

DNA barcodes reveal unrecognized species diversity in *Peltigera* sect. *Peltigera* in Norway, including the new species *P. jonii*

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Phylogenetic analyses of 140 ITS sequences from Norwegian material of *Peltigera* sect. *Peltigera* obtained mainly by the Norwegian DNA barcode project OLICH indicate the presence of 26 putative species. Among those, we accept 18 taxonomic species, including the new species *Peltigera jonii* Timdal & Gjerlaug (also reported from a soil sample from Alaska), four species new to Fennoscandia (*P. “fuscoponjensis”*, *P. islandica*, *P. “neorufescens”* 3, and *P. “neorufescens”* 5), and an unnamed species closely resembling *P. lepidophora*. *Peltigera monticola* is here included in a highly variable *P. ponjensis*. We also report new localities for the rarely identified species *P. “neocanina”* and *P. wulingensis*.

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Introduction

The Norwegian species of the lichen genus *Peltigera* Willd., with the exception of the *P. canina* group, were revised by Holtan-Hartwig (1993). In a molecular phylogenetic analysis, Miadlikowska & Lutzoni (2000) showed that the *P. canina* group in Holtan-Hartwig’s morphological/chemical circumscription was monophyletic and gave it taxonomic recognition as *Peltigera* section *Peltigera*. The sister group of the section was shown to be sect. *Retifoveatae* Miadl. & Lutzoni. A revised species level taxonomy of the section and informal species groups were proposed by Miadlikowska et al. (2003) and further elaborated by Magain et al. (2018) in global, multi-locus phylogenetic analyses. Magain et al. (2018) accepted 88 putative species in the section, including 50 new to science although without descriptions and valid names. Two of them have subsequently been described: *P. hydrophila* W.R. Buck, Miadl. & Magain (Miadlikowska et al. 2020; = *P. sp.* 14 in Magain et al. 2018) and *P. alkalicola* Kaasalainen (Kaasalainen et al. 2022; = *P. lepidophora* 2 [probably]). Han et al. (2018, 2019) added two more species to the section, *P. neodegenii* L.F. Han et al. and *P. shennongjiana* L.F. Han & S.Y. Guo.

In Norway, 12 species are currently recognized in sect. *Peltigera*: *P. canina* (L.) Willd., *P. degenii* Gyeln., *P. didactyla* (With.) J.R. Laundon, *P. extenuata* (Nyl. ex Vain.) Lojka, *P. kristinssonii* Vitik., *P. lepidophora* (Nyl. ex Vain.) Bitter, *P. membranacea* (Ach.) Nyl., *P. monticola* Vitik., *P. ponjensis* Gyeln., *P. praetextata* (Flörke ex Sommerf.) Zopf, *P. rufescens* (Weiss) Humb., and *P. wulingensis* L.F. Han & S.Y. Guo (Vitikainen 1994, 2007, Haugan & Timdal 2019, Westberg et al. 2021). In addition, Magain et al. (2018) and Marthinsen et al. (2019) reported *P. “neocanina”* from Norway, i.e., one of the undescribed putative species in Magain et al. (2018) originally introduced by Miadlikowska & Lutzoni (2000).

We have sequenced 129 specimens of sect. *Peltigera* from Norway (and three extra-Norwegian specimens) for the ITS marker, i.e., the DNA barcode marker for fungi, under the project OLICH (<https://nhm2.uio.no/lichens/barcode>). This project aims at providing DNA barcodes for a wide array of Norwegian lichens and is a part of the Norwegian Barcode of Life (NorBOL), see Marthinsen et al. (2019). Several of the putative species recognized by Magain et al. (2018) were identified in that material as new to Norway (and Fennoscandia) and are reported here. An additional, not previously recognized species is described as *P. jonii*.

