Entomol.rom., 7: 5-14, 2002 ISSN 1224 - 2594

Diversity of Macrolepidoptera in steppe habitats of Căianu Mic (Cluj)

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Rezumat

Diversitatea macrolepidopterelor din habitatele stepice de la Căianu Mic (jud. Cluj)

Habitatele stepice din Transilvania sunt bogate in specii rare şi endemice de lepidoptere. Deoarece acestea reprezintă medii de viaţă particulare, cu distribuţie insulară, fiecare fragment ar trebi cu grijă studiat şi cartat pentru elaborarea unor măsuri concrete de protecţie a întregii reţele. Deşi foarte interesante din punct de vedere floristic şi faunistic, pajiştile stepice de la Căianu nu s-au bucurat până în prezent de atenţia botaniştilor sau zoologilor.

Studiul efectuat pe 5 parcele situate în Căianu Mic a avut ca scop inventarierea faunei de lepidoptere, evaluarea şi compararea biodiversităţii cu habitate similare din Transilvania, situate în arii protejate. Biodiversitatea lepidopterelor din Căianu Mic este asemănătoare cu cea întâlnită în habitate stepice similare, situate în ariile protejate de la Suatu şi Viişoara. Astfel diversitatea lepidopterelor din păşunile stepice din Căianu Mic se păstrează la un nivel ridicat deşi influenţe antropice (plantaţii de pin) au modificat substanţial habitatul. Habitatele stepice din Căianu Mic adăpostesc comunităţi de lepidoptere xerotermofile, deosebite pentru fauna Romaniei. Plantaţiile de pin şi extinderea suprafeţelor agricole, reprezintă ameninţări majore pentru flora şi fauna stepică. Ruperea legăturilor dintre insulele stepice prin extinderea plantaţiilor de pin şi a suprafeţelor agricole intensive poate duce la dispariţia unor populaţii mici şi izolate de lepidoptere. Odată cu înaintarea în vârstă a plantaţiei de pin, puţinele luminişuri cu asociaţii vegetale xerotermofile care se mai păstrează astăzi la Căianu vor dispare şi odată cu ele se stinge şi fauna specifică de lepidoptere. Fără masuri imediate de renaturare, dispariţia elementelor xerotermofile este doar o chestiune de câţiva ani.

Abstract

Steppe habitats in Transylvania are rich in rare and endemic Lepidoptera species. Because of their island-like distribution they should be carefully studied and mapped in order to develop efficient conservation practices. Căianu Mic harbors steppe habitats similar to those in the Suatu nature reserve but they have not been investigated until now. We studied the Lepidoptera fauna at 5 sites within the locality Căianu Mic in order to make an inventory of the species present, to evaluate and to compare the diversity with the one found in similar steppe habitats situated in protected areas. The Lepidoptera diversity of Căianu Mic steppe grasslands was similar to that found in Suatu and Viişoara nature reserves. Thus the biodiversity of the Căianu Mic steppe habitats is high and is well preserved without intense human impact. The Căianu Mic hill with steppe vegetation harbors also precious xerothermophilous plant and insect species. However, *Pinus* plantations and intensification of agriculture are severe threats to the diversity of Transylvanian steppes by reducing habitat area and modifying the floristic and faunistic composition. In time, the xerothermophilous plant associations that are still found in the glades of the *Pinus* plantations will disappear and with them the typical Lepidoptera fauna. Immediate renaturation measures are required for conservation of the xerothermophilous species in the Căianu Mic area.

Keywords: Lepidoptera, species list, diversity measures, steppe, Transilvania

Study area

The steppe regions of Transylvania recently gained the attention of lepidopterists because of their richness in rare and endemic Lepidoptera species. So far investigations of fauna and flora were preferentially carried out in protected steppe areas such as Fânaţele Clujului and Suatu village (RÁKOSY & LÁSZLÓFFY 1997; RÁKOSY 1999). Recent investigations led to the formation of a new steppe nature reserve – "Dealul cu fluturi" from Viişoara village (KOVÁCS et all. 2002). Species which are rare throughout Romania and Europe have been found in the steppe areas investigated until now.

