

## CONTRIBUTIONS TO THE STUDY OF THE LICHEN FLORA FROM BISTRITA MOUNTAINS

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**Abstract:** In this paper, the results of the field-researches made between 2004-2005 in different places of Bistrița Mountains are presented. The lichen flora analysis had carried out to 115 taxa identification, belonging to Ascomycotina Class. The species have been analysed from the ecological point of view, on the values of ecological indexes (light, humidity, temperature and chemical reaction of the substrata) published by Elleberg et al (1992). 93,05% of the total number of species are common species and 6,95% are rare species (*Cladonia amaurocraea*, *C. rangiformis*, *C. sulphurina*, *Cetraria sepincola*, *Pheophyscia ciliata*, *Peltigera pretextata*). One species – *Collema subflaccidum* is for the second time cited in romanian lichenological flora.

**Key words:** lichen, flora, Bistrița Mountains

### Introduction

The Bistrița Mountains are situated in the central-northern part of Eastern Carpathians between Bistrița river valley (to north and east), Bistricioara river valley (to south) and the series of Șarul Dornei-Drăgoiasa-Bilbor-Borsec Depressions (to west).

From the geological point of view, Bistrița Mountains are characterized by a complex structure constituted by cristaline schists, calcareous, porphyroid rocks and gritstones. The soil cover of these mountains is represented in over 50% proportions by brown-acide and brown podsolic soils. The climate of this region is characterized by cold and humid winters and cool and instable summers. The yearly temperature average oscillate between 0°C in the highest parts and 6°C in peripheral depressions and wider deeper valleys. The yearly average values of rainfalls are between 728-950mm and the most frequent are the western winds. The hidrographical network of these mountains is, in the most part, tributary to the Bistrița river.

### Material and methods

For the lichen flora inventory realization, the material had been collected from the trees bark (corticolous species), rotted stumps, trunks and fallen branches (lignicolous species), variety types of rocks (saxicolous species), straight from the soil (terricolous species) and from the moss strata.

The lichen species have been identified in laboratory on the base of macro and microscopic observations regarding the form and colour of thallus, the fixing mode on substrata, the soralia and isidia presence, the structure of thallus, apothecia and perithecia, the spores shape, colour and structure.

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For these species identification I have used the next authors papers: Ciurchea Maria (2004), Dobson F. (1997), Moberg R (1977), Purvis A. (1992), Thomson J.W. (1984), Tibell L. (1980), Wirth V. (1995).

The species nomenclature had been brought up to date using Maria Ciurchea (2004) and Scholtz P. (2000) papers. For every taxa have been established: the ecological character (Ellenberg et al., 1992), the floristic elements (Maria Ciurchea. 2004), biological forms (Ciurchea Maria, Codoreanu V., Burlacu Lucia, 1968).

The lichenological material has been collected from different places of the Bistrita Mountains: 1-Arsita lui Macovei, 2-Neagra Brostenilor valley, 3-Paraul Caprei, 4-Barnar Keys, 5-Brosteni, 6-Zugreni, 7-Paraul Vacariei, 8-Budacu Mountain, 9-Pietrosul Bistritei peak, 10-Ortoaia, 11-Dorna Arini, 12-Cozanesti, 13-Barnar valley, 14-Rusca II, 15-Borca, 16-Holda.

The lichenological material has been verified and confirmed by dr. Katalin Bartok and dr. Florin Crisan.

