

Lichens of the surrounding areas of Termas of Chillán and Las Trancas, Bío-Bío Region, Chile

Líquenes de los alrededores de las Termas de Chillán y Las Trancas, Región del Bío-Bío, Chile

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ABSTRACT

The aim of this study was to contribute to the knowledge of the richness and distribution of the lichens in the Bío-Bío Region. A total of 120 samples were collected in the surroundings of Termas de Chillán and Las Trancas, Bio-Bio region. The sampling was realized at random considering the high diversity of available substrates. Taxonomical identification was performed on the basis of the analysis of morphological, reproductive and chromatographic (TLC) characters. A total of 41 species were identified, which include 18 families and 31 genera. Out of the total of identified species, 49 % are corticolous, 34 % saxicolous and 17 % terricolous. Of the total of species found, four are new records for Chile: *Menegazzia confusa* P. James, *M. pertransita* (Stirt.) R. Sant., *Rinodina sophodes* (Ach.) A. Massal. and *Usnea sinensis* Motyka. For each species, information on lichen name, family, substratum, altitude, global distribution, and sampling site is provided. Also, keys to identify the genera found in the study area are included. Pictures for the new records of lichens for the country are also presented. The work contributes to extend the knowledge on the taxa's distribution in the region. The results suggest that the lichenological expeditions should be continued in unexplored localities of Chile in order to increase the knowledge of the richness, ecology and distribution of lichen biodiversity.

KEYWORDS: Chillán, genera key, distribution, ecology, new records.

RESUMEN

El deseo de este estudio fue contribuir al conocimiento de la riqueza y distribución de los líquenes de la Región del Bío-Bío. Como producto de una excursión realizada por la mayoría de los autores de este trabajo, un total de 120 muestras fueron recolectadas en los alrededores de las Termas de Chillán y Las Trancas, Región del Bío-Bío, Chile. El muestreo fue realizado al azar considerando la mayoría de los sustratos disponibles. La identificación taxonómica fue establecida en base al análisis de caracteres morfológicos, reproductivos y cromatográficos (CCF). Un total de 41 especies fueron identificadas, las cuales se incluyen en 18 familias y 31 géneros. Del total de las especies identificadas, 49 % son corticícolas, 34 % saxícolas y 17 % terrícolas. Del total de especies encontradas, 4 corresponden a nuevos registros para el país: *Menegazzia confusa* P. James, *M. pertransita* (Stirt.) R. Sant., *Rinodina sophodes* (Ach.) A. Massal. y *Usnea sinensis* Motyka. Para cada especie se proporciona información acerca del nombre de la especie, familia, sustrato, altitud, distribución global y localidades muestreadas. Se presentan fotografías de los nuevos registros de líquenes para el país. También, se incluyen claves para identificar los géneros encontrados en el área de estudio. El trabajo contribuyó a ampliar el conocimiento acerca de la distribución de los taxones en la región. Los resultados sugieren que expediciones liquenológicas deberían continuar en localidades no exploradas de Chile para incrementar el conocimiento de la riqueza, ecología y distribución de la biodiversidad de líquenes.

PALABRAS CLAVE: Chillán, clave de géneros, distribución, ecología, nuevos registros.

INTRODUCTION

The mainland territory of Chile is divided into 15 regions. Within these regions, there is no clear knowledge of the richness, distribution, and ecology of lichens. Documented literature on these topics is widely dispersed and for this reason it has not been possible to establish a lichen flora at a regional level. The regions where lichen flora have been more intensively studied and reported so far are: Araucania Region (Rubio *et al.* 2013), Los Lagos Region (Galloway 1992a, Pereira 2007), Aisén Region (Quilhot *et al.* 2012, Vargas Castillo & Morano Büchner 2014, Villagra *et al.* 2009), and Maule Region (Pereira *et al.* 1999, Pereira & San Martín 1998). Furthermore, the researchers dedicated to taxonomic studies are very scarce in the country, and the papers available not always give data on the ecology and distribution of the lichen species. In the first contribution about of the lichen flora, ecology and distribution reported for the Bio-Bío Region, only four species of the genus *Pseudocyphellaria* were cited for the continental territory (Galloway 1992b): *P. coriifolia* (Müll.Arg.) Malme, *P. neglecta* (Müll.Arg.) H.Magn., *P. nudata* (Zahlbr.) D. Galloway and *P. pilosella* Malme. After that, species of genera *Cladia*, *Cladina* and *Cladonia* the genera (Stenroos 1995) has been cited: *Cladia aggregata* (Sw.) Nyl., *Cladina mitis* (Sandst.) Hustich. and *C. pynoclada* (Pers.) Leighton, *Cladonia corniculata* Ahti et Kashiw., *C. didyma* (Fée) Vainio, *C. gracilis* (L.) Willd. subsp. *gracilis*, *C. gracilis* (L.) Willd. subsp. *valdivensis*, *C. humilis* (With.) J.R.Laundon, *C. lepidophora* Ahti et Kashiw., *C. ochrochlora* Flörke, *C. phyllophora* Hoffm., *C. sarmentosa* (Hook. f. et Taylor) C.W. Dodge, *C. scabriuscula* (Delise) Nyl., *C. squamosa* Hoffm. and *C. subchordalis* A. Evans. Finally Pereira *et al.* 2002 have cited epiphytic lichens on *Gomortega keule* (Molina) Baillon localized into of the Bio-Bío Region as *Graphis scripta* (L.) Ach., *Megalaria grossa* (Pers.) Hafellner, *Mycromicrothelia thelena* (Ach.) D. Hawksw., *Parmotrema perlatum* (= *Parmotrema chinense* (Osbeck) Hale & Ahti), *Pertusaria leioplaca* DC., *Pseudocyphellaria coriifolia* (Müll, Arg.) and *Thelotrema lepadinum* (Ach.) Ach.

