Habitat preferences of butterflies (Papilionoidea) in the Karpaz Peninsula, Cyprus

Özge Özden

Department of Landscape Architecture, Faculty of Architecture, Near East University, Nicosia, North Cyprus Mersin 10 Turkey; ozgeozden77@yahoo.com

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Abstract. The Mediterranean region comprises of some of the world's unique and biogeographically important areas, harbouring high levels of biological diversity. On the other hand, anthropogenic disturbances are causing degradation of diverse ecosystems within the region. The aim of this study was to determine the habitat preferences of butterfly species and the potential threats they may face within the Karpaz Peninsula of Cyprus. To understand the importance of local vegetation characteristics of butterflies in the Karpaz Peninsula, 'Pollard Walk' transect counts were used to assess the abundance and species richness of butterflies. Butterflies resting on plants and those in flight were counted and identified. Preferred plant species and habitat types (EUNIS and EU Habitats) of the butterflies are also identified. During the surveys in 2006, eleven butterfly species were recorded. Two of them (*Glaucopsyche paphos* and *Maniola cypricola*) are endemic to Cyprus. Construction developments and road improvements were recorded within the region and have resulted in habitat loss and degradation. Our results provide valuable knowledge about important habitats for Cypriot butterflies within the Karpaz Peninsula and additionally highlight the need for their conservation in the face of large infrastructure developments and unregulated construction.

Introduction

The Mediterranean Basin is rich in biodiversity and in need of conservation (Myers 1990). Cyprus is the third largest island within the Mediterranean Basin, after Sicily and Sardinia. It harbours a variety of ecosystems including pine forests, garrigue, maquis, rocky areas, coastal rocky areas, coastal dunes, wetlands, and agricultural areas together with a high number of threatened and endemic plant and animal species (Baier et al. 2009; Flint & Stewart 1992; Makris 2003; Tsintides 1998; USAID 2006). The northern part of the island has been politically isolated for many years and as a result, development has been relatively slow compared with similar regions in the Mediterranean. In general, the northern part of the island offers a range of varied terrestrial habitats, such as pine forests (both lowland and mountain), juniper shrubs, garrigue, phrygana, limestone pavements and dune vegetations (Tsintides 1998; Viney 1994).

The Karpaz Peninsula is biologically one of the most important areas in Cyprus. It is situated at the easterly point of the Five Finger Mountain Range (Beşparmak Sıra Dağları). It consists of hill-like formations covered with maquis, pine forests, olive and carob plantations, plains containing arable lands, semi-dry stream beds and a coastal zone. The Karpaz Peninsula is particularly known for its unspoilt landscapes and its interesting wildlife; therefore it is an important ecotourism area. The area has recently received official legal protection as an important natural resource for the northern part of the island and was declared a "Special Environmentally Protected Area" according to Environment Law (21/97) article 11 by the Turkish Cypriot authorities. The Karpaz

Special Environmentally Protected Area has been selected due to the occurrence of internationally important habitats and species, including marine turtles *Chelonia mydas* (Linnaeus, 1758), *Caretta caretta* (Linnaeus, 1758), Audouin's Gull *Larus audouinii* Payraudeau, 1826, and Mediterranean Monk Seal *Monachus monachus* (Hermann, 1779) (Godley & Broderick 1992; Haigh 2004; Iris & Gucel 2008). Karpaz is not only known for important animal species; it also harbours many endemic and rare plant species such as Cyprus Orchid (*Ophrys kotschyi* H. Fleischm. & Soó) which is listed under EU Annex II plant species (European Commission 2007a; Kreutz 2004).

Although the peninsula is declared as a "Special Environmentally Protected Area" by local authorities, herbicide and pesticide use in agricultural fields is still allowed. Agricultural cereal fields in the area are mainly wheat and barley production areas and are open monocultures. These areas are not irrigated and farmers apply shallow ploughing in these monoculture fields. The field margins between the grassland fields are not more than 1.5 m wide.

It is known that about one third (31%) of European butterflies has declined over the last 10 years (van Swaay et al. 2010). There are many documented threats to butterflies in Europe, including the increasing use of agricultural herbicides and pesticides, habitat loss, climate change, land management, agricultural conversion and fragmentation (Grill et al. 2005, Stefanescu et al. 2005; Wilson & Maclean 2011). Building and infrastructure developments such as roads, quarries and housing are also strong drivers of population declines affecting 80% of the threatened butterfly species within Europe (van Swaay et al. 2009).

