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Theresimima ampellophaga (Bayle-Barelle, 1808) rediscovered in the Republic of North Macedonia by using sex attractant traps (Lepidoptera: Zygaenidae)

A. Nahirnić-Beshkova, S. Beshkov, E. E. Kucherenko & K. A. Efetov

Abstract

Theresimima ampellophaga (Bayle-Barelle, 1808) was known from only three sites in North Macedonia and has never been considered as a pest of grapevine in this territory. The last time it was recorded in North Macedonia about 80 years ago. Traps baited with synthetic sex attractant EFETOV-2 (racemic mixture of (2*R*)-butyl 2-dodecenoate and (2*S*)-butyl 2-dodecenoate) were set at two localities near Ohrid Lake at Trebenishta village and between Ljubanishta village and Sveti Naum Monastery in 2016, in Vardar river valley near Demir Kapija in 2017 and near Dojran Lake in 2018. In North Macedonia sex attractants were used for the detection of this species for the first time. We recorded *Th. ampellophaga* in traps at all four monitored localities.

KEY WORDS: Lepidoptera, Zygaenidae, *Theresimima ampellophaga*, monitoring, EFETOV-2, sex attractant, North Macedonia.

Theresimima ampellophaga (Bayle-Barelle, 1808) redescubierta en la República Macedonia del Norte usando trampas con atrayente sexual
(Lepidoptera: Zygaenidae)

Resumen

Theresimima ampellophaga (Bayle-Barelle, 1808) era conocida de solo tres sitios en Macedonia del Norte y nunca ha sido considerada como plaga de las viñas en este territorio. Últimamente fue registrada en Macedonia del Norte después de 80 años. Trampas cebo con atrayente sexual sintético EFETOV-2 (mezcla racémica de (2*R*)-butil 2-dodecenoato y (2*S*)-butil 2-dodecenoato) fue puesta en dos localidades cerca del Lago Ohrid en el pueblo de Trebenishta y entre pueblo de Ljubanishta y el Monasterio de Sveti Naum en 2016, en valle de río Vardar cerca de Demir Kapija en 2017 y cerca del Lago Dojran en 2018. En Macedonia del Norte los atrayentes sexuales fueron usados para la detección de esta especie por primera vez. *Th. ampellophaga* fue registrada en todas las trampas en las cuatro localidades monitoreadas.

PALABRAS CLAVE: Lepidoptera, Zygaenidae, *Theresimima ampellophaga*, monitoreo, EFETOV-2, atrayente sexual, Macedonia del Norte.

Introduction

Sex pheromones and sex attractants are fast becoming a key instrument in detection, monitoring and studying the seasonal activity of Lepidoptera, including Zygaenidae species (CAN *et al.*, 2019; EFETOV *et al.*, 2011, 2014a, 2015, 2016, 2018a, 2019; NAHIRNÍĆ *et al.*, 2015; RAZOV *et al.*, 2017; SUBCHEV *et al.*, 2012, 2013, 2016; TOSHOVA *et al.*, 2017). Based on the recent classification, the

Zygaenidae family is represented by five subfamilies: Inouelinae Efetov & Tarmann, 2017, Procridinae Boisduval, 1828, Chalcosiinae Walker, 1865, Callizygaeninae Alberti, 1954, and Zygaeninae Latreille, 1809 (EFETOV & TARMANN, 2017). Zygaenidae include approximately 30 pest species from subfamilies Procridinae, Chalcosiinae and Zygaeninae (TARMANN, 2003), and one of the most known among them is *Theresimima ampelophaga* (Bayle-Barelle, 1808) (Procridinae). *Theresimima ampelophaga* is a Ponto-Mediterranean species. Its main host-plant is *Vitis vinifera* L. and occasionally *Parthenocissus* spp. (EFETOV, 1990; TARMANN, 1998). In some regions it is reported as a pest species in vineyards, however in the Balkans outbreaks were reported only sporadically (e.g. DIMIĆ *et al.*, 1996; HARIZANOV *et al.*, 1994; MACELJSKI, 2002).

Grape and wine production in North Macedonia contributes to around 17-20% of the agricultural Gross Domestic Product and wine production in North Macedonia has large export trade relevance (ANONYMOUS, 2007). Vineyards are covering 5% of a total agricultural area in the country (ANONYMOUS, 2018). Areas of vineyards are reducing, from being 38759 ha in 1981 (VOJNOSKI *et al.*, 2009), ca. 29000 in 1997 (ANONYMOUS, 2008), 22665 ha in 2007 (ANONYMOUS, 2008) to 23703 ha in 2017 (ANONYMOUS, 2018). There are three vine-growing regions in North Macedonia: Povardarie region with 83% of production, Pelagonia - Polog region covering 13% of production and Pchinja - Osogovo region covering 4% of production (ANONYMOUS, 2007).