The aim of this study is to contribute to the knowledge of the flora, ecology and distribution of the lichens in the Bio-Bío Region. The idea of including genera keys in this study was to fill the gap in lichenological taxonomic literature in the country since the majority of the works lack these tools to carry out taxonomic identification at a genera level. As a way of complementing this gap, the authors of this study proposed the following objectives: a) to identify the lichen species in the studied area, b) to give information about the distribution, ecology and global distribution of the species in the studied area, c) to generate keys to identify the genera found in this study and illustrate new records about lichens for the country.

MATERIALS AND METHODS

STUDY AREA

The studied area corresponds to the surroundings of the volcanic complex Nevados de Chillán situated at 36°50'S, 71°25'W, reaching a maximum altitude of 3,212 m. It is located in the transition zone in central Chile with Mediterranean climate vegetation, constituted mainly of sclerophyllous elements and the temperate evergreen forests of southern Chile (Arroyo *et al.* 2004) (Fig. 1). The combination of biogeographic situation and geomorphologic complexity leads to an exceptional degree of botanical biodiversity including lichens. The forest in this region is dominated by different species of *Nothofagus*, like *Nothofagus obliqua* (Mirb.) Oerst., *N. pumilio* (Poepp et Endl.) Krasser, *N. antarctica* (G. Forst.) Oerst. and *N. dombeyi* (Mirb.) Oerst. with Andean low scrub of *Adesmia emarginata* Clos, *Pozoa coriacea* (Lag.) Kuntze, *Berberis empetrifolia* Lam., *Loasa lateritia* Lindl. and *Chusquea culeou* E. Desv.

SAMPLING METHOD

The sampling was made at random considering the great diversity of available substrates (soil, rocks, bark of trees, and shrubs). The lichens were obtained manually or with chisel and hammer. Each site was georeferenced with a GPS Model: eTrex Vista® HCx company: Garmin. Data of the habitat, altitude and site names were recorded.

The sampled sites correspond to:

- 1: Surroundings of Termas de Chillán in three sites,
 - 1.1. Faldeos Volcán Callaqui, 36°54'18.5"S; 71°24'30.7"W, 1,692 m
 - 1.2. Hotel Termas de Chillán, 36°54'19.9"S; 71°24'29.7"W, 1,754 m
 - 1.3. Estero Renegado, 36°54'21.6"S; 71°24'05.5"W, 1,980 m
- 2: Below Termas de Chillán (36°54'33.5"S; 70°24'54.2"W), 1,594 m
- 3: Las Trancas (36°54'41.1"S; 71°24'16.7"W), 1,523 m
- 4: Below Las Trancas (36°55'01.4"S; 71°26'33.3"W), 1,377 m

TAXONOMIC IDENTIFICATION

For the taxonomical identification, morphological (vegetative and reproductive) and chromatographic (TLC) (Orange *et al.* 2010) characters were analysed. The vegetative characters as colour thallus and types of reproductive structures of sexual and asexual origin as perithecia, lirelles or apothecia (lecarorine, biatorin and lecideine), presence or absence of soredia, isidia and picnidia with a binocular stereoscope Kyoma were analysed. The colour, dimensions and form of spores and picnidiospores with a binocular microscope Nikon model Optiphot equipped with a lucida microphotographic camera with graduated ocular were

studied. Spot tests on different parts of the thallus as upper cortex, medulla and in some structures of the reproductive apparatus as apothecium or amphithecium or hypothecium were made considering the following solutions K (saturated solution of KOH to 20 %), C (aqueous solution of sodium hypochlorite 50%), KC (application solution K following C), P (alcohol solution of paraphenyldiamine) and aqueous solution of concentrated nitric acid to 60%. The lichen substances were determined by thin layer chromatography (TLC) using a glass plate coated with TLC Silica gel 60 in solvent systems A (toluene:dioxin:acetic = 180:45:5 (Orange *et al.* 2010). The studied material was deposited in the Herbarium of the Korea Lichen Research Institute (KoLRI) Suncheon National University (Korea) and duplicates were deposited at the Herbarium of the Talca University Talca Chile).

