

Diversity of vernal butterflies of the East Mediterranean region of Turkey

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Abstract. In this study, spring butterflies of the East Mediterranean Region were searched and 104 taxa belonging to 5 families were determined. Butterfly specimens were caught with a butterfly net at 67 locations during the field work. The family distribution of species was Hesperidae: 17, Lycaenidae: 39, Nymphalidae: 25, Papilionidae: 5 and Pieridae: 18. Evaluation of the vertical distribution of all species revealed that the highest and the lowest number of species were found at respectively 1000–1250 m (61 species) and 1750 m (10 species).

Samenvatting. In deze studie werden voorjaarsdagvlinders van het Oost-Mediterrane Zeegebied onderzocht en 104 taxa, behorende tot 5 families, werden bepaald. Gedurende het veldwerk werden op 67 locaties vlinders gevangen met een vlindernet. De soortverdeling per familie was Hesperidae: 17, Lycaenidae: 39, Nymphalidae: 25, Papilionidae: 5 and Pieridae: 18. Uit de evaluatie van de verticale distributie van alle soorten bleek dat het hoogste en laagste aantal soorten gevonden werd op respectievelijk 1000–1250 m (61 soorten) en 1750 m (10 soorten).

Résumé. Dans cette étude, des papillons printaniers dans la Méditerranée Orientale ont été examinés et 104 taxons, appartenant à 5 familles, ont été déterminés. Pendant le travail sur le terrain, les papillons ont été capturés avec un filet à papillon à 67 endroits. La distribution des espèces par famille était Hesperidae: 17, Lycaenidae: 39, Nymphalidae: 25, Papilionidae: 5 and Pieridae: 18. L'évaluation de la distribution verticale de toutes les espèces a montré que le nombre le plus élevé et le plus bas d'espèces se situait respectivement à 1000–1250 m (61 espèces) et à 1750 m (10 espèces).

Key words: Vertical Distribution – Evaluation – Species richness.

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Introduction

A lot of scientific research about Turkish butterflies comprising faunistic records by foreign and native researchers is available. The vernal butterflies (Lepidoptera, Papilionoidea) of the East-Mediterranean region are relatively well studied. There are detailed publications on faunistics (Hesselbarth *et al.*, 1995; Koçak 1982, 1989, 1990; 1993, 2017a, 2017b; Koçak & Seven 1990, 1991; Koçak & Kemal 2007, 2014; Seven 2016).

The aim of this study is to determine the vernal butterflies and their vertical distributions in the Eastern Mediterranean, an important agricultural and touristic area.

Material and methods

Turkey consists of 7 different geographical regions: the Aegean Region, the Black Sea Region, the Central Anatolia Region, the Eastern Anatolia Region, the South-eastern Anatolia Region, the Marmara Region and the Mediterranean Region (Seven 2016). Adana, Kahramanmarař, Kayseri, Konya, Mersin, Niğde, and Osmaniye were selected as research areas and are located in the Mediterranean and in the Central Anatolia Regions (fig. 1). The field research of this study was conducted within the scope of the Anatolian Cross Biodiversity Project of The Nature Conservation Center.

Butterfly species were collected by the authors within the borders of the East Mediterranean region at daytime, between April and June 2008. Collection areas are shown on the map (fig. 1). Butterfly specimens were collected with a butterfly net and then placed in triangle papers using tweezers. Precautions were made to not harm the butterfly populations. Only a small number of specimens

was collected from the locations and some of the captured species were released after examination.

The collected specimens were rehydrated in special containers in the laboratory and mounted on setting boards according to the procedure of the university museum. The dried specimens were labelled and placed in collection boxes of the Gazi University Science Faculty, Zoology Museum collection.

For the identification of specimens, Hesselbarth *et al.* (1995), Tshikolovets (2011) and the author's private collection were consulted. Valid scientific family-group names were given according van Nieukerken *et al.*, (2011).

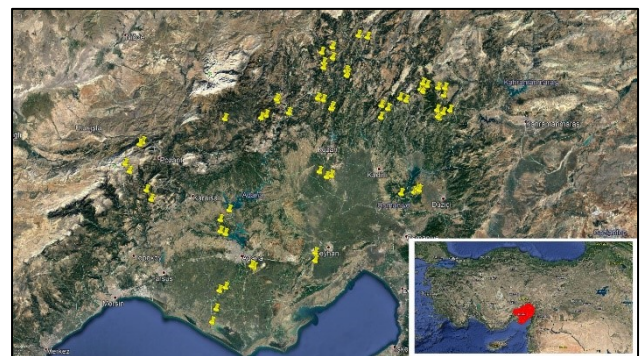


Fig. 1 | The research area and the collecting stations.
Het onderzoeksgebied en de verzamelplaatsen.

