

Supplementary Data

New lineages of *Asterochloris* photobionts in Bolivian lichens, and expand our knowledge on habitat preferences and distribution of *Asterochloris* algae

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Figure S1. Majority- rule consensus tree from Bayesian analysis of *Vulcanochloris* based on ITS rDNA data set with posterior probabilities and bootstrap support values from RaxML analysis presented near the branches. For each record GenBank accession no. or voucher no. (for newly sequenced sample) are followed with photobiont name (if known), mycobiont host name and the origin of specimen together with altitude. Newly sequenced sample from Bolivia is marked in bold.

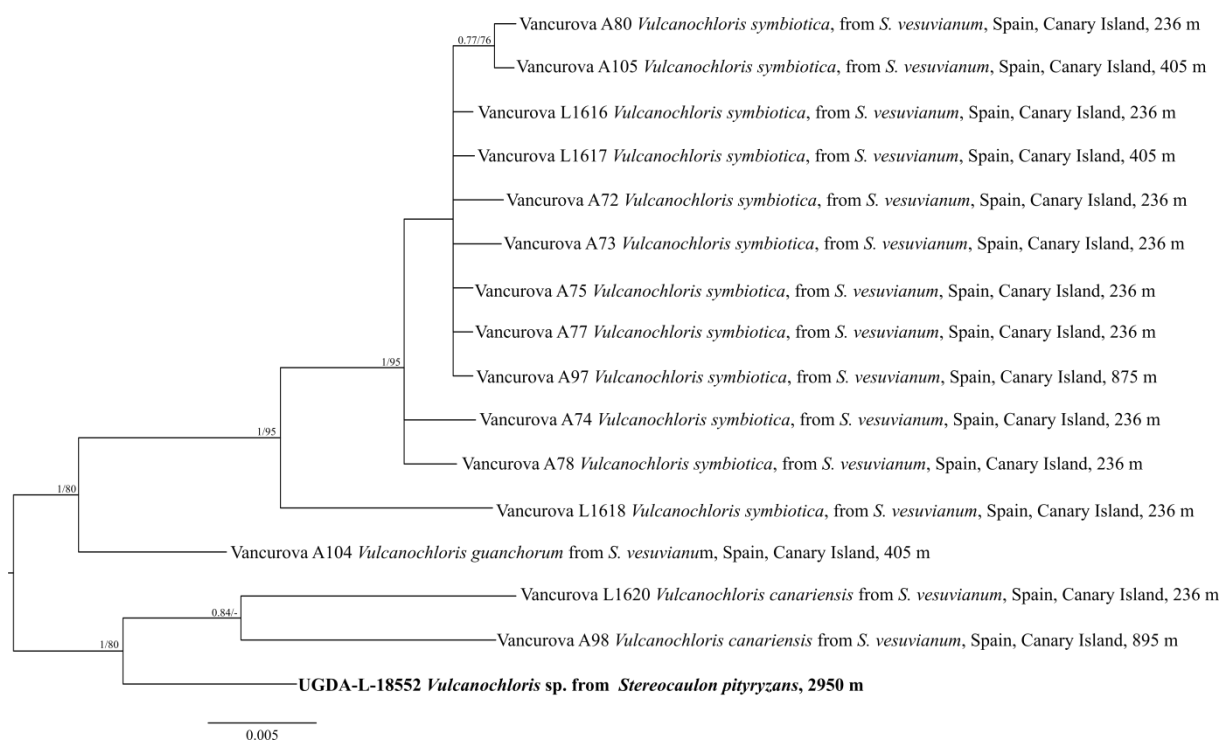


Figure S2. PCA result of *Asterochloris* distribution depending on climatic factors and distribution pattern of lichen forming fungi. Climatic data were obtained from the Global Climate Data – WorldClim. BIO1 = Annual Mean Temperature, BIO2 = Mean Diurnal Range (Mean of monthly (max temp - min temp)), BIO3 = Isothermality (BIO2/BIO7) ($\times 100$), BIO4 = Temperature Seasonality (standard deviation $\times 100$), BIO5 = Max Temperature of Warmest Month, BIO6 = Min Temperature of Coldest Month, BIO7 = Temperature Annual Range (BIO5-BIO6), BIO8 = Mean Temperature of Wettest Quarter, BIO9 = Mean Temperature of Driest Quarter, BIO10 = Mean Temperature of Warmest Quarter, BIO11 = Mean Temperature of Coldest Quarter, BIO12 = Annual Precipitation, BIO13 = Precipitation of Wettest Month, BIO14 = Precipitation of Driest Month, BIO15 = Precipitation Seasonality (Coefficient of Variation), BIO16 = Precipitation of Wettest Quarter, BIO17 = Precipitation of Driest Quarter, BIO18 = Precipitation of Warmest Quarter, BIO19 = Precipitation of Coldest Quarter.

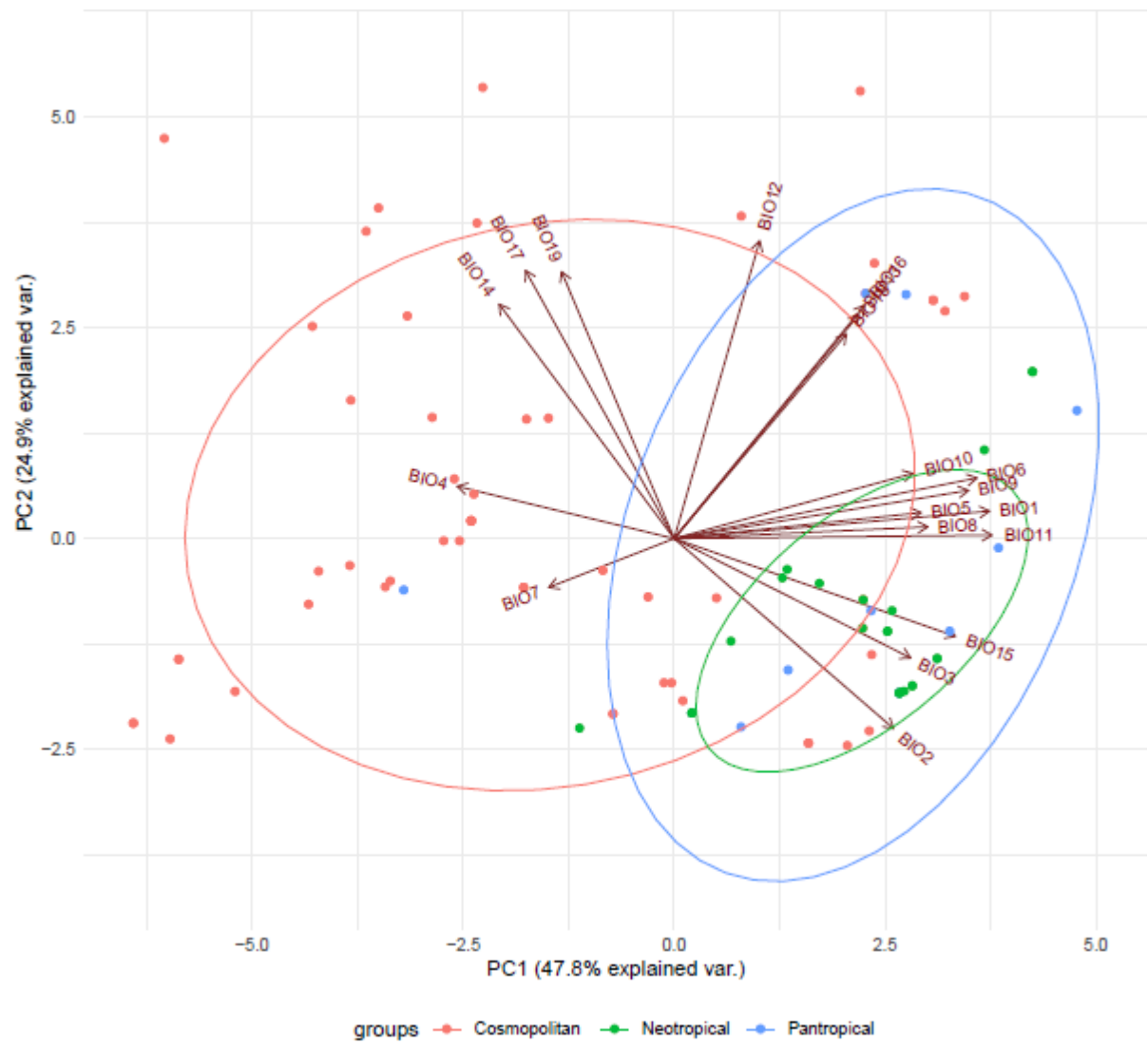


Figure S3. PCA result of *Asterochloris* distribution depending on climatic factors and taxonomic affiliation of lichen forming fungi for cosmopolitan lichens.

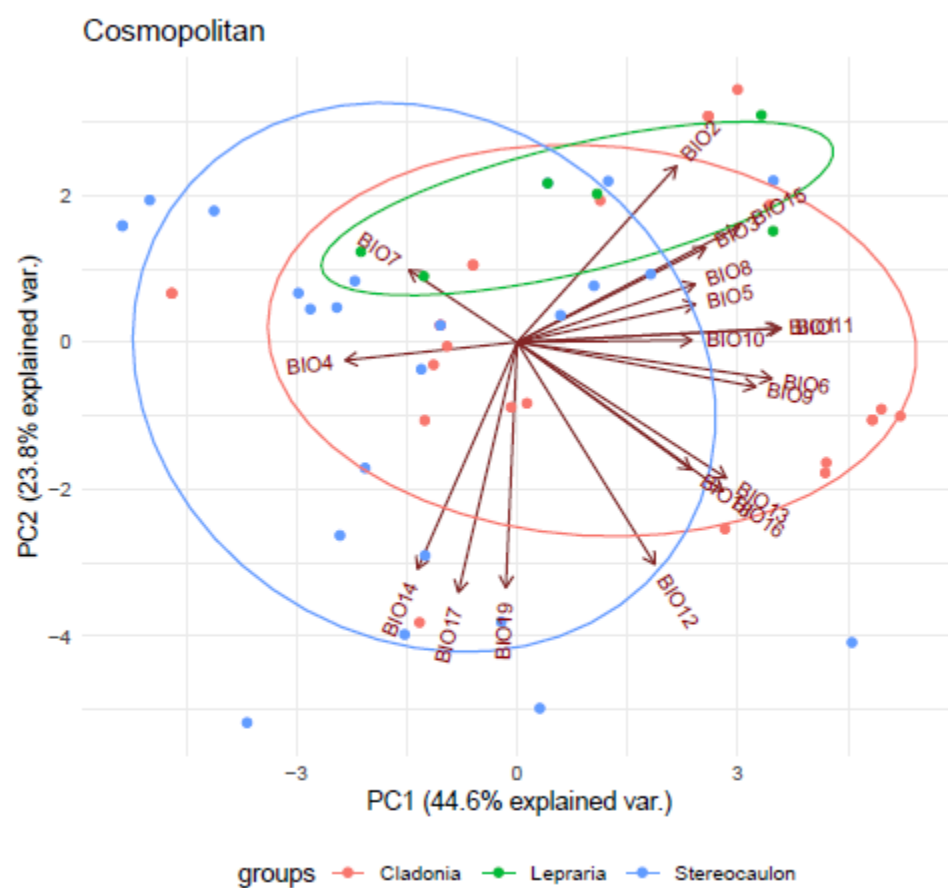


Figure S4. PCA result of *Asterochloris* distribution depending on climatic factors and taxonomic affiliation of lichen forming fungi for Neotropical lichens.

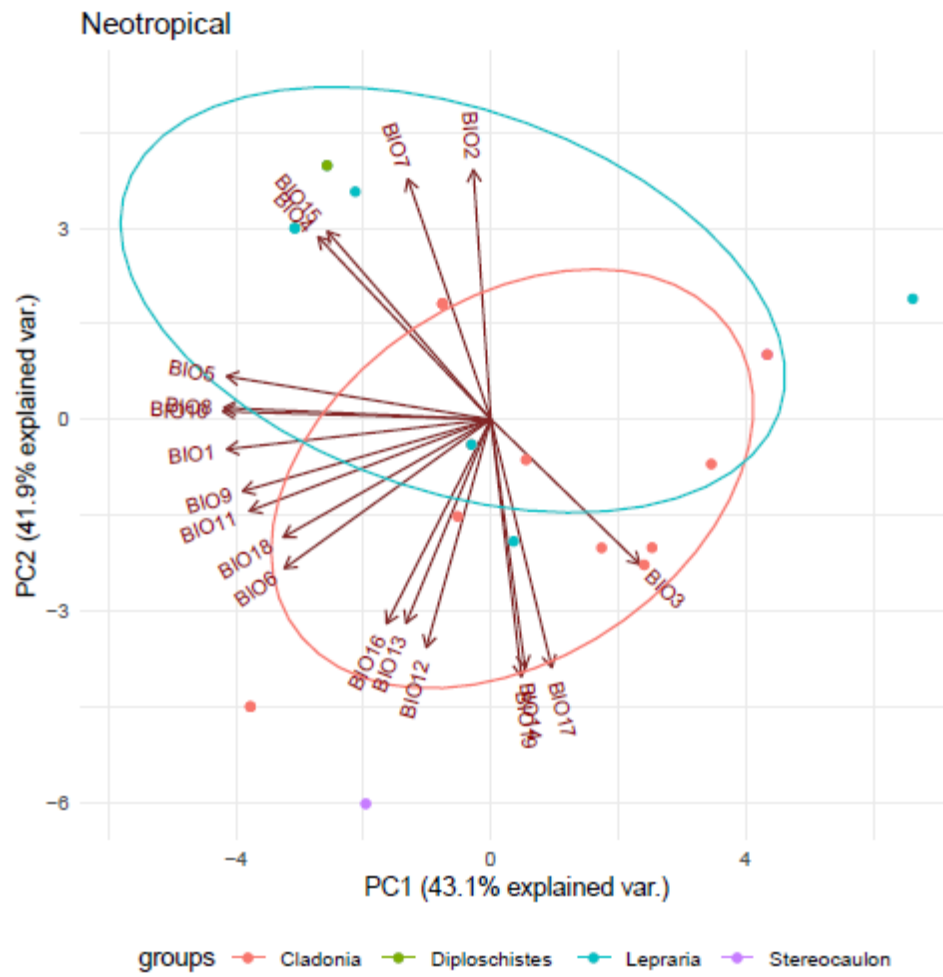


Figure S5. PCA result of *Asterochloris* distribution depending on climatic factors and taxonomic affiliation of lichen forming fungi for Pantropical lichens.