### Results and discussions

ORD. ARTHONIALES Henssen ex. D. Hawksw & O. Eriksson. *Fam. Arthoniaceae* Reichenb ex. Reichenb: *Arthonia radiata* (Pers.) Ach., corticolous, 1,2,3,4; *Fam. Chrysotrichaceae* Zahlbr.: *Chrysotrix candelaris* (L.) J.R. Laundon, corticolous, 1,5; *Chrysotrix chlorina* (Ach.) J.R. Laundon, saxicolous, 3,6; ORD. CALICEALES C. Bessey. *Fam. Caliceaceae* Chev.: *Calicium abietinum* Pers. corticolous, lignicolous, 3,7; *Fam. Coniocybaceae* Reinchenb.: *Chaenotheca chrysocephala* (Turn.) Th. Fr., corticolous, 5; *Chaenotheca furfuracea* (L.) Tibell lignicolous, 5,8; ORD. GRAPHIDALES C. Bessey (1907). *Fam Graphidaceae* Dumort. (1822): *Graphis scripta* (L.) Ach., corticolous, 1,2, 3,4,9; *Fam. Thelotremaaceae* (Nyl.) Stizenb.(1862): *Diploschistes muscorum* (Scop.) R. Sant. & Hawksw., on mosses, terricolous, 8,10; *Thelotrema lepadinum* Ach., corticolous, 1; ORD. LECANORALES Nannf. (1932). *Fam Acarosporaceae* Zahlbr. (1906): *Acarospora fuscata* (Nyl.) Th. Fr., saxicolous, 3,4,9; *Fam Alectoriaceae* (Hue.) Tomas (1949): *Alectoria sarmentosa* (Ach.) Ach.corticolous, 9; *Bryoria bicolor* (Ehrh.) Brodo & D. Hawksw., on mosses, corticolous, 8,9; *Bryoria implexa* (Hoffm.) Brodo & D. Hawksw., corticolous, 8; *Bryoria fuscescens* (Gyelnik) Brodo & Hawksw., corticolous, 7; *Fam. Cladoniaceae* Zenker (1827): *Cladonia amaurocraea* (Florke) Schaer., terricolous, 9; *Cladonia arbuscula* (Wallr.) Flot., terricolous, 9,10,11,12; *Cladonia botrytes* (Hag.) Willd., terricolous, 10,12; *Cladonia carneola* (Fr.) Fr., on mosses, terricolous, 3,12; *Cladonia cervicornis* (Ach.) Flot. ssp. *verticillata* (Hoffm.) Ahti., terricolous, 9; *Cladonia coniocraea* auct., lignicolous, terricolous, 1, 3,5,6,7,9,12,13,14; *Cladonia deformis* (L.) Hoffm., terricolous, 9; *Cladonia digitata* (L.) Hoffm., on mosses, 1,3,5,6,8,9,11,12,13,14; *Cladonia fimbriata* (L.) Fr., lignicolous, terricolous, 1,2,3,5,6,8,9,12,13,14; *Cladonia foliacea* (Huds.) Willd., terricolous, 6,12; *Cladonia furcata* (Huds.) Schrad. ssp. *furcata*, terricolous, 2,5,9; *Cladonia furcata* (Huds.) Schrad. ssp. *subrangiformis* (Sandst.) Abbayes, terricolous, 5,8,10,11,12,13; *Cladonia glauca* Florke, on mosses, terricolous, 3; *Cladonia gracilis* (L.) Willd., terricolous, 9; *Cladonia macilenta* Hoffm ssp *macilenta.*, on mosses, terricolous, 3,12,5; *Cladonia macilenta* Hoffm. ssp. *floerkeana* (Fr.) V. Wirth, on mosses, 8; *Cladonia pleurota* (Florke) Schaer., lignicolous, 9; *Cladonia pyxidata* (L.) Hoffm.terricolous, lignicolous, 3,5,6,8,9,11,12,13,14; *Cladonia rangiferina* (L.) Weber ex F.H. Wigg., terricolous, 9,15; *Cladonia rangiformis* Hoffm., terricolous, 9; *Cladonia squamosa* (Scop.) Hoffm., on mosses, 3,9; *Cladonia subulata* (L.) Weber ex F.H.Wigg., on mosses, terricolous, 1,2,5,8,12,13.; *Cladonia sulphurina* (Michaux.) Fr., terricolous, 9; *Cladonia*

