Tab. 1: Seznam položek, ze kterých byla získána ITS rDNA.

název	mykobiont	lokalita	substrát	altitude (m n. m.)	Tmax	Tmin	T prům	P prům	stanice	GPS	GPS	sběr	Poznámky
A4	Cladonia mediterranea	Azorské o.	půda	NA	23,3	2,3	12,3	860	Ponte delgada (71 m n. m.)	NA	NA	rok 2009	J. Neustupa
G2	Cladonia sp.	Gronsko,Disko Island	půda	140	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G4	cladonia pyxidata	Gronsko,Ilulissat	půda	100	20,5	-25,5	-4,5	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G5	cladonia delessertii	Gronsko,Disko Island	půda	140	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G6	Cladonia mitis	Gronsko,Disko Island	půda	140	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G7	Cladonia Coccifera	Gronsko,Ilulissat	půda	100	20,5	-25,5	-4,5	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G8	Cladonia sp.	Gronsko,Ilulissat	půda	100	20,5	-25,5	-4,5	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G9	Cladonia sp.	Gronsko,Ilulissat	půda	100	20,5	-25,5	-4,5	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G11	Cladonia sp.	Gronsko,Disko Island	půda s mechem	140	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G12	Cladonia sp.	Gronsko,Ilulissat	půda	100	20,5	-25,5	-4,5	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G13	Cladonia sp.	Gronsko,Ilulissat	půda	100	20,5	-25,5	-4,5	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G14	Cladonia pleurota	Gronsko,Ilulissat	půda	100	20,5	-25,5	-4,5	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G15	Cladonia sp.	Gronsko,Disko Island	půda	140	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G18	Cladonia Pyxidata	Gronsko,Ilulissat	půda	100	20,5	-25,5	-4,5	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G20	Cladonia Pluerota	Gronsko,Disko Island	půda	140	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G21	Cladonia sp.	Gronsko,Disko Island	půda s mechem	140	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
G22	Cladonia sp.	Gronsko, Ilulissat	půda	100	20,5	-25,5	-4,5	240	Ilulissat (31 m n. m.)	NA	NA	rok 2011, srp	P. Škaloud
I1	Cladonia aggregata	Indie,Uttarakhand	půda	NA	NA	NA	NA	NA	NA	NA	NA	28.4.2009	Himanshu Rai
I4	Cladonia furcata	Indie,Uttarakhand	štěrková půda až tvrdý jíl	3250	11,1	-7,5	2,4	165	Sprinigar (1585 m n. m.)	30.29189N	79.12544E	23.8.2007	Himanshu Rai
I6	Cladonia rangiferina	Indie,Uttarakhand	štěrková půda až tvrdý jíl	2553	15,6	-3	6,9	165	Sprinigar (1585 m n. m.)	30.13329N	80.13115E	18.10.2007	Himanshu Rai
IH1	Cladonia praetermissa	Indie,Madhyapradesh	red hard soil	1665	26,7	5,7	16,3	1370	Pendra (624 m n.m .)	22.42489N	81.44463E	10.1.2010	Himanshu Rai
IH2	Cladonia scabriuscula	Indie,Assam	dusíkatá půda s org.zbytky	1014	26,1	9,6	18,2	67	Imphal (774 m n.m.)	25.08013N	93.00355E	18.2.2008	Himanshu Rai
IH8A	Cladonia verticillata	Indie,Uttarakhand	štěrková půda až tvrdý jíl	1890	23,6	8,5	11,6	22	Dadelhura (1865 m n. m.)	29.23545N	80.05071E	29.10.2009	Himanshu Rai
IH8B	Cladonia verticillata	Indie,Uttarakhand	štěrková půda až tvrdý jíl	1890	23,6	8,5	11,6	22	Dadelhura (1865 m n. m.)	29.23545N	80.05071E	29.10.2009	Himanshu Rai
IH14	Cladonia coniocraea	Nepal, Mahakali Zone	biological soil crust	1800	24,2	8,9	12	22	Dadelhura (1865 m n. m.)	29,18085N	80,35327E	18.5.2010	Himanshu Rai
IH15	Cladonia coniocraea	Nepal, Mahakali Zone	kůra Rhododendron arboreum	1716	24,8	9,7	12,8	22	Dadelhura (1865 m n. m.)	29.18071N	80.35314E	17.5.2010	Himanshu Rai
IH 16	Cladonia pyxidata	Indie,Uttarakhand	štěrková půda až tvrdý jíl	3118	15,7	-3,8	6,1	165	Dehradun (682 m n.m.)	30.59343N	78.56212E	29.10.2010	Himanshu Rai
IH17	Cladonia fruticulosa	Indie,Uttarakhand	půda na skále	3100	15	-4,7	5,2	165	Dehradun (682 m n.m.)	30.59353N	78.56205E	29.10.2010	Himanshu Rai
IH18	Cladonia Subradiata	Indie,Uttarakhand	půda na skále	3100	15	-4,7	5,2	165	Dehradun (682 m n.m.)	30.59353N	78.56205E	29.10.2010	Himanshu Rai
IH20	Cladonia scabriuscula	Indie, Maharashtra	na skále s půdou a mechy	1410	25,7	10	17,8	87	Rotnagiri (67 m n.m.)	17.55176N	73.40234E	26.3.2010	Himanshu Rai
IH21A	Cladonia delavayi	Indie,Uttarakhand	skála s půdou	1618	24,8	23,6	20,6	22	Dalhousie	29.19577N	80.05278E	27.11.2010	Himanshu Rai
IH21B	Cladonia delavayi	Indie,Uttarakhand	skála s půdou	1618	24,8	23,6	20,6	22	Dalhousie	29.19577N	80.05278E	27.11.2010	Himanshu Rai
IH22	Cladonia fruticulosa	Indie, Tamilnadu	půda v jehličnatém lese	2607	19,6	0,6	11,6	122	Kozhikode (5 m n.m.)	11.23454N	76.43366E	12.1.2008	Himanshu Rai
IH23	Cladonia furcata	Indie, Tamilnadu	půda v jehličnatém lese	2607	19,6	0,6	11,6	122	Kozhikode (5 m n.m.)	11.23454N	76.43366E	12.1.2008	Himanshu Rai
IH26	Cladonia furcata	Indie, Himachal Pradesh	půda s mechem	3078	25,5	-18,5	4,5	100	Amritsar (230 m n.m.)	31.42172N	77.16146E	5.6.2008	Himanshu Rai
IH27	Cladonia furcata	Indie, Himachal Pradesh	půda s mechem	2300	30,5	-13,5	9,5	100	Amritsar (230 m n.m.)	31.59533N	77.24474E	4.5.2008	Himanshu Rai
IH28	Cladonia cariosa	Indie,Uttarakhand	skála s půdou	1745	34,2	-5,8	25,2	70	Dillí (233 m n.m.)	29.25226N	79.04297E	29.10.2009	Himanshu Rai
IH29	Cladonia pyxidata	Indie,Uttarakhand	štěrková půda až tvrdý jíl	3550	12,1	-7,4	2,3	165	Dehradun (682 m n.m.)	30.23349N	79.19087E	8.6.2009	Himanshu Rai
IH30	Cladonia furcata	Indie,Uttarakhand	štěrková půda až tvrdý jíl	3700	11,1	-8,4	1,3	165	Dehradun (682 m n.m.)	30.22275N	7919103E	8.6.2008	Himanshu Rai
IH31A	Cladonia corymbescens	Indie,Uttarakhand	štěrková půda až tvrdý jíl	2743	17,3	-2,2	7,5	165	Dehradun (682 m n.m.)	29.58153N	80.39197E	2.11.2009	Himanshu Rai
IH31B	Cladonia corymbescens	Indie,Uttarakhand	štěrková půda až tvrdý jíl	2743	17,3	-2,2	7,5	165	Dehradun (682 m n.m.)	29.58153N	80.39197E	2.11.2009	Himanshu Rai
IH32A	Cladonia fruticulosa	Indie, Tamilnadu	půda v jehličnatém lese	2607	19,6	0,6	11,6	122	Kozhikode (5 m n.m.)	11.24009N	76.44062E	12.1.2008	Himanshu Rai
IH32B	Cladonia fruticulosa	Indie, Tamilnadu	půda v jehličnatém lese	2607	19,6	0,6	11,6	122	Kozhikode (5 m n.m.)	11.24009N	76.44062E	12.1.2008	Himanshu Rai
IR1	Cladonia sp.	Irsko, Kerry	půda s mechem	60	16,1	3,2	10	132	Valentia Observatory (9 m n.m.)	NA	NA	rok 2010	K. Nemjo vá
JA1	Cladonia Coccifera group	japonsko, Mt. Fuji	kůra	2300	19,5	-13,5	3,5	182	Fuji Air base (683 m n.m.)	NA	NA		P. Škaloud
JA2	Cladonia Chlorophaea group	japonsko, Mt. Fuji	půda s mechem	2300	19,5	-13,5	3,5	182	Fuji Air base (683 m n.m.)	NA	NA		P. Škaloud
JA3	Cladonia Chlorophaea group	japonsko, Mt. Fuji	půda s mechem	2300	19,5	-13,5	3,5	182	Fuji Air base (683 m n.m.)	NA	NA		P. Škaloud
JA4	Cladonia Cf. Furcata	japonsko, Mt. Fuji	půda	2300	19,5	-13,5	3,5	182	Fuji Air base (683 m n.m.)	NA	NA		P. Škaloud
JA5	Cladonia sp.	japonsko, Mt. Fuji	kůra	2300	19,5	-13,5	3,5	182	Fuji Air base (683 m n.m.)	NA	NA		P. Škaloud
JA6	Cladonia Coccifera group	japonsko, Mt. Fuji	půda	2300	19,5	-13,5	3,5	182	Fuji Air base (683 m n.m.)	NA	NA		P. Škaloud
JA8	Cladonia sp.	japonsko, Biodiversity center u Mt. Fuji	kůra	1010	27,9	-5,1	11,9	182	Fuji Air base (683 m n.m.)	NA	NA		P. Škaloud
JA9	Cladonia (červenoplodá)	japonsko, Nikko	kůra	666	21,2	0,2	9,3	180	Nagano 347 (m n.m.)	36.758244N	139.596748E		P. Škaloud
JA10a	Cladonia monomorpha	japonsko, Nikko	podzolová půda	666	21,2	0,2	9,3	180	Nagano 347 (m n.m.)	36.758244N	139.596748E		P. Škaloud
JA10b	Cladonia (červonoplodá)	japonsko, Nikko	podzolová půda	666	21,2	0,2	9,3	180	Nagano 347 (m n.m.)	36.758244N	139.596748E		P. Škaloud
JA11	Cladonia sp.	japonsko, Nikko	kůra	666	21,2	0,2	9,3	180	Nagano 347 (m n.m.)	36.758244N	139.596748E		P. Škaloud
JA12	Cladonia cf. Ramulosa	japonsko, Nikko	půda s mechem	666	21,2	0,2	9,3	180	Nagano 347 (m n.m.)	36.758244N	139.596748E		P. Škaloud
JA14	Cladonia Chlorophaea group	japonsko, Nikko	kámen	666	21,2	0,2	9,3	180	Nagano 347 (m n.m.)	36.758244N	139.596748E		P. Škaloud
KO21	Cladonia sp.	Kanárské o.	borový les, u cesty	900	25,7	5,7	15,7	250	Isla de la Palma (79 m n m.)	28.719684N	17.884197W	rok 2011, říje	L. Vančurová
KO22	Cladonia sp.	Kanárské o.	borový les, u cesty	900	25,7	5,7	15,7	250	Isla de la Palma (79 m n m.)	28.719684N	17.884197W	rok 2011, říje	L. Vančurová
KO25	Stereocaulon sp.	Kanárské o.	u cesty, pod borovicí	2400	16	-4	6	250	Isla de la Palma (79 m n m.)	28.763145N	17.884197W	rok 2011, říje	L. Vančurová
KO28	Cladonia sp.	Kanárské o.	u cesty, borový les, mech	1100	24,4	4,4	14,4	250	Isla de la Palma (79 m n m.)	NA	NA	rok 2011, říje	L. Vančurová

