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Studies on the Ennominae Fauna and Taxonomy of the Dağlıca (Geometridae, Lepidoptera)*

Hanife UÇAK[1†], Muhabbet KEMAL[2]

[1]*Van Yüzüncü Yıl University, Institute of Science, Biology PhD student, 65100 Van, Turkey*
[2]*Van Yüzüncü Yıl University, Faculty of Science, Department of Biology, 65100 Van, Turkey*

(ORCID: 0000-0002-3148-6678) (ORCID: 0000-0003-0183-4050)

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Abstract

Ennominae is an important group in the Geometridae family that contains problematic species with very similar external morphological characters. In this study, Ennominae species collected from Yüksekova Dağlıca town of Hakkari Province between April and September 2017 were evaluated from a faunistic and taxonomic perspective. 28 species were identified in the study. *Charissa onustaria*, *C. subtaurica* and *Crocallis tusciaria* species were identified for the first time from Hakkari Province. *C. loebeli*, *Neognopharmia cataleucaria*, and *Ramitia kufrana* were detected in the region are also important endemic taxa for the Turkish fauna. *Rhoptria mardinata* and *Eumera hoferi*, known only in Türkiye and Iran, are other rare species found in the region. *R. mardinata* was presented with photographs of male genitalia for the first time. Morphological and taxonomic aspects of the species under the genera *Dicrognophos*, *Gnopharmia*, *Crocallis*, *Bellachima*, *Charissa*, *Synopsia* and *Nychiodes* are discussed.

1. Introduction

Hakkari is a rich region of Türkiye in biodiversity. The first entomological research in the area was started by Koçak in 1972, the results [1-3] and the rich biological diversity of the region attracted the attention of many foreign entomologists. On this subject, Görgner [4] wrote in his article: “Lediglich im letzten Jahrzehnt dehnten die in der Türkei tätigen Entomologen ihr Arbeitsgebiet auf diese entlegene und früher fast unzugängliche Provinz aus. So bereiste zuerst A. Ö. KOÇAK (Universität Ankara) 1973 dieses Gebiet und wies aus der Provinz Hakkari sechs Lepidopterenarten für das Staatsgebiet der Türkei neu nach.” (*Only in the last decade have entomologists working in Turkey expanded their field of work to this remote and previously almost inaccessible province. So first A. Ö. KOÇAK (University of Ankara) studied this area in 1973 and identified six lepidopteran species from the province of Hakkari for the national territory of Turkey*.). Dağlıca village, a former sub-district center of Hakkari, Yüksekova district, as one of Türkiye's easternmost border outposts, remained a truly inaccessible, and hard-to-reach settlement due to security reasons for many years. In recent years, some studies on Lepidoptera species [5-8] have been carried out in and around Yüksekova, Dağlıca village. Dağlıca is located in a geography with high potential in terms of biodiversity and also in the Buzul (Glacier) and İkiyaka Mountains (DOG066 code in ÖDA) regions, which should be followed up by additional studies to determine the Important Natural Areas (ÖDA) of Türkiye [9]. Following the first lepidoptera list of Hakkari [10], second, more comprehensive study including 985 species was published [11].

Geometridae, which is in the Lepidoptera order, is one of the richest groups in the with

†Corresponding author: uck_hanife@hotmail.com
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23,872 species. Approximately 80 new species have been defined annually between 2000-2022 [12]. This number shows that the family in question is a moth group with a high potential in terms of species diversity. Geometrids are represented by 687 species in Türkiye's Lepidoptera checklist [11], 193 of them belong to Ennominae. This number includes a new genus that has been added in recent years, *Bellachima* Kemal et al., 2018 [13] and species such as *Ramitia kufrana* Seven, 2015 [14], and *Wehrliola inexpectata* Kemal & Uçak, 2018. After this article, *Charissa adjectaria* Staudinger, 1898, from Batman, *Charissa annubilata* (Christoph, 1885) and *Gnophos sacraria* Staudinger, 1895 were added to the fauna of Türkiye from Siirt Province [15]. In Türkiye, while the genus *Tephronia* is represented by *oppositaria* Mann, 1864 and *sepiaria* (Hufnagel, 1767) species [11], the species *lepraria* Rebel, 1909 is also included in the fauna of Türkiye in European Ennominae [16]. *Eupithecia opistographata* was given from Siirt [17] as a new record for Türkiye, but was omitted in the Koçak and Kemal [11] list. A new species *Eupithecia nemrutica* has been described from Bitlis Province [18]. *Protorhoe centralisata* from Batman and Siirt Provinces and *Perigune jordanaria* from Batman were added together with the genus for the Turkish fauna. A new subspecies *Perigune jordanaria anatolica* was also described in the study [19]. *Kresnaia beschkovi* (Ganev, 1987), previously known only from Iran in the Irano-Turanian Geographical Region, the first record of the fauna of Türkiye was given by Seven from Batman Province [20]. Finally, with *Nychiodes eberti* Wanke, Hausmann & Rajaei, 2020, detected in Erzurum, Türkiye's Geometrids increased to 694 species and the *Ennominae* subfamily increased to 197.

It is suggested that approximately 11,100 species identified in this subfamily worldwide and another 7000 taxa clustered at the species level according to the barcoded genetic data await identification [12]. It should be said that the studies for Türkiye also, especially the Irano-Turanian Geographic Region which has a rich potential in terms of *Ennominae* species, are still at the beginning stage. As a matter of fact, the genetic barcoding studies we have started are very late compared to Europe and our opportunities are extremely limited. Despite these conditions, we anticipate that new species will be discovered in the fauna of Türkiye. In the current study carried out in this context, the number of *Ennominae* species of Dağlıca village has increased to 31. On the other hand, knowing the habitat and food plants they live in is also important ecologically, in terms of agriculture and forestry, of this group, which plants nutrition both in early development stages and when they are adults.

2. Material and Method

The study material consists of samples collected at night with automatic light traps placed in natural areas in Dağlıca village of the research area between April-October 2017. Samples prepared in the laboratory were photographed with a Canon 60D-250D 35-155 lens camera, genital preparations were made according to Robinson [21] for definitive diagnosis, and photographed with a computer-equipped microscope at Leica S8APO, DFC290 resolution.

The noun combinations of the species listed in the study and the taxonomic hierarchy were arranged according to Koçak and Kemal [11], Müller et al., [16] and Wanke et al., [22-23] studies. For the distribution of the species in the world in Türkiye, Koçak and Kemal [11, 24] is based. The records about the specimens collected from the research area are given in Table 1. This table includes the names of the species identified from the area in alphabetical order, their vertical distribution together with the collection dates and the total number of male and female specimens collected from each species. In Table 2, the distribution of the species in the Palearctic Region and Türkiye is presented with country and traffic codes. Accordingly, based on the frequency of occurrence of the species throughout Türkiye, the species were evaluated in 5 categories: endemic if known only in Türkiye, rare if recorded in less than 5 provinces, little known if known between 5 and 10 provinces, well known if known from more than 10 provinces and less than 20 provinces, and common if known from more than 20 provinces. In addition, additional species for Hakkari fauna are marked with '*'. These assessments are based on current literature and information identified in the field study. At the end of the study, a checklist of Dağlıca Ennominae species is presented according to the taxonomic hierarchy under the tribus to which each genus belongs.

Table 1. Material examined from Dağlıca.