*uncialis* (L.) Webber ex F.H. Wigg., terricolous, 9; *Fam. Collemataceae* Zenker. (1827): *Collema flaccidum* (Ach.) Ach., saxicolous, 2,4,13; *Collema subflaccidum* Degel., saxicolous, 4; *Fam. Lecanoraceae* Korb.(1854): *Lecanora albella* (Pers.) Ach., corticolous, 13; *Lecanora allophana* (Ach.) Nyl., corticolous, 2,3; *Lecanora chlarotera* Nyl., corticolous, 13; *Lecanora gangaleoides* Nyl., saxicolous, 9; *Lecanora pulicaris* (Pers.) Ach., corticolous, lignicolous, 7,12; *Lecidella elaeochroma* (Ach.) M. Choisy., corticolous, 13; *Lecania cyrtella* (Ach.) Th. Fr., corticolous, 5; *Porpidia macrocarpa* (DC.) Hertel & A.J. Schwab., saxicolous, 4; *Fam. Ophioparmaceae* Rogers&Hafellner (1988): *Ophioparma ventosa* (L.) Norman, saxicolous, 9; *Fam. Parmeliaceae* Zenker (1827): *Cetraria aculeata* (Schreb.) Fr., terricolous, 9; *Cetraria islandica* (L.) Ach., terricolous, 9,15; *Cetraria sepincola* (Ehrh.) Ach., corticolous, 3; *Vulpicida pinastri* (Scop.) Mattson & M.J.Lai, corticolous, 9; *Cetrelia cetrarioides* (Del. Ex Duby) W. Culb.&C.Culb., lignicolous, 6; *Cetrelia olivetorum* (Nyl.) Culb&C. Culb., on mosses, 5,8; *Evernia divaricata* (L.) Hue., corticolous, 2,3,8; *Evernia prunastri* (L.) Ach., corticolous, lignicolous, 1,2,3,4,5,6,7,8,9,10,12,13,14,16; *Hypogymnia physodes* (L.) Nyl., corticolous, lignicolous, 1,2,3,4,5,6,7,8,9,10,12,13,14,16; *Hypogymnia tubulosa* (Schaer.) Hav., corticolous, 5,8,9; *Hypogymnia vittata* (Ach.) Parr., on mosses, corticolous, 5,7,9,12,13; *Flavoparmelia caperata* (L.) Hale., corticolous, lignicolous, 5,7,8,12,13; *Menegazzia terebrata* (Hoffm.) Massal., saxicolous, 7; *Melanelia exasperatula* (Nyl.) Essl., corticolous, 6; *Melanelia glabra* (Schaer.) Essl., corticolous, 3; *Melanelia glabratula* (Lamy.) Essl., corticolous, 13,7,3; *Parmelia saxatilis* (L.) Ach., saxicolous, 9; *Parmelia sulcata* Tayl., corticolous, 3,7,12,13; *Xanthoparmelia conspersa* (Ach.) Hale, saxicolous, 2,6,13; *Pseudevernia furfuracea* (L.) Zopf., corticolous, lignicolous, 1,2,3,4,5,6,7,8,9,10,12,14,16; *Usnea cavernosa* Tuck., corticolous; *Usnea filipendula* Stirt., corticolous, 7,13; *Usnea florida* (L.) Weber. Ex F:H Wigg., 1,2,3,5,6,8,9,10,13,14; *Usnea glabrata* (Ach.) Vain., corticolous, 13; *Usnea hirta* (L.) Weber ex F.H.Wigg., corticolous, lignicolous, 1,2,6,7,9,10,11,12,14; *Usnea longissima* Ach., corticolous, 5; *Usnea subfloridana* Stirt., corticolous, 1; *Fam. Physciaceae* Zahlbr. (1898): *Buellia disciformis* (Fr.) Mudd., corticolous, 7; *Physcia adscendens* (Fr.) H. Olivier., corticolous, 5,12,17; *Physcia aipolia* (Ehrh. ex Humb.) Furnr., 2,12,13,16; *Physcia caesia* (Hofm.) Furnrohr, saxicolous, 13; *Physcia stellaris* (L.) Nyl., corticolous, 12,14; *Physcia tenella* (Scop.) DC., corticolous, 14; *Phaeophyscia ciliata* (Hoffm.) Moberg., corticolous, 13; *Phaeophyscia orbicularis* (Neck.) Moberg., corticolous, 12,17; *Fam. Ramalinaceae* Ag.(1821): *Ramalina fastigiata* (Pers.) Ach., corticolous, 13; *Fam. Rhizocarpaceae* M. Choisy. ex Hafellner (1984): *Rhizocarpon distinctum* Th Fr., saxicolous, 2,9; *Rhizocarpon geograficum* (L.) DC., saxicolous, 2,9,10; *Rhizocarpon obscuratum* (Ach.) Massal., saxicolous, 3,5; *Fam. Stereocaulaceae* Chev. (1826): *Stereocaulon dactylophyllum* Florke, 9; *Fam. Umbilicariaceae* Chev. (1826): *Umbilicaria cylindrica* (L.) Delise ex Duby., saxicolous, 9; *Umbilicaria deusta* (L.) Baumg., saxicolous, 9; *Umbilicaria proboscidea* (L.) Schrad., saxicolous, 9; *Licheni imperfecti*: *Lepraria incana* L. (Ach.), saxicolous, 3,9,10; *Lepraria lobificans* Nyl., corticolous, 5,6,8; *Thamnolia vermicularis* (Sw.) Schaer., terricolous, 9; *ORD. LEOTIALES* Carpenter (1988). *Fam. Baeomycetaceae* Dumort. (1829): *Baeomyces rufus* (Huds.) Rebut., saxicolous, 1,5,6,8,9,14; *Dibaeis baeomyces* (L.) Rambold & Hertel, terricolous, 12; *Fam. Icmadophilaceae* Rambold, Triebel&Hertel (1993): *Icmadophila ericetorum* (L.) Zahlbr., terricolous, 9; *ORD. OPEGRAPHALES* M.Choisy ex D. Hawskw.&Eriksson (1986). *Fam. Opegraphaceae* Stizenb. (1862): *Opegrapha varia* Pers., corticolous, 8; *Opegrapha viridis* (Pers.ex Ach.) Behlen ex Desberger., corticolous, 1; *ORD. PELTIGERALES* W. Watson. (1929). *Fam.Peltigeraceae* (1822): *Peltigera canina* (L.) Willd., terricolous, 11,15; *Peltigera degenii* Gyeln., terricolous, 2,5; *Peltigera didactyla*

