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ECOLOGICAL AND PHYTOGEOGRAPHICAL STUDIES UPON FOLIOSE AND FRUTICOSE LICHENS FROM THE PĂDUREA CRAIULUI MOUNTAINS (BIHOR COUNTY)

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Abstract: The inventory of foliose and fruticose lichens from the Pădurea Craiului Mountains contains 135 taxa (59 corticolous, 38 saxicolous, 29 tericolous, 5 lignicolous and 5 muscicolous). The lichen species were characterised using the ecological indexes (light, humidity, temperature and chemical reaction of the substrate) published by *Ellenberg* et al. (1992) and *Wirth* (1995), and the analysis of bioforms and geographical elements.

Introduction

The Pădurea Craiului Mountains are located in the north-western part of the Apuseni Mountains. They form a large "half-isle", both from geological and morphological point of view.

They occupy a space between the Iadului Valley (East), the Beiușului Depression (South) and the Vadului depression (North). They form a platform fragmented in peaks and isolated massifs, separated by carstic depressions and valleys. The altitudes gradually decrease toward Northwest, from 986 m (the Iadului Valley) to 350 m (The Oradiei hills) and toward the two peripheral depressions.

The great variety of bed-rocks which constitute the Pădurea Craiului Mountains, their structure and distribution gives a specific feature to the relief, with a very large range of forms born under the action of the modeling factors. As a whole, the Pădurea Craiului Mountains are formed by a succession of peaks orientated from south-east to north-west and by several isolated massifs, which are in contrast with the surrounding relief. The alternation of the positive forms with the negative ones, as well as the vertical and horizontal succession of the limestone with the limefree rocks give the most conspicuous feature of the study mountains.

Two important relief forms can be distinguished in the Pădurea Craiului Mountains depending on the geological substratum, one built on impermeable (limefree) rocks and one built on limestone.

From the hydrographic point of view, the Pădurea Craiului Mountains are located between Crișul Repede (north) and Crișul Negru (south) rivers. All the rivulets in this area flow into one of the two mentioned rivers.

The basic feature of the edaphic cover of the Pădurea Craiului Mountains is the predominance of clay-iluvial soils and the occurrence of rendzins, terra rossa, etc., as intrazonal soils. For example, the abundant rainfall in the Pădurea Craiului Mountains is correlated with the dominance of clay-iluvial soils, while the existence of rendzins and terra rossa isles reflects a specific geological substratum: limestones or dolomites. The Pădurea Craiului Mountains have a piedmont and mountain climate.

Material and method

The analysis of flora was carried out on the basis of foliose and fruticose lichen specimens collected and determined between 1992-1998. The specimens were entirely verified by dr. Roland Moberg from Uppsala University (Sweden) and dr. Emmanuel Sérusiaux from Liège University (Belgium). The rare and new species for the Romanian lichen flora are kept in the Herbarium of the "Al. Borza" Botanical Garden in Cluj-Napoca. For a more complete analysis of lichen flora we have used chorologic data from Moruzi, Petria, Mantu, (1967), *Catalogue of the lichens from Romania* as well as the specimens from the Liège University's Herbarium, the Herbarium of the Botany Institute of Uppsala's University and the Herbarium of the "Al. Borza" Botanical Garden.

The lichen flora was analysed in relation with the ecological preferences of the species toward light (Fig. 1), humidity (Fig. 2), temperature (Fig. 3) and chemical reaction of the substrate (Fig. 4). Indicator values for the lichens that we have used are those published Ellenberg et al. (1992) and Wirth (1995)

Results and discussion

We catalogued 135 species and one variety of foliose and fruticose lichens, belonging to 57 genera, 24 families and 10 orders, all from the class Ascomycotina. The order with the largest number of families is Lecanorales with 12 families and 100 taxons. The families with the largest number of species catalogued in the Pădurea Craiului Mountains are Parmeliaceae (26), Cladoniaceae (20), Physciaceae (13), Collembataceae (12), Lecanoraceae (11) and Peltigeraceae (10).

We mentioned 25 rare species found in the studied area, 8 corticolous, 8 saxicolous, 5 tericolous, 2 lignicolous and 2 muscicolous. We also mentioned 5 new species for the Romanian lichen flora, 4 saxicolous - *Collema subflaccidum* Degel., *Leptogium teretiusculum* (Wallr.) Arnold, *Phaeophyscia chloantha* (Ach.) Moberg, *Phaeophyscia hirsuta* (Mereschk.) Moberg and one corticolous *Parmelina pastilifera* (Harm.) Hale.