	Species identified in the area	Altitude and collection date	Number of specimens
1	*Bellachima diaphanaria*	2♂, 1515m, 23.09.2017; 3♂, 1505m, 15.10.2017; 2♂1♀, 1505, 16.10.2017; 1♀, 1785m, 17.10.2017; 1♀, 1520m, 20.10.2017; 1♂, 1520m, 23.10.2017.	8♂3♀
2	*Charissa annubilata*	1♂, 1505m, 15.10.2017.	1♂
3	*Charissa dubitaria*	1♀, 1505m, 15.10.2017.	1♀
4	*Charissa onustaria*	1♂, 1865m, 22.05.2017; 2♂, 1865m, 23.05.2017; 3♂, 1490m, 24.05.2017; 1♂, 1765m, 25.05.2017; 1♂, 1530m, 19.10.2017.	8♂
5	*Charissa subtaurica*	3♂, 2085m, 22.05.2017; 1♂, 1520m, 24.07.2017;1♂, 1505m, 15.10.2017; 1♂, 1520m, 20.10.2017;	6♂
6	*Chiasmia clathrata*	2♂, 1865m, 23.05.2017; 2♂, 1457m, 24.05.2017; 1♂, 1865m, 23.05.2017; 1♂, 1765m, 25.05.2017.	6♂
7	*Crocallis loebeli*	1♂, 1520m, 22.09.2017; 3♂, 1515m, 23. 09. 2017.	4♂
8	*Crocallis tusciaria*	1♂, 1505m, 15.10.2017	1♂
9	*Dasycorsa modesta*	3♂, 1650m, 24.04.2017.	3♂
10	*Dyscia innocentaria*	1♂, 1865m, 22.05.2017; 12♂2♀ 1865m 23.05.2017; 8♂1♀, 1457m, 24.05.2017; 1♂, 1765m, 25.05.2017; 1♂, 1515m, 19.09.2017; 1♂, 1520m, 20.09.2017; 1♂, 1520m, 22.09.2017; 1♂, 1515m, 23.09.2017.	26♂3♀
11	*Eilicrinia cordiaria*	1♂, 2085m, 22.06.2017; 1♂, 1525m, 23.04.2017.	2♂
12	*Ennomos fraxineti*	1♂, 1560m, 31.08.2017; 3♂, 1505m, 15.10.2017; 2♂, 1505m, 16.10.2017; 2♂, 1520m, 20.10.2017.	8♂
13	*Ennomos quercarius*	1♂, 1480m, 21.07.2017; 1♂, 1700m, 24.08.2017; 1♂, 1505m, 15.10.2017; 2♂, 1♀, 1505m, 15.10.2017; 2♂, 1505m, 16.10.2017; 1♂, 1720m, 18.10.2017; 2♀, 1520m, 20.10.2017.	8♂3♀
14	*Eumera hoeferi*	2♂, 1520m, 22.09.2017; 3♂, 2♀, 1515m, 23.09.2017; 1♂, 1505m, 16.10.2017.	6♂
15	*Gnopharmia colchidaria*	4♂, 1865m, 22.05.2017; 5♂, 1865m, 23.05.2017; 5♂, 4♀, 1457m, 24.05.2017; 1♀, 1765m, 25.05.2017; 1♂, 2075m, 21.06.2017; 7♂, 2♀, 2085m, 22.06.2017; 1♂, 1♀, 1410m, 23.06.2017; 1♂, 1550m, 22.07.2017; 1♀, 1490m, 24.07.2017.	24♂9♀
16	*Gnopharmia irakensis*	6♂, 1♀, 1865m, 22.05.2017; 3♂, 1865m, 23.05.2017; 8♂, 3♀, 1457m, 24.05.2017; 1♂, 1♀, 1765m, 25.05.2017; 4♂, 1♀, 2075m, 21.06.2017; 7♂, 7♀, 2085m, 22.06.2017; 1♂, 2♀, 1410m, 23.06.2017; 1♂, 1♀, 1520m, 24.06.2017; 7♂, 3♀, 1480m, 21.07.2017; 1♂, 3♀, 1550m, 22.07.2017; 1♀, 1520m, 24.07.2017.	39♂22♀
17	*Gnophos gorgatus*	5♂, 4♀, 2075m, 21.06.2017; 6♂, 4♀, 2085m, 22.06.2017; 3♀, 1410m, 23.06.2017; 2♀, 1480m, 21.07.2017; 2♀, 1520m, 24.07.2017; 2♂, 1♀, 1730m, 3.08.2017; 1♂ 1715m, 28.08.2017.	14♂12♀
18	*Gnophos sartatus*	2♂, 2075m, 21.06.2017; 3♂, 2085m, 22.06.2017; 1♀, 1520m, 24.06.2017; 1♂, 2♀, 1515m, 22.09.2017; 1♂, 1♀,1720m, 18.10.2017; 1♀ 1530m, 19.10.2017; 1♂, 1♀, 1520m, 20.10.2017.	8♂4♀
19	*Heliomata glarearia*	4♀, 1865m, 22.05.2017; 11♂, 4♀, 1865m, 23.05.2017; 11♀ 1457m, 24.05.2017; 1♂, 1490m, 1♂, 1♀, 1715m, 28.08.2017.	13♂20♀

Table 1. Material examined from Dağlıca (continue).

	Species identified in the area	Altitude and collection date	Number of specimens
20	*Neognopharmia cataleucaria*	1♂, 1♀, 1865m, 22.05.2017; 4♂, 1865m, 23.05.2017; 7♂, 1♀,1457m, 24.05.2017; 2♂, 1765m, 25.05.2017; 1♂, 3♀, 2075m, 21.06.2017; 1♂, 3♀, 2075m, 21.06.2017; 4♂, 4♀, 2085m, 22.06.2017; 1♂, 1410m, 23.06.2017; 2♀, 1520m, 24.06.2017; 1♀, 1730m, 23.08.2017; 1♀, 1835m, 24.08.2017; 1♀, 1715m, 28.08.2017; 2♀, 1520m, 30.08.2017.	21♂19♀
21	*Nychiodes divergaria*	1♂, 1♀, 1865m, 22.05.2017; 1♂, 1865m, 23.05.2017; 3♂, 1♀, 1457m, 24.05.2017; 3♂, 2♀, 2075m, 21.06.2017; 12♂, 1♀, 2085m, 22.06.2017; 6♂, 1410m, 23.06.2017; 3♂, 1520m 24.06.2017; 3♂, 1730m, 23.08.2017; 5♂, 1835m, 24.08.2017; 2♂, 1830m, 26.08.2017; 4♂, 1715m, 28.08.2017; 1♂, 1520m, 30.08.2017; 1♂, 1560m, 31.08.2017	45♂5♀
22	*Peribatodes rhomboidarius*	1♀, 1490m, 24.05.2017; 2♂, 2075m,21.06.2017; 1♂, 2085m, 22.06.2017; 2♂, 1410m, 23.06.2017; 2♂, 1715m, 28.08.2017; 2♂, 1520m, 22.09.2017; 2♂, 2♀, 1515m, 23.09.2017.	11♂3♀
23	*Peribatodes umbrarius*	2♀, 1765m, 25.05.2017.	2♀
24	*Pseudopanthera syriacata*	2♂, 1♀, 1865m, 22.05.2017; 6♂, 1865m, 23.05.2017; 1♀, 1457m, 24.05.2017; 1♀, 1765m, 25.05.2017.	8♂3♀
25	*Ramitia kufrana*	1♂1650m, 24.04.2017; 1♀ 1457m, 24.05.2017.	1♂1♀
26	*Rhoptria mardinata*	1♂, 1525m, 23.04.2017; 1♂, 1650m, 24.04.2017.	2♂
27	*Synopsia phasidaria*	1♂, 2085m, 22.06.2017.	1♂
28	*Wehrliola inexpectata*	1♂, 1515m, 19.09.2017; 1♀, 1520m, 22.09.2017; 1♂, 1505m, 15.10.2017; 1♂, 1505m, 16.10.2017; 1♂, 1520m, 20.10.2017.	4♂1♀

Table 2. Distribution of Dağlıca *Ennominae* species in the Palearctic Region and Türkiye.