RESULTS AND DISCUSSION

LICHEN RICHNESS

A total of 41 species, belonging to 18 families and 31 genera were identified, of which 49 % are corticolous, 34 % saxicolous, and 17 terricolous (Fig. 2). The studied species are listed in Table I.

The Parmeliaceae family was represented by 12

species, followed by Lecanoraceae (5 species), Lobariaceae and Peltigeraceae (4 species); Stereocaulaceae and Umbilicariaceae (2 species), and the rest families by only 1 species. The species richness of each family is represented in Figure 3.

Four new records are mentioned for the country: *Menegazzia confusa* P. James (Fig. 4, A), *M. pertransita* (Stirt.) R. Sant. (Fig. 4, B), *Rinodina sophodes* (Ach.) A. Massal. (Fig. 4, C), and *Usnea sinensis* Motyka (Fig. 4, D).

DISTRIBUTION OF THE SPECIES

Of the four new records of lichens found in the studied area, the *Menegazzia* species appear as epiphytes on *Nothofagus antarctica* between 1,337 to 1,523 m. *Menegazzia confusa* is currently known only from Australia (Kantvilas & James 1987), therefore these results extend its global distribution. On the other hand, *M. pertransita* is known from Australia, New Zealand, South America, and Antarctica (Santesson 1942). Nevertheless, it has been difficult to pinpoint with exactitude the distribution of this species in South America until now, due to the lack of information about where it was found. *Rinodina sophodes* is known in the Northern Hemisphere and cited in Italy on *Quercus pubescens* Willd. (Rizzi *et al.* 2011) and in France (Roux 2012). *Usnea sinensis* has been cited on wood in China (Zahlbruckner 1938-1940) and in India (Western Ghats and Karnataka)

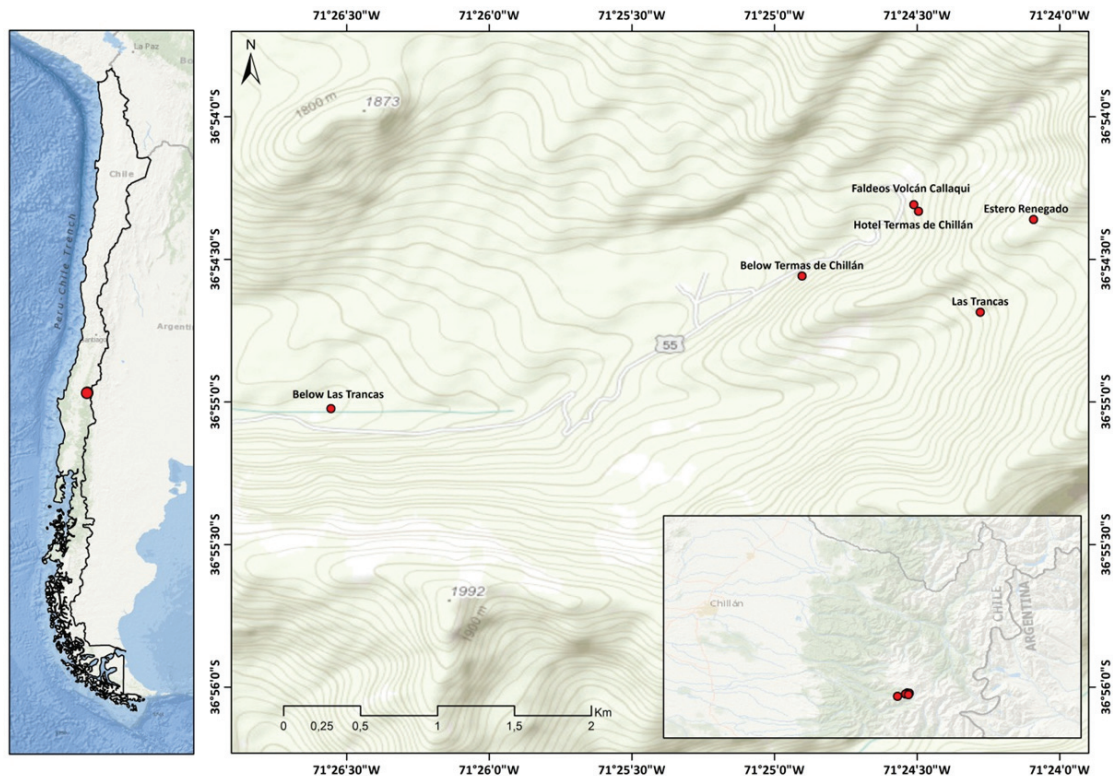


FIGURE 1. Studied area. The number show the collection sites.

