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Short Communication: Altitudinal distribution of Papilionoidea (Lepidoptera) in Mount Aragats, Armenia

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Abstract. *Zarikian N. 2017. Altitudinal distribution of Papilionoidea* (*Lepidoptera) in Mount Aragats, Armenia. Biodiversitas 18: 818-825.* In this study, the altitudinal distribution of butterflies on the highest mountain in Armenia was investigated. Butterflies were collected from March to October in 2015 and 2016. This revealed that the relationship between the total numbers of butterfly species and individuals and altitude shaped as bump. A significant relationship was also recorded between the altitude and the abundance and richness. However, the diversity and evenness index yielded a consistent decrease with increase in altitude because of the dominance of few species at high altitudes.

Keywords: Abundance, Armenia, evenness index, distribution, Lepidoptera, Papilionoidea, species diversity

INTRODUCTION

High altitude ecosystems on mountains are unique ecosystems and the environment of high altitudes deserves to be the studied carefully (Mani 1990). Mountain habitats are spatially and structurally complex when trees or larger shrubs form part of the landscape, producing a mosaic of different habitat types with their own particular vegetation and/or microclimateExploitation of these patches by different plants and animals may reflect more their specific life history strategies and ability to utilize a particular type of habitat than the total taxonomic diversity present at a particular altitude (Haslett 1997; Hodkinson 2005). Patterns in the altitudinal distribution of species richness have been considered as indispensable evidence for hypotheses that propose associations with productivity and ambient energy, as well as the past and current climates taking in account, that these factors alter with altitude (Rahbek 2005 Considerable, two patterns of species richness are observed in the altitudinal distribution (Rahbek 2005). The first is a monotonic decrease with altitude. This is expected if resource limitation and thermal constraints govern species diversity (Fiedler and Beck 2008). The second is that the pattern of species richness is bump-shaped, the mid-domain effect (Colwell & Lees 2000). This pattern is expected if the geometric restrictions on habitat areas change with altitude. Lomolino (2001) indicates that peaks in diversity at intermediate levels along an decline consort to points where the combined effects of many environmental factors and associated processes enhance the co-occurrence of many species. Therefore, it appears that the changes in species richness with altitude may be determined by more complicated mechanisms than previously believed. Proceeding from the same principle, many papers had published about the vertical distribution of butterflies in Central Asia; which brought a new scientific experience in this field (Korb 1994).

Studies on the patterns in the altitudinal distribution in species richness in Mount Aragats have revealed it mostly either decreases monotonically or is hump-shaped. This study sought to determine the altitudinal distribution of Rhopalocera in Mount Aragats and the influence of altitude on butterflies richness and abundance. Aragats is a circular mountain composed of both lavas and tuffsA volcanic cone lies atop far older rocks. The crater of the volcano has become the steep-walled basin. Near the serrated summit are high mountain meadows and rockfalls. On the slopes grows steppe vegetation and xerophytes (dry and arid climate-vegetation), in addition to the widely distributed light forest (Table 1).

Its geographic location and difference in altitude from the majority of the mainland have facilitated many studies on the altitudinal distribution of species richness. But despite several surveys dedicated to the high altitude butterflies of some regions of Armenia the researches and published data on the fauna of Aragats Mount massive are not enough for comprehensive knowledge of the fauna of the high altitude butterflies of there.

Alpine vegetation types are distributed over the whole Caucasus in heights between 2,000 m and 3,500 m above sea level. In alpine turf communities densely growing grasses dominate (Holubec and Křivka 2006), while less dense, but species-rich alpine carpets are at most composed of small, bowing herbs. Alpine turfs and carpets are scraped resulting in a degradation of the vegetation and a convert in species composition towards species that are resistant or protected against browsing damage. Unlike xerophytic the vegetation in lower altitudes, alpine rock vegetation in the Armenia is typically linked with at least substantial precipitation (Holubec and Křivka 2006). In general, Caucasian alpine rock vegetation is very diverse and species composition largely depends on the chemical composition of the rocks (basic or acidic), in the manner, the rocks erode and climatic fluctuations, especially in relation to water availability. Subnival and nival vegetation occur near glaciers and areas permanently covered by snow usually in heights between 3,000 m up to ~4,100 m in the Caucasus. Endemism on species as well as on genus level is high. For example, out of the ~200 species of vascular plants growing in the subnival zone of the Caucasus, about half are endemic (Holubec and Křivka 2006). The vascular plants can grow till 4,095 m (summit of Mount Aragats), where the endemic cruciferous grows (Holubec and Křivka 2006).

MATERIALS AND METHODS

Study sites

Mount Aragats (highest peak: 4090 m, area: 5000 km2) is presented as the highest mountain in Armenia. The annual average temperature is -3°C - +10°C and annual precipitation are 300 - 900 mm, Snow covers the top of the highest peak almost year-round. The circumference of the massif is around 200 km and is a barrier to dispersal for many species (Nazarian 1974).