Species list	World distribution with geographic codes [11, 24]	Distribution on Türkiye with province traffic codes [11], [24-26]	Frequency of
Bellachima diaphanaria	TM IR TR AM	04 12 13 30 51 56 65	little known
Charissa annubilata	TR AZ GG IR	53 56 65 73	rare
Charissa dubitaria	TR LB AM IR TR Cc	13 21 23 30 33 38 47 56 65 72	little known
*Charissa onustaria**	ES FR IT RO YU AL BG GR TR GG Cc AZ AM IQ IL JO IR	05 07 14 16 23 31 33 44 46 52 56 61 65 67	well known
*Charissa subtaurica**	GR TR LB IL CY JO	01 05? 07 16? 21 31 33 42 46 48 56? 65?	?well known
Chiasmia clathrata	MA DZ PT ES FR IT IE GB BE NL LU DE CH AT PL CZ SK HU RO YU AL BG GR TR Cc GG AZ AM DK NO SE FI EE LV LT RU MD UA BY Ui KG	02 05 06 10 13 14 16 18 21 22 30 31 33 34 36 42 46 49 50 56 65 71 75 80 81	common

Table 2. Distribution of Dağlıca *Ennominae* species in the Palearctic Region and Türkiye (continue).

Species list	World distribution with geographic codes [11, 24]	Distribution on Türkiye with province traffic codes [11], [24-26]	Frequency of
Crocallis loebeli	TR	02 07 30 38 44 50 58 62 65 70	endemic
*Crocallis tusciaria**	PT ES FR IT DE CH AT PL CZ SK HU RO YU BG GR TR Cc GG Kir AZ AM RU MD UA BY	01 05 17 31 34 42 46 56 58	little known
Dasycorsa modesta	RO YU BG GR CY TR LB IL IQ IR	01 05 14 17 21 22 30 31 33 34 39 42 44 46 48 49 56 59 65 71 73	well known
Dyscia innocentaria	IT YU HV AL MK BG RO GR RU MD UA TR IQ IR TM JO IL SY CY GG AZ AM AF KG UZ CN Ui	01 05 06 07 13 14 16 17 18 20 21 25 27 30 34 35 36 38 42 44 45 46 47 50 56 65 71	common
Eilicrinia cordiaria	AT SK HU RO YU BG GR RU MD UA BY TR Cc AZ AM GG IQ IR FA IN	01 02 05 06 09 13 14 16 18 22 24 30 36 38 42 44 45 46 51 56 58 59 61 65 71 73	common
Ennomos fraxineti	TÜRKİYE, IRAN, IRAQ	13 30 42? 44? 56 65 80	little known
Ennomos quercarius	PT ES FR IT CH AT PL SK HU RO YU MK AL BG GR Cr TR Cc GG AZ AM IR IQ RU MD UA BY CY LB IL JO	05 07 14 30 31 33 34 42 47 55 56 60 65	well known
Eumera hoeferi	TR IQ Cc AZ IR	30 38 44 56 63	rare
Gnopharmia colchidaria	TR Cc GG IL TM IQ AZ AM IR PK	13 21 23 27 30 31 46 56	little known
Gnopharmia irakensis	TR IQ IR PK AF	02 30 44 47 56 63 65	little known
Gnophos gorgatus	TR, IR	30 65	rare
Gnophos sartatus	IT HV YU AL BG GR TR Cc GG AZ AM LB RU MD UA BY SY IR IL CY	02 05 06 14 16 17 20 21 27 30 31 34 35 42 45 46 56 65 80	well known
Heliomata glarearia	FR IT DE CH AT PL CZ SK HU RO YU AL BG GR TR Cc GG AZ AM IR RU MD UA BY Ui	01 05 06 13 14 16 29 30 36 37 39 43 49 56 60 65 71 75 76	well known
Neognopharmia cataleucaria	TR	30 47	endemic
Nychiodes divergaria	TR LB IL RU Cc IR IQ	13 21 23 30 47 56 65	little known
Peribatodes rhomboidarius	MA PT ES FR IT IE GB BE NL LU DE CH AT PL CZ SK HU RO YU AL BG GR TR Cc AZ GG IQ IR DK SE FI RU MD UA BY IL LB CY	01 05 08 14 15 16 17 22 30 31 33 34 36 37 42 44 45 46 48 52 56 57 59 60 61 65 77 81	common
Peribatodes umbrarius	MA DZ PT ES FR IT CH SK HU RO YU AL BG GR TR IQ IR RU MD UA BY IL LB CY	05 12 14 30 31 42 44 45 46 56 65 71	well known
Pseudopanthera syriacata	TR LB IL IQ	01 02 13 21 30 31 33 44 46 47 56 65 73 80	well known

Table 2. Distribution of Dağlıca *Ennominae* species in the Palearctic Region and Türkiye (continue).

Species list	World distribution with geographic codes [11, 24]	Distribution on Türkiye with province traffic codes [11], [24-26]	Frequency of
Ramitia kufrana	TR	30 56 65 73	endemic
Rhoptria mardinata	TR, IR	30 47 56	rare
Synopsia phasidaria	Cc GG AF IR TM AZ TR	04 13 30 65 73	rare
Wehrliola inexpectata	TR	30	endemic

3. Results

In this study, Dağlıca Ennominae species were investigated faunistically and taxonomically. As a result, 28 species were identified from the area. Distribution information of the species in Türkiye and in the world [11, 24], [25-26] together with the collection records are presented (Table 1). *Charissa onustaria*, *C. subtaurica* and *Crocallis tusciaria* species were added to the fauna of Hakkari, and it was also understood that these species spread to the easternmost part of Türkiye. As a result of the research, *Neognopharmia cataleucaria*, *Crocallis loebeli* and *Ramitia kufrana* species endemic to the fauna of Türkiye were identified along with *Wehrliola inexpectata* which is described from Dağlıca. *Charissa annubilata*, *Synopsia phasidaria*, *Gnophos gorgatus*, *Rhoptria mardinata* and *Eumera hoeferi* are rare species throughout Türkiye and have been located during the field work. Additionally *R. mardinata* and *E. hoeferi*, according to the available data, are taxa known only from Türkiye and Iran and have a narrow distribution area throughout the world [11], [16], [27]. The genus *Eumera* Staudinger,1892 is represented in Türkiye by the species *regina* Staudinger, 1892, *turcosyrica* Wehrli, 1932 and *hoeferi* Wehrli, 1934. However, in previous taxonomic studies, the tribus of this genus was not yet clear [16], while Wanke et al. [23] stated that this genus belongs to the *Prosopolophini* Warren, 1894 tribus. The general morphological characteristics of *E. hoeferi* from the area are similar to Malatya specimens examined in Wanke et al. [23].

Bellachima diaphanaria, *Gnopharmia colchidaria*, *G. irakensis*, *Crocallis tusciaria*, *Ennomos fraxineti*, *Nychiodes divergaria* and *Pseudopanthera syriacata* are species identified in the research that are little known in Türkiye, and are also elements of the Irano-Turanian Geographical Region, not found in Europe. *Dyscia innocentaria*, *Chiasmia clathrata*, *Eilicrinia cordiaria*, *Ennomos quercarius*, *Heliomata glarearia*, *Peribatodes rhomboidarius* and *P. umbrarius* are taxonomically well known species that are widespread in Türkiye from Europe, Caucasus and Middle East to Central Asia [11], [24-26].

Seven [8] recorded the species *Odontognophos zacharius*, *Gnophos pseudosnelleni* and *Crocallis elinguaria* from Dağlıca. Thus, the number of Ennominae species in Dağlıca increased to 31.

4. Discussion

Ennominae are both rich in species diversity and difficult to distinguish by external morphological features, such as wing patterns and coloration. This has at times led to misdiagnosis. External morphological characters and even the structure of the genital organs that enable gene exchange have not been sufficient to distinguish some taxa (as in *Nychiodes* spp). This has led to the division into numerous subgenera in systematic and taxonomic studies, especially in the genera *Charissa*, *Gnophos* and *Gnopharmia*.

