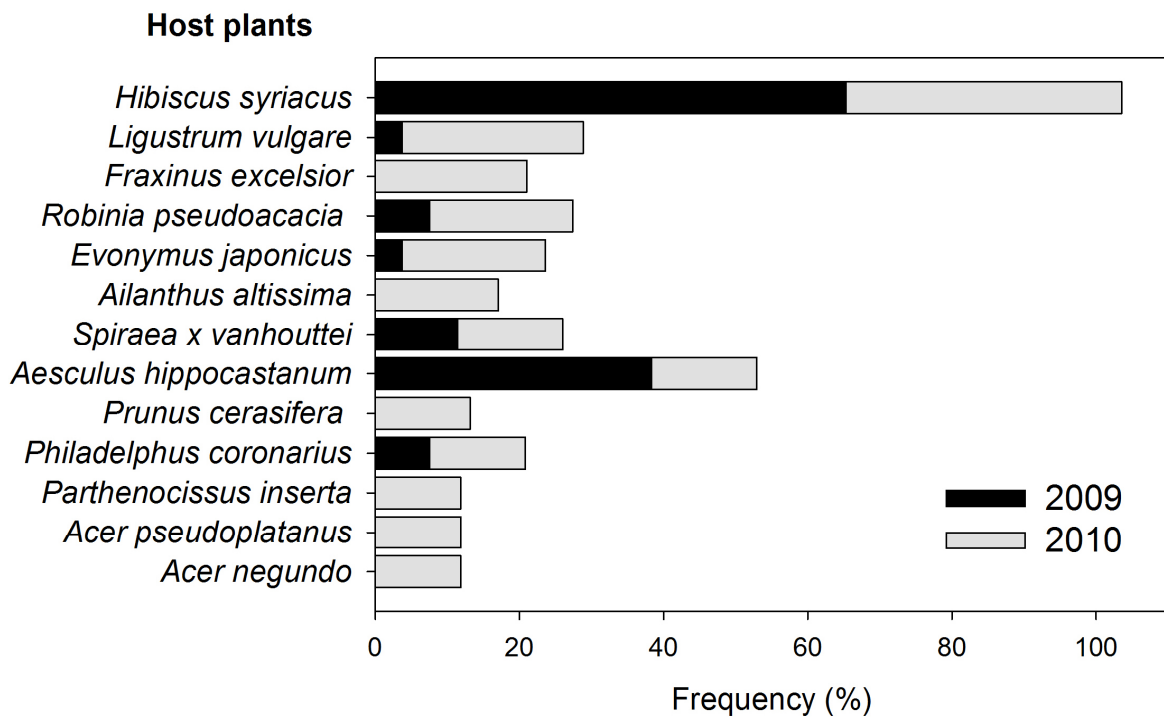


Fig. 4. Host plants on which *Metcalfa pruinosa* was most commonly encountered (n=26 sites in 2009; n=76 sites in 2010).

