Research Article

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First Documented Outbreak and New Data on the Distribution of *Corythucha arcuata* (Say, 1832) (Hemiptera: Tingidae) in Russia

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Abstract: The North American oak lace bug, *Corythucha arcuata,* was introduced to Russia in 2015 and was initially found in the city park of Krasnodar. Extensive sampling efforts performed by the Centre of Forest Health of Krasnodar Territory combined with comparison of satellite images of the oak forests allowed to reveal the dynamics of spatial spread of this invasive alien pest in the Northwestern Caucasus during 2015 and 2016. The aim of our paper is to analyse the spread pattern and present new records of this invasive alien species in Russia.

Key words: Invasive alien pest, oak lace bug, new records, Caucasus

Introduction

The oak lace bug, *Corythucha arcuata* (Say, 1832), is widespread in North America (Drake & Ruhoff 1965). This species was introduced recently to Europe, where it was found for the first time in Lombardy and Piedmont regions of northern Italy (Bernardinelli & Zandigiacomo 2000). Subsequently, the oak lace bug spread through the north-western regions of Italy (Bernardinelli 2000) and reached Switzerland (Forster et al. 2005) and Turkey (Mutun 2003) in 2002. The species was spreading fast in Turkey and five years after the first record in Bolu it was detected in nine Turkish provinces (Mutun et al. 2009, Küçükbasmaci 2014, Çerçi & Koçak 2016). In 2012, the oak lace bug arrived in Bulgaria (Dobreva et al. 2013), and next year it was found also in Croatia (Hrašovec et al. 2013) and Hungary (Csóka et al. 2013).

Corythucha arcuata was introduced to Russia in 2015 – on 17 July 2015, the first group of eggs of the species was found in the city park of Krasnodar, the capital of Krasnodar Territory, Russia (Shchurov et al. 2016). The aim of our study was to reveal the dynamics of spatial spread of this invasive alien species in the Northwestern Caucasus.

Materials and Methods

The sampling was performed by the Centre of Forest Health of Krasnodar Territory during 2015 and 2016, using standard sampling techniques combined with satellite images of the oak forests available through the Copernicus Programme of the EU Earth observation mission (2012-2017). The presence of *C. arcuata* in areas of largely damaged oak forests initially detected

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by the satellite images was confirmed by subsequent visiting the locality in question. More than 3,500 mounted specimens were studied. The extensive material sampled near Ilsky, within Krasnodar and near Nekrasovskaya was retained in the collection of the Zoological Institute, St. Petersburg, Russian Academy of Sciences. Additionally examined specimens are kept in the laboratory of the Centre of Forest Health of Krasnodar Territory.

Results and Discussion

According to the data acquired, *C. arcuata* was not registered in the natural forests of the Northwestern Caucasus until June 2016. However, in the same year this species has been spreading actively over the forest zone of the Northwestern Caucasus and had several mass outbreaks starting from mid-July. Chlorotic discolouration of the oak leaves caused by mass feeding of *C. arcuata* was registered in the valleys of the small rivers Chekups, Schucha, Nepil, and Psebeps (Fig. 1a), as well as the Adagum River (Fig. 1b), located between Natukhaevskaya, Gostagaevskaya, Varenikovskaya, and Krymsk. In addition, the oak lace bug was found in large numbers in the lower courses of the rivers Abin, Bugundyr, Khabl, Zybza, and the Shebsh River.

By the end of July 2016 areas of oak forests damaged by *C. arcuata* were observed also along the Krasnodar-Novorossiysk Road between the cities Krymsk, Abinsk and Krasnodar. In September 2016, *C. arcuata* spread south from this road towards the Great Caucasian Mountain Ridge along the left tributaries of the Kuban River (Fig. 1c) and also extended eastwards to Ust-Labinsk and Novolabinskaya. Thus, in November 2016, *C. arcuata* was rapidly spreading in the Northwestern Caucasus and reached Temryuk in the west, Slavyansk-na-Kubani and Tbilisskaya in the north, Khanskaya (valley of the Belaya River, Republic of Adygea) and Chernigovskoe (valley of the Pshekha River, Krasnodar Territory) in the east (Shchurov & Skvortsov 2016a, 2016b, 2016c). The current distribution of the species in the Northwestern Caucasus is shown on Fig. 2. So far, the species has not been found on the Black Sea coast east of the Shapsukho River (Shchurov et al. 2016).