The genus *Charissa* is currently represented by 53 species from Palaearctic and Orientalic regions [16]. In the fauna of Türkiye, a total of 29 species are known from the following taxonomic groups, *Cnestrognophos*, Wehrli, 1951; *Euchrognophos*, Wehrli, 1951; *Kemtrognophos* Wehrli, 1951; *Neognophina* Wehrli, 1946; *Organognophos* Wehrli, 1951; *Rhopalognophos* Wehrli, 1951 and 7 subgenus including the nominant subgenus *Charissa* Curtis, 1826 [11]. *Charissa annubilata*, *C. dubitaria*, *C. onustaria* and *C. subtaurica* species were identified from the area. The first two

species are distributed in Türkiye and its eastern neighbors [28], but are not known from the European fauna [11], [24-26]. The male genitalia of the *subtaurica* from Dağlıca differ from those of Anamur [29] and Müller et al., [16]. For example, the chitinous structure on the costal margin of the valve is relatively thick, the saccus is round, the ampulla is inclined outward, the aedeagus spine is relatively wide at the base, and the juxta reaches the tip of the uncus (Figure 4. 8: a-b). In the specimen of this species from Diyarbakır (Hazro) [5], the juxta does not reach to the tip of the uncus. Whether these differences are within the limits of variation can only be resolved by future molecular research. *Charissa subtaurica* is distributed in Greece only on the island of Samos, Cyprus and along the Eastern Mediterranean coast [16]. In Türkiye, apart from the Mediterranean region, it is recorded as suspected in Amasya, Bursa, Siirt and Van, and is also known from Diyarbakır and Konya [11, 24]. In a study on the *Gnophini* tribus in Türkiye, it is based on molecular results that *Charissa dubitaria staudingeri,* formerly considered a subspecies, is a taxon at the species level and sister to *C. assoi* and *C. corsica* [30]. As a matter of fact, *C. staudingeri* was later presented at species level in Volume 6 of European Geometrids, and its distribution in the coastal Aegean region of Türkiye was mapped [16]. *Charissa subtaurica* and *C. staudingeri* are difficult to distinguish in terms of appearance. However, male and female genital structures can be easily distinguished [16]. The *subtaurica* examined in the Dağlıca study differs easily from the closest species *staudingeri* in terms of genital structure (Figure 5. 3). Another important species in Dağlıca fauna is *Charissa dubitaria* (Staudinger, 1892). The distribution of this species suggests that there are intermittent records from İçel (Anamur) in the Mediterranean region and from the East and Southeast of Türkiye [11]. Most recently, there have been records from Batman, Elazığ and Diyarbakır [25-26], [31]. This species while there is no European record yet [16] it is known to be distributed in the Caucasus, Lebanon, Armenia and Iran [11, 24], [25-26]. Two male and one female specimens of this species were previously examined from Van (Cesa coll.: GP2407♂, GP2418♂, GP2926♀). The genital characters of the specimens are shorter in the male than in the aedeagus spines *staudingeri* species, while in the female the ductus bursae is relatively long and the corpus bursae is rounded, prominently concave on one side, 1/3 membranous towards the free end. These characters are similar to those of a female from Dağlıca (Figure 5. 4).

Charissa annubilata (Christoph, 1885) is included in the Türkiye checklist under the subgenus *Euchrognophos* Wehrli, 1951. However, Müller et al. [16] transferred it to the subgenus *Cnestrognophos* Wehrli, 1951. While this species is rare in Türkiye, it is also a poorly known taxon in neighboring Azarbeijan, Georgia and Iran [11], [27]. *Charissa onustaria* (Herrich-Schäffer, [1852]) is a well-known species distributed from Europe to Iran and Iraq [11], [16]. It is better represented in the area than the other three species. The genitalia of two male individuals of this species were examined, but some significant differences were detected in the genital structures. The genitalia of the first male (GP22♂), collected in the same habitat and on the same dates are very close to those of Seven [32] and Müller et al. [16]. The other specimen (GP56♂) differs in that the uncus and gnathos are wider and shorter, and the length and width of the thumb-shaped juxta are similar to the saccus (Figure 4. 9: a-b). Whether these differences are variation or a separate taxon will be clarified by future molecular studies.

The genus *Gnopharmia* Staudinger,1892 is represented by 7 species in Türkiye, Middle East, Caucasus, Iran and Iraq [11], [12], [33], distributed outside Europe and a member of the Irano-Turanian Geography. Recorded in Türkiye with *colchidaria*, *irakensis* and *rubraria* species [11], [32], [34-35]. The first two species are distributed in eastern and southeastern Türkiye and are little known. *G. rubraria* is more common in Western, Central and Southeastern Anatolia. Numerous specimens of *G. colchidaria* and *irakensis* species were examined from the study area (Table 1). Among the materials examined, some differences in the male genitalia of the specimens belonging to *colchidaria* are noteworthy. Namely, the proximal projection of sacclus being relatively thick, but a pair of sternite extensions looks like nominate subspecies *colchidaria* [33]. The female genitalia is to some degree similar to the subspecies *colchidaria colchidaria* (Figure 4. 3: a-b-c) [33]. However, the lateral arms of lamellae postvaginalis structure, antrum, ductus bursae and cingum are different to some degree (Figure 5. 2: a-b).

Perhaps these differences are reported by Rajaei et al. [33] photograph may be due to the fact that it is not very clean and unclear.

One of the lesser known species in this genus in Türkiye is *irakensis*. Rajaei et al. [33] also included Köprüköy [Kırıkkale], Kahramanmaraş from Türkiye and Afghanistan from the Middle East countries in its distribution area. According to Koçak and Kemal [11], it is distributed in Türkiye, Iran, Iraq and Pakistan. The above information was confirmed once again in the latest European Geometrid study [16]. This species, described from Erbil in northern Iraq, is very different from the Dağlıca specimen in terms of external morphological characters. The external morphology and structures of the male genitalia of the syntype specimen of this taxon are presented in Rajaei et al. [33]. The genitalia of 5 males and 3 females of this taxon from Dağlıca were examined. These specimens were previously identified as *irakensis*, but differ from the syntype in the structures described below. They also have some differences among themselves. In the Dağlıca *G. irakensis* specimens, the upperside of the wing is darker, the distal spots of the forewing and hindwing are more prominent on the underside than on the upperside. The postdistal line, bordering the broad brown submarginal band on the upperside, is composed of orange spots and continues intermittently to the hindwing. Forewing apical patch is quadrangular and light yellowish cream in color. The thick submarginal band on the underside is dark brown and slightly concave medially on the hindwing (Figure 2.a-b). In male genitalia of GP6♂, GP7♂ and GP11♂ specimens, gnathos and uncus structure, distal and proximal projection of sacculus (except GP34♂), valva, slightly arcuate aedeagus (with GP34, except GP7♂) and abdominal 8th sternite (except GP34♂) are almost the same structure. Differences: GP7♂ has a distinctly outwardly membranous structure up to halfway up the valva. Juxta base is rounded (straight on GP11♂ and GP7♂), aedeagus is almost straight, slightly curved at the tip. Sacculus is similar to that of the syntype [33], in the other specimens (GP11♂, GP6♂ and GP34♂) the sacculus is wider on both wings and distinctly square. The sternite projections of the GP34♂ specimen are thicker and relatively short. Also, the distal and proximal projection of sacculus is relatively thick (Figure 4. 2: a-b-c). In females, the apophyses anterior and apophyses posterior are thin and relatively long in GP74♀ and thick and relatively short in GP53♀ and GP54♀. Lamaella post vaginalis, antrum and ductus bursae are similar in GP53♀ and GP54♀, but different in GP74♀. The signums on all three female genitalia are oval and star-shaped. However, the spines in the center of the signum are separate in GP74♀, relatively separate in GP53♀ and not separate in GP54♀. Furthermore, the signum is relatively rounded in GP74♀ and the lateral spines are longer (Figure 5. 1: a-b). The above-mentioned structural features suggest that *irakensis*-like taxa in Türkiye should be revisited.

