

***Spanioneura fonscolombii* Förster (Hemiptera: Psylloidea) a New Jumping Plant-Lice for Turkish Fauna**

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Abstract

Aim of study: To investigate the distribution area, some biological characteristics and host plant relationship of *Spanioneura fonscolombii* Förster (Hemiptera: Psylloidea) species, a psyllid we recently found its distribution in Turkey, for the first time within this study.

Material and methods: We collected adults and nymphs of the insect from the host plants during the visits to the study area on different dates. The insect was recognised as a psyllid species. Some adult samples were sent to the expert Dr. Burckhard for species identification. The psyllid damage on host plants of *Buxus balearica* was identified for the first time as a new host for *Spanioneura fonscolombii*.

Main results: 1- We identified *Spanioneura fonscolombii* species distribution in Turkey for the first time, 2- Population size was highly dense in the study area based on initial observation, 3- New host plant, *Buxus balearica*, for the pest species was identified for the first time, 4- Overwintering properties of the pest species was determined.

Research highlights: First record of the pest in Turkey. Determination of the most Southern and Eastern, probably so far known, distribution of the pest species in the world. Determination of a new host plant for the pest.

Keywords: *Buxus balearica*, *Spanioneura fonscolombii*, Psyllid, New pest on *Buxus balearica*.

Türkiye Böcek Faunası için yeni bir kayıt *Spanioneura fonscolombii* Förster (Hemiptera: Psylloidea)

Öz

Çalışmanın amacı: Bu çalışma ile Türkiye'deki yayılışı tarafımızdan ilk kez tespit edilen *Spanioneura fonscolombii* Förster (Hemiptera: Psylloidea) türünün yayılış alanı, bazı biyolojik özellikleri ile konukçu bitkisi ile ilişkisinin araştırılması.

Materyal ve yöntem: Farklı tarihlerde konukçu bitki üzerindeki ergin ve nimflerin toplanması, ilk aşamada bir psyllid türü olduğu anlaşılan böceğin tür teşhisi için uzmanı olan Dr. Burekhard'a gönderilmesi ve bir takım arazi gözlemlerinin verilmesi.

Temel sonuçlar: 1-*Spanioneura fonscolombii* türünün Türkiye'de ilk kaydı, 2-Gözleme dayalı popülasyon yoğunluğu ile ilgili tespitler, 3-Türün yeni bir konukçu üzerinde ilk tespiti, 4-Kısıtlama durumuna ait tespitler.

Araştırma vurguları: Türün Türkiye'den ilk kaydı, muhtemelen böceğin dünya dağılımında en güney ve en doğu yayılışının tespiti, yeni bir konukçu üzerinde varlığı.

Anahtar Kelimeler: *Buxus balearica*, *Spanioneura fonscolombii*, Psyllid, *Buxus balearica*'da yeni zararlı

Introduction

Psyllids, also known as jumping plant-lice, are highly specialized pests for their host plants. They mainly feed on sap of host plants, therefore, causing serious damage on plants (Burckhardt, 1994). Sugary sticky fluids are exuded from the phloem as psyllid nymphs suck up sap from the specialized host plants. Therefore, sooty molds can later

develop on the sticky sugary substances, turning the host plant to have blackish sooty appearance. This phenomenon is termed as fumagine (Seemüller and Schneider, 2004). Besides, psyllids are also known to be vectors for various diseases in fruit trees like apple, pear and orange, and in crop plants such as potatoes and tomatoes (Seemüller and Schneider, 2004; Hodkinson, 2009).



Psyllids are considered important pathogens because of their serious damage and for causing significant economical losses. High economical losses occur directly or indirectly as they damage crops and fruits important for human nutrition and reducing their market value (Özgen and Kavak, 2018).

Most part of Turkey's psyllid fauna has been studied and a checklist comprised 99 species was previously reported (Drohojowska and Burckhardt, 2014). So far, four species have been reported in the genus *Spanioneura* from Turkey (Drohojowska and Burckhardt, 2014). The identified species are *Spanioneura caucasica* Loginova, 1968, *S. pechai*, *S. turkiana* (Klimaszewski and Lodos 1977) and *S. persica* (Burckhardt and Lauterer, 1993). With this our new record of *Spanioneura fonscolombii*, the list of *Spanioneura* species in Turkey was raised to five species.