The village Căianu Mic is situated at a distance of 23 km from Cluj-Napoca and 3 km northeast from Suatu village. The pastures in Căianu Mic are similar to those in the Suatu Nature Reserve; they are dominated by xerothermophilous grasses of the genus *Stipa*. Although the steppe pastures from Căianu Mic appeared to be inhabited by an interesting flora and fauna, they have not gained the attention of botanists and zoologists until now.

Because the steppes of Transylvania are peculiar, as they are habitats with an island-like distribution, each fragment should be carefully studied and mapped in order to develop efficient conservation methods for the entire network of habitats. Unfortunately the steppe habitats in Transylvania (except for few protected areas: Suatu, Fânațele Clujului, Zau de Câmpie, Viișoara) are not considered for further conservation.

Since diurnal (ERHARDT 1985) but also nocturnal Lepidoptera are good indicators for habitat quality, a rich Lepidoptera fauna could also indicate favorable habitat conditions for other groups of animals.

The aim of this study was to provide an inventory of the Lepidoptera fauna of Căianu Mic and to evaluate and compare the Lepidoptera diversity of Căianu Mic with similar but protected habitats in Transylvania.

Materials and Methods

To examine the diversity of Lepidoptera in the steppes of Căianu Mic, 5 sites, each covering an area of 2500 m^2 (50 m x 50 m) have been chosen (Fig.1). The sites represent all vegetation types of the locality: two sites of extensively grazed pastures (grazed every 2nd or 3rd year), one site of abandoned grassland with bushes (abandoned 10-15 years ago) and two sites of *Pinus* plantations (10-15 years old). The distance between the sites was 0.2-3 km.

From 21 may to 9 September 2001 all species of day-active Lepidoptera (Rhopalocera, Zygaenidae and day-active individuals of Noctuidae, Geometridae and other moth families) were recorded by transects. Transects were made at all study sites at least once every second week, under good weather conditions (HALL 1981). Transects were conducted in the following way: the sites were patrolled in a serpentine pattern, the observer recorded all Lepidoptera found 5 m in front and to the sides (NIELSEN 1991), so that the whole area of 2500 m^2 was covered by the butterfly net (HALL, 1981, DOUWES, 1976) (Fig.2). Transects were made between 9:00 and 17:00 hours. Acceptable weather

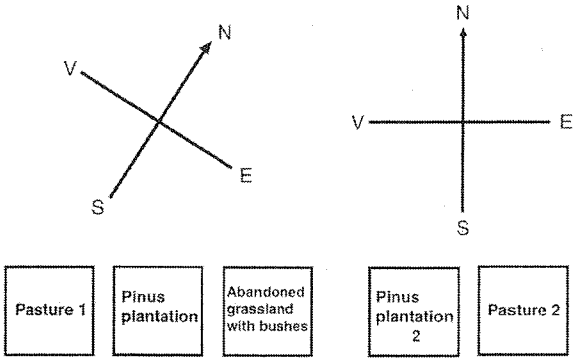

Fig. 1. Position of the sites within the Căianu Mic steppe hill

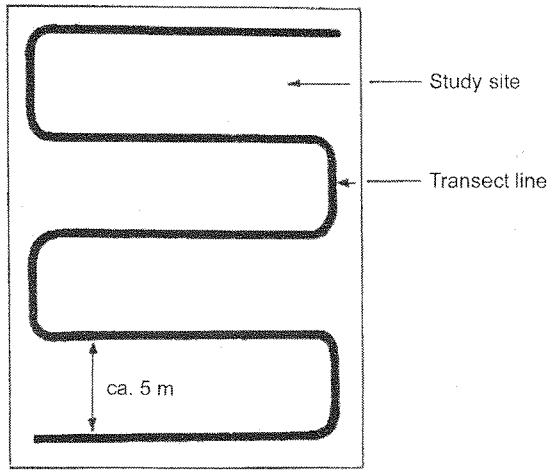

Fig. 2. Movement of the observer on an area transect (Erhardt, 1985)

conditions included sunshine during more than 60% of the patrolling time, temperatures above 18°C and wind-speed below Beaufort Scale 3 (16 km/h). The sequence of transects was kept random to avoid systematic effects of day time on potential activity patterns of the butterflies.

