Biogeographic patterns in a transition zone: a case study on Iranian Lepidoptera

Supplementary Information I

Data Availability

The occurrences dataset was used for the analyses is available under this address:

https://datadryad.org/stash/share/Aq7t6N2qumjVVsxZ2A9pbrO6CGnEbvY9VgVQwXqeJYM

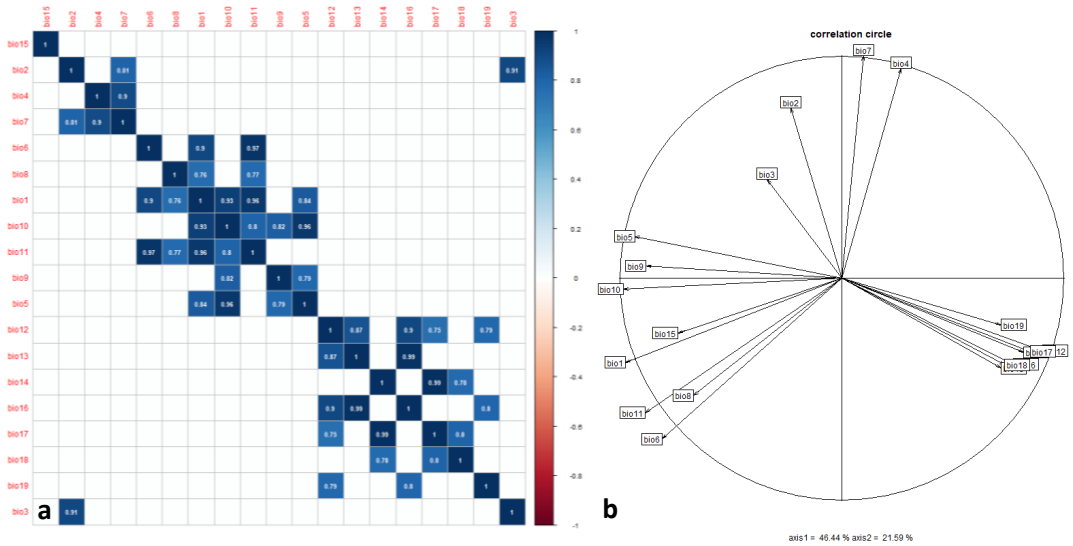

Figure S 1. a) Results of pairwise Pearson's correlation coefficient (> 0.75) and b) The Correlation circle of variables resulted from Principal Component Analysis (PCA) to select the most independent climate variables for the studied species (for more details see CHELSA, https://chelsa-climate.org).

