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The Anti-Lebanon ridge as the edge of the distribution range for Euro-Siberian and Irano-Turanian faunistic elements in the Mediterranean biome: A case study (Lepidoptera: Noctuidae)

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Abstract

The Lebanon and Anti-Lebanon ridges are located in the middle of a narrow "Mediterranean ecozone" corridor stretching along the Levantine coast. Both ridges are high enough to feature a complete range of altitude zones, which includes an alpine tragacanth belt (> 2000 m a.s.l.). The southernmost part of the Anti-Lebanon ridge is situated in the northernmost part of Israel. Among the 548 Israeli Noctuidae species, 106 species (21%) occur only in this small mountainous area. Among them, 17 are endemic and the populations of the remaining 89 species are at the edge of their distribution range. Montane forest acts as the southernmost shelter for Euro-Siberian and Mediterranean arboreal Noctuidae fauna. The higher altitudes host Mediterranean and Irano-Turanian oromontane species with a few lowland Euro-Siberian species. The alpine faunas of the Lebanon and Anti-Lebanon ridges are similar, although the Anti-Lebanon ridge, being in the shadow of the Lebanon ridge, receives significantly less precipitation. Nonetheless, it features a Mediterranean biome on its western slopes, while its eastern slopes, facing the Syrian steppe, feature mainly Irano-Turanian fauna. Constituting a border between the Mediterranean and Irano-Turanian faunas, the higher elevations of this ridge present a meeting point of the alpine and xeromontane Noctuidae, making it exceptionally species-rich.
KEY WORDS: Lepidoptera, Noctuidae, Mediterranean, Irano-Turanian, xeromontane, alpine, orofauna, chorology, biodiversity, peripheral populations, Mount Hermon, Israel.

Las cumbres del Anti-Líbano como límite del rango de distribución para los elementos faunísticos Eurosiberianos e Irano-Turanios en el bioma Mediterráneo: Un caso de estudio (Lepidoptera: Noctuidae)

Resumen

Las sierras del Líbano y Anti-Líbano están localizadas en medio de un estrecho corredor de "ecozona Mediterranea" a lo largo de la costa del Próximo Oriente. Ambas sierras son bastantes altas cómo para tener un completo rango de zonas de altura, que incluye un cinturón de tragacantos alpinos (> 2000 m snm). La parte más meridional de la sierra del Anti-Líbano está situada en la parte más septentrional de Israel. Entre las 548 especies de Noctuidae israelíes, 106 especies (21%) se encuentran sólo en esta pequeña área montañosa. Entre ellas, 17 son endémicas y de las poblaciones restantes 89 especies están en el límite de su área de distribución. El bosque montano actúa como el refugio más meridional para la fauna más meridional Eurosiberiana y Mediterránea de Noctuidae arborícolas. Las mayores alturas albergan especies orotomanas mediterráneas e irano-turanias, junto con unas pocas especies euro-siberianas de baja altura. No obstante, tienen como carácter distintivo un bioma Mediterráneo sobre sus lados occidentales mientras qué, en sus lados orientales, mirando a la estepa de Siria, contiene principalmente la fauna Irano-Turania. Constituyendo una frontera entre las faunas Mediterráneas e Irano-Turanias, las elevaciones más altas de estas cumbres constituyen un punto de reunión de los Noctuidae alpinos y orotomanos, siendo excepcionalmente ricas en especies.

PALABRAS CLAVE: Lepidoptera, Noctuidae, Mediterraneo, Irano-Turanio, xeromontano, alpino, orofauna, corología, biodiversidad, poblaciones periféricas, Monte Hermón, Israel.

Introduction

The southeastern Mediterranean region is a crossroad of the Mediterranean, Irano-Turanian and East Sudanian savanna ecozones (ZOHARY, 1973; DANIN *et al*., 1975; POR, 1975; YOM-TOV & TCHERNOV, 1975; DANIN, 1992). The Jordan Valley, the northern part of the Great Rift Valley, which stretches along the coast of the Mediterranean Sea, is fringed by mountainous ridges from the west and the east, reaching their highest elevation of about 3,000 m on the Lebanon and Anti-Lebanon mountain ridges (Fig. 1a). The windward orientation of the ridges results in higher rainfall on the coastal plain thus providing a corridor for the Mediterranean biome to penetrate far south into the Arabian Peninsula. The Anti-Lebanon ridge borders both the Mediterranean and Irano-Turanian ecozones, while Sudanian faunistic and floristic elements penetrate the area through the Rift Valley (Fig. 1b).