Material and Methods

This study is based on 244 ITS sequences, i.e., 133 produced by us and 111 downloaded from GenBank (Table 1). Our sequences originate from Norway (129), Finland (1), Russia (1), and Slovakia (1); we also include one Norwegian *P. retifoveata* Vitik. (sect. *Retifoveatae*) for the outgroup. Among those, 25 sequences have been published previously, i.e., 24 within the series MK811654–MK812696 (Marthinsen et al. 2019) and MN413901 (Haugan & Timdal 2019). The sequences from GenBank comprise 11 (i.e., all) of sect. *Peltigera* from Norway, 99 representing all additional species hypotheses (putative species) in sect. *Peltigera* proposed by Magain et al. (2018) and in subsequent papers, and one of *P. sp.* 13 sensu Magain et al. (sect. *Retifoveatae*; a second species for the outgroup).

Nearly half of the OLICH material (63 specimens) was collected by us in the former Hedmark county in Southeast Norway in 2021–2022. The field work was initiated for clarifying the circumscriptions of *P. canina*, *P. monticola*, *P. ponojensis*, and *P. rufescens*.

All steps from DNA extractions and PCR amplification through sequencing and editing of the OLICH sequences were performed at the Canadian Centre for DNA Barcoding (<https://ccdb.ca>), using the primer pair ITS1F/ITS4 (Gardes & Bruns 1993, White et al. 1990) or, in a few cases, ITS5 (White et al. 1990)/ITS4. Additional sequence editing was performed by us in BioEdit ver. 7.2.5 (Hall 1999).

The sequences were iteratively aligned by SATé-II ver. 2.2.7 (Liu et al. 2012), using MAFFT ver. 6.717 (Katoh et al. 2005, Katoh & Toh 2008) as aligner, MUSCLE ver. 3.7 (Edgar 2004) as merger, FastTree ver. 2.1.4 (Price et al. 2010) as tree evaluator (i.e., under the maximum likelihood criterion), and with the default settings in the GUI except that the number of iterations after last improvement in the maximum likelihood score was set to 10. The alignment was inspected in BioEdit and trimmed at the ends (CATTAA...ATTTAA), but not further adjusted.

The phylogeny was reconstructed under the Bayesian inference (BI) by MrBayes 3.2.7a (Huelsenbeck & Ronquist 2001, Ronquist & Huelsenbeck 2003) and under the maximum likelihood criterion (ML) by RAxML 8.2.12 (Stamatakis 2014). MrBayes ran for 3.2 million generations (terminated at ASDSF=0.0093), every 1000th generation was sampled, the burnin was set to 25%, and the phylogenetic tree is the 50% majority rule consensus tree. RAxML was run under raxmlGUI ver. 2.0.10 (Edler et al. 2021), using the bundled software ModelTest ver. 0.1.7 (Darriba et al. 2020) which estimated the best substitution model to be GTRGAMMAIX. We ran 1000 rapid bootstrap replicates. The BI consensus tree and the ML best tree were edited in TreeGraph 2 (Stöver & Müller 2010). In the former tree, the branches were collapsed at posterior probability (PP) < 0.95, in the latter tree at bootstrap support (BS) < 70%. The bootstrap values were manually transferred to the BI consensus tree.

A dataset reduced to the Norwegian specimens (140) was aligned by SATé-II as described above and used for calculating a pairwise distance matrix in MEGA 11 (Tamura et al. 2021). The calculation was based on p-distances, pairwise deletion, and uniform rates. After the taxonomic

Table 1. Sequences used for the phylogenetic reconstruction, with current species identification, OLICH ID, GenBank ID, country/province, collection ID, and herbarium/accession number.