FIGURA 1. Área de estudio. Los números muestran los sitios de recolección.

growing on toddy palm bark (Vinayaka *et al.* 2012).

The following species extend its northern distribution in Chile: *Bryoria chalybeiformis* (L.) Brodo & D. Hawksw., *Cetraria aculeata* (Schreb.) Fr., *Lecanora argentata* (Ach.) Malme, *Leptogium cochleatum* (Dicks.) P.M. Jørg. & P. James, *Peltigera collina* (Ach.) Schrad., *P. neckeri* (Ach.) Schrad. and *Umbilicaria nylanderiana* (Zahlbr.) H. Magn.

Pseudocyphellaria dissimilis (Nyl.) D.J. Galloway & P. James has only been cited in Chile in Aisén Region and *Crocodia guillemirii* (Mont.) Nyl. is distributed from Conguillio National Park to Magallanes (Galloway & Elix, 2013, Quillhot *et al.* 2012), therefore the expansion of their distribution is only continental since both species also occur on Juan Fernández Islands (Galloway 1992b).

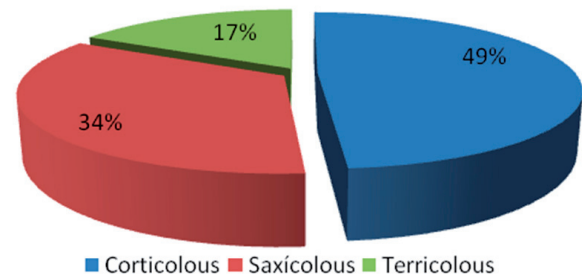


FIGURE 2. Distribution of lichen species by substrate in studied area.

FIGURA 2. Distribución de las especies de líquenes por sustrato en el área de estudio.

TABLE I. Lichen species from the surrounding areas of Termas de Chillán and Las Trancas (Bío-Bío Region, Chile). Data referring the substrate, altitude, and collection site where they were found and its global distribution are detailed.

TABLA I. Especies de líquenes de los alrededores de Termas de Chillán y Las Trancas (Región del Bío-Bío, Chile). Se detallan datos referentes al sustrato, altitud y sitio de recolección donde fueron encontradas y su distribución global.

	LICHEN SPECIES	FAMILY	SUBSTRATES	ALTITUDE (M)	GLOBAL DISTRIBUTION	COLLECTION SITE
1	<i>Acarospora schleicheri</i> (Ach.) A. Massal.	Acarosporaceae	On rocks	1980	Europe, Africa, North and South America	1.1
2	<i>Blastenia ferruginea</i> (Huds.) A. Massal	Teloschistaceae	Trunk	1692	Cosmopolitan	1.3
3	<i>Bryoria chalybeiformis</i> (L.) Brodo & D. Hawksw. **	Parmeliaceae	Trunk	1692	Bipolar	1.3
4	<i>Buellia cf. hyperbolica</i> Bagl.	Caliciaceae	Trunk	1523	United Kingdom and Chile	3
5	<i>Catapyrenium cinereum</i> (Pers.) Körb.	Verrucariaceae	Soil	1594	Native of North America	2
6	<i>Cetraria aculeata</i> (Schreb.) Fr. **	Parmeliaceae	Trunk	1980, 1754, 1692	Bipolar	1.1, 1.2, 1.3
7	<i>Circinaria calcarea</i> (L.) A. Nordin, S. Savić & Tibell	Megasporaceae	On rocks	1980	Cosmopolitan	1.1
8	<i>Crocodia guillemirii</i> (Mont.) Nyl., **	Lobariaceae	Trunk	1337	Endemic to southern South America	4
9	<i>Hypotrachyna sinuosa</i> (Sm.) Hale	Parmeliaceae	Trunk	1523	Cosmopolitan	3
10	<i>Ingvariella bispora</i> (Bagl.) Guderley & Lumbsch	Thelotremaceae	On rocks	1584	Subcosmopolitan	2
11	<i>Lecanora argentata</i> (Ach.) Degel. **	Lecanoraceae	Trunk	1692	Cosmopolitan	1.3
12	<i>Lecanora chlarotera</i> Nyl.	Lecanoraceae	Trunk	1594	Subcosmopolitan	2
13	<i>Lecidea capensis</i> Zahlbr.	Lecideaceae	On rock	1980	Australia, New Zealand, South Africa and Chile	1.1