Twelve sites in the Mount Aragats in Armenia were sampled in this study (Figure 1, Table 1). These sites were selected based on accessibility from the lowest (Byurakan) (1550m) to the highest altitude (Southern peak) (3888 m). These sites were also designated as either riparian or upland, depending on their proximity to streams or lakes. Two sites (Lake Lessing, Aragats village) were located on eastern expositions, one on western (Mantash r.), one on southern (Geghadzor) and the remaining sites on northern expositions.

Rhopalocera data and sampling

The Lepidopteran species targeted included the butterfly's families traditionally falling under the suborder of Rhopalocera and five readily identifiable families (Hesperiidae, Papilionidae, Pieridae, Lycaenidae, Nymphalidae). A total 2,952 individuals belonging to108 species were identified. Five families were represented in the collections by the following numbers of species Hesperiidae (8), Papilionidae (4), Pieridae (21), Lycaenidae (35), Nymphalidae (40) (See Table S1 for species list). The study is based mainly on the analysis of our own materials, collected in all sites above mentioned. The material was collected during expeditions, conducted in 2015 -2016. Specimens were collected using a sweep net and killed in killing jars with ethyl acetate. Each specimen was put into a labeled envelope and brought to the laboratory to be spread and dried. Identification was carried out using the guides of Hesselbarth et al. (1995), Tuzov et al. (1997), Bozano (1999-2012), Kawahara and Breinholt (2014), Korb and Bolshakov (2016), and by comparison with author's reference collections. Besides, all available literature and collection data were taken into account.

Data analysis

The catches of butterflies for the two years were gathered. Species richness (total number of species), abundance (total number of individuals), Simpson's diversity index (D) and the Shannon evenness index (E) were calculated for each site (altitude).

Simpson's diversity index calculates the probability of any two individuals drawn at random from an infinitely large community belonging to the same species (Magurran 2003). The Shannon evenness index is H'/ (ln S) where H' is the Shannon diversity index and (ln S) is the log-transformed species richness. Altitude, altitudinal area, species richness, and abundance were log transformed prior to analysis.

Relationships among altitude, altitudinal area, species richness, abundance, diversity, and butterflies evenness were investigated. First, correlation analyses between altitude, altitudinal area and four dependent variables (species richness, abundance, Simpson's and Shannon evenness index) were executed to determine the significant relationships among the variables. Second, a piecewise regression was carried out with a breakpoint at 2150 m (Amberd). The two models were combined into a single model by creating four new variables.

Two of the new variables, alt1 and alt2, represent the effect of altitude on species richness above and below 2090m, respectively.

alt1 = (altitude - 2150), if (altitude$\geq$2090) alti1 = 0

alt2 = (altitude - 2150), if (altitude < 2090) alt2 = 0

The other two new variables, int1 and int2, represent the intercepts below and above 2090 m, respectively.

int1 = 1, if (altitude $\geq$ 2090) int1 = 0

int2 = 1, if (altitude < 2090) int2 = 0

All correlations and piecewise regression analyses were carried out using SPSS software (SPSS Inc. 2006).

RESULTS AND DISCUSSION

Results

The results of our analysis are generalized in Table 2. The species richness, abundance, diversity and evenness results are detailed in Table 2. The distribution of these variables relative to altitude has a hump-shaped pattern, with the exception of the evenness index (Figures 2-5). No significant correlations have been found between species richness, abundance or diversity, and altitude. However, the reverse correlation between altitude and evenness is significant (Pearson's r = -0 .865, P = 0.01) (Table 3).

Unlike the hump-shaped patterns for the relationships between species richness and abundance relative to altitude recorded in Mount Aragats, which decreased with altitude, the relationship for evenness and diversity were almost constant (Figures 2-5). Shannon evenness is a measure of heterogeneity that considers the degree of evenness in species abundances in terms of the ratio of observed diversity to maximum diversity (Magurran 2003).

