Changes in butterfly assemblages of meadows in a Transcarpathian game reserve

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Summary: Butterfly assemblages of meadows in the Transcarpathian part of the Bereg plain were studied in three consecutive years (2012-2014) with standard transect walks in 6 different sites (14 transects). In different types of dry, semi-dry and humid meadows more than 6500 individuals of 66 species were observed. The mostly disturbed dry pasture has shown the lowest, and the less disturbed semi-dry and humid meadows surrounded by natural forests have shown the highest species numbers and diversity (Shannon-Wiener). Considering the faunal types, the widely distributed, generalist Euro-Siberian species predominate, with significant presence of Holo-Mediterranean and southern Continental elements, however. The list contains some species of European nature conservation significance (*Lycaena dispar*, *Lopinga achine*). In 2014 both the species and individual number of butterfly have shown a sizeable decrease in connection with the early summer aridity. The most radical decrease was observed in species which need some higher level of humidity.

Key words: Bereg plain, linear transects, disturbed pasture, semi-natural meadows, fringe structures, gallery forests, summer drought, Euro-Siberian, generalist species.

Introduction

In large regions of Europe a considerable loss of biodiversity was experienced (e.g. Thomas and Morris 1994, May *et al.* 1995, Hambler and Speight 2004, Thomas and Clarke 2004, Thomas *et al.* 2004, Thomas 2005), despite of the efforts to stop this process (see: Natura 2000). Especially in densely populated West and Central European countries the decrease or vanishing of many butterfly species is connected to habitat fragmentation and loss (Andrén 1996, Fahrig 1997, Steffan-Dewenter and Tscharntke 2000) resulting from the destruction of natural and semi-natural habitats (Wilcox and Murphy 1985, Saunders *et al.* 1991, Harrison and Bruna 1999, Maes and Van Dyck 2001). In other parts of Europe, namely in the Eastern Central and Eastern European countries the abandoning of the traditional land use, connected with social changes, represents the major threat for biodiversity (Warren 1997, Wenzel *et al.* 2006, Schmitt and Rákosy 2007). Such changes have also proceeded in the Transcarpathian part of the former Bereg county (W. Ukraine) which was originally a traditional cultural landscape with mosaics of arable fields, extensively used pastures and hayfields, orchards and wineyards but also with considerable fragments of natural and semi-natural vegetation (Magura *et al.* 1997, Szanyi 2015, Szanyi *et al.* 2015).

Butterflies are considered as sensitive indicators of habitat changes (Murphy and Wilcox 1986, Erhardt and Thomas 1991, Thomas *et al.* 2001, MacNally and Fleishman 2004) since they are known to respond quickly to a several environmental characteristics, e.g. vegetation structure and composition (Rákosy and Schmitt 2011). They are also suitable for monitoring of changes since their taxonomy is relatively stable, diversity and distributions are well-known, they are relatively easy to sample, a significant part of species can be readily identified during the field work (Tolman and Lewington 2008) and they are fairly abundant and diverse in most grassland ecosystems (Scott 1986, Scoble 1992, Caro and O'Doherty 1999). Since butterfly species are often host-specific (Janzen 1988, Shreeve *et al.* 2001), thus they may serve as biodiversity indicators both of plants and other phytophagous insects (Luff and Woiwod 1995). Moreover, specialist (in larval stage oligo- or monophagous) butterfly species are considered to be more affected by environmental changes than the generalist ones (Erhardt and Thomas 1991, New 1997, Steffan-Dewenter and Tscharntke 2000, 2002, Tscharntke *et al.* 2002a).

We surveyed the butterfly assemblages of different types (dry vs, humid) meadows in a relatively understudied pre-Carpathian region. The sites of our surveys are lying on the immediate continuation of the Pannonian lowland (Szatmár-Bereg plain) which is a traditional, low input agricultural region

Table 1. Species and individual numbers in the years 2012-2014 (E: Euryoecious, H-E: Hyper-Euryoecious, E-S: Euro-stenoecious, S: Stenoecious, P: Protected in Hungary).

