

Zygaenidae (Lepidoptera) of Thrace Region of Turkey

FEZA CAN CENGİZ¹, KONSTANTIN A. EFETOV², KAMURAN KAYA³,
ELENA E. KUCHERENKO², ZÜHAL OKYAR⁴, GERHARD M. TARMANN⁵

1 *University of Mustafa Kemal, Faculty of Agriculture, Department of Plant Protection, Entomology Section, 31034 Hatay, Turkey; cezafan_onurcan@hotmail.com*

2 *Crimean Federal University, Department of Biological Chemistry and Laboratory of Biotechnology, 295051 Simferopol, Crimea; efetov.konst@gmail.com*

3 *University of Mustafa Kemal, Agricultural Research and Application Center, 31034 Hatay, Turkey; kayakamuran@gmail.com*

4 *University of Trakya, Faculty of Science, Department of Biology, 22030 Edirne, Turkey; zuhalo@trakya.edu.tr*

5 *Tiroler Landesmuseen, Ferdinandeum, Naturwissenschaftliche Abteilung, Sammlungs- und Forschungszentrum, Krajaun-
Straße 1, 6060 Hall, Austria; g.tarmann@tiroler-landesmuseen.at*

<http://zoobank.org/43606443-41CF-46C5-995E-850982CB8B5A>

Received 18 September 2017; accepted 21 November 2017; published: 18 January 2018

Subject Editor: Jadranka Rota.

Abstract. The Zygaenidae fauna of the Thrace Region (European Turkey) was studied by using attractant traps as well as by netting specimens in biotopes. Esters of 2-dodecenoic acid and stereoisomers of 2-butanol were used as sex attractants. Sixteen Zygaenidae species from five genera were found: *Theresimima* Strand, 1917 (1 species), *Rhagades* Wallengren, 1863 (2 species), *Adscita* Retzius, 1783 (3 species), *Jordanita* Verity, 1946 (4 species), and *Zygaena* Fabricius, 1775 (6 species). *Rhagades* (*Rhagades*) *pruni* (Denis & Schiffermüller, 1775) and *Jordanita* (*Jordanita*) *globulariae* (Hübner, 1793) were found as new for Turkey. The two species of the same genus *Rh.* (*Rh.*) *pruni* and *Rh.* (*Wiegelia*) *amasina* (Herrich-Schäffer, 1851) were discovered in proximity to each other in different localities of the same Province Tekirdağ.

Introduction

The Thrace Region is the European part of Turkey that covers 3% of the whole territory of the country. It comprises the provinces Edirne, Kırklareli and Tekirdağ and some parts of İstanbul and Çanakkale. Turkey, extending from Asia to Europe, is one of the most species-rich countries in the Western Palaearctic (Karaçetin and Welch 2011). A study on the biodiversity of the local lepidopteran fauna can be a useful tool for environment protection. Moths of the family Zygaenidae (Lepidoptera) are excellent indicators of environmental conditions (Efetov 2005). A decline in their number in populations is often a consequence of degradation of suitable habitats because of land-use, intensification of agriculture, and climate change (Hofmann and Tremewan 2017).

Based on recent revisions, the family Zygaenidae includes five subfamilies: Inouelinae Efetov & Tarmann, 2017; Procridinae Boisduval, 1828 (with tribes Artonini and Procridini); Chalcosiinae Hampson, 1892 (with tribes Chalcosiini, Cyclosiini, Agalopini, Aglaopini and Heteropanini); Calizygaeninae Alberti, 1954; and Zygaeninae Latreille, 1809 (with tribes Pryeriini and Zygaenini) (Efetov 1996, 1997a, 1997b, 1998, 1999, 2001b, 2001c, 2006, 2010; Efetov and Tarmann 2000,

2012, 2013a, 2013b, 2014a, 2014b, 2016a, 2016b, 2017; Efetov *et al.* 2004, 2006, 2011, 2014b, 2015a; Efetov and Hayashi 2008; Efetov and Savchuk 2013; Efetov and Knyazev 2014; Knyazev *et al.* 2015a, 2015b; Mutanen *et al.* 2016; Hofmann and Tremewan 2017). According to previous publications, the Zygaenidae fauna of Turkey is represented by two subfamilies: Procridinae (22 species) and Zygaeninae (31 species) (Mollet 1995; Efetov and Tarmann 1999; Naumann *et al.* 1999; Efetov 2001a, 2004, 2005; Kemal and Koçak 2010). Five species of Zygaenidae are so far known from the territory of Turkey only: *Jordanita (Jordanita) chloronata* (Staudinger, 1871), *Zygaena (Mesembrynus) lydia* Staudinger, 1887, *Z. (Agrumenia) formosa* (Herrich-Schäffer, 1852), *Z. (A.) peschmerga* Eckweiler & Görgner, 1981, and *Z. (Zygaena) problematica* Naumann, 1966.

To date, the fauna of Zygaenidae of the Thrace Region has not been sufficiently studied. Some information can be found in the works of Mathew (1881), Rebel (1913), Buresch (1915), Graves (1914, 1925, 1926), de Lattin (1944, 1950), Reiss and Tremewan (1967), Baraniak *et al.* (1994), Seven (1991, 1993, 1995), Okyar and Aktaç (1997), Yurtsever *et al.* (2010), and de Freina (2012). However, these publications lack detailed information on the zygaenid moths of Thrace.

Materials and methods

The Zygaenidae fauna of the Thrace Region was studied by using attractant traps, by netting specimens in different biotopes in 2016, as well as by the investigation of material collected in previous years and deposited in the collection of Mustafa Kemal University (Antakya, Hatay, Turkey).

The sex attractants had been produced at the Crimean Federal University (Efetov *et al.* 2014c) and were esters of 2-dodecenoic acid and isomers of 2-butanol: EFETOV-2 (racemic mixture of *R*- and *S*-enantiomers) and EFETOV-S-2 (*R*-enantiomer). The attractiveness of 2-butyl 2-dodecenoate for males of some Procridinae species had been proved earlier in field observations undertaken in the Crimea (Efetov *et al.* 2016).

For preparing lures, the rubber caps impregnated with the attractants (100 microliters per cap without solvent) were placed in Delta traps containing removable sticky layers. The baits were hung on bushes or trees at a height of 1.0–1.5 m above the ground. In all sites that were prospected we also placed control traps without attractant. The distance between traps was not less than 10 m.

Field observations were undertaken in 61 localities in five provinces of the Thrace Region (Can Cengiz *et al.* 2016, 2017): Edirne, Kırklareli and Tekirdağ and also in the European parts of İstanbul and Çanakkale. Traps with attractants EFETOV-2, EFETOV-S-2 and control traps were set up in ten localities: 02, 07, 09, 29, 32, 36, 38, 51, 53, 60 (see below). The baits were placed on 18–23.v.2016 and inspected on 8–10.vi.2016 and 24–29.vi.2016.

The material that we collected is deposited in the collection of Mustafa Kemal University (Antakya, Hatay, Turkey). All maps are compiled from the BioOffice database of the Tiroler Landesmuseum, Innsbruck, Austria.