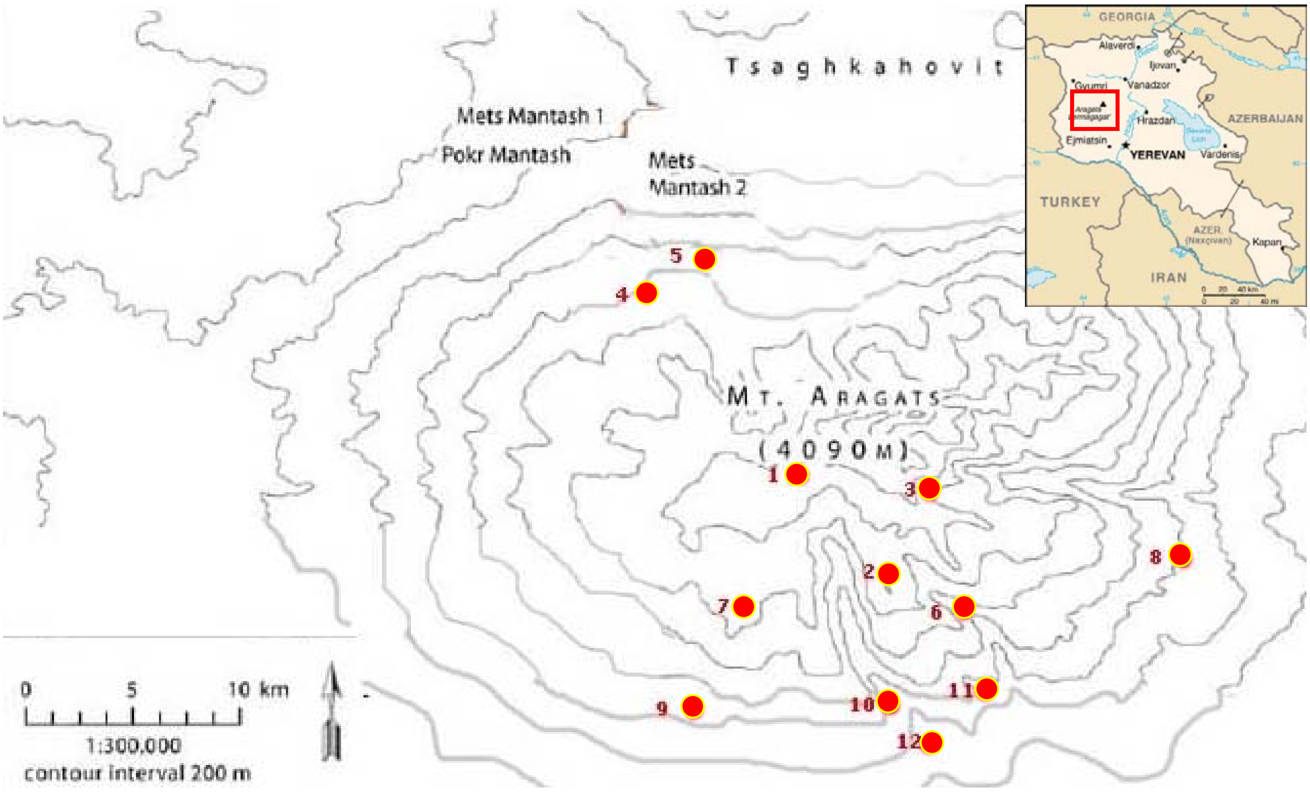

Figure 1. Location of Mount Aragats and the twelve sites in Armenia (sites are numbered as in Table 1.)

Table 1. Description of the sites sampled in Mount Aragats, Armenia

No	Site	Site location	Vegetation type	Aspect	Altitude (m)
1	Northern peak	Upland	Subnival vegetation*	North	3888
2	Lake Kari	Riparian	Alpine vegetation**	North	3200
3	Lake Lessing	Riparian	Alpine vegetation	East	3200
4	Mantash Reservoir	Riparian	Subalpine vegetation***	West	2640
5	Geghadzor	Upland	Subalpine vegetation	South	2290
6	Armenavan	Upland	Subalpine (Light woodland) vegetation	North	2200
7	Amberd	Riparian	Subalpine (Meadow-steppe) vegetation	North	2150
8	Aragats (village)	Riparian	Xeric grass and semi-shrub vegetation****	East	2090
9	Khnusik	Upland	Xeric grass and semi-shrub vegetation	North	1890
10	Tegher	Upland	Xeric grass and semi-shrub vegetation	North	1720
11	Antarut	Upland	Hemi-xeric woodland vegetation*****	North	1650
12	Byurakan	Upland	Hemi-xeric steppe vegetation	North	1550

Note:

*Subnival vegetation. This includes open plant communities occur with *Draba araratica, Poa araratica and Saxifraga hirculus.*

** Alpine vegetation. The upper part of the alpine zone known for its dense vegetation and open coexistences diversity. Dense coexistence main types are the rugs, which consisting of *Campanula tridentata, Chamaesciadium acaule, Carum caucasicum, Taraxacum stevenii, Minuartia oreina, Cerastium cerastoides, Bellardiachloa polychroa*. Alpine grasslands include *Festuca varia, F. chalcophaea, Alopecurus aucheri, Carex tristis*) and mats include *Sibbaldia parviflora, Alchemilla erythropoda*.

*** Subalpine vegetation. Subalpine woodland and grassland zone includes: - *Quercus macranthera* woodlands; - steppes (*Festuca valesiaca, Koeleria cristata, Sesleria phleoides*); - subalpine meadows (*Bromopsis variegata, Phleum nodosum, Koeleria caucasuca*); - meadow steppes (*Festuca valesiaca, F. ovina, Bromopsis variegata, Sesleria phleoides*).

****Xeric grass and semi-shrub vegetation. This includes: - tomillares (*Thymus kotschianus, Scutellaria* spp., *Stachchys inflata*); - friganoids (*Ambliopogon* spp., *Caccinia rauwolfii, Hedysarum formosum*); - thorn-cushion communities (*Astragalus microcephalus, Onobrychis cornuta, Acantholimon glumaceum*); - steppes (*Stipa* spp., *Festuca valesiaca, Bromopsis riparia, Carex humilis*).

