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Flower visitation patterns of butterflies and burnet moths in the Aggtelek-Karst (Hungary)

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Summary. The article is based on the results of a series of observations in the Aggtelek-Karst (northern Hungary) over several years. The plant species in the survey area, the butterfly species visiting these plants and the number of visits are recorded.

Zusammenfassung. Der Aufsatz arbeitet eine Beobachtung-Serie von mehr Jahre aus, die wir an dem Berg Aggteleki-karszt (Nordhungarien) gemacht haben. Wir haben an dem herauswählenden Gelände die Schmetterlingbesucher, beziehungsweise die Zahl der Besuchung registriert.

Résumé. L'article est basé sur les résultats d'une série d'observations faites dans la région karstique d'Aggtelek (nord de la Hongrie), étalées sur plusieurs années. Les espèces végétales de la région étudiée, les espèces de papillons visitant ces plantes et le nombre de visites sont enregistrés.

Key words: Butterflies, plants, flower visits, nectar supply, pollination, Hungary.

Introduction

Observations during several years can generate an important information about the plants of a given survey area, the composition of its butterfly fauna, as well as diversity and changes in diversity within the area. Every population is part of a community. Regarding the population of pollinators and the plants visited by them, the quality and quantity of resources (i.e. nectar producing plants) used is determined by the presence of nectar producing plants (Gonseth, 1992). Flowering plants should ensure the energy requirements of visitors. Visitors search for the most suitable sources, and their choice for a flower is dependent on many factors, such as:

- The size of the population of flowering plants. If this is not large enough there will not exist a stable pollination system (Vogel & Westerkamp, 1991);
- The colour, smell, shape etc. of the flower (Harborne, 1982);
- The position of nectary, thus the accessibility of nectar.

Methods

The study area is the Aggtelek-Karst (northern Hungary, 48° 28′ 36″ N, 20° 33′ 38″ E). The surveys were carried out between 1990 and 1994, during each July, every day between 8 a.m. and 6 p.m., because flower visitors are most active during this time (Gonseth, 1992; Olesen & Warncke, 1989). The flora of the area can be described as Polygalo-Brachypodetum and Caricetum humilis in the group of Cirsio-Brachypodion association. Dominant species in this area are for example: *Dorycnium germanicum, Coronilla varia, Teucrium chamaedrys, T. montanum, Salvia verticillata, Stachys recta, Centaurea scabiosa, Inula salicina, I. ensifolia, Carex humilis* etc. With the strating bordering, rimming (Versaumung), *Brachypodium pinnatum, Carex montana* and sprouting dicotyledons covering as much as 50% in patchwork. There are several important and protected species, such as *Dracocephalum austriacum, Adonis vernalis, Centaurea triumfetti, Polygala major, Cirsium pannonicum, Cytisus procumbens* etc. The original climax vegetation here must have been Querco-Carpinetum and Corno-Quercetum, and larger or smaller areas of these plant associations can still be found in many places in similar situations.

Results and discussion

Table 1 gives a list of selected plant species visited by butterflies in the Aggtelek-Karst. Visited plants are arranged in 5 columns by the number of contacts: the first four contain the species of the main four families while the fifth gives plant families, some species of which were rarely visited. We have examined, regarding all of the contacts, if there were annual differences in the visits to the different plant families and in the number of butterfly visits. The results show that there are significant differences in both. (Plant families: ANOVA, $F_{[4,20]} = 4.43$, $p = 0{,}01$; butterfly families: ANOVA, $F_{[4,20]} = 2.87$, $p = 0{,}01$).

Forty-one plant species were used by the butterflies in the Aggtelek-Karst. Table 2 shows the 10 most frequently visited plant species in decreasing order. At the same time these plants are the most abundant in the study area, especially the first four

Table 1. Flowering plants chosen by butterflies and burnet moths in the Aggtelek-Karst (Hungary), 1990–1994 (nomenclature of the Lepidoptera following Karsholt & Razowski, 1996)