The species of *Spanioneura fonscolombii*, the research subject of this study, was originally distributed in Palearctic area, Western Europe and Caucasus and mistakenly introduced to the USA (Conci et al., 1992; Gertsson, 2015; Hodkinson and White, 1979; Martin and Webb, 1999; O'Connor and Malumphy, 2011). In Europe, *S. fonscolombii* has been so far found in Belgium, France, Great Britain, Italy, Luxemburg, Romania, Spain, Sweden and Switzerland. Furthermore, the species was reported to feed only on *Buxus sempervirens*. The recent distribution of the species in Sweden and Romania was recorded in 2011 and in 2018, respectively (Bagnée, 2001; Fauna Europe; Gertsson, 2015; Mancini, 2018).

This preliminary study was carried out to report the first appearance of *S. fonscolombii* species in Turkey and to investigate the host plants and the feeding habit of this species. Two species of boxwood, *Buxus sempervirens* subsp. *sempervirens* and *B. balearica*, naturally occur in Turkey. The psyllid was previously reported to feed only on *Buxus sempervirens*. However, in this current study, we provided evidence that the

species feeds extensively on *B. balearica* leaves as well.

The world distribution of *B. balearica* is confined to Morocco, Balearic Islands, South and West Spain, Sardinia Island, Southern Anatolia and Northwestern Syria. *B. balearica* naturally occurs in the flora of Turkey, distributed in the cities of Antalya, Adana and Hatay (Browicz, 1986). The damage of the psyllid *S. fonscolombii* on *B. balearica* was recorded from Adana city of Turkey. The pest might be distributed in cities of Antalya and Hatay. The morphology, biology, distribution and the damage of the psyllid on southern both boxwood species will be assessed in details soon later and the results will be shared in future reports.

Material and Method

The study was carried out around Akören area of Aladağ district of Adana city, Turkey (Figure 1). The altitude of the study area was about 400 meters. The total distribution area of *B. balearica* in the study site in Aladağ district was about 230 hectares. Psyllids were observed and collected by various regular visits to the study area since 2021. For identification purposes, adult *Spanioneura fonscolombii* samples were collected by inserting and shaking large clear plastic bags on branches of *Buxus balearica*. Adult psyllids collected from *B. balearica* leaves were fixed in 70% ethyl alcohol and sent to Dr. Daniel Burckhardt for species identification. Dr. Burckhardt provided the species identification. Population density of *S. fonscolombii* was estimated by observing and counting the nymphs feeding on different *B. balearica* plants during the visits to the five different collection sites.

The coordinates of the distribution areas of *S. fonscolombii* were collected and pinned on a map (Figure 1). The coordinates of the areas where the pest was seen are: 1- 37°26'33" N, 35°27'04" E, 2- 37°27'28" N, 35°26'33" E, 3- 37°26'42" N, 35°28'08" E, 4- 37°27'25" N, 35°26'26" E and 5- 37°26'51" N, 35°27'10" E.