So far in Cyprus, 53 species and subspecies of butterflies have been recorded. They include three endemic species (*Maniola cypricola* (Graves, 1928), *Hipparchia cypriensis* Holik, 1949 and *Glaucopsyche paphos* Chapman, 1920) (Makris 2003). Two of the endemic species, *M. cypricola* and *G. paphos*, are of European Conservation Concern (van Swaay & Warren 1999). Here we used a case study of butterfly abundance and behaviour within the Karpaz Peninsula in different habitat types. We compared the butterfly abundance/activity and species richness between different habitat types during the spring season. Understanding the response of different butterfly species to different habitats is essential in order to design conservation management, especially in Mediterranean mosaic landscapes (Pe'er et al. 2011). The aim of this study was to determine the habitat preferences of butterfly species and the potential threats that they may face within the Karpaz Peninsula of Cyprus.

Materials and Methods

This study was carried out in the Karpaz Peninsula of Cyprus between the beginning of April until the end of May 2006. The vegetation in the area is mainly dominated by *Juniperus phoenicea* L. (Cupressaceae), *Olea europaea* Linnaeus (Oleaceae), *Ceratonia siliqua* L. (Fabaceae), *Pistacia lentiscus* L. (Anacardiaceae), *Thymus capitatus* (L.) Hoffmanns. & Link (Lamiaceae), *Sarcopoterium spinosum* (L.) Spach (Rosaceae) and *Genista sphacelata* Spach (Fabaceae). During the spring there are many wild flowers in the area including several endemic plant species such as *Anthemis tricolor* Boiss.

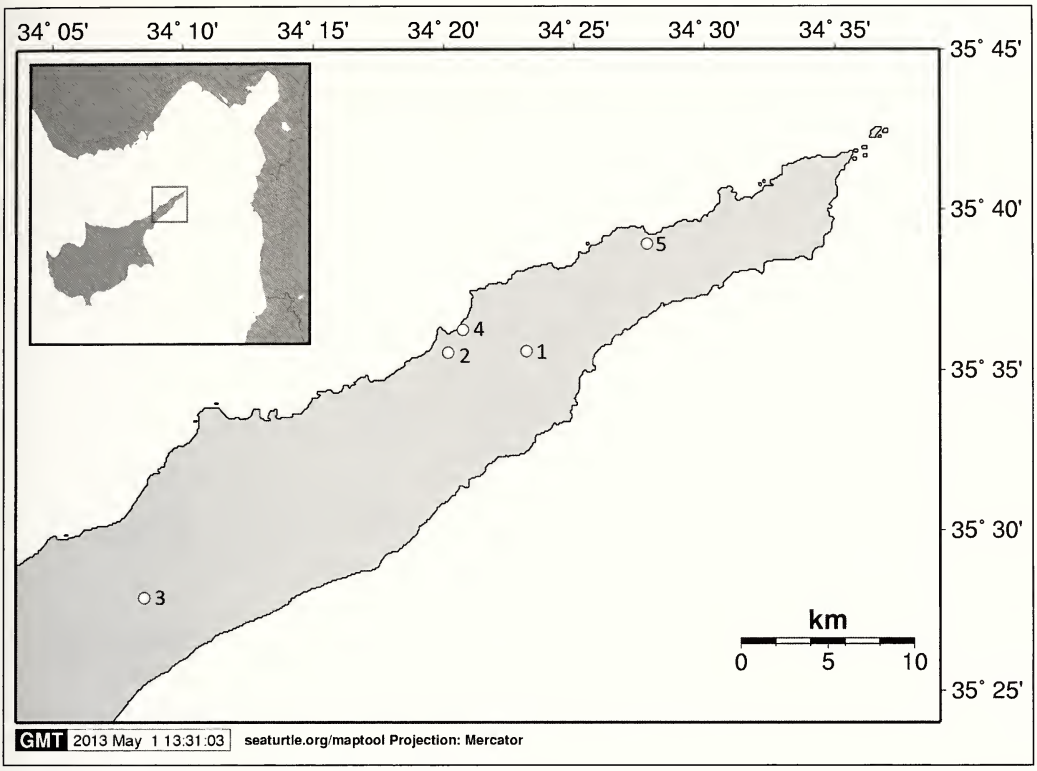

Fig. 1. Numbered open circles (○) provide the location points for each butterfly-survey transect within the Karpaz Peninsula.

(Asteraceae), *Helianthemum obtusifolium* Dunal (Cistaceae) and *Ophrys kotschyi* (Orchidaceae).

