Contribuţii Botanice, *XXXIX*, **2004**
Grădina Botanică "Alexandru Borza"
Cluj-Napoca

CONTRIBUTIONS TO THE LICHEN FLORA AND LICHEN ECOLOGY IN THE PARÂNG AND LOTRU MOUNTAINS (SOUTHERN CARPATHIANS)

***Katalin BARTÓK*[1]*, László LŐKÖS*[2]**
[1] Universitatea "Babeş-Bolyai", Facultatea de Biologie şi Geologie, Catedra de Taxonomie şi Ecologie, str. Republicii, nr. 42, **RO-400015 Cluj-Napoca**
[2] Department of Botany, Hungarian Natural History Museum, Pf. 222, **H-1476 Budapest**

Abstract: The rich lichen flora of the Parâng Mts (S Carpathians, Romania) is still little known, while several papers were published also on the lichen flora of the nearby Retyezat and Fogaras Mts. Earlier collectings resulted in ca 130 species. During a short fieldwork in July 2001 some epiphytic lichens from the high montane region (1,600–1,700 m) and some terricolous and saxicolous lichens from the alpine zone (1,800–2,200 m) were collected at five localities from Norway spruce, dwarf mountain-pine, and alpine grassland vegetation, and from bare rocks. A total of 38 lichen species were identified; among them 13 taxa are mentioned for the first time in the Parâng Mts, while *Arthonia cf. ligniaria* is a new species for the Romanian lichen flora. The 38 taxa represent mainly arctic-alpine and boreal species. The ecological preferences of the lichens (light, humidity, temperature and chemical reaction of the substrate) allowed the discrimination of a high montane region lichen flora *vs*. a subalpine-alpine one.

Introduction

The Parâng Mts. located in the central-western part of the Southern Carpathians are extended over about 1,100 km^2. They consist of Mesozoic crystalline rocks with granitic intrusions in the southwestern part, and of marly-limestone deposits in the western and southern parts. Geomorphologically they present several peaks above 2,000 m altitude, the highest one, Parâng Peak reaching 2,519 m. The climate is typically of a high montane type with average annual temperatures of 0 °C at high altitudes, and of 3–4 °C at medium altitudes. The amount of precipitation is significant (1,200–1,400 mm/year) and the dominant winds blow from the west [5]. The deciduous forest zone reaches altitudes of 1,200–1,400 m, the coniferous forests are found up to 1,800 m altitude, while at higher altitudes (1,800–2,500 m) a mixed vegetation of extended dwarf mountain-pine and subalpine and alpine grasslands develops [8, 12].

The vascular flora of the massif was thoroughly studied and it is well-known [9, 10, 11], but lesser data are available on the lichen flora. Unfortunately no complete checklist is available on the lichens of the Parâng Mts, but several papers were published on the lichen flora of Transylvania [6, 7, 1, 2, 19, 16], which include information on lichens collected from the Parâng Mts. ŞTEFUREAC et al. (1957) mentioned 6 lichen species in the *Buxbaumia aphylla* moss association, and PÓCS (1958) also included lichens in his paper on the flora of the Southern Carpathians (*Gyrophora*, *Rhizocarpon*). Some recent publications [3, 4] are focused on the geobotanical study of the grasslands from the Parâng Mts. Among the accompanying species, these authors have mentioned some fruticose lichens such as: *Cladonia arbuscula*, *C. furcata*, *C. rangiferina*, *Cetraria islandica*, *C. nivalis*, and *Thamnolia vermicularis*.

In the same time, some herbaria in Budapest, Cluj, Sibiu, and Vienna preserve various lichen species collected in the area under study starting with the second half of the XIXth century (Csató, J., 1874; Lojka, H., 1874, 1880; Barth, J., 1878; Nagy, B., 1906; Jávorka, S., 1906, 1910; Zschacke, H., 1910; Gyelnik, V., 1935; Lupe, I., 1938; Pócs, T., 1955–56; Simon, T., 1956; Ştefureac, Tr., 1957 etc.).

Based on the current information on herbarium samples and in the bibliography (1873–2001) a checklist of about 130 species could be compiled that will be published in a later paper elsewhere. Unfortunately, most of these records lack information on the detailed location of the sampling point, and/or on the altitude.

The goal of the present paper is to provide a better knowledge on the lichen flora in the Parâng massif, especially in the subalpine and alpine zones, currently less studied, and to point out the differences related to the ecological demands of the lichens collected at various altitudes and vegetation zones.