	LICHEN SPECIES	FAMILY	SUBSTRATES	ALTITUDE (M)	GLOBAL DISTRIBUTION	COLLECTION SITE
14	<i>Lecidella elaeochroma</i> (Ach.) M. Choisy	Lecanoraceae	Trunk	1754, 1692, 1523, 1337	Subcosmopolitan	1.2, 1.3, 3, 4
15	<i>Lepraria lobificans</i> Nyl.	Stereocaulaceae	Soil	1594	Cosmopolitan	2
16	<i>Leptogium cochleatum</i> (Dicks.) P.M. Jørg. **	Collembataceae	Trunk	1523, 1337	Tropical and temperate regions	3, 4
17	<i>Melanelia</i> cf. <i>exasperatula</i> (Nyl.) Essl.	Parmeliaceae	Trunk	1523	Northern Hemisphere and Chile	3
18	<i>Menegazzia confusa</i> P. James*	Parmeliaceae	Trunk	1337, 1523	Australia	3, 4
19	<i>Menegazzia pertransita</i> (Stirt.) R. Sant. *	Parmeliaceae	Trunk	1523	New Zealand, Australia, and South America	3
20	<i>Montanelia panniformis</i> (Nyl.) Divakar, A. Crespo, Wedin & Essl.	Parmeliaceae	On rock	1980	North America and Eurasia	1.1
21	<i>Neuropogon antarcticus</i> (Du Rietz) I.M. Lamb	Parmeliaceae	On rock	1980	Subantarctic and circumpolar	1.1
22	<i>Ochrolechia parella</i> (L.) A. Massal.	Ochrolechiaceae	On rock	1980	Bipolar	1.1
23	<i>Parmelia sulcata</i> Taylor	Parmeliaceae	Trunk	1523	Cosmopolitan	3
24	<i>Peltigera</i> cf. <i>austroamericana</i> Zahlbr.	Peltigeraceae	Soil	1692	Central and South America	1.3
25	<i>Peltigera collina</i> (Ach.) Schrad. **	Peltigeraceae	Soil	1692, 1337	Circumpolar	1.3, 4
26	<i>Peltigera didactyla</i> (With.) J.R. Laundon	Peltigeraceae	Soil	1594	Cosmopolitan	2
27	<i>Peltigera neckeri</i> Hepp ex Müll. Arg. **	Peltigeraceae	Soil	1337	Temperate and boreal regions of North America, Europe and Asia	4
28	<i>Pertusaria</i> cf. <i>albescens</i> (Huds.) M. Choisy & Werner	Pertusariaceae	Trunk	1523	Bipolar	3
29	<i>Protousnea poeppigii</i> (Nees & Flot.) Krog	Parmeliaceae	Trunk	1692	Endemic to southern South America	1.3
30	<i>Pseudocyphellaria dissimilis</i> (Nyl.) D.J. Galloway **	Lobariaceae	Trunk	1337	Paleotropical	4
31	<i>Pseudocyphellaria neglecta</i> (Müll. Arg.) H. Magn.	Lobariaceae	Soil	1337	Austral	4
32	<i>Pseudocyphellaria nudata</i> (Zahlbr.) D. J. Galloway	Lobariaceae	Trunk	1523	Endemic to southern South America	3
33	<i>Rhizocarpon geographicum</i> (L.) DC	Rhizocarpaceae	On rock	1980	Cosmopolitan	1.1

	LICHEN SPECIES	FAMILY	SUBSTRATES	ALTITUDE (M)	GLOBAL DISTRIBUTION	COLLECTION SITE
34	<i>Rhizoplaca melanophthalma</i> (Ramond) Leuckert & Poelt	Lecanoraceae	On rock	1980	Bipolar, circumboreal, extending to tropic in alpine areas	1.1
35	<i>Rinodina sophodes</i> (Ach.) A. Massal. *	Lecanoraceae	Trunk	1523	Bipolar	3
36	<i>Squamarina squamulosa</i> (Nyl.) Follmann	Stereocaulaceae	On rock	1594	Bipolar	2
37	<i>Tephromela atra</i> (Huds.) Hafellner in K. Kalb.	Tephromelataceae	On rock	1980	Cosmopolitan	1.1
38	<i>Umbilicaria krascheninnikovii</i> (Savicz) Zahlbr.	Umbilicariaceae	On rock	1980	North and South America and Asia	1.1
39	<i>Umbilicaria nylanderiana</i> (Zahlbr.) H. Magn. **	Umbilicariaceae	On rock	1980	Bipolar	1.1
40	<i>Usnea sinensis</i> Motyka*	Parmeliaceae	Trunk	1692	China and Chile	1.3
41	<i>Xanthoparmelia mougeotii</i> (Schaer.) Hale	Parmeliaceae	On rock	1980	Pantemperate to subarctic, Europe, Asia, southern Africa and western North America and South America	1.1