Results and discussion

The Lepidoptera fauna of Turkey has been studied by multiple scientists. According to their reports, the butterfly fauna of Turkey consists of more than 414 species (Koçak 2014). This is the first study to determine the vernal butterfly fauna of the East-Mediterranean region. A total of 104 species and subspecies belonging to 5 families are identified (table 1).

Euchloe (Elphinstonia) penia (Freyer 1851) was first recorded from Adana in 1880 and, after 120 years, recorded for the second time with this study.

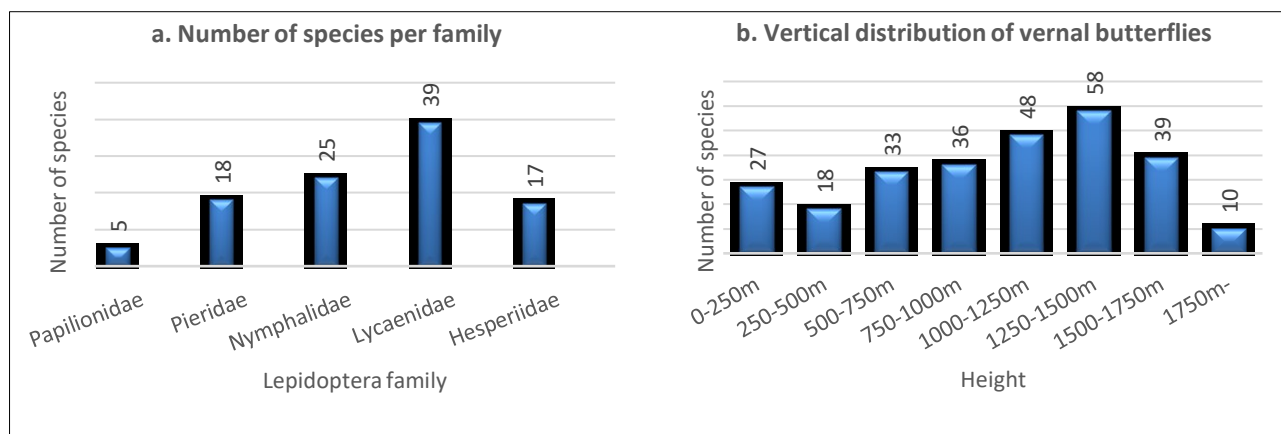


Fig. 2 | The diversity of vernal butterflies of the research area; a. the number of species per family; b. the vertical distribution of the collected vernal butterflies.
De diversiteit van voorjaarsdagvlinders in het studiegebied; a. het aantal soorten per familie; b. de verticale distributie van de gevangen voorjaarsdagvlinders.

As a result of this study, the authors discovered that species richness of the majority of the vernal butterfly fauna in the research area is formed by Hesperidae: 17, Lycaenidae: 39, Nymphalidae: 25, Papilionidae: 5 (fig. 2a). Lycaenidae is the richest family with 39 species from the East Mediterranean Region.

Thirty four species were collected between 0–250 m, 19 species were collected between 250-500 m, 34 species were collected between 500-750 m, 50 species were collected between 750–1000 m, 61 species were collected between 1000–1250 m, 58 species were collected between 1250–1500 m, 40 species were collected on 1500-1750 m and 10 species were collected above of 1700 m (H) (Fig. 2). The low number of species between 250–500 m is due to the low collection activity at these heights. Cultivation of areas play also a negative effect on the number of species richness. At the stations 21, 46, 48, 58 and 66, no collection could be performed because of unfavourable weather conditions.

The highest diversity was detected from 1000–1250 m and 1250–1500 m study zone. The decrease in the anthropogenic factors on the butterfly habitats, and abundance of favourable natural spaces at these heights resulted in an increase of species numbers. Favourable seasonal temperatures and weather conditions are additional positive factors.

Due to the low temperature and the lack of vegetation at the time of the study, the recorded species number at 1500 m is quite low. With the increase of temperatures, an increase of species diversity and a change of species composition are expected.

