

CONTRIBUTIONS TO THE STUDY OF THE CORTICOLOUS LICHEN VEGETATION OF THE PADUREA CRAIULUI MOUNTAINS (BIHOR DEPARTMENT, ROMANIA)

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ABSTRACT. The corticolous lichen communities treated in our paper were included in three associations: *Physcietum ascendentis* Frey & Ochsner 1926, *Parmelietum acetabuli* Ochsner 1928 and *Parmelietum caperatae* Felföldy 1941, belonging to the class *Physcietea* Tomaselli & De Micheli 1957. All the three associations are mentioned for the first time in the studied area. The corticolous lichen coenosis were analysed using phytosociological charts, both in qualitative aspects - according to the ecological indices (L, H, T, R), bioforms - and in the quantitative one based on the mean dominance-abundance (%) and also through ecodiagrams and dendrograms.

Keywords: corticolous lichens, vegetation, Pădurea Craiului Mountains, Romania

INTRODUCTION

With an area of 730 km², the Pădurea Craiului Mountains are located in the north-western part of the Apuseni Mountains. The altitudes gradually decrease toward north-west, from 986 m to 350 m and toward the two peripheral depressions.

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

Regarding the hydrography, 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 Pădurea Craiului Mountains have a piedmont and mountain climate with mild foggy winters and cool summers.

Regarding the cormophyte vegetation, 57% of the Pădurea Craiului Mountains surface is covered with forests. At lower altitudes are developed communities of *Quercus cerris* – *Carpinetum*, *Quercetum petraeae* – *cerris* and *Quercus petraeae* – *Carpinetum*, followed at higher altitudes by *Quercus petraeae* – *Fagetum*. The most spread are the beech forests (*Festuco drymeiae* – *Fagetum silvaticae*). At medium altitudes are present mixed beech and hornbeam forests (*Carpino* – *Fagetum silvaticae*). In the south – western part of the massif, at high altitudes grow fir with beech (*Pulmonario rubro* – *Abieti* – *Fagetum*) small formations (Groza, 2008).

MATERIALS AND METHODS

The analysis of flora was carried out on the basis of lichen specimens collected and determined between 1996-1998 (Crisan, 2001), the botanic nomenclature used is according to Santesson (1993). The method adopted in the study of lichens vegetation corresponds to the Central European phytosociological principles, with specific features to the lichen communities. The

composition of lichen coenosis was made evident by means of relevés on 0.5 m² sample surfaces. A number of 43 relevés were carried out along transects located every 2 km, perpendicular to the contour lines. Identification of associations was based on the specific composition, taking into account the characteristic and dominant species. Species abundance-dominance scale was assessed visually using Braun-Blanquet's scale. Among abiotic variables within each releve were recorded altitude, terrain slope, coverage and exposition. The syntaxonomic nomenclature used, is according to Wirth (1995).

The lichens associations were analyzed using phytosociological charts, both in qualitative aspects - according to the ecological indices (L, H, T, R), bioforms - and in the quantitative ones, based on the mean dominance-abundance (%) and also through ecodiagrams and dendrograms.

RESULTS AND DISCUSSIONS

The corticolous lichen communities treated in our paper were included in three associations: *Physcietum ascendentis* Frey & Ochsner 1926, *Parmelietum acetabuli* Ochsner 1928 and *Parmelietum caperatae* Felföldy 1941, belonging to the order *Xanthorion parietinae* Ochsner 1928, alliance *Physcietalia adscendentis* Hadač 1944 em Barkm. 1958 and class *Physcietea* Tomaselli & De Micheli 1957.