*: New record for Chile. / Nuevo registro para Chile

** : Extension of geographic distribution in Chile. / Extensión de la distribución geográfica en Chile.

Collection sites: 1: Surroundings of Termas de Chillán: 1.1, 1.2 and 1.3; 2: Below Termas de Chillán; 3: Las Trancas; 4: Below Las Trancas, Bio-Bío Region. / Sitios de recolección: 1: Alrededores de las Termas de Chillán: 1.1, 1.2 y 1.3; 2: bajo las Termas de Chillán; 3: Las Trancas; 4: bajo Las Trancas, Región del Bio-Bío.

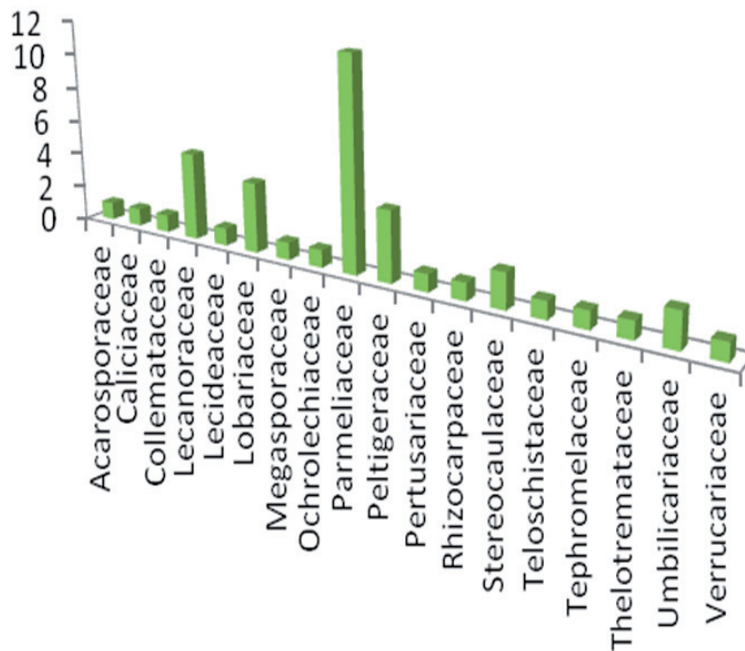


FIGURE 3. Distribution of the lichen richness by family in the studied area.

FIGURA 3. Distribución de la riqueza líquénica por familia en el área de estudio.

