

DIURNAL LEPIDOPTERA COMMUNITIES FROM NATURA 2000 SITE „DEALURILE CLUJULUI EST”

IULIA MUNTEAN^{1,✉}, RĂZVAN POPA¹
and LÁSZLÓ RÁKOSY¹

SUMMARY. The Natura 2000 Site “Dealurile Clujului Est” is a vast area (24,405 ha) with valuable steppic and forest habitats still very well preserved, but very threatened in the future by real estate development and regional agricultural projects, which will increase because of the proximity of Cluj Napoca metropolitan area. The xeric and mesoxeric steppe meadows harbor a high diversity of plants and animals. In this study we tried to emphasize the importance of this site for the butterfly biodiversity in Transylvanian cultural landscape. We used the transect method, investigating three habitat types: peri-pannonian subcontinental shrubs (40A0*), subpannonian steppic meadows (6240*) and *Molinia* meadows (6410), identifying a total of 50 butterfly species. Using similarity measures and ANOVA we showed the similarity between habitat types, regarding the species number, their diversity and equitability, and the number of individuals. We also tried to highlight the number of species with different conservation status, and their distribution in the studied habitat types.

Keywords: butterfly, habitat conservation, protected habitats, similarity, traditional landuse.

Introduction

Semi-natural grasslands represent key habitats for maintaining biodiversity in European agricultural areas (Stoate *et al.*, 2009). This grasslands shelter numerous species whose initial habitats have been destroyed on vast areas (Baur *et al.*, 2006). “Dealurile Clujului Est” site is a very important diversity spot, where we can find the largest populations of *Centaurea trinervia* from our country, one of the largest populations of *Goniolimon tataricum* from Romania and Europe, and some very rare species, like *Nepeta ucranica*, *Ranunculus illyricus*, *Astragalus asper* (Bădăraș *et al.*, 2000). In this site, Wilson *et al.* (2012) registered the global richness record for

¹ Department of Taxonomy and Ecology, Faculty of Biology and Geology, Babeș-Bolyai University, 5-7 Clinicilor Street, 400006, Cluj-Napoca, Romania.

✉ **Corresponding author: Iulia Muntean**, Department of Taxonomy and Ecology, Faculty of Biology and Geology, Babeș-Bolyai University, 5-7 Clinicilor Street, 400006, Cluj-Napoca, Romania, E-mail: iulia_hcc@yahoo.com

semi-dry basiphilous grasslands. Another important aspect of this site is the presence of the *Maculinea* species complex (*M. arion*, *M.alcon*, *M. „rebeli”*, *M. teleius* and *M. nausithous*), this being the only place from Europe where we can find this situation (Vodă *et al.*, 2009). The proximity of Cluj Napoca metropolitan area with all its real estate, industrial and agricultural projects is a real menace for the future conservation of the site, of the habitats and rare population within it. One of the reason they were better preserved in this area is that the most of the site was used until War World Two only as a meadow for Cluj Napoca and it's, meanwhile other grasslands from Transylvania were turned into agricultural crops or overgrazed. Nowadays, the establishment of a Natura 2000 site aims to protect habitats and rare species populations in this area from the threat of real estate projects, agricultural farms and the industrialization. The cultural landscape of the mosaic grasslands from “Dealurile Clujului Est” area with its specific structures it's already affected by the changes in the land use (extensive mowing and grazing) (Natura 2000 standard form, 2011). At the same time the terrain abandonment, drainages, industrial plans are other factors that can lead to the loss of this very important site, with its habitats and rare species. In this study we document the diurnal lepidoptera diversity of semi-natural grasslands, and highlight the importance of these habitats in the Natura 2000 Site “Dealurile Clujului Est”.

Materials and methods

The site is located at about 30 km from Cluj Napoca city (Fig. 1, red dot), in the geographic unit called “Dealurile Clujului și Dejului”, wich are located south of the Someșan Plateau. The habitats found in the site are the following: sub-pannonian steppic grasslands (6240*), lowland hay meadows (6510), *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (6410), pannonian salt steppes and salt marshes (1530*), subcontinental peri-pannonian scrub (40A0) and dacian oak & hornbeam forests (91Y0) (Gafta and Mountford, 2008).