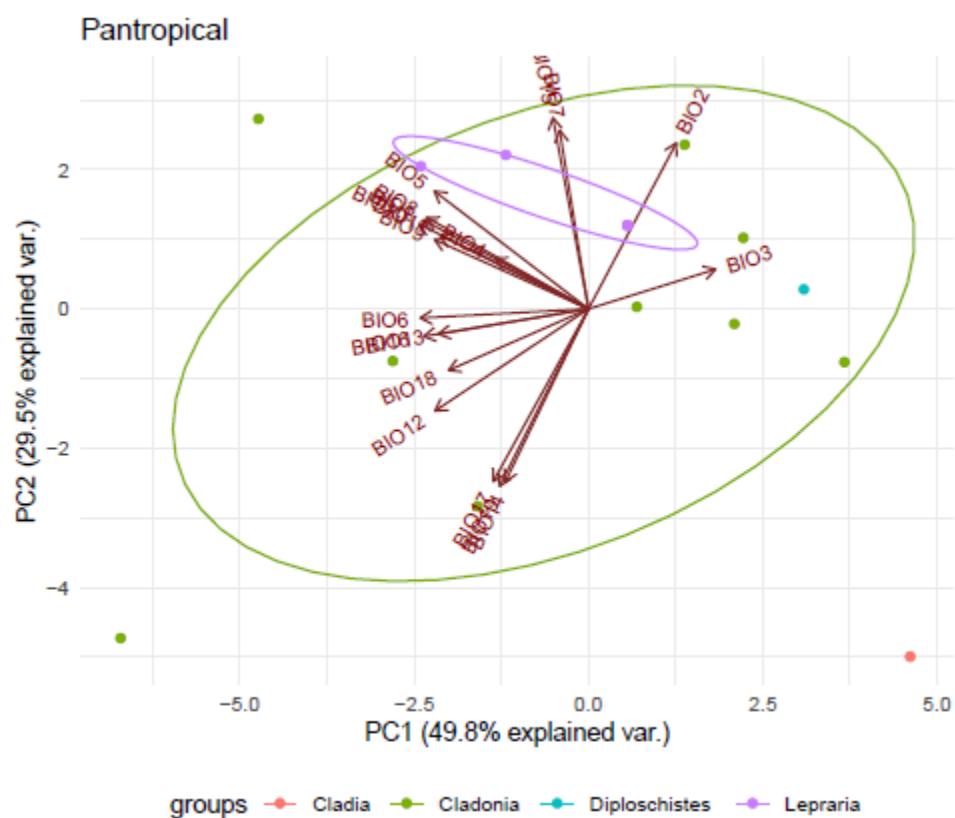


Figure S6. PCA result of *Asterochloris* distribution depending on climatic factors and habitat type; group 1 – lower montane cloud forest, group 2 – upper montane cloud forest section 1, group 3 – upper montane cloud forest section 2, group 4 – open high Andean vegetation.

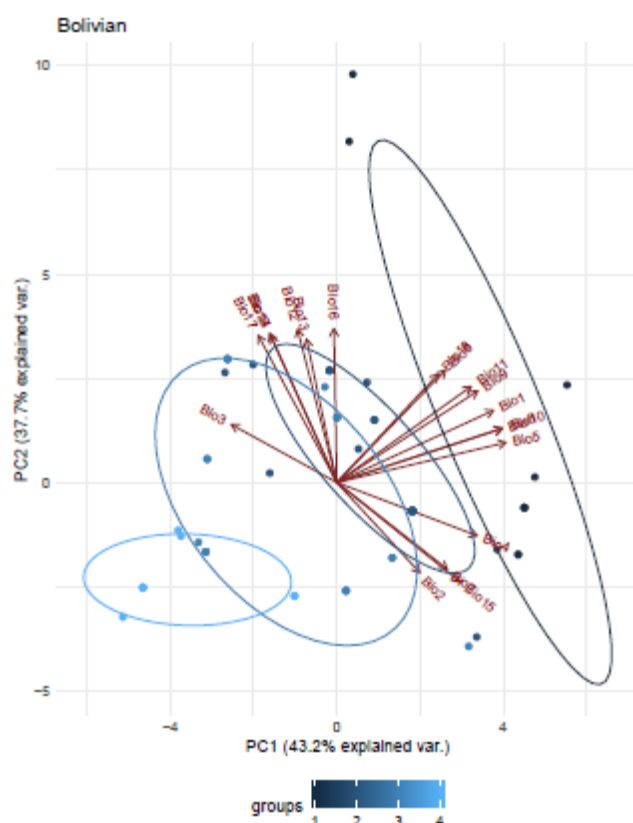


Table S1. List of specimens from which photobiont sequences were newly obtained with their ITS rDNA, *rbcL* and *actin* type I locus GenBank accession numbers. All samples were collected in Bolivia and voucher specimens are deposited in herbaria LPB and UGDA (Excel file, sheet 1.)

Table S2. Sequences of ITS rDNA, *rbcL* and *actin* type I gene of *Asterochloris* and *Vulcanochloris* downloaded from GenBank and used in this study in phylogenetic inference. Altitude above sea level, if not given in the publication, was determined based on a given geographic coordinates using the gps converter (www.gps-coordinates.net) (Excel file, sheet 2.)

Table S3. Substitution models selected for each partition of *Asterochloris* and *Vulcanochloris* dataset using the Akaike Information Criterion (AIC) as implemented in PartitionFinder 2 (Lanfear et al., 2016).

Partition names	organism	Partition length	Best Model
ITS1 rDNA	<i>Asterochloris</i>	177	GTR+I+G
5.8S rDNA	<i>Asterochloris</i>	146	TRNEF
ITS2 rDNA	<i>Asterochloris</i>	183	GTR+I+G
Intron1 of actin type I gene	<i>Asterochloris</i>	258	TVM+G
Exon part of actin type I gene	<i>Asterochloris</i>	123	K80+I+G
Intron2 of actin type I gene	<i>Asterochloris</i>	371	TVM+G
<i>rbcL</i>	<i>Asterochloris</i>	1333	TVM+I+G
ITS1 rDNA	<i>Vulcanochloris</i>	193	SYM+G
5.8S rDNA	<i>Vulcanochloris</i>	169	SYM+G
ITS2 rDNA	<i>Vulcanochloris</i>	171	SYM+G

Table S4. Patterns of distribution of selected lichen forming fungi species and list of occurrences of examined photobionts. Occurrences with lack of precise GPS information are marked with grey.

Mycobiont species	Mycobiont species range	Quotations for photobiont
<i>Cladonia confusa</i>	Pantropical	Bolivia (this study), Brazil (Cordeiro et al., 2005)
<i>Cladia aggregata</i>	Pantropical	Bolivia (this study), Chile (Piercey-Normore and Depriest, 2001)
<i>Cladonia delavayi</i>	Pantropical	India (Ridka et al., 2014)
<i>Cladonia didyma</i>	Pantropical	Bolivia (this study), Brazil (Beilke et al. unpublished), USA: Alabama (Piercey-Normore and Depriest, 2001)
<i>Cladonia fruticulosa</i>	Pantropical	India (Ridka et al., 2014)
<i>Cladonia melanopoda</i>	Pantropical	Bolivia (this study)
<i>Cladonia praetermissa</i>	Pantropical	India (Ridka et al., 2014)
<i>Diploschistes hypoleucus</i>	Pantropical	Bolivia (this study)
<i>Lepraria pallida</i>	Pantropical	Bolivia (this study)
<i>Lepraria sipmaniana</i>	Pantropical	Bolivia (this study)
<i>Lepraria achariana</i>	Neotropical	Bolivia (this study)
<i>Cladonia aff. ahtii</i>	Neotropical	Bolivia (this study)
<i>Cladonia andesita</i>	Neotropical	Bolivia (this study)
<i>Cladonia arcuata</i>	Neotropical	Bolivia (this study)
<i>Cladonia calycantha</i>	Neotropical	Bolivia (this study)
<i>Cladonia ceratophylla</i>	Neotropical	Bolivia (this study)
<i>Cladonia crinita</i>	Neotropical	Brazil (Cordeiro et al., 2005)
<i>Cladonia dactylota</i>	Neotropical	Bolivia (this study)
<i>Cladonia fissidens</i>	Neotropical	Brazil (Cordeiro et al., 2005)
<i>Cladonia granulosa</i>	Neotropical	Bolivia (this study)
<i>Cladonia isabellina</i>	Neotropical	Bolivia (this study)
<i>Diploschistes cf. cinereocesius</i>	Neotropical	Bolivia (this study)
<i>Lepraria cryptovouauxii</i>	Neotropical	Bolivia (this study)
<i>Lepraria aff. hodkinsoniana</i>	Neotropical	Bolivia (this study)
<i>Lepraria impossibilis</i>	Neotropical	Bolivia (this study)
<i>Stereocaulon microcarpum</i>	Neotropical	Bolivia (this study)
<i>Stereocaulon pachycephalum</i>	Neotropical	Bolivia (this study)
<i>Cladonia arbuscula</i>	cosmopolitan	Czech Republic (Báckor et al., 2010), Bolivia (this study), USA: North Carolina Alabama (Piercey-Normore and Depriest, 2001), Slovakia (Škaloud & Peksa 2010).
<i>Cladonia chlorophaea</i>	cosmopolitan	Bolivia (this study), Canada (Beiggi & Piercey-Normore, 2007, Piercey-Normore and Depriest, 2001)
<i>Cladonia coccifera</i>	cosmopolitan	Austria (Steinová et al., 2019), Czech Republic (Báckor et al., 2010, Škaloud et al., 2015, Steinová et al., 2019), Denmark (Steinová et al., 2019), Finland (Steinová et

		al., 2019), Norway (Steinová et al., 2019), Russia (Piercey-Normore and Depriest, 2001), Spain (Škaloud et al., 2015), UK (Steinová et al., 2019)
<i>Cladonia coniocraea</i>	cosmopolitan	Canada (Beiggi & Piercey-Normore, 2007), Nepal (Ridka et al., 2014), Czech Republic (Báckor et al., 2010)
<i>Cladonia furcata</i>	cosmopolitan	Czech Republic (Báckor et al., 2010), Bolivia (this study), India (Ridka et al., 2014), USA: Virginia (Piercey-Normore and Depriest, 2001)
<i>Cladonia pocillum</i>	cosmopolitan	Canada (Beiggi & Piercey-Normore, 2007), Norway: Svalbard (Zang et al., 2015)
<i>Cladonia pyxidata</i>	cosmopolitan	Antarctica (Kim et al., 2017), Canada (Beiggi & Piercey-Normore, 2007), Czech Republic (Báckor et al., 2010), India (Ridka et al., 2014), Italy (Piercey-Normore and Depriest, 2001)
<i>Lepraria congesta</i>	cosmopolitan	Bolivia (this study)
<i>Lepraria finkii</i>	cosmopolitan	Bolivia (this study), USA: Wisconsin (Nelsen & Gargas, 2006, USA (Nelsen & Gargas, 2008)
<i>Stereocaulon alpinum</i>	cosmopolitan	Argentina (Vancurova et al., 2018), Austria (Vancurova et al., 2018), Bolivia (this study), Canada (Vancurova et al., 2018), Denmark (Vancurova et al., 2018), Finland (Vancurova et al., 2018), Georgia (Vancurova et al., 2018), Greenland, Iceland (Vancurova et al., 2018)
<i>Stereocaulon myriocarpum</i>	cosmopolitan	Bolivia (this study), Costa Rica (Vancurova et al., 2018), Venezuela (Vancurova et al., 2018)
<i>Stereocaulon tomentosum</i>	cosmopolitan	Bolivia (this study), USA: Alaska (Vancurova et al., 2018), Slovakia (Báckor et al., 2010)

Table S5. Results of distance-based redundancy analyzes (dbRDA) used to select statistically significant predictors for explaining variation for each data sets used in variation partitioning analyzes.

