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Is the Great Banded Grayling [*Brintesia circe* (FABRICIUS 1775)] (Lepidoptera, Nymphalidae) a stenotopic species?

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A b s t r a c t : The Great Banded Grayling [*Brintesia circe* (FABRICIUS 1775)] has been considered as a species associated with xerothermic habitats. We counted adults and collected caterpillars of the butterfly in the four different habitats belonging to the alliance Arrhenatherion elatioris: (1) extensive meadows mown once a year in extensive orchards, (2) extensive meadows mown twice a year in extensive orchards, (3) meadows in intensive orchards abandoned 15 years ago, (4) ecotones represented by oak-hornbeam forests and extensive orchards mown once a year. The habitats were located in Central Slovakia. Adults were recorded by transect method in 2003, 2004 and 2005, caterpillars by sweeping vegetation in 2005 and 2006. Adults were registered in each habitat every year, except for meadows in abandoned intensive orchards in 2004. The highest abundance of adults was recorded in ecotones, but the differences among the habitats compared were not significant. Also, caterpillars were found in each habitat in both years. There were found no significant differences in their abundance among the habitats. Our results have proved that the larval development also occurs outside typical xerothermic habitats. Thus, meadows in extensively managed orchards could be considered as suitable substitute habitats for *B. circe*.

K e y w o r d s : *Brintesia circe*, larval development, extensive meadows, orchards.

Introduction

In the 20-th century, the Great Banded Grayling [*Brintesia circe* (FABRICIUS 1775)] occurred in Central Europe in xerothermic habitats (SCHWARZ 1948, BLAB & KUDRNA 1982, KOCH 1988, SBN 1987, EBERT & RENNWALD 1991, BENEŠ et al. 2002) and its distribution was patchy in Central Europe. In the 20th century, the species disappeared at several sites in Central Europe (PALL & KRÁLÍČEK 1983, BENEŠ et al. 2002, KUDRNA 2002). Towards the end of the 20th century, it had spread to new localities. Adults occurred frequently also outside their characteristic habitats, in various types of meadows and forest edges (our unpublished data, GOTTWALD & BĚLÍN 2001, KONVIČKA et al. 2005). The question arises as to whether colonization of new habitats by adults is only accidental and temporary. Also, the answer is required if the habitats are sought by females to lay their eggs, and if larvae are developing in them. These questions have not yet been answered. The published results contain only a few observations of oviposition and small number of caterpillars of *B. circe* (cf. EBERT & RENNWALD 1991).

The paper is to show (1) whether *B. circe* occurring in the four selected grassland habi-

tats is also developing in these habitats, and (2) if meadows in extensively managed landscapes aimed to fruit trees cultivation represent suitable substitute habitats for the species.

Material and methods

Study habitats

The study was carried out in the surroundings of the town Nová Baňa, Central Slovakia (18° 38' 40" E, 48° 26' 20" N), at 350 m a.s.l. Meadows with mostly extensive managed orchards prevail in the territory. Four types of meadow habitats with the presence of adults of *B. circe* were selected. According to the Natura 2000 classification, they belong to the habitat No. 6510 (lowland hay meadows) (STANOVÁ & VALACHOVIČ 2002).

In extensively managed orchards, we selected two habitats: (1) extensive meadows mown once a year, (2) extensive meadows mown twice a year. Meadows in the former habitat are mown in late June or July, meadows in the latter habitat in late May to early June (in flowering time of *Leucanthemum vulgare*) and at the end of July or in August. Meadows in both habitats belong to the alliance Arrhenatherion elatioris W. KOCH 1926. They are composed of the following predominant plants: *Poa pratensis*, *Holcus lanatus*, *Anthoxanthum odoratum*, *Alopecurus pratensis*, *Arrhenatherum elatius*, *Dactylis glomerata*, *Bromus erectus*, *Acetosella vulgaris*, *Trisetum flavescens*, *Festuca pratensis*, etc. Fruit trees (mostly apple trees) in these localities are tall-trunked, 50-80 years old, planted at a distance of 10-20 m, with canopy cover approximately 15 %. The third habitat was represented by meadows in intensive orchards abandoned 15 years ago. It was established in the early 1980s. Mowing and applying artificial fertilisers stopped 15 years ago. Meadows belong to the alliance Arrhenatherion elatioris W. KOCH 1926 and show signs of ruderalisation (occurrence of *Calamagrostis epigejos*, *Melilotus albus*, *Elytrigia repens*). The apple trees grow on terraces. They are approximately 25 years old, low-trunked, planted at a distance of 5 m. Canopy cover is approximately 40 %. The fourth habitat (ecotones) is represented by a transitional zone between oak-hornbeam forests and extensively managed orchards mown once a year.