Acknowledgement

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Table 1. Vernal Butterflies of the East Mediterranean Region of Turkey (NS: Number of species, Al: Altitude: A (0–250), B (250–500), C (500–750), D (750–1000), E (1000–1250), F (1250–1500), G (1500–1750), H (>1750).

| Family | Taxon | Locality | NS | Al (m) |
|--------------|---|--|----|------------|
| Papilionidae | 1. <i>Zerynthia cerisy</i> (Godart, 1824) | 50, 61, 43, 65, 23, 35, 51, 52, 60, 67 | 10 | D, E, F, G |
| | 2. <i>Archon apollinus bellargus</i> (Staudinger, [1892]) | 65 | 1 | E |
| | 3. <i>Parnassius mnemosyne nebulosus</i> Christoph, 1873 | 23, 25, 51, 52, 54 | 5 | E, F, G |
| | 4. <i>Iphiclides podalirius</i> (Linnaeus, 1758) | 22, 23, 51, 52, 53 | 5 | D, F |
| | 5. <i>Papilio machaon</i> Linnaeus, 1758 | 31 | 1 | D |
| Pieridae | 6. <i>Leptidea duponcheli lorkovici</i> Pfeiffer, [1932] | 67 | 1 | G |
| | 7. <i>Leptidea sinapis</i> (Linnaeus, 1758) | 51, 60 | 2 | E, F |
| | 8. <i>Pieris ergane</i> (Geyer, [1828]) | 22, 64, 67 | 3 | E, F, G |

| Family | Taxon | Locality | NS | Al (m) |
|-------------|--|--|----|------------------------|
| | 9. <i>Pieris krueperi</i> Staudinger, 1860 | 22 | 2 | F |
| | 10. <i>Pieris psuedorapae</i> Verity, 1908 | 50, 31, 57, 41 | 8 | E, D |
| | 11. <i>Pieris rapae</i> Linnaeus, 1758) | 1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 14, 15, 17, 20, 49, 56, 57, 61, 22, 30, 40, 42, 51, 52, 54, 60, 62, 63 | 14 | A, B, C, D, E, F |
| | 12. <i>Pieris brassicae</i> (Linnaeus, 1758) | 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 57, 61, 43, 44, 45, 65, 22, 23, 25, 27, 28, 29, 31, 33, 35, 36, 38, 39, 40, 41, 51, 52, 54, 60, 62, 63, 67 | 1 | A, B, C, D, E, F, G |
| | 13. <i>Pontia callidice</i> (Hübner, 1800) | 24 | 1 | H |
| | 14. <i>Pontia edusa</i> (Fabricius, 1777) | 8, 15, 31, 36, 37, 40, 42, 52, 53, 54, 60 | 1 | A, C, D, E, F |
| | 15. <i>Anthocharis cardamines</i> (Linnaeus, 1758) | 55, 56, 57, 61, 44 | 5 | C, D, F |
| | 16. <i>Anthocharis damone</i> Boisduval, 1836 | 22, 23 | 2 | F |
| | 17. <i>Euchloe penia</i> (Freyer, [1852]) | 44 | 2 | C |