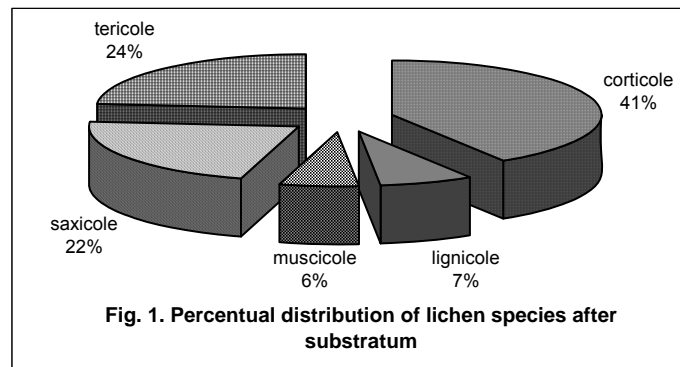
(With.) J.R.Laundon, terricolous, 3,4,12; *Peltigera horizontalis* (Huds.) Baumg., on mosses, terricolous, 3,8; *Peltigera polydactyla* (Neck.) Hoffm., terricolous, 1,3,8; *Peltigera praetextata* (Florke ex Sommerf) Zopf., on mosses, terricolous, 3,13; *Peltigera rufescens* (Weiss.) Humb., terricolous, 13; ORD. PERTUSARIALES M. Choisy ex D. Hawksw. & O. Eriksson (1986). Fam. Pertusariaceae Korb. Ex Korb. (1855): *Pertusaria chiodectionoides* Bagl. Ex Massal., saxicolous, 2; *Pertusaria hemisphaerica* (Flk. ) Erichs., saxicolous, 3; ORD. PYRENULALES Fink. ex D. Hawksw.&O. Eriksson (1986). Fam. Pyrenulaceae Rabh. (1870): *Pyrenula nitida* (Wiegel.) Ach., corticolous, 1,2,7; ORD. TELOSCHISTALES D. Hawksw.&O. Eriksson (1986). Fam. Teloschistaceae Zahlbr. (1898): *Caloplaca flavescens* (Huds.) J.R.Laundon, saxicolous, 9; *Caloplaca saxicola* (Hoffm.) Nordin, saxicolous, 10; *Xanthoria parietina* (L.) Th. Fr., lignicolous, corticolous, terricolous, 5,10,12,13,16,17; ORD. VERRUCARIALES Mattik ex D. Hawksw.&O. Eriksson (1986). Fam. Verrucariaceae Zenker (1827): *Verrucaria muralis* Ach., saxicolous, 5; *Dermatocarpon miniatum* (L.) Mann., saxicolous, 9.