All data considering *Th. ampelophaga* in North Macedonia are faunistic while observations of damages in vineyards caused by this species are unknown to us. It was reported from only three localities in North Macedonia: Drenovo (ALBERTI, 1922), Mt. Galichica (DRENOWSKY, 1930) and Ohrid (THURNER, 1938-1941).

Monitoring with usage of sex attractants or sex pheromones provides information on the presence, abundance and seasonal activity of species and thus it enables us to make a decision whether species should be considered as a pest in a specific area and year. The main component of the sex pheromone of *Th. ampelophaga* was identified as (2*R*)-butyl (7*Z*)-tetradecenoate (SUBCHEV *et al.*, 1998). The presence of this species was established by using synthetic sex pheromone in Albania (VRENOZI *et al.*, 2019), Bulgaria (MUMUN *et al.*, 2018; NAHIRNIĆ-BESHKOVA *et al.*, 2021; SUBCHEV *et al.*, 1998, 2008b; TOSHOVA & SUBCHEV, 2002; TOSHOVA *et al.*, 2017), Croatia (RAZOV *et al.*, 2017), France (DROUET & LAMBERT, 2010; RYMARCZYK & DROUET, 2006), Greece (SUBCHEV *et al.*, 2006), Hungary (SUBCHEV *et al.*, 2004; TOSHOVA & SUBCHEV, 2005; TOSHOVA *et al.*, 2007; VOIGT *et al.*, 2000), Italy (SUBCHEV *et al.*, 2008b), Romania (SUBCHEV *et al.*, 2008a), Russia (SUBCHEV *et al.*, 2008b), Serbia (NAHIRNIĆ *et al.*, 2015) and Turkey (CAN *et al.*, 2010; CAN CENGİZ *et al.*, 2012). *Theresimima ampelophaga* was attracted to the opposite enantiomer (2*S*)-butyl (7*Z*)-tetradecenoate in Turkey (EFETOV *et al.*, 2010). Synthetic sex attractant EFETOV-2 (racemic mixture of (2*R*)-butyl 2-dodecenoate and (2*S*)-butyl 2-dodecenoate) was successfully used for attracting males of *Th. ampelophaga* in Albania (VRENOZI *et al.*, 2019), Greece (TARMANN *et al.*, 2019) and Russia (EFETOV *et al.*, 2018b), while EFETOV-S-2 ((2*R*)-butyl 2-dodecenoate) attracted *Th. ampelophaga* in Russia (EFETOV *et al.*, 2018b) and Turkey (CAN CENGİZ *et al.*, 2018).

The aim of our investigation was to confirm the presence of *Th. ampelophaga* in already known areas in North Macedonia and to discover new ones as well as to determine its seasonal flight.

Material and methods

Sex attractant EFETOV-2 (racemic mixture of (2*R*)-butyl 2-dodecenoate and (2*S*)-butyl 2-dodecenoate) produced in the Crimean Federal University (EFETOV *et al.*, 2014b) was applied onto rubber caps which were attached to hard paper and placed inside the traps. Delta traps of transparent PVC foil and sticky layers were used. Two traps were set in each of the vineyard with a distance of 10-20 m.

Only abandoned vineyards were selected at the following localities: Ohrid town, Trebenishta village, 41°12'44" N, 20°45'33" E, 715 m (Fig. 1).

The area is characterized by vineyards of various management, other agricultural fields, and abandoned fields. It is 5 km in the North from Ohrid Lake.

Ohrid Lake, between Ljubanishta village and Sveti Naum, 40°54'49" N, 20°45'21" E, 710 m (Fig. 2).

The area of ca. 300 ha surrounded by Ohrid Lake and Mt. Galichica foothill consists of one small village, scattered vineyards of various management, other agricultural fields, and many meadows.

Demir Kapija, Chiflik village E, Gorna Ergela, 41°23'18" N, 22°12'44" E, 168 m (Fig. 3).

Demir Kapija is situated in a well-known viticulture area of Tikvesh. It was difficult to find abandoned vineyard of size of at least 2 ha around Demir Kapija. Selected vineyard is almost 7 ha. The majority of the agricultural fields in the valley were moderately to well-managed vineyards with usage of pesticides. Valley is surrounded by hills covered mostly with pseudomaquis.

Dojran Lake, Nov Dojran 6 km NW, Atica, 41°14'38" N, 22°38'07" E, 178 m (Fig. 4).