název	mykobiont	lokalita	substrát	altitude (m n. m.)	Tmax	Tmin	T prům	P prům	stanice	GPS	GPS	sběr	Poznámky
KO30	Cladonia sp.	Kanárské o.	skála nad vodním kanálem, vavřínový les	1300	23,1	3,1	13,1	250	Isla de la Palma (79 m n m.)	NA	NA	rok 2011, říje	L. Vančurová
KO31A	Cladonia sp.	Kanárské o.	skála nad vodním kanálem, vavřínový les	1350	22,7	2,7	12,7	250	Isla de la Palma (79 m n m.)	NA	NA	rok 2011, říje	L. Vančurová
KO31B	Cladonia sp.	Kanárské o.	skála nad vodním kanálem, vavřínový les	1350	22,7	2,7	12,7	250	Isla de la Palma (79 m n m.)	NA	NA	rok 2011, říje	L. Vančurová
KO31C	Cladonia sp.	Kanárské o.	skála nad vodním kanálem, vavřínový les	1350	22,7	2,7	12,7	250	Isla de la Palma (79 m n m.)	NA	NA		L. Vančurová
KO34	Cladonia sp.	Kanárské o.	skála s mechem, soutězka	800	26,3	6,3	16,3	250	Isla de la Palma (79 m n m.)	28.470285N	17.464155W	rok 2011, říje	L. Vančurová
KO35	Cladonia sp.	Kanárské o.	skála, porostlá mehem v soutězce	700	27	7	17	250	Isla de la Palma (79 m n m.)	28.470285N	17.464155W	rok 2011, říje	L. Vančurová
KO36	Cladonia sp.	Kanárské o.	u cesty, okolo vřes	980	25,1	6,1	16,1	250	Isla de la Palma (79 m n m.)	28.443795N	17.451507W		L. Vančurová
KOR1	Cladonia pyxidata	Korfu	půda s mechem	300	37,1	-2,9	15,1	84	Korfu (4 m n. m.)	NA	NA		T. Řídká
KOR2	Cladonia pocillum	Korfu	půda s mechem	300	37,1	-2,9	15,1	84	Korfu (4 m n. m.)	NA	NA		T. Řídká
M2	Cladonia sp.	Mongolsko	lávová pole	2620	4,8	-23,2	2,8	170	Gaiuut (2125 m n. m.)	47.152369S	100.577087E	rok 2011,čer	H. Bestová
M4	Cladonia sp.	Mongolsko	lávová pole	2620	4,8	-23,2	2,8	170	Gaiuut (2125 m n. m.)	47.152369S	100.577087E	rok 2011,čer	H. Bestová
PA1	Cladonia sp.	Patagonie,nad vlakovym mostem TdF	na pařezu	90	24,5	-4,5	5,5	500	Ushuaia (14 m n. m.)	54.829628S	68.433930W	31.12.2012	P. urbánková
PA2	Cladonia sp.	Patagonie, Vila O´Higgins	dřevo	350	28,8	-7,2	6,8	1000	Cochrana (167 m n. m.)	48.476437S	72.547634W		P. urbánková
PA3	Cladonia sp.	Patagonie,sestup 1.les	na dřevě	525	21,7	-7,3	2,7	500	Ushuaia (14 m n. m.)	54.761561S	68.429282W	2.1.2012	P. urbánková
PA4	Cladonia sp.	Patagonie	pařez	250	23,5	-5,5	4,5	500	Ushuaia (14 m n. m.)	54.749954S	68.388587W		P. urbánková
PA6	Cladonia sp.	Patagonie, 1.laguna FR-CR	hlína	786	27	-10	4	1000	Cochrana (167 m n. m.)	49.295718S	72.951937W		P. urbánková
PA7	Cladonia sp.	Patagonie, za vodopadem	na kameni	110	24,4	-4,6	5,4	500	Ushuaia (14 m n. m.)	54.827414S	68.437028W	31.12.2011	P. urbánková
SV1	Cladonia Squamosa	Švédsko, Store mosse	půda	120	32,3	-15,3	8,3	52	Goteborg (169 m n. m.)	58.275101N	11.551337E		H. bestová
SV2	Cladonia Dogitata	Švédsko, Store mosse	kůra	160	28,5	-14,5	7,5	48	Jonkoping (232 m n. m.)	57.180568N	13.554182E		H. bestová
SV3	Cladonia Rangiferina	Švédsko, Store mosse	půda s mechem	160	28,5	-14,5	7,5	48	Jonkoping (232 m n. m.)	57.180568N	13.554182E		H. bestová
T8	Stereocaulon vesuvianum	Afrika, Tanzania, Mt. Little Meru	vulkanická skála	3600	16,4	-2,6	6,6	54	Kilimanjaro, letiště (891 m n. m.)	NA	NA		L. Muggia
T15	Cladonia confusa	Afrika, Tanzania, Mt. Kilimanjaro, Shira plateaux	vulkanická skála, půda	3400	17,7	-1,3	7,9	54	Kilimanjaro, letiště (891 m n. m.)	NA	NA	8.1.2009	L. Muggia
T16A	Cladonia sp.	NA	vulkanický substrát-pleistocén	NA	NA	NA	NA	54	Kilimanjaro, letiště (891 m n. m.)	NA	NA		L. Muggia
T16B	Cladonia sp.	NA	vulkanický substrát-pleistocén	NA	NA	NA	NA	54	Kilimanjaro, letiště (891 m n. m.)	NA	NA		L. Muggia
T20	Stereocaulon vesuvianum	Afrika, Tanzania, Mt. Kilimandjaro	vulkanický substrát-pleistocén	4400	11,2	-7,8	1,4	54	Kilimanjaro, letiště (891 m n. m.)	NA	NA		L. Muggia
T21	Stereocaulon vesuvianum	Afrika, Tanzania, Mt. Kilimandjaro	vulkanický substrát-pleistocén	4400	11,2	-7,8	1,4	54	Kilimanjaro, letiště (891 m n. m.)	NA	NA		L. Muggia
L958 / RA	Stereocaulon alpinum	Rakousko, Kals an Grossglockner, severní svah	kyselá půda	2450	21	-30	-2	70	Zell am See (757 m n. m.)	470252N	12.4125E	23.7.2009	Jirka Malíček
L1248 / SI	Stereocaulon sp.	Rusko, Sibiř,řeka Timpton, pravý břeh	dřevo	300	11,2	-19,5	-4,5	64	Aldan (682 m n. m.)	57.98387N	127.06477E	8.8.2010	D. Svoboda
L991 / RA	Stereocaulon symphycheilum	Rakousko, Štýrské Alpy	křemičitá hornina, mech	2100	23,8	-20,2	1,8	65	Zeltweg (677 m n. m.)	47.0505N	14.3250	24.8.2010	
L992 / RA	Stereocaulon vesuvianum	Rakousko, Štýrské Alpy	křemičitá hornina, mech	2100	23,8	-20,2	1,8	65	Zeltweg (677 m n. m.)	47.0505N	14.3250E	24.8.2010	
L988 / AL	Stereocaulon pascale	USA, Aljaška,Cantwell	půda	200	27,3	-36,7	0,3	22	Healy (396 m n.m.)	NA	NA		L. Muggia
L1058 / AL	Stereocaulon apocalypticum	USA, Aljaška, Panorama Mountain	na skále s mechem	650	27,3	-36,7	0,3	22	Healy (396 m n.m.)	NA	NA	24.8.2010	L. Muggia
L1059 / AL	Stereocaulon intermedium	USA, Aljaška, Panorama Mountain	na skále s mechem	650	27,3	-36,7	0,3	22	Healy (396 m n.m.)	NA	NA	24.8.2010	L. Muggia
L1060 / AL	Stereocaulon tomentosum	USA, Aljaška, Panorama Mountain	na skále s mechem	650	27,3	-36,7	0,3	22	Healy (396 m n.m.)	NA	NA	24.8.2010	L. Muggia
L1061 / AL	Stereocaulon tomentosum	USA, Aljaška, Panorama Mountain	na skále s mechem	650	27,3	-36,7	0,3	22	Healy (396 m n.m.)	NA	NA	24.8.2010	L. Muggia
L1062 / AL	Stereocaulon pascale	USA, Aljaška, Panorama Mountain	na skále s mechem	650	27,3	-36,7	0,3	22	Healy (396 m n.m.)	NA	NA	24.8.2010	L. Muggia
L1063 / AL	Stereocaulon pascale	USA, Aljaška, Panorama Mountain	na skále s mechem	650	27,3	-36,7	0,3	22	Healy (396 m n.m.)	NA	NA	24.8.2010	L. Muggia
L1064 / AL	Stereocaulon pascale	USA, Aljaška, Panorama Mountain	na skále s mechem	650	27,3	-36,7	0,3	22	Healy (396 m n.m.)	NA	NA	24.8.2010	L. Muggia
L1065 /AL	Stereocaulon apocalypticum	USA, Aljaška, Panorama Mountain	na skále s mechem	650	27,3	-36,7	0,3	22	Healy (396 m n.m.)	NA	NA	24.8.2010	L. Muggia
L1066 / AL	Stereocaulon sp.	USA, Aljaška, Talkeetna	smrkový les	400	27,1	-35,9	-0,9	57	Talkeetna (109 m n. m.)	NA	NA	25.8.2010	L. Muggia
L1067 / AL	Stereocaulon tomentosum	USA, Aljaška, Kenai Peninsula, Lost Lake	půda	650	19,8	-21,2	0,8	38	Seward (6 m n.m.)	NA	NA	28.8.2010	L. Muggia
L1068 / AL	Stereocaulon sp.	USA, Aljaška, Kenai Peninsula, Lost Lake okolí	křemičitá půda	650	19,8	-21,2	0,8	38	Seward (6 m n.m.)	NA	NA	29.8.2010	L. Muggia
L1069 / AL	Stereocaulon sp.	USA, Aljaška, Kenai Peninsula, Lost Lake okolí	křemičitá půda	650	19,8	-21,2	0,8	38	Seward (6 m n.m.)	NA	NA	29.8.2010	L. Muggia
L1070 / AL	Stereocaulon sp.	USA, Aljaška, Atigun Pass	křemičitá půda s mechem	1450	19,7	-44,8	-13,3	131	Anaktunuk Pass (642 m n.m.)	NA	NA	19.8.2010	L. Muggia
L1071 / AL	Stereocaulon sp.	USA, Aljaška, Atigun Pass	křemičitá půda s mechem	1450	19,7	-44,8	-13,3	131	Anaktunuk Pass (642 m n.m.)	NA	NA	19.8.2010	L. Muggia
L1073 / AL	Stereocaulon sp.	USA, Aljaška, Kenai Peninsula, Moose Passe	křemičitá půda	650	17	-32	-2	39	Portage glacier (29 m n.m.)	NA	NA	29.8.2010	L. Muggia
L1074 / AL	Stereocaulon sp.	USA, Aljaška, Kenai Peninsula, Moose Passe	křemičitá půda	650	17	-32	-2	39	Portage glacier (29 m n.m.)	NA	NA	29.8.2010	L. Muggia
L1075 / AL	Stereocaulon sp.	USA, Aljaška, Kenai Peninsula, Moose Passe	křemičitá půda	650	17	-32	-2	39	Portage glacier (29 m n.m.)	NA	NA	29.8.2010	L. Muggia
L1076 / AL	Stereocaulon sp.	USA, Aljaška, Kenai Peninsula, Moose Passe	křemičitá půda	650	17	-32	-2	39	Portage glacier (29 m n.m.)	NA	NA	29.8.2010	L. Muggia
L1078 / AL	Stereocaulon sp.	USA, Aljaška, Kenai Peninsula, Moose Passe	křemičitá půda	650	17	-32	-2	39	Portage glacier (29 m n.m.)	NA	NA	29.8.2010	L. Muggia
L1080 / AL	Stereocaulon sp.	USA, Aljaška,Finger Mountain, Dalton Highway	na skále -křemičitá půda	750	24,4	-50,6	-8,6	347	Bettles (196 m n.m.)	NA	NA	17.8.2010	L. Muggia
L1081 / AL	Stereocaulon sp.	USA, Aljaška, Panorama Mountain	na skále s mechem	650	27,3	-36,7	0,3	22	Healy (396 m n.m.)	NA	NA	24.8.2010	L. Muggia
L1641 / KO	Stereocaulon sp.	Kanárské ostrovy - La Palma	NA	NA	20,7	-25,7	-4,7	250	NA	NA	NA	16.10.2011	L. Vančurová
L1642 / G	Stereocaulon sp.	Gronsko	NA	NA	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA		P. Škaloud
L1644 / G	Stereocaulon sp.	Gronsko	NA	NA	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA		P. Škaloud
L1645 / G	Stereocaulon sp.	Gronsko	NA	NA	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA		P. Škaloud
L1646 / G	Stereocaulon sp.	Gronsko	NA	NA	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA		P. Škaloud
L1647 / G	Stereocaulon sp.	Gronsko	NA	NA	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA		P. Škaloud
L1648 / G	Stereocaulon sp.	Gronsko	NA	NA	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA		P. Škaloud
L1649 / G	Stereocaulon sp.	Gronsko	NA	NA	20,7	-25,7	-4,7	240	Ilulissat (31 m n. m.)	NA	NA		P. Škaloud