The altitude of the study locations was about 300 m above sea level. We used the transect method, taking the samples with the entomological net. All the butterflies were counted, by species, in an imaginary space of 2.5 m each side, 5 m ahead and 5 m above. The transects were located in 4 sites: Fânașul Domnesc (46°55.316'N, 23°44.130'E), Fânașul Sătesc (46°55.518'N, 23°43.660'E), Fânaia (46°53.428'N, 23°42.302'E) and Secheliște (46°53.372'N, 23°42.011'E).

The data were collected from 3 habitat types, each one of them with 3 transects (Fig. 2), 100 m long each: sub-pannonian steppic grasslands (two in Fânașul Domnesc, one in Fânaia), *Molinia* meadows (two in Fânașul Domnesc and one in Secheliște) and subcontinental peri-pannonian scrub (one in Fânașul Sătesc, one in Fânașul Domnesc, one in Secheliște). The surveys where made in good, sunny weather conditions, with temperatures above 18°C, wind-speed less than 15 km/h, between 10:00 AM and 16:00 PM, from 21.05.2013 to 05.09.2013, every two weeks. We recorded all species from Rhopalocera and Hesperidae. The identification of diurnal Lepidoptera was made after Tolman and Lewington (2008).

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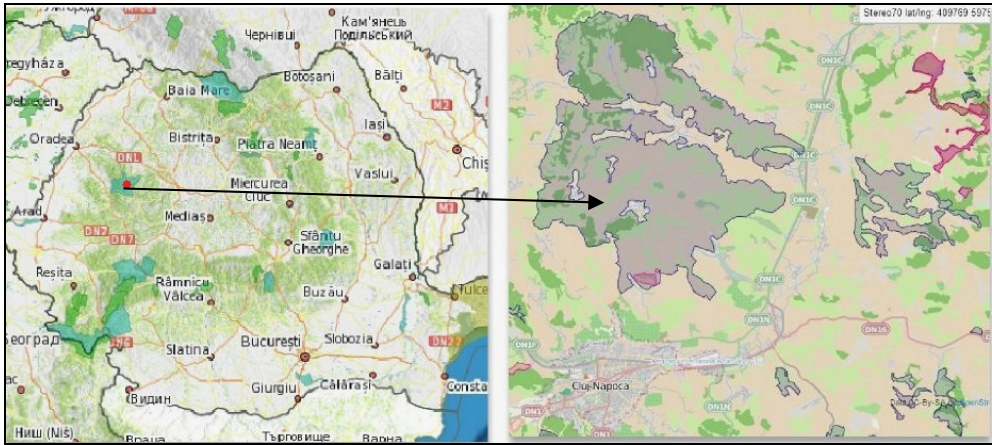


Figure 1. Maps showing the location of Natura 2000 Site “Dealurile Clujului Est” (<http://www.natura2000.ro/resurse/harta/arii/>)

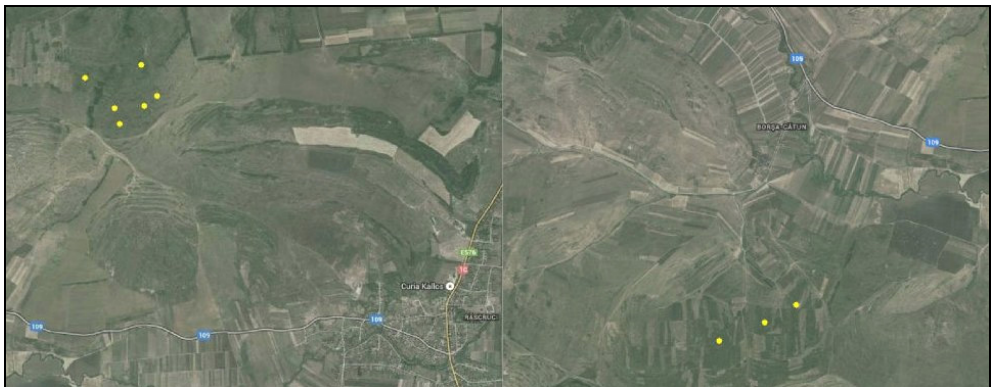


Figure 2. Location of the transects (left image - Fânașul Domnesc and Fânașul Sătesc, right image - Secheliște and Fânaia)