| | 18. <i>Euchloe ausonia taurica</i> Röber, [1907] | 7, 8, 14, 15, 17, 19, 65, 27, 29, 40, 62 | 5 | A, B, C, E |
| | 19. <i>Zegris eupheme menestho</i> (Ménétriés, 1832) | 67 | 1 | G |
| | 20. <i>Colias croceus</i> (Geoffroy, 1785) | 2, 3, 5, 6, 7, 8, 10, 11, 13, 17, 19, 49, 61, 43, 65, 22, 25, 26, 27, 28, 29, 30, 31, 32, 33, 36, 37, 38, 39, 40, 41, 42, 51, 52, 53, 54, 60, 62, 63, 64, 67 | 9 | A, B, C, D, E, F, G |
| | 21. <i>Colias alfacariensis</i> Ribbe, 1905 | 23, 25, 51, 52, 60, 67 | 2 | E, F, G |
| | 22. <i>Gonepteryx cleopatra</i> (Linnaeus, 1767) | 31 | 1 | D |
| | 23. <i>Gonepteryx rhamni</i> (Linnaeus, 1758) | 61, 63 | 1 | D, F |
| Nymphalidae | 24. <i>Libythea celtis</i> (Laicharting, 1782) | 63 | 1 | F |
| | 25. <i>Kirinia roxelana</i> (Cramer, [1777]) | 12, 29, 31, 42 | 1 | A, C, D |
| | 26. <i>Lasiommata maera</i> (Linnaeus, 1758) | 55, 61, 43, 35, 50, 54, 60, 63, 64 | 2 | D, E, F, G |
| | 27. <i>Lasiommata megera</i> (Linnaeus, 1767) | 12, 13, 16, | 1 | A, B, D |
| | 28. <i>Pararge aegeria</i> (Linnaeus, 1758) | 17, 44 | 1 | B, C |
| | 29. <i>Coenonympha pamphilus</i> (Linnaeus, 1758) | 49, 55, 56, 57, 45, 26, 51, 52, 53, 54, 60, 62, 63, 64, 67 | 8 | D, E, F, G |
| | 30. <i>Maniola telmessia</i> (Zeller, 1847) | 7, 8, 9, 10, 12, 16, 17, 18, 19, 20, 61, 26, 29, 30, 31, 32, 33, 34, 35, 36, 39, 40, 68, 41, 42, 53, 54, 62, 63 | 17 | A, B, C, D, E, F |
| | 31. <i>Hipparchia mersina</i> (Staudinger, 1871) | 28, 29, 32, 33, 35, 40, 41 | 5 | C, D, E |
| | 32. <i>Ypthima asterope</i> (Klug, 1832) | 11, 12, 13, 18, 19 | 12 | A, B |
| | 33. <i>Thaleropis ionia</i> (Eversmann, 1851) | 43 | 2 | E |
| | 34. <i>Aglais urticae turcica</i> (Staudinger, 1871) | 22, 24 | 1 | F, H |
| | 35. <i>Nymphalis polychloros</i> (Linnaeus, 1758) | 31, 42 | 1 | D |
| | 36. <i>Polygonia egea</i> (Cramer, [1775]) | 12, 22, 33, 51 | 3 | A, E, F |
| | 37. <i>Vanessa cardui</i> (Linnaeus, 1758) | 2,3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 15, 16, 17, 18, 19, 20, 47, 61, 43, 65, 24, 25, 27, 29, 30, 34, 35, 36, 37, 39, 40, 68, 52, 54, 60, 62 | 1 | A, B, C, D, E, F, G, H |