### Taxonomical analysis

From the total of 11 orders that we have identified, the best represented is the *Lecanorales* order including 14 families with 84 species and 3 subspecies. The families having the most numerous representants are: *Parmeliaceae* –27 species, *Cladoniaceae* –21 species and 3 subspecies, *Physciaceae* –8 species and *Peltigeraceae* –7 species. The botanical genus having the most numerous species is *Cladonia* –21 species and 3 subspecies followed by *Parmelia*, *Lecanora* and *Peltigera* –each of than represented by a number of 7 species.

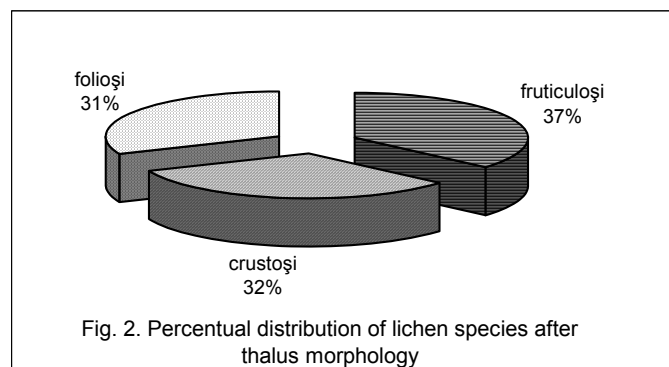
### Thallus morphology analysis

The lichen flora of the studied zone is represented by fruticose lichens (37%), crustose lichens (32%) and foliose lichens (31%). (Fig. 1)

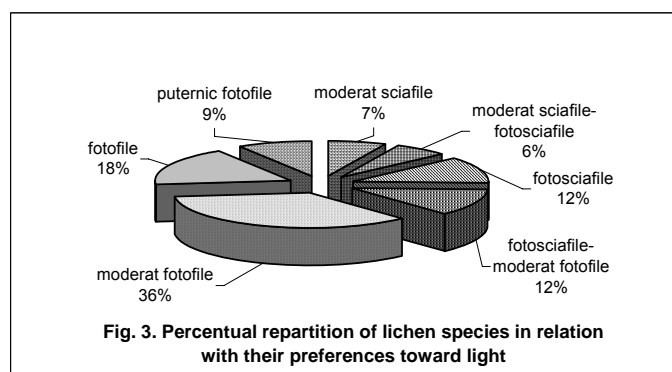


### Ecological analysis

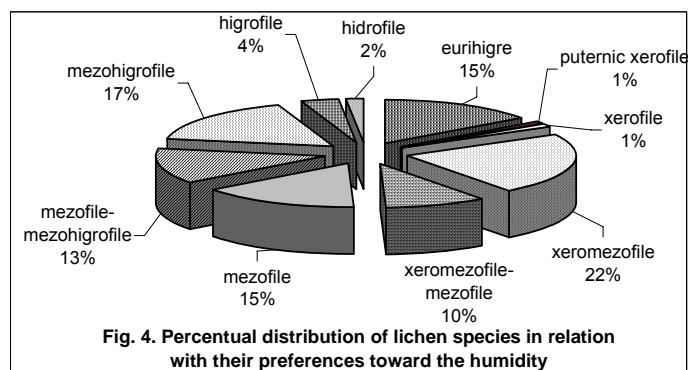
Percentual distribution of the lichen species from the substrata point of view show us the numerical predomination of corticolous lichen species (41%) followed by the terricolous lichens 24%, saxicolous lichens (22%), lignicolous lichens (7%) and situated on mosses lichens (6%) from the total number of the identified lichen species. (Fig. 2)