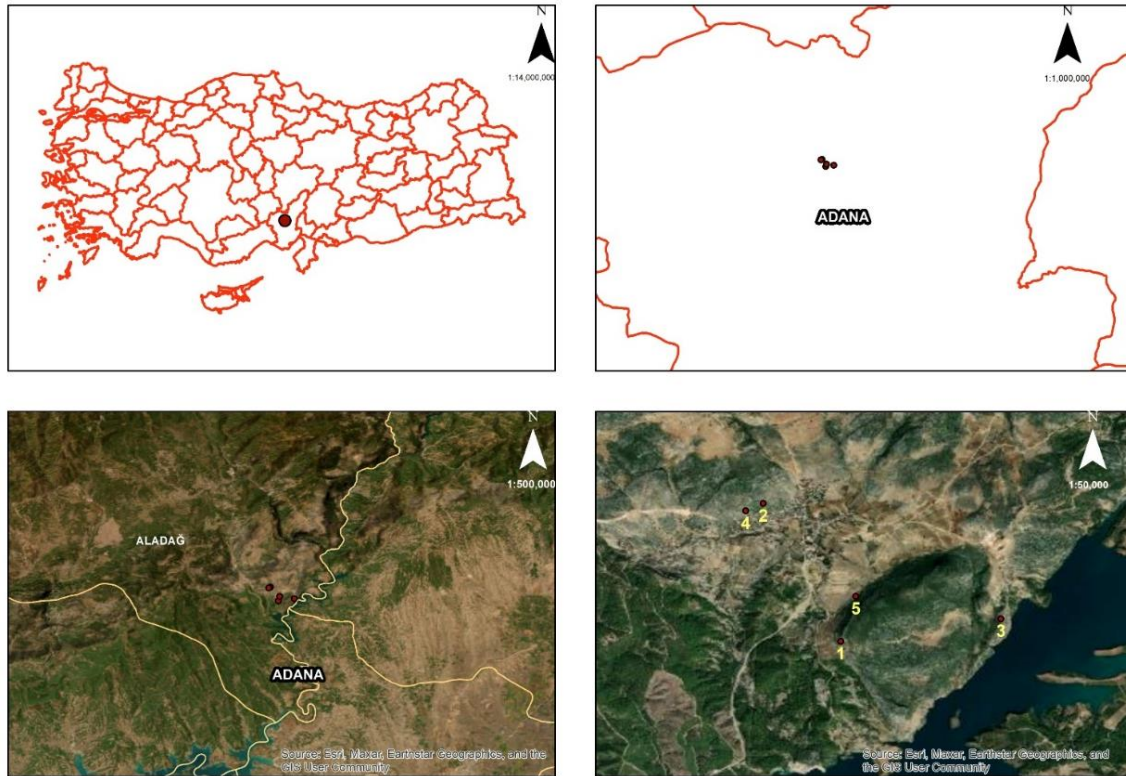


Figure 1. A map of distribution area of *Spanioneura fonscolombii* in Aladağ district of Adana city, Turkey. Five different collection sites from Aladağ district of Adana city were numbered and pinned on the map.

Results and Discussions

Biology of *Spanioneura fonscolombii*

Strictly oligophagous on *Buxus* spp., *S. fonscolombii* is especially found on *B. sempervirens* L. (Buxaceae) (Hodkinson and White, 1979; Burckhardt, 1983, Hodkinson, 1988; Conci et al., 1993; Conci et al., 1996, Burckhardt and Mühlethaler, 2003; Seljak 2006; Hodkinson, 2009). *S. fonscolombii*'s number of generations per year, overwintering as adult, nymph or in eggs have not been clearly documented in newly distributed regions. These aspects of the species have been still under investigation. Morphology and diagnosis of the species were previously described in details by Hodkinson and White (1979). The morphology, diagnosis, biology, hosts and the damage of the species from Southern Turkey will be comprehensively studied in the near future.

Spanioneura fonscolombii Geographical Distribution

As far as presently inferred from literature, *S. fonscolombii* has a predominantly western European distribution, with records originating from Belgium, France, Great Britain, Ireland, Italy, Luxembourg, Slovenia, Spain, Sweden and Switzerland (Hodkinson and White, 1979; Conci et al., 1993; Conci et al., 1996; Burckhardt and Mühlethaler, 2003; Seljak, 2006, O'Connor and Malumphy, 2011; Bieman et al., 2019). It was also reported from the Caucasian Region (Azerbaijan; Conci et al., 1996) and from the USA (Hodkinson, 1988), where probably introduced.

Psyllids generally overwinter as eggs. However, some species overwinter as adults. We observed that *S. fonscolombii* species overwinters as adult. Regular visits to the study site and some biological observations on *S. fonscolombii* during these visits are summarized in Table 1. The species of *S. fonscolombii* were observed for the first time

in Aladağ district of Adana city on November 16, 2021 (Table 1). Adult individuals were intensively observed on this date. Some few adults of *S. fonscolombii* were observed on leaves during the survey visits to research site in January and March (Table 1). An adult of *S. fonscolombii* was collected from the research site and photographed during the visit on March 7, 2022 (Figure 2). This provided a strong clue for the argument that *S. fonscolombii* overwinters as adult in the study area. During another visit to the study area on April 8, 2022, *S. fonscolombii* nymphs were

extensively detected on the leaves of newly developed shoots of *B. balearica* (Figure 3A, Table 1). Another visit was made to the research site on May 17, 2022. Adults of *S. fonscolombii* were also observed intensely in the area during this visit. Moreover, extensive damage by *S. fonscolombii* adults by sucking up on fresh leaves was observed on newly developed shoots (Figure 3B). The damage is obvious and can be easily detected as the sucked-up part of the leaf dries and drops after certain time, resulting on decreased leaf area (Figure 3B, C & D).