List of localities studied in the Thrace Region of Turkey (Fig. 1)

Province Edirne

01. Havsa-Osmanlı, 41°34'22"N, 26°49'55"E, 78 m.
02. Süloğlu Büyükgerdelli, 41°44'21"N, 26°56'47"E, 153 m.
03. Süloğlu, Gökçetepe, 41°46'16"N, 26°52'52"E, 204 m.
04. Musabeyli, 41°41'54"N, 26°41'26"E, 99 m.

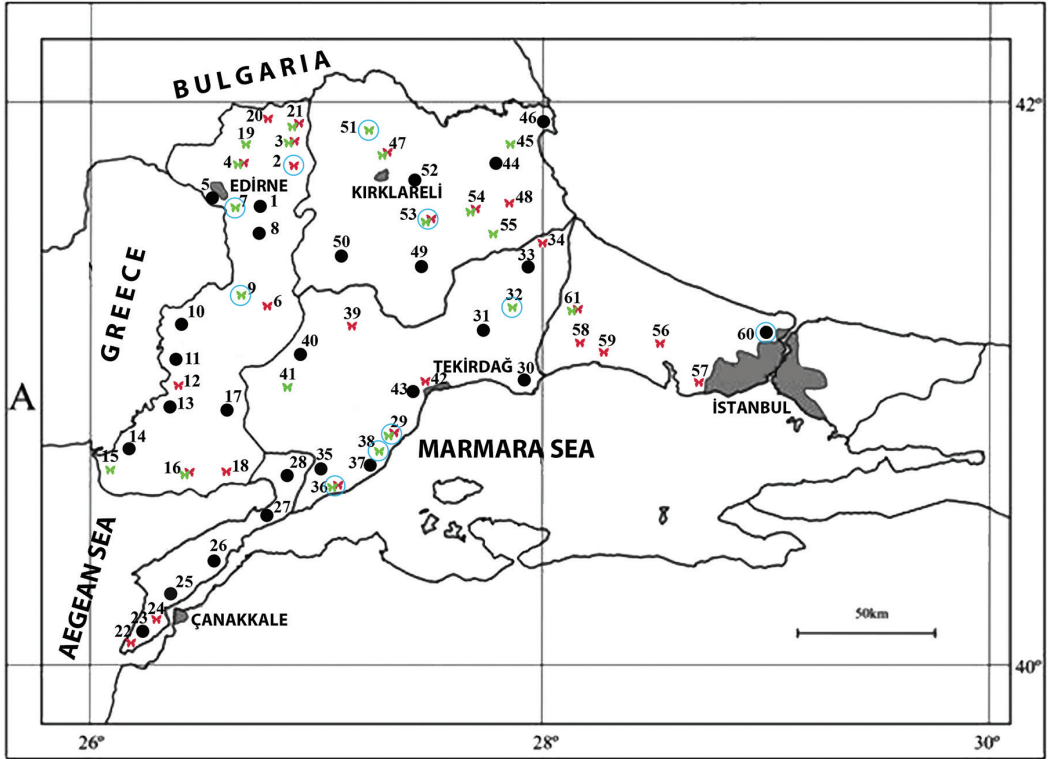


Figure 1. Map of the Thrace Region with studied localities. Moth symbols show sites where Zygaenidae were caught (green: Procridinae; red: Zygaeninae); black dots: sites where Zygaenidae were not found; blue circles: sites where traps with attractants were placed.

05. Bosnaköy, 41°37'16"N, 26°34'01"E, 34 m.
 06. Uzunköprü-Çöpköy, 41°13'45"N, 26°48'25"E, 69 m.
 07. Trakya University Balkan Campus, 41°38'44"N, 26°37'14"E, 80 m.
 08. Çukurköy, 41°27'32"N, 26°49'15"E, 50 m.
 09. Uzunköprü Yeniköy, 41°22'21"N, 26°46'43"E, 121 m.
 10. Meriç, 41°12'32"N, 26°27'18"E, 63 m.
 11. Meriç Küplü, 41°06'51"N, 26°21'22"E, 21 m.
 12. Meriç Balabancık, 41°02'07"N, 26°24'05"E, 13 m.
 13. İpsala, 40°55'44"N, 26°23'50"E, 30 m.
 14. Gala Lake Enez natural park, 40°44'51"N, 26°10'30"E, 15 m.
 15. Enez, 40°43'23"N, 26°05'38"E, 5 m.
 16. Enez-Büyükevren, 40°38'51"N, 26°14'22"E, 39 m.
 17. Keşan, 40°48'29"N, 26°39'30"E, 100 m.
 18. Keşan Gökçetepe, 40°38'16"N, 26°53'53"E, 13 m.
 19. Hacidanisment, 41°52'38"N, 26°41'12"E, 259 m.
 20. Lalapaşa Çallidere, 41°57'14"N, 26°42'48"E, 432 m.
 21. Lalapaşa Süleymandanisment, 41°53'23"N, 26°53'53"E, 388 m.

Province Çanakkale

22. Eceabat Şehitlik, 40°03'22"N, 26°13'31"E, 55 m.
23. Eceabat Alçıtepe, 40°07'32"N, 26°17'17"E, 56 m.
24. Behramlı Kilitbahir, 40°07'45"N, 26°21'09"E, 1 m.
25. Eceabat, 40°12'44"N, 26°23'09"E, 3 m.
26. Burhanlı, 40°17'47"N, 26°31'51"E, 13 m.
27. Koruköy, 40°33'43"N, 26°49'15"E, 44 m.
28. Evreşe, 40°39'30"N, 26°52'28"E, 20 m.

Province Tekirdağ

29. Uçmakdere, 40°47'51"N, 27°21'50"E, 115 m.
30. Marmara Ereğlisi, 41°03'00"N, 27°44'05"E, 9 m.
31. Çorlu, 41°14'55"N, 27°52'32"E, 128 m.
32. Çorlu Velimeşe, 41°14'18"N, 27°53'07"E, 132 m.
33. Saray, 41°24'42"N, 27°55'22"E, 185 m.
34. Saray-Güngörmez, 41°31'09"N, 28°00'53"E, 270 m.
35. Şarköy Yeniköy, 40°38'36"N, 26°59'15"E, 170 m.
36. Şarköy, 40°37'27"N, 27°05'39"E, 18 m.
37. Şarköy Mürefte, 40°39'44"N, 27°14'02"E, 3 m.
38. Mürefte Liman, 40°40'47"N, 27°16'00"E, 16 m.
39. Hayrabolu, 41°13'18"N, 27°00'59"E, 169 m.
40. Hayrabolu-Karababa, 41°07'22"N, 27°00'27"E, 101 m.
41. Malkara-Kiremitlik, 40°59'33"N, 26°56'32"E, 183 m.
42. Tekirdağ, 40°47'21"N, 27°22'10"E, 176 m.
43. Tekirdağ, 41°00'14"N, 27°30'42"E, 185 m.