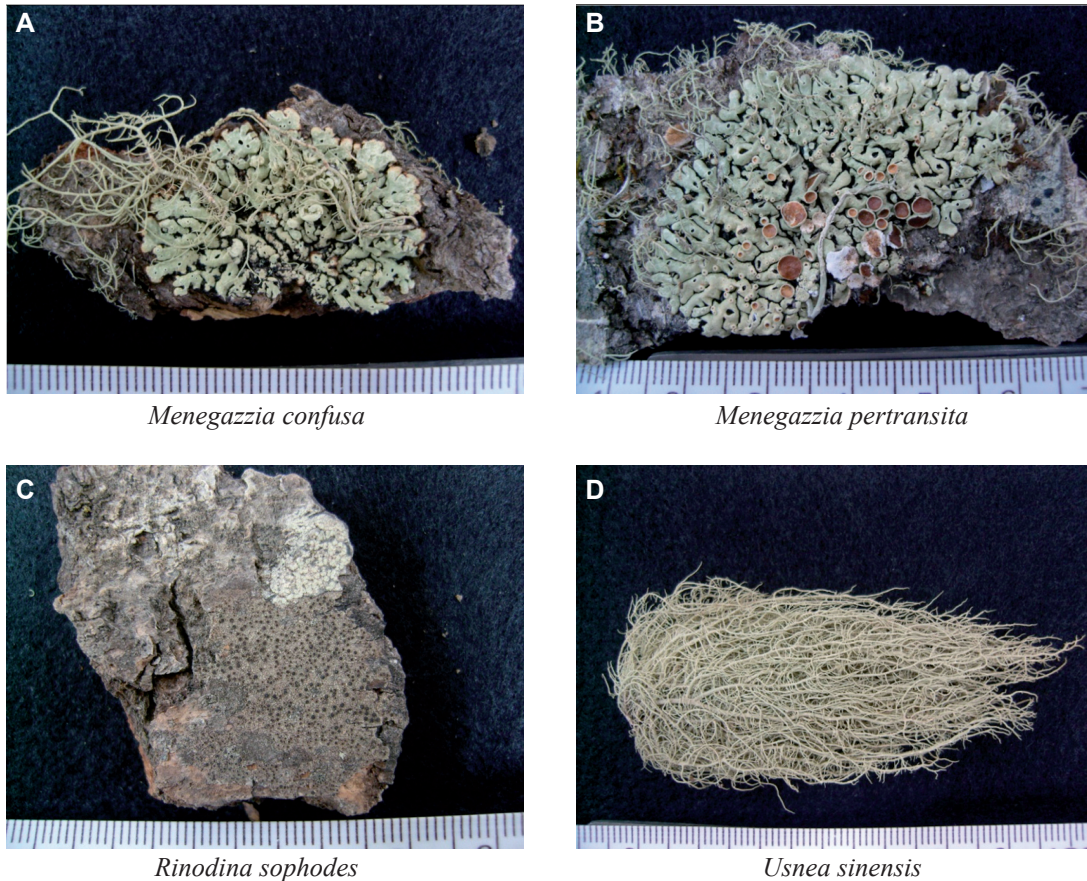


FIGURE 4. New records for Chile: lichen thallus and their substrates. A- *Menegazzia confusa*; B- *Menegazzia pertransita*; C- *Rinodina sophodes*; D- *Usnea sinensis*.

FIGURA 4. Nuevos registros para Chile: talos líquenicos y sus substratos. A- *Menegazzia confusa*; B- *Menegazzia pertransita*; C- *Rinodina sophodes*; D- *Usnea sinensis*.

Tephromela atra (Huds.) Hafellner has been found in Chile on tree bark and shrubs, and rocky substrates (Vargas & Morano 2014). In the locality finding, this species also appears growing on rocks.

ALTITUDINAL RANGE OF THE LICHEN SPECIES

There is a clear relationship between the altitude and the substrates on which grows the lichens. Of this way, the saxicolous and terricolous lichen are concentrated between 1700 to 1960 m of altitude while corticolous lichen is concentrated between 1300 to 1560 m corresponding to arboreal and shrubs strata. *Protousnea poeppigii* (Nees & Flot.) Krog is the species best represented in the arboreal stratum as well as also species of the *Usnea* genus, which grow mixed and it could be easily mistaken for a beginner. *Acarospora schleicheri* (Ach.) A. Massal., *Circinaria calcarea* (L.) A. Nordin, S. Savić & Tibell., *C. aculeata* (Schreb.) Fr., *Lecidea capensis* Zahlbr., *Montanelia*

panniformis (Nyl.) Divakar, A. Crespo, Wedin & Essl., *Neuropogon antarcticus* (Du Rietz) I.M. Lamb, *Ochrolechia parella* (L.) A. Massal., *Rhizocarpon geographicum* (L.) DC., *Rhizoplaca melanophthalma* (DC.) Leuckert & Poelt, *Tephromela atra* (Huds.) Hafellner, *Umbilicaria krascheninnikovii* (Savicz) Zahlbr., *U. nylanderiana* (Zahlbr.) H. Magn., and *Xanthoparmelia mougeotii* (Schaer.) Hale were the species found at a higher altitude (1,980 m), occurring on rocky substrates.

Among the species found at lower altitudes (1,337 m), *Lecidella elaeochroma* (Ach.) Hazsl., *Leptogium cochleatum* (Dicks.) P.M. Jørg. & P. James, *Menegazzia confusa* P. James, *Pseudocyphellaria dissimilis* (Nyl.) D.J. Galloway & P. James, *C. guilleminii* (Mont.) Nyl. and *P. neglecta* (Müll.Arg.) Vain., grows on tree and shrubs barks, while *Peltigera collina* (Ach.) Schrad, and *P. neckeri* Hepp. ex Müll.Arg. on sandy soils.

KEYS TO IDENTIFY OF LICHEN GENERA IN THE STUDIED AREA

The keys presented here are based on morphological and reproductive characters studied. The type of substrate colonized for the lichens were also considered.