Counting adults and collecting caterpillars

Adults were recorded in the four habitats during the summer 2003, 2004 and 2005. In each habitat they were counted on seven independent, not overlapping stripe transects, 4 m wide and 50 m long each, that is, a total of 7 replicates were made. The transect method was used to count them (POLLARD & YATES 1993). The counts were made 4 times (4 days) between June 23 and August 29 in 2003; 7 times between July 1 and August 25 in 2004, and 6 times between July 7 and August 20 in 2005.

Caterpillars were obtained in May 2005 and 2006. We swept them from herbal vegetation before mowing. The sampling was performed between 10 and 12 p.m., because the older caterpillars are active at night (SCHWARZ 1948, EBERT & RENNWALD 1991, SBN 1987, PLJUSH et al. 2005). We used a circular sweeping net (diameter 35 cm, handle 1.5 m long). In each habitat caterpillars were collected in 10 replicates, on independent

transects (50 m long each), showing no overlap. A total of 60 sweepings were made on each transect. The sampled caterpillars were identified in nature, some were reared in the laboratory to verify their identity. Each habitat was sampled once in 2005 and four times in 2006.

The faunal data (number of adults) obtained from corresponding habitats of the four (in 2003), seven (in 2004) or six (in 2005) dates were pooled separately for each year. Thus, every year each habitat was represented by one data set (7 replicates). Similarly, number of larvae of the four dates in 2006 were pooled.

Statistical evaluation

We compared abundance of adults and larvae among the four habitats. Comparisons were made separately for each year. To test for differences among the habitats we resorted to non-parametric statistics (Kruskal-Wallis ANOVA test). Statistically significant differences were localized by multiply comparisons in K-W ANOVA (SOKAL & ROHLF 2000). Prior to this procedure, the data were tested for normality distribution (Shapiro-Wilk´s W-test) and homogeneity of variances (Levene´s test) (SOKAL & ROHLF 2000). The calculations were made using the program STATISTICA.

Results and discussion

A total of 93 adults *B. circe* were counted. They occurred in small numbers and were recorded in each habitat every year, except for meadows in abandoned orchards (habitat 3) in 2004 where the butterfly was not found at all. This habitat showed the lowest total number of adults contrasting the highest number in ecotones. However, this was not statistically significant [2003: $H(3, N=34) = 7{,}0527$, $P = 0{,}072$; 2004: $H(3, N= 34) = 13{,}154$, $P = 0{,}004$; 2005: $H(3, N = 34) = 4{,}3277$, $P = 0{,}228$, Kruskal-Wallis ANOVA].

A total of 45 caterpillars of *B. circe* were sampled. Similarly to adults, their density was low. This is typical for solitary caterpillars of large butterfly species. In both years caterpillars were found in all habitats. There were not detected any significant differences in their abundance among the habitats compared [2005: $H(3, N = 40) = 6{,}8665$, $P = 0{,}076$; 2006: $H(3, N = 40) = 1{,}7310$, $P = 0{,}630$, Kruskal-Wallis ANOVA].

Our results prove that the females lay their eggs not only in xerothermic habitats as mentioned in the literature (SBN 1987, EBERT & RENNWALD 1991). In the study area they occurred in Arrhenatherion elatioris meadows. In such habitats caterpillars overwintered successfully, and continued developing in the spring. Larval host plants (*Anthoxanthum odoratum*, *Bromus erectus*, grasses of genera *Festuca* and *Holcus*) (BLAB & KUDRNA 1982, SBN 1987, EBERT & RENNWALD 1991, PLJUSH et al. 2005) occurred in all the studied habitats.