Sampling Sites and Methods

Our field research took place during the summer of 2001 (July 8–13) and concerned the lichen flora of Mt. Muntinul – an area not studied previously, and of Tărtărău Pass. Mt. Muntinul is located in the central-western part of the Parâng massif, between the Middle Latorița and Lower Latorița valleys, the latter splitting into Urdele and Dengheru brooks. The studied area is characterised by subalpine and alpine vegetation.

Tărtărău Pass is located in the high montane region of Lotru massif, at 12 km from Obârşia Lotrului (= the spring of Lotru river), in the upper mountain area, the sampling site being dominated by Norway spruce (*Picea abies*) forests, about 50 years old.

Our research and the lichen sampling sites concerned the following sampling sites (Fig. 1 – map):

1. Tărtărău Pass, high montane coniferous zone (1,665 m altitude)
2. Mt. Muntinul, subalpine dwarf mountain-pine vegetation (1,800 m altitude)
3. Mt. Muntinul, alpine grassland vegetation (2,100 m altitude)
4. Mt. Urdele, alpine grassland vegetation (2,200 m altitude)
5. Mt. Muntinul, plateau with bare rocks (2,200 m altitude)

The ecological analysis of the collected taxa was based on the factors that determine their distribution: light, temperature, humidity, and chemical reaction of the substrate. According to WIRTH [17, 18], these ecological indices can be evaluated on a scale ranging from 1 to 10. They were used for comparing the lichens of the high montane coniferous region with those of the subalpine-alpine zones.

Results and Discussions

A total of 38 species were identified from the 5 sampling sites (Tab. 1), which were assigned to two orders (97.4% to *Lecanorales*, and 2.6% to *Arthoniales*), 12 families: *Parmeliaceae*, *Cladoniaceae*, *Baeomycetaceae*, *Stereocaulaceae*, *Porpidiaceae*, *Lecanoraceae*, *Lecideaceae*, *Lecidomataceae*, *Teloschistaceae*, *Pertusariaceae*, *Umbilicariaceae*, and *Arthoniaceae*, and respectively 19 genera, all from the class *Ascomycotina*.

Among them, 13 are new for the lichen flora of the Parâng massif (marked with boldface in table 1), while *Arthonia cf. ligniaria* represents a new species for the lichen flora of Romania. *Arthonia cf. ligniaria* were found in the subalpine dwarf mountain-pine vegetation on Mt. Muntinul (sampling site 2), at an altitude of 1,800 m, on a trunk of *Pinus mugo*. This species was mentioned by SCHOLZ, 2000 in Germany and by PURVIS et al., 1992 in the United Kingdom on acidic soil and on *Quercus* trunks. We use "cf." because we did not have comparison material. The identification was possible from PURVIS et al., 1992 according to the big spore size and the one-celled, protococcoid green alga.

The high montane coniferous region is dominated by epiphytic lichens and elements of boreal flora, while in the subalpine and alpine zones of Mt. Muntinul, the terricolous and saxicolous lichens accompanied by arctic-alpine elements prevail.

Table:1 Lichen species distribution in the studied areas

Species	Sampling sites				
	1	2	3	4	5
Arthonia didyma Körber		+			
Arthonia ligniaria Hellb		+			
Bryoria implexa (Hoffm.) Brodo et Hawksw.	+				
Cetraria cucullata (Bellardi) Ach.			+		
Cetraria ericetorum Opiz		+			
Cetraria islandica (L.) Ach.		+	+	+	+
Cetraria nivalis (L.) Ach.				+	
Cetraria sepincola (Ehrh.) Ach.		+			
Cladonia arbuscula (Wallr.) Flot.		+			+
Cladonia coccifera (L.) Willd.		+			+
Cladonia deformis (L.) Hoffm.		+			
Cladonia fimbriata (L.) Fr.		+			
Cladonia gracilis (L.) Willd.		+			
Cladonia mitis Sandst.				+	
Cladonia pyxidata (L.) Hoffm.					+
Cladonia rangiferina (L.) Weber ex F. H. Wigg.					+
Cladonia sulphurina (Michx.) Fr.		+			
Cladonia uncialis (L.) Weber ex F. H. Wigg.		+			+
Dibaeis baeomyces (L. fil.) Rambold et Hertel	+		+		
Hypogymnia physodes (L.) Nyl.	+				
Hypogymnia tubulosa (Schaer.) Hav.	+				
Lecanora chlarotera Nyl.	+				
Lecanora polytropa (Ehrh. ex Hoffm.) Rabenh.	+				+
Lecidoma demissum (Rustr.) Gotth.Schneid. et Hert.		+			
Parmeliopsis ambigua (Wulfen) Nyl.		+			
Parmeliopsis hyperopta (Ach.) Arnold		+			
Pertusaria sp. (steril)				+	
Platismatia glauca (L.) W. L. Culb. et C. F. Culb.	+				
Porpidia macrocarpa (DC.) Hertel et A. J. Schwab					+
Pseudevernia furfuracea (L.) Zopf	+				
Rhizocarpon geographicum (L.) DC.			+		
Stereocaulon alpinum Laurer			+	+	+
Thamnolia vermicularis (Sw.) Schaer.			+	+	+
Trapeliopsis granulosa (Hoffm.) Lumbsch		+			
Umbilicaria cylindrica (L.) Del. ex Duby					+
Usnea cf. filipendula Stirt.	+				
Vulpicida pinastri (Scop.) J.-E. Mattsson et M. J. Lai		+			
Xanthoria elegans (Link) Th. Fr.					+