Tab. č. 2: Použitý script pro výpočet fylogenetického signálu v programu R.

```
# TEST FYLOGENETICKÉHO SIGNÁLU

library(ape)

library(geiger)

library(picante)

MyTree<-read.nexus("treeview3.nex")

plot(MyTree)

MyData<-read.table("test.txt")

attach(MyData)

names(nvyska) <- rownames(MyData)

name.check(MyTree, MyData) -> Overlap

drop.tip(MyTree, Overlap$Tree.not.data) -> MyNewTree

name.check(MyNewTree, MyData)

plot(MyNewTree, show.tip.label=FALSE)

# TESTOVÁNÍ FYLOGENETICKÉHO SIGNÁLU - DISCRETE DATA (GEIGER)

lambdaTree(MyNewTree, 0) -> MyLambda0

lambdaTree(MyNewTree, 0.5) -> MyLambda0.5

par(mfcol=c(1,3))

plot(MyNewTree)

plot(MyLambda0.5)

plot(MyLambda0)

A=fitDiscrete(MyTree, puda[MyTree$tip.label], treeTransform="lambda")

B=fitDiscrete(MyLambda0,puda)

# likelihood ratio test

Pagels.lambda.p.value=1-pchisq(2*(A$Trait1$lnl-B$Trait1$lnl),1)

Pagels.lambda.p.value

A

B

# Blomberg et al´s K (Blomberg et al. 2002).

Kcalc(puda[MyTree$tip.label], MyTree)
```

psignal=phylosignal(puda[MyTree$tip.label], MyTree)

psignal

Blomberg.K.p.value=psignal$PIC.variance.P

Blomberg.K.p.value

 # TESTOVÁNÍ FYLOGENETICKÉHO SIGNÁLU - CONTINUOUS DATA

lambdaTree(MyNewTree, 0) -> MyLambda0

library(phytools)

fitLambda<-phylosig(MyTree,cyto[MyTree$tip.label],method="lambda",test=T)

 # TESTOVÁNÍ FYLOGENETICKÉHO SIGNÁLU (CAPER)

library(caper)

MyDataNew<-comparative.data(phy = MyTree, data = MyData, names.col = name, vcv = TRUE, na.omit = FALSE, warn.dropped = TRUE)

model.lambda<-pgls(log(fyt) ~ 1, data = MyDataNew, lambda='ML')

summary(model.lambda)

Obr. č. 1: Fylogenetický strom unikátních sekvencí zkonstruovaný metodou BI, založený na ITS rDNA a aktin alignmentu. Identické sekvence jsou znázorněny v rámečcích. Bootstrapové hodnoty v pořadí BI/ML/MP.