Variable/Data		Bolivian genus (N=54)	Bolivian species (N=54)	Stereocaulon (N=169)	Cladonia (N=156)	Lepraria (N=35)	Cosmopolitan species (N=75)	Neotropical species (N=23)	Pantropical species (N=20)
Altitude		Pr>F	0.005 **	0.005 **	0.005 **	Pr>F	0.005**	Pr>F	Pr>F
Habitat		0.020 *	0.040 *	-	-	-	-	-	-
Substrate		Pr>F	Pr>F	-	-	-	0.005**	Pr>F	Pr>F
Geographical distance	PCNM1	Pr>F	Pr>F	0.005 **	0.005 **	0.005 **	0.005 **	Pr>F	0.005 **
	PCNM2	0.030 *	0.005 **	0.005 **	0.005 **	Pr>F	0.005 **	0.005 **	Pr>F

	PCNM3	Pr>F	0.020 *	0.005 **	0.010 **	Pr>F	Pr>F	Pr>F	Pr>F
	PCNM4	Pr>F	Pr>F	0.005 **	0.005 **	Pr>F	0.010 **	Pr>F	0.005 **
	PCNM5	Pr>F	Pr>F	0.015 *	0.005 **	Pr>F	0.005 **	Pr>F	0.030 *
	PCNM6	Pr>F	Pr>F	0.005 **	0.025 *	Pr>F	Pr>F	Pr>F	Pr>F
	PCNM7	Pr>F	Pr>F	0.005 **	0.030 *	Pr>F	0.035 *	Pr>F	Pr>F
	PCNM8	Pr>F	Pr>F	0.005 **	0.030 *	Pr>F	Pr>F	Pr>F	Pr>F
	PCNM9	Pr>F	0.005 **	Pr>F	0.035 *	Pr>F	0.035 *	Pr>F	Pr>F
	PCNM10	Pr>F	Pr>F	Pr>F	0.035 *	Pr>F	Pr>F	Pr>F	Pr>F
Climate	BIO1	Pr>F	0.005 **	0.005 **	0.010 **	Pr>F	0.005 **	Pr>F	Pr>F
	BIO2	Pr>F	Pr>F	Pr>F	Pr>F	0.005 **	0.010 **	Pr>F	Pr>F
	BIO3	0.010 **	Pr>F	0.005 **	0.005 **	Pr>F	0.005 **	Pr>F	Pr>F
	BIO4	Pr>F	Pr>F	Pr>F	0.010 **	Pr>F	0.005 **	0.005 **	0.005 **
	BIO5	Pr>F	Pr>F	Pr>F	0.005 **	Pr>F	Pr>F	Pr>F	Pr>F
	BIO6	Pr>F	Pr>F	0.005 **	0.005 **	Pr>F	Pr>F	Pr>F	Pr>F
	BIO7	Pr>F	Pr>F	0.005 **	Pr>F	Pr>F	Pr>F	Pr>F	Pr>F
	BIO8	Pr>F	0.005 **	0.005 **	0.005 **	Pr>F	0.005 **	Pr>F	Pr>F
	BIO9	Pr>F	Pr>F	0.005 **	0.005 **	Pr>F	0.005 **	Pr>F	Pr>F
	BIO10	Pr>F	Pr>F	0.005 **	0.005 **	0.005 **	0.040 *	Pr>F	Pr>F
	BIO11	Pr>F	Pr>F	Pr>F	0.005 **	Pr>F	0.010 **	Pr>F	Pr>F
	BIO12	Pr>F	Pr>F	Pr>F	0.005 **	Pr>F	Pr>F	Pr>F	Pr>F
	BIO13	Pr>F	Pr>F	Pr>F	Pr>F	Pr>F	Pr>F	Pr>F	0.005 **
	BIO14	Pr>F	Pr>F	0.005 **	0.005 **	Pr>F	Pr>F	Pr>F	Pr>F
	BIO15	Pr>F	Pr>F	0.010 **	0.005 **	Pr>F	Pr>F	Pr>F	Pr>F
	BIO16	Pr>F	Pr>F	0.040 *	Pr>F	Pr>F	Pr>F	Pr>F	Pr>F
	BIO17	Pr>F	Pr>F	0.015 *	0.010 **	Pr>F	0.005 **	Pr>F	Pr>F
	BIO18	Pr>F	Pr>F	Pr>F	0.005 **	Pr>F	Pr>F	Pr>F	Pr>F
	BIO19	Pr>F	Pr>F	0.005 **	Pr>F	Pr>F	Pr>F	Pr>F	Pr>F

Table S6. Results of variation partitioning analyses for Bolivian data and selected genera of mycobionts, i.e. *Stereocaulon*, *Cladonia* and *Lepraria*. Values > 0.1 are in bold.

Variable/Data	Bolivian species-habitat (N=54)	Bolivian species- altitude (N=54)	<i>Stereocaulon</i> (N=169)	<i>Cladonia</i> (N=156)	<i>Lepraria</i> (N=35)
Species of mycobiont	0.24	0.22	0.12	0.36	0.35
Climate	0.00	0.00	0.00	0.01	0.05
Altitude/Habitat	0.01	0.00	0.08	0.03	-

Geographical distance	0.00	0.00	0.04	0.02	0.05
Species of mycobiont + Climate	0.07	0.01	0.01	0.01	0.00
Species of mycobiont + Altitude/Habitat	0.00	0.00	0.01	0.00	-
Species of mycobiont + Geographical distance	0.00	0.00	0.06	0.03	0.00
Climate + Altitude/Habitat	0.04	0.04	0.00	0.00	-
Climate + Geographical distance	0.03	0.01	0.00	0.00	0.00
Altitude/Habitat + Geographical distance	0.00	0.00	0.02	0.04	-
Species of mycobiont + Climate + Altitude/Habitat	0.00	0.00	0.00	0.00	-
Species of mycobiont + Climate + Geographical distance	0.01	0.06	0.00	0.02	0.06
Species of mycobiont + Altitude/Habitat + Geographical distance	0.00	0.02	0.01	0.02	-
Climate + Altitude/Habitat + Geographical distance	0.00	0.00	0.03	0.13	-
Species of mycobiont + Climate + Altitude/Habitat + Geographical distance	0.00	0.00	0.01	0.01	-
Residuals	0.60	0.64	0.61	0.32	0.49

Table S7. Results of variation partitioning analyses for selected group of lichen forming fungi representing different distribution pattern: cosmopolitan, Neotropical, Pantropical. Values > 0.1 are in bold.

Variable/Data		Cosmopolitan species (N=75)	Neotropical species (N=25)	Pantropical species (N=20)
Mycobiont+ Geographical distance	Mycobiont	0.07	0.59	0.59
	Geographical distance	0.07	0.00	0.00
	Mycobiont + Geographical distance	0.00	0.17	0.21
	Residual	0.86	0.24	0.20
Mycobiont+ Altitude	Mycobiont	0.13	-	-
	Altitude	0.01	-	-
	Mycobiont + Altitude	0.00	-	-
	Residual	0.86	-	-
Mycobiont+ Substrate	Mycobiont	0.13	-	-
	Substrate	0.01	-	-

	Mycobiont + Substrate	0.00	-	-
	Residual	0.86	-	-
Mycobiont+ Climate	Mycobiont	0.00	0.59	0.59
	Climate	0.15	0.00	0.00
	Mycobiont + Climate	0.00	0.20	0.30
	Residual	0.85	0.21	0.11

Table S8. List of records of *Asterochloris* species or lineages. Records lacking precise GPS information are marked in grey.

Species or lineage of <i>Asterochloris</i>	Country	Species of mycobiont
<i>Asterochloris mediterranea</i>	Bolivia, Germany, Italy, Portugal, Spain, Sweden, Yugoslavia	<i>Cladonia calycantha</i> (this study) <i>Cladonia cervicornis</i> s. str. (Moya et al., 2015) <i>Cladonia convoluta/foliacea</i> (Moya et al., 2015, Pino-Bodas et al. unpublished) <i>Cladonia rangiformis</i> (Moya et al., 2015, Piercey-Normore and DePriest, 2001) <i>Ramalina farinacea</i> (Moya et al., 2017) <i>Stereocaulon pachycephalum</i> (this study) <i>Stereocaulon vesuvianum</i> (Vančurová et al. 2018) <i>Cladonia fimbriata</i> (Piercey-Normore and DePriest, 2001) <i>Cladonia symphylicarpa</i> (Wedin et al., 2015) <i>Diploschistes muscorum</i> (Wedin et al., 2015) <i>Lepraria nylanderiana</i> (Nelsen and Gargas, 2008)
<i>Asterochloris friedlii</i>	Bolivia, Canada, China, Czech Republic, Korea, Romania, Slovakia, USA	<i>Lepraria caesioalba</i> (Škaloud and Peksa, 2010, Nelsen and Gargas, 2008) <i>Lepraria</i> cf. <i>caesioalba</i> (Škaloud and Peksa, 2010) <i>Lepraria cupressicola</i> (Nelsen and Gargas, 2008) <i>Lepraria finkii</i> (this study, Nelsen and Gargas, 2006, 2008) <i>Lepraria achariana</i> (this study) <i>Cladonia caespiticia</i> (Nelsen and Gargas, 2006) <i>Lepraria caesiella</i> (Nelsen and Gargas, 2008) <i>Lepraria elobata</i> (Škaloud et al., 2015) <i>Lepraria incana</i> (Nelsen and Gargas, 2008) <i>Lepraria rigidula</i> (Peksa and Škaloud, 2011) <i>Lepraria nivalis</i> (Nelsen and Gargas, 2008) <i>Myelochroa aurulenta</i> (MH258948) <i>Hypotrachyna minarum</i> (KM250371)
<i>Asterochloris</i> sp. clade 12	Bolivia, Canada, Czech Republic, India, Mexico, USA: Alaska	<i>Cladonia chlorophaea</i> (this study) <i>Cladonia fimbriata</i> (Báckor et al., 2010) <i>Cladonia furcata</i> (Báckor et al., 2010) <i>Cladonia pyxidata</i> (Báckor et al., 2010, Řídká et al., 2014) <i>Cladonia rei</i> (Báckor et al., 2010) <i>Cladonia subulata</i> (Báckor et al., 2010) <i>Diploschistes muscorum</i> (Báckor et al., 2010)

		<i>Stereocaulon dactylophyllum</i> (Vančurová et al. 2018) <i>Stereocaulon paschale</i> (Nelsen and Gargas, 2006) <i>Stereocaulon rivulorum</i> (Vančurová et al. 2018) <i>Cladonia cornuta</i> (Beiggi and Piercey-Normore, 2007) <i>Cladonia pocillum</i> (Beiggi and Piercey-Normore, 2007)
<i>Asterochloris</i> sp. clade 9	Bolivia, Brazil, Costa Rica, Guyana, India, Nepal, USA: Florida, Georgia, North Carolina	<i>Cladonia arcuata</i> (this study) <i>Cladonia cervicornis</i> subsp. <i>verticillata</i> (Cordeiro et al., 2005, Řídká et al., 2014) <i>Cladonia confusa</i> (Beilke et al. unpublished, Cordeiro et al., 2005, Guzow-Krzemińska and Stocker-Wörgötter, 2013) <i>Cladonia coniocraea</i> (Řídká et al., 2014) <i>Cladonia dactylota</i> (this study) <i>Cladonia delavayi</i> (Řídká et al., 2014) <i>Cladonia evansii</i> (Yahr et al., 2004) <i>Cladonia fruticulosa</i> (Řídká et al., 2014) <i>Cladonia granulosa</i> (this study) <i>Cladonia leporina</i> (Yahr et al., 2004) <i>Cladonia praetermissa</i> (Řídká et al., 2014) <i>Cladonia scabriuscula</i> (Řídká et al., 2014) <i>Cladonia spinea</i> (Piercey-Normore and DePriest, 2001) <i>Cladonia subtenuis</i> (Yahr et al., 2004, 2006) <i>Cladia aggregata</i> (Nelsen and Gargas, 2008) <i>Cladonia crispatula</i> (Beilke et al. unpublished) <i>Cladonia didyma</i> (Beilke et al. unpublished) <i>Cladonia rappii</i> (Piercey-Normore and DePriest, 2001) <i>Cladonia variegata</i> (Piercey-Normore and DePriest, 2001)
<i>Asterochloris</i> sp. P2	Bolivia, Costa Rica	<i>Cladia aggregata</i> (this study) <i>Cladonia arbuscula</i> ubsp. <i>boliviana</i> (this study) <i>Cladonia calycantha</i> (this study) <i>Cladonia didyma</i> (this study) <i>Cladonia furcata</i> (this study) <i>Cadonia melanopoda</i> (this study) <i>Cladonia</i> cf. <i>subradiosa</i> (this study) <i>Pilophorus</i> cf. <i>cereolus</i> (Nelsen and Gargas, 2006) <i>Stereocaulon myriocarpum</i> (this study)
<i>Asterochloris</i> sp. clade StA1	Bolivia, Denmark	<i>Cladonia andesita</i> (this study) <i>Cladonia confusa</i> (this study) <i>Cladonia isabellina</i> (this study) <i>Stereocaulon rivulorum</i> (Vančurová et al. 2018) <i>Stereocaulon vesuvianum</i> (Vančurová et al. 2018)
<i>Asterochloris</i> sp. clade StA5	Austria, Bolivia, Canada, Georgia	<i>Cladonia pocillum</i> (this study) <i>Stereocaulon alpinum</i> (Vančurová et al. 2018) <i>Stereocaulon</i> cf. <i>grande</i> (Vančurová et al. 2018) <i>Stereocaulon vesuvianum</i> (Vančurová et al. 2018)
<i>Asterochloris</i> sp. clade A14	Bolivia, Panama	<i>Cladonia</i> cf. <i>ramulosa</i> (this study) <i>Lepraria</i> cf. <i>vouauxii</i> (this study) <i>Stereocaulon</i> cf. <i>obesum</i> (Vančurová et al. 2018)
<i>Asterochloris</i> sp. clade L54	Costa Rica, Bolivia	<i>Lepraria hodkinsoniana</i> (this study) <i>Lepraria</i> sp. (Nelsen and Gargas, 2008)
<i>Asterochloris</i>	Bolivia,	<i>Lepraria crassissima</i> (Peksa and Škaloud, 2011)

sp. clade A6	Costa Rica, Czech Republic	<i>Lepraria cryptovouauxii</i> (this study) <i>Lepraria nigrocincta</i> (Nelsen and Gargas, 2008)
<i>Asterochloris</i> sp. clade S1	Bolivia, Costa Rica	<i>Cladonia didyma</i> (this study) <i>Stereocaulon</i> sp. (Nelsen and Gargas, 2006) <i>Stereocaulon tomentosum</i> (this study)

Table S9. List of haplotypes showing relationships between ITS rDNA sequences of *Asterochloris* associating with *Stereocaulon* spp. Sequences from tropical region are marked in green.