Table 1. Field trips to the study area of Aladağ district of Adana city on different dates and biological observations made on *Spanioneura fonscolombii* from *Buxus balearica* plants.

Dates of the visits to the study area	Biological observations made during the visits
1- November 16, 2021	Many adults detected for the first time on <i>B. balearica</i>
2- March 7, 2022	Few adults collected from shoots of <i>B. balearica</i>
3- April 8, 2022	Intensive nymphs on newly developed shoots
4- May 17, 2022	A large number of adults on leaves of <i>B. balearica</i>
5- November 17, 2022	Many adults observed on leaves of <i>B. balearica</i>
6- January 1, 2023	Few adults were detected on some plants



Figure 2. A close-up picture of an adult of *Spanioneura fonscolombii* psyllid collected from the study area of Aladağ district in Adana on March 7, 2022.

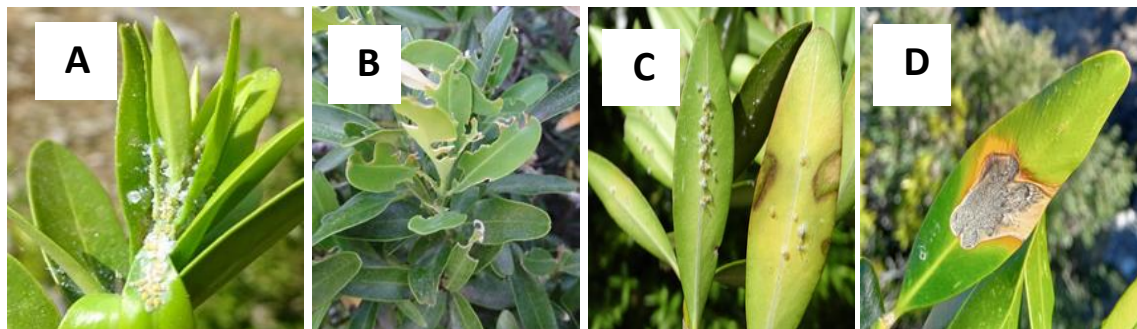


Figure 3. A) Nymphs of *Spanioneura fonscolombii* on *Buxus balearica* newly developed shoots (08.04.2022). B, C & D) The damage caused by *Spanioneura fonscolombii* on newly developed leaves of *Buxus balearica* (17.05.2022).

Few nymphs per plant can cause damage, however, more nymphs might be needed for serious damage (Burckhardt, 1994). We observed tens of nymphs on the leaves of *B. balearica* during the visits to the study area. In order to estimate the population size of *S. fonscolombii*, different individual plants were observed during the visits to the natural distribution area of *B. balearica* in Aladağ-Adana region. According to our observation, there were enough nymphs (more than 3-4 nymphs) to cause damage on the leaves of observed plants (Figure 4 A&B). Özgen and

Kavak (2018) reported that 3 to 4 nymphs may be enough to cause damage on each plant, however, more nymphs may be needed to cause serious damage. Large parts of the leaf tissues first dry up and then later drop as psyllids suck up and feed on *Buxus* leaves as seen in Figure 3. Besides this damage, various insects, mainly bees, are attracted to the sugary exude produced during or after feeding of nymphs. Because of developed fumagine, sooty molds can cover leaf surface, giving the leaf blackish sooty appearance (Figure 3 C&D).