LEPIDOPTERA	ASTERACEAE	FABACEAE	DIPSACACEAE	LABIATAE	OTHER
Erynnis tages (Linnaeus, 1758)	Carduus acanthoides 1 *Centaurea scabiosa* 12		*Dipsacus laciniatus* 1 *Scabiosa ochroleuca* 2	*Origanum vulgare* 1	
Pyrgus malvae (Linnaeus, 1758)	*Centaurea scabiosa* 3 *Inula ensifolia* 6		*Scabiosa ochroleuca* 3		
Thymelicus lineola (Ochsenheimer, 1808)	*Achillea millefolium* 1 *Carduus acaanthoides* 1 *Centaurea scabiosa* 3 *Inula ensifolia* 15	*Cytisus albus* 2	*Knautia arvensis* 1		*Linum hirsutum* 6
T. sylvestris (Poda, 1761)	*Achillea millefolium* 1 *Anthemis tinctoria* 4 *Carduus acanthoides* 4 *Centaurea scabiosa* 2 *Inula ensifolia* 9 *I. hirta* 7	*Coronilla coronata* 1 *Trifolium pratense* 1	*Knautia arvensis* 2		
Hesperia comma (Linnaeus, 1758)	*Carduus acanthoides* 26 *Centaurea scabiosa* 1		*Knautia arvensis* 4 *Scabiosa ochroleuca* 4	*Betonica officinalis* 3	
Ochlodes venata (Bremer & Grey, 1853)	*Anthemis tinctoria* 1 *Carduus acanthoides* 21 *Centaurea scabiosa* 7 *Chrysanthemum corymbosum* 1 *Cirsium arvense* 1 *Inula ensifolia* 23 *I. hirta* 3	*Cytisus albus* 3 *Medicago lupulina* 1	*Knautia arvensis* 5 *Scabiosa ochroleuca* 9	*Betonica officinalis* 4	*Convolvulus arvensis* 1
Iphiclides podalirius (Linnaeus, 1758)	*Carduus acanthoides* 25 *Centaurea scabiosa* 1				*Echium vulgare* 1 *Sambucus ebulus* 3
Leptidea sinapis (Linnaeus, 1758)		*Cytisus albus* 2 *Dorycnium germanicum* 1 *Medicago lupulina* 1 *Trifolium pratense* 1		*Origanum vulgare* 1	*Dianthus pontederae* 1
Colias alfacariensis Ribbe, 1905	*Anthemis tinctoria* 1 *Carduus acanthoides* 1 *Centaurea scabiosa* 2 *Cirsium arvense* 3 *Inula ensifolia* 2	*Trifolium pratense* 1	*Knautia arvensis* 1 *Scabiosa ochroleuca* 8		
C. hyale (Linnaeus, 1758)	*Carduus acanthoides* 9 *Cirsium arvense* 2		*Knautia arvensis* 1 *Scabiosa ochroleuca* 2		*Linum hirsutum* 1
Pieris brassicae (Linnaeus, 1758)	*Carduus acanthoides* 8			*Salvia officinalis* 1	*Chenopodium vulgare* 1 *Sambucus ebulus* 6
P. napi (Linnaeus, 1758)	*Inula hirta* 1	*Trifolium pratense* 1			*Sambucus ebulus* 3