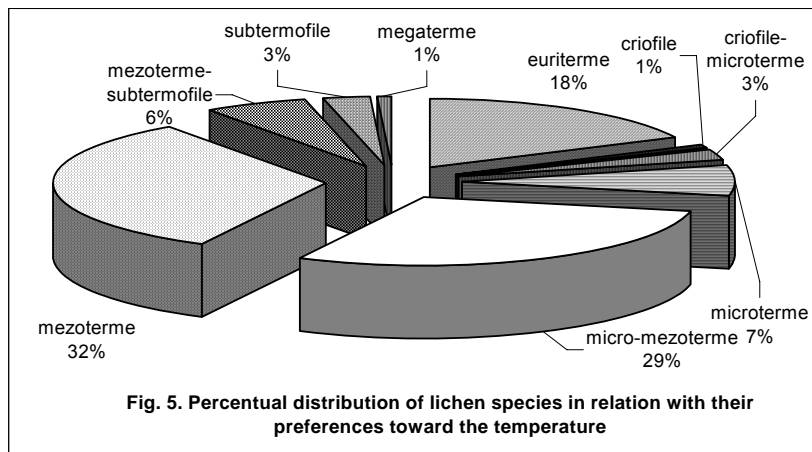
The analysis of the lichen flora in relation with the species preferences to the light (Fig. 3) indicates the predominance of moderate photophilous species (36%) followed by the photophilous species (18%), photo-ombrophilous – moderate photophilous species (12%), strong photophilous (9%), moderate ombrophilous (7%) and moderate ombrophilous – photo-ombrophilous species (6%).



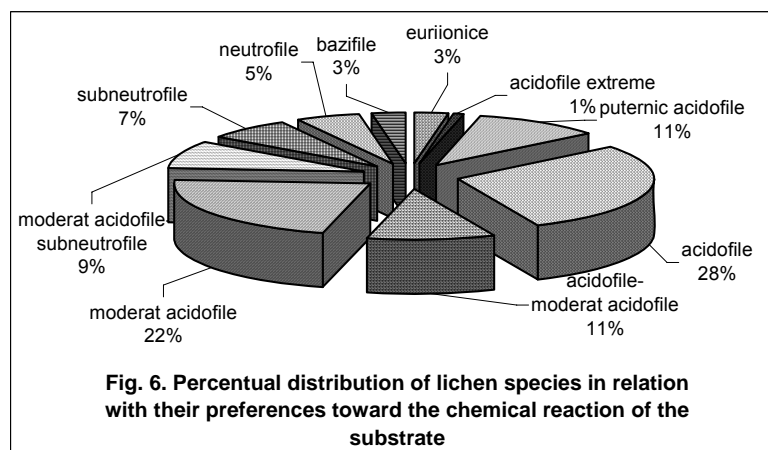
The analysis of lichen flora in relation with the species preferences to the humidity (Fig. 4) reveals the domination of xeromesophilous lichen species (22%) followed by mesohygrophilous species (17%), mesophilous species (15%), eury-hygrous species (15%) and xeromesophilous-mesophilous species (10%). Less represented are hygrophilous (4%), hydrophilous (2%), xerophilous (1%) and strong xerophilous (1%) species.



The lichen species preferences for the temperature (Fig. 5) is manifested by the increased proportion of mesothermophilous species (32%), micromesothermophilous (29%) and eurithermic species as a result of small altitudes from Dorna Arini, Cozanesti, Zugreni, Brosteni. The seven percent of microthermophilous species are probably the result of the high altitude from Pietrosul Bistritei and Budacu peaks. At these high altitudes we have met also cryophilous-microthermophilous species (3%) and cryophilous species (1%). In the locations having small altitudes we have collected some mesothermophilous – subthermophilous (6%), subthermophilous (3%) and megathermophilous (1%) species.



The lichen species preferences related to chemical reaction of the substratum (Fig. 6) shows increased values for the acidophilous (28%), moderate acidophilous (22%), strong acidophilous (11%) and moderate acidophilous – subneutrophilous (11%) categories. Smaller values are registered for sub-neutrophilous (7%) and neutrophilous (5%) species. The basiphilous (3%), eury-ionic and extreme acidophilous (1%) species are less represented.



### Phytogeographical analysis

The analysis of the floristic elements of lichen flora from this region (table 1.) reveals that the most numerous species from the boreal-mediterranean category (24 species) followed by the boreal-mediterranean-montane (13 species) and the south-boreal-mediterranean and arctic-middle-european, each of them having 7 species. Less represented are the boreal-submediterranean (6 species), boreal-middleeuropean (6 species), arctic-middle-european (6 species), south boreal-middle-european-mediterranean (5 species) and arctic-boreal-montane (5 species) elements, the other categories having a very decreased number of species.