The southernmost part of the Anti-Lebanon ridge (hereafter referred to as the Hermon) is situated in the northernmost part of Israel. Together with its foothills, it occupies less than 1% of the territory of the country, yet it possesses an unbelievable species richness in both flora and fauna of vertebrates and invertebrates, with high percentage of the species that occur within the borders of Israel being present solely or almost solely in the Hermon. The list for some taxons of animals and plants is given in Table 1. The highest percentage of unique species is recorded in Lepidoptera both for Rhopalocera - 32.7% (35: 107) and for Noctuidae - 19.3% (106: 548).

Table 1.– Amount of species unique to the Hermon in different taxons.

Taxon	Number of species in Israel	Number of species recorded from the Hermon and other places in Israel	Number of species recorded in Israel only from the Hermon	Source
Plants	2630	1026	225	DANIN, 1992; NATAN & WERNER, 1999
Reptiles	88	34	7	NATAN & WERNER, 1999
Birds	~500	83	15	NATAN & WERNER, 1999
Mammals	106	35	4	SHALMON, 1993
Weevils (Coleoptera: Curculionoidea)	~1000	~100	~30	Unpublished data of the authors
Butterflies (Lepidoptera: Rhopalocera)	107	67	35	BENYAMINI, 2010
Owlet moths (Lepidoptera: Noctuidae)	548	291	106	KRAVCHENKO *et al*., 2007a; KRAVCHENKO *et al*., 2007b

The vertical distribution of plants on the Hermon has been covered in detail (AUERBACH & SHMIDA, 1992; COHEN *et al*., 1981). In contrast, information on most insect groups is at best rudimentary. In this paper, we analyze the species composition, vertical distribution and chorotypical characteristics of the Noctuidae, the most abundant and species-rich family of the Lepidoptera worldwide as well as in the Mediterranean basin and on the Hermon (CHOI & MILLER, 2013).