Province Kırklareli

44. Yenice, 41°45'19"N, 27°41'05"E, 810 m.
45. Demirköy, 41°50'27"N, 27°33'23"E, 358 m.
46. İğneada, 41°52'33"N, 27°54'41"E, 34 m.
47. Karakoç, 41°47'40"N, 27°11'58"E, 326 m.
48. Vize-Akpınar, 41°36'14"N, 27°52'13"E, 302 m.
49. Lüleburgaz Evrensekiz, 41°21'28"N, 27°28'39"E, 66 m.
50. Babaeski, 41°24'30"N, 27°15'35"E, 68 m.
51. Kofcaz, 41°49'53"N, 27°10'56"E, 259 m.
52. Üsküpdere, 41°41'25"N, 27°22'07"E, 197 m.
53. Karıncak, 41°40'05"N, 27°26'58"E, 231 m.
54. Vize-Çavuşköy, 41°35'15"N, 27°44'40"E, 180 m.
55. Vize, 41°35'00"N, 27°47'45"E, 325 m.

Province İstanbul

56. Çatalca, 41°04'42"N, 28°30'29"E, 33 m.
57. Avcılar İstanbul University Campus, 40°59'30"N, 28°43'23"E, 74 m.
58. Yolçatı, 41°12'30"N, 27°59'58"E, 176 m.

59. Silivri, 41°05'48"N, 28°21'11"E, 83 m.

60. Bahçeköy Belgrad Forest, 41°10'30"N, 28°59'23"E, 95 m.

61. Silivri-Beyciler, 41°15'11"N, 28°06'53"E, 222 m.

We studied the collection deposited in Mustafa Kemal University to see if more material of Zygaenidae from the Thrace Region could be found. The nineteen specimens that we found were identified and are also included in the list of the Zygaenidae fauna of the Thrace Region. The pin-label data are provided in Table 4. When citing the labels, the symbol ‘/’ denotes the end of a line. In two cases handwritten labels with species’ names were corrected after examination.

Results

A total of 16 species of Zygaenidae are now known for the Thrace Region. Five Procrinae species were attracted to pheromone traps (Table 1). In spite of syntopic occurrences of Procrinae with *Zygaena* species, our traps were not attractive for burnets (*Zygaena* spp.). The males of *Theresimma ampellophaga* (Bayle-Barelle, 1808) and *Rhagades (Rhagades) pruni* (Denis & Schiffermüller, 1775) were attracted only to EFETOV-S-2. However, the males of *Adscita (Adscita) statures drenowskii* (Alberti, 1939) and *Jordanita (Solaniterna) subsolana* (Staudinger, 1862) were found in traps with EFETOV-S-2 as well as with EFETOV-2. The males of *J. (Jordanita) globulariae* (Hübner, 1793) were caught by trap with EFETOV-2. Among the species attracted, males of *A. (A.) statures drenowskii* and *Th. ampellophaga* were the most numerous: more than 30 specimens could be found in one trap (Fig. 2). The control traps were empty in all localities.

In addition to the five Procrinae species attracted to pheromone traps, we collected another five species of Procrinae by netting during our fieldwork (Table 2), as well as five species of Zygaeninae (Table 3).

By examination of material from the Thrace Region in the collection of Mustafa Kemal University, we discovered six species (Table 4), one of which was not collected by us in 2016 – *Zygaena (Mesembrynus) purpuralis* (Brünnich, 1763). For all specimens we provide data from the handwritten pin-labels.

Table 1. Males of attracted Procrinae species.

Attracted species	8–10.vi.2016		24–29.vi.2016	
	EFETOV–2	EFETOV–S–2	EFETOV–2	EFETOV–S–2
<i>Th. ampellophaga</i>	–	–	–	1 ♂ – loc. 36 33 ♂ – loc. 38 3 ♂ – loc. 29
<i>Rh. (Rh.) pruni</i>	–	1 ♂ – loc. 32	–	1 ♂ – loc. 32
<i>A. (A.) statures drenowskii</i>	9 ♂ – loc. 53 12 ♂ – loc. 51 5 ♂ – loc. 07 10 ♂ – loc. 09 1 ♂ – loc. 36 1 ♂ – loc. 29 34 ♂ – loc. 32	2 ♂ – loc. 51 7 ♂ – loc. 07 4 ♂ – loc. 09 14 ♂ – loc. 32	3 ♂ – loc. 53 4 ♂ – loc. 51 8 ♂ – loc. 32	1 ♂ – loc. 36 3 ♂ – loc. 32
<i>J. (J.) globulariae</i>	2 ♂ – loc. 53	–	–	–
<i>J. (S.) subsolana</i>	1 ♂ – loc. 36	1 ♂ – loc. 36	–	1 ♂ – loc. 09 1 ♂ – loc. 32



Figure 2. Sticky trap baited with EFETOV-2 with 34 males of *Adscita statures drenowskii*, Province Tekirdağ, Çorlu Velimeşe, 8–10.vi.2016.

Thus, the checklist of Zygaenidae of the Thrace Region based on our fieldwork in 2016, as well as the material in the collection of Mustafa Kemal University includes 16 species:

Theresimima ampellophaga (Bayle-Barelle, 1808) – 37 males attracted to EFETOV-S-2 (Tekirdağ).

Rhagades (Wiegelia) amasina (Herrich-Schäffer, 1851) – 1 male collected by net (Tekirdağ).

Rhagades (Rhagades) pruni (Denis & Schiffermüller, 1775) – 2 males attracted to EFETOV-S-2 (Tekirdağ); 1 male collected by net (İstanbul).

Adscita (Adscita) statures drenowskii (Alberti, 1939) – 87 males attracted to EFETOV-2 (Edirne, Kırklareli, Tekirdağ) and 31 males attracted to EFETOV-S-2 (Edirne, Kırklareli, Tekirdağ); 45 males and 10 females collected by net (Edirne, Kırklareli, Tekirdağ, İstanbul).

Adscita (Adscita) obscura (Zeller, 1847) – 8 males collected by net (Kırklareli, İstanbul).

Adscita (Tarmannita) manni (Lederer, 1853) – 3 males and 3 females collected by net (Kırklareli).

Jordanita (Tremewanita) notata (Zeller, 1847) – 2 males collected by net (Edirne, Kırklareli).

Table 2. Procridinae species caught in the Thrace Region in 2016. Specimens attracted to EFETOV-2 are marked with one asterisk; specimens attracted to EFETOV-S-2 are marked with two asterisks; specimens collected by net are not marked.

Localities No	03	04	07	09	15	16	19	21	29	32	36	38	41	45	47	51	53	54	55	61
<i>Th. ampellophaga</i>									3**♂		1**♂	33**♂								
<i>Rh. (W.) amasina</i>													1♂							
<i>Rh. (Rh.) pruni</i>										2**♂										1♂
<i>A. (A.) statices drenowskii</i>	2♂ 1♀		5*♂ 7**♂ 1♂	10*♂ 4**♂ 5♂ 2♀		2♂	1♀		1*♂	42*♂ 17**♂ 13♂ 4♀	1*♂ 1**♂			1♂	1♀	16*♂ 2**♂ 12♂	12*♂			1♂
<i>A. (A.) obscura</i>																3♂	2♂	1♂		2♂
<i>A. (T.) manni</i>																1♂	2♂ 3♀			
<i>J. (T.) notata</i>																				1♂
<i>J. (J.) graeca</i>		1♂	2♂		1♂ 1♀			1♂							2♂ 3♀		1♂ 1♀			
<i>J. (J.) globulariae</i>																	2*♂			
<i>J. (S.) subsolana</i>	1♂			1**♂						1**♂	1*♂ 1**♂						1♂	1♂		

Table 3. Zygaeninae species caught in the Thrace Region in 2016.