Nocturnal Lepidoptera were surveyed once a month at each site from 21 May to 12 October with light traps (8 W UV-tubes fixed to the top of black buckets covered by white funnels, fed by a small 12 V accumulator) avoiding full-moon nights (RÁKOSY 1999). The light traps were always installed at the same place of a site; one trap per site was operated from dusk to dawn. The collected specimens were determined and released in the morning. Only samples of problematic species were collected for identification by genitals.

Table 1.

Lepidoptera species found in Căianu Mic from May to October 2001, their abundance, zoogeographical and ecological status. (eua = Euro-Asiatic, bva = balkanic-western Asiatic, asee = Asiatic-eastern European, hol = holarctic, vam = western Asiatic-Mediterranean, evam = European-Western Asiatic-Mediterranean, cosm = cosmopolitan, eur = European, str = subtropical, tst = tropical-subtropical, end = endemic; mxtf = meso-xero-termophilous, mtf = meso-termophilous, xtf = xero-thermophilous, mf = mesophilous, mg = migratory, eu = euryoecious, mhf = meso-hygrophilous, mx = meso-xerophilous)

Species	Abundance (number of individuals)	Zoogeographical status	Ecological status
ZYGAENIDAE			
Zygaena carniolica	13	eua	mxtf
Zygaena purpuralis	13	eua	mxtf
Rhagades pruni	1	eua	mxtf
HESPERIIDAE			
Erynnis tages	6	eua	mxtf
Charcharodus alceae	1	eua	mtf
Muschampia crisbrellum	1	asee	xtf
Pyrgus carthami	4	eua	mtf
PAPILIONIDAE			
Iphiclides podalirius	2	eua	mxtf
Papilio machaon	1	hol	mtf
PIERIDAE			
Leptidea sinapis	35	eua	mf
Aporia crataegi	20	eua	mf
Pieris brassicae	5	eua	mf,mg
Pieris rapae	93	hol	eu,mg
Pontia daplidice	1	eua	mtf
Colias hyale	7	eua	mf,mg
Colias alfacariensis	27	vam	mtf,mg
Colias chrysotheme	1	asee	xtf
Colias crocea	12	evam	mtf,mg
NYMPHALIDAE			
Vanessa atalanta	3	cosm	eu,mg
Vanessa cardui	1	cosm	eu,mg
Nymphalis urticae	1	eua	eu,mg
Nymphalis c-album	1	eua	eu
Argynnis aglaja	2	eua	mf
Argynnis niobe	1	eua	mf
Boloria dia	14	eua	mf
Melitaea cinxia	5	eua	mf
Melitaea aurelia	4	eua	mf
Melitaea britomartis	21	eua	mtf
Melanargia galathea	103	eua	mf
Chazara briseis	8	pm	xtf
Minois dryas	99	eua	mtf