| Family | Taxon | Locality | NS | Al (m) |
|------------|--|---|----|---------------------|
| | 38. <i>Vanessa atalanta</i> (Linnaeus, 1758) | 2, 7, 8, 20, 43, 44, 22, 29, 36, 54, 60, 62 | 1 | A, B, C, D, E, F |
| | 39. <i>Limenitis reducta</i> Staudinger, 1901 | 30, 31, 40, 68, 41, 60 | 1 | C, D, E |
| | 40. <i>Argynnis niobe</i> (Linnaeus, 1758) | 23 | 1 | F |
| | 41. <i>Argynnis pandora</i> (Denis & Schiffermüller, 1775) | 22, 68, 51, 52, 53, 60, 62, 63 | 1 | C, D, E? F |
| | 42. <i>Issoria lathonia</i> (Linnaeus, 1758) | 65, 22, 24, 25, 27, 28, 30, 32, 34, 36, 39, 68, 42, 51, 60 | 1 | C, D, E, F, G, H |
| | 43. <i>Melitaea phoebe</i> (Denis & Schiffermüller, 1775) | 17, 18, 44, 30, 31, 68, 53, 54, 60 | 11 | B, C, D, E |
| | 44. <i>Melitaea ornata telona</i> Fruhstorfer, 1908 | 23, 28, 30, 40, 51, 60, 67 | 7 | C, D, E, F, G |
| | 45. <i>Melitaea collina</i> Lederer, 1861 | 45 | 1 | E |
| | 46. <i>Melitaea didyma</i> (Esper, 1778) | 25, 51, 52, 60, 67 | 6 | E, F, G |
| | 47. <i>Melitaea trivia fascelis</i> (Esper, 1783) | 11, 17, 65, 33, 34, 53, 60, 62 | 9 | A, B, D, E |
| | 48. <i>Melitaea arduinna</i> (Esper, 1783) | 22 | 1 | F |
| | 49. <i>Melitaea cinxia</i> (Linnaeus, 1758) | 24, 38, 51, 52, 60, 64, 67 | 11 | E, F, G, H |
| Lycaenidae | 50. <i>Satyrium ilicis</i> (Esper, [1779]) | 31, 11, 12, 40, 68 | 10 | A, C, D |
| | 51. <i>Satyrium spini</i> (Denis & Schiffermüller, 1775) | 11, 12, 35, 36, 42 | 7 | A, C, D, E |
| | 52. <i>Callophrys danchenkoi</i> Zhdanko, 1998 | 64 | 2 | E |
| | 53. <i>Callophrys paulae</i> Pfeiffer, 1932 | 24 | 3 | H |
| | 54. <i>Callophrys rubi</i> (Linnaeus, 1758) | 22, 23, 28, 33, 41, 67 | 3 | E, F, G |
| | 55. <i>Tomares nesimachus</i> (Oberthür, 1893) | 24, 25, 27, 28 | 12 | E, G, H |
| | 56. <i>Tomares nogelii</i> (Herrich-Schäffer, 1851) | 22, 33 | 4 | E, F |
| | 57. <i>Lampides boeticus</i> (Linnaeus, 1767) | 1, 7, 8, 23, 24, 28, 29, 30, 31, 33, 35, 36, 54, | 1 | A, C, D, E, F |
| | 58. <i>Tarucus balkanica</i> (Freyer, [1844]) | 8, 10, 13, 39 | 3 | A, D |
| | 59. <i>Zizeeria karsandra</i> (Moore, 1865) | 2, 4, 12 | 2 | A |
| | 60. <i>Cupido minimus</i> (Fuessly, 1775) | 22 | 1 | F |
| | 61. <i>Cupido osiris</i> (Meigen, 1829) | 23, 25, 51, 52, 67 | 8 | F, G |
| | 62. <i>Glaucopsyche astraea</i> (Freyer, [1851]) | 67 | 1 | G |
| | 63. <i>Glaucopsyche lessei</i> Bernardi, 1964 | 17, 23, 33, 32 | 2 | B, E, F |
| | 64. <i>Iolana iolas</i> (Ochsenheimer, 1816) | 8, 17, 18, 19, 49, 44, 45, 65, 22, 23, 25, 41, 51, 52, 67 | 8 | A, B, C, E, F, G |
| | 65. <i>Pseudophilotes vicrama</i> (Moore, 1865) | 67 | 1 | G |
| | 66. <i>Pseudophilotes bavius egea</i> (Herrich-Schäffer, [1852]) | 22, 25, 40, 52 | 1 | C, F, G |
| | 67. <i>Aricia anteros</i> (Freyer, [1838]) | 42, 52, 64 | 4 | D, E, F |
| | 68. <i>Aricia agestis</i> (Denis & Schiffermüller, 1775) | 8, 17, 50, 57, 65, 23, 25, 30, 31, 39, 40, 41, 51, 52, 53, 54 | 14 | A, B, C, D, E, F, G |