Localities No	02	03	04	06	12	16	18	20	21	22	24	29	34	36	39	42	47	48	53	54	56	57	58	59	61
<i>Z. (M.) diaphana</i>														3♂											
<i>Z. (M.) punctum</i>	1♂	2♂ 3♀	1♂	1♂	2♂	1♂			2♀	3♂					1♂	1♀	3♂			1♂				1♀	1♂
<i>Z. (A.) carniolica</i>							1♀	1♂							8♂ 4♀			2♂ 1♀					1♂ 3♀		
<i>Z. (A.) loti</i>								1♂ 1♀															3♂ 3♀		
<i>Z. (Z.) filipendulae</i>									1♂	1♀	1♂	1♂	11♂ 1♀	2♂ 1♀			2♂ 1♀			1♀	4♂ 1♀				1♂

Table 4. Zygaenidae species from the Thrace Region in the collection of Mustafa Kemal University (Antakya, Hatay, Turkey) collected before 2016.

Species	Label data
<i>A. (A.) statices drenowskii</i>	5♂ 'TURKEY / EDIRNE / Leg. Z. Göbekçioğlu', '6-6-1987 / Lalapaşa'; 1♀ '21.5.1992 / Hamzabeyli – / Lalapaşa'; 1♂ '14.6.1992 / Saray / 160 m'; 1♂ '14.6.1993 / Velika deresi / Demirköy / 500 m'; 1♂ '23.5.1998 / Hamzabeyli / 400 m'.
<i>J. (T.) notata</i>	1♂ 'TURKEY / EDIRNE / Leg. Z. Göbekçioğlu', '6-6-1987 / Donköy – / Lalapaşa'.
<i>Z. (M.) purpuralis</i>	1♂ 'TR-EDIRNE / Güllapoğlu / 06.10.2001 / Leg. Z. OKYAR'.
<i>Z. (M.) punctum</i>	1♂ '13.6.1988 / Hadımağa / EDIRNE / Leg. C. Çakmak', 'Zygaena purpuralis [sic!]; 1♀ '13.6.1988 / Hadımağa / EDIRNE / Leg. C. Çakmak', 'Trakya Univ. / Entom. Collect. / leg. C. Çakmak'.
<i>Z. (A.) carniolica</i>	1♀ '6.7.1991 / Koru dağ / 350 m', 'Zygaena fausta [sic!]'.
<i>Z. (Z.) filipendulae</i>	1♂ 'TURKEY / KIRKLARELİ / Leg. Z. Göbekçioğlu', '17-6-1987 / Limanköy – / İğneada / 50 m'; 1♂ '4-6-1988 / Yılanlıkaya / mevkii / Tatarlar'; 2♂ '4.7.1992 / Kocayazı – / Kofçaz / 300 m'; 1♂ '24.6.1993 / Bahçeköy / Sarıyer'.

Jordanita (Jordanita) graeca (Jordan, 1907) – 8 males and 5 females collected by net (Edirne, Kırklareli).

Jordanita (Jordanita) globulariae (Hübner, 1793) – 2 males attracted to EFETOV-2 (Kırklareli).

Jordanita (Solaniterna) subsolana (Staudinger, 1862) – 1 male attracted to EFETOV-2 (Tekirdağ) and 3 males to EFETOV-S-2 (Edirne, Tekirdağ); 3 males collected by net (Edirne, Kırklareli).

Zygaena (Mesembrynus) diaphana Staudinger, 1887 (bona species, see Nahirnić 2016) – 3 males collected by net (Tekirdağ).

Zygaena (Mesembrynus) purpuralis (Brünnich, 1763) – 1 male collected by net (Edirne).

Zygaena (Mesembrynus) punctum Ochsenheimer, 1808 – 18 males and 8 females collected by net (Çanakale, Edirne, Kırklareli, Tekirdağ, İstanbul).

Zygaena (Agrumenia) carniolica (Scopoli, 1763) – 12 males and 10 females collected by net (Edirne, Kırklareli, Tekirdağ, İstanbul).

Zygaena (Agrumenia) loti (Denis & Schiffermüller, 1775) – 4 males and 4 females collected by net (Edirne, İstanbul).

Zygaena (Zygaena) filipendulae (Linnaeus, 1758) – 27 males and 6 females collected by net (Çanakale, Edirne, Kırklareli, Tekirdağ, İstanbul).

Discussion

Two compounds named as ‘EFETOV-S-2’ (*R*-enantiomer of 2-butyl 2-dodecenoate) and ‘EFETOV-2’ (racemic mixture of *R*- and *S*-enantiomers of 2-butyl 2-dodecenoate) were used in sticky traps. *A. (A.) statices drenowskii* was the most numerous attracted species (118 males were caught). This subspecies is distributed from the southern Balkans to the central and southern Turkey (Efetov and Tarmann 1999; Efetov 2001a, 2004). The large numbers of specimens caught during our study in different localities (Fig. 3) prove that *A. (A.) statices drenowskii* is widely distributed and abundant in the region investigated. Moreover, this is the first record of a sex attractant for *A. (A.) statices drenowskii*. The number of specimens (males) was significantly higher in traps baited with the racemic mixture of (2*R*)-butyl 2-dodecenoate and (2*S*)-butyl 2-dodecenoate than the number in traps baited only with (2*R*)-butyl 2-dodecenoate.

Experiments with other sex attractants of similar structure (*R*- and *S*-enantiomers of 2-butyl (7*Z*)-dodecenoate and 2-butyl (9*Z*)-tetradecenoate) in Crimea, Bulgaria, Hungary, Italy, Croatia, Armenia, and Turkey have shown that species of the genera *Rhagades* Wallengren, 1863, *Zygaenoprocris* Hampson, 1900, *Adscita* Retzius, 1783, and *Jordanita* Verity, 1946, also react differently to stereoisomers of the attractants and their various combinations (Efetov *et al.* 2010, 2011, 2014a, 2015b; Subchev *et al.* 2010, 2012, 2013, 2016; Subchev 2014; Razov *et al.* 2017).

In 2013 in the Crimea we attracted the males of *Th. ampellophaga* to the racemic mixture of (2*R*)-butyl 2-dodecenoate and (2*S*)-butyl 2-dodecenoate (Efetov *et al.* 2014c). In the field experiments (presented here) in the Thrace Region (Fig. 4) the males of *Th. ampellophaga* were attracted to (2*R*)-butyl 2-dodecenoate. Earlier the main sex pheromone component of *Th. ampellophaga* females was identified as (2*R*)-butyl (7*Z*)-tetradecenoate (Subchev *et al.* 1998). It is noteworthy that all above mentioned substances are esters of 2-butanol and fatty unsaturated acids with a long carbohydrate chain. Thus, the males can be attracted not only by the natural female pheromone but also by substance with a similar structure.