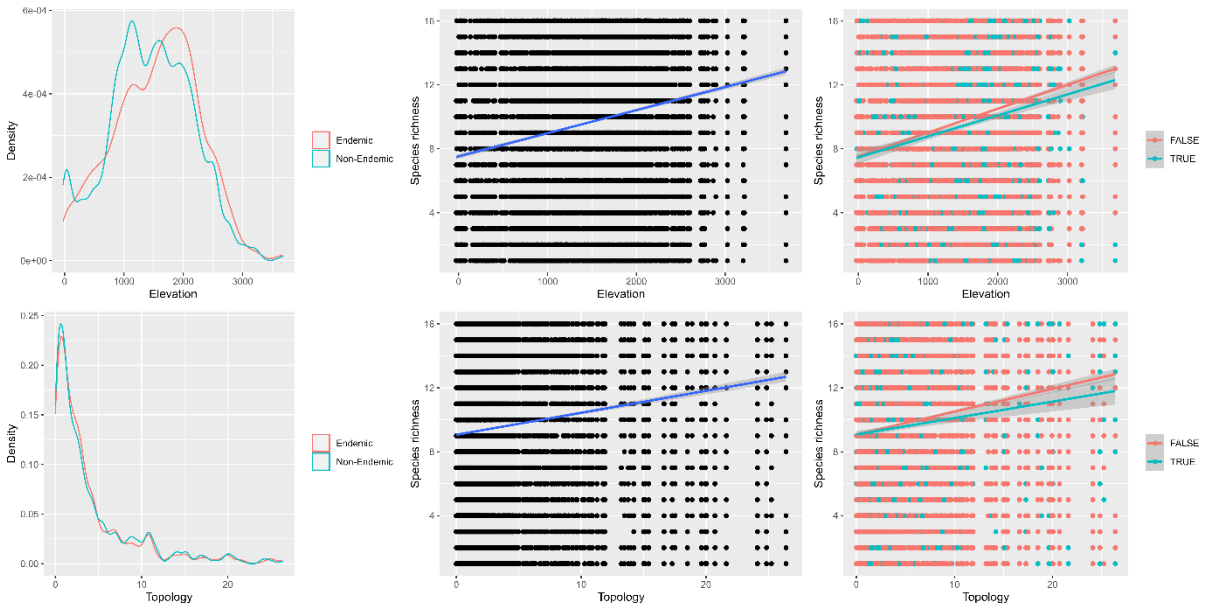

Figure S 2. The graph indicates density distribution of the species range regarding elevation and topology for Geometridae (left graphs up and down), and results linear regression between species richness by elevation, topology, for all the species (middle) and endemic and non-endemic species (right).

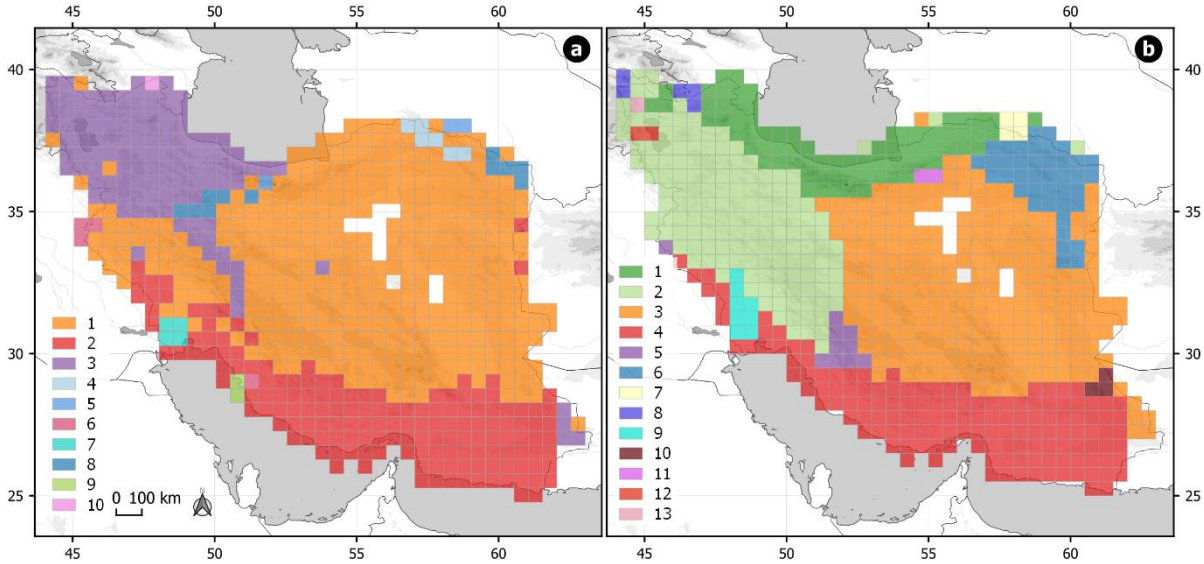

Figure S 3. Bioregionalization of Iranian Geometridae using a) distance-based and b) network-based methods.

Table S 1. A comparison of bioregionalization results for distance-based (DM), and network-based (NM) for Geometridae. The table includes a name for the detected bioregions followed by corresponding bioregions number for each method, and list of the most indicative species for each bioregion. Results of bioregionalization for Geometridae Using two methods: distance-based (DM) network-based (NM) methods