Haplotype 1	AF345382 <i>A. glomerata</i> from <i>S. evolutoides</i> , USA: Massachusetts
Haplotype 2	AF345404, AF345405 <i>A. glomerata</i> from <i>S. pileatum</i> , USA: Massachusetts, FJ626732 <i>A. glomerata</i> from <i>S. evolutoides</i> , USA: Massachusetts, FM945392 <i>A. glomerata</i> from <i>S. saxatile</i> , Slovakia, MH415204 <i>A. glomerata</i> from <i>S. pileatum</i> , Slovakia, KP314550 <i>A. glomerata</i> from <i>S. vesuvianum</i> , Svalbard, MH415301 <i>A. glomerata</i> from <i>S. arcticum</i> , Iceland, MH415302 <i>A. glomerata</i> from <i>S. cf. alpinum</i> , South Argentina, MH415393 <i>A. glomerata</i> from <i>S. cf. grande</i> , Finland, MH415396 <i>A. glomerata</i> from <i>S. symphycheilum</i> , Czech Republic, MH415433 <i>A. glomerata</i> from <i>S. rivulorum</i> , Denmark AF345405
Haplotype 3	AF345442 <i>A. erici</i> from <i>S. dactylophyllum</i> , Canada
Haplotype 4	AM905993 <i>A. excentrica</i> from <i>S. dactylophyllum</i> , USA: Vermont
Haplotype 5	DQ229880, MH415326 <i>A. irregularis</i> from <i>S. botryosum</i> , USA: Alaska, DQ229881 <i>A. irregularis</i> from <i>S. subcoralloides</i> , USA: Alaska, KP314615 <i>A. irregularis</i> from <i>S. botryosum</i> , Svalbard, MH415205 <i>A. irregularis</i> from <i>S. vesuvianum</i> , Slovakia, MH415259, MH415262, MH415265, MH415266, MH415270, MH415271 <i>A. irregularis</i> from <i>S. arcticum</i> , Iceland MH415260, MH415261, MH415267, MH415300 <i>A. irregularis</i> from <i>S. vesuvianum</i> , Iceland, MH415268 <i>A. irregularis</i> from <i>S. cf. alpinum</i> , Iceland, MH415272 <i>A. irregularis</i> from <i>S. vesuvianum</i> , Japan, MH415310, MH415387, MH415413 <i>A. irregularis</i> from <i>S. vesuvianum</i> , Czech Republic, MH415314, MH415321 <i>A. irregularis</i> from <i>S. apocalypticum</i> , USA: Alaska, MH415315, MH415316, MH415317 <i>A. irregularis</i> from <i>S. intermedium</i> , USA: Alaska, MH415318, MH415319, MH415320, MH415325, MH415332, MH415335 <i>A. irregularis</i> from <i>S. paschale</i> , USA: Alaska, MH415356, MH415362 <i>A. irregularis</i> from <i>S. paschale</i> , Greenland, MH415358, MH415360, MH415361 <i>A. irregularis</i> from <i>S. alpinum</i> , Greenland, MH415359 <i>A. irregularis</i> from <i>S. cf. arcticum</i> , Greenland, MH415368 <i>A. irregularis</i> from <i>S. tomentosum/sasakii</i> , USA: Alaska, MH415377 <i>A. irregularis</i> from <i>S. rivulorum</i> , Denmark, MH415392 <i>A. irregularis</i> from <i>S. cf. paschale</i> , Finland, MH415394 <i>A. irregularis</i> from <i>S. alpinum</i> , Finland, MH415397, MH415398 <i>A. irregularis</i> from <i>S. symphycheilum</i> , Czech Republic, MH415399 <i>A. irregularis</i> from <i>S. paschale</i> , Russia, MH415405 <i>A. irregularis</i> from <i>S. vesuvianum</i> , Norway, MH415406 <i>A. irregularis</i> from <i>S. dactylophyllum</i> , Finland, MH415306, MH415308, MH415309, MH415340 <i>A. irregularis</i> from <i>S. sp.</i> , Russia MH415324, MH415327, MH415328, MH415331, MH415333, MH415336 <i>A. irregularis</i> from <i>S. sp.</i> , USA: Alaska, MH415363 <i>A. irregularis</i> from <i>S. sp.</i> , Greenland,

	AF345411 <i>A. irregularis</i> from <i>S. sp.</i> , Iceland
Haplotype 6	DQ229882 <i>A. sp.</i> clade StA4 from <i>S. paschale</i> , Canada, MH415357 , <i>A. sp.</i> clade StA4 from <i>S. alpinum</i> , Greenland, MH415281 <i>A. sp.</i> clade StA4 from <i>S. sp.</i> , Sweden
Haplotype 7	DQ229885 <i>A. aff. irregularis</i> from <i>S. vesuvianum</i> , USA: Alaska, MH415323 <i>A. aff. irregularis</i> from <i>S. tomentosum/sasakii</i> , USA: Alaska
Haplotype 8	DQ229886 <i>A. sp.</i> clade S3 from <i>S. saxatile</i> , USA: Alaska
Haplotype 9	DQ229887 <i>A. sp.</i> clade 12 from <i>S. paschale</i> , USA: Alaska, MH415322 <i>A. sp.</i> clade 12 from <i>S. rivulorum</i> , USA: Alaska
Haplotype 10	KJ690281 <i>A. sp.</i> clade 12 from <i>S. paschale</i> , Canada
Haplotype 11	KJ690289 <i>A. sp.</i> clade 12 from <i>S. paschale</i> , Canada
Haplotype 12	KP314536 <i>A. aff. irregularis</i> from <i>S. vesuvianum</i> , Svalbard, KP314583 <i>A. aff. irregularis</i> from <i>S. botryosum</i> , Svalbard, MH415263 <i>A. aff. irregularis</i> from <i>S. arcticum</i> , Iceland, MH415367 <i>A. aff. irregularis</i> from <i>S. paschale</i> , USA: Alaska, MH415378 <i>A. aff. irregularis</i> from <i>S. arcticum</i> , Denmark, MH415407 <i>A. aff. irregularis</i> from <i>S. pileatum</i> , Austria, MH415408 <i>A. aff. irregularis</i> from <i>S. cf. alpinum</i> , Austria, MH415409 <i>A. aff. irregularis</i> from <i>S. alpinum</i> , Canada
Haplotype 13	KP314586 <i>A. aff. irregularis</i> from <i>S. botryosum</i> , Svalbard
Haplotype 14	KP318667 <i>A. woessiae</i> from <i>S. cf. azureum</i> , Spain, Canary Island, MH415232 , MH415235 , MH415418 <i>A. wossieae</i> from <i>S. azureum</i> , Portugal, Mareida, MH415234 , MH415237 , MH415244 <i>A. woessiae</i> from <i>Stereocaulon sp.</i> , Portugal, Mareida, MH415383 <i>A. woessiae</i> from <i>S. alpinum</i> , Denmark, MH415379 <i>A. woessiae</i> from <i>S. sp.</i> , Denmark
Haplotype 15	MH415203 <i>A. sp.</i> clade A9 from <i>S. nanodes</i> , Slovakia
Haplotype 16	MH415206 <i>A. lobophora</i> from <i>S. nanodes</i> , Slovakia, MH415297 , MH415298 , MH415299 <i>A. lobophora</i> from <i>S. alpinum</i> , Georgia, FM945391 <i>A. lobophora</i> from <i>Stereocaulon tomentosum</i> , Slovakia
Haplotype 17	MH415210 <i>A. sp.</i> from <i>S. vesuvianum</i> , Tanzania
Haplotype 18	MH415212 <i>A. sp.</i> clade StA3 from <i>S. vesuvianum</i> , Tanzania
Haplotype 19	MH415216 , MH415273 <i>A. sp.</i> clade StA6 from <i>S. cf. alpinum</i> , South Argentina
Haplotype 20	MH415217 <i>A. italiana</i> from <i>S. alpinum</i> , South Argentina
Haplotype 21	MH415218 <i>A. sp.</i> clade A9 from <i>S. cf. vesuvianum</i> , South Argentina, MH415290 <i>A. sp.</i> clade A9 from <i>S. vesuvianum</i> , South Argentina, MT036569 , MT036570 , MT036571 <i>A. stereocaulonicola</i> from <i>S. alpinum</i> , Antarctica
Haplotype 22	MH415219 <i>A. sp.</i> clade StA7 from <i>S. cf. vesuvianum</i> , South Argentina
Haplotype 23	MH415221 , MH415222 , MH415224 , MH415225 <i>A. sp.</i> clade StA5 from <i>S. alpinum</i> , Georgia, MH415282 <i>A. sp.</i> clade StA5 from <i>S. vesuvianum</i> , Georgia, MH415291 <i>A. sp.</i> clade StA5 from <i>S. cf. alpinum</i> , Georgia, MH415366 <i>A. sp.</i> clade StA5 from <i>S. alpinum</i> , Austria
Haplotype 24	MH415223 <i>A. sp.</i> clade A9 from <i>S. cf. alpinum</i> , South Argentina, MH415226 <i>A. sp.</i> clade A9 from <i>S. vesuvianum</i> , South Argentina, MH415274 <i>A. sp.</i> clade A9 from <i>S. vesuvianum</i> , Italy, MH415303 <i>A. sp.</i> clade A9 from <i>S. sp.</i> , South Argentina
Haplotype 25	MH415229 <i>A. sp.</i> clade StA8 from <i>S. myriocarpum</i> , Costa Rica
Haplotype 26	MH415230 , MH415231 , MH415246 , MH415253 , MH415254 , MH415423 <i>A. italiana</i> from <i>S. azureum</i> , Portugal, Madeira, MH415339 <i>A. italiana</i> from <i>S. condensatum</i> , Germany, MH415439 <i>A. italiana</i> from <i>S. rivulorum</i> , Denmark
Haplotype 27	MH415238 , MH415424 <i>A. wossieae</i> from <i>S. azureum</i> , Portugal, Mareida, MH415252 <i>A. wossieae</i> from <i>S. azureum</i> , Portugal, Mareida, MH415419 , MH415425 , MH415426 <i>A. wossieae</i> from <i>S. pileatum</i> , Portugal, Mareida
Haplotype 29	MH415255 <i>A. aff. italiana</i> from <i>S. sp.</i> , Portugal, Madeira,

	MH415422 <i>A. aff. italiana</i> from <i>S. azoreum</i> , Portugal, Madeira, MH415391 <i>A. aff. italiana</i> from <i>S. dactylophyllum</i> , Sweden
Haplotype 30	MH415257, MH415258 <i>A. sp.</i> clade StA2 from <i>S. alpinum</i> , Iceland
Haplotype 31	MH415264 <i>A. sp.</i> clade A9 from <i>S. cf. alpinum</i> , Iceland
Haplotype 32	MH415269 <i>A. sp.</i> clade StA2 from <i>S. saxatile</i> , Iceland
Haplotype 33	MH415287 <i>A. sp.</i> clade StA8 from <i>S. myriocarpum</i> , Venezuela
Haplotype 34	MH415288 <i>A. sp.</i> clade StA8 from <i>S. myriocarpum</i> , Venezuela
Haplotype 35	MH415294 <i>A. sp.</i> clade StA8 from <i>S. myriocarpum</i> , Venezuela
Haplotype 36	MH415296 <i>A. sp.</i> from <i>S. cf. obesum</i> , Panama
Haplotype 37	MH415313 <i>A. mediterranea</i> from <i>S. vesuvianum</i> , Spain, Canary Island
Haplotype 38	MH415334 <i>A. phycobiontica</i> from <i>S. alpinum</i> , Austria
Haplotype 39	MH415364 <i>A. sp.</i> clade StA4 from <i>S. alpinum</i> , Greenland, MH415329, MH415330 <i>A. sp.</i> clade StA4 from <i>S. sp.</i> , USA: Alaska
Haplotype 40	MH415369 <i>A. irregularis</i> from <i>S. symphycheilum</i> , Austria, MH415370 <i>A. irregularis</i> from <i>S. vesuvianum</i> , Austria, MH415434 <i>A. irregularis</i> from <i>S. vesuvianum</i> , Denmark, MH415279 <i>A. irregularis</i> from <i>S. sp.</i> , Austria
Haplotype 41	MH415375, MH415382, MH415386, MH415390, MH415430, MH415431, MH415437 <i>A. sp.</i> clade StA1 from <i>S. rivulorum</i> , Denmark, MH415376, MH415384, MH415385, MH415428, MH415429, MH415432, MH415436 <i>A. sp.</i> clade StA1 from <i>S. vesuvianum</i> , Denmark, MH415381 <i>A. sp.</i> clade StA1 from <i>S. cf. vesuvianum</i> , Denmark, MH415388, MH415389, MH415435 <i>A. sp.</i> clade StA1 from <i>S. cf. rivulorum</i> , Denmark, MH415380 <i>A. sp.</i> clade StA1 from <i>S. sp.</i> , Denmark
Haplotype 42	MH415395 <i>A. sp.</i> clade 12 from <i>S. dactylophyllum</i> , CzechRepublic
Haplotype 43	MH415410 <i>A. sp.</i> StA5 from <i>S. alpinum</i> , Canada, MH415411, MH415412 <i>A. sp.</i> clade StA5 from <i>S. cf. grande</i> , Canada, MH415414 <i>A. sp.</i> clade StA5 from <i>S. cf. alpinum</i> , Canada
Haplotype 44	MH415415 <i>A. sp.</i> clade 8 from <i>S. cf. grande</i> , Canada, MH415451 <i>A. sp.</i> clade 8 from <i>S. dactylophyllum</i> , CzechRepublic
Haplotype 45	MH415427 <i>A. glomerata</i> from <i>S. pileatum</i> , Portugal, Madeira
Haplotype 46	Kukwa 14827 <i>A. sp.</i> clade Bol 8 from <i>S. alpinum</i> , La Paz 1
Haplotype 47	UGDA-L 18555 <i>A. sp.</i> clade Bol 6 from <i>S. microcarpum</i> , La Paz 3
Haplotype 48	UGDA-L 18613 <i>A. sp.</i> clade P2 from <i>S. myriocarpum</i> , La Paz 4
Haplotype 49	UGDA-L 18566 <i>A. mediterranea</i> from <i>S. pachycephalum</i> , La Paz 4
Haplotype 50	UGDA-L 25173 <i>A. sp.</i> clade S1 from <i>S. tomentosum</i> , Santa Cruz 1
Haplotype 51	MH415220 <i>A. sp.</i> from <i>S. sp.</i> , Argentina
Haplotype 52	MH415307 <i>A. lobophora</i> from <i>S. sp.</i> , Russia
Haplotype 53	MH415374 <i>A. sp.</i> clade 12 from <i>S. sp.</i> , Mexico
Haplotype 54	DQ229884 <i>A. sp.</i> clade S1 from <i>S. sp.</i> , Costa Rica
Haplotype 55	AF345433 <i>A. excentrica</i> from <i>S. dactylophyllum</i> , USA: Vermont

Table S10. List of haplotypes showing relationships between ITS rDNA sequences of *Asterochloris* associating with *Cladonia* spp. Sequences from tropical region are marked in green.