The introduced range of *C. arcuata* in the Krasnodar Territory and the Republic of Adygea was assessed as the area within the most distant localities of its range. Currently the species has spread over an area of more than 19,000 km^2, most of which is occupied by natural broadleaved forests. The area of oak woods damaged by the oak lace bug

Fig. 1. Oak forests damaged by *Corythucha arcuata*: (a) – valley of the Psebeps River, 24 July 2016; (b) – valley of the Adagum River, 19 August 2016; (c) – valley of the Abin River, view from the Shize Mountain, 13 September 2016. Refer to Fig. 2 for exact localities. Photos by V. Shchurov (a, b) and A. Shchurova (c)

in 2016 was also alarmingly high, up to 3,340 km^2 in the Krasnodar Territory and 20 km^2 in the Republic of Adygea. The observed damage included chlorotic discolouration and desiccation of leaves.

Possible introduction of *C. arcuata* into the south of European Russia with planting material from Turkey was discussed by Abasov & Blummer (2012). They assumed that soon *C. arcuata* would be imported to Russia with vehicles and goods by ferry connecting the Black Sea ports Samsun (Turkey) and Novorossiysk (Krasnodar Territory, Russia). However, localisation of the damaged oak forests in July 2016 suggests that *C. arcuata* most likely entered Krasnodar Territory through the ports of Taman Peninsula, namely Taman and Kavkaz ports, and subsequently spread along the main motorways and railway lines (Fig. 2). Within less than two years this invasive alien species was able to spread over 250-270 km from Kerch Strait westwards to Tbilisskaya and Khanskaya.

Eggs (Fig. 3b) and larvae of all stages of

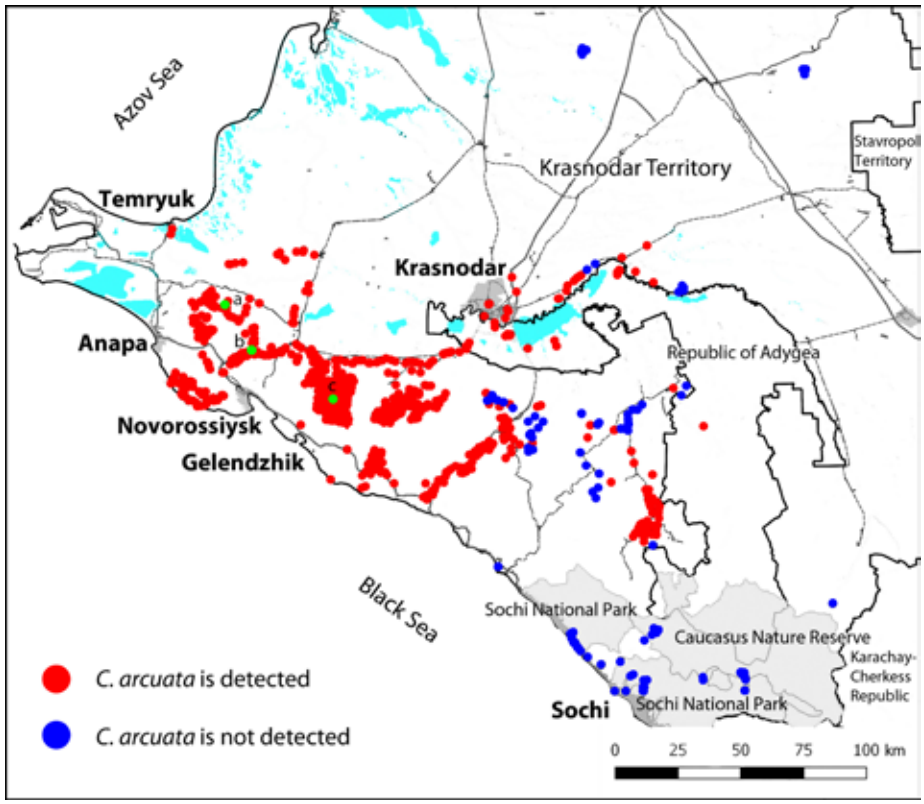

Fig. 2. Current distribution of *Corythucha arcuata* in the Krasnodar Territory and the Republic of Adygea, Russia, according to the Centre of Forest Health of Krasnodar Territory. Photos shown on Fig. 1(a-c) were taken in localities marked as green dots a, b and c, respectively