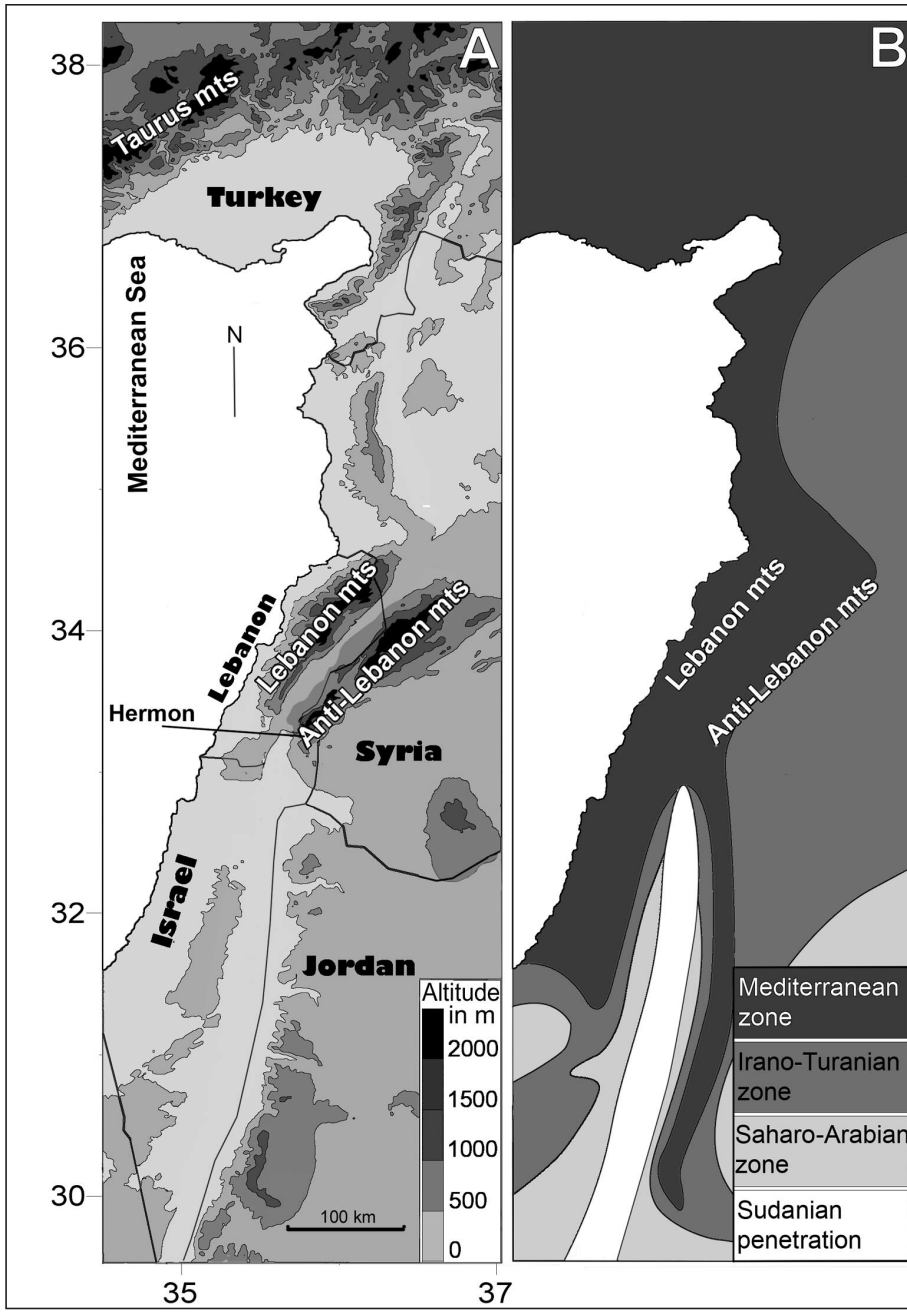

Figure 1.– The East Mediterranean. A - relief; B - biogeographical zones modified (DANIN, 1992; GRACE, 2010).

Material and methods

Abbreviations used:

SMNH-TAU: Steinhardt Museum of Natural History, Tel Aviv University
a.s.l.: Above sea level.

In seven years between 2002 and 2014 we operated six to 18 automatic light-traps, equipped with black-light ultra violet tubes (TL-D 18W/80), 220 V, in order to sample Noctuidae in the six main biomes identified on Mount Hermon (1-3 traps in each biome) along the main access road from Tel Dan National Park at 177 m a.s.l. (3314'37.03"N; 3538'45.85"E) to the Israel Cosmic Ray Center at 2050 m a.s.l. (3318'27.79"N; 3547'07.45"E). Each trap worked constantly for at least one complete year. A detailed description of the Israeli light trap network is given elsewhere (MÜLLER, KRAVCHENKO & SCHLEIN, 2005a; MÜLLER & KRAVCHENKO, 2005b; MÜLLER, 2006).

The distribution of the sampled biomes corresponds largely to the altitudinal zonation of the Hermon (AUERBACH & SHMIDA, 1992; COHEN *et al*., 1981; SHMIDA, 1977). It is comprised of four zones: 1) foothills with riverine forests and lush grassland (< 300 m a.s.l.); 2) evergreen Mediterranean maquis (300-1,300 m a.s.l.); 3) xeromontane open scrub with montane forest and montane steppe (1,300-1,900 m a.s.l.) and 4) alpine tragacanth vegetation (> 1,900 m a.s.l.).

The nomenclature, systematics, general distribution pattern, affiliation to chorotype, phenology and host plants of the Israeli noctuid species follow those used in previous studies (KRAVCHENKO *et al*., 2007a; KRAVCHENKO *et al*., 2007b). The collected voucher material is deposited in the Steinhardt Museum of Natural History, Tel Aviv University (SMNH-TAU).

We used Simpson's similarity index to compare species composition and Fisher's exact test was applied to examine the differences between the ratio of Mediterranean and Irano-Turanian species (MAGURRAN, 2004). Significance was taken at $P < 0.05$.

Results

Species richness and species composition

From the collected material, 291 species in 125 genera were identified. Apart from the riverine forest where only 52 species were found, the number of species in each biome varied within a rather narrow range: 100 species were found in lush grassland, 121 in maquis, 109 in montane forest, 78 in montane steppe and 111 in the alpine tragacanth zone.

Only the following 18 polyphagous and migratory species with wide distribution ranges were found throughout the entire area: *Agrotis ipsilon* (Hufn.), *A. segetum* (D. & Schiff.*), Anarta trifolii* (Hufn.), *Cornutiplusia circumflexa* (L.), *Eublemma ostrina* (Hb.), *E. parva* (Hb.), *Helicoverpa armigera* (Hb.), *Heliothis peltigera* ([D. & Schiff.]), *Hypena lividalis* (Hb), *Leucania loreyi* (Dup.), *Mythimna vitellina* (Hb.), *M. unipuncta* (Hw.), *Noctua pronuba* (L.), *Peridroma saucia* (Hb.*), Spodoptera cilium* (Gn.), *S. exigua* (Hb.), *S. littoralis* (B.), *Trichoplusia ni* (Hb.).

