

**Table S1.** Samples information. Those in *italics* were newly sequenced for this study.

Taxon	ID	Voucher	Locality	Collector(s)	<i>ITS2</i>	<i>rps4</i>	<i>trnG</i>	<i>trnL-F</i>
<i>Atlantichella calvescens</i> (Carrington) F.Lara, Garilleti & Draper	ID199	MAUAM 4182	Spain, Canary Islands	F. Lara	MW264111	MW401337	MW401424	MW401501
<i>Atlantichella calvescens</i> (Carrington) F.Lara, Garilleti & Draper	ID400	MAUAM 4442	Spain, Asturias	B. Estébanez	MW264114	MW401340	MW401427	MW401504
<i>Australoria chilensis</i> (Calabrese & F. Lara) F.Lara, Garilleti & Draper	FL013	MAUAM 3767	Argentina, Neuquén	F. Lara & R. Garilleti	<i>OP508358</i>	<i>OP487613</i>	<i>OP487640</i>	<i>OP487660</i>
<i>Codonoblepharon forsteri</i> (Dicks.) Goffinet	ID384	MAUAM 1950	Spain, Álava	B. Albertos et al.	MW264075	MW401280	MW401362	MW401442
<i>Codonoblepharon forsteri</i> (Dicks.) Goffinet	ID397	MAUAM 4956	Spain, Málaga	F. Lara	MN529593	MN596378	MN542450	MN542426
<i>Codonoblepharon forsteri</i> (Dicks.) Goffinet	PAR011	MAUAM 3774	Spain, Málaga	G. Terroba & J. Terroba	-	<i>OP487614</i>	<i>OP487641</i>	<i>OP487661</i>
<i>Codonoblepharon forsteri</i> (Dicks.) Goffinet	PAR018	MAUAM 3778	Spain, Málaga	G. Terroba	<i>OP508359</i>	<i>OP487615</i>	<i>OP487642</i>	<i>OP487662</i>
<i>Codonoblepharon forsteri</i> (Dicks.) Goffinet	PAR020	MAUAM 3780	Spain, Málaga	G. Terroba	<i>OP508360</i>	<i>OP487616</i>	<i>OP487643</i>	<i>OP487663</i>
<i>Codonoblepharon forsteri</i> (Dicks.) Goffinet	PAR023	MAUAM 3782	France, Hérault	V. Hugonnot	<i>OP508361</i>	<i>OP487617</i>	<i>OP487644</i>	<i>OP487664</i>
<i>Codonoblepharon forsteri</i> (Dicks.) Goffinet	PAR024	MAUAM 3783	France, Cantal	V. Hugonnot	<i>OP508362</i>	<i>OP487618</i>	<i>OP487645</i>	<i>OP487665</i>
<i>Codonoblepharon forsteri</i> (Dicks.) Goffinet	PAR025	MAUAM 3784	France, Corse	V. Hugonnot	-	<i>OP487619</i>	<i>OP487646</i>	<i>OP487666</i>
<i>Codonoblepharon menziesii</i> Schwägr.	PAR026	CAS 34885	USA, California	J.R. Shevock	-	<i>OP487623</i>	-	<i>OP487670</i>
<i>Codonoblepharon menziesii</i> Schwägr.	PAR027	CAS 33741	USA, California	J.R. Shevock	-	<i>OP487624</i>	-	<i>OP487671</i>
<i>Codonoblepharon menziesii</i> Schwägr.	PAR028	CAS 33550	Australia, Southern Forest Region	J.R. Shevock & W.R. Buck	-	<i>OP487625</i>	-	<i>OP487672</i>
<i>Codonoblepharon menziesii</i> Schwägr.	PAR002b	MAUAM 3395	Australia, Macquarie Island	L. Pertierra	<i>OP508363</i>	<i>OP487620</i>	-	<i>OP487667</i>

