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Lichen community response to different management situations in Cerro Colorado protected forest (Cordoba, Argentina)

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Abstract: Quiroga, G., Estrabou, C. & Rodríguez, J.M. *Lichen community response to different management situations in a protected forest of Cordoba, Argentina. Lazaroa 29: 131-138 (2008).*

The conservation of native forests is an essential component for the maintenance of the biodiversity that they sustain, including lichens, which are good indicators of changes in the forest. These are sensitive to the changes of light, humidity, temperature and availability of nutrients produced by the deforestation and other processes of change in the forest.

In order to know the response of the lichen communities to forest disturbance, we did an analysis of the community in two forest units with different management situations. We made a phytosociological table of the lichen community and a PCA analysis, and then evaluated the reproductive strategies of the species in each area. We selected the samples at random with a total of sixty phorophyte, in which the total coverage of the species was accounted on a 30x30 cm grid.

We determined 36 species within twenty genera, with the exception of crustose lichens that we did not determine at specific level and considered as a group. Two different lichen communities are found, an "A" community dominated by *Canoparmelia crozalsiana*, of the forest with low disturbance and another one "B" dominated by *Parmotrema reticulatum* of the more disturbed forest zone. The analyses of reproductive strategies shows a greater presence of species with asexual reproduction in the less disturbed area.

Keywords: Lichen, Epiphytic, Communities, Diversity, Forest Management.

Resumen: Quiroga, G., Estrabou, C. & Rodríguez, J.M. *Respuesta de las comunidades liquénicas a distintos tipos de manejo en un bosque protegido de Cerro Colorado (Cordoba, Argentina). Lazaroa 29: 131-138 (2008).*

La conservación de los bosques nativos es un componente esencial para el mantenimiento de la biodiversidad que sustentan, entre ellos, los líquenes que son buenos indicadores de cambios en el bosque. Éstos son sensibles a los cambios de luz, humedad, temperatura y disponibilidad de nutrientes producidos por la deforestación y otros procesos de cambio en el bosque.

A fin de conocer la respuesta de las comunidades liquénicas a la fragmentación de bosque se realizó un inventario de la comunidad en dos unidades boscosas con dos distintas situaciones de manejo. Se realizó un cuadro fitosociológico de la comunidad liquénica, se evaluaron las estrategias reproductivas presentes en cada área y se realizó un ACP. Los muestreos fueron al azar con un total de sesenta forófitos, en los cuales se midió la cobertura total por especie sobre una malla de 30x30 cm.

Se determinaron veinte géneros, con 36 especies en total a excepción de los líquenes crustáceos que no se determinaron a nivel específico y fueron considerados como un grupo. Se determinaron dos comunidades liquénicas diferentes, una comunidad A dominada por *Canoparmelia crozalsiana* de la zona boscosa con poco disturbio y otra B de la zona boscosa con mayor degradación, dominada por *Parmotrema reticulatum*. Los análisis de estrategias reproductivas mostraron una mayor presencia de especies con reproducción asexual en el área boscosa menos degradada.

Palabras clave: Líquenes, Epífitos, Comunidades, Diversidad, Manejo forestal.

INTRODUCTION

The conservation of the native forests is an essential component for the maintenance of the biodiversity that they sustain. In the province of Cordoba, large forest areas are affected by different factors, specially the deforestation for lumber use or by the advance of the agricultural border that, lately, has led to the fragmentat-

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ion of formerly contiguous forests (Cabido & Zak, 1999). These practices generate changes in the responses of communities associated with forests, like lichens (Estrabou & *al*., 2005).

The ecological consequences of management of the forests are extremely diverse (Laurence & Bierregaard, 1997). The lichen communities play an important role in the forest ecosystem, although they are not the major part of the biomass. Included these roles are the nitrogen fixation, the cycle of nutrients and the provision of materials for feeding or nests construction (Will-Wolf & *al.*, 2002).