The analysis of the lichens flora in relation with the preferences of the species toward **light** (Fig. 1) shows the predominance of the moderate photophilous (31,61%), followed by the photophilous (21,32%), photo - ombrophilous (16,91%) and photo - ombrophilous - moderate photophilous (15,44%).

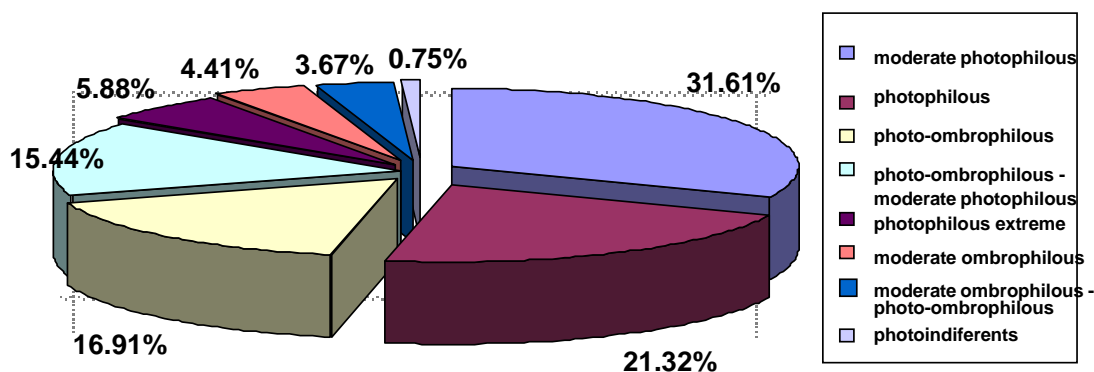


Fig. 1: Percentual repartition of the species in relation with their preferences toward light.

Less represented the species strong photophilous (5,88%), moderate ombrophilous (4,41%), moderate ombrophilous - photo - ombrophilous (3,67%) and euryphotic (0,75%).

The **humidity** regime (Fig. 2) shows that the xeromesophilous species are predominant (32,35%). Well represented are the mesophilous (16,17%) and meso-higrophilous (10,29%) species. Less represented are the xerophilous and mesophilous - meso-higrophilous species (8,83% each), xero-mesophilous and higrophilous ((8,83% each) and euryhygrous (7,36%).

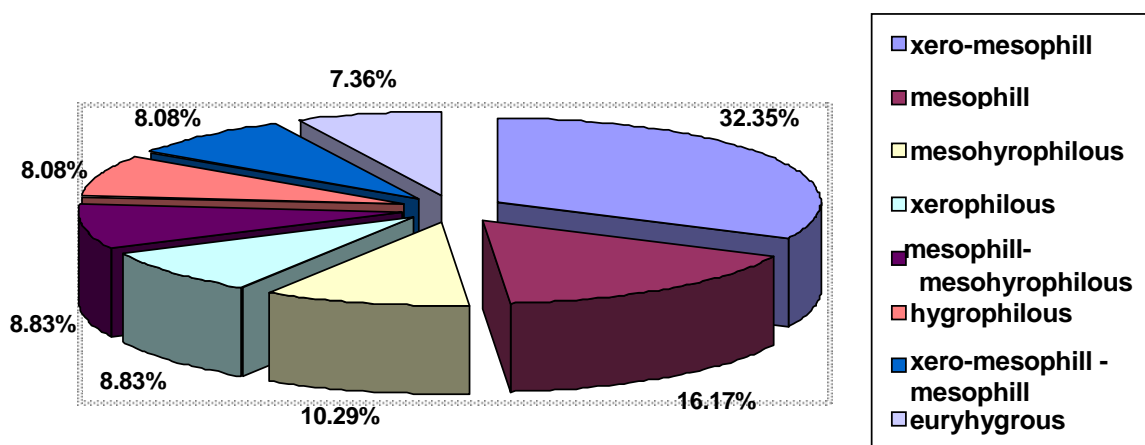


Fig. 2: Percentual distribution of the species in relation with their preferences toward the humidity.