According to local records, the average annual rainfall in the area is 455–506 mm. The highest rainfall occurs during December–January. The average temperature is 20°C in the region (Yeni Erenkoy Meterological Station).

The census procedure used for this research was the Pollard Walk method, as described by Pollard (1977) and Royer et al. (1998). Five Pollard walk transects were established across the Karpaz Peninsula during this project (Fig. 1.). Transects of a fixed length (1 km) were walked and adult butterflies recorded. All transects were carried out at the optimum time of the day for seeing butterflies (11.00–13.00 hours), on warm sunny days at temperatures of 24–28°C, with little or no wind (Beaufort force 0–2) and all transects were below 130 metres elevation. Transects were chosen to cover a range of habitat types. Plant identifications were carried out during transect selection. Butterflies nectaring on plants and those in flight were counted and identified. If the exact identification of the species was not possible, a butterfly net was used to capture those butterflies in question, in order to facilitate field identification using the available literature (Makris 2003; Tolman & Lewington 1997). After identification, captured butterflies were released at their point of capture. In addition, butterflies nectaring on plants were recorded together with the plant species.

Tab. 1. Transects and habitat classifications for each transect

Transect number	coordinates	EU habitat type	EUNIS habitat type	Common flowering plants	Habitat definition
1	35,59293 N 34,38642 E	0	J2 Low density buildings	*Onopordum cyprium*, *Chrysanthemum crononarium*	Village Area
2	35,59206 N 34,33646 E	5210 Arborescent matorral with *Juniperus* spp.	0	*Cistus* spp., *Thymus capitatus*	Arborescent matorral
3	35,46469 N 34,14230 E	0	E 2.6 Agriculturally-improved, re-seeded and heavily fertilized grassland, including sports fields and grass lawns	*Centaurea hyalolepis*, *Onopordum cyprium*	Agricultural area
4	35,60391 N 34,34566 E	5420 *Sarcopterium spinosum* phryganas	C2 Surface running waters	Few *Cistus* spp. and *Onopordum cyprium*	Phrygana
5	35,64884 N 34,46318 E	5210 Arborescent matorral with *Juniperus* spp.	0	*Cistus* spp.	Arborescent matorral

Transect 1 was established within the Dipkarpaz village, and the transect was walked along the house garden edges which were mainly dominated by *Onopordum cyprium* Eig (Asteraceae), *Chrysanthemum coronarium* L. (Asteraceae), *Cistus creticus* L. (Cistaceae) and grassy patches. Transect 2 was established in the arborescent matorral with *Juniperus* habitat. The habitat was dominated by *Pistacia lentiscus*, *Juniperus phoenicea* and *Cistus salviifolius* L. (Cistaceae) with small grassland patches. Transect 3 was established along the edge of the field crop (wheat and barley) growing area. The vegetation was dominated by *Centaurea hyalolepis* Boiss. (Asteraceae) and *Onopordum cyprium*. Transect 4 was established along the Ronnas River and vegetation was dominated by *Pistacia lentiscus*. Transect 5 was established within the arborescent matorral with *Juniperus* habitat. The habitat was dominated by *Juniperus phoenicea*, *Pistacia lentiscus* and *Calicotome villosa* (Poir.) Link (Fabaceae) (Tab. 1, Fig. 1).

The plant species were identified using Viney (1994) as a reference. In addition, for each transect site the existing habitat type was also identified according to the Interpretation Manual of European Union Habitats and EUNIS habitat classification (Tab. 1) (Davies et al. 2004; European Commission 2007b).

Results and Discussion

Butterfly abundance and species richness were studied in different habitat types within the Karpaz Peninsula. During the surveys, a total of 169 individual butterflies from

Tab. 2. Butterfly species and their total abundance observed in different habitats. T = Transect.

Species Name	Village area (T 1)	Arborescent matorral (T 2 and T 5)	Agricultural area (T 3)	Phrygana (T 4)	Total number
Pieris rapae	0	0	8	0	8
Colias crocea	0	0	3	2	5
Gegenes pumilio	2	0	0	0	2
Glaucopsyche paphos	4	9	0	5	18
Gonepteryx cleopatra	1	0	1	5	7
Maniola cypricola	0	11	39	10	60
Papilio machaon	1	0	0	3	4
Pieris brassicae	7	5	4	1	17
Thymelicus acteon	0	0	15	12	27
Vanessa cardui	1	3	16	0	20
Vanessa atalanta	1	0	0	0	1
Total Abundance	17	28	86	38	169
Total Species	7	4	7	7	11

11 species were recorded across the five transects in the Karpaz Peninsula region of Cyprus. Surprisingly, the highest number of butterflies (86) was recorded from agricultural habitat, especially high abundance of the endemic species *Maniola cypricola*. Most of the individuals recorded from farmland habitat were nectaring on *Centaurea hyalolepis* along the field margins. Flower-rich field margins may be crucial for spring-flying butterflies (Dover 1989), as nectar feeding increases individual longevity, female fecundity and patterns of oviposition in local populations (Erhardt & Mevi-Schütz 2009; Stefanescu & Traveset 2009). An important factor behind butterfly losses is the loss of flower-rich habitats from open farmlands (Nilsson et al. 2008).