***** Hemi-xeric woodland vegetation. This one includes: - *Quercus macranthera* woodlands; - low woodlands (*Pyrus* spp., *Acer hyrcanum, Crataegus* spp., *Juniperus polycarpos*); - hemi-xeric shrublands (*Cotoneaster* spp., *Sorbus graeca*); - steppes (*Stipa tirsa, Festuca valesiaca, Koeleria cristata, Nepeta grossheimii*); - thorn-cushion communities (*Astragalus* spp., *Onobrychis cornuta, Acantholimon glumaceum*); - meadow steppes (*Festuca ovina, Poa densa, Phleum phleoides, Carex humilis*) (Voskanian 1976; Baloyan 1987; Zazanashvili et al. 2000)

Table 2. Summary of the species richness (total number of species), abundance (total number of individuals), Simpson's diversity (D) and Shannon's evenness (E) indices recorded at each of the sites.

Site	Species richness	Abundance	Simpson's diversity (1-D)	Shannon's evenness (E)
1	5	7	0.91	0.435
2	22	68	0.94	0.696
3	15	46	0.90	0.668
4	29	100	0.93	0.725
5	46	179	0.95	0.752
6	61	231	0.98	0.762
7	65	285	0.98	0.766
8	53	268	0.98	0.754
9	63	305	0.99	0.762
10	65	287	0.98	0.766
11	77	633	0.99	0.773
12	78	558	0.98	0.776

Table 3. Regression analysis of the abundance, species richness, diversity and evenness of butterflies.

Dependent variable	R^2	*F*	Independent variable Altitude
Species richness	0.96	146.02	-12.09
Abundance	0.70	27.135	-5.209
Diversity	0.78	40.45	-6.36
Evenness	0.74	29.697	-5.450

Note: * $P < 0.5$, ** $P < 0.05$.

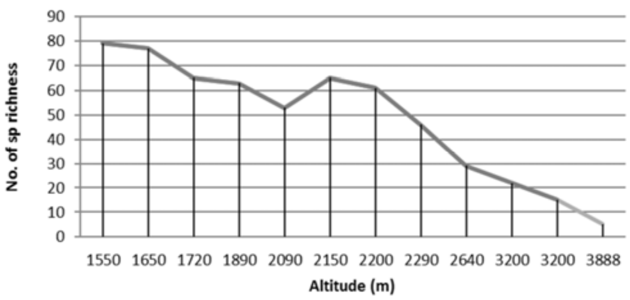

Figure 2. The relationship between species richness and altitude in Mt. Aragats, Armenia

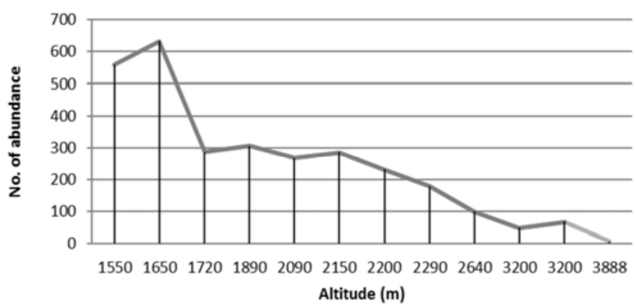

Figure 3. The relationship between and altitude in Mt. Mt. Aragats, Armenia

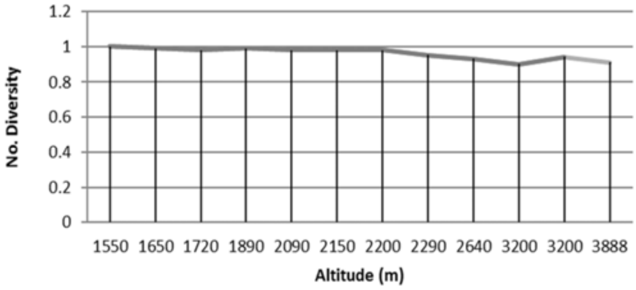

Figure 4. Relationship between species diversity index of the butterflies and altitude in MtAragats, Armenia.

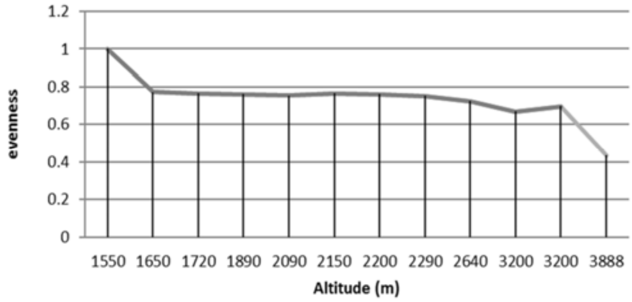

Figure 5. Monotonic decrease in the relationship between the evenness index altitudes in Mt. Aragats, Armenia.