Abandoned vineyard of 50 ha. Vines are growing upon horizontal network trellis. There are several vineyards of similar size and with various management as well as abandoned vineyards and vineyards of smaller sizes.

Results

Theresimima ampelophaga males were observed in traps at all four investigated sites: Trebenishta and between Ljubanishta village and Sveti Naum in 2016, in Demir Kapija in 2017 and near Nov Dojran in 2018. In the area of Ohrid Lake traps were checked once or twice just to record the presence of *Th. ampelophaga*. In Trebenishta traps were set on 9 June and removed on 8 August and checked only once on 9 July. Two and three moths were caught in both periods, respectively. On 9 July one specimen was found alive in the trap. In the vineyard between Ljubanishta village and Sveti Naum traps were set on 5 June and checked on 4 July when they were removed. Three moths were caught in the traps. In Demir Kapija traps were set in the field from 6 May to 25 August, and lures were replaced on 9 July. Altogether 45 moths were recorded in traps from 20 May until 9 July (Fig. 5). Near Nov Dojran traps were placed on 2 June and checked on 11 June, 8 July, 5 August and removed on 25 September. Only one male was found in a trap on 11 June.

Discussion

In North Macedonia sex attractants were used for the detection of this species for the first time. The last time *Th. ampelophaga* was recorded in North Macedonia about 80 years ago by THURNER (1938-1941). We confirmed the occurrence of this species in the area of Ohrid Lake – Mt. Galichica and reported it from two new localities (Fig. 6). Demir Kapija is a new locality in central part of North Macedonia ca. 27 km from Drenovo, the next nearest locality of *Th. ampelophaga*. Dojran Lake represents the first locality of *Th. ampelophaga* in south-eastern North Macedonia.

Theresimima ampelophaga was very rarely found at altitudes above 700 m. DRENOWSKY (1930) placed this species in a group of species that appear up to 1000 m. As Ohrid Lake surface is at 700 m this span appears to be 700-1000 m. We recorded exact altitudes in this area (710 and 715) which represent the highest altitudes on the Balkan Peninsula where *Th. ampelophaga* occurs. Besides localities at Ohrid Lake, the only locality where *Th. ampelophaga* occurs around 700 m on the Balkan Peninsula is Dragoman town area in Bulgaria at 700 m and 250 km inland (FREINA & WITT, 2001). It occurs at higher altitudes in France (DROUET & LAMBERT, 2010; RYMARCZYK & DROUET, 2006), Italy (BERTACCINI & FIUMI, 1999) and Turkey (CAN *et al.*, 2010), but most of these localities are close to the sea. In Kahramanmaraş province in Turkey *Th. ampelophaga* was found at several localities at 784-916 m and ca. 100-130 km inland (CAN *et al.*, 2010; Can, personal communication). However, these localities are on smaller latitude and situated in a Amuq - Islahiye - Maraş depression which is opened to the sea. Another exceptional locality is Pond in Italian Alps (BERTACCINI & FIUMI, 1999) where *Th. ampelophaga* could have penetrated through Aosta river

valley. Pond is situated at 900 m and it is ca. 180 km inland. The distance of 105-110 km from the sea over the mountains, not connected to any valley opened to the sea, makes Ohrid area quite unique among the other *Th. ampelophaga* localities. The presence of *Th. ampelophaga* so high and so inland is driven by the limestone bedrock, western exposition and the vicinity of the big water body Ohrid Lake which mitigates the local climate.

In the area Ohrid-Galichica assumable flight period was in July, thought it is possible that specimens could have been caught in June as well, however one of the two specimens in traps was alive on 9 July in Trebenishta. Moreover, flight period could extend to August since our observation period was from 10 July to 8 August in Trebenishta. THURNER (1938-1941) found this species in Ohrid in June. In Demir Kapija flight period began between 20 May and 10 June and lasted until the period 3 July - 9 July. During the period of 10-17 June, no moths were caught in traps which can be explained by the very bad weather that time. ALBERTI (1922) reported *Th. ampelophaga* from the beginning of May in Drenovo. Although we do not have weekly data, we can conclude that flight period of *Th. ampelophaga* in the area Ohrid-Galichica started approximately one month later than in Demir Kapija probably because of the difference in elevation which is ca. 550 m higher. Only one male in Dojran Lake area was certainly not expected considering wide area of vineyards especially those abandoned, good connectivity between vineyards, vicinity of other vineyard areas such as Valandovo and Bogdanci and suitable climate.