Epiphytic lichen diversity can be strongly affected by changes caused by the alteration of the forest. For example, the foliose lichen *Erioderma pedicellatum* disappeared from an area in Switzerland, apparently as a result of microclimatic changes caused by deforestation of contiguous areas (Jørgensen, 1978). Sillet (1994) found a noticeable reduction of growth in two foliose cyanolichens transplanted at the edge of a tempered fir forest and he attributed it to drying, since that generates a diminution in the time of photosynthetic activity.

Kivistö & Kuusinen (2002) found a significant difference in the species richness in edge-interior gradients, with greater richness towards the center of the forest, also Sillett & al. (2000) noticed that maximizing the number and dispersion of remnant trees in cutting units should maximize the rate of accumulation of *Lobaria oregana* biomass in the regenerating forest. Rolstad & *al.* (2001) suggest that moderate selective cuttings may prove an acceptable management option to sustain viable lichen assemblages.

The aim of this work is to determine the response of lichen communities, in the hills of the Sierra Chaco forest, to different situations of management. To do this, we described the types of communities and their reproductive strategies.

MATERIALS AND METHODS

Study Area

The Protected Area "Cerro Colorado" is part of the mountain system denominated Sierras del Norte, formed mainly by granites, crystalline rocks and conglomerates, that are just above the 1000 m of elevation (30º 0.4´S; 63º 54´W). The climate belongs to the semi desert dominion, next to the semidry dominion. The precipitations are influenced by the height, Cerro Colorado has an annual average precipitation of 745.6 mm (Capitanelli, 1979). Phytogeographicaly, the vegetation of the reserve belongs to the belt of mountain woodland and the transition with the Chaco lowland forest, where typical species from the Chaco woodland are found. Besides the characteristic species of the Sierra Chaco forest —such as *Lithraea ternifolia* (Gill.) Barkley & Rom., *Celtis tala* Gill. ex Planchon, *Prosopis alba* Gris.— others can also be found, such as *Myrcianthes cisplatensis* (Camb.) Berg and *Trithrinax campestris* (Burmeist.) Drude & Grises. among others (Luti & al., 1979).

The study area presents a forest matrix with different degrees of fragmentation, determined by human activities pressure. According to this, we selected two units of forest area, one less than 15 years old and the other more than 50 years old since the process of selective cutting (Schwindt, 2004) (Fig. 1).

The Unit less than 15 years old since the disturbance is an opened shrubland of *Celtis tala*, *Condalia montana* Castell. and *Acacia caven* (Mol.) Mol., with isolated trees of *Prosopis alba*, *Myrcianthes cisplatensis*, *Celtis tala*, *Aspidosperma quebracho-blanco* Schlecht. and *Ruprechtia apetala* Wedd. The superior layer reaches 5 m of height and 5 % of coverage, whereas shrubland layer reaches from 2 to 4 m of height and from 30 to 40% of coverage (Schwindt, 2004).

The Unit more than 50 years old since the disturbance is a woodland of *Myrcianthes cisplatensis*, *Prosopis alba* and *Aspidosperma quebracho-blanco* of up to 6 m of height and 50 % of coverage. The shrubland layer dominated by *Condalia montana* and *Acacia caven* reaches 4 m of height and from 40 to 50 % of coverage (Schwindt, 2004).

Sampling

In each unit, we drew up five transects of 100 m of length. We registered the total coverage of each lichen species present by phorophyte (in percentage). We sampled 6 phorophytes by transect with DBH greater than 15 cm, using a 30 x 30 cm grid in the southwestern face of the trunk (that is frequently the one that presents lichens) at 1.5 m above the ground (Estrabou & García, 1995; Estrabou, 2007).

The phorophytes sampled in both Units were *Prosopis alba*, *Acacia caven*, *Celtis tala*, *Condalia montana* and *Ruprechtia apetala*.