Species				2012	2013	2014
Pyrgus malvae	Euro-Siberian	**E**		**64**	**65**	**53**
Pyrgus armoricanus	Holo-Mediterranean	**E-S**		**2**	**0**	**0**
Thymelicus lineola	Euro-Siberian	**E**		**3**	**28**	**21**
Thymelicus sylvestris	Euro-Siberian	**E**		**44**	**35**	**14**
Hesperia comma	Euro-Siberian	**E**		**15**	**7**	**4**
Erynnis tages	Euro-Siberian	**E**		**3**	**16**	**18**
Ochlodes sylvanus faunus	Holo-Palearctic	**E**		**25**	**27**	**21**
Papilio machaon	Holarctic	**E-S**	**P**	**2**	**6**	**11**
Iphiclides podalirius	Ponto-Mediterranean	**S**	**P**	**6**	**14**	**18**
Leptidea sinapis /juvernica	Mediterranean-West-Asiatic	**E**		**86**	**67**	**133**
Aporia crataegi	Euro-Siberian	**E**		**0**	**7**	**2**
Pieris brassicae	Holarctic	**HE**		**11**	**37**	**23**
Pieris napi	Holarctic	**E**		**86**	**97**	**85**
Pieris rapae	Euro-Siberian	**HE**		**122**	**127**	**95**
Colias crocea	Paleotropic-Mediterranean	**E**		**14**	**17**	**5**
Colias hyale	Southwest-Siberian	**E**		**18**	**23**	**12**
Gonepteryx rhamni	Euro-Siberian	**E-S**	**P**	**12**	**4**	**29**
Antocharis cardamines	Euro-Siberian	**E**		**0**	**0**	**20**
Pontia daplidice	Ponto-Mediterranean	**E**		**16**	**13**	**4**
Lycaena phlaeas	Holarctic	**HE**		**10**	**8**	**7**
Lycaena thersamon	Ponto-Caspian	**S**	**P**	**2**	**4**	**2**
Lycaena dispar rutilus *	Euro-Siberian	**S**	**P**	**1**	**3**	**12**
Satyrium pruni	Euro-Siberian	**S**	**P**	**2**	**3**	**2**
Satyrium spini	Ponto-Mediterranean	**S**	**P**	**2**	**3**	**1**
Satyrium ilicis	Holo-Mediterranean	**S**	**P**	**0**	**2**	**0**
Satyrium w-album	Euro-Siberian	**S**	**P**	**2**	**6**	**2**
Callophrys rubi	Euro-Siberian	**S**		**0**	**0**	**1**
Cupido alcetas	Euro-Siberian	**S**	**P**	**15**	**18**	**15**
Cupido argiades	Euro-Siberian	**E**		**33**	**37**	**35**
Cupido minimus	Euro-Siberian	**E-S**		**4**	**11**	**1**
Celastrina argiolus	Holarktikus	**E**		**20**	**33**	**11**
Plebejus argus	Euro-Siberian	**HE**		**18**	**35**	**11**
Polyommatus icarus	Euro-Siberian	**HE**		**174**	**326**	**191**
Polyommatus semiargus	Euro-Siberian	**E-S**		**0**	**2**	**0**
Polyommatus bellargus	Holo-Mediterranean	**E-S**		**5**	**13**	**0**
Hamearis lucina	Holo-Mediterranean	**E-S**		**7**	**18**	**29**
Apatura ilia	European-East-Asiatic	**S**	**P**	**17**	**39**	**20**
Neptis sappho	Southwest-Siberian	**S**	**P**	**10**	**23**	**23**
Polygonia c-album	Euro-Siberian	**E-S**	**P**	**18**	**23**	**20**
Nymphalis antiopa	Holarctic	**S**	**P**	**2**	**3**	**0**
Nymphalis xanthomelas	Southwest-Siberian	**S**	**P**	**0**	**5**	**0**
Nymphalis polychloros	Ponto-Mediterranean	**E-S**	**P**	**1**	**3**	**1**
Inachis io	Euro-Siberian	**E**	**P**	**47**	**29**	**6**
Inachis urticae	Euro-Siberian	**E**	**P**	**2**	**6**	**4**
Vanessa atalanta	Mediterranean-West-Asiatic	**E**	**P**	**21**	**12**	**14**
Vanessa cardui	Cosmopolitan	**HE**		**16**	**22**	**24**
Araschnia levana	Euro-Siberian	**E**		**82**	**63**	**31**
Issoria lathonia	Euro-Siberian	**E**		**23**	**57**	**9**
Argynnis aglaja	Euro-Siberian	**E-S**		**0**	**2**	**0**
Argynnis paphia	Euro-Siberian	**E-S**	**P**	**273**	**221**	**58**
Argynnis pandora	Ponto-Mediterranean	**S**	**P**	**6**	**8**	**1**
Brenthis daphne	Southwest-Siberian	**E-S**	**P**	**14**	**28**	**7**
Boloria selene	Boreo-Continental	**S**	**P**	**40**	**35**	**74**
Boloria dia	Euro-Siberian	**E-S**		**20**	**35**	**17**
Melitaea phoebe	Southwest-Siberian	**E**		**40**	**35**	**40**
Melitaea athalia	Euro-Siberian	**E-S**		**43**	**39**	**31**