A typical lichen flora has been identified at high altitudes, around 2000 m. The subalpine and alpine grasslands mixed with herbs and moss patches are characterised by the dominance of fruticose lichens belonging to genera *Cetraria* (*C. cucullata*, *C. ericetorum*, *C. islandica*, *C. nivalis*), and *Cladonia* (*C. arbuscula*, *C. coccifera*, *C. gracilis*, *C. mitis*, *C. pyxidata*, *C. rangiferina*, *C. uncialis*). *Stereocaulon alpinum* and *Thamnolia vermicularis* are abundant in the sampling sites 3, 4, and 5. In the areas lacking vegetation, covered by humus, or on the surface of decayed grass (sampling site 2), light-grey or greenish crustose lichens belonging to the species *Dibaeis baeomyces*, *Lecidoma demissum*, *Pertusaria* sp., or *Trapeliopsis granulosa* have settled.

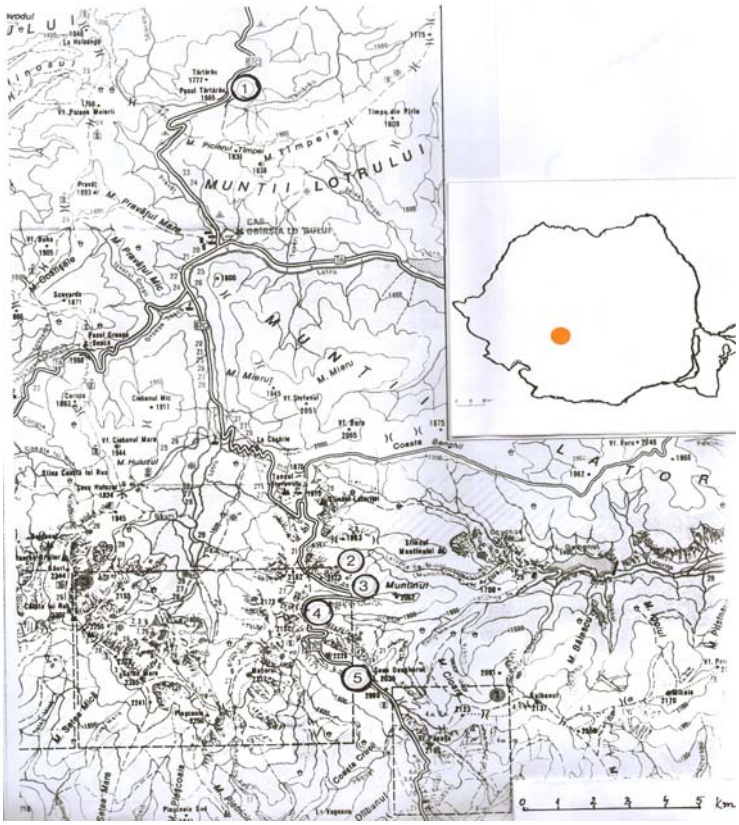

Fig. 1: Sampling sites in the Parâng and Lotru Mountains

The surface of the isolated blocks and of crystalline rocks (sampling site 5) is coloured in light grey by the thalli of *Porpidia macrocarpa*, in blackish-grey by that of *Umbilicaria cylindrica*, in greenish-yellow by *Rhizocarpon geographicum*, or in reddish-orange by *Xanthoria elegans*.

The lichen flora of the Norway spruce forest from Tărtărău Pass was analysed in relation with the ecological preferences of the species toward temperature (Fig. 2), humidity (Fig. 3), chemical reaction of the substrate (Fig. 4), and light (Fig. 5).

The plot showing the temperature preference of lichens (Fig. 2) indicates the dominance of the microthermal species (55.5%); the micro-mesothermal (22.2%) and respectively eurythermic (22.2%) species are distributed in equal amounts.

Based on the humidity preference (Fig. 3), the xeromesophilous (44.4%) and mesophilous (33.3%) lichens show an almost similar distribution; only 22.2% are represented by mesophilous-mesohygrophilous lichens, which develop optimally at amounts of precipitation higher than 800 mm/year.