Physcietum adscendentis Frey & Ochsner 1926 is a lichen association (Table 1) specific for the hill area, characterized by the predominance of folicolous lichens. Lichen communities were identified in the studied area at altitudes between 350-540 m, populating the bark of *Quercus cerris*, *Q. petraea* and *Populus tremula*. The lichen coenosis were located on mature trees with rough bark, covered with dust or by bird droppings, situation emphasized by the high

abundance-dominance of the indicator species *Physcia adscendens*, *P. tenella*, *Phaeophyscia orbicularis*. The lichen coenosis of this association prefer south, south-west and west exposition, coverage ranging between 70-90%. In our country it is very frequent in Banat (Burlacu, L., Ciurchea, M., Codoreanu, V., 1969), Dobrogea (Mantu, 1968), Moldova (Sava, 1983) Muntenia (Klement, 1941) and Transilvania (Ciurchea, Codoreanu, 1967; Codoreanu, Micle, 1976).

The analysis of the lichen species preferences towards the light (Fig. 1) shows the predominance of the moderate photophilous species (59%), followed by the photo-sciaphilous-moderate photophilous (18.18%) and photo-sciaphilous (13.63%) species. Less represented are the strong photophilous and moderate-sciaphilous species, 4.54% each.

The humidity regime (Fig.1) ranks on a higher position the xero-mesophilous species (68.18%), followed by the xero-mesophilous – mesophilous

(22.72%) species - mesohygrophilous (17%) and mesophilous (13%). The least represented are the mesophilous - mesohygrophilous and eurohygrous species, 4.54% each.

Considering the temperature factor (Fig. 1), the highest position is held by the micro-mesothermal species (68.18%), followed by the eurythermic (18.18%) and moderate thermophilous ones (13.63%).

Regarding the chemical reaction of the substrate (Fig. 1), 36.36% represents the moderate acidophilous species. They are followed by the moderate acidophilous-subneotrophilous and subneotrophilous species (22.72% each) and the acidophilous ones (18.18%).

Quantitative (Fig. 2), the most frequent are the xero-mesophilous, micro-mesothermal, subneotrophilous species, the other categories being less represented.

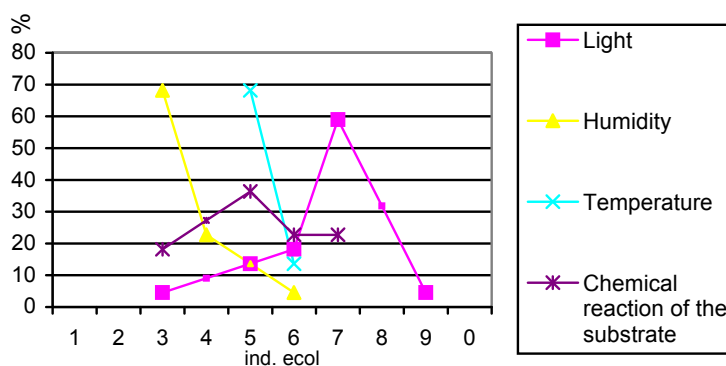


Fig. 1 The diagram of ecological indexes of *Physcietum adscendentis* association