Species				2012	2013	2014
Coenonympha pamphilus	Euro-Siberian	**E**		**273**	**328**	**245**
Coenonympha glicerion	Euro-Siberian	**E**		**27**	**39**	**28**
Maniola jurtina	Holo-Mediterranean	**E**		**133**	**199**	**122**
Aphantopus hyperantus	Euro-Siberian	**E**		**123**	**99**	**33**
Minois dryas	Southwest-Siberian	**E-S**		**127**	**123**	**23**
Lasiommata maera	Euro-Siberian	**E**		**1**	**2**	**0**
Parage aegeria	Holo-Mediterranean	**E**		**9**	**8**	**18**
Pararge megera	Holo-Mediterranean	**E-S**		**8**	**8**	**6**
Lopinga achine	Southwest-Siberian	**S**	**P**	**0**	**0**	**1**
Melanargea galathea	Ponto-Mediterranean	**E**		**0**	**3**	**3**
				2200	**2609**	**1747**

with several rests of the natural and semi-natural vegetation: lowland oak-hornbeam forests, hard- and softwood gallery forests, humid meadows and forest clearings (Simon 1952), but recently also with abandoned pastures and fallow lands. A considerable part of the area is dissected by dreanage channels of the former huge peatland which existed here until the last decades of the XIX century (Boros 1964). The climate of the Szatmár-Bereg lowland (Kormány 1976) is slightly cooler (yearly average 8,9^{o} C) and more continental than the average of the Great Hungarian Plain (January – 3,4^{o} C). The yearly sum of precipitation is also higher, about mm in average (610-640 mm). Biogeographically it belongs to the Pannonian region, however, with significant Carpathian influences in some groups of terrestrial invertebrates (land gastropods, ground beetles, see: Deli *et al.* 1997, Magura *et al.* 1997, Ködöböcz and Magura 1999, Gálik *et al.* 2001).

Our surveys were carried out near to the village Velyka Dobron', mostly in the Velyka Dobron' Game Reserve but also in some closely adjacent territories. We were mostly interested in the species and biogeographical composition, frequency, seasonal and annual changes of butterfly assemblages. We collected data on the frequency of butterfly species in three subsequent years at different habitat types in six sampling sites and analysed the data in order to test the following hypotheses:

- We supposed that the seasonal numbers of observed individuals mostly depend on the generation cycles of some polycyclic generalist species.
- We also expected that these cycles should be basically similar in some consecutive years, at least in the more nature-like habitats.
- We supposed that the changes mostly depend from the „individual" reaction of the different species on the environmental factors, thus these changes do not essentially influence the biogeographical spectrum of the butterfly assemblage.
- We also did not expected essential changes in the composition of the ecological groups (faunal components) in the surveyed years.
- We also expected that the patterns of species numbers are significantly different in the diverse vegetation types since this mostly depends from the presence vs. absence of some specialist species.
- Finally, we expected that the number of observed species and individuals show some connections with the weathering conditions of the surveyed years.

To test these hypotheses, in each year we compared the species and individual numbers of butterflies at the different sites, we calculated the relative frequencies and Shannon-Wiener diversity indices, the proportions of the different faunal elements, the specialist vs. generalist species, the oligo- vs. polyphagous species, according to the relevant references (Weidemann 1986, 1988, Tolman and Lewington 2008, Shreeve *et al.* 2001, Varga *et al.* 2004, Varga 2011). We tried to find some regulatities which species show a relatively constant high or moderate frequency and which species show considerable fluctuations or decrease in the three subsequent years. We evaluated

Table 2. Species and individual numbers in the different habitats.

	2012		2013		2014		SUM	
	Species	Individual	Species	Individual	Species	Individual	Species	Individual
Szapat	17	227	21	337	20	202	21	766
Körerdő	20	169	25	285	27	168	28	622
Felső-erdő	**34**	**809**	**37**	**769**	**42**	**484**	**43**	**2062**
Rezervátum 1	26	369	33	464	32	295	33	1128
Rezervátum 2	**30**	**443**	**35**	**517**	**36**	**363**	**37**	**1323**
Kismakkos	30	183	32	237	31	235	32	655
	57	**2200**	**62**	**2609**	**58**	**1747**	**66**	**6556**

Table 3. Changes of species and individual numbers in the summer months

	June	July	Aug	Sept
Species				
	June	*July*	*Aug*	*Sept*
2012	26	46	41	15
2013	34	59	41	14
2014	24	50	32	11
Individuals				
	June	*July*	*Aug*	*Sept*
2012	390	723	815	272
2013	371	1363	701	173
2014	151	561	409	72

these data in connection to the character of the vegetation and tried to forecast the possible changes, formulating some suggestions for the conservation management of the Game Reserve.