We assessed the species richness and the number of individuals in all sites and habitat types. We computed the Shannon-Wiener diversity index and Pielou evenness index. To compare different types of habitats we used Kruskal-Wallis and one-way ANOVA. In order to compare similarity of the butterfly communities in different sites and habitat types we used single-link clustering method with Morisita's index of similarity. For data analyses we used Past 2.09 (Hammer and Harper, 2001) and Statview 5.0 (SAS Institute, 1992-1998) statistical programs.

Results and discussion

A total number of 50 species of diurnal Lepidoptera were found in the 5 sampling months, belonging to 5 different families: Nymphalidae (20), Lycaenidae (18), Pieridae (6), Hesperidae (4) Papilionidae (2) (Table 1). The total number of individuals was 2742, found in all 9 transects.

Table 1.

The list of diurnal Lepidoptera from the studied area

TAXON	No. of ind.	Biogeographical profile	Ecological profile	Red list
Hesperiidae				
<i>Ochlodes sylvanus</i>	10	Eua	U	LC
<i>Pyrgus malvae</i>	8	Eua	Mx	LC
<i>Thymelicus lineola</i>	23	Hol	U	LC
<i>Thymelicus sylvestris</i>	36	V.Pal	U	NT
Papilionidae				
<i>Iphiclides podalirius</i>	6	Eua	Xt	VU
<i>Papilio machaon</i>	7	Hol	M	EN
Pieridae				
<i>Aporia crataegi</i>	42	Pal	M	NT
<i>Colias croceus</i>	21	E.Vas.	U	LC
<i>Colyas hyale/alfacariensis</i>	147	E.Vas.	Xt	LC
<i>Leptidea juvernica</i>	163	Eua	M	LC
<i>Pieris brassicae</i>	13	S.Eur.	U	VU
<i>Pieris rapae</i>	7	Pal	U	LC
Lycaenidae				
<i>Callophrys rubi</i>	12	Pal	Mxt	LC
<i>Celastrina argiolus</i>	9	Hol	M	LC
<i>Cupido minimus</i>	9	S.Eur.	Xt	NT
<i>Glaucopsyche alexis</i>	28	S.Eur.	Xt	LC
<i>Lycaena alciphron</i>	1	Eua	Mh	VU
<i>Lycaena dispar</i>	1	S.Eur.	H	VU
<i>Lycaena tytirus</i>	1	Eua	M	NT
<i>Maculinea alcon</i>	10	S.Eur.	Mh	EN
<i>Maculinea nautisthous</i>	8	S.Eur.	Mh	CR
<i>Maculinea "rebeli"</i>	13	S.Eur.	Mx	VU
<i>Maculinea teleius</i>	19	S.Eur.	Mh	EN
<i>Plebejus argus</i>	271	S.Eur.	M	LC
<i>Plebejus argyrognomon</i>	5	S.Eur.	Mx	LC
<i>Polyommatus bellargus</i>	1	Eur	Mxt	NT
<i>Polyommatus coridon</i>	1	E.Vas.	Mxt	NT