All the lichen species identified in the studied Norway spruce forest show a clear preference for acidic substrates (Fig. 4), as it is also the case of the conifer trunks where they are established. Dominant are the acidophilous (pH values of 4.1–4.8), and strong acidophilous (pH values of 3.4–4) species (33.3%); to a lesser extent (11.1%) also the moderately acidophilous (pH 4.6–5.2) species are present.

Regarding the light preferences (Fig. 5), the lichen species identified in this forest habitat do not show restrictive behaviours; the moderately photophilous species are dominant (66.7%), followed by the photophilous ones (22.2%), the photo-ombrophilous – moderately photophilous species being subordinated (11.1%).

Due to the fact that the sampling sites 2, 3, 4 and 5 are all located at similar altitudes in the subalpine and alpine zones on Mt. Muntinul, the lichens being hosted by subalpine and alpine

grasslands, developing on the soil or on the bare rocks spread among grass, or on the dwarf mountain-pine (*Pinus mugo*) and *Vaccinium* sp. vegetation, the ecological indices have been calculated and plotted together (Figs. 6, 7, 8 and 9).

The lichens of the subalpine-alpine zones show little preference towards temperature (Fig. 6): 41.4% of them are microthermal, and 34.1% are eurythermic; however, some cryophilous species (14.6%) were adapted to the low temperatures of the alpine zone.

On the contrary, the humidity preferences of the lichens in these habitats (Fig. 7) are more diversified: 31.7% of the species are mesophilous, preferring precipitation levels >750 mm/year, 21.9% are euryhygrous species, while similar relative amounts are represented by mesohygrophilous (17.1%) and hygrophilous (14.6%) species – that prefer precipitation levels of up to 1400 mm/year. The xeromesophilous species are less frequent (2.4%).

It is well-known that the soils in subalpine and alpine areas are strongly acidic, thus most of the terricolous and saxicolous lichen species in the studied areas shows preference for strongly acidic substrates (Fig. 8): 48.8% are strong acidophilous species, 26.8% are acidophilous, but also extremely acidophilous species have been identified (representing 2.4%). Very scarce are the euryionic species (14.6%), *i.e.* species showing no relation with the pH of the substrate, as well as the moderately acidophilous and neutrophilous species (each present in equal distributions, 2.4%).

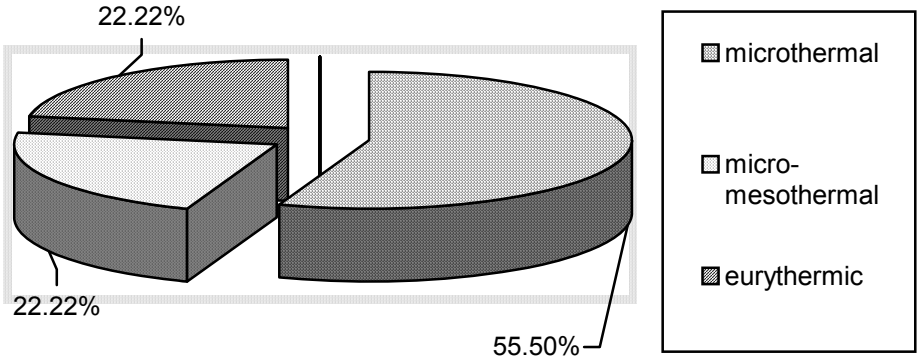

Fig. 2: Percentual distribution of the lichen species from Tărtărău Pass, in relation with their preferences toward the temperature

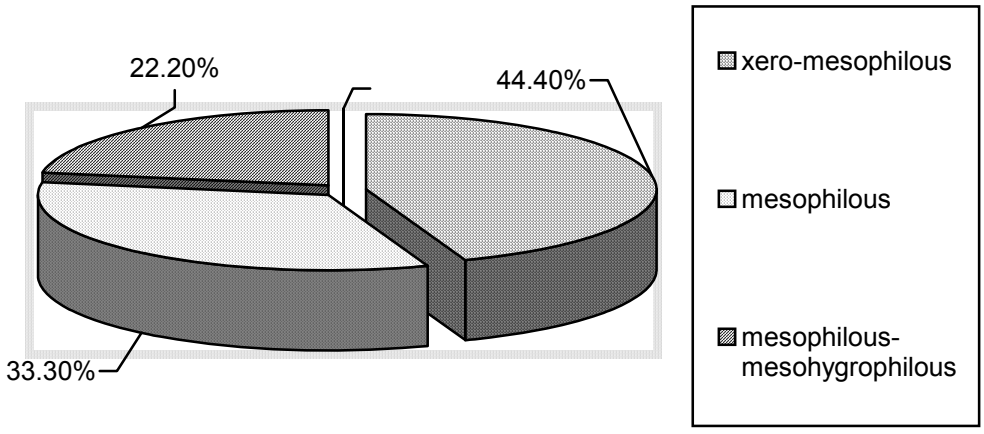

Fig. 3: Percentual distribution of the lichen species from Tărtărău Pass, in relation with their preferences toward the humidity