It may be concluded that the Great Banded Grayling is not a typical stenotopic species in areas at the northern limit of its range. In addition to xerothermic biotopes (forest-steppes, rocky and sandy habitats, dry bushy and woodland habitats, rocky slopes, etc.) it occurs and takes its development in meadow habitats in both extensively managed and abandoned orchards and, highly likely, in some other meadow types too. According to our records made near Cachtice, Western Slovakia, in the 1970s, adults *B. circe* preferred

the topped parts of karst hills (unpublished results). Thus, behaviour of *B. circe* (hilltopping) is very similar to that of the Swallowtail (*Papilio machaon*). Fertilised females *B. circe* may spread to new habitats as known from Switzerland (SBN 1987). This may support the recovery of the butterfly to areas where it has become extinct.

Recent studies on distribution of some stenotopic insect species in Slovakia reveal their occurrence also in habitats not typical for them. This is well-documented, for example, by the occurrence of the butterflies *Lycaena dispar* (PANIGAJ 1999b) and *Argyronome laodice* (PANIGAJ 1999a) or bush crickets *Ruspolia nitidula* (KRIŠTÍN et al. 2007b) and *Gampsocleis glabra* (KRIŠTÍN et al. 2007a). The occurrence of the two butterfly species was studied focusing on adults. Therefore it is not clear as to whether their larvae are successfully developing in such "new habitats". The successful larval development of both bush cricket species was documented even in habitats which did not seem suitable for their occurrence. Another example is the Eastern Pale Clouded Yellow (*Colias erate*) known for its shifts in ecological requirements. It has extended its range to Central Europe preferring the fields of alfalfa (*Medicago sativa*) (BENEŠ et al. 2002, TIBENSKÝ & KULFAN 1999).

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Zusammenfassung

Der Weiße Waldportier [*Brintesia circe* (FABRICIUS 1775)] wird für eine an xerotherme Habitate gebundene Art gehalten. Wir haben Imagines registriert und die Raupen dieses Schmetterlings an vier Habitaten gesammelt, welche zum Verband Arrhenatherion elatioris gehören: (1) auf extensiven Wiesen einmal im Jahr gemäht, (2) auf extensiven Wiesen in extensiven Obstanlagen zweimal im Jahr gemäht, (3) auf Wiesen in früheren, jetzt schon 15 Jahre verlassenen intensiven Obstanlagen, (4) zwischen Eichen-Hainbuchenwäldern und extensiven nur einmal im Jahr gemähten Obstanlagen. Die Habitate befanden sich in der Mittelslowakei. Die Imagines wurden in den Jahren 2003, 2004 und 2005 mittels Transektmethode erfasst, die Raupen durch Streifen der Vegetation in den Jahren 2005 und 2006 gesammelt. Die Imagines wurden in allen Habitaten alljährlich mit Ausnahme der Wiesen in den verlassenen intensiven Obstanlagen in Jahre 2004 beobachtet. Die Raupen wurden in allen Habitaten und während beider Beobachtungsjahre festgestellt. Man verzeichnet jedoch keine signifikanten Unterschiede in deren Abundanz zwischen den einzelnen Habitaten. Unsere Resultate haben bewiesen, dass die Larvalentwicklung von *B. circe* außerhalb der typischen xerothermen Habitaten verlaufen kann. Die Wiesen in den extensiv bewirtschafteten Obstanlagen können somit für geeignete Ersatzhabitate von *B. circe* gehalten werden.

References

BENEŠ J., KONVIČKA M., DVOŘÁK J., FRIC Z., HAVELDA Z., PAVLÍČKO A., VRABEC V. & Z. WEIDENHOFFER (eds) (2002): Motýli České republiky: Rozšírení a ochrana I, II /Butterflies of the Czech Republic: Distribution and conservation I, II. — SOM, Praha: 1-857. [in Czech and English.]

BLAB J. & O. KUDRNA (1982): Hilfsprogramm für Schmetterlinge. — Kilda-Verlag, Greven: 1-135.

EBERT G. & E. RENNWALD (1991): Die Schmetterlinge Baden-Württembergs. Band 2: Tagfalter II. — Eugen Ulmer GMBH, Hohenheim: 1-535.