Photobiont diversity in Indian *Cladonia* lichens, with special emphasis on the geographical patterns

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Contents:

Abstract

The biogeography of lichen photobionts is still poorly known, in particular as the majority of reports have been published from Europe and North America. In this study we examined the diversity of *Asterochloris* photobionts from terricolous lichens (*Cladonia* spp.) collected in five different areas in India and Nepal during the years 2007 and 2010. In total, we obtained 20 ITS rDNA photobiont sequences from 11 different *Cladonia* species. The phylogenetic position of *Asterochloris* photobionts was investigated by the phylogenetic analysis based on the concanated ITS rDNA and actin type I intron dataset. The newly obtained photobiont sequences were inferred in 6 clades, including two novel clades exclusively formed by photobionts of Indian *Cladonia* lichens. Since the sequences of these two clades were genetically considerably different from all other known *Asterochloris* lineages, they very probably represent new, undescribed photobiont species. According to our data, three clades seem to have rather restricted distribution, reported so far only from Europe and Asia, respectively. However, we propose that the restricted distribution of these three photobiont clades is not caused by either historic or biological factors, but more likely by specific climatic or habitat preferences and the under-exploration of such habitats in different regions.

1. Introduction

Lichens show distinctive patterns of distribution at both micro and macro levels (Galloway 2008). Sixteen major biogeographical patterns have been distinguished in lichens, including cosmopolitan taxa, bipolar taxa, taxa specific for particular continents or areas, and endemic taxa (Galloway 2008). However, these patterns are applicable to lichen-forming fungi only. Up to date, we have almost no idea about the biogeography of lichenized algae and cyanobacteria – the photobionts.

During the last 20 years, molecular phylogenetic studies dramatically changed our views regarding coevolution of lichen partners. Supposed cospeciation and parallel cladogenesis of mycobionts and photobionts has been generally rejected (Kroken and Taylor 2000, Piercey-Normore and DePriest 2001), and replaced with the domestication model, in which the fungal partner could select the best available photobiont (DePriest 2004). In general, the mycobionts are able to cooperate with several algal species and to switch them (Muggia et al. 2008, Nelsen and Gargas 2009, Nyati 2007, Piercey-Normore 2006, Wornik and Grube 2010), simultaneously, several mycobionts can share single algal partner (Beck 1999, Doering and Piercey-Normore 2009, Hauck et al. 2007, Piercey-Normore 2009, Rikkinen et al. 2002). Moreover, lichen algae and cyanobacteria could exhibit their own environmental requirements, which seem to be independent of particular mycobionts to a large extent (Cordeiro et al. 2005, Fernandez-Mendoza et al. 2011, Helms 2003, Muggia et al. 2008, Peksa and Skaloud 2011). Naturally, since the environmental preferences of an organism could be narrowly linked to its distribution, the geographical pattern of photobionts could be markedly different from that of their fungal partners.

Both cyanobacteria and algae are microscopic organisms. Moreover, the lichen vegetative propagules containing both symbionts (soredia, isidia, etc.) are mostly not much larger than particular algal cells (20–50 μm, Büdel and Scheidegger 2008) and they are capable of being dispersed over large distances as well (Bailey 1976). The well-known theory of ubiquitous dispersal of microbial species (Finlay and Clarke 1999) presumed that most organisms smaller then ca 1 mm should occur worldwide (in a niche-based context only).

Indeed, some photobiont lineages are apparently widely distributed. For example, *Asterochloris* clade A7 (sensu Peksa and Škaloud 2011) has been found in lichens collected from Europe, USA and China, indicating its ubiquitous dispersal. On the other hand, many photobiont lineages have been reported only from specific continents or regions. However, because of very uneven distribution of lichen collections, it is premature to classify them as species with narrow distribution patterns. For the most studied photobiont genera (*Asterochloris, Trebouxia*, *Nostoc*), majority of reports have been published from Europe and North America (e.g. Bačkor et al. 2010, Blaha et al. 2006, Guzow-Krzemińska 2006, Nelsen and Gargas 2008, O´Brien et al. 2005, Paulsrud et al. 2000, Peksa and Skaloud 2011, Piercey-Normore 2004, 2006, 2009, Yahr et al. 2004), slightly less from Central and South America (Cordeiro et al. 2005, Helms 2003, Reis 2005) and Antarctica (Aoki et al. 1998, Engelen and Ott 2010, Nyati 2007, Otálora et al. 2010, Romeike at al. 2002, Wirtz et al. 2003). However, only few or no data have been reported from Africa, Asia, Australia and close islands (Helms 2003, Nelsen and Gargas 2008, 2009, Nyati 2007, Piercey-Normore and DePriest2001). Therefore, further exploration of photobionts in these areas is necessary to obtain relevant information about biogeographical patterns in lichenized algae and cyanobacteria.

2. Objectives:

In this study, we investigated *Asterochloris* photobionts from terricolous lichens (*Cladonia* spp.) collected in India and Nepal using DNA sequencing. Traditionally, *Asterochloris* (incl. former *Trebouxia*) species have been determined according to the morphological features such as cell shape, chloroplast structure and pyrenoid ultrastructure. However, a large cryptic variability recently discovered within the genus (Piercey-Normore & DePriest 2001; Yahr et al. 2004; Skaloud & Peksa 2010) clearly point out the deficiency of morphological features to delimit real species entities within *Asterochloris*. Therefore, we sequnced the ITS rDNA marker to genetically investigate the diversity of photobionts in *Cladonia* lichens. The newly obtained ITS rDNA sequences were added to the dataset of all sequences deposited in GenBank database to analyze the phylogenetic position of Indian photobionts and biogeographic patterns of selected *Asterochloris* lineages.

3. Materials and Methods:

3.1 Sample Collection:

Lichen samples were collected in five different areas in India and Nepal (Fig. 1). Single lichen sample was collected in Maharashtra, Madhyapradesh and Assam states, located in west, central and north-eastern India, respectively. Three lichen samples were obtained from collections made in Tamilnadu state, located in south India. The majority of lichen thalli were collected in Himalayas, in Uttarakhand and Himachal Pradesh states. Finally, two lichen thalli were collected in eastern Nepal. The collections have been made at different times during the years 2007 and 2010 (Table 1).

3.2 DNA isolation, PCR, and Sequencing:

Total genomic DNA was extracted following the standard CTAB protocol (Doyle and Doyle 1987), with minor modifications. The total genomic DNA was dissolved in sterile dH_2O and amplified by polymerase chain reaction (PCR). The ITS1-5.8S-ITS2 rDNA region was amplified using universal primer ITS4-3' (5'-TCCTCCGCTTATTGATATGC-3'; White et al. 1990) and the algal-specific primer nr-SSU-1780-5' (5'-CTGCGGAAGGATCATTGATTC-3'; Piercey-Normore and DePriest 2001). All PCR reactions were performed in total volume of 20 µl contained 12.4 µL of sterile Mili-Q water, 2 µL of AmpliTaq Gold® 360 Buffer 10X (Applied Biosystems, Life technologies, Carlsbad, CA, USA), 1.5 µL of $MgCl_2$ (25 mM), 0.4 µL of dNTP mix (10 mM), 0.25 µL of each primer (25 nM), 2 µL of 360 GC Enhancer, 0.2 µL of AmpliTaq Gold® 360 DNA Polymerase and 1 µl of DNA (10 ng μL^{-1}). PCR and cycle-sequencing reactions were performed in a Touchgene Gradient cycler (Krackeler Scientific, Albany, NY, USA). PCR amplification of the algal ITS rDNA began with an initial denaturation at 95˚C for 10 min, followed by 35 cycles of denaturing at 95˚C for 1 min, annealing at 50˚C for 1 min and elongation at 72˚C for 1 min, with a final extension at 72˚C for 10 min. The PCR products were quantified on a 1% agarose gel stained with ethidium bromide and purified using the JetQuick PCR Purification kit (Genomed, Löhne, Germany) according to the manufacturer's protocols. The purified amplification products were sequenced with PCR primers using an Applied Biosystems (Seoul, Korea) automated sequencer (ABI 3730xl) at Macrogen Corp. in Seoul, Korea. Sequencing reads were assembled and edited using the SeqAssem programme (Hepperle 2004).

3.3 Phylogenetic Analyses:

The newly obtained ITS rDNA sequences were added to the concatenated (ITS rDNA, actin I locus) alignment analyzed in Škaloud and Peksa (2010). Then, we added several additional ITS rDNA sequences obtained from GenBank to cover all *Asterochloris* diversity. The final concatenated matrix contained 69 taxa, was 1137 bp long, and was 100% filled for the ITS data and 67% filled for the actin data (Table 2). The matrix is available from P.Š. The phylogenetic tree was inferred with Bayesian inference (BI) using MrBayes version 3.1 (Ronquist and Huelsenbeck 2003). The analysis was carried out on the partitioned dataset using the strategy described in Peksa and Škaloud (2011). Bootstrap analyses were performed by maximum likelihood (ML) and weighted parsimony (wMP) criteria using GARLI, version 0.951 (Zwickl, 2006) and PAUP version 4.0b10 (Swofford 2002), respectively. ML analysis consisted of rapid heuristic searches (100 pseudo-replicates) using automatic termination (genthreshfortopoterm command set to 100,000). The wMP bootstrapping (1,000 replications) was performed using heuristic searches with 100 random sequence addition replicates, TBR swapping, and random addition of sequences (the number limited to 10,000 for each replicate). The weight to the characters has been assigned using the rescaled consistency index, in a scale from 0 to 1000. New weights were based on the mean of the fit values for each character over all of the trees in memory.

To map the biogeographic information onto the phylogenetic tree, we prepared a dataset of 319 ITS rDNA sequences (obtained in this study and acquired from GenBank database) with known biogeographic data. The distribution of *Asterochloris* in particular continents was finally shown for those clades containing at least 10 sequences with known origin.