Haplotype number	Sample ID
Haplotype 1	Kukwa 14684 <i>A. sp.</i> clade StA1 from <i>C. andesita</i> , La Paz 1
Haplotype 2	Kukwa 16168, Kukwa 16909 <i>A. sp.</i> clade Bol 1 from <i>C. aff. ahtii</i> , Chuquisaca 2, Kukwa 14785 , <i>A. sp.</i> clade Bol 1 from <i>C. ceratophylla</i> , La Paz 1, Kukwa 18470 <i>A. sp.</i> clade Bol 1 from <i>C. ceratophylla</i> , Santa Cruz 1
Haplotype 3	Kukwa 14886 <i>A. sp.</i> clade P2 from <i>C. calycantha</i> , La Paz 2,
Haplotype 4	Kukwa 14890 <i>A. sp.</i> clade A14 from <i>C. cf. ramulosa</i> , La Paz 2

Haplotype 5	HE803050 <i>A. sp.</i> clade 12 from <i>C. pyxidata</i> , India
Haplotype 6	Kukwa 15040 <i>A. sp.</i> clade 12 from <i>C. chlorophaea</i> , Cochabamba 1
Haplotype 7	UGDA-L 16584 <i>A. sp.</i> clade 9 from <i>C. dactylota</i> , Santa Cruz 1, Kukwa 16205 <i>A. sp.</i> clade 9 from <i>C. granulosa</i> , Chuquisaca 2
Haplotype 8	Kukwa 16553 <i>A. sp.</i> clade Bol 5 from <i>C. furcata</i> , Tarija 1
Haplotype 9	Kukwa 16621 <i>A. sp.</i> clade StA1 from <i>C. confusa</i> , Tarija 1
Haplotype 10	UGDA-L 18961 <i>A. mediterranea</i> from <i>C. calycantha</i> , La Paz 3
Haplotype 11	UGDA-L 18963 <i>A. sp.</i> clade StA5 from <i>C. pocillum</i> , La Paz 5, AF345427 <i>A. sp.</i> clade StA5 from <i>C. subulata</i> , Germany
Haplotype 12	UGDA-L 18987 <i>A. sp.</i> clade P2 from <i>C. melanopoda</i> , La Paz 4, UGDA-L 19021 <i>A. sp.</i> clade P2 from <i>C. arbuscula</i> subsp. <i>boliviana</i> , Santa Cruz 1, Kukwa 14880a <i>A. sp.</i> clade P2 from <i>C. cf. subcariosa</i> , La Paz 2, UGDA-L 19004 <i>A. sp.</i> clade P2 from <i>C. didyma</i> , La Paz 4
Haplotype 13	Kukwa 15030b <i>A. sp.</i> clade StA1 from <i>C. confusa</i> , Cochabamba 1, UGDA-L 18992 <i>A. sp.</i> clade StA1 from <i>C. isabellina</i> , La Paz 4
Haplotype 14	UGDA-L 18999 <i>A. sp.</i> clade S1 from <i>C. didyma</i> , La Paz 2
Haplotype 15	UGDA-L 19009 <i>A. sp.</i> clade 9 from <i>C. arcuata</i> , Santa Cruz 2
Haplotype 16	AF345375 <i>A. glomerata</i> from <i>C. strepsilis</i> , Canada, AF345391 <i>A. glomerata</i> from <i>C. stellaris</i> , USA: North Carolina, AF345392 <i>A. glomerata</i> from <i>C. atlantica</i> , USA: Massachusetts AF345393 <i>A. glomerata</i> from <i>C. atlantica</i> , USA: Alabama, AF345394 <i>A. glomerata</i> from <i>C. cervicornis</i> subsp. <i>verticillata</i> , USA: North Carolina, AF345395 <i>A. glomerata</i> from <i>C. caroliniana</i> , USA: Alabama, AF345397 <i>A. glomerata</i> from <i>C. grayi</i> , Canada, AF345399 <i>A. glomerata</i> from <i>C. strepsilis</i> , Japan, AF345398 , AF345400 <i>A. glomerata</i> from <i>C. strepsilis</i> , USA: North Carolina, AY622822 , AY622826 , AY622831 , AY622832 , AY622833 <i>A. glomerata</i> from <i>C. gracilis</i> , Canada AY622836 , AY622837 , AY622838 , AY622839 , AY622840 <i>A. glomerata</i> from <i>C. rangiferina</i> , Canada, AY712688 <i>A. glomerata</i> from <i>C. subsetacea</i> , USA: Florida, DQ530178 <i>A. glomerata</i> from <i>C. cervicornis</i> subsp. <i>verticillata</i> , Canada DQ530181 <i>A. glomerata</i> from <i>C. pyxidata</i> , Canada, FM945351 , FM945352 , FM945353 <i>A. glomerata</i> from <i>C. coccifera</i> , Czech Republic, FM945357 <i>A. glomerata</i> from <i>C. deformis</i> , Czech Republic, FM945363 , FM945364 <i>A. glomerata</i> from <i>C. macilenta</i> , Czech Republic, FM945367 , FM945368 <i>A. glomerata</i> from <i>C. mitis</i> , Czech Republic, FM945372 <i>A. glomerata</i> from <i>C. cf. novochlorophaea</i> , Czech Republic, KP031547 <i>A. glomerata</i> from <i>C. rangiferina</i> , FM945370 , FM945371 , KT989951 , KT989953 , KT989955 , KT989956 , KT989957 , KT989958 , KT989959 , KT989960 , KT989961 , KT989964 , KT989965 <i>A. glomerata</i> from <i>C. pleurota</i> , Czech Republic, KT989952 <i>A. glomerata</i> from <i>C. pleurota</i> , Austria, KT989954 <i>A. glomerata</i> from <i>C. pleurota</i> , Romania, KT989962 <i>A. glomerata</i> from <i>C. pleurota</i> , Germany, KT989963 <i>A. glomerata</i> from <i>C. pleurota</i> , Finland, KT989966 <i>A. glomerata</i> from <i>C. pleurota</i> , Denmark
Haplotype 17	AF345376 , AF345379 , AF345380 <i>A. glomerata</i> from <i>C. grayi</i> , Canada, AF345377 <i>A. glomerata</i> from <i>C. botrytes</i> , Canada, AF345378 <i>A. glomerata</i> from <i>C. crispata</i> , Canada, AF345381 <i>A. glomerata</i> from <i>C. squamosa</i> , Canada, AY622824 <i>A. glomerata</i> from <i>C. gracilis</i> , Canada
Haplotype 18	AF345383 <i>A. glomerata</i> from <i>C. strepsilis</i> , Italy

	AY712689 <i>A. glomerata</i> from <i>C. dimorphoclada</i>, USA: Florida, DQ530182 <i>A. glomerata</i> from <i>C. ochrochlora</i>, Canada, DQ530186 <i>A. glomerata</i> from <i>C. merochlorophaea</i>, Canada, HE803028 <i>A. glomerata</i> from <i>C. coniocraea</i>, Nepal, KT989941, KT989945, KT989949 <i>A. glomerata</i> from <i>C. pleurota</i>, Austria, KT989942, KT989943, KT989944, KT989950, KT989967 <i>A. glomerata</i> from <i>C. pleurota</i>, Czech Republic KT989946, KT989947 <i>A. glomerata</i> from <i>C. deformis</i>, Finland, KT989948 <i>A. glomerata</i> from <i>C. deformis</i>, Czech Republic
Haplotype 19	AF345384 <i>A. glomerata</i> from <i>C. arbuscula</i> , USA: North Carolina
Haplotype 20	AF345385 <i>A. glomerata</i> from <i>C. grayi</i> , Canada
Haplotype 21	AF345386 <i>A. glomerata</i> from <i>C. robbinsii</i> , USA: North Carolina
Haplotype 22	AF345387 <i>A. glomerata</i> from <i>C. strepsilis</i> , USA: North Carolina
Haplotype 23	AF345388 <i>A. glomerata</i> from <i>C. strepsilis</i> , Canada, DQ530187 <i>A. glomerata</i> from <i>C. grayi</i> , Canada
Haplotype 24	AF345390 <i>A. glomerata</i> from <i>C. arbuscula</i> , USA: North Carolina
Haplotype 25	AF345396 <i>A. glomerata</i> from <i>C. floridana</i> , USA: Massachusetts
Haplotype 26	AF345401, AF345402 <i>A. glomerata</i> from <i>C. strepsilis</i> , Canada
Haplotype 27	AF345408 <i>A. irregularis</i> from <i>C. cenotea</i>, Russia, AF345409 <i>A. irregularis</i> from <i>C. coccifera</i>, Russia, AF345410 <i>A. irregularis</i> from <i>C. stellaris</i>, Finland, AM906000 <i>A. irregularis</i> from <i>C. arbuscula</i>, Slovakia, AY622821, AY622823, AY622827, AY622828, AY622829 <i>A. irregularis</i> from <i>C. gracilis</i>, Canada, FM945347 <i>A. irregularis</i> from <i>C. arbuscula</i>, Czech Republic, KT989923, KT989924, KT989935 <i>A. irregularis</i> from <i>C. pleurota</i>, Czech Republic, KT989925, KT989926 <i>A. irregularis</i> from <i>C. pleurota</i>, Finland, KT989927 <i>A. irregularis</i> from <i>C. diversa</i>, Belgium, KT989928 <i>A. irregularis</i> from <i>C. deformis</i>, Finland, KT989929, KT989930 <i>A. irregularis</i> from <i>C. coccifera</i>, Finland, KT989931, KT989934 <i>A. irregularis</i> from <i>C. pleurota</i>, Norway, KT989932 <i>A. irregularis</i> from <i>C. deformis</i>, Czech Republic, KT989933 <i>A. irregularis</i> from <i>C. coccifera</i>, Czech Republic
Haplotype 28	AF345412 <i>A. sp.</i> from <i>C. uncialis</i>, Finland, AY622830 <i>A. sp.</i> from <i>C. gracilis</i>, Canada, AY622835 <i>A. sp.</i> from <i>C. rangiferina</i>, Canada
Haplotype 29	AF345413 <i>A. aff. irregularis</i> from <i>C. bellidiflora</i>, Norway, AY622825 <i>A. aff. irregularis</i> from <i>C. gracilis</i>, Canada, AY622834 <i>A. aff. irregularis</i> from <i>C. rangiferina</i>, Canada, FM945376 <i>A. aff. irregularis</i> from <i>C. rangiferina</i>, Czech Republic KP314531, KP314538, KP314541, KP314544, KP314584, KP314600, KP314659, KP314664 <i>A. aff. irregularis</i> from <i>C. borealis</i>, Svalbard, KP314585, KP314593, KP314649, KP314657 <i>A. aff. irregularis</i> from <i>C. mitis</i>, Svalbard, KT989936 <i>A. aff. irregularis</i> from <i>C. coccifera</i>, Norway, KT989937 <i>A. aff. irregularis</i> from <i>C. pleurota</i>, Montenegro, KT989938 <i>A. aff. irregularis</i> from <i>C. pleurota</i>, Austria, KT989939 <i>A. aff. irregularis</i> from <i>C. pleurota</i>, Norway
Haplotype 30	AF345414 <i>A. sp.</i> from <i>C. gracilis</i> , Russia
Haplotype 31	AF345415 <i>A. sp.</i> from <i>C. didyma</i> , USA: Alabama
Haplotype 32	AF345416 <i>A. sp.</i> from <i>C. peltastica</i> , French Guyana,
Haplotype 33	AF345417 <i>A. sp.</i> clade 9 from <i>C. rappii</i>, USA: North Carolina, AY712696 <i>A. sp.</i> clade 9 from <i>C. evansii</i>, USA: Florida
Haplotype 34	AF345418 <i>A. sp.</i> from <i>C. spinea</i>, French Guyana, AF345419 <i>A. sp.</i> from <i>C. variegata</i>, French Guyana,