Neognopharmia cataleucaria (Staudinger, 1901), whose type locality is Mardin, was originally proposed as a subspecies in the original study as *Gnophos stevenaria* var. *cataleucaria* Staudinger, 1901, and later elevated to species level. The genus is represented by 3 species including *stevenaria* (Boisduval, 1840), *cataleucaria* (Staudinger, 1901) and *horhammeri* (Brandt, 1941) [16], [36]. In the Türkiye checklist, *stevenaria* is distributed in Europe, Caucasus, Türkiye, Iran and Iraq, while *cataleucaria* is an endemic species found only in Türkiye [11]. *Neognopharmia horhammeri* (Brandt, 1941) is known only from Iran according to current records [14], [27].

The genus *Rhoptria* Guenée, [1858] is represented worldwide by the species *Rhoptria asperaria* (Hübner, [1817]), *R. dolosaria* (Herrich-Schäffer, [1848]), *R. mardinata* (Staudinger, 1900) and *R. erebata* (W. Warren, 1897). The first two species are distributed in some European countries including Türkiye, while *mardinata* was described in Mardin and is only known from Türkiye and Iran. In this study, it is presented for the first time with male genital photographs (Figure 4. 4: a-b). In the 123 years since it was described, the research shows that the species has remained as a taxon in the endemic to Irano-Turanian geographic region. The *R. erabata* is known from Brazil in the Neotropical region [10-11]. Only *asperaria* and *dolosaria* are listed in the European Geometrids of the 6th volume [16].

The genus *Crocallis* Treitschke, 1825 is represented by 19 species in the Palearctic region [16], [36]. In Türkiye, the number of species increased to 8 with the study of Stadie & Fiebig [37], as it is on the Koçak & Kemal [11] checklist. According to Skou & Sihvonen [36],

transcaucasica Wehrli, 1940 is a subspecies of *tusciaria* that distribution in Türkiye and the Caucasus. However, it is presented at the species level in recent studies [11], [16], [27]. Thus, the fauna of Türkiye today includes *elinguaria* (Linnaeus,1758), *tusciaria* (Borkhausen,1793), *inexpectata* Warnecke,1940; *elingomorpha* Stadie & Fiebig, 2014; *loebeli* Stadie & Fiebig, 2014 (type locality: Sivas, Gürün), *rothei* Stadie & Fiebig, 2014 (type locality: Hakkari, Merkez [Durankaya]) and *sylvana* Fiebig, 2014 (type locality: Tunceli, Ovacık). The last three species seem to be endemic species distributed only in Türkiye for now. Specimens of *tusciaria* (GP47♂) and *loebeli* (GP19♂) were examined from Dağlıca. *Crocallis loebeli* (Figure 4. 6: a-b) (GP436♂) external morphology has some differences. Fore and hind wing ground color is pale yellow, antemedian and postmedian fascia is very faint, difficult to determine (Figure 2. g-h). Anterior wing discal spot is very small, very weak. This species has been recorded from 10 provinces in Türkiye [11], [37]. In this study, even if we evaluate it in the category of lesser-known species whose distribution is limited only to Türkiye, it is likely to be found in countries neighboring Türkiye in the future. According to the available data *Crocallis tusciaria* (Borkhausen, 1793), distribution intermittently in Western Anatolia, Mediterranean region and Central Anatolia [11]. The data in the thesis study has been added to the Eastern Anatolia fauna [11, 24], [25-26]. Examined material wing color and patterns, genital structures also have some differences in Skou & Sihvonen [36]. Uncus tapers abruptly in the 2/3 part. Annelus is short, projecting laterally at the base. Clasper process is closer to the tip, large and perpendicular to the clasper. Annelus short, protruding laterally at base (Figure 4.5: a-b). This is also observed in Siirt populations [32].

Eilicrinia Hübner,[1823] is known in the palearctic region with the species *cordiaria* (Türkiye, Iran, Iraq, Eastern Europe and Caucasus region), *subcordiaria* (Türkiye: only Van and Igdir; Caucasus region and central Asia) and *trinotata* (Türkiye, Eastern Europe, Caucasus region) [11, 36]. Two specimens (GP41♂ and GP423♂) of *cordiaria* (Hübner, 1790) from Dağlıca were examined. In both male specimens, unlike Skou and Sihvonen [36], the uncus is long pointed, and the base of the furca connected to the juxta is prominently lobed on both sides. A pair of furca arms are long and thin and the right side is slightly long. Valva is wider, costa and the anal margin is slightly convex. The aedeagus vesica teeth are small and sparse (Figure 4.7: a-b).

Ennomos Treitschke,1825, according to the by Koçak and Kemal [10], is represented by 12 species in the palaearctic region. However, 9 species are listed in the 6th volume of European Geometrids [16]. *E. fuscantaria ssp. efractaria* Freyer, [1842] from the European part of Russia; *E. quercaria ssp. freidbergi* Hausmann, 1997 is presented as subspecies from the eastern Mediterranean region. On the other hand *zandi* Wiltshire 1947, listed in Koçak & Kemal [10] from Iran, but not included in the *Ennominae* checklist [16]. This may be due to the hesitant definition of the genre as "... may be an aberration or a race ..." [38]. But this species has been listed in the last Iranian Lepidoptera catalog [27].

In Türkiye, the genus *Ennomos* is represented by a total of 5 species together with the following two species [11], *Ennomos fraxineti* Wiltshire, 1947 and *Ennomos quercarius* (Hübner, [1813]). The first species is distributed in Türkiye, Iran and Iraq. It is probably endemic to the Irano-Turanian geographic region. It is little known species in Türkiye [11]. Distribution of the species in Müller et al. [16] is limited to Southern Turkmenistan and Iran. However, the examined material and previous records strongly support the distribution of the species in Türkiye. The second species, *E. quercaria*, is well known and occurs in the Palearctic region.

Dicrognophos Wehrli, 1951 is transferred from *Gnophini* to *Abraxini* + *Cassymini* + *Eutoeini* group, tentatively in *Cassymini* [16]. The species *amanensis* (endemic for Türkiye), *sartatus*, *anophaeus*, *choristus*, *orthogonius* and *pseudosnelleni*, as well as the newly described species *siciliana* (from Italy, Sicily), were revised under this genus. However, *choristus* and *pseudosnelleni* differ significantly from the other species in terms of their genital structures [32]. The species presented in the thesis with the name combination *Gnophos (Dicrognophos) gorgatus* Brandt,1938 was added to the fauna of Hakkari (Figure 4. 1: a-b). *Gnophos* (*Dicrognophos*) *sartatus* Treitschke, 1827 is well known in Eastern Europe, Caucasus, Middle East and Türkiye, and Müller et al. [16] and Rajaei et al. [27] listed this species in the genus *Dicrognophos*.

The previously valid genera *Synopsia* Hübner, 1825 and *Synopsidia* Djakonov, 1935 were represented by one species each in the palearctic region [11], [16]. Wanke et al. [22], based on morphological characters, molecular data and distribution records, *Synopsidia* Djakonov, 1935 is downgraded to synonym with *Synopsia* Hübner, 1825. Accordingly, *Synopsidia phasidaria* (Rogenhofer, 1873) was transferred to the genus *Synopsia* as *Synopsia phasidaria* (Rogenhofer, 1873). Thus, in the fauna of Türkiye, the genus *Synopsia* is represented by *sociaria* and *phasidaria* species. The first species is distributed in Europe, including Türkiye, the Caucasus, the Urals and Central Asia (Kazakhstan, Uyghur Province) and Iran [11], [22], while *phasidaria* is distributed in eastern Türkiye (Ağrı, Bitlis, Hakkari, Van, Şırnak), the Caucasus, Afghanistan, Azerbaijan, Iran and Turkmenistan. The s*ubsp*. *centralis* Wiltshire, 1966, formerly described as a subspecies of *Synopsidia phasidaria*, was elevated to species level and the name combination was changed to *Synopsia centralis* (Wiltshire, 1966) [22]. This species is only known from Iran [22], [27].