4. Results and Discussion

4.1 Diversity of *Asterochloris* photobionts:

In total, 57 natural samples of various *Cladonia* species were collected from five different areas in India and Nepal. However, the amplification of ITS rDNA region was successful in only 20 of these samples (Table 1). Unsuccessful amplification of more than half of the samples might have been caused by their age and storage conditions (some *Cladonia* samples were more than 4 years old) or by the presence of non-specific inhibitors. Usually, single photobiont has been detected in each lichen sample. However, in three cases we found two different *Asterochloris* genotypes in the single lichen thallus (samples IH2, IH8 and IH21).

All *Cladonia* samples were found to be associated with green algae belonging to the genus *Asterochloris*. The Bayesian analysis of the concatenated ITS rDNA and actin type I dataset led to the recognition of 20 lineages designated as clades 1–16 (according to Skaloud and Peksa 2010), clades A4, A9 (according to Peksa and Škaloud 2011), and two novel clades I1 and I2 (Fig. 2). The newly obtained photobiont sequences were inferred in 6 clades (I1, I2, 1, 9, 12 and 16). Two novel clades I1 and I2, exclusively formed by photobionts of Indian *Cladonia* lichens, were genetically considerably different from all other known *Asterochloris* lineages. Therefore, they very probably represent new, undescribed photobiont species. The clade I1 consisted of 6 photobiont sequences obtained from four *Cladonia* species (*C. rangiferina*, *C. furcata*, *C. pyxidata*, and *C. corymbescens*) collected in Himalayas at relatively high altitude (2300–3700 m a.s.l.; Fig. 3). The clade I2 comprised only three photobiont sequences obtained from *Cladonia* lichens collected in both Himalayas (samples I4 and IH26) and South India (sample IH23). All three lichen samples were also collected at high altitudes (2607–3250 m a.s.l.). Interestingly, all photobionts were found in *Cladonia furcata*, suggesting their specificity for this fungal partner.

The majority of investigated photobionts (found in 12 *Cladonia* samples belonging to 7 different species) were inferred in the clade 9. The clade is known as a lineage of North, Central and South American lichen photobionts, having low specificity towards the lichen-forming fungi (it associates at least with 18 species from 5 lichen genera – Cordeiro et al. 2005, Nelsen and Gargas 2006, Piercey-Normore and DePriest 2001, Reis 2005, Yahr et al., 2004). Our lichen samples containing clade 9 photobionts were collected from various substrate types, such as bare soil, red hard soil, soil in coniferous forest, or rocks. In comparison with algal genotypes inferred in clades I1 and I2, clade 9 photobionts were found in the *Cladonia* samples collected at lower altitudes (1014–2607 m a.s.l.; Fig. 3). The remaining photobionts, found in *Cladonia* samples IH15, IH16 and IH 17 were inferred in three separate clades. The photobiont of *Cladonia coniocraea* (IH15) belongs to a very common species *Asterochloris glomerata* (clade 1). Two remaining photobionts, found in lichens *Cladonia pyxidata* (IH16) and *C. fruticulosa* (IH17) were inferred as members of clades 12 and 16, respectively.

4.2 Biogeography of lichen photobionts:

During the last decade, biogeography of protists has become a highly controversial topic. It has been postulated that the small size, extremely large populations and high dispersal potential of protists result in the cosmopolitan distribution of the vast majority of species (Finlay 2002, Finlay and Fenchel 2004). Conversely, the limited geographical distributions has been implied by Foissner (1999), based mainly on the observed restricted distribution of "flagship" species, i.e. species with easily recognizable morphologies whose presence/absence can be easily demonstrated (Foissner 2006, 2008). However, all protistan biogeographic studies have been based on the investigation of the free-living organisms.

Our study could bring valuable information about the distribution patterns of symbiotic protists. So far, the investigations on *Asterochloris* photobionts were predominantly conducted on European and American lichen samples, only a few data have been obtained from other continents (see Introduction). Therefore, addition of more than 20 newly generated *Asterochloris* sequences obtained from Indian *Cladonia* samples could improve the dataset for subsequent estimation of biogeographical patterns in lichen photobionts.

The biogeography of particular lichen photobiont clades is illustrated in Fig. 2. Only those clades containing at least 10 sequences with known origin were analyzed. In general, the majority of clades show wide (eurychoric) distribution, i.e. they were found in two or three continents. For example, *Asterochloris glomerata*, the commonest species of the genus, display almost ubiquitous distribution. According to all published data so far, this species has been found in a number of various lichen taxa (almost 50 species from genera *Cladia*, *Cladonia*, *Stereocaulon*, *Pycnothelia*, *Diploschistes*, *Hertelidea*) collected in many different places in Europe, North America and Asia. It has obviously wide ecological amplitude, occurring in lichens growing on a variety of different substrates and in various microclimatic conditions. Nevertheless, all records of *A. glomerata* originate from warm-temperate to (sub)arctic zones of northern hemisphere (similarly to the clades 2, 10, 11, 12 and 16).

In comparison to other photobiont lineages, the clade 9 has extraordinary distribution pattern because of its absence in Europe (see Fig. 2). It is widely dispersed, reported from South to North America and Asia, however, all records occurred between latitudes 25° S (Brazil, Paraná) and 36° N (USA, North Carolina). Thus, the algae from clade 9 probably prefer tropical to warm-temperate climate. This fact could explain their absence in European samples (only warm Mediterranean regions of Europe can comply with such criterion, however, they have been poorly investigated for *Asterochloris* photobionts so far).

The above mentioned *Asterochloris* lineages exhibit wide distribution, nevertheless, their habitat area seems to be more or less restricted. Our current data together with the results of Fernandez-Mendoza et al. (2011), Helms (2003), Kroken and Taylor (2000), Muggia et al. (2008) and Peksa and Škaloud (2011) suggest that one of the most important factors influencing the distribution of eukaryotic photobionts is a climate. Such climatic preferences influence the type and size of species habitat. There are reports on lineages of *Trebouxia* photobionts occurring predominantly in tropical regions (Helms 2003), on the other hand, other clades (haplotypes) exhibit polar (bipolar) distribution pattern (Fernandez-Mendoza et al. 2011).

Thus, it is obvious that at least some clades occur only in specific biomes or latitudes in general, across different continents. It is a question whether there is any photobiont lineage living in one continent or region only (endemic species). According to our data, three clades seem to have rather restricted distribution. Photobionts of clades 7 (30 samples) have been reported so far only from Europe. Similarly, the clades I1 and I2 seem to be restricted to Asia (India). According to Foissner (2006), the restricted distribution of protist species could be caused by either historic, biological, climatic, or habitat factors. The biogeography of clades 7, I1 and I2 cannot be affected by the limited dispersal of their fungal partners. *Lepraria caesioalba* and *L. rigidula* (mycobionts of clade 7 algae), as well as *Cladonia furcata*, *C. rangiferina* and *C. pyxidata* (mycobionts of I1 and I2 algae) represent lichens with very wide to cosmopolitan distribution (Smith et al. 2009) and many of them disperse intensively via vegetative propagules (soredia, granules) which provide a possibility of intensive dispersal of both mycobionts and photobionts. Moreover, we cannot rule out the simple dispersal of photobionts independent of a fungus. *Asterochloris*, a unicellular green alga asexually reproducing by high number of aplanospores (Skaloud and Peksa 2010) has virtually unlimited dispersal capacity. It is well supported by its common distribution and ubiquity of the majority of its species. Therefore, the restricted distribution of photobiont clades 7, I1, and I2 cannot be explained by either historic or biological factors. More likely, the clades are restricted in their distribution by having specific climatic or habitat preferences. The clade 7 photobionts, so far reported only from Europe, have been recently demonstrated to be significantly associated with ombrophobic lichens (i.e. growing in fully rain-sheltered sites, where the vapour is the only available source of water) growing predominantly on the bark of broadleaf trees in temperate belt. It is highly probable that further investigation of photobiont diversity in bark-associated green-algal lichens conducted in other continents than Europe would reveal much wider distribution of this clade.

5. Conclusion

This study revealed significant photobiont diversity in *Cladonia* lichens collected in India and Nepal. The discovery of two novel, not yet reported clades emphasizes the large hidden diversity of lichen photobionts. Despite the fact that we investigated symbiotic organisms, almost all *Asterochloris* lineages exhibit eurychoric distribution. We suppose that the existence of several *Asterochloris* clades so far reported from single continent is affected by limited sampling and specific climatic or habitat preferences rather than by restricted distribution patterns. It is increasingly evident that the distinct preferences for environmental factors, not the dispersal barriers, shape the global distribution patterns of lichen photobionts. Consequently, narrow ecological preferences of lichen photobionts could to a certain extent determine the distribution pattern of the entire lichen association.

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Figure captions:

Fig. 1. Map showing the sampling localities of *Cladonia* lichens used in this study.