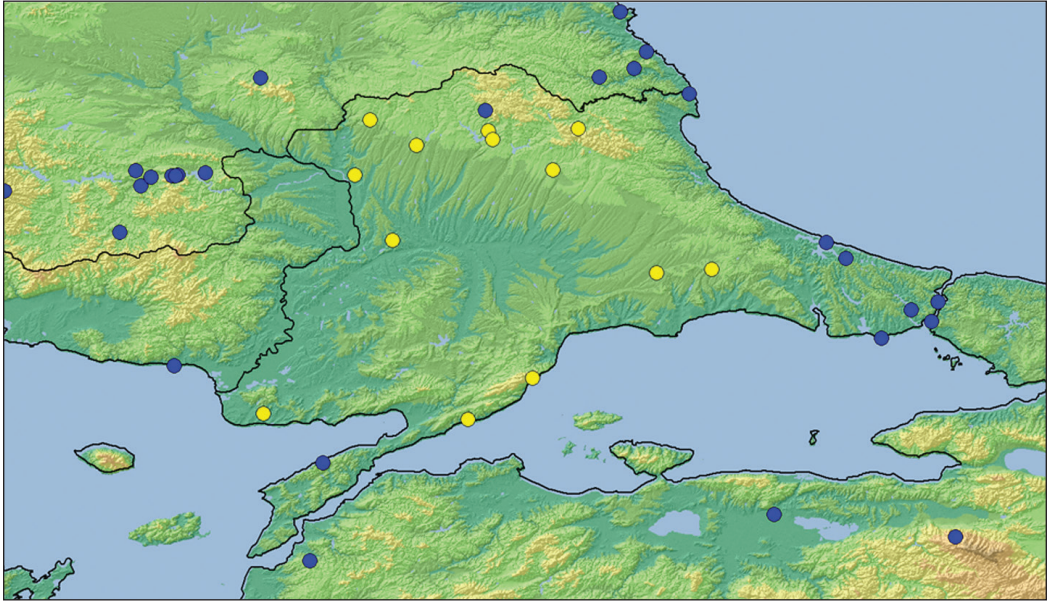


Figure 3. Distribution map of *Adscita stacies drenowskii* in the Thrace Region with new data (yellow dots).

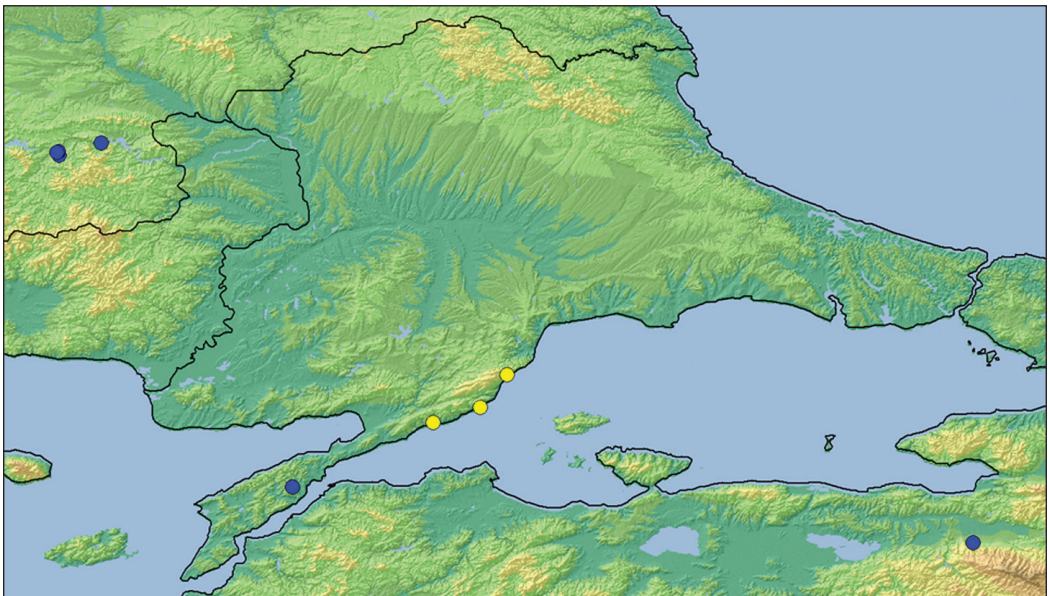


Figure 4. Distribution map of *Theresimima ampellophaga* in the Thrace Region with new data (yellow dots).

Rh. (Rh.) pruni was found for the first time in Turkey. That was possible due to the application of the sex attractants. *Rh. (Rh.) pruni* and *Rh. (W.) amasina* were recorded in the same Province Tekirdağ: *Rh. (Rh.) pruni* – in Çorlu, and *Rh. (W.) amasina* – in Malkara (Fig. 5). The known dis-

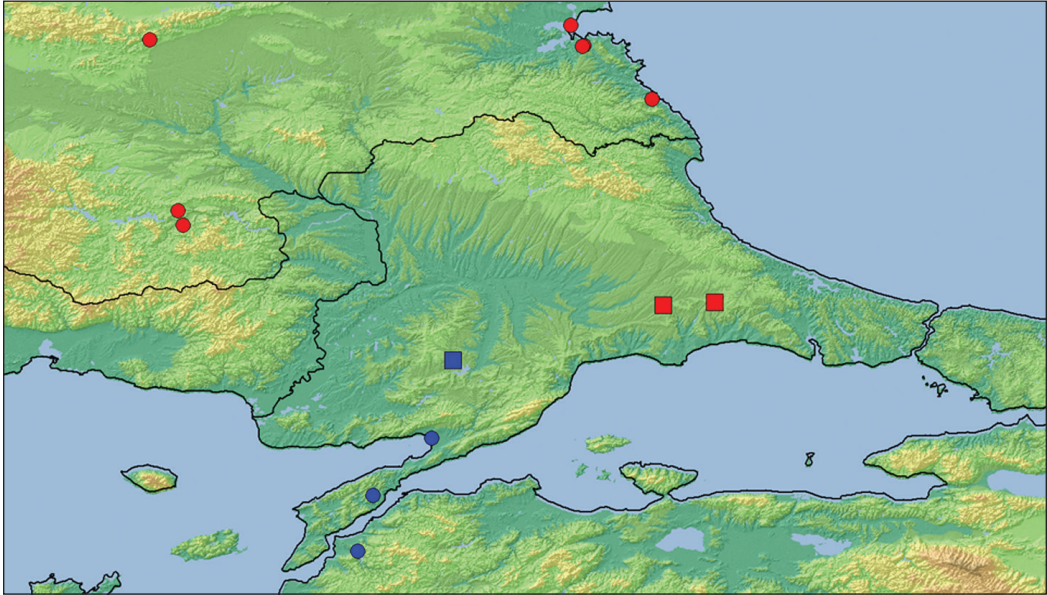


Figure 5. Distribution map of *Rhagades amasina* (blue) and *Rh. pruni* (red) in the Thrace Region. New data are marked as squares.

tribution of *Rh. (Rh.) pruni* outside of Turkey: north-eastern Spain, France, Belgium, Luxembourg, Netherlands, Denmark, Germany, Switzerland, Austria, northern Italy, Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro, Albania, Macedonia, Greece, Poland, Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Finland, Estonia, Latvia, Lithuania, Belarus, Ukraine, Moldova, Russia (northern, central and southern European part, Northern Caucasus, Siberia, Far East), Georgia, Azerbaijan, Kyrgyzstan, Kazakhstan, China, North Korea, and Japan (Efetov 2004).