Table 1. continued

<i>Polyommatus icarus</i>	135	Pal	U	LC
<i>Satyrrium pruni</i>	4	S.Eur.	Xt	NT
<i>Satyrrium spini</i>	15	Eur	Xt	NT
Nymphalidae				
<i>Aphantopus hyperanthus</i>	52	S.Eur.	M	LC
<i>Argynnis addipae</i>	5	Pal	Mxt	NT
<i>Argynnis aglaja</i>	8	Pal	M	NT
<i>Argynnis paphia</i>	15	Pal	M	LC
<i>Boloria dia</i>	3	Eua	Mx	LC
<i>Brenthis daphne</i>	1	S.Eur.	M	VU
<i>Brenthis hecate</i>	155	Eua	M	VU
<i>Coenonympha arcania</i>	3	V.Pal	U	LC
<i>Coenonympha glycerion</i>	20	V.Pal	U	NT
<i>Coenonympha pamphilus</i>	112	Pal	M	LC
<i>Erebia medusa</i>	1	S.Eur.	Mxh	NT
<i>Inachis io</i>	2	S.Eur.	U	LC
<i>Lasiommata maera</i>	6	Pal	Xt	LC
<i>Maniola jurtina</i>	702	V.Pal	M	LC
<i>Melanargia galathea</i>	470	E.Vas.	M	LC
<i>Melitaea athalia</i>	8	S.Eur.	U	NT
<i>Melitaea aurelia</i>	8	Eua	Mxt	VU
<i>Melitaea phoebe</i>	16	Pal	Xt	NT
<i>Minois dryas</i>	75	S.Eur.	Xt	NT
<i>Vanessa atalanta</i>	2	Hol	U	LC
<i>Vanessa cardui</i>	11	Cos	U	LC

Abbreviations:

Biogeographical profile: Eur-european, Eua-eurasian, Hol-holarctical, Pal-Palearctical, Cos-Cosmopolitan, S.Eur.- sibero-European, E.Vas.-European-west-asian.

Ecological profile: U-ubicvist, M-mesophilic, Mx-meso-xerophilic, Mt-meso-thermophilic, Mh-meso-hygrophile, Mxt-meso-xero-thermophilic, Xt-xero-thermophilic, H-hygrophilic.

Red list: LC-least concern, NT-near threatened, VU-vulnerable, EN-endangered, CR-critically endangered.

Of all of these species, 25 (50%) have different degrees of endangerment: 13 near threatened, which means 50% of all species found. This demonstrates once again the importance of this site (Rákósy *et al.*, 2003).

From a biogeographical point of view, the Sibero-European species are dominant, followed by the Palearctical and European-Asian ones. The other categories (Cosmopolitan, European-west-asian European, Holarctical, West-palearctical) are poorly

represented (Fig. 3) (Rákósy, 2007). Regarding the ecological profile, we can observe that the dominant species are the mesophilic ones. Species with a high ecological tolerance are also very well represented in the study, as the ones that prefer warmth and dryness (Fig. 3 and 4) (Rákósy, 2007).

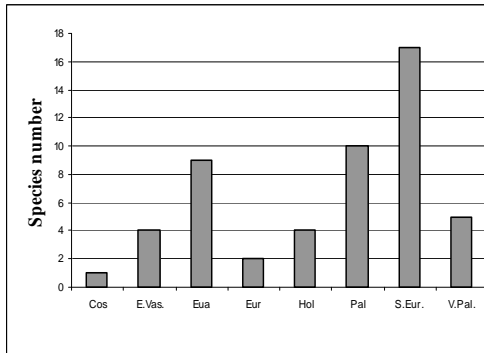


Figure 3. The biogeographical profile of the diurnal Lepidoptera identified species (Eur-European, Eua- Eurasian, Hol-holarctical, Pal-Palaearctical, Cos-Cosmopolitan, S.Eur.- sibero-EEuropeanEuropean, E.Vas.-European-west-asian)