Bioregion name	**Detected bioregions**		**Most indicative species**	
	DM	NM	DM	NM
Alborz-Azerbaijan	3	1, 2, 8	*Ochodontia adustaria, Lithostege infuscate, L. witzenmanni, Protorhoe unicata, Epirrhoe alternata, Cabera pusaria, Scotopteryx aelptes,* ***L. stadiei, Charissa asymmetra, Scopula orbeorum***	***Scotopteryx decolor****, Xanthorhoe designata, Pasiphila hyrcanica, Chloroclysta siterata, Scotopteryx kuznetzovi, Kresnaia beschkovi, Charissa mardinaria, Eupithecia adjemica, Synopsia sociaria, Scopula rubiginata*
Zagros-Azerbaijan	3, 2	2	*Lithostege witzenmanni, Eupithecia adjemica, Nychiodes rayatica, Nychiodes amygdalaria,* ***Dicrognophos eurytiches****, Isturgia hopfferaria, Ochodontia adustaria, Xanthorhoe rhodoides, Lithostege infuscate,* ***Pasiphila palaearctica***	*Kresnaia beschkovi, Zystrognophos nimbata, Eucrostes disparate, Eupithecia adjemica,* ***E. truschi, Dicrognophos anophaea***
Central Basin	1	3	***Rhodostrophia vahabzadehi, Eupithecia aradjouna, Dicrognophos elahi****, Idaea deversaria, Epirrita terminassianae, Kresnaia beschkovi,* ***Photoscotosia antitype, Charissa ali***	***Rhodostrophia vahabzadehi, Nychiodes mirzayansi, Nyssiodes rhodopolitis****, Dicrognophos orthogonia, D. chorista* ***Lithostege kiabii, Lithostege samandooki, Synopsia centralis***
Khuzestan-Baluchestan	2	4	***Scopula lactarioides****, Traminda mundissima, Microloxia indecretata, Isturgia disputaria, Zamarada minimaria, Pseudosterrha paulula, Idaea mimetes, Coenina collenettei, Gonodontis clelia, Idaea sanctaria*	***Scopula lactarioides,*** *Isturgia disputaria, Microloxia indecretata, Pseudosterrha paulula, Zamarada minimaria, Idaea mimetes, Gonodontis clelia, Coenina collenettei, Idaea sanctaria*

Kopet-Dag	4, 5, 8	6, 7	*Eupithecia turkmena, Digrammia rippertaria, Dyscia leucogrammaria, Cinglis eurata,* ***Eupithecia edaphopteryx****, Nebula approxiamata,* ***Eupithecia tarensis***	*Cinglis eurata, Eupithecia obtinens, Rhodostrophia lenis,* ***Photoscotosia antitype, Euphyia khorassana, Crocallis mirabica,*** *Stegania dalmataria, Protorhoe turkmenaria, Phyllometra culminaria*
Central Zagros	1, 2	5	***Scopula hoerhammeri, Idaea wiltshirei, Eupithecia mahomedana, E. brandti, E. sectila, E. cheituna,*** *E. bastelbergeri*	
Khuzestan plain	1, 2, 7	9	*Phaiogramma polemia, Isturgia hopfferaria, Zygophyxia relictata, Chiasmia syriacaria, Eupithecia ultimaria,* ***Pasiphila palaearctica***	

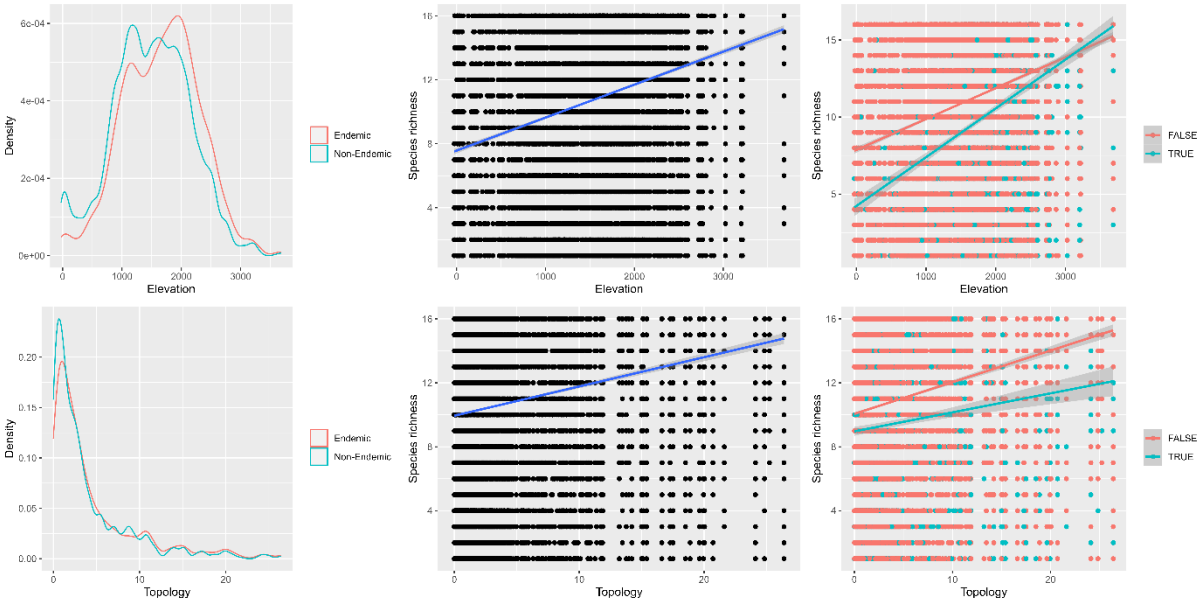

Figure S 4. The graph indicates density distribution of the species range regarding elevation and topology for Lycaenidae (left graphs up and down), and results linear regression between species richness by elevation, topology, for all the species (middle) and endemic and non-endemic species (right).