Discussion

The results recorded in the present study doesn't agree with previous studies that the insect communities at high altitudes are characterized by few species and a greater abundance of individuals (Mani 1968). Due to the generally extreme conditions at high altitudes, a high degree of inter-specific integration with concomitant community independence and isolation is one of the peculiar characteristics of high altitude insect communities (Mani 1968).

The results show also strong altitudinal zonation convenient to the vegetation belts, as in many previous studies (Despland et al., 2012) Butterflies are closely linked to plants, both as herbivores and pollinators and our work suggests, as much did before, that the altitudinal distribution of a butterfly might depend on that of its larval host plant existence (Pyrcz et al., 2009) and hence that attitudinal model in butterfly diversity might match those of plants. The larval forms and host plants have been described for some of the (Tshikolovets et al. 2012) and these fit with the observations recorded here. For instance, *C. croceus* larvae develop on (*Medicago sativa*), which was common in all sites of Mount Aragats, while Adults feed primarily on nectar of Dandelion (*Taraxacum* sp.), which spreads in sub-alpine, xeric and hemi-xeric vegetation.

It is obvious here the highest altitude (3888 m) adapted spices are *Pieris brassicae*, *Colias croceus*, *Vanessa cardui* and much more *Aglais urticae* and *Polyommatus icarus*. Although the availability of other spices host plants in the highest altitude site was not indicator to their existence, due to the climate factor or butterfly physiology. Equally, a better understanding of the extent and speed of adaptation is crucial to the responses of biodiversity and ecosystems to climate change, which are still unclear for Mount Aragats.

Comparing with low-altitude fauna (Zarikian et al. 2016) the subalpine vegetation habitats showed similar faunas to the low-altitude lands dominated by natural vegetation but with much higher abundance: these were dominated by *Libythea celtis*, *Kirinia climene*, *Coenonympha pamphilus*, *Melanargia larissa*, *Argynnis aglaja* and *Argynnis pandora.*

However, the ability to acclimate to human-modified landscapes is clearly variable among our study species. The pierid *Pieris bowdeni* documented as wide spread. *Arabis caucasica* (Cruciferae) feeders found in xeric vegetation belt (Tuzov 1997). In our study, *Pieris bowdeni* was not observed in the xeric sites, but has alpine vegetation (Lake Kari, site 2). Conversely, most Lycaenidae family spices was still only seen in the native habitat. The diapause strategies of some butterflies are unknown. Some species can remain in diapause during dry years such *Colias thisoa.*

Comparative studies of altitudinal gradients are needed to identify the consistent patterns in scale effects, which can then be used to study the effects of contemporary climate, history and stochastic factors (Rahbek 2005).

Further study of the pattern in the altitudinal distribution of butterflies of Mount Aragats must be carried out in comparison with those for other taxa (e.g. spiders, beetles, breeding birds, etc.). Also the underlying mechanisms determining the different altitudinal patterns were not examined in the present study; Analysis of different taxa dependent altitudinal patterns (monotonic decrease vs. hump-shaped) in species richness at the same locality, Mount Aragats, Armenia is intriguing.

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REFERENCES

Baloyan SA. 1987. Seasonal dynamics of alpine plant communities in the Mt. Aragats. VINITI 3639-B87, Moscow.

Bozano GC (ed.). 1999. Satyridae I: Lethini Subfamily Elymniinae, Tribe Lethini (Lasiommata, Pararge, Lopinga, Kirinia, Chonale, Tatinga, Rhaphicera, Ninguta, Neope, Lethe, Neorina). Guide to the Butterflies of the Palearctic Region. Omnes Artes, Milano.

Bozano GC (ed.). 2001. Lycaenidae I: Lycaeninae. Lycaena, Hycranana, Athamanthia, Phoenicurusia, Heliophorus. Guide to the Butterflies of the Palearctic Region. Omnes Artes, Milano.

Bozano GC (ed.). 2002. Satyridae II: Satyrini. 2. ed. Argestina, Boeberia, Callerebia, Grumia, Hemadara, Loxerebia, Paralasa, Proterebia. Guide to the Butterflies of the Palearctic Region. Omnes Artes, Milano.

Bozano GC (ed.). 2002. Satyridae III: Melanargiina and Coenonymphina Melanargia, Coenonympha, Sinonympha, Triphysa. Guide to the Butterflies of the Palearctic Region. Omnes Artes, Milano.

Bozano GC (ed.). 2003. Nymphalidae I. Argynnini. Argynnis, Issoria, Brenthis, Argyreus. Guide to the Butterflies of the Palearctic Region. Omnes Artes, Milano.

Bozano GC (ed.). 2006. Nymphalidae 2. Boloria, Proclossiana, Clossiana. Guide to the Butterflies of the Palearctic Region. Omnes Artes, Milano.

Bozano GC (ed.). 2007. Lycaenidae III: Theclinae: Tomarini, Aphnaeini, Theclini. partim). Guide to the Butterflies of the Palearctic Region. Omnes Artes, Milano.