In thesis study, a male of this species, listed as *Synopsidia phasidaria*, was examined. The genital structure of the specimen is generally consistent with Wanke et al., [22] (the Türkiye population was excluded from the genetic analysis). However, the free end of the harp is rounded and the spiny process dorsal to the apex of the valva is distinctly lobed (stand out budge). These characters may not change the results of the aforementioned study. However, the need for extensive genetic research on Türkiye populations remains important. In this context, we tentatively accept the Dağlıca sample in the combination presented by Wanke et al., [22] and transferred the taxon *phasidaira* (Rogenhofer, 1873) to the genus *Synopsia* Hübner, 1925.

The genus *Wehrliola* is represented by a single species in the subfamily Ennominae. While *Revocaria* Staudinger, 1892, described from Lebanon, is known from Mersin, Konya and Kahramanmaraş Provinces in Türkiye [11], the second species of the genus was revealed by examining the specimens collected from Dağlıca. With the external morphological features and genital structure characters of the taxon, it was easily be distinguished from *recorvaria* and defined as *Wehrliola inexpectata* Kemal & Uçak, 2018 and took its place in the scientific world [39]. In Volume 6, Part 1 of the Geometrids of Europe, the genus *Wehrliola* is temporarily placed in the *Gnophini* tribus, while its classification in the higher categories remains uncertain [16].

The genus *Apochima*, founded by Agassiz in 1847, is known in the Western Palearctic region with the species *flabellaria* (Heeger,1838) and *diaphanaria* (Püngeler, 1904) [13]. There are faunistic records of these two species in Türkiye [11]. When the individuals belonging to the *diaphanaria* species among the Dağlıca materials were examined morphologically, it was revealed that they had different structural characters at the genus level from *flabellaria*. This was also supported by molecular research, and a new genus *Bellachima*, the type species of which is *diaphanaria*, was defined [13]. In the study of Europe Ennominae, the molecular analysis was based only on the mtCOI gene and was not compared with the subspecies *A. diaphora rjabovi* and the genus *Chondrosoma* (this genus is represented only by *fiducaria*, with wingless females, and is morphologically very different) [16, 40], suggesting that they are not considered as separate genera [16]. However, the morphological characters of *Bellachima diaphanaria* (Püngeler, 1904) from the genus *Apochima* have been detailed, and the genetic distance between the two species has been determined to be at the level of a separate lineage in the genus category, well above a species distinction [13]. According to available data, the species is distributed in Türkiye, Iran, Armenia and Turkmenistan [11, 16, 41]. However, the specimen in the Turkmenistan record differs from the Dağlıca specimen with features such as clasper in the genital structure, aedeagus spine and short caecum [41]. Based on these characters, it would be appropriate to evaluate the species in another study covering the distribution areas of the species.

The genera *Nychiodes* and *Peribatodes* are included in the tribus *Boarmini* Duponchel, 1845 according to the latest systematic arrangements [16]. *Nychiodes* Lederer, 1853 is represented by 8 species in the fauna of Türkiye [11]. In recent years, the non-European species of the genus *Nychiodes* have been revised [22]. Accordingly, the previously listed species of *amygdalaria, divergaria, rayatica, waltheri* and with the newly described *eberti* Wanke,

Hausmann and Rajaei, 2020 (type locality Erzurum, Kopdağı Pass) increased to 5 species in Türkiye. Based on genetic data in the study, variabila became synonymous with *divergaria*. Thus, the specimen from Dağlıca, which was previously diagnosed as *variabila*, is presented in this study with the combination *Nychiodes divergaria* (Staudinger, 1892). The *rhomboidarius* and *umbrarius* species belonging to the genus *Peribatodes* were also identified from the research area. Research on these species is also in progress.

Ennominae taxa are highly variable in terms of external morphological characters and show high variation. This situation becomes more complicated especially for the species represented in genera such as *Charissa*, *Gnophos*, *Gnopharmia* and. The fauna of the Irano-Turanian Geographical Region, which is still at the beginning of research, is in need of comprehensive research. Even if the differences in genital structure, which provide gene transfer in morphological studies, are helpful to some extent, they are not sufficient to solve the problem. The data obtained by molecular methods and genetic differences at the species and subspecies level contribute to the solution of the problem in taxonomic and phylogenetic studies. In this study, genetic research is needed to clarify the taxonomic status of some species.

Tentative checklist of Dağlıca Ennominae Species

Tribus **Abraxini** Warren, 1893
1) *Odontognophos zacharius* (Staudinger, 1879)

Tribus **Cassymini** Holloway, 1994
2) *Dicrognophos sartatus* Treitschke, 1827 (sensu Müller et al., [16])
3) *Dicrognophos pseudosnelleni* Rjabov, 1964 (sensu Müller et al., [16])
4) *Dicrognophos gorgatus* Brandt, 1938 (sensu Rajaei et al., [27])

Tribus **Macariini** Guenée, 1858
5) *Heliomata glarearia* (Brahm, 1791)
6) *Neognopharmia cataleucaria* (Staudinger, 1901)
7) *Gnopharmia irakensis* Wehrli, 1938
8) *Gnopharmia colchidaria* (Lederer, 1870)
9) *Chiasmia clathrata* (Linnaeus, 1758)
10) *Rhoptria mardinata* (Staudinger, 1900)

Epionini of uncertain association (sensu Müller et al., [16])
11) *Pseudopanthera syriacata* (Guenée, 1858)
12) *Eilicrinia cordiaria* (Hübner, 1790)

Tribus **Ennomini** Duponchel, 1845
13) *Ennomos (Deuteronomos) quercarius* (Hübner, [1813])
14) *Ennomos (Deuteronomos) fraxineti* Wiltshire, 1947
15) *Crocallis (s.str.) tusciaria* (Borkhausen, 1793)
16) *Crocallis elinguaria* (Linnaeus, 1758)
17) *Crocallis (s.str.) loebeli* Stadie & Fiebig, 2014

Tribus **Prosopolophini** Warren, 1894
18) *Bellachima diaphanaria* (Püngeler, 1904)
19) *Dasycorsa modesta* (Staudinger, 1879
20) *Eumera hoeferi* Wehrli, 1934 (sensu Wanke et al., [22])

Tribus **Theriini** Herbulot, 1963
21) *Ramitia kufrana* Seven, 2015

Tribus **Gnophini** Duponchel, 1845
22) *Charissa (Euchrognophos) dubitaria* (Staudinger, 1892)
23) *Charissa (Euchrognophos) annubilata* (Christoph, 1885)
24) *Charissa (Euchrognophos) subtaurica* (Wehrli, 1934)
25) *Charissa (Kemtrognophos) onustaria* (Herrich-Schäffer, [1852])
26) *Synopsia phasidaria* (Rogenhofer, 1873)
27) *Dyscia (Calodyscia) innocentaria* (Christoph, 1885)

Gnophini of uncertain association (sensu Müller et al., [16])
28) *Wehrliola inexpectata* Kemal & Uçak, 201

Tribus **Boarmiini** Duponchel, 1845
29) *Nychiodes (Eunychiodes) divergaria* (Staudinger, 1892)
30) *Peribatodes rhomboidarius* ([Denis & Schiffermüller], 1775)
31) *Peribatodes umbrarius* (Hübner, [1809]