Other species showed a high level of discreteness in distribution. The majority were found only in one (128 species) or two (101 species) biomes. Preference for a certain biome is also pronounced at the genus level. All 14 species of the genus *Dichagyris*, all seven species of the genus *Chersotis*, 10 of the 12 species of the genus *Hadena*, and four of the five species of the genus *Episema* inhabit only the montane grassland and the tragacanth biomes of high altitudes, while species of the genera *Acronicta* and *Lithophane* are restricted to the riverine forest.

Excluding the 18 widely-distributed species, the similarity between the neighboring biomes, measured using Simpson's index, was > 0.5 (greater than 50% of species common to both biomes). In all other cases, the index was much below this threshold. (Table 2).

Table 2.– Simpson's Index of Similarity between the biomes.

Simpson's Index of Similarity	Riparian forest	Lush grassland	Maquis	Montane forest	Montane steppe	Alpine Tragacanth
Riparian forest	1					
Lush grassland	0.11	1				
Maquis	0.74	0.77	1			
Montane forest	0.29	0.31	0.53	1		
Montane steppe	0	0.09	0.04	0.1	1	
Alpine Tragacanth	0.11	0.22	0.06	0.01	0.77	1

CHOROTYPICAL DISTRIBUTION OF SPECIES

The majority (48%) of collected Noctuidae belong to the Mediterranean chorotype, followed by the Irano-Turanian (34%), Euro-Siberian (7%), Palaeotropic (6%) and Palaearctic (5%) types of distribution.

The Mediterranean species occur ubiquitously and comprise more than 50% of the total Noctuidae species in the maquis and montane forest, while in the montane grassland and the tragacanth they comprise only 27% (Fig. 2). In contrast to the Mediterranean species, the Irano-Turanian species do not exceed 6% of the total Noctuidae species below 1,900 m. However, in the montane steppes and tragacanth biomes they make up more than one-third of the species. About one-third of the discussed species in each of the biomes are polyphagous, ubiquitous, Palaearctic and Palaeotropic elements.

The highest numbers of Euro-Siberian species were collected in the riparian forest (eight species) and montane forest (six species), while the only two eremic species were found in maquis and lush grasslands: *Autophila cerealis* (Stgr.) and *Condica viscosa* (Frr.).

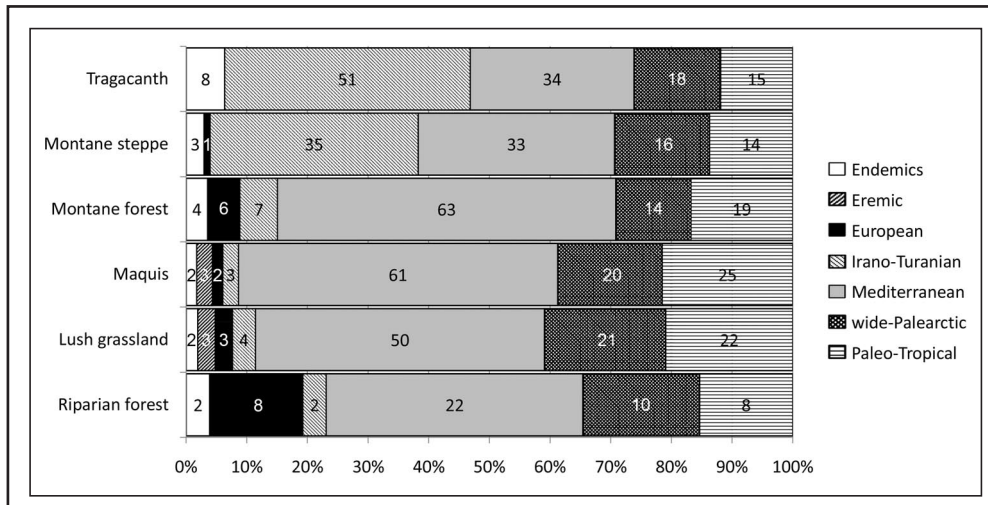

Figure 2.– Distribution of the chorotypes throughout the biomes. Numbers in the bars indicate number of species.