P. rapae (Linnaeus, 1758)	*Carduus acanthoides* 8 *Centaurea scabiosa* 1 *Inula ensifolia* 4		*Knautia arvensis* 5 *Scabiosa ochroleuca* 3	*Origanum vulgare* 5	
Pontia daplidice (Linnaeus, 1758)	*Carduus acanthoides* 1 *Centaurea scabiosa* 1		*Knautia arvensis* 1 *Scabiosa ochroleuca* 3		
Lycaena dispar (Haworth, 1802)	*Cirsium arvense* 2 *Inula ensifolia* 10			*Mentha aquatica* 3	
L. virgaureae (Linnaeus, 1758)	*Achillea millefolium* 1 *Anthemis tinctoria* 8 *Chrysanthemum corymbosum* 3 *C. leucanthemum* 2 *Inula ensifolia* 12 *I. hirta* 16			*Origanum vulgare* 1	
L. tityrus (Poda, 1761)	*Inula ensifolia* 4				
Callophrys rubi (Linnaeus, 1758)		*Cytisus albus* 1		*Betonica officinalis* 2	
Satyrium w-album (Knoch, 1782)	*Centaurea scabiosa* 1			*Origanum vulgare* 7	
S. spini ([Denis & Schiffermüller], 1775)	*Achillea millefolium* 1 *Inula ensifolia* 1 *I. hirta* 2				
S. acaciae (Fabricius, 1787)	*Anthemis tinctoria* 6 *Chrysanthemum corymbosum* 2 *Inula hirta* 1				
Cupido minimus (Fuessly, 1775)	*Inula ensifolia* 1	*Medicago lupulina* 5			
C. argiades (Pallas, 1771)	*Inula ensifolia* 16				
C. alcetas (Hoffmannsegg, 1804)		*Medicago lupulina* 1		*Salvia verticillata* 1	
Plebeius argus (Linnaeus, 1758)	*Centaurea scabiosa* 2 *Inula ensifolia* 5				
P. idas (Linnaeus, 1761)	*Centaurea scabiosa* 39 *Cirsium arvense* 2 *Inula ensifolia* 1	*Cytisus austriacus* 1 *Dorycnium germanicum* 2 *Medicago lupulina* 2 *Trifolium pratense* 1		*Origanum vulgare* 1	
P. argyrognomon (Bergsträsser, 1779)	*Centaurea scabiosa* 1 *Inula ensifolia* 32				
Aricia artaxerxes (Fabricius, 1793)	*Inula ensifolia* 1	*Lotus coniculatus* 1			
Polyommatus icarus (Rottemburg, 1775)	*Anthemis tinctoria* 2 *Centaurea scabiosa* 62 *Inula ensifolia* 1	*Cytisus albus* 1 *Coronilla coronata* 2 *Dorycnium germanicum* 1 *Lotus corniculatus* 3	*Knautia arvensis* 1 *Scabiosa ochroleuca* 2	*Origanum vulgare* 1	*Dianthus pontederae* 2 *Sambucus ebulus* 2
Meleageria bellargus (Rottemburg, 1775)	*Achillea millefolium* 1 *Centaurea scabiosa* 15 *Inula ensifolia* 20			*Salvia verticillata* 1	
M. coridon (Poda, 1761)	*Achillea millefolium* 1 *Carduus acanthoides* 1 *Centaurea scabiosa* 9 *Inula ensifolia* 2		*Knautia arvensis* 2 *Scabiosa ochroleuca* 1	*Origanum vulgare* 3	
Argynnis paphia (Linnaeus, 1758)	*Carduus acanthoides* 6 *Cirsium arvense* 2 *Eupatorium cannabinum* 3		*Metha aquatica* 13	*Saambucus ebulus* 30	