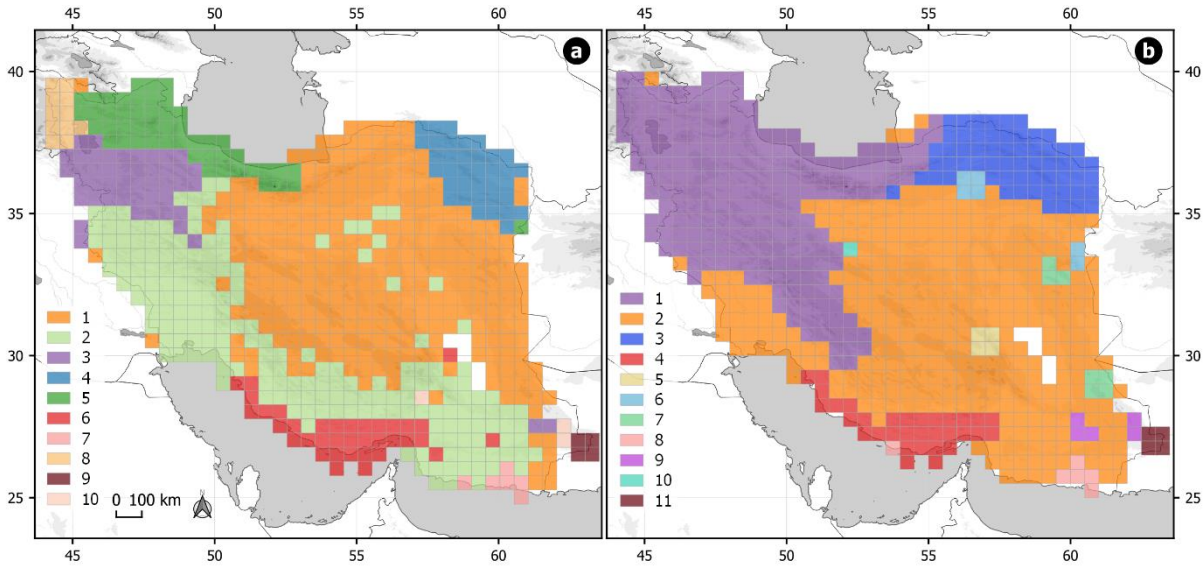

Figure S 5. Bioregionalization of Iranian Lycaenidae using a) distance-based and b) network-based methods.

Table S 2. A comparison of bioregionalization results for distance-based (DM), and network-based (NM) for Lycaenidae. The table includes a name for the detected bioregions followed by corresponding bioregions number for each method, and list of the most indicative species for each bioregion. Results of bioregionalization for Lycaenidae using two methods: distance-based (DM) network-based (NM) methods.

Bioregion name	**Detected bioregions**		**Most indicative species**	
	DM	NM	DM	NM
Alborz-Azerbaijan	3, 5, 8	1	***Polyommatus aereus**, **P. luna**, Lysandra dezina, Phengaris alcon, P. arasbarani, P. gorbunovi, **P. paulae**, Aricia Artaxerxes, Aricia isauricus, Plebejus argyrognomon*	*Polyommatus alcestis, Cyaniris semiargus, Cupido osiris, Lycaena alciphron, P. damonides, **P. ahmadi**, P. eriwanensis, L. candens, **P. pfeifferi***
Zagros-Azerbaijan	2, 3	1	***Plebejus alizadehorum, Polyommatus Zarathustra, P. aereus, P. luna, Neolysandra fereiduna, P. Achaemenes**, P. zapvadi, **P. ardschira, P. peilei***	
Central Basin	1, 2	2	***Polyommatus eckweileri,** Athamanthia balucha, P. bogra, **P. shahkuhensis**, **Plebejus alizadehorum, Polyommatus sephidarensis***	***Plebejus ardashir, P. sephidarensis**, **P. baltazardi**, Athamanthia balucha, **Callophrys naderii**, **Satyrium Persepolis,** Tarucus indica*
Bushehr	6	4	*Anthene amarah, Azanus ubaldus, Deudorix livia, Tarucus nara, Tarucus rosacea, Tarucus indica, Lachides contracta, Lampides boeticus, Zizeeria karsandra*	
Kopet-Dag	4	3	*Neolycaena tengstroemi, Polyommatus transcaspica, P. khorasanensis, Turanana dushak, **P. mofidii**, P. phyllides, **P. tenhageni***	***Polyommatus khorasanensis, P. mofidii, P. tenhageni,** Turanana dushak, P. transcaspica, Lycaena dispar, Neolycaena tengstroemi, **Plebejus Afshar**, P. phyllides*
Taftan	9	11	*Tarucus alternatus*	