Twenty-one species are endemic and sub-endemic to the Levant. Five taxa were recently described from the Hermon and are known so far only from the type locality.

Species restricted within Israel to the Hermon

Although most of the species collected are widely distributed throughout the Mediterranean region of Israel, 106 of them were found only on the Hermon. These species occur only at medium and higher elevations with the highest species diversity in the tragacanth (20 species in the montane forest, 41 in the montane steppe, and 45 in the tragacanth) Fig. 3. For most of these taxa, the Hermon is the southernmost distribution border. Additionally, 11 Levantine endemics, sub-endemics, and five true Hermon endemics are found here.

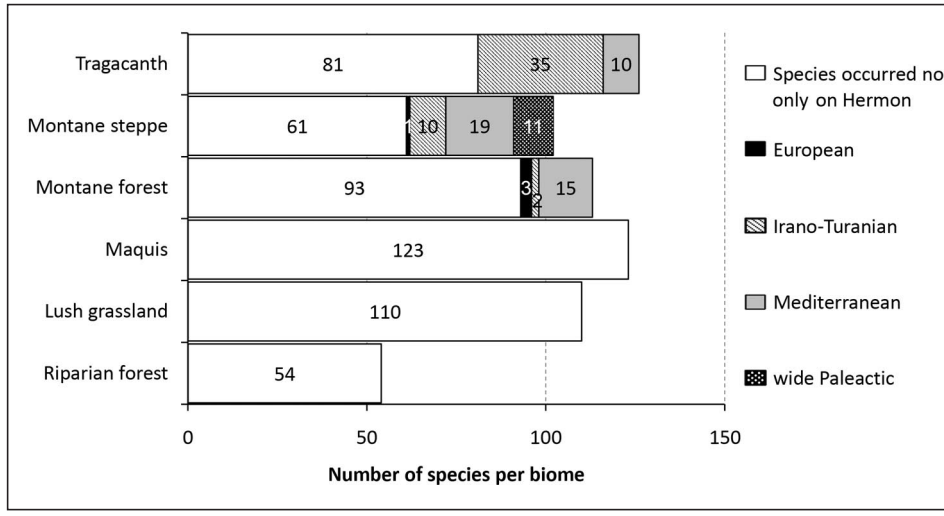

Figure 3.– Distribution and chorotypes of the species restricted the Hermon in Israel.

The species were subdivided into those that are oromontane-inhabiting mountainous biomes throughout the entire area of their distribution (Table 3a) and non-oromontane which also occur in lowlands (Table 3b). The typical oromontane species are further subdivided (VARGA, 2003) into two major types: the European alpine species which inhabit the mesophilic mountains of Europe, and the xeromontane species which inhabit the dry mountains of Iran and Central Asia.

Table 3a.– Oromontane species restricted to the Hermon in Israel, their type of montane distribution pattern: A - alpine, X - xeromontane and general presence (+), or absence (-) on the Lebanon Mountain Ridge.

Species	**General distribution**
Montane forest	
Ostheldera gracilis (Osthelder, 1933)	Irano-Turanian – X, -
Montane steppe	
Autophila luxoriosa Zerny, 1933	Irano-Turanian – X, +
Eugnorisma pontica (Staudinger, 1879)	Irano-Turanian – X, +
Euxoa robiginosa (Staudinger, 1895)	Irano-Turanian – X, -
Metopoplus excelsa (Christoph, 1885)	Irano-Turanian – X, -