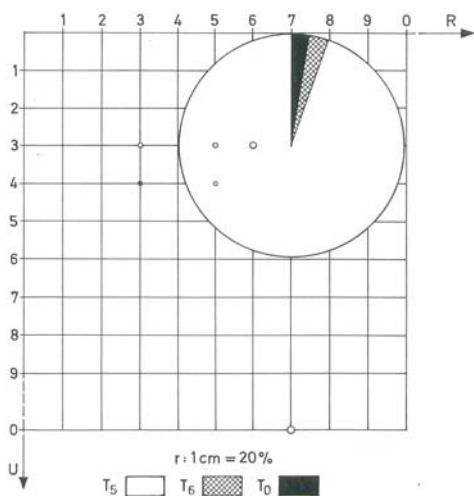


Fig. 2 The ecodiagram of *Physcietum adscendentis* association

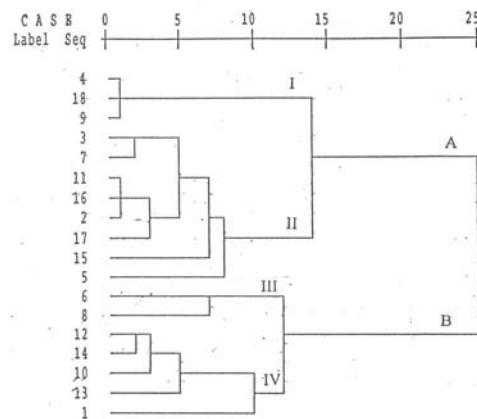


Fig. 3 The dendrogram of *Physcietum adscendentis* association

Dendrogram analysis (Fig. 3) indicates the presence of two main clusters (A and B), each having two branches (I - IV). Branch I of the A cluster includes the lichen coenosis in early stages of installation (final stages of replacement of the communities belonging to *Lecanoretum subfuscae*). Those coenosis are characterized by the presence of *Lecanora carpinea* among the accompanying species and by reduced values of A/D of edificator species *Phaeophyscia orbicularis*, *Physcia stellaris*, *P. tenella*, *Physconia distorta*. Branch II contains communities at different stages of development, the less advanced characterized by the absence or presence with A/D low amounts of the species *Xanthoria parietina*, *Evernia prunstri*, *Pleurosticta acetabulum*, *Melanelia fuliginosa*, *Parmelia tiliacea*, etc.

Cluster B comprises lichen coenosis in mature stage of development, as evidenced by the presence of fruticulous lichens *Ramalina farinacea*, *R. fastigiata*. Branch III consists mainly in communities established

in the upper trunk and trees branches, communities which probably will transit in succession to lichen coenosis of *Xanthorietum candelariae* association. Branch IV includes communities developed in the middle part of the trees trunks, which with increasing of bark roughness (due to aging) and thus maintain substrate humidity will succeed, probably, to the communities of *Parmelietum caperatae* association.

The lichen coenosis of *Parmelietum acetabuli* Ochsner 1928 association (Table 2) were found in forests from the hilly and lower mountain areas of Pădurea Craiului Mountains, at altitudes of 320-700 m. The lichen communities inhabit old trunks of *Quercus petraea*, *Q. cerris* and *Populus tremula*, on steep slopes with 8-40 degree tilt range. This association's coenosis occupy south, west and south-west expositions on the trees trunks, with a cover ranging between 65-80%. Is rarely mentioned in Romania from Moldova (Sava, 1983) Muntenia (Klement, 1941) and Oltenia (Bartók, 1990).

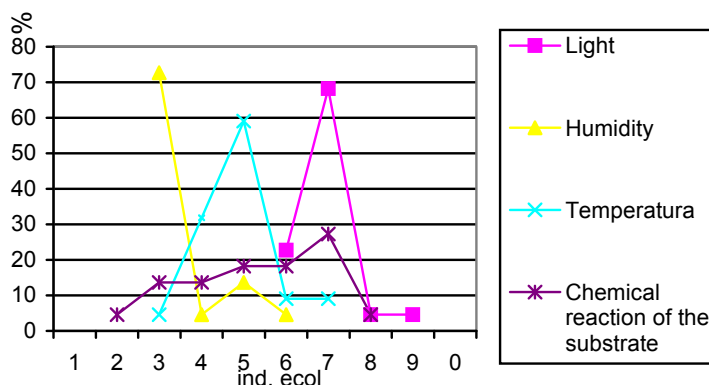


Fig.4 Diagram of the ecological indexes of the *Parmelietum acetabuli* association

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The preferences of the lichen species toward light (Fig. 4) shows the obvious predominance of the moderate photophilous (68.18%), followed, in lower percentages by the photo-sciaphilous-moderate photophilous (22.72%), photophilous (4.54%), and strong photophilous (4.54%).

The analysis according to preferences to humidity (Fig. 4) ranks on a higher position the xero-mesophilous species (72.72%) and the eurohigrous ones (23%). They are followed, with lower values by the mesophilous (13.63%); the least represented being the xero-mesophilous-mesophilous, mesophilous - mesohygrophilous and the euryhygrous species, 4.54% each.

The temperature (Fig. 4) indicates the dominance of the micro-mesothermal (53.09%), followed by the eurythermic and moderate termophilous, 18.18% each. The fewest are the microthermal species (4.54%).