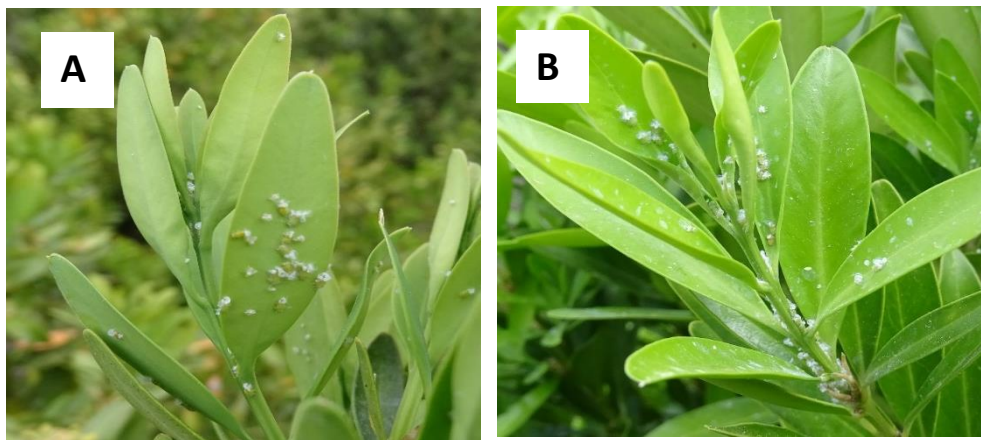


Figure 4. A & B. The damage caused by nymphs of *S. fonscolombii* on leaves of *B. balearica*.

According to EPPO (European and Mediterranean Plant Protection Organization), there are three pests causing serious damage on *Buxus balearica*. The listed pests are *Ceroplastes ceriferus* (Fabricius) (the Indian wax scale, Homoptera: Coccidae), *Cydalima perspectalis* (Walker) (Lepidoptera: Crambidae) and *Orgyia leucostigma* (Lepidoptera: Erebidae) species. *Cydalima perspectalis* causes the most serious damage among those pests. We observed that *Cydalima perspectalis* did not cause serious damage on *B. balearica* compared to the damage on *B. sempervirens* during the visits to Hatay and Adana cities of Southern Turkey in the years of 2021 and 2022. This pest massively feeds on all leaves of *B. sempervirens*, leading to the destruction of all leaves and leafless bare plant. However, only a marginal damage was seen on the leaves of *B. balearica*. The pest of *Spanioneura*

fonscolombii causes the main damage on *B. balearica*.

Biological, biotechnical, chemical, physical, mechanical and cultural pest control techniques are all the listed control measures against the general control of the species included in the Psyllidae family (Özgen and Kavak, 2018). Among those control measures, biological control method is the most preferred pest control technique against the species of the Psyllidae family. Biological control technique might be very effective, because it is environmentally friendly and economically feasible. The method is applied as first identifying the natural enemies of the psyllids and then releasing those ex-situ propagated enemies to the area where the pests are dense (Özgen and Kavak, 2018). Psyllids are attacked by many invertebrates, vertebrates and fungi. Parasites Hymenoptera (e.g. Encyrtidae, Eulophidae and others) and Diptera (e.g. Cecidomyiidae, Syrphidae and others) are synchronized with

certain stages of the life cycle of nymphs or adults of the pest. They effectively keep down the population size of the psyllids. Hemiptera (e.g. Anthocoridae and others) and Coleoptera (e.g. Coccinellidae) are not specific predators, therefore, they are weakly synchronized and not effective in biological control (Burckhardt, 1994).

Natural enemies can keep psyllids under control and reduce their damage. The species of the families of Coccinellidae, Cicadellidae, Syrphidae, Chrysopidae and Anthocoridae are some well-known natural enemies of the pest species of Psyllidae family (Özgen and Kavak, 2018). During this study, we encountered some natural enemies such as Coccinellids and Anthocorids and many spider species. Further studies related to natural enemies of *Spanioneura fonscolombii* are still under investigation.

This study is significant as it provides evidence, for the first time, for the most southern and eastern distribution of *Spanioneura fonscolombii* in the World. Moreover, *S. fonscolombii* was previously reported to cause damage on only *Buxus sempervirens*. With this study, we found, for the first time, that the pest causes serious damage on *Buxus balearica* as well.

Ethics Committee Approval

N/A

Peer-review

Externally peer-reviewed.

Author Contributions:

Conceptualization: B.L., T.O. and F.K.; Investigation: B.L. and T.O.; Material and Methodology: B.L. and T.O.; Supervision: B.L. and F.K.; Writing-Original Draft: B.L. and F.K.; Writing-review & Editing: B.L., T.O. and F.K.; Other: All authors have read and agreed to the published version of the manuscript.

Conflict of Interest

The authors have no conflicts of interest to declare.

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