<i>Peltigera</i>	OLICH ID	GenBank ID (ITS)	Country (Province)	Collection ID	Herbarium, Accession ID
<i>alkalicola</i>		MZ385614	Tanzania	UK171254d, holotype	
<i>antarctica</i>		MH758273	Chile (Region XII)	Goffinet 10521-2	CONN
<i>aubertii</i>		MH758233	Chile (Region X)	Wheeler & Nelson 3191	CONC
<i>austroamericana/ fibrilloides 1</i>		MH758440	Colombia	Dumont et al. 4066	H
<i>austroamericana/ fibrilloides 2</i>		MH758462	Mexico	Herrera-Campos 13381	MEXU
<i>austroamericana/ fibrilloides 3</i>		MH758451	Colombia	Lücking 33628	UDBC
<i>austroamericana/ fibrilloides 4</i>		MH758453	Costa Rica	Miadlikowska et al. s. n.	DUKE
<i>austroamericana/ fibrilloides 5</i>		MH758438	Brazil	Miadlikowska et al. s. n.	CGMS 34505
<i>austroamericana/ fibrilloides 6</i>		MH758444	Peru	Bennett s. n.	WIS
<i>canina</i>	OLICH2610	MK811916	Norway (Sør-Trøndelag)	J.T. Klepsland JK14-L448	O L-200554
<i>canina</i>	OLICH4134	MK812107	Norway (Østfold)	K.A. Lye 34098	O L-206918
<i>canina</i>	OLICH4135	MK811752	Norway (Østfold)	K.A. Lye 34191	O L-206873
<i>canina</i>	OLICH6084	OQ843168	Norway (Oppland)	E. Timdal 16260	O L-201452
<i>canina</i>	OLICH7832	OQ843122	Norway (Telemark)	S. Rui & E. Timdal 18846	O L-228528
<i>canina</i>	OLICH7869	OQ843150	Norway (Hedmark)	H.C. Gjerlaug 7452	O L-229821
<i>canina</i>	OLICH8296	OQ843177	Norway (Hedmark)	H.C. Gjerlaug 7636	O L-229638
<i>canina</i>	OLICH8297	OQ843147	Norway (Hedmark)	H.C. Gjerlaug 7652	O L-229639
<i>canina</i>	OLICH8298	OQ843119	Norway (Hedmark)	H.C. Gjerlaug 7689	O L-229640
<i>canina</i>	OLICH8300	OQ843115	Norway (Hedmark)	H.C. Gjerlaug 7693	O L-229642
<i>canina</i>	OLICH8513	OQ843162	Norway (Hedmark)	H.C. Gjerlaug 7657	O L-229288
<i>canina</i>	OLICH8514	OQ843171	Norway (Hedmark)	H.C. Gjerlaug 7658	O L-229289
<i>canina</i>	OLICH8530	OQ843116	Norway (Hedmark)	H.C. Gjerlaug 7670	O L-229297
<i>canina</i>	OLICH8535	OQ843175	Norway (Hedmark)	H.C. Gjerlaug 7680	O L-229302
<i>canina</i>	OLICH8554	OQ843167	Norway (Sogn og Fjordane)	H.C. Gjerlaug 10004	O L-229313
<i>canina</i>	OLICH8559	OQ843101	Norway (Hedmark)	H.C. Gjerlaug 7484	O L-229260
<i>canina 1</i>		MH758474	The Netherlands	Aptroot 53752	ABL