| Family | Taxon | Locality | NS | Al (m) |
|-------------|--|--|----|---------------------|
| | 69. <i>Polyommatus antiochenus</i> (Lederer, 1861) | 41, 38 | 5 | E, G |
| | 70. <i>Polyommatus bellis</i> (Freyer, [1842]) | 65, 22, 25, 33, 39, 41, 42, 51, 52, 53, 54, 60, 64 | 15 | D, E, F, G |
| | 71. <i>Polyommatus bellargus</i> (Rottemburg, 1775) | 65, 23, 25, 39, 41, 42, 51, 52, 54, 60, 67 | 14 | D, E, F, G |
| | 72. <i>Polyommatus syriacus burak</i> Koçak, 1992 | 31 | 2 | D |
| | 73. <i>Neolysandra coelestina ponticus</i> (Courvoisier, 1911) | 64, 67 | 8 | E, G |
| | 74. <i>Polyommatus amandus</i> (Schneider, 1792) | 28, 42, 67 | 3 | D, E, G |
| | 75. <i>Polyommatus cornelia</i> (Freyer, [1850]) | 22, 24, 25, 35, 38, 41, 67 | 16 | E, F, G, H |
| | 76. <i>Polyommatus thersites</i> (Cantener, [1835]) | 23, 25, 39, 41, 51, 52, 60, 64 | 3 | D, E, F, G |
| | 77. <i>Polyommatus icarus</i> (Rottemburg, 1775) | 3, 8, 17, 18, 19, 20, 50, 57, 55, 61, 65, 22, 25, 29, 30, 31, 34, 33, 32, 36, 37, 38, 39, 40, 41, 51, 52, 53, 54, 60, 62, 63, 64, 67 | 49 | A, B, C, D, E, F, G |
| | 78. <i>Freyeria trochylus</i> (Freyer, [1843]) | 11, 12, 40 | 4 | A, C |
| | 79. <i>Chilades galba</i> (Lederer, 1855) | 11 | 2 | A |
| | 80. <i>Kretania sephirus</i> (Frivaldszky, 1835) | 9, 22, 23, 25, 26, 30, 31, 33, 32, 35, 38, 40, 41, 42, 52, 67 | 13 | A, C, D, E, F, G |
| | 81. <i>Plebejus argus</i> (Linnaeus, 1758) | 52, 64 | 5 | E, F |
| | 82. <i>Lycaena alciphron melibaeus</i> (Staudinger, 1878) | 22, 23 | 1 | F |
| | 83. <i>Lycaena tityrus</i> (Poda, 1761) | 22, 25, 64 | 1 | E, F, G |
| | 84. <i>Lycaena asabinus</i> (Gerhard, [1850]) | 24, 25, 28 | 1 | E, G, H |
| | 85. <i>Lycaena ochimus</i> (Herrich-Schäffer, [1851]) | 23, 41, 51, 64 | 5 | E, F |
| | 86. <i>Lycaena thersamon</i> (Esper, [1784]) | 22 | 2 | F |
| | 87. <i>Lycaena phlaeas</i> (Linnaeus, 1761) | 2, 11, 12, 17, 19, 49, 56, 61, 43, 44, 65, 22, 23, 24, 27, 29, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 42, 51, 52, 54, 60, 63, 64 | 9 | A, B, C, D, E, F |
| Hesperiidae | 88. <i>Carcharodus orientalis</i> Reverdin, 1913 | 8, 12, 22, 25, 36, 60, 67 | 6 | A, D, E, F, G |
| | 89. <i>Carcharodus alceae</i> (Esper, [1780]) | 8, 17, 25, 30, 31, 36, 63 | 7 | A, B, C, D, F, G |
| | 90. <i>Erynnis tages</i> (Linnaeus, 1758) | 24, 25, 51, 52, 64 | 4 | E, F, G, H |
| | 91. <i>Muschampia nomas</i> (Lederer, 1855) | 31 | 2 | D |
| | 92. <i>Muschampia proto aragonensis</i> (De Sagarra, 1924) | 31 | 1 | D |
| | 93. <i>Muschampia tessellum</i> (Hübner, [1802]) | 31, 39, 40, 68, 41 | 3 | A, C, D |
| | 94. <i>Pyrgus armoricanus persicus</i> (Reverdin, 1913) | 22, 25, 31, 39, 68, 41, 51, 52, 53 | 11 | C, D, E, F |
| | 95. <i>Pyrgus melotis melotis</i> (Duponchel, [1834]) | 8, 12, 49, 47, 57, 44, 45, 28, 54 | 9 | A, C, D, E, F |
| | 96. <i>Pyrgus melotis ponticus</i> (Reverdin, 1914) | 65, 67, | 2 | E, G |
| | 97. <i>Pyrgus serratulae major</i> (Staudinger, 1878) | 67 | 1 | G |
| | 98. <i>Pyrgus sidae</i> (Esper, [1784]) | 22, 23, 52 | 3 | F |

| Family | Taxon | Locality | NS | Al (m) |
|--------|---|---|----|------------------|
| | 99. <i>Spialia orbifer</i> (Hübner, 1823) | 8, 11, 12, 61, 22, 23, 25, 26, 30, 31, 32, 33, 35, 36, 38, 39, 41, 42, 51, 52, 53, 54, 60, 62, 63, 67 | 27 | A, C, D, E, F, G |
| | 100. <i>Gegenes nostradamus</i> (Fabricius, 1793) | 11 | 1 | A |
| | 101. <i>Gegenes pumilio</i> (Hoffmannsegg, 1804) | 8, 11, 12, 17, 18, 19, 31 | 12 | A, B, D |
| | 102. <i>Pelopidas thrax</i> (Hübner, [1821]) | 8, 12, 13 | 3 | A |
| | 103. <i>Thymelicus acteon</i> (Rottemburg, 1775) | 33 | 1 | E |
| | 104. <i>Thymelicus sylvestris syriacus</i> (Tutt, [1905]) | 8, 26, 31, 33, 34, 36, 40, 42 | 5 | A, C, D, E |

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