<i>Codonoblepharon menziesii</i> Schwägr.	PAR003b	MAUAM 2975	New Zealand, North Island	F. Lara & E. San Miguel	-	OP487621	-	OP487668
<i>Codonoblepharon menziesii</i> Schwägr.	PAR005	MAUAM 3765	New Zealand, South Island	F. Lara & R. Garilleti	OP508364	OP487622	-	OP487669
<i>Codonoblepharon menziesii</i> Schwägr.	1603	BG 18773		Shevock	-	MW401281	MW401363	MW401443
<i>Codonoblepharon menziesii</i> var. <i>angustifolium</i> (Malta) Matcham & O'Shea	PAR037b	MAUAM 3828	New Zealand, North Island	F. Lara & R. Garilleti	OP508365	OP487626	OP487647	OP487673
<i>Codonoblepharon minutum</i> (Müll.Hal. & Hampe) Matcham & O'Shea	PAR009	MAUAM 3772	New Zealand, South Island	F. Lara & R. Garilleti	-	OP487627	-	OP487674
<i>Codonoblepharon minutum</i> (Müll.Hal. & Hampe) Matcham & O'Shea	PAR012	MAUAM 3775	New Zealand, South Island	F. Lara & R. Garilleti	OP508366	OP487628	OP487648	OP487675
<i>Codonoblepharon pungens</i> (Müll.Hal.) A.Jaeger	LaFarge-England 8097	Herb. Goffinet LaFarge-England 8097		LaFarge-England	-	AY618383	-	AY636005
<i>Leratia obtusifolia</i> (Hook.) Goffinet	798	Allen 12284		Allen	MW264076	MW401282	MW401364	MW401444
<i>Lewinskya acuminata</i> (H.Philib.) F.Lara, Garilleti & Goffinet	BV010	MAUAM 3272	Spain, Ávila	F. Lara	KT862263	KT862293	MN542451	KT862322
<i>Lewinskya incana</i> (Müll.Hal.) F.Lara, Garilleti & Goffinet	BV079	MAUAM 4576	Chile, Capitan Prat	J. Larraín	MN529598	MN177272	MN542455	MN542430
<i>Lewinskya praemorsa</i> (Venturi) F.Lara, Garilleti & Goffinet	BV060	MAUAM 4570	USA, Nevada	J.R.Shevock	MW264088	MN177265	MW401377	MW401456
<i>Lewinskya shawii</i> (Wilson) F.Lara, Garilleti & Goffinet	BV068	MAUAM 4587	Greece, Ipiros	F. Lara et al.	MW264093	MN177270	MW401379	MW401461
<i>Lewinskya arborescens</i> (Thér. & Naveau) F.Lara, Garilleti & Goffinet	BV070	MAUAM 4590	Tanzania, Kilimanjaro	F. Lara et al.	MN529595	MN177279	MN542452	MN542427
<i>Macrocoma lycopodioides</i> (Schwägr.) Vitt	BV024	MAUAM 2953	South Africa, Western Cape	F. Lara & E. San Miguel	KT804254	KT862288	KT804294	KT804333
<i>Nyholmiella gymnostoma</i> (Bruch ex Brid.) Holmen & E. Warncke	1219	NY 4809	Canada, Newfoundland and Labrador	Zander	-	MW401299	MW401387	MW401469
<i>Nyholmiella obtusifolia</i> (Brid.) Holmen & E. Warncke	O118	MAUAM 4343	Spain, Burgos	F. Lara	MN529599	JQ836797	JQ836901	JQ836986

<i>Orthotrichum anomalum</i> Hedw.	O120	MAUAM 4330	Spain, Asturias	B. Estébanez	MH275453	JQ836799	JQ836903	JQ836988
<i>Orthotrichum callistomum</i> Fisch.-Oost. ex Bruch & Schimp.	FL002	MAUAM 3403	Nepal, Sagarmatha National Park	F. Lara & I. Draper	MT902367	MW401300	MW401389	MW401470
<i>Orthotrichum casasianum</i> F.Lara, Garilleti & Mazimpaka	R398	MAUAM 1702	Spain, Álava	B. Albertos et al.	MN529600	JQ836811	JQ836915	JQ837000
<i>Orthotrichum confusum</i> R. Medina, F.Lara & Garilleti	R680	MAUAM 4323	USA, California	F. Lara et al.	MH275463	JQ836878	JQ836978	JQ837067
<i>Orthotrichum persimile</i> F.Lara, R.Medina & Garilleti	R580	UC-1650645	USA, California		MH275479	JQ836833	JQ836937	JQ837022
<i>Pentastichella chilensis</i> (Broth.) F.Lara, Garilleti & Draper	FL020	MAUAM 3787	Chile, Elqui	P. Drapela	OP508367	OP487629	OP487649	OP487676
<i>Pentastichella chilensis</i> (Broth.) F.Lara, Garilleti & Draper	FL021	JL 43034	Chile, Choapa	J. Larraín	OP508368	OP487630	OP487650	OP487677
<i>Pentastichella pentasticha</i> (Mont.) Müll.Hal. ex Thér.	FL022	MAUAM 3769	Chile, Aysén	F. Lara & R. Garilleti	OP508369	OP487631	OP487651	OP487678
<i>Pentastichella pentasticha</i> (Mont.) Müll.Hal. ex Thér.	ID207/BV038	MAUAM 2981	Argentina, Neuquén Villa La Angostura	F. Lara & E. San Miguel	KT862259	KT862289	KT804296	KT804335
<i>Plenogemma phyllantha</i> (Brid.) Sawicki, Plášek & Ochyra	ID331	MAUAM 5189	USA, Washington National Park	F. Lara, R. Garilleti & B. Albertos	KT804291	MW401330	KT804330	KT804370
<i>Plenogemma phyllantha</i> (Brid.) Sawicki, Plášek & Ochyra	ID387	MAUAM 2911	United Kingdom, England	F. Lara	MW264106	MW401332	MW401418	MW401497
<i>Pulviger a lyellii</i> (Hook. & Taylor) Plášek, Sawicki & Ochyra	BV018	MAUAM 4451	USA, California	F. Lara, V. Mazimpaka & B. Vigalondo	KT862282	KT862310	MN542458	KT862339
<i>Pulviger a papillosa</i> (Hampe) F.Lara, Draper & Garilleti	ID409	MAUAM 3477	Canada, British Columbia	F. Lara & R. Garilleti	MN529620	MN596395	MN542474	MN542446
<i>Sehnemobryum paraguense</i> (Besch.) Lewinsky & Hedenäs	1516	ALTA 21087	Brazil	Vitt	MW264109	AY618382	MW401421	AY636013
<i>Stoneobryum bunyaense</i> D.H. Norris & H.Rob.		US 00070599	Australia, Kiangaro Mt.		-	QBX99061	QBX99061	QBX99061
<i>Stoneobryum mirum</i> (Lewinsky) D.H.Norris & H. Rob.	1506	DUKE 156	South Africa, Eastern Cape	Vanderpoorten	MW264110	AY618381	MW401422	AY636012