LICHENS WITH CRUSTOSE THALLUS

1. Thallus yellowish, lemon yellow or more rare beige.....	2
2. Thallus beige, apothecia with a dark red disc, corticolous.....	<i>Blastenia</i>
2'. Thallus yellowish or lemon yellow, apothecia with yellow or black disc, saxicolous.....	3
3. Thallus dark yellow, continuous, apothecia submerged in the thallus.....	<i>Acarospora</i>
3'. Thallus lemon green, areolate, black lecideine apothecia between the areolae, not submerged in the thallus.....	<i>Rhizocarpon</i>
1'. Thallus of other colour (whitish, grey, green, brown).....	4
4. Thallus terricolous or corticolous.....	5
4'. Thallus saxicolous.....	10
5. Terricolous, with perithecia, spores simple, 10-15 long.....	<i>Catapyrenium</i>
5'. Corticolous, with apothecia, spores simple, uniseptate to muriform.....	6
6. Apothecia in warts, spores halonate.....	<i>Pertusaria</i>
6'. Apothecia not in warts, spores no halonate.....	7
7. Apothecia lecanorine.....	8
7'. Apothecia lecideine.....	9
8. Spores simple, hyaline.....	<i>Lecanora</i>
8'. Spores bicellular, brown.....	<i>Rinodina</i>
9. Spores simple.....	<i>Lecidella</i>
9'. Spores polarilocular.....	<i>Buellia</i>
10. Apothecia lecideine or urceolate.....	11
11. Apothecia lecideine, spores simple or uniseptate, hyaline, 5-25 µm long.....	<i>Lecidea</i>
11'. Apothecia urceolate, spores muriform, hyaline or brown, 28-42 µm long.....	<i>Ingvariella</i>
10'. Apothecia lecanorine, biatorine or immersed in the thallus, spores simple.....	12
12. Apothecia lecanorine or biatorine.....	13
12'. Apothecia immersed in the thallus, spores simple, 10-15 µm long.....	<i>Circinaria</i>
13. Apothecia lecanorine, spores simple, 60-100 µm long.....	<i>Ochrolechia</i>
13'. Apothecia lecanorine or biatorine, spores simple, 10-15 µm long.....	<i>Tephromela</i>

LICHENS WITH FOLIOSE AND FRUTICOSE THALLUS

1. Thallus fruticose.....	2
2. Thallus brown.....	3
2'. Thallus of other colour (blue-green, light green, blackish.....	4
3. With flattened branches, very branched, terricolous.....	<i>Cetraria</i>
3'. With cylindrical branches, corticolous.....	<i>Bryoria</i>
4. Thallus saxicolous, blue-green to blackish, erect.....	<i>Neuropogon</i>
4'. Thallus corticolous, light green, pendulous.....	5
5. Branches irregularly flattened.....	<i>Protousnea</i>
5'. Branches cylindrical.....	<i>Usnea</i>
1'. Thallus foliose.....	6
6. Thallus with pseudocyphellae in the lower side or in both.....	<i>Pseudocyphellaria</i>
6'. Thallus without pseudocyphellae, but only occasionally near the ends of the lobules.....	7
7. Thallus olive brown, saxicolous or corticolous, closely attached to substrate.....	<i>Montanelia</i>
7'. Thallus of other colour (greenish grey, leaden, ocher, light yellow).....	8
8. Thallus hollow, with perforations.....	<i>Menegazzia</i>
8'. Thallus not hollow, without perforations.....	9
9. Thallus greenish grey.....	10
9'. Thallus leaden, ocher, light yellow.....	11
10. Thallus lobulate with dichotomously branched rhizines.....	<i>Hypotrachyna</i>
10'. Thallus lobulate with simple rhizines.....	<i>Parmelia</i>
11. Thallus leaden, terricolous, marginal brown apothecia, photobiont Cyanobacteria.....	<i>Peltigera</i>
11'. Thallus ocher to light yellow, saxicolous, laminal apothecia or absent, photobiont Chlorophyte.....	12
12. Thallus ocher, apothecia common, laminal, with white disc, pruinose.....	<i>Rhizoplaca</i>
12'. Thallus yellowish green. Apothecia rare, marginal, cinnamon-brown to dark brown, without pruina.....	<i>Xanthoparmelia</i>

LICHENS WITH PULVERULENT, UMBILICATE, GELATINOUS AND SQUAMULOSE THALLUS

1. Thallus corticolous or terricolous.....	2
2. Thallus gelatinous, foliose, brown to black.....	<i>Leptogium</i>
2'. Thallus not gelatinous, pulverulent, whitish green.....	<i>Lepraria</i>
1'. Thallussaxicolous.....	3
3. Thallus squamulose or placoide, light or dark green.....	<i>Squamarina</i>
3'. Thallus umbilicate, brown, black or grey.....	<i>Umbilicaria</i>

CONCLUSIONS

There is a direct relationship between the richness of saxicolous species and the highest altitude.

The greatest lichen richness is concentrated in the tree and shrub strata.

It requires to makes more efforts in the material collection that to allow increasing the knowledge about of the distribution of the lichen species in the region with the purpose to establish the true status of conservation of the species in the region.

Also is necessary to increase the taxonomic studies for more of the genera of lichens in Chile used different taxonomic tools.

Lichenological expeditions should be continued in unexplored localities of Chile with emphasis on lichen biodiversity.

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