LEPIDOPTERA	ASTERACEAE	FABACEAE	DIPSACACEAE	LABIATAE	OTHER
A. adippe ([Denis & Schiffermüller], 1775)	*Carduus acanthoides* 13 *Centaurea scabiosa* 3			*Mentha aquatica* 11	*Sambucus ebulus* 11
A. niobe (Linnaeus, 1758)	*Carduus acanthoides* 23 *Centaurea scabiosa* 1 *Cirsium arvense* 1				
Issoria lathonia (Linnaeus, 1758)	*Carduus acanthoides* 1		*Knautia arvensis* 1		
Brenthis ino (Rottemburg, 1775)	*Achillea millefolium* 1 *Inula ensifolia* 5 *I. hirta* 3		*Knautia arvensis* 5		*Dianthus pontederae* 1
B. hecate ([Denis & Schiffermüller], 1775)	*Achillea millefolium* 1 *Anthemis tinctoria* 2 *Centaurea scabiosa* 4 *Chrysanthemum corymbosum* 1 *Inula ensifolia* 17 *I. hirta* 1	*Dorycnium germanicum* 9	*Knautia arvensis* 4		*Cynanchum vincetoxicum* 1
Boloria dia (Linnaeus, 1767)	*Inula ensifolia* 5		*Knautia arvensis* 3 *Scabiosa ochroleuca* 2		
Melitaea didyma (Esper, 1778)	*Anthemis tinctoria* 1 *Carduus acanthoides* 2 *Centaurea scabiosa* 22 *Cirsium arvense* *Inula ensifolia* 28 *I. hirta* 2	*Dorycnium germanicum* 1	*Knautia arvensis* 1 *Scabiosa ochroleuca* 4	*Salvia verticillata* 3	*Dianthus pontederae* 4 *Erysium odoratum* 1 *Teucrium chamaedris* 1
M. aurelia Nickerl, 1850	*Achillea millefolium* 1 *Centaurea scabiosa* 6 *Chrysanthemum corymbosum* 2 *Inula ensifolia* 64 *I. hirta* 9	*Coronilla varia* 3 *Dorycnium germanicum* 20 *Trifolium pannonicum* 9	*Knautia arvensis* 11	*Salvia verticillata* 5 *Dianthus pontederae* 2	*Cynanchum vincetoxicum* 6
M. britomartis Assmann, 1847	*Achillea millefolium* 1 *Centaurea scabiosa* 6 *Chrysanthemum corymbosum* 3 *Cirsium arvense* 2 *Inula ensifolia* 47 *I. hirta* 4	*Dorycnium germanicum* 12 *Trifolium rubens* 1	*Knautia arvensis* 9 *Scabiosa ochroleuca* 1		*Cynanchum vincetoxicum* 1 *Dianthus pontederae* 1
M. athalia (Rottemburg, 1775)	*Achillea millefolium* 3 *Anthemis tinctoria* 4 *Centaurea scabiosa* 11 *Chrysanthemum corymbosum* 5 *Cirsium arvense* 3 *Inula ensifolia* 78 *I. hirta* 31	*Coronilla coronata* 4 *Dorycnium germanicum* 7 *Trifolium pannonicum* 10	*Knautia arvensis* 16 *Scabiosa ochroleuca* 1	*Origanum vulgare* 4 *Salvia verticillata* 3	*Cynanchum vincetoxicum* 2
Lopinga achine (Scopoli, 1763)	*Centaurea scabiosa* 1 *Inula ensifolia* 6			*Mentha aquatica* 12	

Coenonympha arcania (Linnaeus, 1761)	*Centaurea scabiosa* 4 *Cirsium arvense* 14 *Inula ensifolia* 41	*Medicago falcata* 1 *Trifolium rubens* 2		*Betonica officinalis* 3 *Mentha aquatica* 9	
C. glycerion (Borkhausen, 1788)	*Centaurea scabiosa* 21 *Cirsium arvense* 1 *Inula ensifolia* 15	*Dorycnium germanicum* 5	*Knautia arvensis* 1	*Salvia verticillata* 1	
Coenonympha sp. *C. pamphilus* (Linnaeus, 1758)	*Inula ensifolia* 1 *Cirsium arvense* 9		*Scabiosa ochroleuca* 1	*Betonica officinalis* 2	*Dianthus pontederae* 2
Aphantopus hyperantus (Linnaeus, 1758)	*Centaurea scabiosa* 1 *Inula ensifolia* 10		*Knautia arvensis* 2		
Maniola jurtina (Linnaeus, 1758)	*Achillea millefolium* 1 *Anthemis tinctoria* 1 *Carduus acanthoides* 104 *Centaurea scabiosa* 161 *Cirsium arvense* 33 *Chrysanthemum corymbosum* 1 *Inula ensifolia* 286 *I. salicina* 10	*Coronilla coronata* 2 *Dorycnium germanicum* 1 *Trifolium pratense* 4	*Knautia arvensis* 45 *Scabiosa ochroleuca* 12	*Betonica officinalis* 5 *Mentha aquatica* 15 *Origanum vulgare* 9 *Salvia verticillata* 1	*Convolvulus arvensis* 1 *Dianthus pontederae* 8 *Helianthemum ovatum* 1 *Sambucus ebulus* 25
Melanargia galathea (Linnaeus, 1758)	*Achillea millefolium* 1 *Carduus acanthoides* 22 *Centaurea scabiosa* 85 *Cirsium arvense* 4 *Inula ensifolia* 30 *I. hirta* 4	*Coronilla varia* 5 *Cytisus albus* 3 *Dorycnium germanicum* 3 *Trifolium pratense* 4	*Knautia arvensis* 16 *Scabiosa ochroleuca* 2	*Veronica officinalis* 1	*Cynanchum vincetoxicum* 1 *Dianthus pontederae* 9
Minois dryas (Scopoli, 1763)	*Carduus acanthoides* 8 *Centaurea scabiosa* 1 *Cirsium arvense* 4 *Inula ensifolia* 16			*Mentha aquatica* 1	*Sambucus ebulus* 2
Amata phegea (Linnaeus, 1758)	*Carduus acanthoides* 3 *Centaurea scabiosa* 3 *Inula ensifolia* 1			*Origanum vulgare* 1	
Zygaena purpuralis (Brünnich, 1763)	*Carduus acanthoides* 2 *Centaurea scabiosa* 26 *Cirsium arvense* 1		*Knautia arvensis* 2	*Origanum vulgare* 1	*Dianthus pontederae* 1
Z. carniolica (Scopoli, 1763)	*Carduus acanthoides* 1 *Centaurea scabiosa* 60 *Cirsium arvense* 2 *Inula ensifolia* 2		*Knautia arvensis* 15 *Scabiosa ochroleuca* 5	*Salvia verticillata* 2	
Z. viciae ([Denis & Schiffermüller], 1775)	*Achillea millefolium* 2 *Centaurea scabiosa* 2 *Inula ensifolia* 2		*Knautia arvensis* 1	*Salvia verticillata* 1	
Z. filipendulae (Linnaeus, 1758)	*Carduus acanthoides* 25 *Centaurea scabiosa* 40 *Cirsium arvense* 6 *Inula ensifolia* 7		*Knautia arvensis* 45 *Scabiosa ochroleuca* 8	*Betonica officinalis* 2 *Origanum vulgare* 2	*Dianthus pontederae* 1
Z. lonicerae (Scheven, 1777)	*Centaurea scabiosa* 1 *Chrysanthemum corymbosum* 1 *Inula ensifolia* 2		*Knautia arvensis* 3	*Betonica officinalis* 3	*Dianthus pontederae* 1