Comparing with the results recorded from the same area at higher plants (Tab. 1) by Groza (1999), we observe the values almost similar for the xero-mesophil species (35,3 % for higher plants, 32,35 % for lichens) and xerophilous species (11,5 % for higher plants, 10,29 % for lichens). Differences appears at the level of mesophil species - 39,6 % for higher plants, 16,17 % for lichens.

Probably, the difference is the result of the intermediate categories which exist for lichens (xero-mesophil - mesophil 8,08 % and mesophil - mesohygrophilous 8,08 %). Adding the values recorded for those two categories to the percent of lichen mesophil species we will obtain 33,08 %, a value close to that recorded for higher plants (39,6 %).

Table 1: Comparative situation of the percentual repartition of the higher plant species and lichens in relation with their preferences toward humidity.

	HIGHER PLANTS	LICHENS
xero-mesophil	35,3 %	32,35 %
mesohygrophilous	11,5 %	10,29 %
xerophilous	5,8 %	8,83 %
mesophil	39,6 %	16,17 %
xero-mesophil - mesophil	-	8,08 %
mesophil - mesohygrophilous	-	8,08 %

The **temperature** figure (Fig. 3) indicate the dominance of the micro-mesothermal (33,09%), eurythermic (28,68%) and microthermal (22,05%) species. In small number participate the moderate termophilous (12,50%), termophilous (2,94%) and criophilous (0,73%) species.

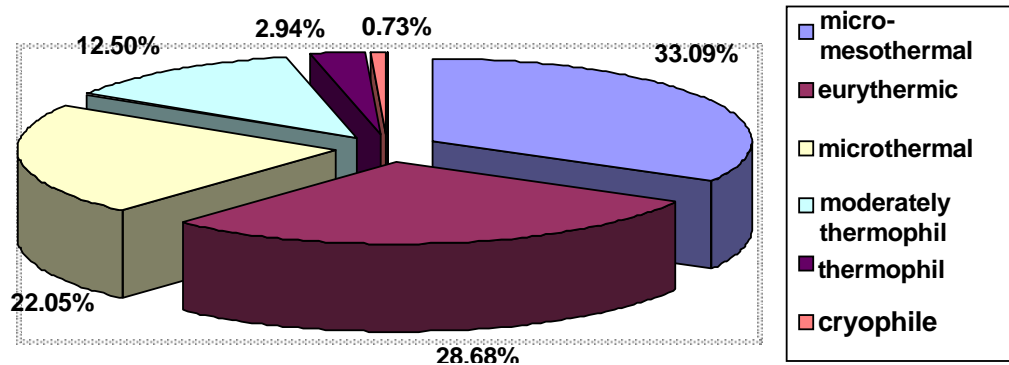


Fig. 3: Percentual distribution of the species in relation with their preferences toward the temperature

Comparing with the results recorded at higher plants in Pădurea Craiului Mts. (Tab. 2) by Groza (1999), we observe the very close values scored for the cryophile species (0,6 % for higher plants, 0,73 % for lichens) and moderately thermophil species (12,2 % for higher plants, 12,5 % for lichens). Even the thermophil species present almost similar values (1,2 % for higher plants, 2,94 % for lichens). Major differences appears at the level of micro-mesothermal species

(65,6 % for higher plants, 33,09 % for lichens) and especially for the microthermal species (22,05 % for the lichens and none for the higher plants).

Table 2: Comparative situation of the percentual repartition of the higher plant species and lichens in relation with their preferences toward temperature.

	HIGHER PLANTS	LICHENS
cryophile	0,6 %	0,73 %
moderatey thermophil	12,2 %	12,5 %
thermophil	1,2 %	2,94 %
micro-mesothermal	65,6 %	33,09 %
microthermal	-	22,05 %

Regarding the **chemical reaction of the substrate** (Fig. 4) we notify the close values of the categories subneutrofilous (16,17%), basiphilous (14,71%), acidophilous (13,97%), moderate acidophilous (13,23%), acidophilous - moderate acidophilous (12,50%), neutrofilous (11,76%) and moderate acidophilous - subneutrofilous (11,02%). Less represented are the strong acidophilous (5,88%) and amphotolerant (0,75%) species.