<i>canina 2</i>		MH758482	USA (Missouri)	Buck 48584	NY 729928
<i>castanea</i>		MH758239	Russia (Khabarovsk Territory)	Miadlikowska et al. s. n.	DUKE
<i>cinnamomea</i>		MH758379	Canada (British Columbia)	Goward s. n.	UBC
<i>continentalis</i>		MH758236	China (Ningxia)	Niu Dongling 12-0087	Ningxia Univ.
<i>degenii</i>	OLICH1950	MK812238	Norway (Telemark)	E. Timdal 13516	O L-196276
<i>degenii</i>	OLICH2273	MK812333	Norway (Akershus)	S. Rui & E. Timdal WG1-0794	O L-196335
<i>degenii</i>	OLICH4259	MK812618	Norway (Buskerud)	S. Rui & E. Timdal 16017	O L-208031
<i>degenii</i>	OLICH7355	OQ843089	Norway (Oslo)	E. Timdal 16625	O L-225418
<i>degenii</i>	OLICH7958	OQ843157	Norway (Akershus)	S. Rui & E. Timdal 18803	O L-228398
<i>degenii 1</i>		MH758402	Norway	Magain s. n.	LG
<i>degenii 1</i>		MH758403	Norway	Magain s. n.	LG
<i>degenii 1</i>		MH758404	Norway	Magain s. n.	LG
<i>degenii 2a</i>		MH758412	Canada (Quebec)	Miadlikowska & Lutzoni s. n.	DUKE
<i>degenii 2b</i>		MH758408	Japan (Honshu)	Thor 11963	UPS 395916
<i>degenii 3a</i>		MH758419	Russia (Sakhalin)	Tchabanenko	SAKH 3083
<i>degenii 3b</i>		MH758416	Russia (Kurile Islands)	Abrahamczyk 15	H
<i>degenii 3c</i>		MH758418	Japan (Honshu)	Ohmura et al. s. n.	DUKE 0188055
<i>didactyla</i>	OLICH3877	MK811844	Norway (Telemark)	E. Timdal WG3-768	O L-208003
<i>didactyla</i>	OLICH6088	OQ843154	Norway (Oppland)	E. Timdal 16269	O L-201461
<i>didactyla 1</i>		MH758244	Norway	Magain s. n.	LG
<i>didactyla 2</i>		MH758243	China (Sichuan)	Wang LiSong 10-31861	KUN
<i>didactyla 3</i>		MH758242	Canada (British Columbia)	Goward s n	DUKE 0017197
<i>erioderma 1</i>		MH758380	Papua New Guinea	Serussiaux s. n.	LG
<i>erioderma 2</i>		MH758381	Papua New Guinea	Serussiaux 14107	LG
<i>evansiana</i>		MH758490	USA (North Carolina)	Miadlikowska et al. s. n.	DUKE
<i>extenuata</i>	OLICH1903	MK811873	Norway (Sør-Trøndelag)	E. Timdal WG1-0820	O L-196343
<i>extenuata</i>	OLICH1981	MK811908	Norway (Oslo)	E. Timdal WG1-0963	O L-200007
<i>extenuata</i>	OLICH1992	MK811654	Norway (Buskerud)	S. Rui & E. Timdal WG1-0981	O L-200018
<i>extenuata 1</i>		MH758247	Chile (Region XI)	Wheeler & Nelson 6297	CONC