Species	Abundance (number of individuals)	Zoogeographical status	Ecological status
Maniola jurtina	41	evam	mf
Coenonympha pamphilus	13	eua	mf
Coenonympha glycerion	33	eua	mhf
LYCAENIDAE			
Satyrium acaciae	44	eua	mtf
Cupido osiris	1	eua	mtf
Glaucopsyche alexis	3	eua	mhf
Plebeius argus	130	eua	mf
Plebeius sephirus	2	bva	xtf
Plebeius idas	4	eua	mtf
Polyommatus coridon	1	eur	mxtf
Polyommatus bellargus	6	eua	mtf
Polyommatus icarus	8	eua	mf
GEOMETRIDAE			
Cabera exanthemata	2	eua	mf
Lomaspilis marginata	5	eua	mf
Ligdia adustata	8	eua	mf
Semiothisa clathrata	8	eua	mf
Semiothisa glarearia	25	vam	mxtf
Opisthograptis luteolata	1	eua	mf
Pseudopanthera macularia	85	eua	mf
Erannis defoliaria	4	eua	mf
Ematurga atomaria	3	eua	mf
Odontognophos dumetata	1	eua	mtf
Aplocera plagiata	2	eua	mtf
Camptogramma bilineata	8	eua	mf
Catarhoe cuculata	1	eua	mf
Cidaria fulvata	1	eua	mf
Cosmorhoe ocellata	2	eua	mhf,m
Chlorissa viridata	7	eua	mtf
Cataclysme riguata	35	eua	mxtf
Dyscia conspersaria	7	vam	xtf
Eupithecia abbreviata	1	vam	xtf
Eupithecia centaureata	9	eua	mf
Eupithecia linariata	3	eua	mf
Eupithecia plumbeolata	4	eua	mf
Epirrhoe alternata	4	eua	mhtf
Epirrhoe galiata	2	eua	mf
Hemistola chrysoprasaria	3	eua	mxtf
Horisme vitalbata	4	eua	mtf
Idaea aversata	15	eua	mf

Species	Abundance (number of individuals)	Zoogeographical status	Ecological status
Idaea rufaria	3	eua	xtf
Idaea ochrata	16	vam	xtf
Idaea aureolaria	1	eua	xtf
Idaea macilentaria	1	vam	tf
Orthonama obstipata	2	eua	mf
Peribatodes rhomboidaria	1	eua	mf
Rhodostrophia vibicaria	14	eua	xtf
Scopula immorata	10	eua	mxtf
Scopula immutata	12	eua	mf
Scopula incanata	11	eua	xtf
Scopula marginepunctata	26	eua	mxtf
Scopula ornata	1	eua	mxtf
Scopula rubiginata	10	eua	mxtf
Scopula virgulata	8	eua	xtf
Scotopteryx bipunctaria	3	vam	mxtf
Siona lineata	3	eua	mf
Thalera fimbrialis	2	eua	mxtf
Thetidia smaragdaria	1	eua	mf
Timandra griseata	23	eua	mtf,mth
Triphosa dubitata	1	eua	mf
Xanthorhoe birivata	3	eua	mhf
SPHINGIDAE			
Agrius convolvuli	1	str	mg
Delilephila elpenor	4	eua	mf
Delilephila porcellus	4	eua	mf
Hyles euphorbiae	2	eua	mx,mg
LYMANTRIIDAE			
Dicallomera fascelina	2	eua	mtf
ARCTIIDAE			
Atolmis rubricollis	5	eua	mf
Eilema pygmaeola pallifrons	12	eua	mxtf
Eilema sororcula	7	eua	mf
Lithosia quadra	2	eua	mf
Phragmatobia caesarea	4	eua	mtf
Phragmatobia fuliginosa	28	eua	mf
Spilosoma lubricipeda	4	eua	mf
Spilosoma lutea	4	eua	mf
Syntomis phegea	1	pm	mf
NOCTUIDAE			
Apamea monoglypha	1	eua	mf
Agrotis cinerea	7	eua	mxtf