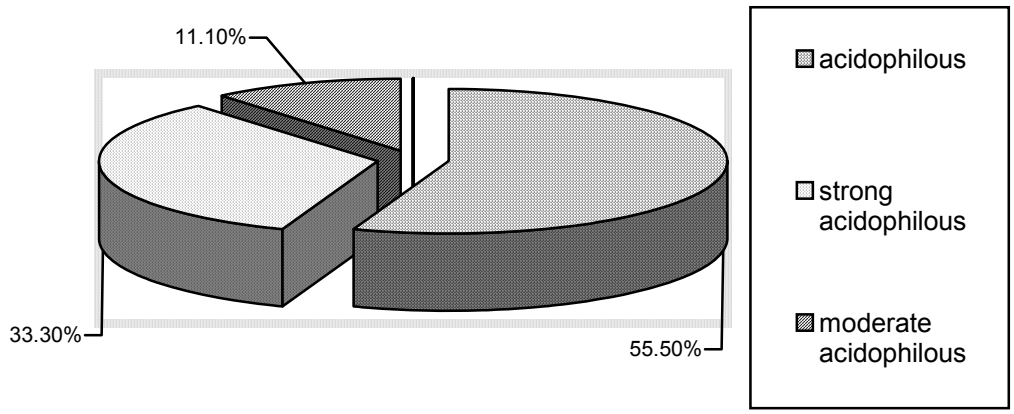

Fig. 4: Percentual distribution of the lichen species from Tărtărău Pass, in relation with their preferences toward the chemical reaction of the substrate

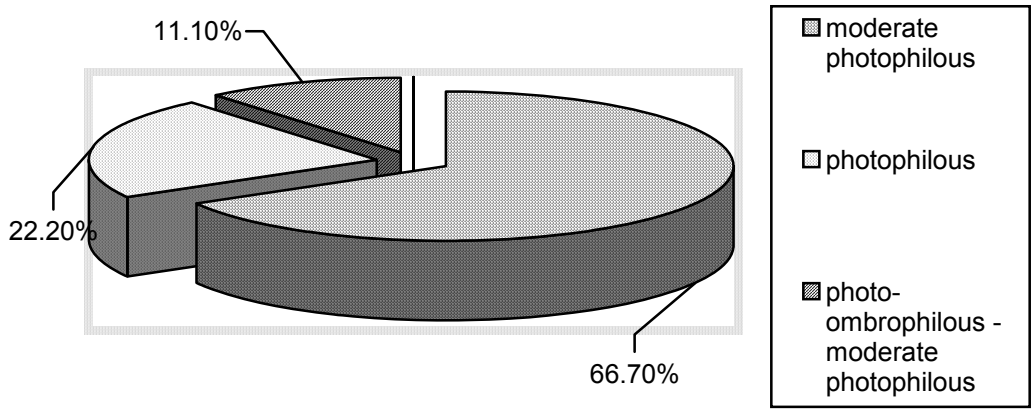

Fig. 5: Percentual distribution of the lichen species from Tărtărău Pass, in relation with their preferences toward light

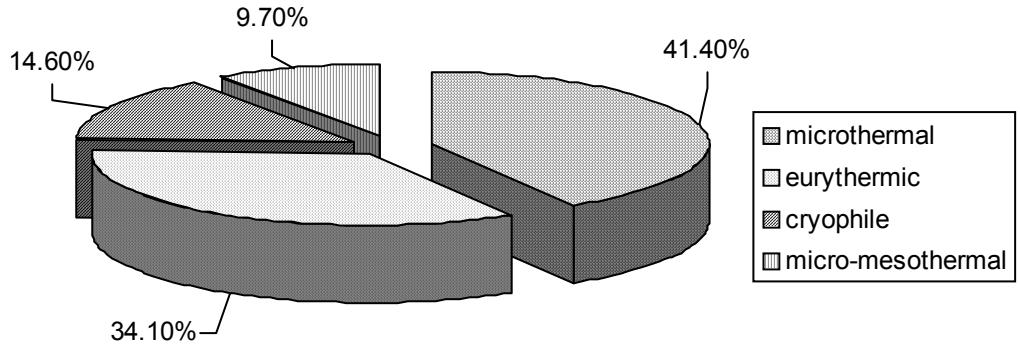

Fig. 6: Percentual distribution of the lichen species from Muntinul Mountains, in relation with their preferences toward the temperature