Bozano GC (ed.). 2008. Nymphalidae III: Limenitidinae: Neptini. Guide to the Butterflies of the Palearctic Region. Omnes Artes, Milano.

Bozano GC (ed.). 2009. Papilionidae I: Leptocircini and Teinopalpini. Guide to the Butterflies of the Palearctic Region. Omnes Artes, Milano.

Bozano GC (ed.). 2010. Papilionidae II. Troidini. pp. 86. It includes a full revision of the genus *Byasa*. Guide to the Butterflies of the Palearctic Region. Omnes Artes, Milano.

Bozano GC (ed.). 2011a. Satyrinae IV. Maniola, Pyronia, Aphantopus, Hyponephele. Guide to the Butterflies of the Palearctic Region. Omnes Artes, Milano.

Bozano GC (ed.). 2011b. Nymphalidae 4: Apaturinae. Guide to the Butterflies of the Palearctic Region. Omnes Artes, Milano.

Bozano GC (ed.). 2012. Nymphalidae 5: Nymphalini, Kallimini, Junoniini. Guide to the Butterflies of the Palearctic Region. Omnes Artes, Milano.

Colwell RK, Lees DC. 2000. The mid-domain effect: geometric constraints on the geography of species richness. Trends Ecol Evol 15: 70-76.

Despland E, Humire R, San Martin S. 2012. Species richness and phenology of butterflies along an altitude gradient in the desert of Northern Chile. Arct. Antarct. Alp. Res. 44 423-431 10.1657/1938-4246-44.4.423

Fiedler K, Beck E. 2008. Investigating gradients in ecosystem analysis. In: Beck E, Bendix J, Kottke I, Makeschin F, Mosamdl R (eds.). Gradients in a Tropical Mountain Ecosystem of Ecuador. Springer, Berlin.

Guliashvili VZ, Mahatadze LB, Prilipko LI. 1975. Rastitelnost Kavkaza. Nauka, Moscow.

Haslett JR. 1997. Insect communities and the spatial complexity of mountain habitats. Global Ecol Biogeogr Lett 6: 49-56.

Hesselbarth G, Van Oorschot H, Wagner S. 1995. Die Tagfalter der Turkei unter berücksichtigung der angrenzenden länder, Bocholt (Selbstverlag), 3 Bande. {Germany]

Hodkinson ID. 2005. Terrestrial insects along elevation gradients: species and community responses to altitude. Biol Rev 80: 489-513.

Holubec V, Křivka P. 2006. The Caucasus and its Flowers. LOXIA, Prague.

Kawahara AY, Breinholt JW. 2014. Phylogenomics provides strong evidence for relationships of butterflies and moths. Proc R Soc B: Biol Sci 281 (1788): 20140970.

Korb SK. 1994. A Vertical distribution of *Ropalocera* (Lepidoptera) within the Kirghiz mountain ridge. Zool Zh 73. [Russian].

Korb SK, Bolshakov LV. 2016. A systematic catalogue of butterflies of the former Soviet Union (Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kyrgyzstan, Kazakhstan, Latvia, Lituania, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan) with special account to their type specimens (Lepidoptera: Hesperioidea, Papilionoidea). Zootaxa 4160 (1): 1-324.

Lomolino MV. 2001. Elevation gradients of species-density: historical and prospective views. Global Ecol. Biogeogr 10: 3-13.

Magurran AE. 2003. Measuring Biological Diversity. Blackwell, Malden, MA.

Mani MS. 1968. Ecology and Biogeography of High Altitude Insects. Dr. W. Junk, The Hague.

Nazarian Kh. 1974. Aragats. Soviet Armenian Encyclopedia Volume I. [Armenian].

Pyrcz T, Wojtusiak J, Garlacz R. 2009. Diversity and distribution patterns of *Pronophilina* butterflies (Lepidoptera: Nymphalidae: Satyrinae) along an altitudinal transect in north-western Ecuador Neotrop Entomol 38: 716-726.

Rahbek C. 2005. The role of spatial scale and the perception of large-scale species-richness patterns. Ecol Lett 8: 224-239.

SPSS INC. 2006: SPSS for Windows. Ver. 14.0. SPSS Inc.

Tembotova FA, Tsepkova NL. 2009. On the problem of steppe ecosystem conservation in the Central Caucasus. Russian J Ecol 40: 65-67.

Tshikolovets V, Nekrutenko Y. 2012. The butterflies of Caucasus and Transcaucasia. Tshikolovets Publications, Pardubice.

Tuzov VK. 1993. The synonymic List of Butterflies from the ex- USSR. Rosagroservice, Moscow.

Tuzov VK (ed.). 1997. Guide to the Butterflies of Russia and adjacent territories (Rhopalocera: Lepidoptera). Vol 1. (Hesperidae, Hesperiidae, Nymphalidae, Saturidae). Pensoft, Sofia & Moscow.