	HE803043 <i>A. sp.</i> from <i>C. scabriuscula</i> , India
Haplotype 35	AF345420 <i>A. italiana</i> from <i>C. glauca</i> , Denmark, AF345421 <i>A. italiana</i> from <i>C. capitellata</i> , Austria, AF345422 <i>A. italiana</i> from <i>C. staufferi</i> , Austria, KT989890 <i>A. italiana</i> from <i>C. coccifera</i> , Czech Republic, KT989889, KT989899 <i>A. italiana</i> from <i>C. diversa</i> , Czech Republic, KT989891, KT989900, KT989901, KT989902 <i>A. italiana</i> from <i>C. diversa</i> , Denmark, KT989892 <i>A. italiana</i> from <i>C. diversa</i> , Belgium, KT989893 <i>A. italiana</i> from <i>C. diversa</i> , Netherlands, KT989894, KT989903 <i>A. italiana</i> from <i>C. diversa</i> , Spain, KT989895, KT989904 <i>A. italiana</i> from <i>C. diversa</i> , Norway, KT989896, KT989897 <i>A. italiana</i> from <i>C. diversa</i> , UK, KT989898 <i>A. italiana</i> from <i>C. diversa</i> , Austria
Haplotype 36	AF345424 <i>A. italiana</i> from <i>C. scabriuscula</i> , Austria,
Haplotype 37	AF345425 <i>A. sp.</i> from <i>C. cristatella</i> , USA: Alabama
Haplotype 38	AF345426 <i>A. sp.</i> from <i>C. parasitica</i> , Canada, AY712703, AY712706 <i>A. sp.</i> from <i>C. pachycladodes</i> , USA: Florida, DQ530179 <i>A. lobophora</i> from <i>C. coniocraea</i> , Canada, DQ530184 <i>A. lobophora</i> from <i>C. pocillum</i> , Canada, DQ530189 <i>A. lobophora</i> from <i>C. fimbriata</i> , Canada, FM945354 <i>A. lobophora</i> from <i>C. coniocraea</i> , Czech Republic FM945356, FM945382, FM945387 <i>A. lobophora</i> from <i>C. rei</i> , Czech Republic, FM945366 <i>A. lobophora</i> from <i>C. macilenta</i> , Czech Republic, FM945369 <i>A. lobophora</i> from <i>C. ochrochlora</i> , Czech Republic, FM945373 <i>A. lobophora</i> from <i>C. pyxidata</i> , Czech Republic, FM945377 <i>A. lobophora</i> from <i>C. rangiformis</i> , Czech Republic, FM945379 <i>A. lobophora</i> from <i>C. subulata</i> , Czech Republic, KP318674, KT989907 <i>A. lobophora</i> from <i>C. coccifera</i> , Czech Republic, KT989906 <i>A. lobophora</i> from <i>C. diversa</i> , Czech Republic
Haplotype 39	AF345428 <i>A. sp.</i> from <i>C. turgida</i> , Russia
Haplotype 40	AF345429 <i>A. sp.</i> from <i>C. furcata</i> , USA: Virginia
Haplotype 41	AF345430 <i>A. sp.</i> clade 8 from <i>C. symphyocarpa</i> , Finland,
Haplotype 42	AF345431, DQ530188 <i>A. sp.</i> clade 8 from <i>C. chlorophaea</i> , Canada, FM945358 <i>A. sp.</i> clade 8 from <i>C. fimbriata</i> , Slovakia, FM945365 <i>A. sp.</i> clade 8 from <i>C. macilenta</i> , Czech Republic, FM945383 <i>A. sp.</i> clade 8 from <i>C. subulata</i> , Czech Republic, FM945386 <i>A. sp.</i> clade 8 from <i>C. rei</i> , Czech Republic, KT989916 <i>A. sp.</i> clade 8 from <i>C. coccifera</i> , Austria, KT989917, KT989918 <i>A. sp.</i> clade 8 from <i>C. coccifera</i> , Czech Republic
Haplotype 43	AF345432 <i>A. sp.</i> clade 8 from <i>C. farinacea</i> , USA: New York
Haplotype 44	AF345434 <i>A. mediterranea</i> from <i>C. fimbriata</i> , Sweden
Haplotype 45	AF345435 <i>A. mediterranea</i> from <i>C. rangiformis</i> , Yugoslavia,
Haplotype 46	AF345436 <i>A. sp.</i> from <i>C. pyxidata</i> , Italy
Haplotype 47	AF345438 <i>A. italiana</i> from <i>C. ochrochlora</i> , Australia
Haplotype 48	AF345439, AF345440, AF345441 <i>A. erici</i> from <i>C. cristatella</i> , USA: Massachusetts
Haplotype 49	AF345443 <i>A. sp.</i> from <i>C. pulviniformis</i> , French Guyana, JN990658, JN990660 <i>A. sp.</i> from <i>C. didyma</i> , Brasil
Haplotype 50	AM906016 <i>A. woessiae</i> from <i>C. foliacea</i> , Czech Republic, FM945348, FM945350 <i>A. woessiae</i> from <i>C. humilis</i> , Czech Republic, FM945385 <i>A. woessiae</i> from <i>C. subulata</i> , Czech Republic, KP318669 <i>A. woessiae</i> from <i>C. coccifera</i> , Spain
Haplotype 51	AY712690 <i>A. sp.</i> clade 9 from <i>C. subtenuis</i> , USA: Florida
Haplotype 52	AY712691 <i>A. sp.</i> clade 9 from <i>C. evansii</i> , USA: Florida
Haplotype 53	AY712692 <i>A. sp.</i> clade 9 from <i>C. evansii</i> , USA: Florida

Haplotype 54	AY712693 <i>A. sp.</i> clade 9 from <i>C. evansii</i> , USA: Florida
Haplotype 55	AY712694 <i>A. sp.</i> clade 9 from <i>C. subtenuis</i> , USA: Florida
Haplotype 56	AY712695 <i>A. sp.</i> clade 9 from <i>C. leporina</i> , USA: Florida
Haplotype 57	AY712697 <i>A. sp.</i> clade 9 from <i>C. subtenuis</i> , USA: Florida
Haplotype 58	AY712698 <i>A. sp.</i> clade 9 from <i>C. subtenuis</i> , USA: Florida
Haplotype 59	AY712699 <i>A. sp.</i> clade 9 from <i>C. subtenuis</i> , USA: Florida
Haplotype 60	AY712700 <i>A. sp.</i> clade 9 from <i>C. subtenuis</i> , USA: Florida
Haplotype 61	AY712701 <i>A. sp.</i> from <i>C. perforata</i> , USA: Florida
Haplotype 62	AY712702 <i>A. sp.</i> from <i>C. prostrata</i> , USA: Florida
Haplotype 63	AY712704 <i>A. sp.</i> from <i>C. pachycladodes</i> , USA: Florida
Haplotype 64	AY712705 <i>A. sp.</i> from <i>C. prostrata</i> , USA: Florida
Haplotype 65	AY712707, AY712710 <i>A. lobophora</i> from <i>C. pachycladodes</i> , USA: Florida, AY842280 <i>A. lobophora</i> from <i>C. perforata</i> , USA: Florida,
Haplotype 66	AY712708 <i>A. lobophora</i> from <i>C. leporina</i> , USA: Florida
Haplotype 67	AY712709 <i>A. lobophora</i> from <i>C. prostrata</i> , USA: Florida
Haplotype 68	AY712711 <i>A. sp.</i> from <i>C. pachycladodes</i> , USA: Florida
Haplotype 69	AY842276 <i>A. sp.</i> clade 9 from <i>C. verticillaris</i> , Brasil
Haplotype 70	AY842277 <i>A. sp.</i> from <i>C. crinita</i> , Brazil
Haplotype 71	AY842278 <i>A. sp.</i> from <i>C. fissidens</i> , Brasil
Haplotype 72	AY842279 <i>A. sp.</i> clade 9 from <i>C. confusa</i> , Brasil, JQ359767 <i>A. sp.</i> clade 9 from <i>C. confusa</i> , Poland
Haplotype 73	DQ229879 <i>A. friedlii</i> from <i>C. caespiticia</i> , USA: Pennsylvania
Haplotype 74	DQ482671 <i>A. lobophora</i> from <i>C. subtenuis</i> , USA: Missouri
Haplotype 75	DQ482672 <i>A. sp.</i> from <i>C. subtenuis</i> , USA: Virginia
Haplotype 76	DQ482673 <i>A. sp.</i> from <i>C. subtenuis</i> , USA: Virginia
Haplotype 77	DQ482674 <i>A. sp.</i> from <i>C. subtenuis</i> , USA: Arkansas
Haplotype 78	DQ482675 <i>A. sp.</i> from <i>C. subtenuis</i> , USA: North Carolina
Haplotype 79	DQ482676 <i>A. sp.</i> from <i>C. subtenuis</i> , USA: Pennsylvania
Haplotype 80	DQ482677 <i>A. sp.</i> from <i>C. subtenuis</i> , USA: Missouri
Haplotype 81	DQ482678 <i>A. sp.</i> clade 8 from <i>C. subtenuis</i> , USA: North Carolina,
Haplotype 82	DQ482679 <i>A. sp.</i> clade 8 from <i>C. subtenuis</i> , USA: Virginia
Haplotype 83	DQ482680 <i>A. sp.</i> clade 8 from <i>C. subtenuis</i> , USA: Pennsylvania
Haplotype 84	DQ482681 <i>A. sp.</i> clade 9 from <i>C. subtenuis</i> , USA: Georgia
Haplotype 85	DQ482682 <i>A. sp.</i> clade 9 from <i>C. subtenuis</i> , USA: Florida
Haplotype 86	DQ530180 <i>A. sp.</i> clade 12 from <i>C. cornuta</i> , Canada DQ530190 <i>A. sp.</i> clade 12 from <i>C. pocillum</i> , Canada FM945355, FM945378, FM945381 <i>A. sp.</i> clade 12 from <i>C. rei</i> , Czech Republic FM945359 <i>A. sp.</i> clade 12 from <i>C. fimbriata</i> , Czech Republic FM945360, FM945361, FM945362 <i>A. sp.</i> clade 12 from <i>C. furcata</i> , Czech Republic, FM945374, FM945375 <i>A. sp.</i> clade 12 from <i>C. pyxidata</i> , Czech Republic FM945384 <i>A. sp.</i> clade 12 from <i>C. subulata</i> , Czech Republic
Haplotype 87	DQ530183 <i>A. glomerata</i> from <i>C. ecmocyna</i> , Canada
Haplotype 88	DQ530185 <i>A. lobophora</i> from <i>C. macrophyllodes</i> , Canada
Haplotype 89	DQ530191 <i>A. sp.</i> from <i>C. pocillum</i> , Canada
Haplotype 90	FM205720 <i>A. mediterranea</i> from <i>C. convoluta/foliacea</i> , Portugal, KP257384, KP257385, KP257386, KP257388, KP257389, KP257390, KP257391, KP257392 <i>A. mediterranea</i> from <i>C. convoluta/foliacea</i> , Spain, KP257395 <i>A. mediterranea</i> from <i>C. rangiformis</i> , Spain, KP257396 <i>A. mediterranea</i> from <i>C. cervicornis</i> , Spain, KT215300, KT215301, KT215302, KT215309, KT215310, KT215311 <i>A. mediterranea</i> from <i>C. symphycarpa</i> , Sweden, KT215306, KT215307 <i>A. mediterranea</i> from <i>C. symphycarpa</i> , Germany
Haplotype 91	FM945349 <i>A. aff. italiana</i> from <i>C. humilis</i> , Czech Republic,

	KT989908, KT989909, KT989910, KT989914 <i>A. aff. italiana</i> from <i>C. coccifera</i> , Czech Republic, KT989911 <i>A. aff. italiana</i> from <i>C. coccifera</i> , Austria, KT989912 <i>A. aff. italiana</i> from <i>C. diversa</i> , Germany, KT989913 <i>A. aff. italiana</i> from <i>C. diversa</i> , Spain
Haplotype 92	FM945380 <i>A. sp. clade 8</i> from <i>C. rei</i> , Slovakia
Haplotype 93	HE803029 <i>A. sp. clade I1</i> from <i>C. rangiferina</i> , India, HE803030 <i>A. sp. clade I1</i> from <i>C. furcata</i> , India
Haplotype 94	HE803032 <i>A. sp. clade I1</i> from <i>C. furcata</i> , India, HE803031 <i>A. sp. clade I1</i> from <i>C. pyxidata</i> , India, HE803033, HE803034 <i>A. sp. clade I1</i> from <i>C. corymbescens</i> , India
Haplotype 95	HE803035, HE803036 <i>A. sp. clade I2</i> from <i>C. furcata</i> , India
Haplotype 96	HE803037 <i>A. sp. clade I2</i> from <i>C. furcata</i> , India
Haplotype 97	HE803038 <i>A. sp. clade 9</i> from <i>C. scabriuscula</i> , India
Haplotype 98	HE803039 <i>A. sp. clade 9</i> from <i>C. coniocraea</i> , Nepal, HE803040 <i>A. sp. clade 9</i> from <i>C. delavayi</i> , India
Haplotype 99	HE803041 <i>A. sp. clade 9</i> from <i>C. verticillata</i> , India,
Haplotype 100	HE803042 <i>A. sp. clade 9</i> from <i>C. delavayi</i> , India
Haplotype 101	HE803044 <i>A. sp.</i> from <i>C. verticillata</i> , India
Haplotype 102	HE803045, HE803046, HE803047 <i>A. sp.</i> from <i>C. fruticulosa</i> , India
Haplotype 103	HE803048 <i>A. sp.</i> from <i>C. praetermissa</i> , India
Haplotype 104	HE803049 <i>A. sp.</i> from <i>C. cariosa</i> , India
Haplotype 105	JN990651 <i>A. sp. clade 9</i> from <i>C. confusa</i> , Brasil
Haplotype 106	JN990652 <i>A. sp. clade 9</i> from <i>C. confusa</i> , Brasil, JN990657 <i>A. sp. clade 9</i> from <i>C. crispatula</i> , Brasil
Haplotype 107	JN990653 <i>A. sp. clade 9</i> from <i>C. confusa</i> , Brasil
Haplotype 108	JN990654 <i>A. sp. clade 9</i> from <i>C. crispatula</i> , Brasil
Haplotype 109	JN990655 <i>A. sp. clade 9</i> from <i>C. crispatula</i> , Brasil
Haplotype 110	JN990656 <i>A. sp. clade 9</i> from <i>C. crispatula</i> , Brasil
Haplotype 111	JN990659 <i>A. sp. clade 9</i> from <i>C. didyma</i> , Brasil
Haplotype 112	KJ690277 <i>A. sp.</i> from <i>C. pleurota</i> , Canada
Haplotype 113	KJ690285 <i>A. sp.</i> from <i>C. pleurota</i> , Canada
Haplotype 114	KP257366 <i>A. mediterranea</i> from <i>C. convoluta/foliacea</i> , Spain
Haplotype 115	KP257367, KP257368, KP257369, KP257371, KP257372, KP257373, KP257374, KP257375, KP257376, KP257377, KP257378, KP257380 <i>A. mediterranea</i> from <i>C. convoluta/foliacea</i> , Spain
Haplotype 116	KP257370 <i>A. mediterranea</i> from <i>C. convoluta/foliacea</i> , Spain
Haplotype 117	KP257379, KP257387 <i>A. mediterranea</i> from <i>C. convoluta/foliacea</i> , Spain
Haplotype 118	KP257381 <i>A. mediterranea</i> from <i>C. convoluta/foliacea</i> , Spain, KP257393, KP257394 <i>A. mediterranea</i> from <i>C. rangiformis</i> , Spain, KP257397, KP257398 <i>A. mediterranea</i> from <i>C. cervicornis</i> , Spain
Haplotype 119	KP257382 <i>A. mediterranea</i> from <i>C. convoluta/foliacea</i> , Spain
Haplotype 120	KP257383 <i>A. mediterranea</i> from <i>C. convoluta/foliacea</i> , Spain
Haplotype 121	KP314492 <i>A. erici</i> from <i>C. pocillum</i> , Svalbard
Haplotype 122	KP314498, KP314501, KP314581, KP314595, KP314648 <i>A. sp.</i> from <i>C. pocillum</i> , Svalbard
Haplotype 123	KP314503 <i>A. erici</i> from <i>C. pocillum</i> , Svalbard
Haplotype 124	KP314523 <i>A. sp.</i> from <i>C. pocillum</i> , Svalbard
Haplotype 125	KP314558 <i>A. sp.</i> from <i>C. pocillum</i> , Svalbard
Haplotype 126	KP314578 <i>A. aff. irregularis</i> from <i>C. borealis</i> , Svalbard
Haplotype 127	KP314582 <i>A. sp.</i> from <i>C. pocillum</i> , Svalbard
Haplotype 128	KP314590 <i>A. aff. irregularis</i> from <i>C. borealis</i> , Svalbard
Haplotype 129	KP314598 <i>A. erici</i> from <i>C. pocillum</i> , Svalbard
Haplotype 130	KP314604 <i>A. sp.</i> from <i>C. pocillum</i> , Svalbard
Haplotype 131	KP314633 <i>A. erici</i> from <i>C. pocillum</i> , Svalbard