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<i>extenuata 2</i>		MH758249	Ecuador (Galapagos)	Spielmann 10611	CDS 51978
<i>fimbriata</i>		FJ527272	Papua New Guinea	H Koponen 32996	
<i>friesiorum</i>		MH758322	Bolivia	Kukwa 8465	UGDA L-17699
<i>frigida</i>		MH758223	Chile (Region XII)	Shaw 18024	DUKE
" <i>fuscoponojensis</i> "	OLICH7837	OQ843151	Norway (Hedmark)	S. Rui & E. Timdal 18869	O L-228547
" <i>fuscoponojensis</i> "	OLICH7871	OQ843145	Norway (Hedmark)	H.C. Gjerlaug 7461	O L-229823
" <i>fuscoponojensis</i> "	OLICH7873	OQ843142	Norway (Hedmark)	H.C. Gjerlaug 7519	O L-229825
" <i>fuscoponojensis</i> "	OLICH7874	OQ843110	Norway (Hedmark)	H.C. Gjerlaug 7507	O L-229826
" <i>fuscoponojensis</i> "	OLICH7886	OQ843099	Norway (Hedmark)	H.C. Gjerlaug 7508	O L-229833
" <i>fuscoponojensis</i> "	OLICH8549	OQ843121	Norway (Østfold)	E. Timdal 19648	O L-229345
" <i>fuscoponojensis</i> "	OLICH8590	OQ843135	Norway (Hedmark)	H.C. Gjerlaug 7615	O L-229275
" <i>fuscoponojensis</i> "		LT852875	Estonia		
" <i>fuscopraetextata</i> "		MH758501	Argentina	Tibell 17537	UPS 40375
<i>granulosa</i>		MH758338	Papua New Guinea	Serussiaux 15150	LG
<i>hydrophila</i>		MH758218	Chile (Region XII)	B. Shaw 17848, holotype	DUKE 0401861
<i>isidiophora</i>		KJ095107	China	Guo & Han 2042152	
<i>islandica</i>	OLICH7889	OQ843152	Norway (Hedmark)	H.C. Gjerlaug 7349	O L-229836
<i>islandica</i>	OLICH8511	OQ843090	Norway (Hedmark)	H.C. Gjerlaug 7654	O L-229286
<i>islandica</i>	OLICH8545	OQ843086	Norway (Sogn og Fjordane)	H.C. Gjerlaug 10003	O L-229312
<i>islandica</i>		KJ413244	Iceland	SSM355 UI LA-32002 IINH	
<i>islandica</i>		KJ413245	Iceland	OSA332 UI LA-32000 IINH holotype	
<i>islandica</i>		LT852849	Estonia		
<i>jonii</i>	OLICH8301	OQ843172	Norway (Hedmark)	H.C. Gjerlaug 7694	O L-229643
<i>jonii</i>	OLICH8302	OQ843155	Norway (Hedmark)	H.C. Gjerlaug 7696	O L-229644
<i>jonii</i>	OLICH8515	OQ843096	Norway (Hedmark)	H.C. Gjerlaug 7659	O L-229290
<i>jonii</i>	OLICH8516	OQ843111	Norway (Hedmark)	H.C. Gjerlaug 7660	O L-229291
<i>jonii</i>	OLICH8533	OQ843073	Norway (Hedmark)	H.C. Gjerlaug 7674	O L-229300
<i>jonii</i>	OLICH8579	OQ843139	Norway (Hedmark)	H.C. Gjerlaug 7392	O L-229256

<i>jonii</i>	OLICH8592	OQ843166	Norway (Hedmark)	H.C. Gjerlaug 7619	O L-229277
<i>kristinssonii</i>	OLICH7603	OQ843097	Norway (Sør-Trøndelag)	E. Timdal 18772	O L-227873
<i>kristinssonii</i>	OLICH7951	OQ843104	Norway (Sør-Trøndelag)	E. Timdal 10661	O L-149348
<i>kristinssonii</i>	OLICH8586	OQ843085	Norway (Hedmark)	H.C. Gjerlaug 7594	O L-229271
<i>kristinssonii</i>		MH758224	Canada (British Columbia)	Goward 11-16	UBC
<i>laciniata 1</i>		MH758347	Ecuador	Yanez-Anabaca 2556	CDF
<i>laciniata 2</i>		MH758340	Bolivia	Kukwa 9562	UGDA L-17724
<i>lepidophora</i>	OLICH3835	MK812313	Norway (Telemark)	S. Rui & E. Timdal WG3-600	O L-200874
<i>lepidophora</i>	OLICH6083	OQ843076	Norway (Oppland)	E. Timdal 16259	O L-201451
<i>lepidophora</i>	OLICH732	MK812625	Norway (Sør-Trøndelag)	E. Timdal 13117	O L-184530
<i>lepidophora</i>	OLICH7528	OQ843159	Norway (Nordland)	E. Timdal 18664	O L-227765
<i>lepidophora 1</i>		MH758353	Iceland	Kristinsson 49244 LA-29491	AMNH
<i>lepidophora 2</i>		MH758352	USA (Alaska)	Miadlikowska s. n.	DUKE
<i>membranacea</i>	OLICH1836	MK811987	Norway (Sør-Trøndelag)	R. Haugan WG3-0095	O L-195991
<i>membranacea</i>	OLICH2472	MK812374	Norway (Buskerud)	S. Rui & E. Timdal WG1-0987	O L-200024
<i>membranacea</i>	OLICH7546	OQ843088	Norway (Nordland)	E. Timdal 18690	O L-227792
<i>membranacea</i>	OLICH7596	OQ843093	Norway (Nordland)	E. Timdal 18759	O L-227860
<i>membranacea</i>	OLICH7780	OQ843137	Norway (Akershus)	S. Rui & E. Timdal	O L-229838
<i>membranacea</i>	OLICH8227	OQ843173	Norway (Finnmark)	J.T. Klepsland JK19-130	O L-227399
<i>membranacea</i>	OLICH8519	OQ843153	Norway (Hedmark)	H.C. Gjerlaug 7667	O L-229294
<i>membranacea</i>	OLICH8555	OQ843072	Norway (Sogn og Fjordane)	H.C. Gjerlaug 10005	O L-229314
<i>membranacea</i>	OLICH8558	OQ843134	Norway (Hedmark)	H.C. Gjerlaug 7408	O L-229259
<i>membranacea 1</i>		MH758428	Norway	Magain s. n.	LG
<i>membranacea 2</i>		MH758430	Russia (Khabarovsk Territory)		
<i>montis-wilhelmii 1</i>		MH758382	Papua New Guinea	Serussiaux s. n.	LG
<i>montis-wilhelmii 2</i>		MH758383	Papua New Guinea	Serussiaux 13984	LG
" <i>neocanina</i> "	OLICH1878	MK812413	Norway (Buskerud)	R. Haugan & E. Timdal WG1-0128	O L-196062