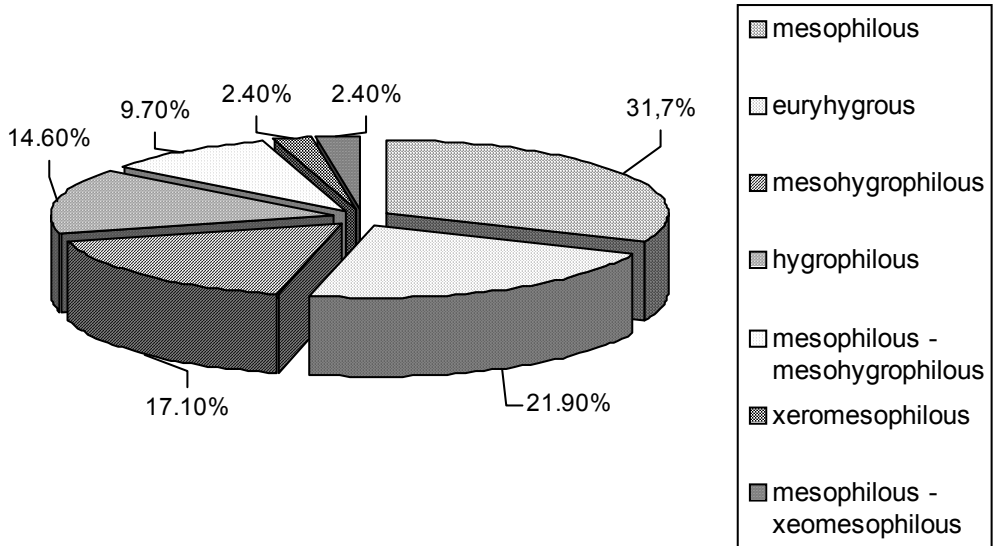

Fig. 7: Percentual distribution of the lichen species from Muntinul Mountains, in relation with their preferences toward the humidity

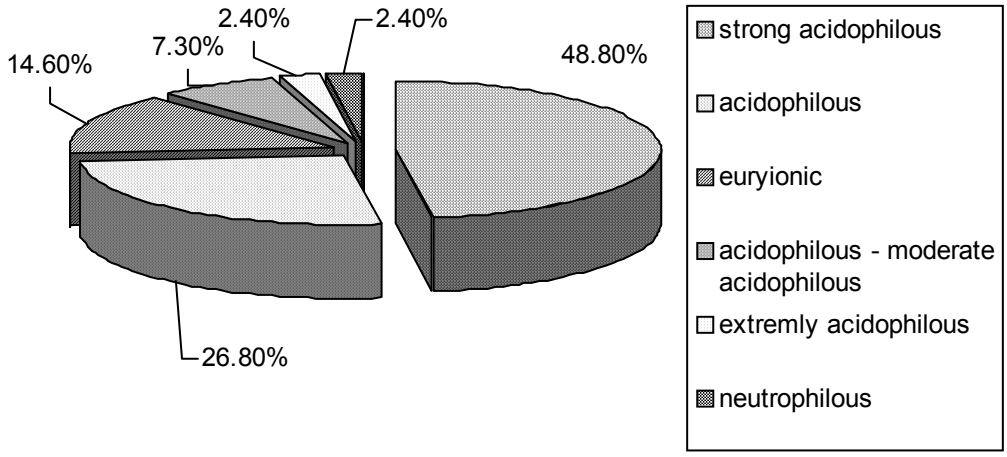

Fig. 8: Percentual distribution of the lichen species from Muntinul Mountains, in relation with their preferences toward the chemical reaction of the substrate