**Table 1**  
The repartition of taxa in relation with floristic elements categories and type of substratum

Nr.	Geoelemente	corticolous	lignicolous	on mosses	saxicolous	tericolous	total
1.	Bor-med	12	4	3	3	2	24
2.	Bor-submed	-	-	-	3	3	6
3.	Bor-med-mo	7	2	-	3	1	13
4.	Bor-submed-mo	3	-	-	-	1	4
5.	Bor-mediueur	1	-	-	1	4	6
6.	Bor-mediueur-med	1	-	-	-	-	1
7.	Bor-mediueur-mo	2	-	-	-	2	4
8.	Bor-mediueur-subatl-med	1	-	-	-	-	1
9.	Bor-atl-submed	-	1	-	-	-	1
10.	Sud-mediueur-med	-	-	-	1	-	1
11.	Sud-bor-mediueur-med	3	-	-	1	1	5
12.	Sud-bor-med	4	-	1	1	1	7
13.	Sud-bor-med-mo	1	-	-	-	-	1
14.	Sud-bor-submed	-	-	-	-	1	1
15.	Sud-bor-subatl-med	-	-	2	-	-	2
16.	Sud-bor-subatl-med-mo	1	-	-	1	-	2
17.	Mediueur-subatl-med	1	-	-	1	1	3
18.	Mediueur-med	3	-	-	-	1	4
19.	Mediueur-med-mo	4	-	-	-	-	4
20.	Arcto-med	2	-	1	2	2	7
21.	Arcto-submed-mo	-	-	-	-	1	1
22.	Arcto-bor-med	1	-	-	2	-	3
23.	Arcto-bor-mo	-	-	-	3	2	5
24.	Arcto-mediueur	-	1	-	1	4	6
25.	Arcto-mediueur-med-mo	-	-	-	2	1	3
26.	Total	47	8	7	25	28	115

### Bioform analysis

The general analysis of the bioform spectrum from the studied zone (table 2.) reveals that the most numerous lichen species are the fruticose lichens having an *Cladonia* type of thallus (Ch C1 –26 taxa: 18 terricolous species, 5 lignicolous species, 2 lichen species on mosses and one saxicolous species). From the same category we have identified epiphyte-hemicryptophytic species having an *Usnea* type of thallus (10 corticolous species and one on mosses).

The crustose lichens are represented by the epiphyte with external crust species (HE ex–15 species: 8 corticolous and 7 saxicolous species) followed by the hemicryptophyte with sorediate crust (H so–8 species: 5 corticolous, 2 lignicolous and one saxicolous species) and the lichens having an hypophloedic thallus (E hyp–4 species), the other categories having insignificant values.

The most numerous foliose lichens are the hemicryptophytic with an *Parmelia* type of thallus lichens (HE Pa–22 species: 15 corticolous species, 4 saxicolous species, 2 species on mosses and one lignicolous specie) followed by the hemicryptophytic with an *Peltigera* type of thallus (H Pe–7 species: 6 terricolous species and one on mosses specie) the other biologic forms having decreased values.

**Table. 2.**

**The repartition of taxa in relation with bioforms and their preferences toward the substratum**

Nr.	Bioforms	corticolous	lignicolous	on mosses	saxicolous	terricolous	Total
1.	H Pl	-	-	1	2	-	3
2.	H Pe	-	-	1	-	6	7
3.	H Co	-	-	-	2	-	2
4.	H Ba	-	-	-	1	2	3
5.	H So	5	2	-	1	-	8
6.	H ep. ex	-	-	-	3	-	3
7.	H ep. Um	-	-	-	4	-	4
8.	Ch Cl	-	5	2	1	18	26
9.	Ch Ce	2	-	-	-	1	3
10	HE Us	10	-	1	-	-	11
11	HE Ra	3	-	-	-	-	3
12	HE Pa	15	1	2	4	-	22
13	HE ex	8	-	-	7	-	15
14	HE So	-	1	-	-	-	1
15	E hyp	4	-	-	-	-	4

### Conclusions

The study of the lichen flora realised in Bistrita Mountains has as result the identification of 115 taxa (112 species and 3 subspecies) belonging to 28 families and 11 orders.

Ecological analysis demonstrate that the most numerous are moderate photophilous (36%), xeromezophilous (22%), mesothermophilous (32%) and acidophilous (28%) species of lichens.

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