For the identification of the lichen species we used routine techniques of chemical analysis of substances (color spot test) as well as TLC tests for chemical

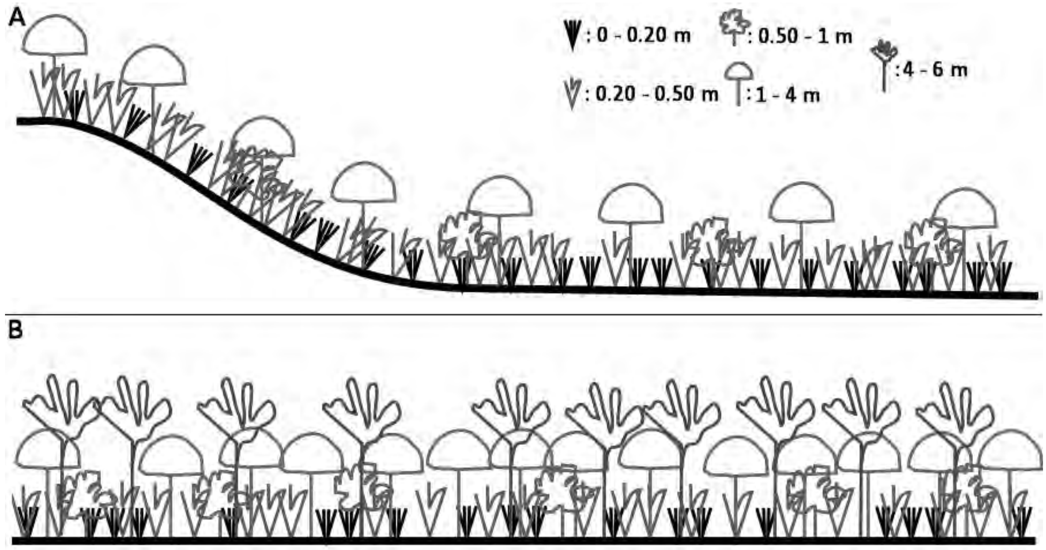

Figure 1. Vegetation profile, according to different cover layers and abundance of vegetation. A: profile of the Unit with less than 15 years since thinning. B: profile of the Unit with more than 50 years since thinning.

identification (Culberson & *al.,* 1988), and for the analysis of morphological and anatomical characters, we used stereoscope (Carl-Zeiss Stereoscope, Stemi 2000-C) and microscope (Microscope Bausch and Lomb RD).

Data Analysis

Based on Braun-Blanquet methodology lichen communities were analysed. We ordered data in a phytosociological table (Matteucci & Colma, 1982), in which all samples were numbered from 1 to 60, the 30 first are from the Unit less than 15 years old since the disturbance, and the last 30 are from the Unit with more than 50 years since the disturbance. In addition, a matrix of the species cover/study site was made to perform other data analysis.

We calculated the Sørensen similarity index (qualitative), by means of the formula, where C is the number of common species in both communities, A the number of species of the community A and B the number of species of community B.

Using software Infostat Ver. 2006e.2, we applied the multivariate test Principal Components Analysis (PCA) to the data with the intention of inferring its structure and establishing relations between them.

We performed a comparative analysis between the reproductive strategies (sexual/asexual) of the species found in both areas. We consider as "asexual" reproduction both vegetative (isidia and soredia) and asexual reproduction (picnidia).

RESULTS AND DISCUSSION

We identified a total of 36 species, pertaining to 20 genera (Table 1). We did not include the crustose species of lichens.

Of the 36 found species, six are exclusive of the forest less than 15 years old since the disturbance, and six are exclusive of the Unit more than 50 years old since the disturbance, with the remaining 24 common between both Units. *Canoparmelia crozalsiana* is a dominant species in both sites, with a relative coverage of 31.8 % in the first Unit, and 43.66 % in the second. *Parmotrema reticulatum* presents values of coverage of 19.3 % in the forest less than 15 years old since thinning, where *C. crozalsiana* is not present. In the forest of more than 50 years old since disturbance, *P. reticulatum* presents a coverage of 4.5 %.

With regards to the diversity of species, the Sørensen similarity index appears with a high value of 74 % (Sørensen x 100), which suggests that the difference between both places is not due to species composition of each place *per se*, but to the relative abundance of them.