Material and Methods

Sampling

The surveys were carried out by standard transect walks in 2012, 2013 and 2014 in four, five and eight repetitions, respectively (2012: 16-18. 06; 11-14. 07; 04-06. 08; 06-08. 09; 2013: 05-06. 06; 05-08. 07; 21-23. 07; 13-15. 08; 30. 08.-01. 09; 2014**:** 23-24. 04; 21-23. 05; 09-10. 06; 11-13. 07; 22-24. 07; 14-16. 08; 27-29. 08; 08-10. 09). We designated on 6 sites 14 transects (length 50 m) and recorded all butterflies 2.5 m to their right, 2.5 m to their left, 5 m ahead of them and 5 m above them. Visits were conducted when the temperature was above 20^{o} C in sunny weather, without strong wind and rain (see: Van Swaay *et al.* 2008). Most butterflies were readily identified by observation. The dubious specimens were captured by net and they were either immediately released after identification or in some cases (e.g. some Lycaenidae and *Melitaea* species) preserved as voucher specimen for determination. For identification we mostly used the books of Tolman and Lewington (2008) and Varga (2011).

Study sites

- Szapat" – (48°26'05.56"N; 22°23'50.52"E) degraded dry pasture with periodically wet small depressions, irregularly grazed by cattle, surrounded by arable fields and mostly dryed channels. Constant-dominant plant species: *Agrimonia eupatoria*, *Ambrosia artemisiifolia*, *Arrhenatherum elatius*, *Cichorium intybus*, *Daucus carota*, *Leontodon hispidus*, *Lythrum salicaria*, *Potentilla neumanniana*.
- „Körerdő" – (48°25'50.21"N; 22°24'12.36"E) semi-dry grassland between a mixed hardwood gallery forest (forest fringe with *Melampyrum nemorosum*) and arable fields and surrounded by a drainage channel. Constant-dominant plants of the semi-dry sward: *Agrimonia eupatoria*, *Arrhenatherum elatius*, *Calamagrostis epigeios*, *Cirsium arvense*, *Galium mollugo, Galium verum*.
- „Felső-erdő" – (48°25'44.80"N; 22°25'07.47"E) tall grass meadow with scrubs and completely surrounded with hardwood gallery forest. Forest edge with dominant *Rubus caesius*. Constant-dominant plants of the sward: *Cirsium arvense*, *Mentha arvensis*, *Poa angustifolia*, *Symphytum officinale*.
- „Rezervátum I" – (48°25'16.62"N; 22°25'59.29"E) tall grass humid meadow bordered by hardwood gallery forest, groups of willow scrubs and abandoned hayfield. Constant-dominant plants: *Arrhenatherum elatius*, *Convolvulus arvensis*, *Erigeron annuus, Juncus effusus*.
- „Rezervátum II" – (48°25'13.53"N; 22°25'48.93"E) extended tall grass mesic-humid meadow surrounded by hardwood gallery forest and scrubs of *Rubus fruticosus* with abundant *Melampyrum nemorosum*). Constant-dominant plants of the meadow: *Cirsium arvense*, *Convolvulus arvensis, Erigeron annuus*, *Galium aparine*, *Juncus effusus*, *Ranunculus acris*, *Solidago canadensis*, *Symphytum officinale*.
- „Kismakkos" – (48°25'59.08"N; 22°24'43.14"E) mesic-humid meadow partly overgrown with scrubs of *Rubus fruticosus* and surrounded by hardwood gallery forest and black locust plantation. Constant-dominant plants of the meadow: *Achillea collina*, *Agrimonia eupatoria*, *Centaurea jacea*, *Galium aparine*, *Lathyrus pratensis*, *Phleum pratense*, *Potentilla neumanniana*, *Ranunculus acris*.

Statistics

The assemblages were compared in each year separately and also with combined data of the three years. The Shannon-Wiener diversity indexes were calculated with the programme package SynTax (Podani, 1997). Faunal elements and components are given according to Varga (1977) and Varga *et al.* (2004).

Results

Species and individual numbers

During the transect walks 6556 individuals of 66 butterfly species were registered (Table 1). The highest species numbers were observed at the sites 3 and 5 (Felső-erdő: transitional, Rezervátum II: humid). The other two mesic or humid sites (Rezervátum I: transitional, Kismakkos: humid) only showed somewhat lower numbers of species. Oppositely, the dryer sites 1 and 2 (Szapat, Körerdő) proved much poorer, especially the partly overgrazed and degraded site 1 (Table 2). These relations remained rather similar in each years although the observed species numbers were somewhat higher in 2013. However, despite the enhanced sampling intensity, the numbers of individuals were in 2014 below the values of the precedent years in all summer months in connection with the early summer (June!) drought (Tables 1-3, Figs. 2-3).

The species content of the dryer sites was the most different due to the lack of several mesic/hygrophilous or specialist species (e.g. all *Theclini* and *Boloria, Brenthis* and *Argynnis* species). There were only eight species which occurred at every sites and in high or at least medium individual numbers: *Pyrgus malvae*, *Thymelicus silvestris**, *Pieris rapae, P. napi, Cupido argiades, Polyommatus icarus*, *Coenonympha pamphilus**, *Maniola jurtina** (Tables 1, 4). These are polyphagous generalist species from which three species are connected to grasses* (Poaceae) while the others to herbaceous dicots. Two further species, feeding on Fabaceae (*Lotus, Lathyrus, Medicago*, etc.), occur at all sites with the exception of the mostly degraded and drainaged first one: *L. sinapis/juvernica, Cupido alcetas*. Surprisingly, *Cupido minimus* was only observed on the dry pasture despite of the general frequency of its food plant *Lotus corniculatus*.