Haplotype 132	KP314635 <i>A. sp.</i> from <i>C. pocillum</i> , Svalbard
Haplotype 133	KP314665 <i>A. sp.</i> from <i>C. pocillum</i> , Svalbard
Haplotype 134	KP318671 <i>A. echinata</i> from <i>C. diversa</i> , Portugal
Haplotype 135	KT215308 <i>A. mediterranea</i> from <i>C. symphycarpa</i> , Germany
Haplotype 136	KT989888 <i>A. italiana</i> from <i>C. coccifera</i> , Czech Republic
Haplotype 137	KT989905 <i>A. sp.</i> clade StA4 from <i>C. coccifera</i> , Czech Republic
Haplotype 138	KT989915 <i>A. sp.</i> clade StA2 from <i>C. coccifera</i> , Austria
	MT036576 <i>A. antarctica</i> from <i>C. sp.</i> , Antarctica
Haplotype 139	KT989919, KT989921 <i>A. sp.</i> clade StA3 from <i>C. coccifera</i> , Austria
	KT989920 <i>A. sp.</i> clade StA3 from <i>C. coccifera</i> , Czech Republic
	MH415438 <i>A. sp.</i> clade StA3 from <i>C. macrophylla</i> , Denmark
Haplotype 140	KT989922 <i>A. sp.</i> clade A9 from <i>C. coccifera</i> , Czech Republic
Haplotype 141	KT989940 <i>A. aff. irregularis</i> from <i>C. deformis</i> , Spain
Haplotype 142	KX051235, KX051236, KX051238 <i>A. sejongensis</i> from <i>C. pyxidata</i> , Antarctica
Haplotype 143	MT036564, MT036566, MT036567, MT036568 <i>A. pseudoirregularis</i> from <i>C. sp.</i> , Antarctica,
	MT036565 <i>A. pseudoirregularis</i> from <i>C. gracilis.</i> , Antarctica
Haplotype 144	MT036573, MT036574, MT036575 <i>A. antarctica</i> from <i>C. sp.</i> , Antarctica

Table S11. List of haplotypes showing relationships between ITS rDNA sequences of *Asterochloris* associating with *Lepraria* spp. Sequences from tropical region are marked in green.

Haplotype	List of samples
Haplotype 1	Kukwa 14695 <i>A. sp.</i> clade Bol 9 from <i>L. aff. congesta</i> , La Paz 1
Haplotype 2	Kukwa 14831 <i>A. sp.</i> clade Bol 11 from <i>L. congesta</i> , La Paz 1
Haplotype 3	Kukwa 15186 <i>A. sp.</i> clade Bol 9 from <i>L. congesta</i> , Cochabamba 1, Kukwa 14827a <i>A. sp.</i> clade Bol 9 from <i>L. congesta</i> , La Paz 1
Haplotype 4	Kukwa 16204 <i>A. sp.</i> Bol 2 from <i>L. harrisiana</i> , Chuquisaca 2, Kukwa 16858, Kukwa 16831 <i>A. sp.</i> Bol 2 from <i>L. impossibilis</i> , Tarija 2, Kukwa 16584 <i>A. sp.</i> Bol 2 from <i>L. impossibilis</i> , Tarija 1
Haplotype 5	Kukwa 16829 <i>A. sp.</i> clade A14 from <i>L. cf. cryptovouauxii</i> , Tarija 2
Haplotype 6	Kukwa 16907 <i>A. sp.</i> clade Bol 4 from <i>L. pallida</i> , Chuquisaca 2
Haplotype 7	Kukwa 16941 <i>A. sp.</i> clade Bol 1 from <i>L. sipmaniana</i> , Tarija 2, Kukwa 16915b <i>A. sp.</i> clade Bol 1 from <i>L. sipmaniana</i> , Tarija 1
Haplotype 8	Kukwa 18069 <i>A. friedlii</i> from <i>L. achariana</i> , Cochabamba 1
Haplotype 9	Kukwa 19459 <i>A. friedlii</i> from <i>L. finkii</i> , Santa Cruz 1, AM905995 <i>A. friedlii</i> from <i>L. caesioalba</i> , Slovakia, EU008659 <i>A. friedlii</i> from <i>L. cupressicola</i> , China, EU008661, EU008662 <i>A. friedlii</i> from <i>L. caesiella</i> , USA, EU008663, EU008666 <i>A. friedlii</i> from <i>L. caesioalba</i> , USA, EU008668 <i>A. friedlii</i> from <i>L. incana</i> , USA, EU008674, EU008676, EU008677, EU008679, EU008680 <i>A. friedlii</i> from <i>L. finkii</i> , USA, FN556034 <i>A. friedlii</i> from <i>L. rigidula</i> , Czech Republic
Haplotype 10	Kukwa 19468 <i>A. sp.</i> clade L54 from <i>L. aff. hodkinsoniana</i> , Santa Cruz 1
Haplotype 11	Kukwa 19499 <i>A. sp.</i> clade Bol 7 from <i>L. impossibilis</i> , Santa Cruz 1
Haplotype 12	Kukwa 14848a <i>A. sp.</i> clade A6 from <i>L. cryptovouauxii</i> , La Paz 2
Haplotype 13	AM900492, AM906015 <i>A. woessiae</i> from <i>L. borealis</i> , Bulgaria, AM906014 <i>A. woessiae</i> from <i>L. caesioalba</i> , Czech Republic
Haplotype 14	AM905992 <i>A. echinata</i> from <i>L. rigidula</i> , Czech Republic, FN556029 <i>A. echinata</i> from <i>L. granulata</i> , Bulgaria
Haplotype 15	AM905994 <i>A. friedlii</i> from <i>L. cf. caesioalba</i> , Slovakia
Haplotype 16	AM905997, KP318664, FM955668 <i>A. gaertneri</i> from <i>L. rigidula</i> , Czech Republic, FN556037 <i>A. gaertneri</i> from <i>L. incana</i> , Czech Republic,

	FN556038 <i>A. gaertneri</i> from <i>L. membranacea</i> , Czech Republic
Haplotype 17	AM906002 , AM906005 <i>A. leprarii</i> from <i>L. neglecta</i> , Czech Republic, AM906003 , AM906004 <i>A. leprarii</i> from <i>L. caesioalba</i> , Czech Republic
Haplotype 18	AM906008 , AM906009 <i>A. lobophora</i> from <i>L. caesioalba</i> , Czech Republic, AM906010 <i>A. lobophora</i> from <i>L. alpina</i> , Czech Republic, AM906007 <i>A. lobophora</i> from <i>L. cf. caesioalba</i> , Czech Republic
Haplotype 19	DQ229877 <i>A. friedlii</i> from <i>L. finkii</i> , USA: Wisconsin
Haplotype 20	DQ229878 <i>A. lobophora</i> from <i>L. finkii</i> , USA: Wisconsin
Haplotype 21	FJ406576 <i>A. sp.</i> clade A9 from <i>L. borealis</i> , Antarctica
Haplotype 22	FM955667 <i>A. echinata</i> from <i>L. caesioalba</i> , Czech Republic, FN556026 <i>A. echinata</i> from <i>L. alpina</i> , Spain
Haplotype 23	FM955669 <i>A. gaertneri</i> from <i>L. rigidula</i> , Czech Republic
Haplotype 24	FN556031 <i>A. sp.</i> clade A4 from <i>L. rigidula</i> , Czech Republic
Haplotype 25	FN556035 <i>A. sp.</i> clade A9 from <i>L. alpina</i> , Spain
Haplotype 26	FN556042 <i>A. sp.</i> clade A11 from <i>L. caesioalba</i> , USA: California
Haplotype 27	FN556044 <i>A. lobophora</i> from <i>L. borealis</i> , Czech Republic
Haplotype 28	EU008664 , EU008665 <i>A. friedlii</i> from <i>L. caesioalba</i> , USA, EU008678 <i>A. friedlii</i> from <i>L. finkii</i> , USA
Haplotype 29	EU008681 <i>A. sp.</i> clade L55 from <i>L. yunnaniana</i> , Costa Rica
Haplotype 30	EU008683 <i>A. mediterranea</i> from <i>L. nylanderiana</i> , Italy
Haplotype 31	AM906013 , AM900491 <i>A. phycobiontica</i> from <i>L. neglecta</i> , Ukraine, FN556023 <i>A. phycobiontica</i> from <i>L. alpina</i> , Czech Republic, FN556024 <i>A. phycobiontica</i> from <i>L. caesioalba</i> , Czech Republic
Haplotype 32	AM906006 <i>A. lobophora</i> from <i>L. caesioalba</i> , Czech Republic
Haplotype 33	AM905996 <i>A. friedlii</i> from <i>L. caesioalba</i> , Romania
Haplotype 34	FN556027 <i>A. echinata</i> from <i>L. caesioalba</i> , Slovakia
Haplotype 35	FN556028 <i>A. echinata</i> from <i>L. caesioalba</i> , Spain
Haplotype 36	FN556033 <i>A. sp.</i> clade A6 from <i>L. crassissima</i> , Czech Republic
Haplotype 37	FN556045 <i>A. lobophora</i> from <i>L. caesioalba</i> , Czech Republic
Haplotype 38	KP318670 <i>A. friedlii</i> from <i>L. elobata</i> , Slovakia
Haplotype 39	FN556030 <i>A. sp.</i> clade A4 from <i>L. caesioalba</i> , Czech Republic, FN556032 <i>A. sp.</i> clade A4 from <i>L. rigidula</i> , Czech Republic
Haplotype 40	FN556036 <i>A. sp.</i> clade A9 from <i>L. caesioalba</i> , Czech Republic
Haplotype 41	FN556039 <i>A. sp.</i> clade A11 from <i>L. borealis</i> , USA: California
Haplotype 42	FN556040 <i>A. sp.</i> clade A11 from <i>L. caesioalba</i> , USA: California
Haplotype 43	FN556041 <i>A. sp.</i> clade A11 from <i>L. caesioalba</i> , USA: California
Haplotype 44	Kukwa 16828 <i>A. sp.</i> Bol 2 from <i>L. impossibilis</i> , Tarija 2,

Table S12. List of haplotypes showing relationships, between ITS rDNA sequences of *Asterochloris* from lichen forming fungi, representing cosmopolitan distribution pattern. Sequences from tropical region are marked in green.