J. (J.) globulariae is possibly also new for Turkey as the only literature data known so far originates from southern Turkey (Mollet 1995) and is doubtful because the mentioned locality is far away from the distributional range of this species. Old Rebel's (1934) record of '*Procris globulariae*' for Ankara must be attributed to another species, viz. *J. (T.) notata* (Zeller, 1847). Besides Turkey *J. (J.) globulariae* is known from central and northern Spain, Andorra, southern England, France, Belgium, Luxembourg, central and southern Germany, Switzerland, Austria, northern and central Italy, Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro, Albania, Macedonia, Greece, Poland, Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Belarus, Ukraine, and Russia (European part, Northern Caucasus) (Efetov 2004).

Conclusions

Sixteen Zygaenidae species from two subfamilies Procrinae (10 species) and Zygaeninae (6 species) have been recorded for the Thrace Region. Two species, *Rh. (Rh.) pruni* and *J. (J.) globulariae*, have been found for the first time in Turkey.

2-butyl 2-dodecenoate is a new sex attractant for the males of *A. (A.) statices drenowskii*.

Acknowledgements

We would like to thank Mr Serdar Akar (Turkey) for his great support during our field work. We also wish to thank Dr J. Rota (Sweden), Prof. Dr P. Jakšić (Serbia) and Mr A. Hofmann (Germany) for fruitful discussions and improving this paper. This study was supported by BAP with Project № 15445 financed by Mustafa Kemal University of Turkey.

References

- Alberti B (1954) Über die stammesgeschichtliche Gliederung der Zygaenidae nebst Revision einiger Gruppen (Insecta, Lepidoptera). Mitteilungen aus dem Zoologischen Museum der Humboldt-Universität Berlin 30: 115–480. <https://doi.org/10.1002/mmz.19540300202>
- Baraniak E, Bąkowski M, Nowacki J (1994) A contribution to the knowledge of the Lepidoptera of European Turkey. Part 1. Macrolepidoptera. Centre for Entomological Studies, Miscellaneous Papers 9: 1–15.
- Buresch I (1915) Beitrag zur Lepidopterenfauna von Trazien und Mazedonien. Zeitschrift der Bulgarischen Akademie der Wissenschaften 12: 37–54. [in Bulgarian]
- Can Cengiz F, Efetov KA, Kaya K, Kucherenko EE, Okyar Z, Tarmann GM (2016) Monitoring of Procrinae (Zygaenidae) by new sex attractants in Thrace Region (European Turkey). In: Tarmann GM, Tremewan WG, Spalding A (Eds) XV International Symposium on Zygaenidae, Mals/Malles, Italy, 11–18 September 2016. Gerhard M. Tarmann and BGO Bürgergenossenschaft Obervinschgau, Mals/Malles, 4–5.
- Can Cengiz F, Efetov KA, Kaya K, Kucherenko EE, Okyar Z, Tarmann GM (2017) Zygaenidae in Thrace Region of Turkey. In: Šašić M, Rota J, Mihoci I (Eds) Book of abstracts of the 20th European Congress of Lepidopterology. April 24th–April 30th 2017, Podgora, Croatia. Croatian National History Museum, Zagreb, 38.
- Efetov KA (1996) The description of the female of *Illiberis (Alterasvenia) yuennanensis* Alberti, 1951 (Lepidoptera: Zygaenidae, Procrinae). Entomologist's Gazette 47(2): 111–113.
- Efetov KA (1997a) Two new species of the genus *Artona* Walker, 1854 (Lepidoptera: Zygaenidae, Procrinae). Entomologist's Gazette 48(3): 165–177.
- Efetov KA (1997b) Three new species of the genus *Illiberis* Walker, 1854, from Taiwan and Vietnam (Lepidoptera: Zygaenidae, Procrinae). Entomologist's Gazette 48(4): 231–244.
- Efetov KA (1998) A revision of the genus *Goe* Hampson, [1893] (Lepidoptera: Zygaenidae, Procrinae), with descriptions of two new species. Entomologist's Gazette 49(1): 49–62.
- Efetov KA (1999) *Inouela* gen. n. from Japan and Taiwan (Lepidoptera: Zygaenidae, Chalcosiinae). Entomologist's Gazette 50(2): 91–95.
- Efetov KA (2001a) A Review of the Western Palaearctic Procrinae (Lepidoptera: Zygaenidae). CSMU Press, Simferopol, 328 pp.
- Efetov KA (2001b) On the systematic position of *Zygaenoprocris* Hampson, 1900 (Lepidoptera: Zygaenidae, Procrinae) and the erection of two new subgenera. Entomologist's Gazette 52(1): 41–48.
- Efetov KA (2001c) An annotated check-list of Forester moths (Lepidoptera: Zygaenidae, Procrinae). Entomologist's Gazette 52(3): 153–162.
- Efetov KA (2004) Forester and Burnet Moths (Lepidoptera: Zygaenidae). The genera *Theresimima* Strand, 1917, *Rhagades* Wallengren, 1863, *Zygaenoprocris* Hampson, 1900, *Adscita* Retzius, 1783, *Jordanita* Verity, 1946 (Procrinae), and *Zygaena* Fabricius, 1775 (Zygaeninae). CSMU Press, Simferopol, 272 pp.
- Efetov KA (2005) The Zygaenidae (Lepidoptera) of the Crimea and other regions of Eurasia. CSMU Press, Simferopol, 420 pp.
- Efetov KA (2006) Nine new species of the genus *Chrysartona* Swinhoe, 1892 (Lepidoptera: Zygaenidae, Procrinae). Entomologist's Gazette 57(1): 23–50.