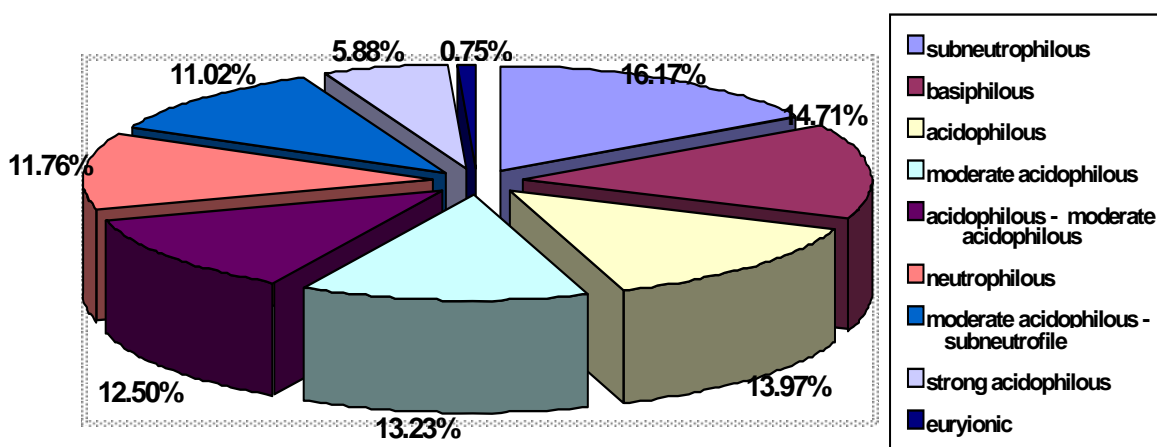


Fig. 4: Percentual distribution of the species in relation with their preferences toward the chemical reaction of the substrate.

The analysis of bioforms (Tab. 3) shows the predominance of the *Parmelia* type (23,52%) species followed by the *Cladonia* type (14,07 %) and *Collema* type 11,02%.

The analysis of the geographical elements spectra (Tab. 4) indicate the predominance of boreal-mediterranean species (30,88%), followed by the arcto-mediterranean (11,76%) species and the middle european - mediterranean species

(10,29%). Less represented are the boreal-mediterranean - montan (4,41%) elements and the middle european-subatlantic-mediterranean (4,41%) species, the other categories having very low values of representation.

Table 3: The taxa distribution in relation with the bioform type and the preferences toward the substrate.

Nr.	Bioforms	Corticolous	Lignicolous	Muscicolous	Saxicolous	Tericolous	Total
1	H Pl	1	-	2	8	1	12
2	H Pa	-	-	-	5	-	5
3	H Pe	-	-	1	-	9	10
4	H Co	-	-	-	12	3	15
5	H Ba	-	-	-	-	2	2
6	H So	4	-	-	-	-	4
7	H ep ex	-	-	-	12	-	12
8	H ep Um	-	-	-	1	-	1
9	Ch Cl	-	5	1	-	14	20
10	H E Us	3	-	-	-	-	3
11	H E Ra	5	-	-	-	-	5
12	H E Pa	26	-	1	-	-	27
13	H E An	3	-	-	-	-	3
14	H E ex	10	-	-	-	-	10
15	H E So	3	-	-	-	-	3
16	H E hyp	4	-	-	-	-	4

Conclusions

The studies of the foliose and fruticose lichenflora of the Pădurea Craiului Mountains had carried out to the identification of 136 taxa (135 species and one variety), 90 taxons were mentioned for the first time from the studied area and 5 species are new for the Romanian lichen flora.

The lichen species were characterised using the ecological indexes (light, humidity, temperature and chemical reaction of the substrate) published by Ellenberg et al. (1992) and Wirth (1995). According to their preferences toward light, the predominance of the moderate photophilous and photophilous species could be explained by the large number of corticolous species, developed on the trunks of deciduous trees and also by the relatively great number of saxicolous species installed on sun exposed rocks. The analysis of the humidity figure reveals the predominance of xero-mesophilous and mesophilous species, developed on sunny exposed and low altitude slopes. The small percent of meso-higrophilous and higrophilous species is the consequence of the reduced surface of humid zones in the studied area. Considering the preferences toward the temperature, the climate characteristic to the low mountain zone, specific for the Pădurea Craiului Mountains, determine the preponderance of the micro-mesothermal and microthermal species. The presence of a relatively large number of moderate termophilous species is correlated with the limestone substrate. Regarding the chemical reaction of the substrate, predominant are the subneutrophilous species,

represented by a large number of corticolous lichens developed on subneutrophil pH bark, followed by the basiphilous species installed on limestone substrate.