To sum up, the species number and also the diversity (Fig. 1) was consequently the highest in the nearly undisturbed semi-humid meadow (Felső-erdő) and one of the humid meadows (Rezervátum II), both surrounded by natural hardwood forest with natur-like forest fringe and the lowest in artificially drained, disturbed abandoned pasture. It seems to be a general tendency that the nature-like forest fringes support a higher diversity of species, faunal elements and ecological types (Figs. 1 and 4-5). These values seem to be independent from the extension of the sampling sites. Of course, the number of observed individuals was the smallest on the site near to the village and surrounded by agricultural areas.

Trends and changes in species composition and frequency

The individual numbers were rather uneven. The most individuals were observed at site 3 (2062) which is only slightly lower than one-third of the sum of the individual numbers. The „transitional" sites (3-4) show the highest individual number while the „dry" site the lowest values. Ten species have shown the highest individual numbers (Table 4): ***Coenonympha pamphilus*** (846), ***Polyommatus icarus*** (691), *Argynnis paphia* (552, only in transitional and humid sites) **, ***Maniola jurtina*** (454), *Pieris rapae* (344), *Leptidea sinapis/juvernica* (286) *Minois dryas* (273, in one transitional site only!)**, *Pieris napi* (268), *Aphantopus hyperanthus* (255)**, *Pyrgus malvae* (182). However only three species (***bold***) were dominating (i.e. over 5%) during all the three years. Some of these species* and also *Inachis io*

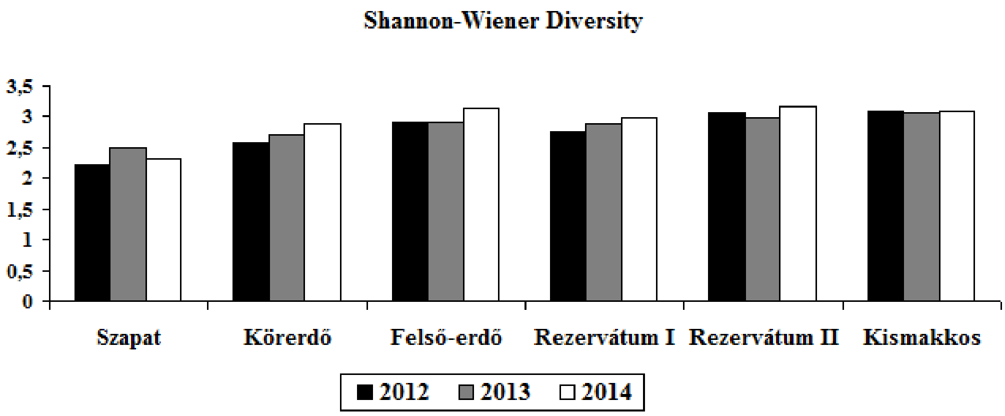

Fig 1. The Shannon-Wiener diversity of butterfly assemblages in the sampling sites.

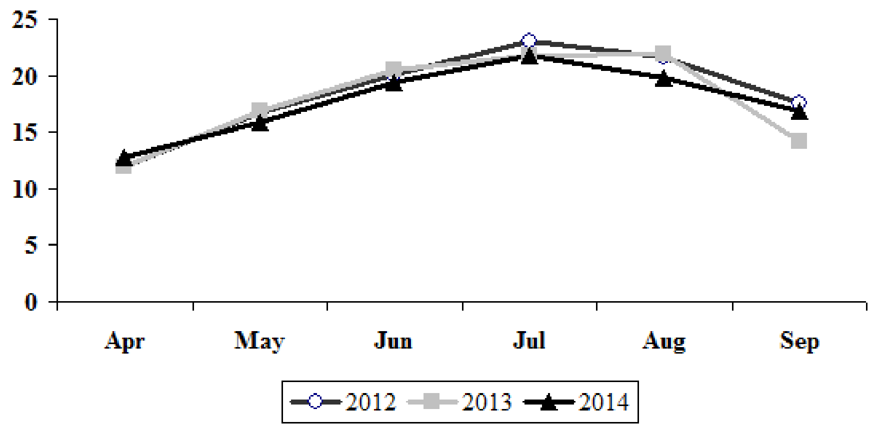

Fig 2. The average temperature in the vegetation period (°C) 2012-2014.

and *Araschnia levana* showed a decline of frequency as a three year's trend (Table 4). Some species has shown a rather typical distribution: lack or rather low presence in dry sites and high or moderate number of individuals in mesic or humid sites. Such species are e.g. the nymphalid species living on common nettle (*Urtica dioica*) with the highest frequency of *Araschnia levana* in nearly all sites. Similarly, high and rather even numbers were registered in some fritillary species in mesic and humid sites, as *Brenthis daphne, Boloria selene, B. dia, Melitaea phoebe* and *M. athalia.* Despite the fact that most sites were bordered or surrounded by hardwood forests with nature-like forest-fringe, the typical species of these habitats were generally scarce, e.g. all hairstreak (Theclini) species. Some large, mobile species connected to woody vegetation were also registered but they were mostly scarce. Surprisingly, two grass-feeding generalist species (*Minois dryas, Melanargia galathea*) were observed on a single site only. The former species shows, however, a strongly declining tendency.