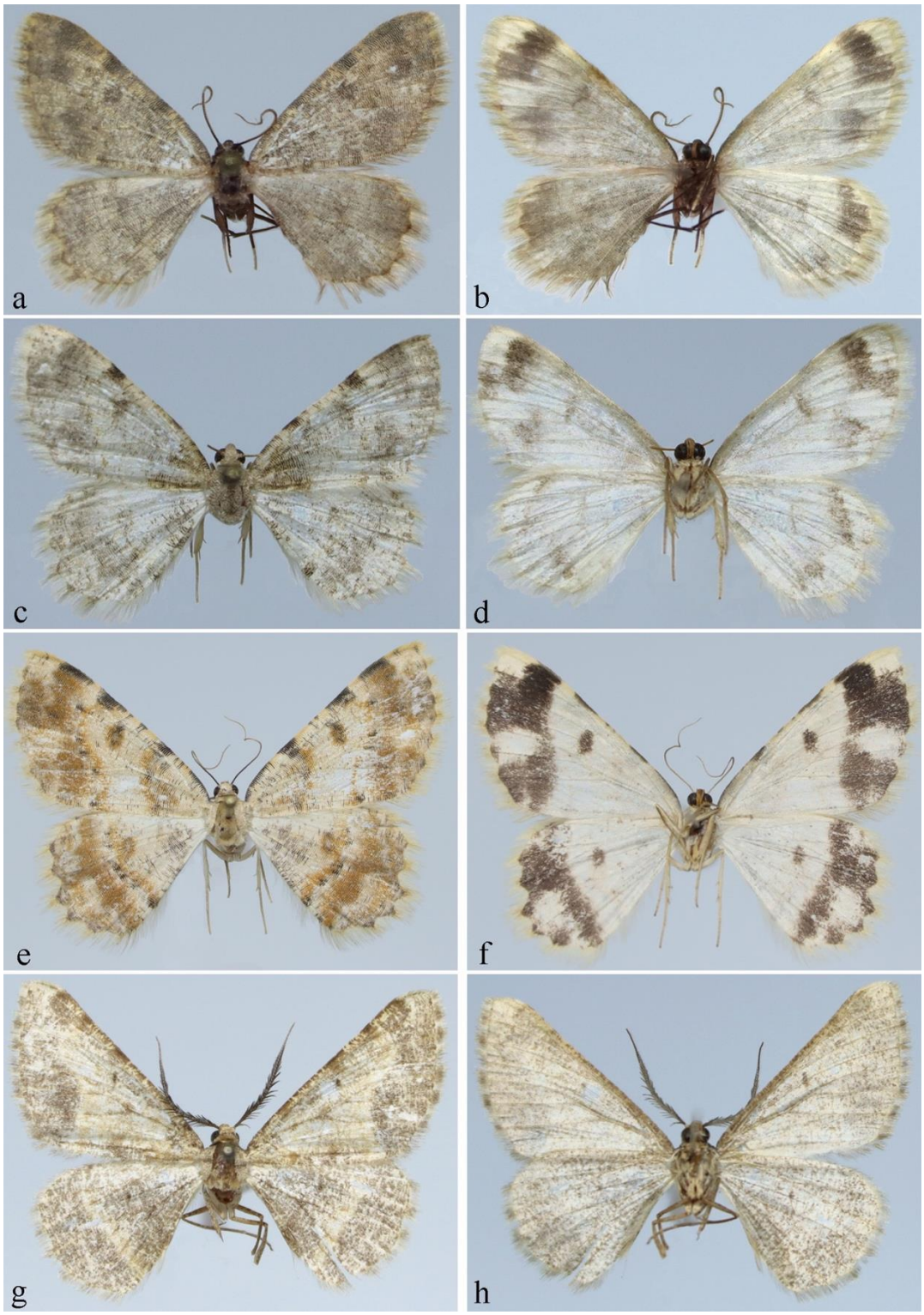

Figure 1. a-b. *Charissa annubilata* **a.** upperside **b.** underside. **c-d**. *Charissa subtaurica* **c.** upperside **d.** underside. **e-f**. *Charissa dubitaria* **e.** upperside **f.** underside. **g-h**. *Gnopharmia colchidaria* **g.** upperside **h.** underside.

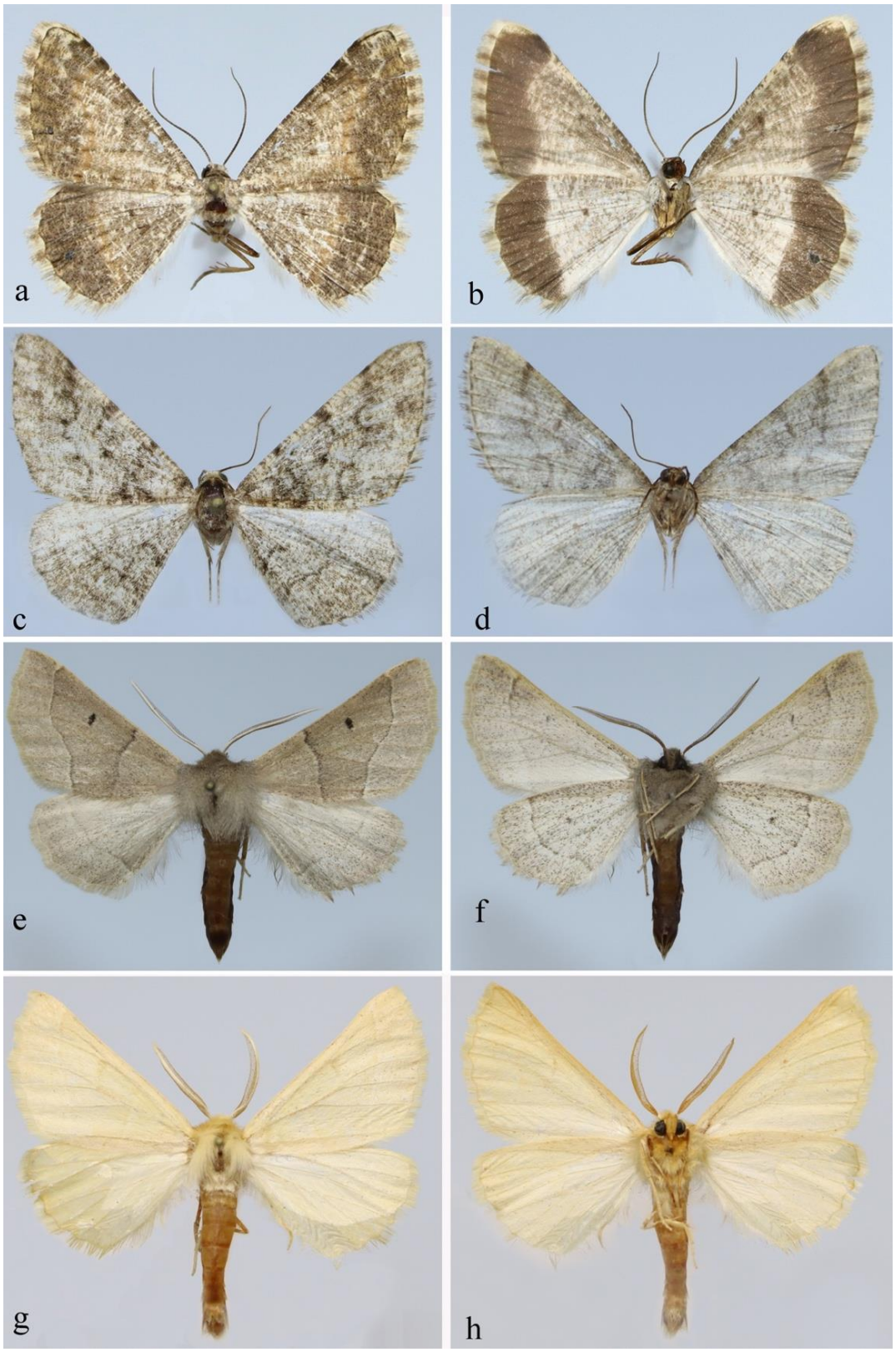

Figure 2. a-b. *Gnopharmia irakensis* **a.** upperside **b.** underside. **c-d**. *Rhoptria mardinata* **c.** upperside **d.** underside. **e-f.** *Crocallis tusciaria* **e.** upperside **f.** underside. **g-h**. *Crocallis loebeli*. **h.** upperside. **g.** underside