Table 4: The taxa distribution in relation with the geographical elements and the preferences toward the substrate.

Nr	Geographical elements*	Corticolous	Lignicolous	Muscicolous	Saxicolous	Tericolous	Total
1	Bor-med	19	2	3	14	4	42
2	Bor-smed	1	1	-	-	3	5
3	Bor-med-mo	5	-	-	1	-	6
4	Bor-smed-mo	3	-	-	-	2	5
5	Bor-mieur	1	-	-	1	3	5
6	Bor-mieur-med	1	-	-	-	-	1
7	Bor-mieur-med-mo	1	-	-	-	-	1
8	Bor-mieur-mo	1	-	-	-	-	1
9	Bor-mieur-subatl	-	1	-	-	1	2
10	Bor-mieur-subatl-med	-	-	-	1	-	1
11	Bor-atl-smed	-	-	-	-	1	1
12	S'mieur-med	-	-	-	3	-	3
13	S'eur	-	-	-	1	-	1
14	S'bor-mieur-med	1	-	-	-	-	1
15	S'bor-med	4	-	-	-	1	5
16	S'bor-med-mo	2	-	-	-	-	2
17	S'bor-smed	-	-	-	-	1	1
18	S'bor-subatl-med	-	-	1	-	-	1
19	S'bor-subatl-med-mo	1	-	-	-	-	1
20	Mieur-atl	1	-	-	-	-	1
21	Mieur-subatl-med	4	-	-	1	1	6
22	Mieur-med	7	-	-	7	-	14
23	Mieur-smed	1	-	-	-	1	2
24	Mieur-med-mo	1	-	-	2	-	3
25	Mieur-subatl-smed	-	1	-	-	-	1
26	Arkt-med	3	-	1	6	6	16
27	Arkt-smed	1	-	-	-	-	1
28	Arkt-smed-mo	-	-	-	-	1	1
29	Arkt-bor-med	-	-	-	1	-	1
30	Arkt-bor-mo	-	-	-	-	1	1
31	Arkt-mieur	-	-	-	-	1	1
32	Arkt-mieur-med-mo	1	-	-	1	1	3

*The shortcuts used for geographical elements are according to Wirth [22].

The ecological analysis of the lichen flora complete the results recorded from the area for higher plants and allows a better understanding of the ecological characteristics of the Pădurea Craiului Mountains.

Regarding the bioforms, predominant are the *Parmelia* and *Cladonia* type, bioforms characteristic for the fruticose and foliose lichens. As a consequence of

the geographical position and of the altitude of Pădurea Craiului Mountains, the dominant geographical element is boreal - mediterranean, interferred with arcto - mediterranean and middle european elements.

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STUDII ECOLOGICE ȘI FITO GEOGRAFICE ASUPRA LICHENILOR FOLIACEI ȘI FRUTICULOȘI DIN MUNȚII PĂDUREA CRAIULUI (JUD. BIHOR).**(Rezumat)**

Inventarul floristic al lichenilor foliacei și fruticuloși din Munții Pădurea include 136 de taxoni (135 de specii și o varietate). Cercetările s-au desfășurat în formațiuni forestiere mature, edificate de arbori cu ritidom neted sau rugos, lichenii foliacei și fruticuloși identificați în Munții Pădurea Craiului preferând, în marea lor majoritate, substratul lemnos (59 de specii sunt corticole și 5 lignicole). De asemenea, s-au recoltat licheni și de pe stâncării, uscate și umede, unde au fost identificate 38 de specii saxicole. Pe solul dintre stânci și în apropierea arborilor sau în rariști și luminișuri au fost identificate 29 de specii tericole și 5 specii muscicole. Pentru analiza ecologică a florei lichenologice am utilizat valorile indicilor ecologici (lumină, umiditate, temperatură, reacția chimică a substratului) după Ellenberg et al. (1992) și Wirth (1995). Preferințele lichenilor față de umiditate și temperatură au fost analizate comparativ cu preferințele cormofitelor din suprafața studiată, pe baza datelor publicate de Groza (1999). Lichenoflora a fost analizată și din perspectiva bioformelor și a elementelor floristice.