- Efetov KA (2010) *Illiberis (Hedina) louisi* sp. nov. (Lepidoptera: Zygaenidae, Procrinae) from China. Entomologist's Gazette 61(4): 235–241.
- Efetov KA, Can F, Toshova T, Subchev M (2010) New sex attractant for *Jordanita anatolica* (Naufock) (Lepidoptera: Zygaenidae: Procrinae). Acta Zoologica Bulgarica 62: 315–319.
- Efetov KA, Hayashi E (2008) On the chaetotaxy of the first instar larva of *Artona martini* Efetov, 1997 (Lepidoptera: Zygaenidae, Procrinae, Artonini). Entomologist's Gazette 59(2): 101–104.
- Efetov KA, Hofmann A, Tarmann GM (2014a) Application of two molecular approaches (use of sex attractants and DNA barcoding) allowed to rediscover *Zygaenoprocris eberti* (Alberti, 1968) (Lepidoptera, Zygaenidae, Procrinae), hitherto known only from the female holotype. Nota Lepidopterologica 37(2): 151–160. <https://doi.org/10.3897/nl.37.7871>
- Efetov KA, Hofmann A, Tarmann GM, Tremewan WG (2014b) Taxonomic comments on the treatment of the Zygaenidae (Lepidoptera) in volume 3 of *Moths of Europe*, Zygaenids, Pyralids 1 and Brachodids (2012). Nota Lepidopterologica 37(2): 123–133. <https://doi.org/10.3897/nl.37.7940>
- Efetov KA, Knyazev SA (2014) New records of *Jordanita (Roccia) volgensis* (Möschler, 1862) (Lepidoptera: Zygaenidae, Procrinae) from Siberia (Russia) and Ukraine. Entomologist's Gazette 65(3): 175–178.
- Efetov KA, Kucherenko EE, Parshkova EV, Tarmann GM (2016) 2-butyl 2-dodecenoate, a new sex attractant for *Jordanita (Tremewania) notata* (Zeller, 1847) and some other Procrinae species (Lepidoptera: Zygaenidae). SHILAP Revista de Lepidopterología 44(175): 519–527. <http://www.redalyc.org/articulo.oa?id=45549999013>
- Efetov KA, Parshkova EV, Baevsky MY, Poddubov AI (2014c) Sec-butyl ester of dodecenoate: synthesis and attractive properties. The Ukrainian Biochemical Journal 86(6): 175–182. <https://doi.org/10.15407/ubj86.06.175>
- Efetov KA, Parshkova EV, Koshio C (2004) The karyotype of *Illiberis (Primilliberis) rotundata* Jordan, [1907] (Lepidoptera: Zygaenidae, Procrinae). Entomologist's Gazette 55(3): 167–170.
- Efetov KA, Parshkova EV, Tarasova LG, Tarmann GM (2015a) The karyotypes of Procrinae (Lepidoptera: Zygaenidae), with the first record of the karyotype of *Pollanisus commoni* Tarmann, 2004, a representative of the tribe Artonini. Entomologist's Gazette 66(2): 121–125.
- Efetov KA, Savchuk VV (2013) Newly discovered morphs of *Zygaena dorycnii* Ochseneheimer, 1808 (Lepidoptera: Zygaenidae, Zygaeninae) in the Crimea, Ukraine. Entomologist's Gazette 64(2): 111–115.
- Efetov KA, Subchev MA, Toshova TB, Kiselev VM (2011) Attraction of *Zygaenoprocris taftana* (Alberti, 1939) and *Jordanita horni* (Alberti, 1937) (Lepidoptera: Zygaenidae, Procrinae) by synthetic sex pheromones in Armenia. Entomologist's Gazette 62(2): 113–121.
- Efetov KA, Tarmann GM (1999) Forester Moths. The genera *Theresimima* Strand, 1917, *Rhagades* Wallengren, 1863, *Jordanita* Verity, 1946, and *Adscita* Retzius, 1783 (Lepidoptera: Zygaenidae, Procrinae). Apollo Books, Stenstrup, 192 pp.
- Efetov KA, Tarmann GM (2000) On the systematic position of *Procris alpina italica* Alberti, 1937 and *Procris storaiae* Tarmann, 1977 (Lepidoptera: Zygaenidae, Procrinae). Tavricheskiy Mediko-biologicheskii Vestnik 3(1–2): 161–167.
- Efetov KA, Tarmann GM (2012) A checklist of the Palaearctic Procrinae (Lepidoptera: Zygaenidae). CSMU Press, Simferopol and Innsbruck, 108 pp.
- Efetov KA, Tarmann GM (2013a) *Illiberis (Alterasvenia) cernyi* sp. nov. (Lepidoptera: Zygaenidae, Procrinae) from northern Thailand. Entomologist's Gazette 64(1): 33–39.
- Efetov KA, Tarmann GM (2013b) *Chrysartona (Chrystartonna) mineti* sp. nov. (Lepidoptera: Zygaenidae, Procrinae) from northern Vietnam. Entomologist's Gazette 64(3): 197–206.
- Efetov KA, Tarmann GM (2014a) *Illiberis (Alterasvenia) banmauka* sp. nov. (Lepidoptera: Zygaenidae, Procrinae) from China and Myanmar. Entomologist's Gazette 65(1): 62–70.
- Efetov KA, Tarmann GM (2014b) A new European species, *Adscita dujardini* sp. nov. (Lepidoptera: Zygaenidae, Procrinae) confirmed by DNA analysis. Entomologist's Gazette 65(3): 179–200.

- Efetov KA, Tarmann GM (2016a) *Pseudophacusa multidentata* Efetov & Tarmann, a new genus and species of Procradini from Myanmar, China and Laos (Lepidoptera: Zygaenidae, Procridinae). SHILAP Revista de Lepidopterologia 44(173): 81–89. <http://www.redalyc.org/articulo.oa?id=45545991011>
- Efetov KA, Tarmann GM (2016b) A new *Illiberis* species: *I. (Alterasvenia) kislovskiyi* (Lepidoptera: Zygaenidae, Procridinae) from Myanmar. Entomologist's Gazette 67(2): 137–142.
- Efetov KA, Tarmann GM (2017) The hypothetical ground plan of the Zygaenidae, with a review of the possible autapomorphies of the Procridinae and the description of the Inouelinae subfam. nov. Journal of the Lepidopterists' Society 71(1): 20–49. <https://doi.org/10.18473/lepi.v71i1.a5>
- Efetov KA, Tarmann GM, Hayashi E, Parshkova EV (2006) New data on the chaetotaxy of the first instar larvae of Procradini and Artonini (Lepidoptera: Zygaenidae, Procridinae). Entomologist's Gazette 57(4): 229–233.
- Efetov KA, Tarmann GM, Tshova TB, Subchev MA (2015b) Enantiomers of 2-butyl 7Z-dodecenoate are sex attractants for males of *Adscita manni* (Lederer, 1853), *A. geryon* (Hübner, 1813), and *Jordanita notata* (Zeller, 1847) (Lepidoptera: Zygaenidae, Procridinae) in Italy. Nota Lepidopterologica 38(2): 161–169. <https://doi.org/10.3897/nl.38.6312>
- Efetov KA, Tarmann GM, Tremewan WG (2011) *Zygaena nevadensis* Rambur, 1858 (Lepidoptera: Zygaenidae, Zygaeninae) newly recorded from the southern tip of the Peninsula Appenninica (Apennine Peninsula), Italy. Entomologist's Gazette 62(2): 123–129.
- Freina JJ de (2012) 11. Beitrag zur systematischen Erfassung der Bombyces- und Sphinges-Fauna Kleinasiens – Ergänzungen zu Artenspektrum und Verbreitungsbildern durch interessante Nachweise (Insecta, Lepidoptera). Atalanta 43(1/2): 191–210.
- Graves PP (1914) Collecting in Turkey, mainly near Constantinople, in 1913. The Entomologist's Record and Journal of Variation 26: 17–21.
- Graves PP (1925) Lepidoptera of Constantinople. Entomologist 63: 191–194.
- Graves PP (1926) Heterocera from Macedonia, Gallipoli and Central Greece. Entomologist's Record and Journal of Variation 38: 152–158, 165–170.
- Hofmann AF, Tremewan WG (2017) The Natural History of Burnet Moths (*Zygaena* Fabricius, 1775) (Lepidoptera: Zygaenidae). Part 1. Museum Witt, Munich, 631 pp.
- Karaçetin E, Welch HJ (2011) Red Book of Butterflies in Turkey. Doğa Koruma Merkezi, Ankara, 125 pp.
- Kemal M, Koçak AÖ (2010) Illustrated list of the *Zygaena* Fabr. species in Turkey based upon the Info-system of the Cesa (Lepidoptera, Zygaenidae, Zygaeninae). Cesa News 54: 1–35.
- Knyazev SA, Efetov KA, Ponomaryov KB (2015a) Zygaenidae (Lepidoptera) from Omsk Region. Zoologicheskii Zhurnal 94(11): 1297–1302.
- Knyazev SA, Efetov KA, Ponomaryov KB (2015b) Zygaenidae (Lepidoptera) of Omsk Province. Entomological Review 95(8): 1106–1111. <https://doi.org/10.1134/S0013873815080175>
- Lattin G de (1944) Einige bemerkenswerte Lepidopterenfunde aus der Türkei. Zeitschrift der Wiener Entomologischen Gesellschaft 29: 74–78.
- Lattin G de (1950) Türkische Lepidopteren – I. Istanbul Universitesi Fen Fakültesi Mecmuasi (Seri B) 15(4): 301–331.
- Mathew GF (1881) List of Lepidoptera observed in the neighbourhood of Gallipoli Turkey, in 1878. Entomologist's Monthly Magazine 18: 10–13, 29–32, 92–100.
- Mollet B (1995) Contribution à la connaissance des Procridinae du Turquie et des isles grecques de l'est de la mer Egée (Lepidoptera: Zygaenidae). Linneana Belgica 15: 127–136.
- Mutanen M, Kivelä SM, Vos RA, Doorenweerd C, Ratnasingham S, Hausmann A, Huemer P, Dincă V, van Nieukerken EJ, Lopez-Vaamonde C, Vila R, Aarvik L, Decaëns Th, Efetov KA, Hebert PDN, Johnsen A, Karsholt O, Pentinsaari M, Rougerie R, Segerer A, Tarmann G, Zahiri R, Godfray H CJ (2016) Species-level para- and polyphyly in DNA barcode gene trees: strong operational bias in European Lepidoptera. Systematic Biology 65(6): 1024–1040. <https://doi.org/10.1093/sysbio/syw044>