Haplotype number	Sample ID
Haplotype 1	FM945347 <i>A. irregularis</i> from <i>Cladonia arbuscula</i> , Czech Republic, MH415358 , MH415360 , MH415361 <i>A. irregularis</i> from <i>Stereocaulon alpinum</i> , Greenland, MH415368 <i>A. irregularis</i> from <i>Stereocaulon tomentosum/sasakii</i> , USA: Alaska, MH415394 <i>A. irregularis</i> from <i>Stereocaulon alpinum</i> , Finland
Haplotype 2	FM945351 , FM945352 , FM945353 <i>A. glomerata</i> from <i>Cladonia coccifera</i> , Czech Republic
Haplotype 3	HE803028 <i>A. glomerata</i> from <i>Cladonia coniocraea</i> , Nepal
Haplotype 4	HE803035 , HE803036 <i>A. sp.</i> clade I2 from <i>Cladonia furcata</i> , India
Haplotype 5	HE803037 <i>A. sp.</i> clade I2 from <i>Cladonia furcata</i> , India

Haplotype 6	KP314492 <i>A. erici</i> from <i>Cladonia pocillum</i> , Svalbard
Haplotype 7	KP314498 <i>A. sp</i> clade A19 from <i>Cladonia pocillum</i> , Svalbard
Haplotype 8	KP314503 <i>A. erici</i> from <i>Cladonia pocillum</i> , Svalbard
Haplotype 9	KP314523 <i>A. sp.</i> from <i>Cladonia pocillum</i> , Svalbard
Haplotype 10	KP314558 <i>A. sp.</i> from <i>Cladonia pocillum</i> , Svalbard
Haplotype 11	KP314582 <i>A. sp.</i> from <i>Cladonia pocillum</i> , Svalbard
Haplotype 12	KP314598 <i>A. erici</i> from <i>Cladonia pocillum</i> , Svalbard
Haplotype 13	KP314604 <i>A. sp.</i> from <i>Cladonia pocillum</i> , Svalbard
Haplotype 14	KP314633 <i>A. erici</i> from <i>Cladonia pocillum</i> , Svalbard
Haplotype 15	KP314635 <i>A. sp.</i> from <i>Cladonia pocillum</i> , Svalbard
Haplotype 16	KP314665 <i>A. sp</i> clade A19 from <i>Cladonia pocillum</i> , Svalbard
Haplotype 17	MH415323 <i>A. aff. irregularis</i> from <i>Stereocaulon tomentosum/sasakii</i> , USA: Alaska
Haplotype 18	MH415409 <i>A. aff. irregularis</i> from <i>Stereocaulon alpinum</i> , Canada
Haplotype 19	MH415229 <i>A. sp. clade StA8</i> from <i>Stereocaulon myriocarpum</i> , Costa Rica
Haplotype 20	MH415287 <i>A. sp. clade StA8</i> from <i>Stereocaulon myriocarpum</i> , Venezuela
Haplotype 21	MH415288 <i>A. sp. clade StA8</i> from <i>Stereocaulon myriocarpum</i> , Venezuela
Haplotype 22	MH415294 <i>A. sp. clade StA8</i> from <i>Stereocaulon myriocarpum</i> , Venezuela
Haplotype 23	Kukwa 14827 <i>A. sp. clade Bol 8</i> from <i>Stereocaulon alpinum</i> , La Paz 1
Haplotype 24	Kukwa 15040 <i>A. sp. clade 12</i> from <i>Cladonia chlorophaea</i> , Cochabamba 1, HE803050 <i>A. sp. clade 12</i> from <i>Cladonia pyxidata</i> , India
Haplotype 25	Kukwa 15044 <i>A. sp. clade P2</i> from <i>Cladonia furcata</i> , Cochabamba 1
Haplotype 26	Kukwa 16553 <i>A. sp. clade Bol 5</i> from <i>Cladonia furcata</i> , Tarija 1
Haplotype 27	UGDA-L 18613 <i>A. sp. clade P2</i> from <i>Stereocaulon myriocarpum</i> , La Paz 4, UGDA-L 19021 <i>A. sp. clade P2</i> from <i>Cladonia arbuscula</i> , Santa Cruz 1
Haplotype 28	UGDA-L 18963 <i>A. sp. clade StA5</i> from <i>Cladonia pocillum</i> , La Paz 5, MH415221, MH415222, MH415224, MH415225 <i>A. sp. clade StA5</i> from <i>Stereocaulon alpinum</i> , Georgia, MH415366 <i>A. sp. clade StA5</i> from <i>Stereocaulon alpinum</i> , Austria
Haplotype 29	UGDA-L 19009 <i>A. sp. clade 9</i> from <i>Cladonia arcuata</i> , Santa Cruz 2
Haplotype 30	Kukwa 19459 <i>A. friedlii sp.</i> from <i>Lepraria finkii</i> , Santa Cruz 1
Haplotype 31	UGDA-L 25173 <i>A. sp. clade S1</i> from <i>Stereocaulon tomentosum</i> , Santa Cruz 1
Haplotype 32	AF345431 <i>A. sp. clade 8</i> from <i>Cladonia chlorophaea</i> , Canada
Haplotype 33	DQ229877 <i>A. friedlii</i> from <i>Lepraria finkii</i> , USA: Wisconsin
Haplotype 34	DQ229878 <i>A. lobophora</i> from <i>Lepraria finkii</i> , USA: Wisconsin
Haplotype 35	FM945354 <i>A. lobophora</i> from <i>Cladonia coniocraea</i> , Czech Republic, FM945373 <i>A. lobophora</i> from <i>Cladonia pyxidata</i> , Czech Republic, FM945391 <i>A. lobophora</i> from <i>Stereocaulon tomentosum</i> , Slovakia, MH415297, MH415298, MH415299 <i>A. lobophora</i> from <i>Stereocaulon alpinum</i> , Georgia
Haplotype 36	FM945360, FM945361, FM945362 <i>A. sp. clade 12</i> from <i>Cladonia furcata</i> , Czech Republic, FM945374, FM945375 <i>A. sp. clade 12</i> from <i>Cladonia pyxidata</i> , Czech Republic
Haplotype 37	HE803030 <i>A. sp. clade I1</i> from <i>Cladonia furcata</i> , India
Haplotype 38	HE803031 <i>A. sp. clade I1</i> from <i>Cladonia pyxidata</i> , India HE803032 <i>A. sp. clade I1</i> from <i>Cladonia furcata</i> , India
Haplotype 39	HE803039 <i>A. sp. clade 9</i> from <i>Cladonia coniocraea</i> , Nepal
Haplotype 40	KX051235 <i>A. sajongensis</i> from <i>Cladonia pyxidata</i> , Antarctica
Haplotype 41	MH415217 <i>A. italiana</i> from <i>Stereocaulon alpinum</i> , South Argentina
Haplotype 42	MH415257, MH415258 <i>A. sp. clade StA2</i> from <i>Stereocaulon alpinum</i> , Iceland
Haplotype 43	MH415334 <i>A. phycobiontica</i> from <i>Stereocaulon alpinum</i> , Austria
Haplotype 44	MH415357 <i>A. sp. clade StA4</i> from <i>Stereocaulon alpinum</i> , Greenland
Haplotype 45	MH415364 <i>A. sp. clade StA4</i> from <i>Stereocaulon alpinum</i> , Greenland
Haplotype 46	MH415383 <i>A. woessiae</i> from <i>Stereocaulon alpinum</i> , Denmark
Haplotype 47	MH415410 <i>A. sp. clade StA5</i> from <i>Stereocaulon alpinum</i> , Canada
Haplotype 48	Kukwa 14831 <i>A. sp. clade Bol 11</i> from <i>Lepraria congesta</i> , La Paz 1

Haplotype 49	Kukwa 15186 <i>A. sp.</i> clade Bol 9 from <i>Lepraria congesta</i> , Cochabamba 1
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Table S13. List of haplotypes showing relationships, between ITS rDNA sequences of *Asterochloris* from lichen forming fungi, representing Neotropical distribution pattern.

Haplotype number	Sample ID
Haplotype 1	Kukwa 16168 <i>A. sp.</i> clade Bol 1 from <i>Cladonia</i> aff. <i>ahitii</i> , Chuquisaca 2, Kukwa 16909 <i>A. sp.</i> clade Bol 1 from <i>Cladonia</i> aff. <i>ahitii</i> , Chuquisaca 2, Kukwa 14785 <i>A. sp.</i> clade Bol 1 from <i>Cladonia ceratophylla</i> , La Paz 1, Kukwa 18470 <i>A. sp.</i> clade Bol 1 from <i>Cladonia ceratophylla</i> , Santa Cruz 1
Haplotype 2	UGDA-L 19009 <i>A. sp.</i> clade 9 from <i>Cladonia arcuata</i> , Santa Cruz 2
Haplotype 3	UGDA-L 18961 <i>A. mediterranea</i> from <i>Cladonia calycantha</i> , La Paz 3
Haplotype 4	Kukwa 14886 <i>A. sp.</i> clade P2 from <i>Cladonia calycantha</i> , La Paz 2
Haplotype 5	AY842277 <i>A. sp.</i> from <i>Cladonia crinita</i> , Brazil
Haplotype 6	UGDA-L 19015 <i>A. sp.</i> clade 9 from <i>Cladonia dactylota</i> , Santa Cruz 1, Kukwa 16205 <i>A. sp.</i> clade 9 from <i>Cladonia granulosa</i> , Chuquisaca 2
Haplotype 7	AY842278 <i>A. sp.</i> from <i>Cladonia fissidens</i> , Brazil
Haplotype 8	Kukwa 14848a <i>A. sp.</i> clade A6 from <i>Lepraria cryptovouauxii</i> , La Paz 2
Haplotype 9	Kukwa 19468 <i>A. sp.</i> clade L54 from <i>Lepraria</i> aff. <i>hodkinsoniana</i> , Santa Cruz 1
Haplotype 10	Kukwa 16831 , Kukwa 16858 <i>A. sp.</i> clade Bol 2 from <i>Lepraria impossibilis</i> , Tarija 2, Kukwa 16584 <i>A. sp.</i> clade Bol 2 from <i>Lepraria impossibilis</i> , Tarija 1
Haplotype 11	UGDA-L 18555 <i>A. sp.</i> clade Bol 6 from <i>Stereocaulon microcarpum</i> , La Paz 3
Haplotype 12	UGDA-L 18566 <i>A. mediterranea</i> from <i>Stereocaulon pachycephalum</i> , La Paz 4
Haplotype 13	UGDA-L 18992 <i>A. sp.</i> clade StA1 from <i>Cladonia isabellina</i> , La Paz 4
Haplotype 14	Kukwa 14684 <i>A. sp.</i> clade StA1 from <i>Cladonia andesita</i> , La Paz 1
Haplotype 15	UGDA-L 18556 <i>A. sp.</i> clade clade Bol 13 from <i>Lepraria achariana</i> , Santa Cruz 1
Haplotype 16	Kukwa 16829 <i>A. sp.</i> clade A14 from <i>Lepraria</i> cf. <i>cryptovouauxii</i> , Tarija 2
Haplotype 17	Kukwa 16586 <i>A. sp.</i> clade Bol 3 from <i>Diploschistes</i> cf. <i>cinereocesius</i> , Tarija 1
Haplotype 18	Kukwa-16828 <i>A. sp.</i> clade Bol. 2 from <i>Lepraria impossibilis</i> , Tarija 2
Haplotype 19	Kukwa-16907a <i>A. sp.</i> clade Bol 12 from <i>Lepraria impossibilis</i> , Chuquisaca 2

Table S14. List of haplotypes showing relationships, between ITS rDNA sequences of *Asterochloris* from lichen forming fungi, representing Pantropical distribution pattern.

Haplotype number	Sample ID
Haplotype 1	UGDA-L 18987 <i>A. sp.</i> clade P2 from <i>Cadonia melanopoda</i> , La Paz 4, Kukwa 16911 <i>A. sp.</i> clade P2 from <i>Cladia aggregata</i> , Chuquisaca 2, UGDA-L 19004 <i>A. sp.</i> clade P2 from <i>Cladonia didyma</i> , La Paz 4
Haplotype 2	AY842279 <i>A. sp.</i> clade 9 from <i>Cladonia confusa</i> , Brazil
Haplotype 3	UGDA-L 18999 <i>A. sp.</i> clade S1 from <i>Cladonia didyma</i> , La Paz 2
Haplotype 4	HE803045 , HE803046 , HE803047 <i>A. sp.</i> clade 9 from <i>Cladonia fruticulosa</i> , India
Haplotype 5	Kukwa 15987 , Kukwa 15988 <i>A. sp.</i> clade Bol 10 from <i>Diploschistes hypoleucus</i> , Chuquisaca 1
Haplotype 6	Kukwa 16204 <i>A. sp.</i> clade Bol 2 from <i>Lepraria harrisiana</i> , Chuquisaca 2
Haplotype 7	Kukwa 16907 <i>A. sp.</i> clade A14 from <i>Lepraria pallida</i> , Chuquisaca 2
Haplotype 8	Kukwa 16915b <i>A. sp.</i> clade Bol 1 from <i>Lepraria sipmaniana</i> , Tarija 1, Kukwa 16941 <i>A. sp.</i> clade Bol 1 from <i>Lepraria sipmaniana</i> , Tarija 2
Haplotype 9	AF345437 <i>A. sp.</i> clade StA7 from <i>Cladia aggregata</i> , Chile
Haplotype 10	HE803048 <i>A. sp.</i> clade 9 from <i>Cladonia praetermissa</i> , India
Haplotype 11	HE803042 <i>A. sp.</i> clade 9 from <i>Cladonia delavayi</i> , India

Haplotype 12	HE803040 <i>A. sp.</i> clade 9 from <i>Cladonia delavayi</i> , India
Haplotype 13	Kukwa 15030b <i>A. sp.</i> clade StA1 from <i>Cladonia confusa</i> , Cochabamba 1
Haplotype 14	Kukwa 16621 <i>A. sp.</i> clade StA1 from <i>Cladonia confusa</i> , Tarija 1

Table S15. Summary of data for haplotype networks.

Variable/dataset	<i>Stereocaulon</i>	<i>Cladonia</i>	<i>Lepraria</i>	Cosmopolitan	Neotropical	Pantropical
Number of samples [N]	200	404	82	75	25	20
Number of mycobionts species [N]	36	91	26	12	17	10
Alignment length	501	522	503	550	503	501
Nucleotide diversity	0.01700833	0.00795703	0.02065656	0.02717573	0.02125604	0.02225655
Number of <i>Asterochloris</i> haplotypes [N]	55	144	44	49	19	14
Haplotype diversity	0.28	0.36	0.54	0.65	0.76	0.85

Table S16. Summary of data for haplotype networks with division into tropical and temperate samples.

Variable/dataset	<i>Stereocaulon</i> tropical	<i>Stereocaulon</i> temperate	<i>Cladonia</i> <i>tropical</i>	<i>Cladonia</i> temperate	<i>Lepraria</i> tropical	<i>Lepraria</i> temperate	Cosmopolitan tropical	Cosmopolitan temperate
Number of samples [N]	46	154	90	314	20	62	29	46
Number of mycobionts species [N]	10	24	41	60	13	14	13	10
Number of <i>Asterochloris</i> haplotypes [N]	24	36	65	85	14	31	20	29
Haplotype diversity	0.52	0.23	0.72	0.27	0.70	0.50	0.69	0.63