<i>Ulota coarctata</i> (P.Beauv.) Hammar	ID360	MAUAM 4438	Spain, Cantabria	F. Lara et al.	KT804260	MN596397	KT804299	KT804338
<i>Ulota crispula</i> Bruch	ID355	MAUAM 4814	Ireland, Wicklow	B. Estébanez	KT804275	MN596398	KT804314	KT804353
<i>Ulota drummondii</i> (Hook. & Grev.) Brid.	ID356	MAUAM 5188	Japan, Hokkaido	R. Garilleti & F. Lara	KT804280	MW401344	KT804319	KT804359
<i>Ulota macrodontia</i> Dusén ex Malta	RG025	RG2016-236a	Chile, Aysén	R. Garilleti & F. Lara	MW264120	MW401348	MW401433	MW401510
<i>Ulota streptodon</i> Garilleti, Mazimpaka & F.Lara	RG022	RG2017-012e	Chile, Aysén	R. Garilleti & F. Lara	MW264124	MW401357	MW401437	MW401514
<i>Zygodon campylophyllus</i> Müll.Hal.	1128	DUKE 23100		Steere	MW264125	MW401358	-	MW401515
<i>Zygodon catarinói</i> C.A.Garcia, F.Lara, Sérgio & Sim-Sim	PAR015	MAUAM 3385	Spain, Ciudad Real	F. Lara	OP508370	OP487632	OP487652	OP487679
<i>Zygodon dentatus</i> (Limpr.) Breidl. ex Gams	Zy1402	Kucera 17011	Czech Republic, Debrník		MT921514	MT926369	-	MT926279
<i>Zygodon fragilifolius</i> Broth. ex Malta	FL018	MAUAM 3786	Tanzania, Mt. Kilimanjaro	F. Lara et al.	OP508371	OP487633	OP487653	OP487680
<i>Zygodon hookeri</i> var. <i>leptobolax</i> (Müll.Hal.) Calabrese	PAR007b	MAUAM 3771	New Zealand, South Island	F. Lara & R. Garilleti	OP508372	OP487634	OP487654	OP487681
<i>Zygodon intermedius</i> Bruch & Schimp.	PAR014	MAUAM 3777	New Zealand, South Island	F. Lara & R. Garilleti	-	OP487635	OP487655	OP487682
<i>Zygodon peruvianus</i> Sull.	1131	DUKE PV132		Griffin	MW264127	MW401360	MW401439	MW401517
<i>Zygodon rupestris</i> Schimp. ex Lorentz	PAR017	MAUAM 1893	Spain, Cádiz	F. Lara	OP508373	OP487636	OP487656	OP487683
<i>Zygodon seriatus</i> Thér. & Naveau	FL016	MAUAM 3785	Kenya, Mt. Kenya	J.A. Calleja et al.	OP508374	OP487637	OP487657	OP487684
<i>Zygodon sibiricus</i> Ignatov, Ignatova, Z.Iwats. & B.C.Tan	1183	MHA 1/82	Russia, Altai	Ignatov	-	MW401361	MW401440	MW401518
<i>Zygodon stirtonii</i> Schimp.	PAR022	MAUAM 4521	Spain, Cantabria	B. Estébanez	OP508375	OP487638	OP487658	OP487685
<i>Zygodon trichomitrius</i> Hook. & Wilson	PAR016	MAUAM 5000	Ethiopia, Kaffa	K. Hylander	OP508376	OP487639	OP487659	OP487686
<i>Zygodon viridissimus</i> (Dicks.) Brid.	ID208/BV0372	MAUAM 2910	United Kingdom, England	F. Lara	KT804258	KT862290	MW401441	KT862319