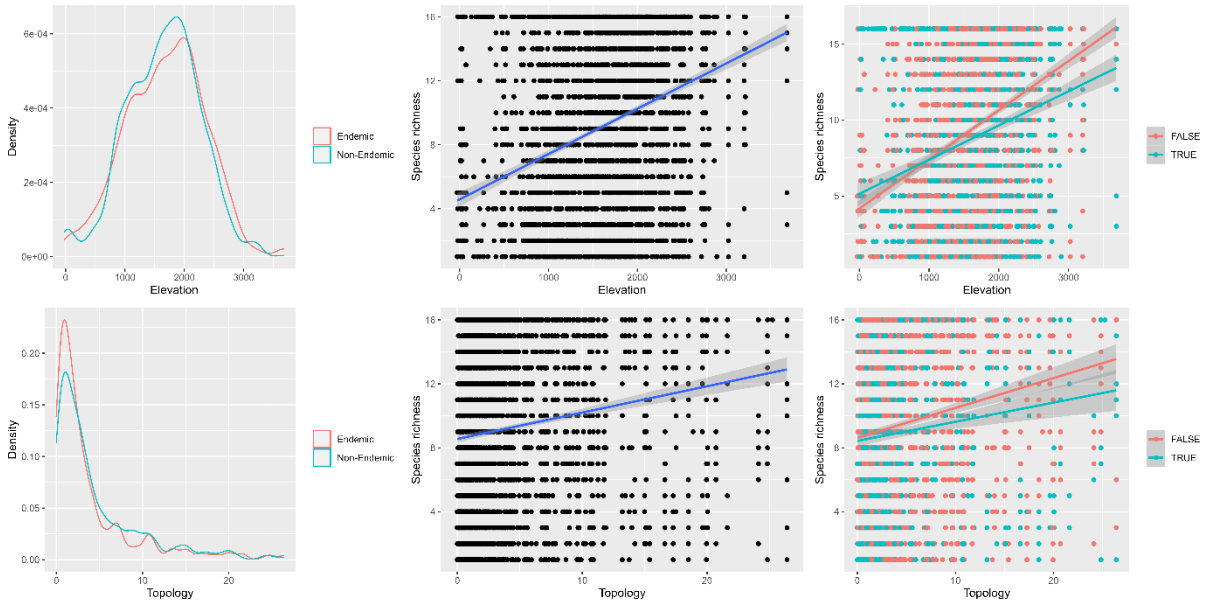

Figure S 6. The graph indicates density distribution of the species range regarding elevation and topology for Zygaenidae (left graphs up and down), and results linear regression between species richness by elevation, topology, for all the species (middle) and endemic and non-endemic species (right).