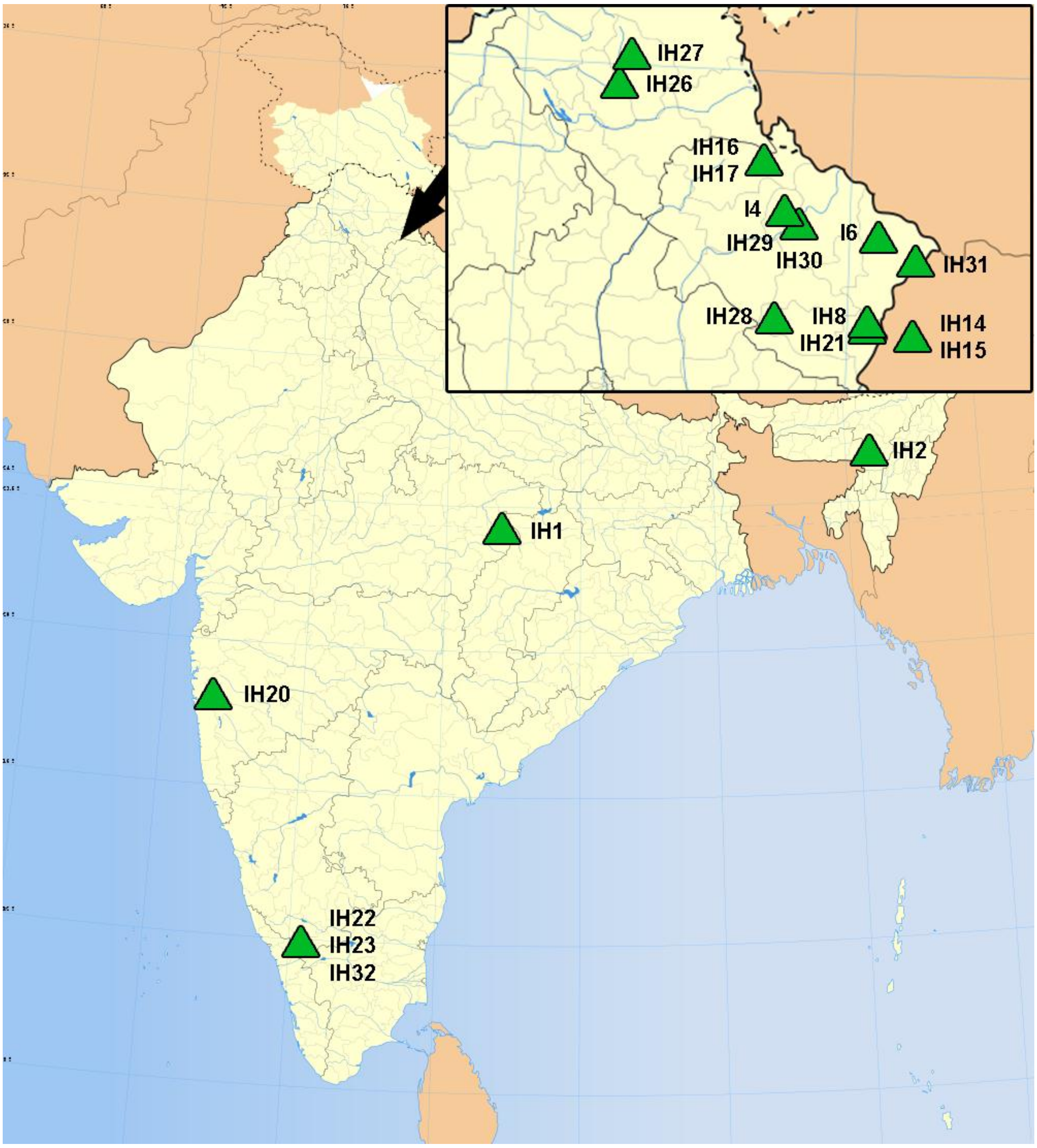
Fig. 2. Phylogenetic tree and biogeography of lichen photobiont *Asterochloris*. Bayesian analysis is based on the combined and partitioned ITS rDNA and actin type I dataset using a HKY+I model for ITS1 and ITS2, F81 model for 5.8 rRNA partition, a HKY+Γ model for the actin-intron 206, GTR+Γ model for the actin intron 248 and K80+I model for the actin-exon partition. Values at the nodes indicate statistical support estimated by three methods: MrBayes posterior node probability (left), maximum likelihood bootstrap (in the middle) and maximum parsimony (right). Thick branches represent nodes receiving high Bayesian support (≥0.99) or consisting of genetically identical strains. New sequences from Indian *Cladonia* lichens are given in bold. Strain affiliation to 20 clades is indicated. Biogeography of selected lineages (those containing at least 10 sequences with known origin) is shown next to the tree, including the total number of occurrences on each continent. Scale bar – estimated number of substitutions per site.

Fig. 3. Differences in the distribution of selected three *Asterochloris* clades along the altitudinal gradient. Box plots are based on altitudinal data of *Cladonia* samples analyzed in this study. All samples were collected in India and Nepal.

Table legends:

Table 1. List of *Cladonia* samples used for sequencing of algal ITS rDNA.

Table 2. List of all samples used in the study, including GenBank accession numbers for photobiont sequences. Newly obtained sequences are given in bold. The samples are ordered with respect to their position in the Bayesian phylogenetic tree (Fig. 2). Identical sequences omitted in the final alignment used for the Bayesian analysis are marked by asterisks.



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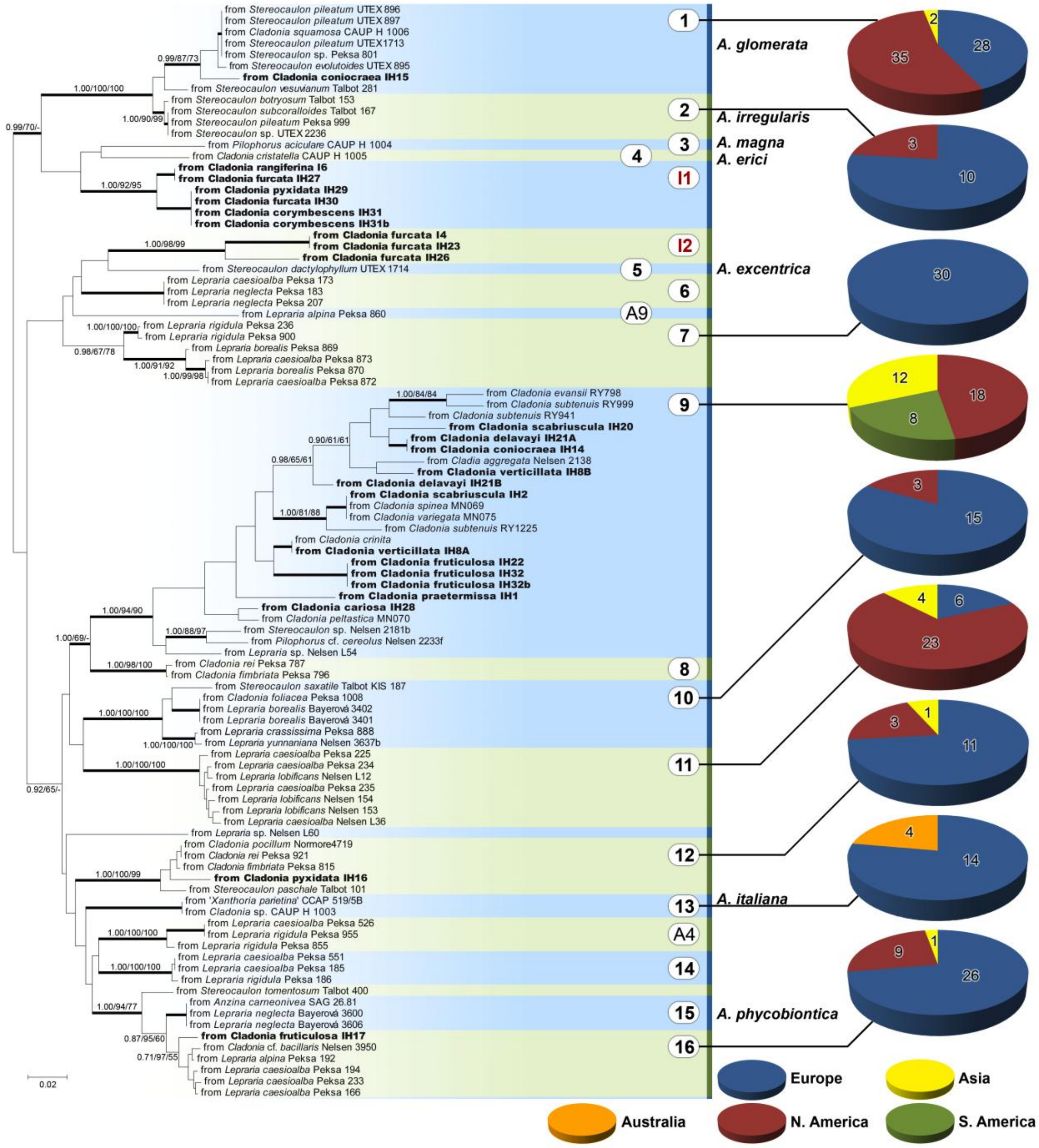