In terms of the chemical nature of the substrate (Fig. 4), 27.27% represents the subneutrophilous species, 18.18% the moderate acidophilous species, followed, in equal percentages (13.63%) by the acidophilous and moderate acidophilous - subneutrophilous species. Less represented are the strong acidophilous as well as the neutrophilous ones, 4.54% each.

Quantitative (Fig. 5), the most frequent are the xero-mesophilous, moderate termophilous and subneutrophilous species, followed by a core of mesophilous, micro-mesothermal and subneutrophilous species, the other categories being less represented.

Dendrogram (Fig. 6) contains cluster A with two branches (I, II) and cluster B. Branch I includes two groups of relevés, a and b, the group a comprising lichen communities in mature stage of development,

fact supported by the presence of bryophytes, in succession the coenosis of this association being replaced by bryophyte communities; group B comprises communities of lichens installed on the median trunk portion, adjacent to communities of another association, dominated by folicolous lichens, probable *Xanthorietum candelariae*. Branch II of cluster A includes lichens coenosis installed on isolated trees, on south-west exposition, edificator species *Parmelia acetabulum* having A/D 4 in these relevés.

Cluster B includes two coenosis with western exposition, developed on old trees with deeply furrowed bark; both coenosis have a mesophilous character, shown by A/D 3 of *Anaptychia ciliaris* species.

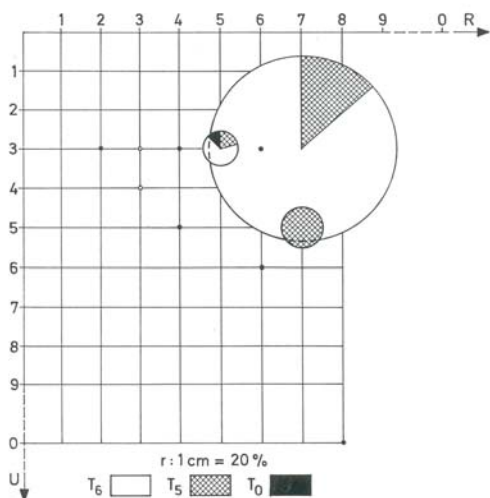


Fig. 5 The ecodiagram of *Parmelietum acetabuli* association

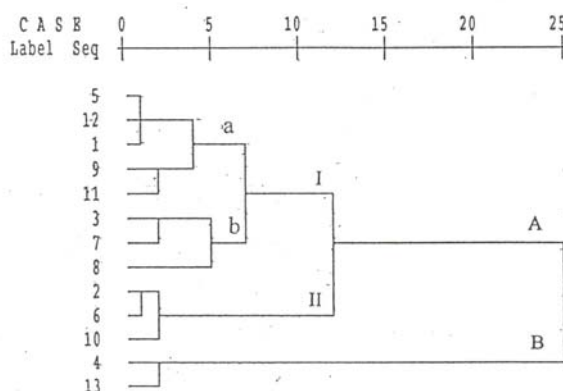


Fig. 6 The dendrogram of *Parmelietum acetabuli* association

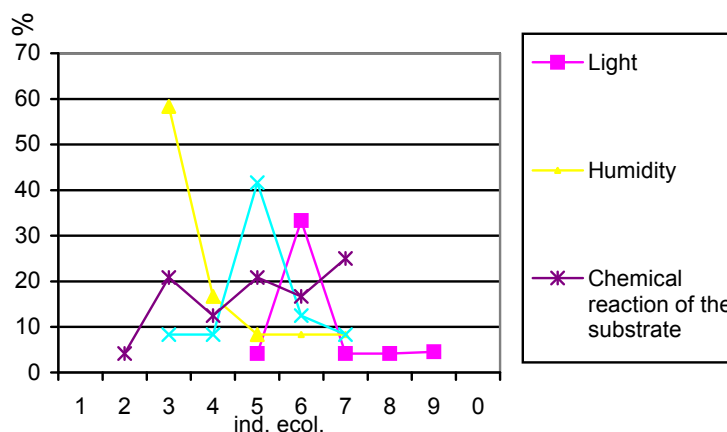


Fig. 7 Diagram of the ecological indexes of *Parmelietum caperatae* association

Regarding the lichen species preferences toward light (Fig. 7), is remarkable the high percentage of moderate photophilous (54.1%), followed by the

photo-sciaphilous - moderate sciaphilous (33.3%).