- Nahirnić A (2016) *Zygaena diaphana* Staudinger, 1887, bona species! (Zygaenidae, Zygaeninae). In: Tarmann GM, Tremewan WG, Spalding A (Eds) Abstracts of the XV International Symposium on Zygaenidae, Mals/Malles, Italy, 11–18 September 2016. Mals/Malles, 28.
- Naumann CM, Tarmann GM, Tremewan WG (1999) The Western Palaearctic Zygaenidae (Lepidoptera). Stenstrup, 304 pp.
- Okyar Z, Aktaç N (1997) Trakya Bölgesi Heterocera (Lepidoptera) faunasına katkılar. [Contribution to the Heterocera (Lepidoptera) fauna of Turkish Thrace]. Türkiye Entomoloji Dergisi 22(1): 47–56.
- Razov J, Efetov KA, Franin K, Toshova TB, Subchev MA (2017) The application of sex pheromone traps for recording the Procrarinae fauna (Lepidoptera: Zygaenidae) in Croatia. Entomologist's Gazette 68(1): 49–53.
- Rebel H (1913) Studien über die Lepidopterenfauna der Balkanländer. III. Teil. Sammelsergebnisse aus Montenegro, Albanien, Mazedonien und Thrazien. Annalen des Naturhistorischen Museums in Wien 27: 281–334.
- Rebel H (1934) Lepidopteren aus der Umgebung Ankaras (Teil 2). Annalen des Naturhistorischen Museums in Wien 47: 43–58.
- Reiss H, Tremewan WG (1967) A systematic catalogue of the genus *Zygaena* Fabricius (Lepidoptera: Zygaenidae). Series Entomologica. Vol. 2. Hague, 329 pp. <https://doi.org/10.1007/978-94-011-8001-6>
- Seven S (1991) Trakya Lepidoptera faunası üzerine bibliyografik arařtırmalar. Priamus 6(1/2): 1–95.
- Seven S (1993) Trakya Lepidoptera sı üzerine faunistik notlar (Faunistische Notizen über die Lepidopteren von Thrakien). Miscellaneous Papers 18: 4–8.
- Seven S (1995) Trakya Lepidoptera faunasına katkılar. Miscellaneous Papers 23/24: 1–13.
- Subchev M (2014) Sex pheromone communication in the family Zygaenidae (Insecta: Lepidoptera): a review. Acta Zoologica Bulgarica 66: 147–158.
- Subchev MA, Efetov KA, Toshova TB, Koshio C (2016) Sex pheromones as isolating mechanisms in two closely related *Illiberis* species – *I. (Primilliberis) rotundata* Jordan, 1907, and *I. (P.) pruni* Dyar, 1905 (Lepidoptera: Zygaenidae, Procrarinae). Entomologist's Gazette 67(1): 51–57.
- Subchev M, Efetov KA, Toshova T, Parshkova EV, Toth M, Francke W (2010) New sex attractants for species of the zygaenid subfamily Procrarinae (Lepidoptera: Zygaenidae). Entomologia Generalis (Stuttgart) 32: 243–250. <https://doi.org/10.1127/entom.gen/32/2010/243>
- Subchev MA, Koshio C, Toshova TB, Efetov KA (2012) *Illiberis (Primilliberis) rotundata* Jordan (Lepidoptera: Zygaenidae: Procrarinae) male sex attractant: Optimization and use for seasonal monitoring. Entomological Science 15: 137–139. <https://doi.org/10.1111/j.1479-8298.2011.00485.x>
- Subchev M, Koshio C, Toshova T, Efetov KA, Francke W (2013) (2R)-butyl (7Z)-dodecenoate, a main sex pheromone component of *Illiberis (Primilliberis) pruni* Dyar (Lepidoptera: Zygaenidae: Procrarinae)? Acta Zoologica Bulgarica 65: 391–396.
- Subchev M, Harizanov A, Francke W, Franke S, Plass E, Reckziegel A, Schröder F, Pickett JA, Wadhams LJ, Woodcock CM (1998) Sex pheromone of female vine bud moth, *Theresimima ampellophaga* comprises (2S)-butyl (7Z)-tetradecenoate. Journal of Chemical Ecology 24(7): 1141–1151; Journal of Chemical Ecology 25(5): 1203; erratum, i.e. corrected to (2R)-butyl (7Z)-tetradecenoate. <https://doi.org/10.1023/A:1022438717287> [erratum 1999]
- Yurtsever S, Okyar Z, Guler N (2010) What colour flowers do some Lepidoptera prefer for foraging? Biologia (Section Zoology) 65/6: 1049–1056. <https://doi.org/10.2478/s11756-010-0125-4>

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Nota lepidopterologica](#)

Jahr/Year: 2018

Band/Volume: [41](#)

Autor(en)/Author(s): Cengiz Feza Can, Efetov Konstantin A., Kaya K., Kucherenko Elena E., Okyar Zuhail, Tarmann Gerhard Michael

Artikel/Article: [Zygaenidae \(Lepidoptera\) of Thrace Region of Turkey 23-36](#)