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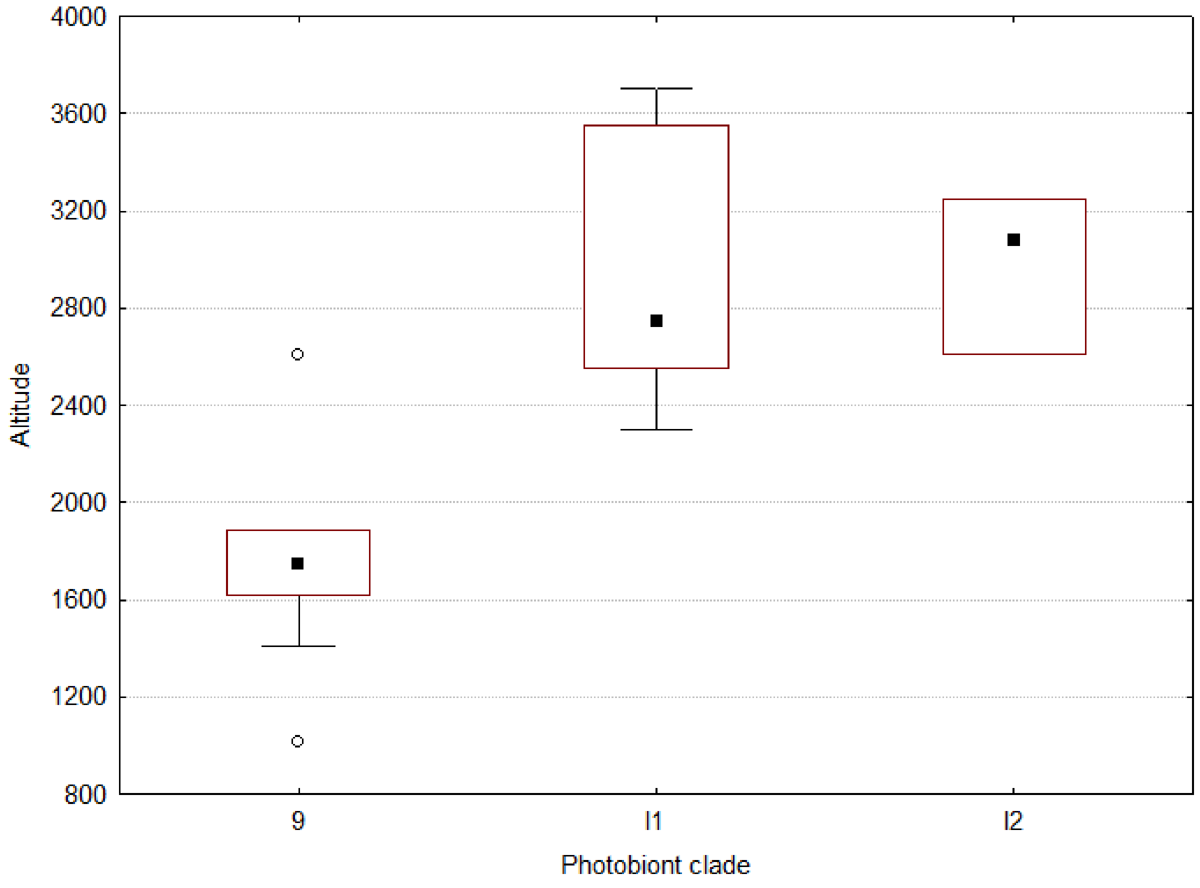

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Table 1. List of *Cladonia* samples used for sequencing of algal ITS rDNA.

Sample No.	Taxon	Date of Collection	Altitude (m)	Country	State	District	Site	Substratum	Lattitude	Longitude
I4	*Cladonia furcata* (Huds.) Schrad.	23.8.2007	3250	India	Uttarakhand	Rudraprayag	Tungnath	Soil	30^{0}29’18.9” N	79^{0}12’54.4” E
I6	*Cladonia rangiferina* (L.) Weber ex Wigg.	18.10.2007	2553	India	Uttarakhand	Pithoragarh	Between Bogdiyar and Naher Devi	Soil	30^{0}13’32.9” N	80^{0}13’11.5” E
IH1	*Cladonia praetermissa* A.W. Archer	10.5.2010	1665	India	Madhyapradesh	Anuppur	Shambhudhara, Amarkantak Protected area	Red hard soil	22^{0}42’48.9” N	81^{0}44’46.3” E
IH2	*Cladonia scabriuscula* (Delise) Nyl.	18.11.2008	1014	India	Assam	North Cachar	Haflong	Soil	25^{0}08’01.3” N	93^{0}00’35.5” E
IH8	*Cladonia verticillata* (Hoffm.) Schaer.	29.10.2009	1890	India	Uttarakhand	Champawat	Lohaghat to Mayawati	Soil	29^{0}23’54.5” N	80^{0}05’07.1” E
IH14	*Cladonia coniocraea* (Flörke) Spreng.	18.5.2010	1800	Nepal	Mahakali zone	Dadeldhura	Dadeldhura community forest	Soil in biological soil crust	29^{0}18’08.5” N	80^{0}35’32.7” E
IH15	*Cladonia coniocraea* (Flörke) Spreng.	17.5.2010	1716	Nepal	Mahakali zone	Dadeldhura	Dadeldhura community forest	Bark of *Rhododendron arboreum*	29^{0}18’07.1” N	80^{0}35’31.4” E
IH16	*Cladonia pyxidata* (L.) Hoffm.	29.10.2010	3118	India	Uttarakhand	Uttarkashi	Gangotri	Soil	30^{0}59'34.3"N	78^{0}56'21.2"E
IH17	*Cladonia fruticulosa* Kremp.	29.10.2010	3100	India	Uttarakhand	Uttarkashi	Gangotri	Soil	30^{0}59'35.3"N	78^{0}56'20.5"E
IH20	*Cladonia scabriuscula* (Delise) Nyl.	26.3.2010	1410	India	Maharashtra	Satara	Mahabaleshwar, Wilson Point	Rocks with mosses	17^{0}55'17.6"N	73^{0}40'23.4"E
IH21	*Cladonia delavayi* Abbayes	27.11.2010	1618	India	Uttarakhand	Champawat	Marodkhan on way to Ghat	Rock	29^{0}19'57.7"N	80^{0}05’27.8” E
IH22	*Cladonia fruticulosa* Kremp.	12.1.2008	2607	India	Tamilnadu	Nilgiri	Dodabetta, trails from Samer to Tiger Hills	Soil in coniferous forest	11^{0}23'45.4"N	76^{0}43'36.6"E
IH23	*Cladonia furcata* (Huds.) Schrad.	12.1.2008	2607	India	Tamilnadu	Nilgiri	Dodabetta, trails from Samer to Tiger Hills	Soil in coniferous forest	11^{0}23'45.4"N	76^{0}43'36.6"E
IH26	*Cladonia furcata* (Huds.) Schrad.	5.6.2008	3078	India	Himachal Pradesh	Kullu	on route to Dhela	Soil	31^{0}42'17.2"N	77^{0}16'14.6"E
IH27	*Cladonia furcata* (Huds.) Schrad.	4.5.2008	2300	India	Himachal Pradesh	Kullu	7 km before Pulga	Soil among mosses	31^{0}59'53.3"N	77^{0}24'47.4"E
IH28	*Cladonia cariosa* (Ach.) Spreng.	29.10.2009	1745	India	Uttarakhand	Champawat	Mayawati to Lohaghat	Rock	29^{0}25'22.6"N	79^{0}04'29.7"E
IH29	*Cladonia pyxidata* (L.) Hoffm.	8.6.2008	3550	India	Uttarakhand	Chamoli	Kothidhar	Soil	30^{0}23'34.9"N	79^{0}19'08.7"E
IH30	*Cladonia furcata* (Huds.) Schrad.	8.6.2008	3700	India	Uttarakhand	Chamoli	Srenikhal	Soil	30^{0}22'27.5"N	79^{0}19'10.3"E
IH31	*Cladonia corymbescens* Nyl. ex Leight	2.11.2009	2743	India	Uttarakhand	Pithoragarh	Narain Swami Ashram	Soil	29^{0}58'15.3"N	80^{0}39'19.7"E
IH32	*Cladonia fruticulosa* Kremp.	12.1.2008	2607	India	Tamilnadu	Nilgiri	Dodabetta, Trails from Samer to Tiger Hills	Soil in coniferous forest	11^{0}24'00.9"N	76^{0}44'06.2"E