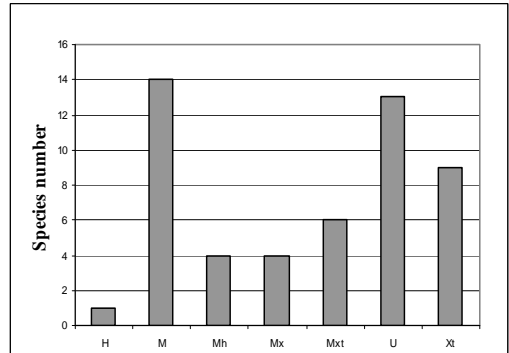


Figure 4. The ecological profile of the diurnal Lepidoptera identified species (U-ubicvist, M-mesophilic, Mx-meso-xerophilic, Mt-meso-thermophilic, Mh-meso-hygrophile, Mxt-meso-xero-thermophilic, Xt-xero-thermophilic, H-hygrophilic)

The average number of species per habitat shows that the subcontinental peri-panonian shrubs have the highest number of species, followed by steppe grasslands and then *Molinia* grasslands (Fig. 5).

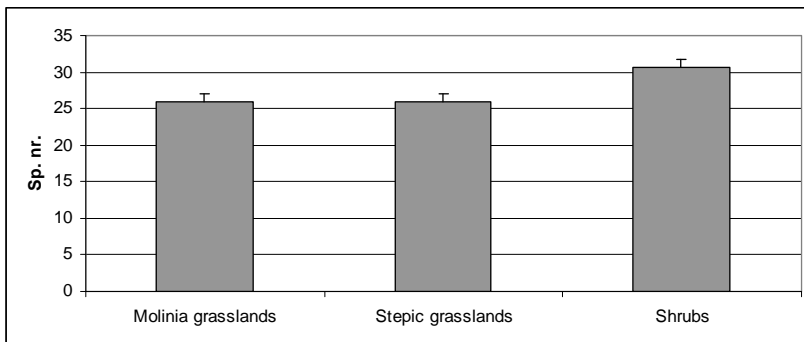


Figure 5. Average number of species by habitat type

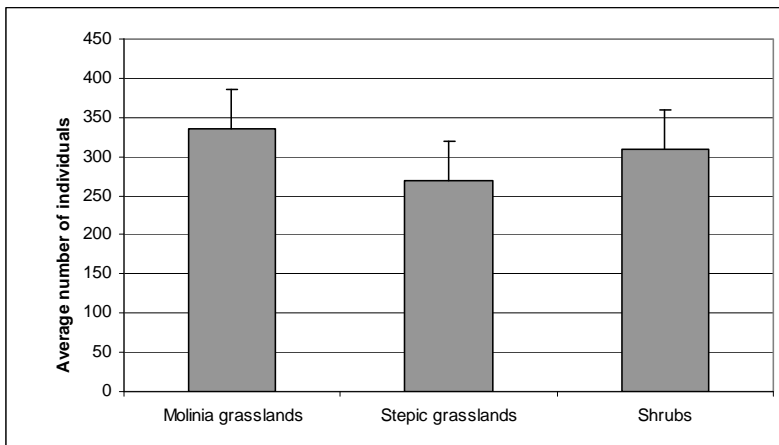
The Kruskal-Wallis analysis of variance shows that there are not any major differences between the three habitat types investigated, regarding the species number, their diversity and equitability (Table 2).

The ANOVA similarity test showed significant differences regarding the number of individuals in the different habitat types ($F_2=5.87$, $p=0.049$), and post-hoc test showed a higher number of individuals in the *Molinia* compare to the steppe grasslands (Fig. 6).

Table 2.

Kruskal-Wallis one-way analysis of variance

	H	P value	Degrees of freedom DDL
Species Number	4.444	0.1084	2
Equitability	0.250	0.8825	2
Diversity	2.889	0.2359	8

**Figure 6.** The average number of individuals by habitat type

Looking at the similarity in species composition, the sampled butterfly communities are grouped by locality (Fig. 7). The two transects from Secheliște are very similar in species composition, even if there are in different habitat types (*Molinia* grasslands and peripanonian shrubs). The communities from the *Molinia* grasslands in Fânașul Domnesc are as well very similar, like the ones from the steppe grasslands.