In the phytosociological analysis, we differentiated clearly two communities (Table 2): the community A dominated by *Canoparmelia crozalsiana* and the

Table 1
List of 36 lichen species founded in protected area.The two first columns are the exclusive, preferential and selective species of each community (according to Braun-Blanquet). In the column "reproductive strategies" (Rep. Strat.): A = Asexual, M = Mixed and S = Sexual. The last column presents the abbreviations used in the figures. The species that are unmarked are the common species between both communities

Specie	Comunity A	Community B	Rep. Strat.	Abbreviation
Candelaria concolor (Dicks.) Stein			A	Cnd
Canoparmelia crozalsiana (de Lesd.) Elix & Hale	x		M	Ccrz
Canoparmelia texana (Tuck.) Elix & Hale	x		M	Ctx
Dirinaria picta (Sw.) Clem. & Shear	x		M	Dpic
Heterodermia albicans (Pers.) Swinscow & Krog	x		M	Hal
Heterodermia comosa (Eschw.) Follmann & Redón			A	Hco
Heterodermia diademata (Taylor) Awasthi			S	Hdia
Heterodermia obscurata (Nyl.) Trevis	x		M	Hob
Hyperphyscia granulata (Poelt) Moberg	x		M	Hygr
Leptogium cyanescens (Ach.) Körb	x		M	Lep
Myelochroa lindmanii (Lynge) Elix & Hale		x	M	Mli
Normandina pulchella (Borr.) Nyl	x		S	Npu
Parmotrema cetratum (Ach.) Hale & A. Fletcher	x		M	Pice
Parmotrema conferendum (Hale) Kurok		x	M	Parco
Parmotrema pilosum (Stizenb.) Elix & Hale	x		M	Ppil
Parmotrema praesorediósum (Nyl.) Hale			M	Ppr
Parmotrema reticulatum (Taylor) Hale & A. Fletcher		x	M	Pare
Phaeophyscia chloantha (Ach.) Moberg			A	Pechl
Physcia aipolia (Humb.) Fürnr		x	S	Phai
Physcia alba (Fée) Müll. Arg.		x	S	Phal
Physcia atrostriata Moberg	x		A	Phat
Physcia erumpens Moberg		x	M	Pher
Physcia poncisnii Hue.	x		A	Phpo
Physcia rolfii Moberg	x		M	Phro
Physcia tribacia (Ach.) Nyl.			A	Phtr
Physcia undulata Moberg	x		M	Phun
Punctelia hypoleucites (Nyl.) Krog			M	Puhy
Punctelia microsticta (Müll. Arg.) Krog	x		M	Pumi
Punctelia perreticulata (Räsänen) G. Wilh. & Ladd			A	Pupe
Punctelia punctilla (Hale) Krog	x		A	Pupu
Punctelia semansiana (W. L. Culb. & C. F. Culb.) Krog	x		A	Puse
Pyxine cocoes (Sw.) Nyl		x	A	Pico
Ramalina celastri (Spreng.) Krog & Swinscow			S	Riel
Teloschistes cymbalifer (Meyen.) Müll Arg.			S	Tcy
Usnea angulata Ach.	x		A	Uan
Xanthoria sp. (Fr.) Th. Fr.	x		A	Xan
Crustose genera not identified	x		M	Crs

community B dominated by *Parmotrema reticulatum*, being the second one characteristic of the Unit less than 15 years old since the disturbance. We could determine exclusive, preferential, selective and accompanying species in both communities (Table 2).

We could define the A community with *Canoparmelia crozalsiana* as dominant species, *Parmotrema pilosum*, *Heterodermia albicans*, *Physcia poncinsii* and *Leptogium cyanescens* as selective species and *Heterodermia obscurata*, *Physcia atrostriata* and *P. rolfii* as main exclusive species.

Also, we could define the B community with *Parmotrema reticulatum* as dominant species, *Parmotrema conferendum*, *Physcia alba* and *Physcia erumpens* as preferential species and *Physcia aipolia*, *Pyxine cocoes* and *Myelochroa lindmanii* as exclusive species.

Table 2
Analysis of lichen communities, Community A.Samples from 1 to 30 are from unit with less than 15 years since thinning and those from 31 to 60 are from unit with more than 50 years since thinning.