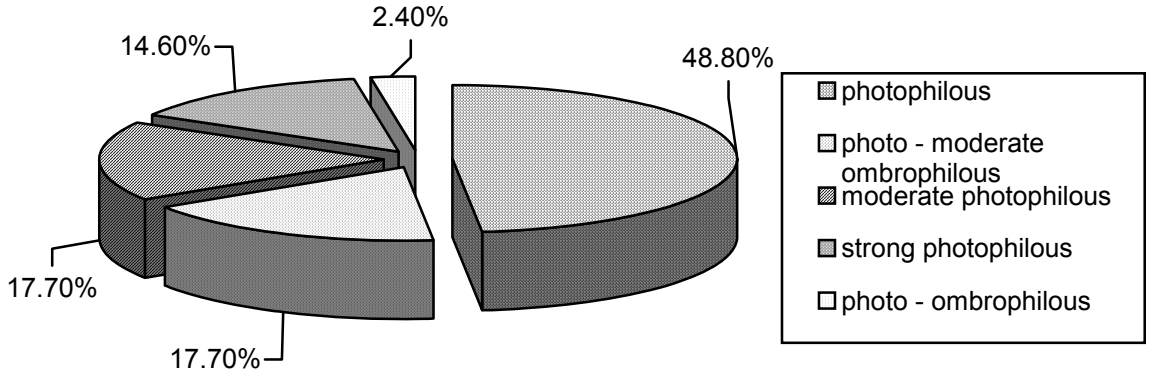

Fig. 9: Percentual distribution of the lichen species from Muntinul Mountains, in relation with their preferences toward light

Based on the light preferences (Fig. 9), the great majority of the lichens in these habitats show a strong preference for light; 48.8% are photophilous, 14.6% are strong photophilous, and 17. 7 % are moderately photophilous species. The ombrophilous lichens are rare (2.4%). This distribution corresponds to the actual light exposure of the vegetation in the area under study.

Conclusions

The field research performed during the summer of 2001 in Parâng and Lotru Mountains area led to the sampling and identification of 38 lichen species, among which 13 are new species for the lichen flora of the area, while *Arthonia cf. ligniaria* is a new species for Romania.

Our study was carried out on the vegetation of the Norway spruce forest from Tărtărău Pass (1,665 m altitude) on the one hand, and on various vegetation types: dwarf mountain-pine, subalpine and alpine grasslands, as well as the bare rocks plateau of the subalpine and alpine zones of Mt. Muntinul (1,800–2,200 m altitude), on the other.

The dwarf mountain-pine vegetation is dominated by boreal elements, while the subalpine-alpine zones by arctic-alpine elements.

The increase in altitude favoured the installation of lichen species showing stronger preferences toward light and humidity, a strongly acidic substrate, as well as lower temperatures.

In conclusion, the evaluation of the ecological preferences of the lichens allowed the discrimination of a high montane region lichen flora *vs*. a subalpine-alpine one.

Acknowledgements: – We are grateful to Dr. Edit Farkas (MTA ÖBKI, Vácrátót) for her help in identification of *Arthonia cf. ligniaria*, and to Ms. Lehoczky Frigyesné for her assistance in screening the herbarium material. This research work was partly supported by the Hungarian Scientific Research Fund (OTKA Grant Nos T 30209 and T 47160).

REFERENCES

1. Barth, I., 1883a, Zur Kryptogamenflora Siebenbürgens, *Verh. Mitteil. Siebenb. Ver. Naturw.*, **27**: 97.
2. Barth, I.,1883b, Eine Exkursion in's Hatzegerthal, dann in beiden Schielthaler und auf das Pareng, *Verh. Mitteil. Siebenb. Ver. Naturw*., **33**: 1–10.
3. Buia, Al., Păun, M.,1962, Consideratii asupra florei si vegetatiei. In: *Pajiştile din Masivul Parîng şi îmbunătăţirea lor*, Supl. Bul. Ştiint., Editura Agro-Silvica, Bucuresti: 75–95.
4. Buia, Al., Păun, M., Pavel, C., 1962, Studiul geobotanic al pajiştilor. In: *Pajiştile din Masivul Parîng şi îmbunătăţirea lor*, Supl. Bul. Ştiint., Editura Agro-Silvica, Bucuresti: 141–271.
5. Ghinea, D., 1996, *Enciclopedia geografica a Romaniei*, Vol. 2, Edit. Enciclopedică, Bucureşti.
6. Lojka, H., 1873, Adatok Magyarhon zuzmóirányához I, *Math. és Term. Közlem.*, **11**: 39–76.
7. Lojka, H., 1874, Adatok Magyarhon zuzmóirányához II, *Math. és Term. Közlem.*, **12**: 89–129.
8. Pócs, T., 1958, A Déli-Kárpátok növényvilága. (Flora of the Southern Carpathians), *Természettudományi Közlöny*, **89***,* (11): 485–488.
9. Pócs, T., 1961, Flore du massif du Parîng (Carpathes méridionaux en Roumanie) I. (A Páreng hegység flórája I), *Fragm. bot.*, **1**: 49–128.
10. Pócs, T., 1962, Flore du massif du Parîng (Carpathes méridionaux en Roumanie) II. (A Páreng hegység flórája II), *Fragm. bot.*, **2**: 73–130.
11. Pócs, T., 1967, Flora du massif du Paring (Carpathes méridionaux en Roumanie) III. (A Páreng hegység flórája III), *Fragm. bot.*, **5**: 69–98.
12. Popescu, N., 1986, *Parîng, Munţii noştri colecţie*, nr. 35, Edit. Sport-Turism, Bucuresti.
13. Purvis, O.W., Coppins, B.J., Hawksworth, D.L., James, P.W., Moore, D.M. (eds), 1992, T*he lichen flora of Great Britain and Ireland*, The British Lichen Society, Natural History Museum Publications, London.
14. Scholz, P., 2000, *Katalog der Flechten und flechtenbewohnenden Pilze Deutschlands*, Bundesamt für Naturschutz, Bonn–Bad Godesberg.
15. Ştefureac, Tr.I., Popescu, A., Lungu, L., 1957, Aspects de l'association a *Buxbaumia aphylla* L. dans les formation d'epicea (Picea excelsa (Lam.) Link) des monts Lotru-Paring des Carpates meridionales, *Buletin Ştiinţific, secţia Biologie şi Ştiinţe Agricole*, **9**: 61–75.