Antitype jonis (Lederer, 1865)	Mediterranean – A, +
Apamea platinea (Herrich-Schäffer, 1852)	Mediterranean – A, +
Autophila ligaminosa (Eversmann, 1851)	Mediterranean – A, +
Dasypolia ferdinandi Rühl, 1892	Mediterranean – A, +
Episema lederi Christoph, 1885	Mediterranean – A, +
Hecatera cappa (Hübner, [1809])	Mediterranean – A, +
Periphanes treitschkei (Frivaldzsky, 1835)	Mediterranean – A, +
Spaelotis senna contorta (Rebel & Zerny, 1931)	Mediterranean – A, +
Standfussiana lucernea (Linnaeus, 1758)	Mediterranean – A, +
Tragacanth	
Agrotis psammocharis Boursin, 1950	Irano-Turanian – X, -
Agrotis scruposa (Draudt, 1936)	Irano-Turanian - X, +
Autophila depressa (Püngeler, 1914)	Irano-Turanian - X, +
Autophila libanotica (Staudinger, 1901)	Irano-Turanian - X, +
Dichagyris leucomelas Brandt, 1941	Irano-Turanian - X, +
Dichagyris melanura (Kollar, 1846)	Irano-Turanian - X, +
Episema didymogramma (Boursin, 1955)	Irano-Turanian - X, +
Euxoa anatolica Draudt, 1936	Irano-Turanian - X, +
Euxoa praestrigiosa Brandt, 1941	Irano-Turanian - X, -
Hadena pfeifferi (Corti & Draudt, 1933)	Irano-Turanian - X, -
Victrix marginelota (Joannis, 1888)	Irano-Turanian - X, +
Victrix tabora (Staudinger, 1892)	Irano-Turanian - X, -
Aedophron phlebophora Lederer, 1858	Irano-Turanian - X, -
Chersotis capnistis (Lederer, 1872)	Irano-Turanian - X, -
Chersotis ebertorum Koçak, 1980	Irano-Turanian - X, +
Dichagyris amoena Staudinger 1892	Irano-Turanian - X, -
Dichagyris anastasia (Draudt, 1936)	Irano-Turanian - X, -
Dichagyris elbursica (Draudt, 1937)	Irano-Turanian - X, -
Dichagyris erubescens (Staudinger, 1892)	Irano-Turanian - X, -
Dichagyris melanuroides Kozhantshikov, 1930	Irano-Turanian - X, -
Dichagyris pfeifferi (Corti & Draudt, 1933)	Irano-Turanian - X, -
Dichagyris rubidior (Corti, 1933)	Irano-Turanian - X, +
Dichagyris sureyae (Rebel, 1931)	Irano-Turanian - X, -
Dichagyris terminicincta (Corti, 1933)	Irano-Turanian - X, +
Euxoa heringi (Staudinger, 1877)	Irano-Turanian - X, +
Hadena drenowskii (Rebel, 1930)	Irano-Turanian - X, -
Hadena gueneei (Staudinger, 1901)	Irano-Turanian - X, -
Hadena persimilis Hacker, 1996	Irano-Turanian - X, -
Hadena pumila (Staudinger, 1879)	Irano-Turanian - X, +
Margelana flavidior Wagner, 1931	Irano-Turanian - X, -
Oncocnemis exacta Christoph, 1887	Irano-Turanian - X, -
Oncocnemis strioligera Lederer, 1853	Irano-Turanian - X, -
Episema lemoniopsis Hacker, 2001	Irano-Turanian - X, +
Oncocnemis confusa Lederer, 1878	Mediterranean - A, -
Episema korsakovi (Christoph, 1885)	Mediterranean - A, -
Chersotis elegans (Eversmann, 1837)	Mediterranean - A, +
Chersotis fimbriola (Esper, 1803)	Mediterranean - A, +

Chersotis laeta (Rebel, 1904)	Mediterranean - A, +
Chersotis margaritacea (Villers, 1789)	Mediterranean - A, +
Chersotis multangula (Hübner, [1803])	Mediterranean - A, -
Dichagyris candelisequa ([Denis & Schiffermüller], 1775)	Mediterranean - A, +
Hadena adriana (Schawerda, 1921)	Mediterranean - A, +
Hadena clara (Staudinger, 1901)	Mediterranean - A, +

Table 3b.– Non-oromontane species restricted to the Hermon within Israel, their affiliation to biomes, and their general distribution pattern.