Relevé number	7	14	16	12	27	19	43	37	31	32	33	36	41	50	34	58	51	9	22	13	30	49	38	39	46	44	20	28	1	23	8	21	29	2	4	53	47	55	57	40	45	48	52	56	59	35	60	54	42
Community A selective species:																																																	
Canoparmelia crozalsiana	+	1	+	3	+	+	3	1	1	2	2	+	1	1	1	2	2	+	+	+	+	+	.	.	3	5	.	.	4	3	3	5	3	.	.	+	+	1	2	.	4	3	1	+	3	.	.	.	.
Parmotrema pilosum	+	+	+	1	r	r	r	1	+	+	+	1	+	2	+	1	+	+	+	+	2	.	+	2	.	.	1	1	.	.	.	.	.	.	r	.	.	.	.	+	.	.	.	.	.	.	.	r	.
Crusted	2	+	+	+	+	2	r	3	+	3	2	+	+	.	.	.	.	.	.	.	.	1	4	+	+	+	+	r	1	.	.	.	.	3	.	1	.	1	.	.	.	+	.	.	+	.	+	.	.
Heterodermia albicans	+	1	+	.	1	.	.	.	.	.	.	.	.	.	r	+	+	2	.	+	.	r	.	.	.	.	+	.	+	+	.	+	.	.	.	+	.	.	.	.	r	.	.	.	.	.	.	+	.
Physcia poncinsii	.	.	.	+	.	.	r	r	.	r	.	.	.	r	.	.	+	.	+	.	.	+	r	+	r	.	.	+	.	+	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	2	+	.	.
Leptogium cyanescens	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	2	.
Community A exclusive species:																																																	
Heterodermia obscurata	.	.	.	.	.	.	r	.	.	.	+	.	.	+	.	.	.	.	+	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.
Physcia rolfii	1	.	.	.	+	.	r	r	.	.	.	r	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.
Physcia atrostriata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	3	.	.	.	.	.	.	.	.	.	.	.	.	2	.
Community A exclusive and rare species:																																																	
Physcia undulata	.	.	.	+	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Punctelia puntilla	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.
Normandina pulchela	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Xantoria sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Canoparmelia texana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Punctelia microsticta	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Punctelia semansiana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Parmotrema cetratum	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Usnea angulata	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dirinaria picta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Hyperphyscia granulata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.
Companion species																																																	
Punctelia hypoleucites	.	.	.	.	.	.	.	.	.	.	.	r	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	+	.
Heterodermia diademata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	r	.	.	.	.	.	.
Candelaria concolor	r	.	.	.	.	r	r	.	.	.	r	.	.	.	.	.	r	.	.	.	.	.	.	.	.	r	.	.	r	r	.	.	+	.	r	.	.	1	r	.	.	.	.	.	.	.	.	.	.
Heterodermia comosa	r	.	r	.	.	.	.	.	r	.	.	r	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Parmotrema praesorediosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Teloschistes cymbalifer	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phaeophyscia chloantha	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.
Physcia tribacia	.	.	.	+	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pucntelia perreticulata	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ramalina celastri	r	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Community B preferential species:																																																	
Parmotrema reticulatum	.	+	+	.	.	3	+	.	+	+	+	1	.	+	1	+	.	.	+	4	+	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	1	1	.	.	.	.	.	.	.	.	r	.
Parmotrema conferendum	1	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.
Physcia alba	.	+	.	.	.	.	.	r	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	r	.	.	.	1	.	r	.	.	.	.	.	.	.	.	.	.
Physcia erumpens	.	.	+	.	.	.	.	r	.	+	.	.	+	.	.	.	+	.	.	.	.	.	.	+	.	+	.	.	+	.	r	+	.	.	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.
Community B exclusive and rare species:																																																	
Physcia aipolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Pyxine cocoes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.

We determined a total of ten companion species, *Candelaria concolor*, *Punctelia hypoleucites*, *Heterodermia comosa*, *Heterodermia diademata*¸ *Phaeophyscia chloantha*, *Physcia tribacia*, *Ramalina celastri*, *Punctelia perreticulata*, *Parmotrema praesorediosum* and *Teloschistes cymbalifer*.