C. arcuata were found from early May to early November, typically aggregating on under sides of leaves. Although the oak lace bug mainly utilises *Quercus* spp. (Fagaceae), as hosts, it can develop on other trees as well. In the Krasnodar Territory and the Republic of Adygea adults, nymphs and fifth-instar larval cases of *C. arcuata* were documented from the following hosts: *Quercus hartwissiana* Steven, *Q. pedunculiflora* (K. Koch) Menitsky, *Q. petraea* (Mattuschka) Lieblein (Fig. 3c), *Q. pubescens* Willdenow, *Q. robur* Linnaeus (Fig. 3d), *Ulmus minor* Miller (Ulmaceae; Figs. 3f, g), *Prunus avium* Linnaeus (Rosaceae; Figs. 3e, h), *Acer laetum* C. A. Meyer (Aceraceae), and *Robinia pseudoacacia* Linnaeus (Fabaceae; Figs. 3i, 2j).

Another member of the genus *Corythucha*, the sycamore lace bug *C. ciliata* (Say, 1832), inhabits the North Caucasus and damages foliation of the plane trees (*Platanus* spp.) (Voigt 2001, Kalinkin et al. 2002). This species was also imported to Europe from North America (Péricart 1983, Rabitsch 2008). Although *C. ciliata* and *C. arcuata* are very similar, they may be easily distinguished by the colouration. Particularly, hemelytron in *C. ciliata* is snowy white, with brown posterior part of the discoidal elevation and a few partly and slightly darkened areolae subapically. The dark colour pattern in *C. arcuata* is much better expressed, with hemelytron having wide transverse brown bands basally and apically (Fig. 3a), sometimes disintegrating into four narrow dark bands with pale brown. In contrast to *C. arcuata*, the sycamore lace bug in the Northwestern Caucasus utilises only planes as hosts, mainly *Platanus orientalis* Linnaeus (Kalinkin et al. 2002).

Given the native area and the current speed of spreading, *C. arcuata* may soon inhabit a fairly large area within European Russia. The fast spread of this species may result in significant economic and ecological drawbacks in the oak wood zone of Russia and especially South Russia where this invader might take full advantage of the multivoltine life cycle and the broad range of utilised hosts.

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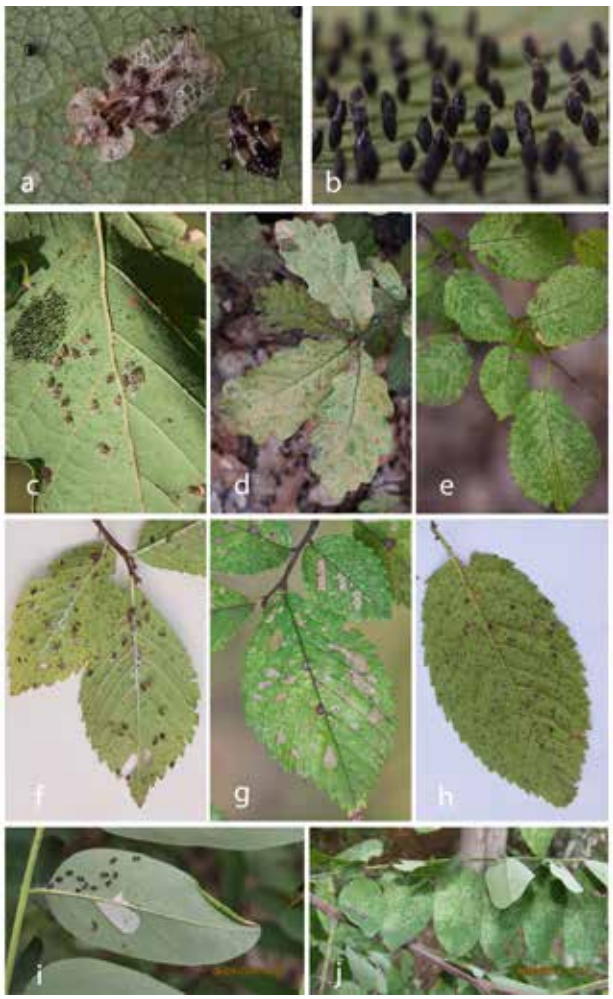

Fig. 3. *Corythucha arcuata* (Say, 1832): (a) – adult and fifth-instar larvae; (b) – eggs; (c) – adults and eggs on the lower leaf surface of *Quercus petraea*; (d) – chlorosis of *Quercus robur* leaves; chlorotic discolouration of infested leaves: (e, h) – wild cherry, *Prunus avium*; (f, g) – elm, *Ulmus pumila*; (i, j) – black locust, *Robinia pseudoacacia*. Photos by V. Neimorovets (a–h) and V. Shchurov (i–j)

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