Species	**General distribution**
Montane forest	
Conistra veronicae (Hübner, [1813])	Euro-Siberian
Dicycla oo (Linnaeus, 1758)	Euro-Siberian
Valeria oleagina ([Denis & Schiffermüller], 1775)	Euro-Siberian
Acronicta pasiphae Draudt, 1936	Irano-Turanian
Allophyes asiatica (Staudinger, 1892)	Mediterranean
Catephia alchymista ([Denis & Schiffermüller], 1775)	Mediterranean
Catocala diversa (Geyer, [1828])	Mediterranean
Dichonia aeruginea (Hübner, [1808])	Mediterranean
Dichonia aprilina (Linnaeus, 1758)	Mediterranean
Dichonia pinkeri (Kobes, 1973)	Mediterranean
Drasteria cailino (Lefèbvre, 1827)	Mediterranean
Dryobotodes eremita (Fabricius, 1775)	Mediterranean
Jodia croceago ([Denis & Schiffermüller], 1775)	Mediterranean
Maraschia grisescens Osthelder, 1933	Mediterranean
Rileyiana fovea (Treitschke, 1825)	Mediterranean
Amphipyra boursini Hacker, 1998	Mediterranean
Conistra acutula (Staudinger, 1892)	Mediterranean
Valeria sp. n.	Endemic
Wiltshireola praecipua Hacker & Kravchenko, 2001	Endemic
Montane steppe	
Caradrina zernyi (Boursin, 1936)	Euro-Siberian
Anarta mendica (Staudinger, 1879)	Irano-Turanian
Apamea leucodon (Eversmann, 1837)	Irano-Turanian
Luperina rjabovi (Kljutschko, 1967)	Irano-Turanian
Lygephila lusoria (Linnaeus, 1758)	Irano-Turanian
Yigoga truculenta Lederer, 1853	Irano-Turanian
Ammoconia senex (Geyer, [1828])	Mediterranean
Conisania luteago meridionalis (Brandt, 1938)	Mediterranean
Dichagyris signifera ([Denis & Schiffermüller], 1775)	Mediterranean
Hypena munitalis Mann, 1861	Mediterranean
Oligia latruncula grisescens (Heydemann, 1932)	Mediterranean
Polymixis rufocincta (Geyer, [1828])	Mediterranean
Psedohadena chenopodiphaga (Rambur, 1932)	Mediterranean
Ulochlaena hirta (Hübner, [1813])	Mediterranean
Standfussiana defessa (Lederer, 1858)	Mediterranean

Victrix klapperichi Hacker, 2001	Mediterranean
Luperina kravchenkoi Fibiger & Müller, 2005	Endemic
Apamea anceps ([Denis & Schiffermüller], 1775)	Palearctic
Euxoa aquilina ([Denis & Schiffermüller], 1775)	Palearctic
Euxoa cos (Hübner, [1824])	Palearctic
Euxoa distinguenda (Lederer, 1857)	Palearctic
Euxoa foeda (Lederer, 1855)	Palearctic
Hadena capsincola ([Denis & Schiffermüller], 1775)	Palearctic
Hadena compta ([Denis & Schiffermüller], 1775)	Palearctic
Hadena magnolii (Boisduval, 1829)	Palearctic
Macdunnoughia confusa (Stephens, 1850)	Palearctic
Mesapamea secalis (Linnaeus, 1758)	Palearctic
Mesoligia furuncula ([Denis & Schiffermüller], 1775)	Palearctic
Tragacanth	
Dichagyris singularis (Staudinger, 1892)	Irano-Turanian
Pseudohadena eibinevoi Fibiger, Kravchenko & Muller, 2006	Endemic

Of the 13 oromontane species inhabiting the steppe of the Hermon, nine are alpine and belong to the Mediterranean chorotype, and four are xeromontane and belong to the Irano-Turanian chorotype. The tragacanth biome is comprised of 43 oromontane species. They include 33 Irano-Turanian xeromontane species and ten alpine species that have a Mediterranean-type distribution.

In the montane forest, mainly arboreal Mediterranean (13 species) and Euro-Siberian (three species) are found at the southernmost border of their distribution (Table 2), only two species (*A. pasiphae* and *O. gracilis*) are Irano-Turanian. These species are predominantly monophagous on oaks (deciduous *Quercus boissieri* and *Q. libani* and evergreen *Q. calliprinos*) and Rosaceae (*Cotoneaster nummularia, Crataegus monogyna* and *Prunus ursina*). The species assemblage of the montane steppe is more diverse, with 19 Mediterranean, 11 Palearctic, 10 Irano-Turanian and one European species.

Some of the Palaearctic and Euro-Siberian species (*H. compta*, *H. munitalis, L. lusoria*, *M. confusa* and *A. anceps*) that would be widely distributed in the center of their lowland ecozones are, on the Hermon, at their southern limit of distribution and are restricted to higher altitudes with temperate climate. *M. confusa* and *A. anceps* are common agricultural pests in Europe, but at their limit of distribution on the Hermon they become rare.

There is also evidence that some of the species collected in this study were once more widely distributed. In historic collections of the SMNH-TAU, we found *E. korsakovi*, *P. treitschkei*, *E. aquilina*, *E. robiginosa* and *E. cos* specimens all collected from high elevations in the Judean desert at the beginning of the 20th century. *D. melanura* and *D. singularis* were even found in the mountains of the central Negev. Despite various studies, neither of these species have been recorded there recently (unpublished data of the authors).