Regarding the species from the Red List, the *Molinia* grasslands from “Dealurile Clujului Est” have a significantly higher number of endangered species than the peri-panonian shrubs and the xerophilic grasslands ($F_{\text{degrees of freedom}}=5.672$, $p=0.0414$) (Fig. 8). Comparing the least concern, near threatened, vulnerable, and critically endangered species, there was no major differences between the three studied habitat types.

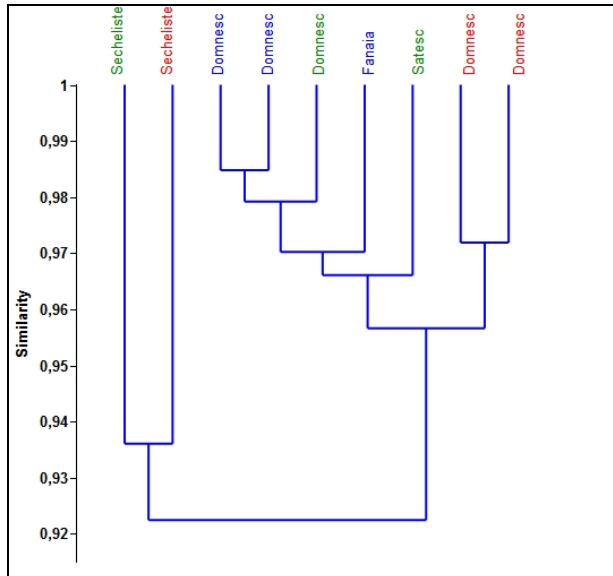


Figure 7. Similarity (Morisita index) in species composition cluster (single-linkage method) (from left to right: the 1st, 5th and 7th habitat type - peripanonnian shrubs; the 2nd, 8th and 9th - *Molinia* grasslands; the 3rd, 4th and 6th - steppe grasslands)

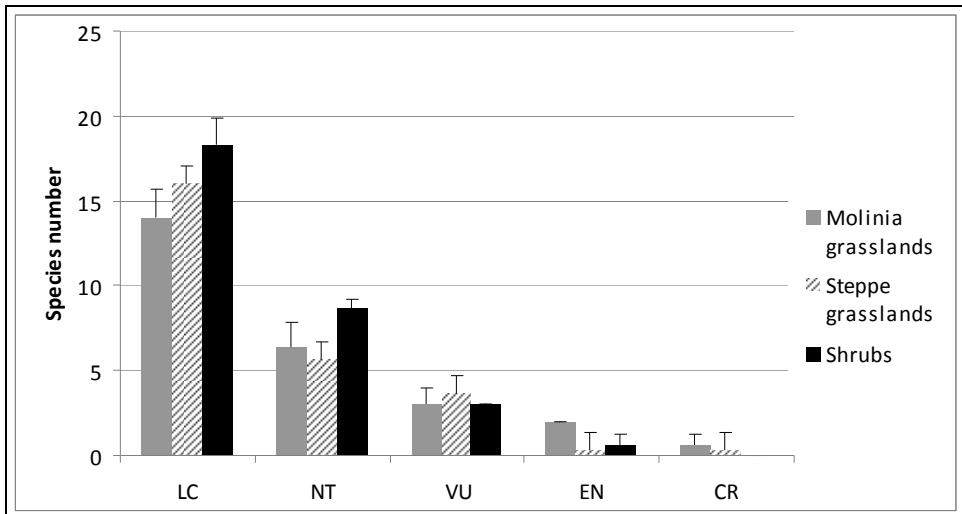


Figure 8. The average number of Red List species in each habitat type (LC-least concern, NT-near threatened, VU-vulnerable, EN-endangered, CR-critically endangered)

Conclusions

A number of 50 diurnal Lepidoptera species was found in the studied habitat types in Natura 2000 Site “Dealurile Clujului Est”, but the total number of species from this site goes up to 80 (Rákosy and Laszloffy, 1997). The average number of species per habitat shows that the highest is in the peri-panonian shrubs areas. Most species are sibero-European and mesophilic. There were significant differences between *Molinia* and steppe grasslands, regarding the number of individuals. The sampled butterfly communities are grouped by locality and not by habitat type. Half of the species are on the Red List with different degrees of endangerment, the number of endangered ones being significantly higher in the *Molinia* grasslands compared to the other two habitat types.