Biogeographical elements and diversity

The sites of our surveys are enbedded into an agricultural landscape and are mostly surrounded by anthropogenic habitats. Thus, the bulk of the fauna is formed by widely distributed Euro-Siberian species (Fig. 4) with broad ecological tolerance (generalists, Fig. 5). They do not have any food plant specialisation and occur, as a rule, also in disturbed or anthropogenically transformed habitats. Special biogeographic elements, as the Holo-Mediterranean (-West Asiatic), Ponto-Mediterranean, Southern Continental or Boreo-Continental species are much less represented (Fig. 4). The number of migrant („extra-Palaearctic") species is relatively high, probably connected with the high summer temperatures of the last years.

The classification of the faunal components was based on the concept of Varga (1977), recognising that the bionomy of the lepidopterans is primarily influenced by the life history of the caterpillars, the larval hostplants, etc. and therefore it can be characterized by a certain type of habitat (like humid vs. dry sward, humid tall forb formations, softwood vs. hardwood forest, etc.). The composition of faunal components (Fig. 5) also proved to be essentially similar to the faunal types since the highly tolerant, euryoecious species predominate. The specialists are mostly connected either to humid habitats, e.g. *Lycaena dispar rutila, Boloria selene* or scrubby forest skirt formations, as *Satyrium species*, *Neptis sappho, Brenthis daphne*, etc. In these respects we

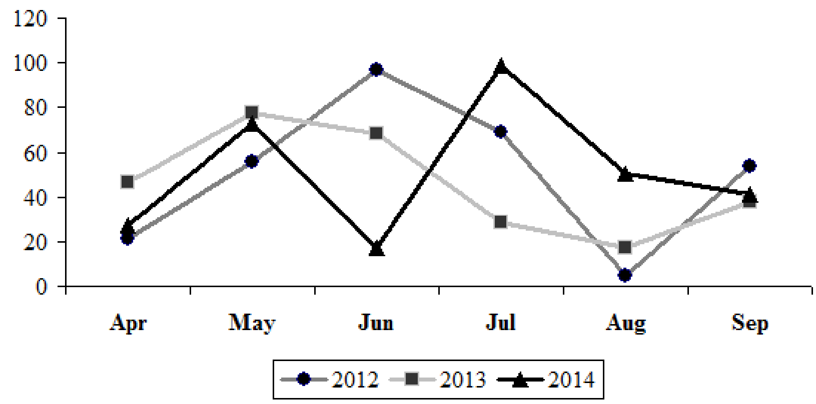

Fig.3. The monthly precipitation (mm) in the vegetation period, 2012-2014.

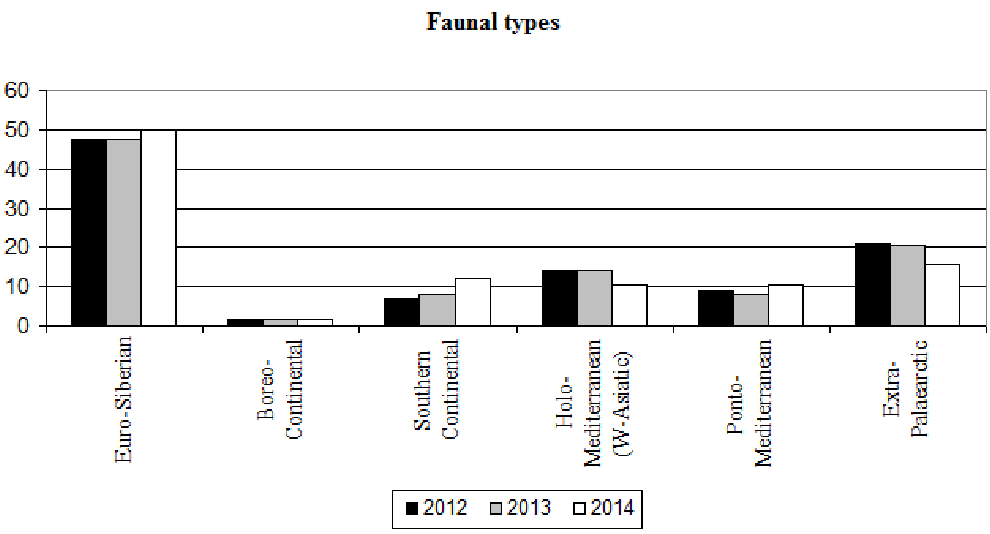

Fig. 4. The relative frequency of faunal types.