The lichen categories photo- sciaphilous, photophilous

and strong photophilous are present in equal percentages, 4.16% each.

The humidity regime (Fig. 7) shows that the majority of species are xeromesophilous (58.33%), less represented being the xero-mesophilous - mesophilous (16.6%). Smaller percentages have the mesophilous, meso-hygrophilous and euryhygrous species, 8.33% each.

The temperature figure (Fig. 7) indicate the dominance of the micro-mesothermal (41.6%), followed in equal percentage by the moderate termophilous and eurythermic (20.83% each), less represented (16.66%) being the microthermal species.

Regarding the chemical reaction of the substrate (Fig. 7) we notify a relatively high percentage of the subneutrophilous species (25%), and the equal values of acidophilous and moderate acidophilous species (20.83%). Follows with decreasing values the categories moderate acidophilous - subneutrophilous (16.6%), acidophilous - moderate acidophilous (12.5%) and strong acidophilous (4.16%).

Quantitative (Fig. 8) in this lichen community are dominating the xero-mesophilous - mesophilous, moderate termophilous and acidophilous - moderate

acidophilous species, while the other categories were very poorly represented.

The dendrogram (Fig. 9) contains two clusters A and B, cluster B with two branches (I and II). Cluster A includes the lichen coenosis installed on *Fagus sylvatica* (no. 6, 10, 4) and on *Quercus petraea* (no. 1, 2, 9). The communities developed on beech, characterized by high values of abundance-dominance (A/D 4) of the edificatory species *Parmelia caperata*, had a xeromesophilous - mesophilous, micro-mesothermal and acidophilous - moderate acidophilous nature; the lichen coenosis identified on sessile oak, on south-eastern exposition, are showing a mesophilous nature, revealed by the presence of *Ramalina pollinaria*.

Branch I of cluster B includes lichen communities developed on *Carpinus betulus*, with a xeromesophilous nature, induced by species like *Punctelia subrudecta* and *Evernia prunastri*. Branch II of cluster B comprises communities of lichens developed on *Quercus cerris* and *Q. petraea*; the presence in those coenosis of *Melanelia subaurifera* with A/D 2 indicates their mesophilous nature and their preference for a moderate acidophilous substrate.