Figure 3. a-b. *Eilicrinia cordiaria* **a.** upperside. **b.** underside

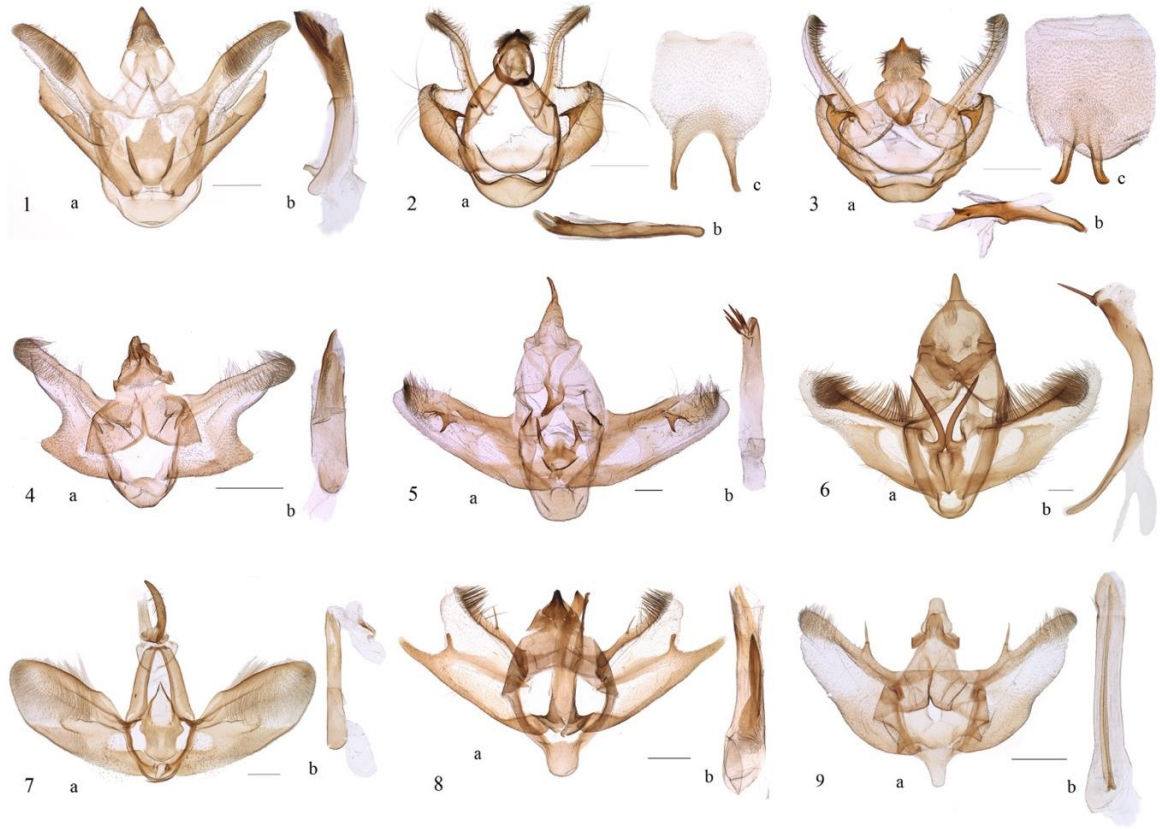

Figure 4. Genitalia Structures. **1.** *Gnophos gorgatus*. **a.** Male genitalia (17GP♂). **b.** Aedeagus. **2.** *Gnopharmia irakensis* (GP34♂). **a.** Male genitalia. **b.** Aedeagus. **c.** Sternite. **3.** *Gnopharmia colchidaria* **a.** Male genitalia (GP9♂). **b.** Aedeagus. **c.** Sternite. **4.** *Rhoptria mardinata* **a.** Male genitalia (GP42♂). **5.** *Crocallis tusciaria*. **a.** Male genitalia (GP47♂). **b.** Aedeagus. **6.** *Crocallis loebeli*, **a.** Male genitalia (GP436♂). **b.** Aedeagus. **7.** *Eilicrinia cordiaria*, **a.** Male genitalia (GP423♂). **b.** Aedeagus. **8.** *Charissa subtaurica.* **a.** Male genitalia (GP27♂). **b.** Aedeagus. **9.** *Charissa onustaria*, **a.** Male genitalia (GP56♂). **b.** Aedeagus. (Scale bar: 1mm).

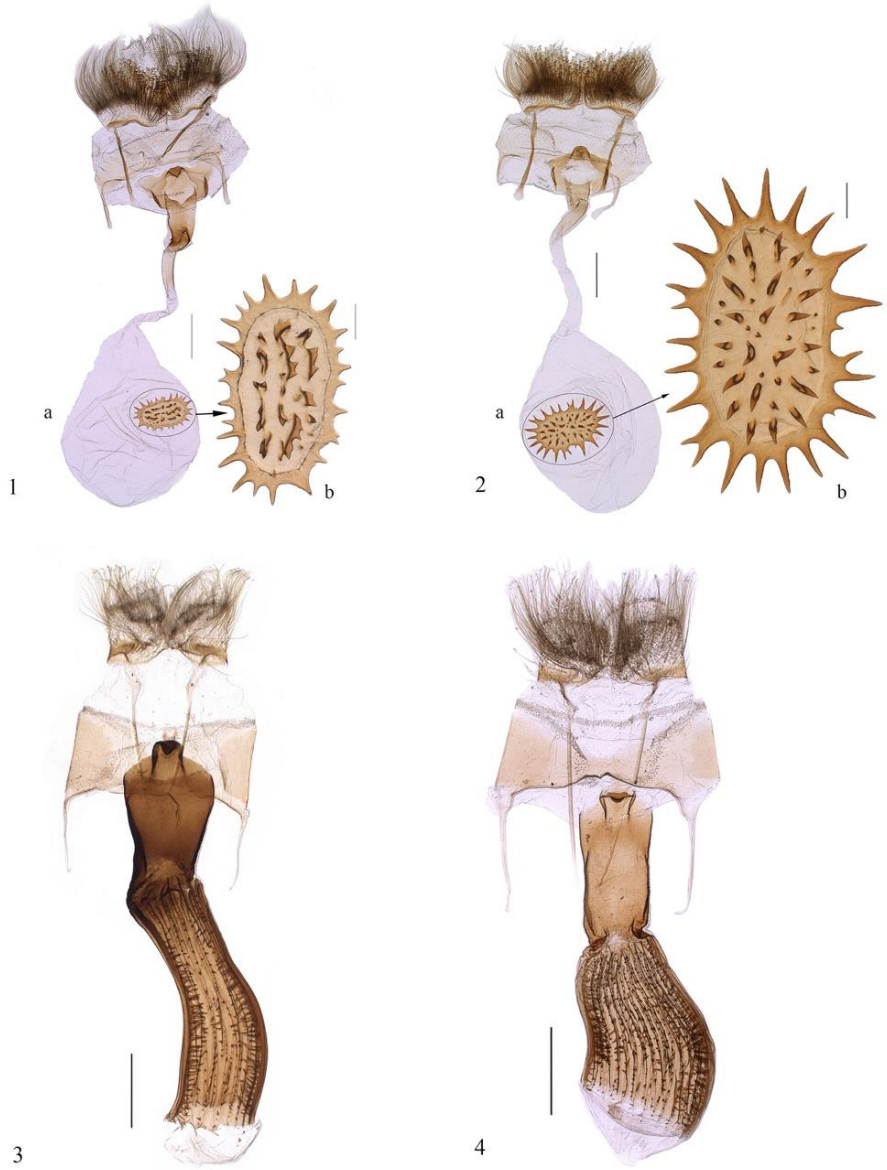

Figure 5. Genital Structures. **1.** *Gnopharmia irakensis*, **a.** Female genitalia (GP54♀). **b.** Signum **2.** *Gnopharmia colchidaria*, **a.** Female genitalia (GP33♀). **b.** Signum (Scale bar: 0.5mm). **3.** *Charissa subtaurica*, Female genitalia GP26♀). **4.** *Charissa dubitaria* Female genitalia (GP48♀). (Female genitalia: Scale bar: 1mm, Signum: Scale bar: 0.5mm).

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Author's Contributions

All authors contributed equally to the study.

Statement of Conflicts of Interest

No potential conflict of interest was reported by the authors.

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