The second highest number of butterflies (38) was recorded from *Sarcopoterium spinosum* phrygana habitat (EU Annex I 5420) from the Ronnas River area. *Sarcopoterium* phryganas are low thorny shrub-like formations within the thermo-Mediterranean zone of Aegean islands, Greece, Coastal Anatolia and Cyprus. This habitat type harbours many flowering and aromatic plant species such as *Thymus capitatus*, *Cistus creticus*, *Cistus salviifolius* and *Teucrium* spp. (Lamiaceae) (EC 2007b). In particular *Cistus* spp. and *Teucrium* spp. are important butterfly nectar sources in Cyprus (Özden & Hodgson 2011). Species richness of butterflies was similar within four transects apart from the species-poor arborescent matorral habitat transect (Tab. 2).

Maniola cypricola (60), *Thymelicus acteon* (Rottemburg, 1775) (27) and *Vanessa cardui* (Linnaeus, 1758) (20) were the three most abundant species observed from different transects. The endemic *M. cypricola* was recorded from arborescent matorral, phrygana habitats and agricultural farmlands but not from the village area. This observation was interesting, because *M. cypricola* is a very common species across Cyprus (Özden et al. 2008; Özden & Hodgson 2011). Natural habitats and field margins may provide suitable habitat for this species; however, this limited data cannot be considered conclusive. As expected, the generalist *Pieris brassicae* (Linneaus, 1758) was recorded from all types of habitats (Tab. 2).

Tab. 3. Number of butterflies recorded while nectaring on different plant species. * – A total of 32 *Maniola cypricola* was recorded on *C. hyalolepis* from agricultural area. ** – A total of 14 (all) *Thymelicus acteon* was recorded on *C. hyalolepis* from agricultural area. *** – A total of 16 *Vanessa cardui* was recorded on *C. hyalolepis* from agricultural area.

Species Name	*Onopordum cyprium*	*Cistus creticus*	*Centaurea hyalolepis*	*Genista sphaceleata*
Pieris rapae	0	0	8	0
Colias crocea	0	0	3	0
Gegenes pumilio	2	0	0	0
Glaucopsyche paphos	0	2	4	5
Gonepteryx cleopatra	0	0	0	0
Maniola cypricola	2	3	33 *	0
Papilio machaon	1	0	0	0
Pieris brassicae	1	0	3	0
Thymelicus acteon	0	2	14**	0
Vanessa cardui	0	0	17***	0
Vanessa atalanta	0	1	0	0
Total Numbers	6	8	82	5

Regarding nectaring records, the highest number of butterflies utilised *Centaurea hyalolepis* (82 individuals) as a source of nectar. *Thymelicus acteon* was also recorded nectaring on *Centaurea hyalolepis* (Tab. 3). *T. acteon* is considered as a Near Threatened species at the European level (van Swaay et al. 2010). Plants of the genus *Centaurea* are widely regarded as providing a good source of nectar. The high nectar yield of plants in this genus makes it very attractive to insects, especially butterflies (Wackers et al. 2005). *Centaurea hyalolepis* is spreading annually or biennially reaching a height of 60 cm and is much-branched; it is a common plant throughout northern Cyprus, flowering from April to July.

Conclusion

In conclusion, the results presented in this paper provide valuable information on Cypriot butterflies and their close relationship with different habitat types within the Karpaz Peninsula. Further research is needed in order to discover which plant species are preferred sources of nectar for butterflies over a longer time frame.

Observations of butterfly behaviour have revealed that the flora of the field margins provides rich nectar sources for butterflies in Karpaz. Therefore, local authorities should be made aware of the importance of field margins in cereal farmlands and this information should be used when implementing the management plans of the EU Habitats Directive within the agricultural farmland ecosystems of Karpaz Special Protected Area. Also, for the future protection of special biodiversity-rich habitats, unnecessary road improvements along with uncontrolled building constructions should be excluded from this area.

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