Voskanian VE. 1976. Flora and vegetation of the upper part of the Alpine and subnival belts of Mount Aragats. Biol Zh Arm. [Russian]

Zarikian N, Kalashian M. 2016. Diversity and abundance of Nymphalidae (Lepidoptera) in Kotayk province, Armenia. Indian J Entomol 78 (1): 77-81.

Zazanashvili N, Gagnidze R, Nakhutsrishvili G. 2000. Main types of vegetation zonation on the mountains of the Caucasus. Acta Phytogeographica Suecica 85:7-16.

Table S1. List of the butterfliey species sampled at Mount Aragats, Armenia (See Figure 1. for the locations)

Family / scientific name	1	2	3	4	5	6	7	8	9	10	11	12	Total
Family Hesperiidae													
Erynnis tages (Linnaeus, 1758)				1	1	2	1			3	4	4	16
Muschampia tessellum (Hubner, [1803])					2	1	3	1	2	2	3	7	21
Pyrgus melotis (Duponchel, [1834])										1	4	3	8
Pyrgus serratulae (Rambur, [1839])			2	3		8							13
Pyrgus jupei (Alberti, 1967)			2										2
Pyrgus alveus (Hubner, [1803])					4	2	2	3	3	4	10		28
Pyrgus cinarae (Rambur, [1839])									3	1	8	8	20
Spialia orbifer (Hubner, [1823])					1	3	2	3	5	1	4		19
Family Papilionidae													
Papilio machaon Linnaeus, 1758					2	4	4	3	2	1	5	7	28
Papilio alexanor Esper, 1799							2		1				3
Iphiclides podalirius Linnaeus, 1758				1	1	1	3	2	3	3	5	8	27
Parnassius mnemosyne Linnaeus, 1758						5	3		5	6	9		28
Family Pieridae													
Leptidea duponcheli Staudinger, 1871					3	4	2				2	1	
Leptidea sinapis Linnaeus, 1758					1	2	1				1		
Aporia crataegi Linnaeus, 1758					30	15	23	9	10	8	33	43	171
Pieris rapae Linnaeus, 1758		11	6	24	26	12	11	21	12	14	26	29	192
Pieris mannii Mayer, 1851							1	1	2	1	4	3	12
Pieris pseudorapae Verity, [1908]						8	3	6	4	3	9	9	42
Pieris napi Linnaeus, 1758		3	4	3	2	5	6	3	3	2	7	7	45
Pieris bowdeni Eitschberger, 1984		2											2
Pieris brassicae Linnaeus, 1758	1	3	3	4	6	5	9	4	3	8	19	13	78
Euchloe ausonia Hubner, 1805						6	3	6	4	2	5	3	29
Anthocharis gruneri Herrich-Schäffer, 1851					2	4	5		5				16
Anthocharis cardamines Linnaeus, 1758					5	8	8		5	7	11		44
Anthocharis damone Boisduval, 1836					2	3	3	2	2	5	8	5	30
Pontia daplidice Linnaeus, 1758		3		3	5	5	7	14	9	11	21	23	101
Zegris eupheme Esper, 1805					3	2	5	6	2	2	6	6	32
Colias croceus Geoffroy, 1785	1	3	1	5	4	8	11	15	9	10	25	22	114
Colias thisoa Ménétriés, 1832		4											4
Colias aurorina Herrich-Schäffer, 1850							3						3
Colias alfacariensis Staudinger, 1871		2		4	3	2	4	7	3	2	9	11	47
Gonepteryx farinosa Zeller, 1847							2	1	1	1	4	3	12
Gonepteryx rhamni Linnaeus, 1758					1	2	2						5
Family Nymphalidae													
Libythea celtis (Laichating, 1782)						2		5		3	5	8	23
Kirinia climene (Esper, [1783])						1	2			2	5	2	12
Lasiommata maera (Linnaeus, 1758)				2	3	2	2	1	1	2	4	3	20
Lasiommata megera (Linnaeus, 1767)		1		1	1	2	2	1	1	1	4	3	17
Coenonympha leander (Esper, [1783])							3		5	5	8		21
Coenonympha pamphilus (Linnaeus, 1758)		4		5	6	5	5	11	12	11	23	21	103
Maniola jurtina (Linnaeus, 1758)				3	3	5	4	9	12	10	19	11	76
Hyponephele lycaon (Rottemburg, 1775)				2	2	5	5	9	12	7	18	9	69
Hyponephele lupina (Costa, [1836])								7	6	4	9	10	36
Erebia medusa ([Schiffermuller], 1775)							9		7	4	7		27
Erebia graucasica (Jachontov, 1909)		11	12										23
Chazara briseis (Linnaeus, 1764)					2		4		4	4	7	3	24
Chazara persephone (Hunber, [1805])				1	1		3	2	3	1	2		13
Pseudochazara thelephassa (Geyer,[1827])						2			4	3	6	2	17
Pseudochazara pelopea (Klug, 1832)				1	2	2				3	3	1	14
Pseudochazara mamurra (Herrich-Schaffer, [1846])										2			2
Pseudochazara geyeri (Herrich-Schaffer, [1846])					1		3		2	1	1	1	9
Melanargia galathea (Linnaeus, 1758)				5	5	5	5	5	14	11	18	15	83
Melanargia larissa (Geyer, [1828])					5	6	9	9	7	6	16	16	74
Limenitis reducta (Staudinger, 1901)					2	3	5	6	4	3	8	9	40
Neptis rivularis (Scopoli, 1763)					2	2	6	3	4	4	9	10	40
Vanessa atalanta (Linnaeus, 1758)		1	1	1	1	1	1	2	2	1	3	4	18
Vanessa cardui (Linnaeus, 1758)	1	2	2	4	2	3	3	7	6	6	5	8	49