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Clade No.	Fungal taxon	Origin	Collection number	GenBank accession ITS	actin	
1	Cladonia squamosa (Scop.) Hoffm.	USA, MA	CAUP H1006	AF345406	AM906025	
1	*Stereocaulon pileatum* Ach.	USA, MA	UTEX 896	AF345404	-	*
1	*Stereocaulon pileatum* Ach.	USA, MA	UTEX 897	AF345405	-	*
1	*Stereocaulon pileatum* Ach.	USA, MA	UTEX 1713	AF345407	-	*
1	*Stereocaulon* sp.	Slovakia	Peksa 801	FM945392	-	*
1	*Stereocaulon evolutoides* (H. Magn.) Frey	USA, MA	UTEX 895	AF345382	AM906024	
1	*Cladonia coniocraea* (Flörke) Spreng.	Nepal	IH15	**will be added**	-	
1	*Stereocaulon vesuvianum* Pers.	USA, Alaska	Talbot 281	DQ229885	DQ229888	
2	*Stereocaulon botryosum* Ach.	USA, Alaska	Talbot 153	DQ229880	DQ229889	
2	*Stereocaulon pileatum* Ach.	Czech Republic	Peksa 999	AM905999	AM906028	
2	*Stereocaulon subcoralloides* (Nyl.) Nyl.	USA, Alaska	Talbot 167	DQ229881	DQ229890	*
2	*Stereocaulon* sp.	Iceland	UTEX 2236	AF345411	AM906027	*
3	*Pilophorus aciculare* (Ach.) Th. Fr.	USA, WA	CAUP H1004	AM906012	AM906041	
4	*Cladonia cristatella* Tuck.	USA, MA	CAUP H1005	AF345440	AM906018	
I1	*Cladonia rangiferina* (L.) Weber ex F.H. Wigg.	India	I6	**will be added**	-	
I1	*Cladonia furcata* (Huds.) Schrad.	India	IH27	**will be added**	-	*
I1	*Cladonia pyxidata* (L.) Hoffm.	India	IH29	**will be added**	-	
I1	*Cladonia furcata* (Huds.) Schrad.	India	IH30	**will be added**	-	*
I1	*Cladonia corymbescens* Nyl. ex Leight	India	IH31	**will be added**	-	*
I1	*Cladonia corymbescens* Nyl. ex Leight	India	IH31a	**will be added**	-	*
I2	*Cladonia furcata* (Huds.) Schrad.	India	I4	**will be added**	-	
I2	*Cladonia furcata* (Huds.) Schrad.	India	IH23	**will be added**	-	*
I2	*Cladonia furcata* (Huds.) Schrad.	India	IH26	**will be added**	-	
5	*Stereocaulon dactylophyllum* Flörke	USA, VT	UTEX 1714	AM905993	AM906019	
6	*Lepraria caesioalba* (de Lesd.) J.R.Laundon	Czech Republic	Peksa 173	AM906003	AM906032	
6	*Lepraria neglecta* (Nyl.) Lettau	Czech Republic	Peksa 183	AM906002	AM906031	*
6	*Lepraria neglecta* (Nyl.) Lettau	Czech Republic	Peksa 207	AM906005	AM906034	*
A9	*Lepraria alpina* (de Lesd.) Tretiach & Baruffo	Spain	Peksa 860	FN556035	FN556048	
7	*Lepraria rigidula* (de Lesd.) Tønsberg	Czech Republic	Peksa 236	AM905997	AM906023	
7	*Lepraria rigidula* (de Lesd.) Tønsberg	Czech Republic	Peksa 900	FM955669	FM955673	
7	*Lepraria borealis* Lohtander & Tønsberg	USA, CA	Peksa 869	FN556039	FN556049	
7	*Lepraria caesioalba* (de Lesd.) J.R.Laundon	USA, CA	Peksa 873	FN556042	FN556051	
7	*Lepraria* sp.	USA, CA	Peksa 870	FN556043	FN556052	
7	*Lepraria caesioalba* (de Lesd.) J.R.Laundon	USA, CA	Peksa 872	FN556041	FN556050	*
9	*Cladonia evansii* Abbayes	USA, FL	RY798	AY712691	-	
9	*Cladonia subtenuis* (Abbayes) Mattick	USA, FL	RY999	AY712698	-	
9	*Cladonia subtenuis* (Abbayes) Mattick	USA, FL	RY941	AY712690	-	
9	*Cladonia scabriuscula* (Delise) Nyl.	India	IH20	**will be added**	-	
9	*Cladonia coniocraea* (Flörke) Spreng.	Nepal	IH14	**will be added**	-	
9	*Cladonia delavayi* Abbayes	India	IH21A	**will be added**	-	*
9	*Cladia aggregata* (Sw.) Nyl.	Costa Rica	Nelsen 2138	EU008658	-	
9	*Cladonia verticillata* (Hoffm.) Schaer.	India	IH8B	**will be added**	-	
9	*Cladonia delavayi* Abbayes	India	IH21B	**will be added**	-	
9	*Cladonia scabriuscula* (Delise) Nyl.	India	IH2	**will be added**	-	
9	*Cladonia spinea* Ahti	Guyana	MN-069	AF345418	-	*
9	*Cladonia variegata* Ahti	Guyana	MN-075	AF345419	-	*
9	*Cladonia subtenuis* (Abbayes) Mattick	USA, PA	RY1225	DQ482676	-	
9	*Cladonia verticillata* (Hoffm.) Schaer.	India	IH8A	**will be added**	-	
9	*Cladonia crinita*	Brazil	-	AY842277	-	

9	*Cladonia fruticulosa* Kremp.	India	IH22	**will be added**	-	
9	*Cladonia fruticulosa* Kremp.	India	IH32	**will be added**	-	*
9	*Cladonia fruticulosa* Kremp.	India	IH32b	**will be added**	-	*
9	*Cladonia praetermissa* A.W. Archer	India	IH1	**will be added**	-	
9	*Cladonia cariosa* (Ach.) Spreng.	India	IH28	**will be added**	-	
9	*Cladonia peltastica* (Nyl.) Muell. Arg.	Guyana	MN-070	AF345416	-	
9	*Stereocaulon* sp.	Costa Rica	Nelsen 2181b	DQ229884	DQ229896	
9	*Pilophorus* cf. *cereolus* (Ach.) Th. Fr.	Costa Rica	Nelsen 2233f	DQ229883	DQ229895	
9	*Lepraria* sp.	Costa Rica	Nelsen L54	EU008684	EU008711	
8	*Cladonia rei* Schaer.	Slovakia	Peksa 787	FM945380	FM955675	
8	*Cladonia fimbriata* (L.) Fr	Slovakia	Peksa 796	FM945358	FM955674	
10	*Stereocaulon saxatile* H.Magn.	USA, Alaska	Talbot KIS 187	DQ229886	DQ229897	
10	*Cladonia foliacea* (Huds.) Willd.	Czech Republic	Peksa 1008	AM906016	AM906049	
10	*Lepraria borealis* Lohtander & Tønsberg	Bulgaria	Bayerová 3402	AM906015	AM906048	
10	*Lepraria borealis* Lohtander & Tønsberg	Bulgaria	Bayerová 3401	AM900492	AM906045	
10	*Lepraria crassissima* (Hue) Lettau	Czech Republic	Peksa 888	FN556033	-	
10	*Lepraria yunnaniana*Diederich, Sérus. & Aptroot	Costa Rica	Nelsen 3637b	EU008681	EU008710	
11	*Lepraria caesioalba* (de Lesd.) J.R.Laundon	Romania	Peksa 225	AM905996	AM906022	
11	*Lepraria caesioalba* (de Lesd.) J.R.Laundon	Slovakia	Peksa 234	AM905994	AM906020	
11	*Lepraria lobificans* Nyl.	USA, WI	Nelsen L12	EU008675	EU008704	
11	*Lepraria caesioalba* (de Lesd.) J.R.Laundon	Slovakia	Peksa 235	AM905995	AM906021	
11	*Lepraria lobificans* Nyl.	USA, WI	Nelsen 154	DQ229877	DQ229898	
11	*Lepraria lobificans* Nyl.	USA, WI	Nelsen 153	EU008678	EU008707	
11	*Lepraria caesioalba* (de Lesd.) J.R.Laundon	USA, PA	Nelsen L36	EU008664	EU008697	
-	*Lepraria* sp.	China	Nelsen L60	EU008690	EU008715	
12	*Cladonia rei* Schaer.	Czech Republic	Peksa 921	FM945378	FM955677	
12	*Cladonia pocillum* (Ach.) Grognot	Canada	Normore4719	DQ530209	DQ530190	*
12	*Cladonia fimbriata* (L.) Fr	Slovakia	Peksa 815	FM945359	FM955676	
12	*Cladonia pyxidata* (L.) Hoffm.	India	IH16	**will be added**	-	
12	*Stereocaulon paschale* (L.) Hoffm.	USA, AK	Talbot 101	DQ229887	DQ229891	
13	*Xanthoria parietina* (L.) Th. Fr.“	Italy	CCAP 519/5	AM906001	AM906030	
13	*Cladonia* sp.	The Netherlands	CAUP H1003	AF345423	DQ229894	
A4	*Lepraria caesioalba* (de Lesd.) J.R.Laundon	Czech Republic	Peksa 526	FN556030	-	
A4	*Lepraria rigidula* (de Lesd.) Tønsberg	Czech Republic	Peksa 955	FN556032	-	*
A4	*Lepraria rigidula* (de Lesd.) Tønsberg	Czech Republic	Peksa 855	FN556031	FN556047	
14	*Lepraria caesioalba* (de Lesd.) J.R.Laundon	Czech Republic	Peksa 551	FM955667	FM955671	
14	*Lepraria caesioalba* (de Lesd.) J.R.Laundon	Czech Republic	Peksa 185	FM955666	FM955670	*
14	*Lepraria rigidula* (de Lesd.) Tønsberg	Czech Republic	Peksa 186	AM905992	AM906017	
-	*Stereocaulon tomentosum* Fr.	USA, AK	Talbot 400	DQ229882	DQ229893	
15	*Anzina carneonivea* (Anzi) Scheid.	Italy	SAG 26.81	AM900490	AM906042	
15	*Lepraria neglecta* (Nyl.) Lettau	Ukraine	Bayerová 3600	AM906013	AM906044	*
15	*Lepraria neglecta* (Nyl.) Lettau	Ukraine	Bayerová 3606	AM900941	AM906043	*
16	*Cladonia fruticulosa* Kremp.	India	IH17	**will be added**	-	
16	*Cladonia* cf. *bacillaris* (Ach.) Nyl.	USA, PA	Nelsen 3950	DQ229878	DQ229892	
16	*Lepraria alpina* (de Lesd.) Tretiach & Baruffo	Czech Republic	Peksa 192	AM906010	AM906039	
16	*Lepraria caesioalba* (de Lesd.) J.R.Laundon	Czech Republic	Peksa 194	AM906009	AM906038	
16	*Lepraria caesioalba* (de Lesd.) J.R.Laundon	Czech Republic	Peksa 233	AM906006	AM906035	
16	*Lepraria caesioalba* (de Lesd.) J.R.Laundon	Czech Republic	Peksa 166	AM906008	AM906037	