Table 4. Changes of individual numbers and relative frequencies of some common species.

Species	2012 N (%)	2013 N (%)	2014 N (%)
Pyrgus malvae	64 (2.91)	65 (2.49)	53 (3.03)
Ochlodes sylvanus faunus	25 (1.14)	27 (1.03)	21 (1.20)
Leptidea sinapis /juvernica	86 (3.91)	67 (2.57)	133 (7.61)
Pieris napi	86 (3.91)	97 (3.72)	85 (4.87)
Pieris rapae	122 (5.55)	127 (4.87)	95 (5.44)
Polyommatus icarus	174 (7.91)	326 (12.50)	191 (10.93)
Inachis io	47 (2.14)	29 (1.11)	6 (0.34)
Araschnia levana	82 (3.73)	63 (2.41)	31 (1.77)
Issoria lathonia	23 (1.05)	57 (2.18)	9 (0.52)
Argynnis paphia	273 (12.41)	221 (8.47)	58 (3.32)
Boloria selene	40 (1.82)	35 (1.34)	74 (4.24)
Melitaea phoebe	40 (1.82)	35 (1.34)	40 (2.29)
Melitaea athalia	43 (1.95)	39 (1.49)	31 (1.77)
Coenonympha pamphilus	273 (12.41)	328 (12.57)	245 (14.02)
Coenonympha glycerion	27 (1.23)	39 (1.49)	28 (1.60)
Maniola jurtina	133 (6.05)	199 (7.63)	122 (6.98)
Aphantopus hyperanthus	123 (5.59)	99 (3.79)	33 (1.89)
Minois dryas	127 (5.77)	123 (4.71)	23 (1.32)

could not find any differences between the three consecutive years, since the frequency of some food-plant specialists did not show any decline (Fig. 5).

Discussion

Habitat fragmentation and loss are known to reduce species richness and to change the community structure (Wilcox and Murphy 1985, Steffan-Dewenter and Tscharntke 1999, 2000, Tscharntke *et al.*, 2002a, b). These negative processes are mostly connected with the alteration in land use practices, mostly intensifying in West and Central Europe (Maes and Van Dyck 2001, Van Swaay 2002, Reidsma *et al.* 2006) and abandoning the former traditional, low input practices (Cremene *et al.* 2005, Baur *et al.* 2006, Schmitt and Rákosy 2007, Skórka *et al.* 2007). These changes are particularly dramatic for butterfly species (Erhardt *et al.* 1985, Bourn and Thomas 2002, Van Swaay 2002, Polus *et al.* 2006, Wenzel *et al.* 2006). The decline of many butterfly species across Europe (León-Cortés *et al.* 2000, Maes and Van Dyck 2001, Van Swaay *et al.* 2003, 2011) highlights the need to identify the factors influencing species diversity and characteristic habitats for contemporary conservation action.

The agriculturally dominated mosaic landscapes are mostly suitable to identify the situations in which species diversity is high and can be sustained, and in which the species diversity is in decline (see e.g. Filz *et al.* 2013). Riverine lowlands like the Bereg plain, may represent especially valuable fields for such surveys (Magura *et al.* 1997). In such landscapes the traditional land use often preserved more or less extended stands of natur-like gallery forests and floodplain habitats. However, the regulation of waterways, the drainage of plains with fluctuating

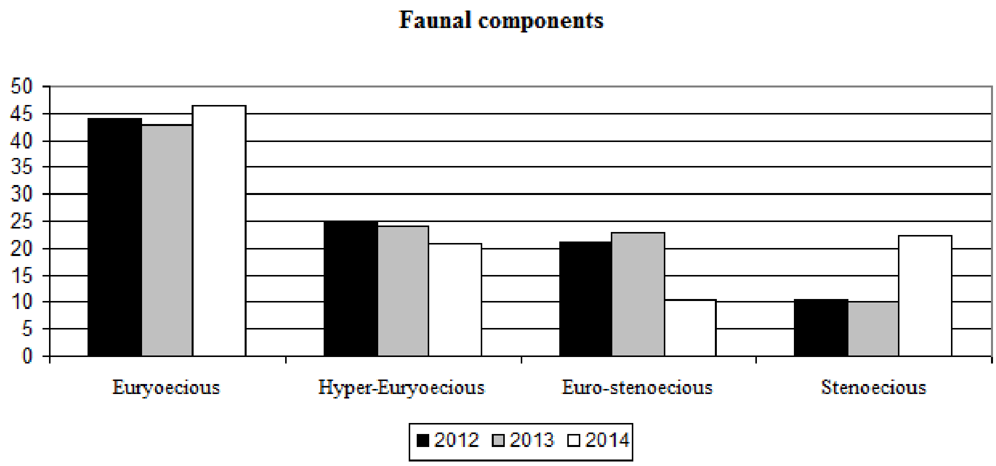

Figure 5. The relative frequency of faunal components.

humidity and also the abandoning the traditional land use practices strongly transformed or destroyed large areas (Szanyi *et al.* 2015). Thus we have contrasting habitats in different extension. Therefore we have to formulate and discuss numerous questions.