Table 2. Relative frequencies of visits on the different plant species (prf) and number of visiting butterfly species / visits on the different plant species (pv/vp)

Most frequently visited plants	prf	pv/vp
1. *Inula ensifolia*	0.33	0.045
2. *Centaurea scabiosa*	0.257	0.058
3. *Carduus acanthoides*	0.129	0.075
4. *Knautia arvensis*	0.0826	0.133
5. *Cirsium arvense*	0.0375	0.206
6. *Inula hirta*	0.0342	0.155
7. *Sambucus ebulus*	0.0334	0.097
8. *Scabiosa ochroleuca*	0.0297	0.26
9. *Mentha aqutica*	0.026	0.109
10. *Dorycnium germanicum*	0.0252	0.177

(*Inula ensifolia, Centaurea scabiosa, Carduus acanthoides, Knautia arvensis*). This fact has a significant effect on food searching behaviour of butterflies. Colours of the plants mentioned above are mostly lilac or purple and, more rarely, yellow or white. These data agree with our knowledge concerning the colour selectivity of insects (Harborne, 1982; Jolivet, 1986). Besides, these plants are robust and tall, which could also have importance for food-recognition of insects (Porter *et al.*, 1992). Table 2 shows the relative frequencies of visits on the different plant species (prf) and the ratio of the number of the visiting butterflies to the number of the visits on the different plant species. These values (pv/vp) show how many butterfly species were responsible for the contacts. Thus, for example, on *Cirsium arvense* and *Scabiosa ochroleuca* fewer visits were paid by more butterfly species, and on the first three plant species more visits were paid by fewer butterfly species.

The family Asteraceae dominated throughout the survey period (over 50% in every year), especially in 1991 (87.4%) and 1994 (79.46%). This is the most species-rich plant group — they are present on almost all continents and habitats. Thus, they provide enough food for numerous flower visitors. Their lack or decrease in the area would substantially affect species composition of the insects.