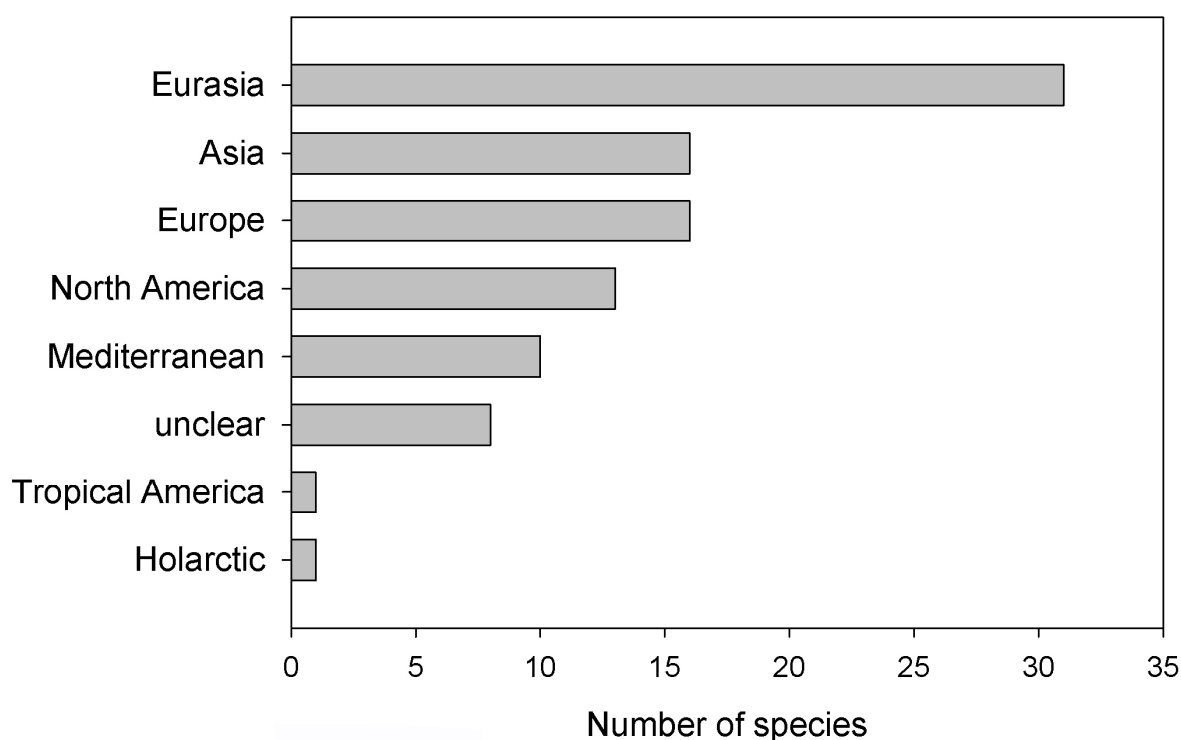


Fig. 5. Native range of the species of host plants identified in the south-eastern part of Romania (n=96).

Another contributing factor might be the climate of the region. According to LIEBHOLD & TOBIN (2008) low density populations such as newly founded invading populations are strongly influenced by abiotic factors, among others. *Metcalfa pruinosa* is less found in dry regions and occurs mainly in humid regions with annual average precipitation between 600 and 1625 mm (STRAUSS, 2010). By comparing climographs based on average monthly temperature and precipitation data in areas from native range and Europe, WILSON & LUCCHI (2000) concluded that *Metcalfa pruinosa* is capable of overcoming this barrier and occupy even microhabitats in areas considered unsuitable like Italy and southern France. Another example is the south-eastern part of Romania where the average annual precipitation registered in the period 1965-2000 ranged between 300 and 500 mm (TORICĂ, 2008).

Based on the large number of planthoppers observed, of different life

stages, and on the extension of the area covered, we hypothesized that *Metcalfa pruinosa* arrived in the south eastern part of Romania at least two years prior to our observations. Several possibilities exist in terms of the planthopper's arrival in this part of Romania: directly introduced from Italy with imported plant material as is the case of Czech Republic (LAUTERER, 2002) or natural spread from Bulgaria. We also considered possible the colonization from western or central Romania (PREDA & SKOLKA, 2009). In the summer of 2010, the presence of *Metcalfa pruinosa* was reported from Timișoara, in the western part of the country (GOGAN *et al.*, 2010). This is not surprising since the planthopper was already present in Hungary for several years. However, we believe that we are dealing with multiple separate introductions and stratified dispersal of *Metcalfa pruinosa*. Since the abundance of *Metcalfa pruinosa* was scarce close to the Bulgarian border, we believe that *Metcalfa pruinosa* was introduced

in the south-eastern part of Romania with plant material. Point introductions might act as source populations and contribute to the rapid range expansion of the planthopper. Field observations in Constanța city reveal the same pattern. In 2009, several sites with high abundance of individuals were observed mainly in city parks and unsupervised terrains covered with vegetation located in the central area of the city and in Constanța harbor enclosure. The next year, the expansion of the covered area was easily noticed through the increased number of recently infested sites, almost 40%, towards the outskirts of the city (Fig.2). The impact of *Metcalfa pruinosa* can be both detrimental on natural plants and beneficial for bee keepers due to the secretion of honeydew. Although interactions between *M. pruinosa* and native species need further investigations, it is safe to assume that *Metcalfa pruinosa* competes with native phytophagous species for resources and causes structural changes in their community. So far, the only predator on *M. pruinosa* we observed was *Araneus diadematus* Clerck, 1757. The risks of economic losses due to *M. pruinosa* are high since vineyards and orchards (mostly peach and apricot) occupy a large surface of south-eastern Romania. In some cases seedlings or fruits become unfit for sale. In northern Italy *Metcalfa pruinosa* was responsible for the loss of about 40% of the soybean crop (CIAMPOLINI *et al.*, 1987). The presence of *Metcalfa pruinosa* in Romania requires extensive monitoring to determine the breadth of its spread and estimate its impact and potential control measures.

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