There are some necessary measures for the protection of this site in the future: maintaining grassland ecosystems by extensive grazing and traditional mowing, maintaining the mosaic landscape by grazing, alternating shrub areas with grassland areas (Page *et al.*, 2012). From this study we weren't able to find significant differences in diurnal Lepidoptera fauna between different types of land use (for example: grazed and mowed land, or abandoned and grazed/mowed land, etc.), but a current underway study, using alternative diurnal Lepidoptera evaluation methods, will probably mark out this kind of differences. Information and public awareness actions are very important, too. People in this area need to know about the existence of this site, about the importance of maintaining the current high biodiversity of these cultural landscapes. They also need to be informed about the possibility of accessing agro-environmental funds for the *Maculinea* sp. meadows.

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REFERENCES

- Baur, B., Cremene, C., Groza, G., Rákosy, L., Schileyko, A. A., Baur, A., Stoll, P., Erhardt, A. (2006) Effects of abandonment of subalpine hay meadows on plant and invertebrate diversity in Transylvania, Romania, *Biological Conservation*, **132**, 261-273
- Bădărău, A. S., Dezsi, Ș., Comes, O. (2000) Analiza biogeografică a două specii relicte xerofile din Câmpia Transilvaniei: *Nepeta ucranica* L. și *Centaurea trinervia* Steph., *Studia Univ. Babeș-Bolyai, Geogr.*, **45(1)**, 51-68
- Gafta, D., Mountford, J. O. (2008) *Manual de interpretare a habitatelor Natura 2000 din România*, Ed. Risoprint, Cluj Napoca
- Hammer, O., Harper, D. A. T. (2001) PAST: Paleontological Statistics software package for education and data analysis, *Palaeontologia Electronica*, **4(1)**

- Page, N., Balan, A., Huband, S., Popa, R., Rákosy, L., Sutcliffe, L. (2012) Romania. In: *High Nature Value Farming in Europe. 35 European countries – experiences and perspectives*, Oppermann R., Beaufoy G., Jones G. (eds.), Verlag regionalkultur, Ubstadt-Weiher-Heidelberg-Berlin, pp 346-257
- Rákosy, L., Goia, M., Kovacs, Z. (2003) *Catalogul Lepidopterelor României*, Societatea Lepidopterologică Română, Cluj Napoca
- Rákosy, L. (2007) *Entomofauna Parcurilor Naționale Retezat și Valea Cernei*, Societatea Lepidopterologică Română, Cluj Napoca
- Rákosy L., Laszlóffy, Z. (1997) Fauna de macrolepidoptere de la Fânațele Clujului (Lepidoptera) (Cluj, România), *Buletin de informare entomologică*, **8(3-4)**, 165-186
- Stoate, C., Baldi, A., Beja, P., Boatman, N. D., Herzon, I., Doorn, A., Snoo, G. R., Rakosy, L., Ramwel, C. (2009) Ecological impacts of early 21st century agricultural change in Europe – A review, *Journal of Environmental Management*, **91**, 22–46
- Tolman, T., Lewington, R. (2008) *Collins butterfly guide*, Collins Publishers London
- Vodă, R., Timuș, N., Paulini, I., Popa, R., Mihali, C., Crișan, A., Rákosy, L. (2010) Demographic parameters of two sympatric *Maculinea* species in a Romanian site (Lepidoptera: Lycaenidae), *Entomologica Romanica*, **15**, 25-32
- Wilson, J. B., Peet, R. K., Dengler, J., Partwl, M. (2012) Plant species richness: the world records, *Journal of Vegetation Science*, **23**, 796–802