Changes in flower visits were identified at family level between 1990 and 1994. In 1990, species of Nymphalinae were the main flower visitors while in 1994, by a gradual process, the Satyrinae

had become main visitors. Regarding the vegetation of the study area the main feature is the expansion of *Brachypodium pinnatum*, which surpasses that of important nectar-producing plants. This phenomenon can provide explanation for the dominance changes in flower visits mentioned above. Butterfly-indication shows clearly the absence or decrease in those plant species that are their main nectar sources. With some exceptions, nectar plant specialisation is not characteristic for butterflies. Although the Asteraceae are the preferred plant family among butterflies, this does not mean that other plant families are not visited by them. The preference for Asteraceae lies in the shape of their inflorescence. The heads of their flowers serve as an appropriate roost for butterflies, and after landing they only have to reach out for nectar. As flower heads (capitulum) of the Asteraceae contain many flowers, the amount of nectar is enough to satisfy the appetite of visitors. Nectary is usually present at the base of the flower, at the base of the style or between the pistil and stamen. The shape of butterflies prevents them from climbing into the flower as in the case of bees.

Regarding the butterfly species, the main visitor was *Maniola jurtina* (on 21 plant species 726 contacts were registered). Its food plant list observed by us is more or less the same as previously indicated in the literature (Gonseth, 1992; Weidemann, 1995). Ebert & Rennwald (1991) have listed 65 out of 164 plant species known to occur in Baden-Württemberg. In contrast to the Meadow Brown, the Lycaenidae pay the fewest visits. This supports, on one hand, a hypothesis that the quality of the vegetation in the study area has an influence on the presence of butterflies. On the other hand, it is well known that the Lycaenidae prefer fewer nectar-producing plants. Most species of this butterfly family occupy a large range and can be found in many kinds of plant associations. In contrast to this, there are many species among the Lycaenidae and Nymphalinae that are more confined to plant associations. Thus, the disappearance of important food sources could affect their distribution pattern. Choice of food plants by butterflies depends on different factors. Thus, for example, *Melanargia galathea* chooses plants with lilac or purple flowers, species of Papilionidae (*Iphiclides podalirius*) and Nymphalinae (*Argynnis paphia, A. adippe, A. niobe, Issoria*

lathonia) prefer robust plants overhanging the vegetation cover in their habitat (*Centaurea scabiosa, Carduus acanthoides*, etc.).

Conclusions

Several plant species can be ranked as food plants (nectar sources) of butterflies. An important factor is the availability of plants in a given area. The continuous — year by year — presence of these plant species also has certain effects on the pollinator-population. We cannot find a unified methodology to explain the food plant choice of butterflies. Depending on the circumstances, these insects prefer the different food sources. That is why it is so important to take into consideration their indicative role, they can be pollinators only when the food plant is present.

References

Ebert, G. & Rennwald, E. (eds.), 1991. Die Schmetterlinge Baden-Württembergs, Bd.I.–II. — Eugen Ulmer, Stuttgart. 552 S. (Bd. I) + 535 S. (Bd. II).

Gonseth, Y., 1992. Relations observées entre Lépidoptères diurnes adultes (Lepidoptera, Rhopalocera) et plantes nectarifères dans le Jura occidental. — *Nota lepid.* 2: 106–122.

Harborne, J. B., 1982. Introduction to Ecological Biochemistry. — Academic Press, London.

Jolivet, P., 1986. Insects and plants. Flora & fauna handbook, no. 2. — E. J. Brill Flora & Fauna Publications, USA.

Karsholt, O. & Razowski, J. (eds.), 1996. The Lepidoptera of Europe. A Distributional Checklist. — Apollo Books, Stenstrup. 380 p.

Olesen, J. M. & Warncke, E., 1989. Flowering and seasonal changes in flower sex ratio and frequency of flower visitors in a population of *Saxifraga hirculus*. — *Holarctic Ecology* 12: 21–30.

Porter, K., Steel, C. A. & Thomas, J. A. 1992. Butterflies and communities. *In*: Dennis R. L. H. (ed.). The Ecology of Butterflies in Britain. — University Press, Oxford, New York, Tokyo. pp. 139–177.

Vogel, S. & Westerkamp, C., 1991. Pollination: an integrating factor of biocenoses, species conservation: a population-biological approach. — Birkhauser Verlag, Basel. pp. 159–170.

Weidemann, H. J., 1995. Tagfalter beobachten, bestimmen. 2. Auflage. — Naturbuch-Vlg., Augsburg. 659 S.