The multivariate analysis (the PCA) shows little variability between sites, since the five first axes absorb 100% of the variability, being the axis 1 (with 32.8 %) and axis 2 (with 24.4 %) little explanatory of the diversity. The separation of groups is subjective and manual: it is possible to distiguish two groups that would respond to the different times of thinning in the study site (CP1), and one of these groups is subdivided on axis 2 and seems to respond to light as factor (Figure 2).

Group 1 presents several of the accompanying species and some of the A community. Nevertheless, it is necessary to emphasize that almost all species in the B community are also present, which denotes, therefore, that this group seems to respond to thinning management as main factor.

Sub-group 1a is formed by *Parmotrema reticulatum*, *Heterodermia comosa*, *H. albicans*, *diademata*, *Normandina pulchella*, *Parmotrema praesorediosum*, *Phaeophyscia chloantha*, *Physcia atrostriata*, *P. undulata*, *Punctelia microsticta*, *Usnea angulata* and *Xanthoria sp*.

Sub-group 1b is formed by *Parmotrema pilosum*, *Candelaria concolor*, *Physcia alba*, *P. rolfii*, *P. tribacia*, *Teloschistes cymbalifer*, *Myelochroa lindmanii*, *Punctelia perreticulata*, *Ramalina celastri*. This sub-group is made up mainly of species that have small thalli and are highly pigmented, responding to conditions of high luminosity.

Group 2 is formed by *Canoparmelia crozalsiana*, *Physcia poncinsii*, *Punctelia punctilla*, *Parmotrema cetratum*, *Punctelia semansiana*, *Dirinaria picta*, *Canoparmelia texana*, *Hyperphyscia granulata*, *Heterodermia obscurata*, *Leptogium cyanescens*, *Physcia aipolia*, *Pyxine cocoes*, *Punctelia hypoleucites* and crustose lichens. This group responds to the conditions of forest with low disturbance, and includes a great part of the species of the community A.

In the analysis of the reproductive strategies, we observed the occurrence in both sites of species with sexual and asexual reproduction, the latter being most frequent. In previous study structures of sexual reproduction have been not observed in a 74% of the studied species to Parmeliaceae family (ESTRABOU, 1999). Also, unlike the expected result, the species with asexual reproduction are present in greater number in the Unit more than 50 years old since the disturbance (93%) that in the Unit less than 15 years old since the disturbance (67%).