GOTTWALD A. & V. BĚLÍN (eds) (2001): Motýli Bílých a Bielych Karpat. (Lepidoptera of the White Carpathians Mts.). — Sborník Přírodovědného klubu v Uherském Hradišti, Supplementum 7, 1-153.[in Czech.]

KOCH M. (1988): Wir bestimmen Schmetterlinge. — Neumann Verlag, Leipzig, Radebeul: 1-792.

KONVIČKA M., BENEŠ J. & L. ČÍŽEK (2005): Ohrožený hmyz nelesních stanovišť: ochrana a management. (Endangered insects in non forest habitats: conservation and management.). — Sagittaria, Olomouc: 1-127. [in Czech.]

KRIŠTÍN A., KAŇUCH P., BALLA M. & V. GAVLAS (2007a): On distribution and ecology of *Gampsocleis glabra* and *Tettigonia caudata* (Orthoptera) in Slovakia. — Articulata **22**: 53-61.

KRIŠTÍN A., KAŇUCH P. & M. SÁROSSY (2007b): Distribution and ecology of *Ruspolia nitidula* (SCOPOLI 1786) and *Aiolopus thalassinus* (FABRICIUS 1781) (Orthoptera) in Slovakia. — Linzer biol. Beitr. **39** (1): 451-461.

KUDRNA O. (2002): The distribution atlas of European Butterflies. — Oedippus **20**: 1-343.

PALL J. & M. KRÁLÍČEK (1983): Lepidoptera jako indikátory ekologické kvality venkovské krajiny. (Lepidoptera – indicators of ecological quality of rural landscape.). — Folia Universitatis Agriculturae, řada A, Vysoká škola zemědělská, Brno: 1-43. [in Czech with German and English summary.]

PANIGAJ Ľ. (1999a): Poznámky k rozšíreniu *Argyronome laodice* PALL. (Lepidoptera, Nymphalidae) na Slovensku. [Notes on the distribution of *Argyronome laodice* PALL. (Lepidoptera, Nymphalidae) in Slovakia.]. — Natura Carpatica **40**: 235-238. [in Slovak with English abstract.]

PANIGAJ Ľ. (1999b): Poznatky o rozšírení a ekológii *Lycaena dispar* (Lepidoptera: Lycaenidae) na východnom Slovensku. [Data on the distribution and ecology of *Lycaena dispar* (Lepidoptera: Lycaenidae) in eastern Slovakia.]. — Entomofauna carpathica **11**: 65-70. [in Slovak with English abstract.]

PLJUSH I.G., MORGUN D.V., DOVGAJLO K.E., RUBIN N.I. & I.A. SOLODOVNIKOV (2005): Dnevnye babochki (Hesperioidea i Papilionoidea, Lepidoptera) vostochnoj Evropy. [Diurnal Lepidoptera (Hesperioidea i Papilionoidea, Lepidoptera) of eastern Europe]. — K.E.Dovgajlo, Minsk, Kiev, Moskva. CD, ISBN: 985-90000-5-0 [in Russian.]

POLLARD E. & T.J. YATES (1993): Monitoring butterflies for ecology and conservation.— Chapman & Hall, London: 1-274.

SBN (Ed.) (1987): Tagfalter und ihre Lebensräume. — Fotorotar AG, Egg: 1-516.

SCHWARZ R. (1948): Motýli denní 1. (Butterflies 1.). — Vesmír, Praha: 1-14 + I-XLII. [in Czech.]

SOKAL R.R. & F.J. ROHLF (2000): Biometry: the principles and practice of statistics in biological research. — W.H. Freeman and company, New York: 1-887.

STANOVÁ V. & M. VALACHOVIČ (eds) (2002): Katalóg biotopov Slovenska. (Catalogue of habitats in Slovakia.). — Daphne, Bratislava: 1-225. [in Slovak.]

TIBENSKÝ R. & J. KULFAN (1999): K ekológii žltáčika *Colias erate* (Lepidoptera, Pieridae). [To ecology of *Colias erate* (Lepidoptera, Pieridae).]. — Folia oecologica **26**: 215-221. [in Slovak with English abstract.]

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