Pollygonia egea (Cramer, [1775])												1	1
Aglais urticae (Linnaeus, 1758)	2	4	4	6	8	11	10	7	9	11	12	9	93
Nymphalis xanthomeles (Esper, [1781])						2	1	1	1	1	4	3	13
Argynnis niobe (Linnaeus, 1758)											1	3	4
Argynnis paphia (Linnaeus, 1758)											4	4	8
Argynnis pandora ([Schiffermauler], 1775)								7	11	11	21	18	68
Argynnis aglaja (Linnaeus, 1758)				4	4	5	7						20
Brenthis ino (Rottemburg, 1775)		1		1	1	2	1						6
Brenthis hecate ([Schiffermauler], 1775)						1						1	2
Issoria lathonia (Linnaeus, 1758)				3	4	3	3	3	6	7	8	13	50
Boloria caucasica (Lederer, 1852)		1	2			2							5
Melitaea ornate (Christoph, 1893)												2	2
Melitaea phoebe ([Schiffermauler], 1775)						1		1				2	4
Melitaea didyma (Esper, [1778])						3	8	8	7	6	11	10	53
Melitaea athalia (Rottemburg, 1775)						1						2	3
Melitaea cinxia (Linnaeus, 1758)										1	1	1	3
Euphydryas aurinia (Rottemburg, 1775)					4	3	5	4	5	5	7	3	36
Family Lycaenidae													
Favonius quercus Verity, 1943												2	2
Satyrium ilicis Esper, 1779												6	6
Callophrys rubi (Linnaeus, 1758)								4	3	3	6	5	21
Callophrys paulae (Pfeiffer, 1932)												2	2
Callophrys suaveola (Staudinger, 1881)											1	2	3
Lycaena phlaeas Linnaeus, 1761		3	4	3	2	3	4	3	5	4	10	15	56
Lycaena thersamon (Esper, 1784)										4	6	4	14
Lycaena ochimus (Herrich-Schäffer,[1851])						3					5	5	13
Lycaena alciphron (Rottemburg, 1775)						1		2	2	2	4	3	14
Lycaena virgaureae (Linnaeus, 1758)						5		5	4	3	9	8	34
Lycaena candens (Herrich-Schäffer,[1844])							5						5
Celastrina argiolus (Linnaeus, 1758)									2	4	6	6	18
Cupido osiris Meigen, 1829											5	3	8
Glaucopsyche alexis Poda, 1761							1	2				5	8
Maculinea alcon (Denis & Schiffermüller, 1775)					3	3	5	5					16
Plebejus idas (Linnaeus, 1761)				1		2	2						5
Plebejus zephyrinus (Christoph, 1884)		2											2
Plebejus loewii (Zeller, 1847)				2		3	3				5	5	18
Plebejus eurypilus (Freyer, 1851)										1	2		3
Plebejus agestis (Denis & Schiffermüller, 1775)											2	2	4
Plebejus anteros (Züllich, 1929)		1	1	1	2	1	2	3	2	2	4	4	23
Plebejus crassipunctus (Christoph, 1893)							3		2	4	4	4	17
Plebejus pyrenaicus (Boisduval, 1840)		1	1				2						4
Polyommatus coelestinus (Eversmann, 1843)							2		2			1	5
Polyommatus semiargus (Rottemburg, 1775)					1	3	4	3	5	5	8	6	35
Polyommatus thersites (Cantener, 1834)								2	3		4	3	12
Polyommatus bellargus (Rottemburg, 1775)							8	8	9		12	12	49
Polyommatus corydonius (Herrich-Schäffer, [1852])								4			5	2	11
Polyommatus daphnis (Denis & Schiffermüller, 1775)				4	5	5	4	4	7	5	12	8	54
Polyommatus icarus (Rottemburg, 1775)	2	3	1	2	3	5	5	5	7	11	19	10	73
Polyommatus ripartii (Freyer, 1830)								3					3
Polyommatus eriwanensis (Forster,1960)									4		8	6	18
Polyommatus ninae (Forster, 1956)										5	5	6	16
Polyommatus phyllis (Christoph, 1877)									2				2
Polyommatus altivagans (Forster, 1956)		2							3				5
													2952