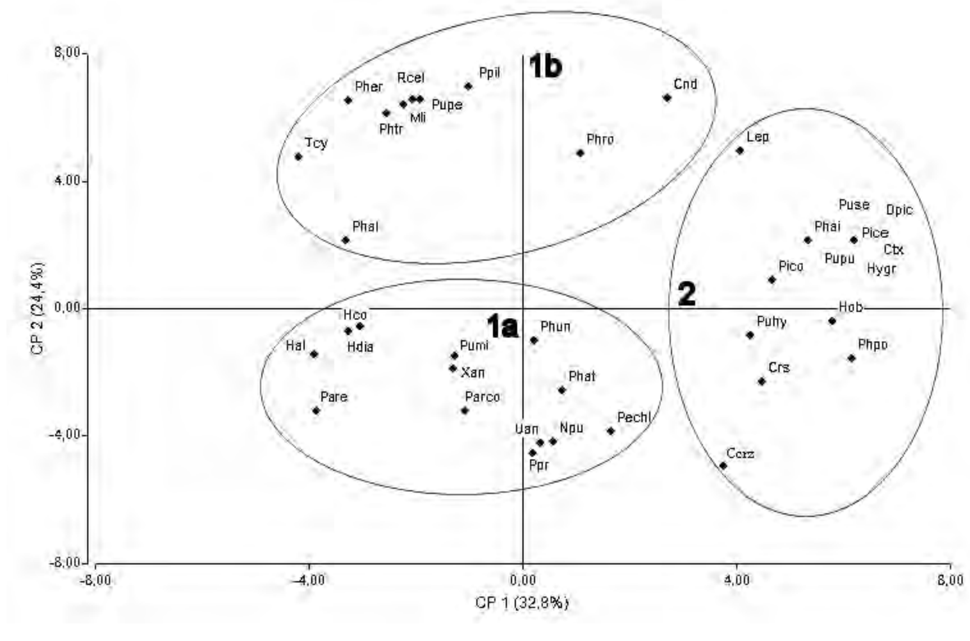

Figure 2. Reciprocal ordering of the species cover according to the two first Principal Components (1 and 2). 1- Species of a high disturbed area. a - whit low light incidence. b - whit high light incidence. 2 – Species of a low disturbed area.

Table 3
Analysis of lichen communities, Community B.Samples from 1 to 30 are from unit with less than 15 years since thinning and those from 31 to 60 are from unit with more than 50 years since thinning.

	24	15	17	3	10	11	6	18	5	26	25
Community B preferential species:											
Parmotrema reticulatum	1	1	1	1	2	1	3	+	+	1	.
Parmotrema conferendum	1	+	.	2	+	3	+	.	.	.	+
Physcia alba	+	2	+	+	.	.	.	+	+	.	+
Physcia erumpens	.	+	+	+	1	.	.	.	.	2	.
Community B exclusive and rare species:											
Physcia aipolia	.	.	.	.	.	.	.	r	.	.	.
Pyxine cocoes	.	.	.	.	.	+	.	.	.	.	.
Myelochroa lindmanii	.	.	.	.	.	.	.	.	.	+	.
Community A selective species:											
Canoparmelia crozalsiana	1	+	1	.	+	.	.	.	1	.	.
Parmotrema pilosum	.	.	.	.	+	.	+	2	.	.	.
Crusted	.	.	+	.	r	.	.	.	1	1	+
Heterodermia albicans	.	.	.	+	.	.	.	.	.	.	.
Physcia poncinsii	.	.	+	.	.	.	+	.	.	.	.
Leptogium cyanescens	.	.	+	.	.	.	.	.	.	.	.
Companion species:											
Puncteliahypoleucites	.	.	.	.	.	.	.	.	+	.	.
Heterodermia diademata	.	+	.	.	+	.	.	+	.	.	.
Candelaria concolor	.	.	.	.	r	.	r	.	.	r	.
Heterodermia comosa	.	.	.	.	.	.	.	r	.	.	.
Parmotrema praesorediosum	3	.	+	.	.	+	.	.	.	.	.
Teloschistes cymbalifer	r	.	+	.	.	.	.	.	.	.	.
Pucntelia perreticulata	.	.	.	.	.	.	.	.	.	.	1

Comparing the growth strategies of the dominant species of each community, both species present a foliose morphology. Nevertheless, *P. reticulatum* has a thallus with more turgid lobes and greater diameter than *C. crozalsiana*, which allows it a greater absorption of energy and nutrients and, in addition, a reproductive advantage due to fragmented forest conditions.

CONCLUSION

The fragmentation and different types of forest management generate changes in the composition of the lichen community, which agrees with KIVISTÖ & KUUSINEN (2002) and with ESSEEN & RENHORN (1998). In the forest less than 15 years old since the thinning, the communities defined as A and B coexist. Whereas the lichen community defined as A occurs in a forest with more than 50 years without disturbances. Thus it can be possible to identify *P. reticulatum* as an indicator of the process of disturbance in the forest as well as its the dominant specie at B community.

We consider as important to maintain a group of old trees as source of propagules in all managed forests, as well our results shows that open forests provide better conditions for the establishment and growth of certain dominant lichen species. In a manner we agree with SILLETT & al. (2000): "The single most important action promoting the propagation of lichens in managed forests will be the retention of propagules sources in and near all cutting units. Maintaining a full complement of epiphytic lichens in managed forest will not only increase biodiversity, but it will also greatly benefit a wide variety of other organisms utilizing lichens".

Regarding the reproductive strategies in the species, both sites are similar, but contrary to the expected results, in the fragmented area there was not a majority of species with asexual reproduction.

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