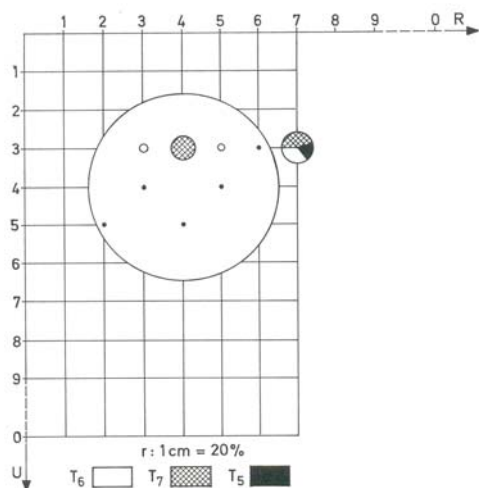


Fig. 8 The ecodiagram of *Parmelietum caperatae* association

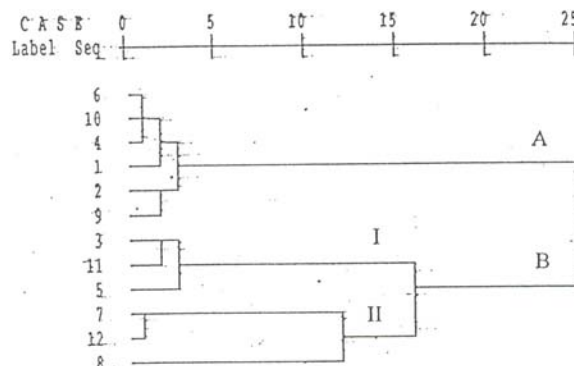


Fig. 9 The dendrogram of *Parmelietum caperatae* association

CONCLUSIONS

The corticolous lichen communities treated in our paper were included in three associations: *Physciatum adscendentis* Frey & Ochsner 1926, *Parmelietum acetabuli* Ochsner 1928 and *Parmelietum caperatae* Felföldy 1941, belonging to the class *Physcietea* Tomaselli & De Micheli 1957. All the three associations are mentioned for the first time in the studied area.

Because of the low altitude of the massif, the corticolous lichens vegetation is characteristic to the hills and low mountains lefty forests.

According to their preferences toward the relief of the bark, the corticolous lichen associations identified in the studied area belongs to two categories:

- the first category consists of the coenosis preferring the rugged bark, as the lichen communities of *Physciatum adscendentis* and *Parmelietum acetabuli* associations, developed on *Quercus petraea*, *Q. cerris* and old *Populus tremula*;
- the second category comprises the lichen communities which were found both on smooth and rugged bark, here belonging the coenosis of *Parmelietum caperatae* (on *Fagus sylvatica*, *Carpinus betulus* but also on *Quercus petraea* and *Q. cerris*).

The distribution on altitude of the corticolous lichen associations shows that:

- in the north - western part of the Mountains Padurea Craiului, where the altitude is low (300 - 400 m), are located the coenosis of the *Parmelietum caperatae* association, developed in *Quercetum petraeae* - *cerris*;

- at higher altitudes (350-540 m), in *Quercetum petraeae* - *cerris* and *Quercetum petraeae* - *Carpinetum* were found the lichen coenosis of *Physcietum adscendentis* association.

- in *Quercetum petraeae* - *Fagetum*, at 500-550 m, but also at lower altitude, at 350-400 m in *Carpino* - *Quercetum cerris*, were identified the communities belonging to *Parmelietum acetabuli* association

According to their preferences toward light the corticolous lichen communities are:

- moderate photophilous - photo-ombrophilous: *Parmelietum caperatae*;

- moderate photophilous: *Physcietum adscendentis* and *Parmelietum acetabuli*.

The analysis of the humidity figure reveals the next categories:

- xero-mesophilous communities developed on southern, south-western and western expositions (*Physcietum adscendentis* and *Parmelietum acetabuli*);

- xero-mesophilous - mesophilous, developed on south-western, south and south-eastern exposure, including the lichen coenosis of *Parmelietum caperatae* association.

Regarding the temperature figure in all associations dominant are the micro-mesothermal species, fact explained by their location in the hilly and lower mountain area.

Concerning the chemical reaction of the substrate the lichen communities belong to 2 categories:

- acidophilous - moderate acidophilous, lichen coenosis of the *Parmelietum caperatae* association;

- subneutrophilous, concerning the lichen communities of the *Physcietum adscendentis* and *Parmelietum acetabuli* associations.

Regarding the dynamics of those corticolous lichen associations, we appreciate that:

- the coenosis of *Physcietum adscendentis* association in which occur *Ramalina* type lichens, installed in the upper part of trunks and branches, shall transit likely to *Xanthorietum candelariae* communities; the coenosis that inhabit the median area of trunks will succeed, perhaps with increasing roughness of the bark, as a result of tree aging, to communities of *Parmelietum caperatae*;

- the bryophyte presence in several coenosis of *Parmelietum acetabuli* association indicates that, in succession, this association communities will probably be replaced by bryophytes;

- although normally the coenosis of *Parmelietum caperatae* association are replaced by the coenosis characteristic to *Pseudevernetum furfuraceae*, low altitude at which the association *Parmelietum caperatae* was met suggests that this development is unlikely.

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