16. Szatala, Ö., 1932, Lichenes a divo H. Lojka relictae. (Lojka Hugó hagyatékának zuzmói), *Magyar Botanikai Lapok*, **31**: 67–126.
17. Wirth, V., 1992, Zeigerwerte von Flechten. In: Ellenberg, H. (ed.): Zeigerwerte von Pflanzen in Mitteleuropa, *Scripta Geobotanica*, **18**: 215–237.
18. Wirth, V., 1995, *Die Flechten Baden-Württembergs*, Verlag Eugen Ulmer, Stuttgart.
19. Zschacke, H., 1913, Zur Flechtenflora von Siebenbürgens, *Verh. Mitteil. Siebenb. Ver. Naturw.*, **63**: 111–166.

CONTRIBUȚII LA STUDIUL FLOREI LICHENOLOGICE ŞI LA ECOLOGIA LICHENILOR DIN MUNȚII PARÂNG ŞI LOTRU (CARPAȚII MERIDIONALI)

(Rezumat)

Date asupra florei lichenologice a Munților Parâng se găsesc inserate în diferite lucrări botanice referitoare la aceşti munți, sau în general la Carpații românești, iar eşantioane de licheni se păstrează în unele herbarii din țară şi străinătate. O lucrare dedicată special acestui subiect nu a fost publicată.

Cercetările noastre au fost realizate în vara anului 2001, în 5 staționare situate în Munții Parâng şi Lotru, corespunzând tot atâtor tipuri de biotopuri, după cum urmează: 1. Pasul Tărtărău, Mții Lotrului, molidiş montan superior (alt. 1665 m); 2. Mt. Muntinu, Mții Parâng, jnepeniş subalpin (alt.. 1800 m,); 3. Mt. Muntinu, pajişte alpină (alt. 2100 m); 4. Mt. Urdele, pajişte alpină (alt. 2200 m); 5. Mt. Muntinu, platou cu pietre (alt. 2200m).

În materialul colectat au fost identificate 38 specii de licheni, care aparțin la 19 genuri, 12 familii şi 2 ordine din clasa Ascomycotina. Dintre acestea, 13 specii (*Arthonia* cf. *ligniaria, Cetraria sepincola, Cladonia coccifera, Cladonia deformis, Cladonia sulphurina, Cladonia uncinalis, Dibaeis baeomyces, Hypogymnia physodes, Lecanora chlarotera, Parmeliopsis ambigua, Parmeliopsios hyperopta, Trapeliopsis granulosa, Xanthoria elegans*) sunt noi pentru flora lichenologică a Munților Parâng, iar *Arthonia* cf. *ligniaria (*descoperită în staționarul nr. 2 pe scoarță de *Pinus mugo)* este specie nouă pentru lichenoflora României.

Pe baza *indexului ecologic,* după Ellenberg şi Wirth (1992), calculat pentru licheni din molidiş şi separat pentru licheni din etajele subalpin şi alpin, s-a constatat schimbarea preferințelor acestora față de condițiile mediului înconjurător. Este evident faptul că o creştere a altitudinii favorizează instalarea unor licheni cu cerințe mai mari față de lumină şi umiditate, în acelaşi timp cu preferințe accentuate față de un substrat puternic acid şi față de temperaturi mai scăzute. Astfel, din acest punct de vedere se poate distinge flora lichenologică a etajului montan superior de cea a etajului subalpin-alpin.

Sub raport biogeografic, se constată că în molidiş predomină elementele boreale, iar în etajul subalpin-alpin, elementele arcto-alpine.

Lucrarea noastră constituie doar un prim pas spre cunoaşterea complexă a lichenoflorei Munților Parâng, care considerăm că ar trebui studiată în cât mai multe puncte situate pe culmile şi pe versanții acestor munți.