Species	Abundance (number of individuals)	Zoogeographical status	Ecological status
Agrotis exclamationis	38	eua	eu
Agrotis ipsilon	7	cosm	mg,eu
Agrotis segetum	27	eua	eu
Calophasia lunula	1	eua	mxtf
Cerastis rubricosa	3	eua	mg,mf
Conisania poelli ostrogovichi	1	end	xtf
Euxoa distinguenda	2	eua	xtf
Euxoa obelisca	4	eua	mxtf
Noctua interposita	1	vam	mg,mf
Noctua fimbriata	6	vam	mg,mf
Noctua orbona	2	vam	mg,mf
Noctua pronuba	29	eua	mg,mf
Ochropleura plecta	9	hol	mf
Xestia triangulum	1	eua	mf
Xestia c-nigrum	15	cosm	eu,mg
Xestia xanthographa	1	vam	mtf
Ygoga forcipula	4	eua	xtf,mxtf
Agrochola circellaris	2	eua	mf
Agrochola lota	2	eua	mhf
Agrochola macilenta	1	vam	mf
Agrochola nitida	1	vam	mf
Athetis gluteosa	4	eua	xtf
Allophyes oxyacanthae	2	vam	mtf
Ammoconia caecimacula	3	eua	mtf
Paradrina clavipalpis	12	eua	eu,mg
Charanyca trigrammica	2	vam	mf
Actinotia hyperici	1	vam	mxtf
Conistra erytrocephala	3	vam	eu
Conistra vaccinii	7	eua	eu
Calamia tridens	1	eua	mxtf
Episema glaucina	1	vam	xtf
Eriopygodes imbecilla	2	eua	mhf
Hadena luteago	1	vam	mxtf
Heliophobus reticulata	13	eua	mxtf
Hoplodrina octogenaria	14	eua	mf
Hoplodrina ambigua	5	vam	mtf
Hoplodrina blanda	7	eua	mf
Litophane ornithopus	3	eua	mhf
Luperina testacea	1	vam	mf
Mesapamea secalis	2	eua	mf

Species	Abundance (number of individuals)	Zoogeographical status	Ecological status
Mesogona acetosellae	2	eua	xtf
Lacanobia w-latinum	11	eua	mf
Lacanobia aliena	3	eua	mtf
Lacanobia suasa	11	eua	mhf
Mamestra brassicae	3	eua	mf,mg
Mythimna l-album	15	eua	eu,mg
Mythimna ferrago	4	eua	mhf
Mythimna pallens	1	eua	mhf
Mythimna vitellina	2	str	xtf,mg
Mythimna albipuncta	5	vam	mf
Pachetra sagittigera	2	eua	mf
Polia bombycina	2	eua	mf
Phlogophora meticulosa	3	vam	mf,mg
Sideridis albicolon	1	vam	xtf
Tholera decimalis	59	eua	mf
Tholera cespitis	36	eua	mf
Mamestra bicolorata	6	eua	mtf
Mamestra dysodea	2	eua	mf
Hada nana	3	eua	mf
Cucullia fraudatrix	1	eua	mtxf
Cucullia mixta lorica	3	end	xtf
Cucullia umbratica	9	eua	mf
Omphalophana antirhinii	4	vam	xtf
Acronicta rumicis	8	eua	mhf
Acronicta tridens	4	eua	mtf
Simyra albovenosa	5	eua	thf
Craniophora ligustri	1	eua	mf
Amphipyra tragopoginis	2	hol	mf
Emmelia trabealis	18	eua	mxtf
Abrostola triplasia	6	eua	mf
Abrostola trigemina	4	eua	mf,mhf
Autographa gamma	14	eua	eu,mg
Dyachrisia chrysitis	2	eua	mf
Macdunnoughia confusa	18	eua	mtf,mg
Catocala fulminea	1	eua	mtf
Lygephilla craccae	233	eua	mtf
Tyta luctuosa	15	eua	xtf
Hypena proboscidalis	1	eua	mhf
Hypena rostralis	2	eua	mhf
Phytometra viridaria	2	eua	mf
Eublemma purpurina	5	vam	xtf

Species	Abundance (number of individuals)	Zoogeographical status	Ecological status
Helicoverpa armigera	6	tst,cosm	tf
Scoliopteryx libatrix	1	eua	mf
DREPANIDAE			
Cilix glaucata	1	eua	mf
Drepana binaria	1	eua	mf
Diloba coerulocephala	8	eua	mf
SATURNIIDAE			
Saturnia pavonia	2	eua	mxf
LASIOCAMPIDAE			
Eriogaster catax	2	eua	xtf
Trichiura crataegi	15	eua	mxtf

Diversity measures

Diversity includes two aspects: species richness and evenness, i.e. the distribution of individuals over the species present in a sample (KREBS 1998). We calculated species richness and abundance of individuals for each group of Lepidoptera (diurnal and nocturnal), for each site and for the whole locality. We also determined the evenness (Shannon's J) (LAMBSHEAD et all. 1983, SHANNON et all. 1949) for each site. These diversity measures (the species richness and abundance were ln-transformed to obtain normal distributions) were compared with corresponding measures from similar studies conducted in the surroundings of the villages Viişoara and Suatu by means of a one way ANOVA.