A comparison of orofauna of the Lebanon and Anti-Lebanon ridges

A series of publications on the noctuid fauna of Lebanon (CZERNY, 1932; ELLISON & WILTSHIRE, 1939; WILTSHIRE, 1940; TALHOUK, 1997) and our own data on Noctuidae of the Hermon, enable a comparison of the orofauna composition of the Lebanon and Anti-Lebanon ridges. Overall, 60 true montane species are found on the Hermon, 31 of which are also recorded from the Lebanon ridge (Table 3a). These species belong either to the Irano-Turanian or to Mediterranean chorotypes, but the ratio between the two chorotypes differs on each ridge. The Irano-Turanian species clearly dominate on the Hermon (41 Irano-Turanian species: 20 Mediterranean species), while on the

Lebanon ridge the number of species of these two chorotypes is nearly equal (16 Irano-Turanian species: 19 Mediterranean species). These ratios differ significantly (Fisher's exact test; $P > 0.05$).

Differences in the ratio of alpine and xeromontane species are caused by the lower number of xeromontane species on the Lebanon ridge, while the numbers of alpine species on both ridges are nearly equal. A total of 25 xeromontane species common on the Hermon are not found on the Lebanon ridge (Table 3a).

Discussion

All 106 species of Noctuidae restricted to the Hermon are found at the higher altitudes. Apart from 17 endemics, this group consists of species specific to mountain biomes of Europe and the Middle East. Some of the lowland Palaearctic and Euro-Siberian species exist at the southern limit of their distribution and only at high altitudes. The area most similar to the Hermon, with comparably high elevations and similar plant communities of thorn-cushion and dwarf-shrubs is found at least 600 km away in the Taurus Mountains of southern Turkey (PAROLLY, 2004; LATIF *et al*., 2006).

The Lebanon and Anti-Lebanon ridges, both reaching almost 3,000 m a.s.l., comprise the only location between southern Turkey and the Sinai Peninsula high enough to accommodate montane and alpine biomes. The connection between these biomes, and the similar xeromontane biomes of the Taurus Mountains to the north, was interrupted probably five to six thousand years ago, during the aridification of the Middle East (THOMPSON, 2000; VERHEYDEN *et al*., 2008). South of the Hermon, the closest places with similarly high altitudes, the Azir Mountains in Saudi Arabia and Santa Katherine Mountain on the Sinai Peninsula) support neither Mediterranean montane forest nor the Mediterranean tragacanth biomes on their higher altitudes (NATAN & WERNER, 1999). Therefore, for the Euro-Siberian, Mediterranean arboreal, and European oro-alpine species, the Lebanon and Anti-Lebanon ridges are the southernmost edge of their distribution. However, according to historical data, some species were found far southward along steppe tops of mountains, at least in the recent past (historical data collections in Tel Aviv).

The Lebanon ridge receives about 2,500 mm of annual precipitation, in contrast to the Anti-Lebanon ridge, which receives about one-fifth of that on its western slope (available on line at http: see in references). The eastern slope of the Anti-Lebanon ridge faces the Syrian Desert and as a result, the top of the ridge receives only 100-250 mm of annual precipitation resulting in xeromorphic vegetation (COHEN *et al.*, 1981; SHMIDA, 1977). The highest part of the Anti-Lebanon ridge thus functions as the eastern limit for the Irano-Turanian xeromontane species.

Conclusions

Many invertebrate, Arthropoda, and plant species changed distribution depending on elevation in similar patterns, thus the cold climate resulted in an "elevational species richness pattern" (ROMDAL & GRYTNES, 2007). The pattern suggests that the highest species richness exists at mid-elevations and declines at higher elevations. This has been shown for different insects such as the Noctuidae in Azerbaijan (ALIEV, 1984), or macro-moths in Oregon, USA and South Korea (CHOI & AN, 2010). On the Hermon, this "hump-shaped" distribution was demonstrated for reptiles, birds (NATAN, WERNER, 1999), and vascular plants (WILSON & SHMIDA, 1984; LEVIN *et al*., 2007). However, the Noctuidae of the Hermon show no decline in the number of species toward the top. This is likely because this location constitutes a meeting point of the rich European alpine orofauna and xeromontane fauna, related to those of Iran and Central Asia.

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