From our data the first and most evident question is the probable background of decline in the frequency of some, in some cases even dominant species (see: Table 4). We have seen that the course of the summer temperatures did not show any extreme events in 2012-14 although being somethat higher than average. Moreover, in continental climate, the maximum of precipitation is usually in June which is critical for the vegetation and also for agriculture for the next hot periods of mid-summer. In 2014, however, this month was extremely dry and we suppose that the striking decline of the meso-hygrophilous species should be connected with this extreme summer drought.

It is one of the most frequently declared working hypotheses that the strong disturbance leads to dominance of generalist species and causes the decline of the more specialist ones, and these processes are usually connected with some homogenisation in the composition of species assemblages (Devictor *et al.* 2008, Ekroos *et al.* 2010). However, there are here complex situations in which the two components should be separated. The dominance of generalist species seems to be evident in both respect: in geographical aspect, i.e. the majority of Euro-Siberian species and also in ecological scale: lack of connectivity of the nature-like, diverse habitats. We cannot observe however, any homogenisation of assemblages, as we can see it both from species numbers and diversity values. The number of observed species is practically the same which was observed in other abandoned grasslands in the Eastern part of the Carpathian basin (66 vs. 68, see: Baur *et al.* 2006) and higher than in western Central Europe (Öckinger and Smith 2006) or even in southern Poland (Skórka *et al.* 2007). The specialist species are restricted to some habitat types and have been observed at a single (*Satyrium pruni, S. ilicis, Callophrys rubi, Polyommatus semiargus, Lopinga achine*) or few sampling sites only. But, the other side of the coin is the unexpectedly high frequency of some extra-Palearctic migrant species. Of course, we need further, at least mid-term surveys to clarify, whether is there a trend of change connected with the climate warming or we only have seen short term events in the surveyed three years.

The other frequent question is whether the size vs quality of habitat patches is more relevant for sustaining species diversity (reviewed e. g. by Báldi *et al.* 2007, Krämer *et al.* 2012). Here we have seen essentially three different habitat types in very different extensions. Our results clearly demonstrate that the extended but heavily disturbed, drained site(s) cannot support any species rich assemblages. Oppositely, the site with smaller extension but with nature-like forest-fringe structures can sustain a nearly so rich assembly than the much larger meadows of the „Reserve”. Although we only have some „anecdotic” information on the earlier land use practices, we can believe that these more disturbed sites with low level of diversity were grazed (or even overgrazed and trampled) while the other meadows were suitable for mowing and were used as hayfields. The more detailed study of soil and vegetation will be necessary in the next step of surveys.

In this connection we also have seen that the forests, and especially the fringe structures can positively influence the species diversity (Weidemann 1988, Tews *et al.* 2004), since numerous butterflies feeding on nectar sources of meadows are connected by their larval foodplants to forest fringes or light-penetrated glades of forests (e.g. Theclini: *Satyrium spp*., *Argynnis paphia, Brenthis daphne, Lopinga achine*). Some other species possibly prefer meadow patches surrounded by forests from micro-climatic reasons, e.g. sheltering from wind, humidity, less extreme fluctuation of temperature, etc. Unfortunately, these questions cannot be answered yet. References show that in contrast to broad-scale climatic impacts on biodiversity (e.g. Parmesan 2006), small-scale impacts influencing the composition of insect assemblages are much less understood.

The survey of the small-scale effects of micro-climate, vegetation structure, etc. would essentially improve the understanding of composition in natural communities, especially which harbour specialist species. Moreover, it would enhance the effectivity of conservation measures maintaining species diversity under climate change. Such measures seem to be rather urgent if we consider the occurrences and also decline of some, in neighbouring countries already protected species (as nearly all large Papilionidae and Nymphalidae species) and the presence of the Habitats Directive species *Lycaena dispar* and *Lopinga achine*, in neighbouring sites also *Euphydryas maturna*, etc. In this respect the preservation of wet or semi-dry meadows (*Boloria* and *Melitaea* spp.), the natur-like fringe structures of forests (e. g. Theclini: *Satyrium spp*.; *Argynnis paphia, Brenthis daphne*) and the light-penetrated structure of gallery forests (e.g. *Neptis sappho, Nymphalis xanthomelas, Euphydryas maturna, Lopinga achine*) should have the highest significance.

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