We also calculated percentages of species richness of diurnal and nocturnal Lepidoptera families.

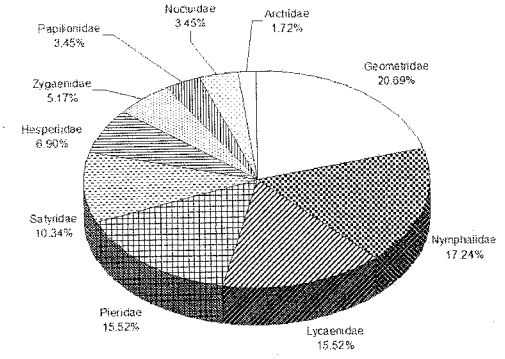

Fig. 3. Percentage of diurnal Lepidoptera species per family found in Căianu Mic.

Furthermore, we compared the species list of Căianu Mic with lists of Suatu and Viişoara in order to identify rare and peculiar species (KOVACS et all., 2001, RÁKOSY, 1999).

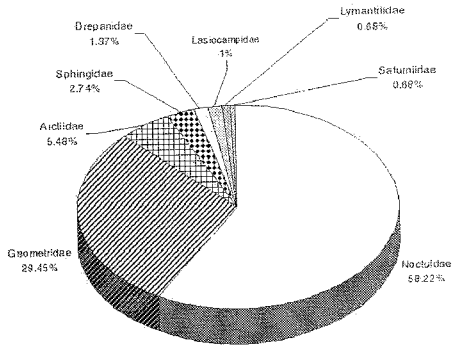

Fig. 4. Percentage of nocturnal Lepidoptera species per family found in Căianu Mic.

Results

From 21 May to 9 September 2001, 932 individuals belonging to 58 species and 10 families of diurnal Lepidoptera were recorded on the transects at the study sites of Căianu Mic.

21% of the diurnal Lepidoptera species were Geometridae, 17% Nymphalidae, 16% Lycaenidae, 16% Pieridae, 10% Satyridae, 7% Hesperiidae, 5% Zygaenidae, 3% Papilionidae, 3% Noctuidae and 2% Arctiidae (Fig.3).

Species richness, abundance and evenness of diurnal Lepidoptera recorded at the different investigated sites are indicated in table 2.

Between 21 May and12 October 2001, 1186 individuals belonging to 146 species and 8 families of nocturnal Lepidoptera were recorded in Căianu

Table 2.
Summary of the diversity measures for diurnal Lepidoptera in Căianu Mic

Study sites	Species richness	Abundance (number of individuals)	Evenness (Shannon's J)
pasture1	32	183	0,777
pasture2	28	120	0,864
bushes	34	296	0,797
Pinus plantation1	27	135	0,841
Pinus plantation 2	24	199	0,650

Table 3.
Summary of the diversity measures for nocturnal Lepidoptera in Căianu Mic

Study sites	Species richness	Abundance (number of individuals)	Evenness (Shannon's J)
pasture1	62	202	0.878
pasture2	81	367	0.780
bushes	121	432	0.872
Pinus plantation1	34	67	0.950
Pinus plantation 2	50	118	0.871

Mic (Table 1).

59% of the recorded nocturnal Lepidoptera species were Noctuidae, 29% Geometridae, 5% Arctiidae, 3% Sphingidae, 1% Drepanidae, 1% Lasiocampidae, 1% Lymantriidae and 1% Saturnidae (Fig. 4).

Species richness, abundance and evenness of nocturnal Lepidoptera recorded at each site are indicated in table 3.