Theresimima ampelophaga does not represent a threat for vineyards in North Macedonia. However, abandoned vineyards in vicinity of managed ones can constitute potential reservoirs of various diseases and pests. On the other side, they may provide a refuge for wildlife in highly intensified agricultural areas. Eventually, succession will take place and they will change toward primary potential vegetation.

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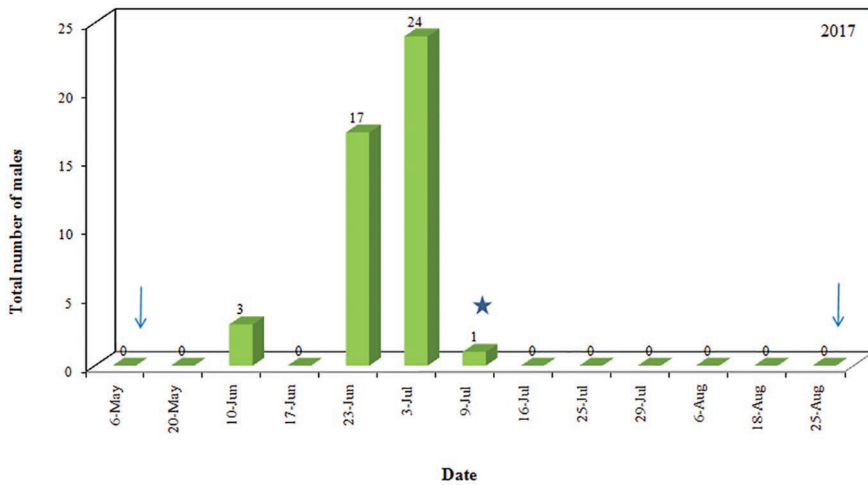
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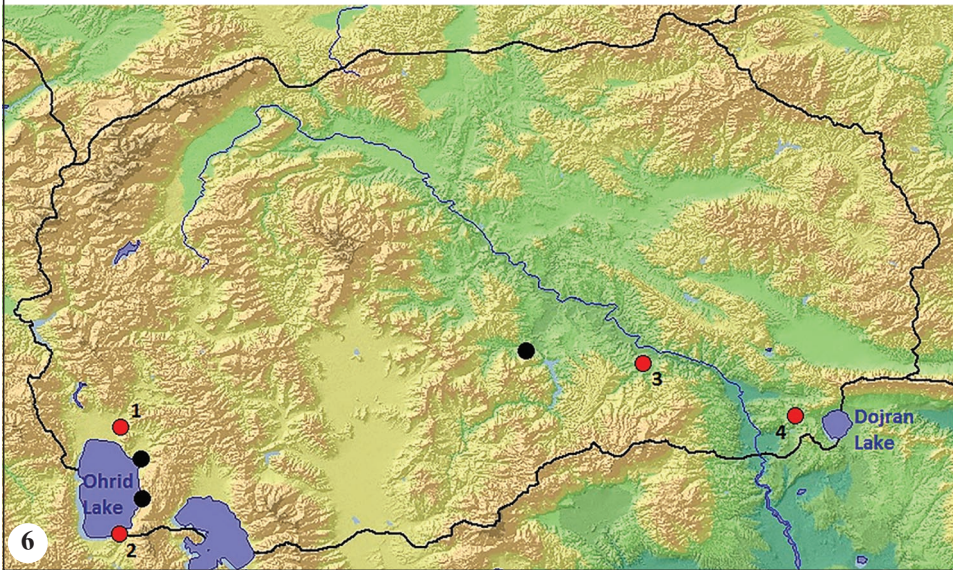
Figures 1-2.– Studied localities: 1. Ohrid town, Trebenishta village, 09-VI-2016; 2. Ohrid Lake, between Ljubanishta village and Sveti Naum, 05-VI-2016. (Photos: A. Nahirnić).



Figures 3-4.– Studied localities: 3. Demir Kapija, Chiflik village E, Gorna Ergela, 18-VIII-2017; **4.** Dojran Lake, Nov Dojran 6 km NW, Atica, 08-VII-2018. (Photos: A. Nahirnić).



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Figures 5-6.– 5. Seasonal flight of *Th. ampellophaga* males at Chiflik village (Demir Kapija) in 2017 recorded from two replicates of traps baited with synthetic sex attractant EFETOV-2 (racemic mixture of (2R)-butyl 2-dodecenoate and (2S)-butyl 2-dodecenoate). The arrows indicate the monitoring period while asterisk indicates date when lures were renewed. 6. Localities of *Theresimima ampellophaga* in North Macedonia. Black dots - published records, red dots - new records. 1 - Trebenishta, 2 - between Ljubanishta and Sveti Naum, 3 - Demir Kapija, 4 - Nov Dojran.