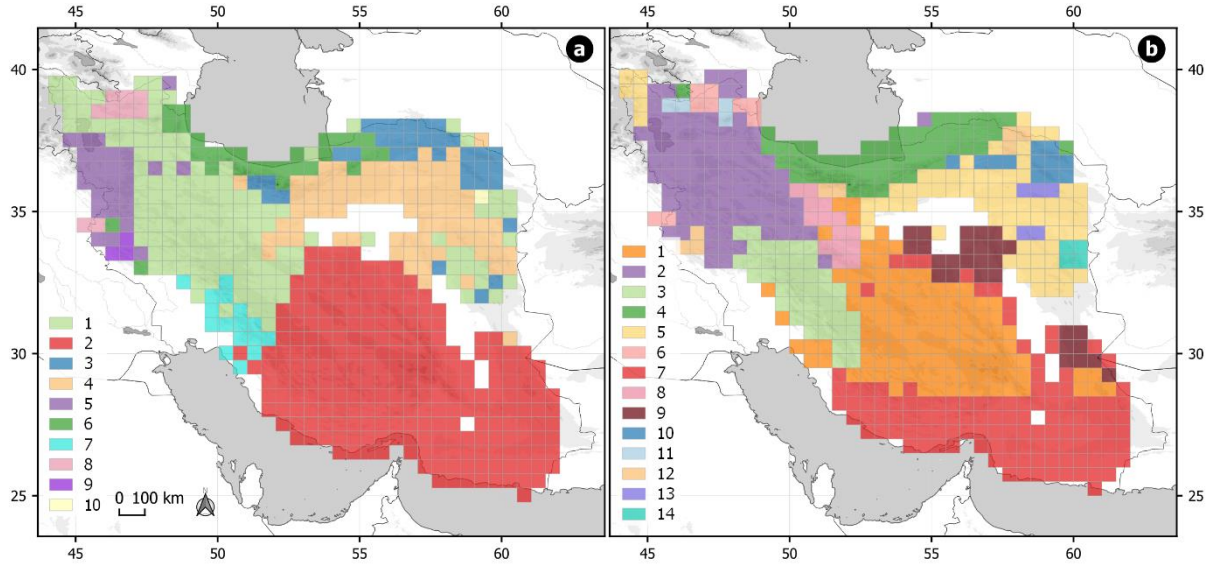

Figure S 7. Bioregionalization of Iranian Zygaenidae using a) distance-based and b) network-based methods.

Table S 3. A comparison of bioregionalization results for distance-based (DM), and network-based (NM) for Zygaenidae. The table includes a name for the detected bioregions followed by corresponding bioregions number for each method, and list of the most indicative species for each bioregion. Results of bioregionalization for Zygaenidae using two methods: distance-based (DM) network-based (NM) methods.

Bioregion name	**Detected bioregions**		**Most indicative species**	
	DM	NM	DM	NM
Alborz	3, 6	4	***Zygaenoprocris hofmanni,*** Zygaena mana, *Z. purpuralis, Z. viciae, Z. loti,* ***Z.***	*Jordanita paupera, J. ambigua,* ***Zygaenoprocris hofmanni,*** ***Zygaena cacuminum,*** *Z.*

			cacuminum, *Jordanita paupera*	*carniolica, Z. haberhaueri, Z. minos, Z. loti*
Zagros-Azerbaijan	1, 5, 7, 8	2, 3, 5	***Jordanita christinae, Zygaena naumanni, Z. tenhagenova, Z. bakhtiyari,*** *Z. fraxini, Z. lonicerae, Z. araxis,* ***Z. mirzayansi, Zygaenoprocris puschmanni***	*Zygaena cuvieri,* ***Z. tenhagenova,*** *Jordanita notata, J. kurdica, Z. filipendulae, Z. haematina,* ***Z. seitzi, Rhagades tarmanni,*** *Z. turkmenica,* ***Z. fredi,***
Central Basin	1, 2, 4	1, 8, 9	***Jordanita christinae, J. rietzschi, Zygaena naumanni, Z. aisha, Z. ginnereissi, Z. kermanensis, Zygaenoprocris duskei, Z. hasarani, Z. schahdadiani***	***Zygaenoprocris schahdadiani, Z. hasarani, Z. kliri, Z. duskei, Z. taftana, Zygaena sengana, Z. aisha, Z. fusca, Z. manlia,***
Southern Seashores	2	7	***Zygaenoprocris duskei, Zygaena kermanensis***	***Zygaenoprocris duskei, Z. taftana****, Zygaena fredi*
Khorasan	4	5	***Zygaenoprocris efetovi, Z. rjabovi,*** *Z. mystrocera, Z. albertii, Zygaena afghani,* ***Z. cacuminum, Z. manlia, Z. fusca***	*Zygaenoprocris mystrocera, Zygaena turkmenica,* ***Z. manlia****, Z. fredi, Z. dorycnii, Jordanita kurdica*
Kopet-Dag	3, 10	10, 12, 13	***Zygaena esseni, Zygaenoprocris khorassana, Z. fredi****, Z. minna, Z. alberti, Z. dorycnii, Jordanita chloros*	***Zygaena esseni,*** *Z. dorycnii, Z. carniolica, Z. afghana Z. alberti, Z. minna, Z. mystrocera, Jordanita chloros*