The recorded species their abundance, zoogeographical and ecological status are listed in table 1. 76% of the Lepidoptera are represented by euroasiatic species, 13.3% by western-Asiatic Mediterranean species and under 5% by species from other zoogeographical regions. 38.8% of the Lepidoptera were mesophilous species, 13.8% meso-thermophilous species, 14.8% meso-xerothermophilous species, 12.2% xero-thermophilous species and under 10% species with other ecological preferences.

The analysis of variance showed no significant differences ($p<0.05$) between species richness, abundance and evenness of Lepidoptera from Căianu Mic and similar sites at Suatu and Viişoara (data not shown).

Discussion

We would expect that the anthropic influence in Căianu Mic would be more pregnant than that in Suatu because Căianu Mic has no protected areas and thus the diversity of Lepidoptera species should be lower. Nevertheless the ANOVA did not indicate any significant differences among these localities. The fact that Căianu Mic is not significantly different in the diurnal and nocturnal Lepidoptera species richness, abundance and evenness from Suatu and Viişoara is a strong argumentation that Căianu Mic deserves more attention concerning its biodiversity than it received so far.

Steppe habitats from Căianu Mic harbour uncommon and very precious xero-thermophilous species as e.g. *Muschampia cribrellum* (Eversmann, 1841), *Cucullia mixta* (Ronkay & Ronkay, 1987) or *Cupido osiris* (Meigen, 1828), which confirms the fact that the steppe habitats of Căianu Mic need conservation.

The steppe habitats of Căianu Mic have been strongly reduced by *Pinus* plantations. *Pinus* plantations are highly threatening for the remaining steppe areas not only because *Pinus* itself is atypical for these habitats, but even more because these plantations change the ecological characteristics of the habitat (Martin-Cano et all. 1998) and eliminate in a short time many of the xerothermophilous species. The negative effect of *Pinus* plantations becomes already obvious after 2-3 years and increases after canopy closure. In a 10-20 years old *Pinus* plantation typical steppe plant or Lepidoptera species have disappeared. Only species typical to coniferous forests become frequent in such plantations.

Both the biodiversity and the presence of specific steppe species at Căianu Mic are also threatened by increased intensity of agriculture.

Steppe habitats of Transylvania are further threatened by fragmentation. The conversion of steppe habitat isles to intensive agricultural land or pine plantations breaks the communications between remaining isles and interrupts the genetic flow. As a consequence a number of small, isolated populations may easily become extinct. In order to save plants, invertebrates and vertebrates typical for steppe habitats, a functional habitat network according to the metapopulational concept should be rebuilt (Settele 1998).

Conclusions

The present study shows that the species diversity of Lepidoptera in the steppe habitats of Căianu Mic is similar to that of other protected steppe habitats of Transylvania.

Extensive grazing does not negatively affect the diversity of Lepidoptera in these grasslands and some species seem even to profit from this type of cultivation.

Without intense human impact, the biodiversity of these steppe habitats is high and is well preserved even without being protected.

However, *Pinus* (*Pinus silvestris* and *Pinus nigra*) plantations eliminate species typical of steppe habitats within 2-5 years after planting. If trees are planted at lower densities, xero-thermophilous species may persist for 5-8 years. Thus *Pinus* plantations are a severe threat to the diversity of Transylvanian steppes by reducing habitat area and modifying the floristic and faunistic composition. The extent of this reduction depends on the age and the densities of the plantation.

Steppe habitats of Transylvania are thus endangered by both agricultural and sylvicultural practices i.e. intensive grazing, *Pinus* and/or acacia plantations and by resulting fragmentation.

The Căianu Mic hill with steppe vegetation harbors precious xerothermophilous plant and insect species. For the conservation of these species efficient conservation measures are needed. As a start the atypical *Pinus* plantations should be eliminated.

Acknowledgments

This study is part of a project funded by the Swiss National Science Foundation (project Nr.7SUPJ062313.00/1). We thank Prof. Dr. Baur Bruno from the University of Basel who initiated this project and also Eng. Marin Goia and Octavian Craioveanu for their support in the field and lab work.

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Received: 31.05.2003
Accepted: 11.10.2003
Printed: 30.12.2003

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