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" <i>neocanina</i> "	OLICH8510	OQ843103	Norway (Hedmark)	H.C. Gjerlaug 7642	O L-229285
" <i>neocanina</i> "	OLICH8521	OQ843144	Norway (Hedmark)	H.C. Gjerlaug 7669	O L-229296
" <i>neocanina</i> "	OLICH8567	OQ843140	Norway (Hedmark)	H.C. Gjerlaug 7569	O L-229268
" <i>neocanina</i> "	OLICH8568	OQ843158	Norway (Hedmark)	H.C. Gjerlaug 7581	O L-229269
" <i>neocanina</i> " 1		MH758395	USA (New Mexico)	Hollinger 2460	DUKE
" <i>neocanina</i> " 2		MH758398	USA (Utah)	Truong 3995	DUKE
" <i>neocanina</i> " 3		MH758392	Russia (Khabarovsk Territory)	Miadlikowska s. n.	DUKE
" <i>neocanina</i> " 4		MH758389	Norway	Goward 02-1480	UBC
" <i>neocanina</i> " aff.		LT852912	Estonia		
" <i>neocanina</i> " aff.		LT852916	Estonia		
" <i>neocanina</i> " aff.		LT852920	Estonia		
<i>neodegenii</i>		MF085563	China (Shennongjia)	Guo & Han 21111 holotype	
" <i>neorufescens</i> " 1		MH758362	Mexico	Barcenas-Pena 1229	MEXU
" <i>neorufescens</i> " 2		MH758363	Peru	Bennett s. n.	WIS
" <i>neorufescens</i> " 3	OLICH7854	OQ843133	Norway (Oppland)	E. Timdal 18856	O L-228536
" <i>neorufescens</i> " 3	OLICH8226	OQ843080	Norway (Finnmark)	E. Timdal 9735	O L-123259
" <i>neorufescens</i> " 3		MH758361	Germany	Sipman 53601	B 600127393
" <i>neorufescens</i> " 4		MH758359	Canada (Alberta)	Miadlikowska et al. s. n.	DUKE
" <i>neorufescens</i> " 5	OLICH8512	OQ843179	Norway (Hedmark)	H.C. Gjerlaug 7655	O L-229287
" <i>neorufescens</i> " 5	OLICH8587	OQ843113	Norway (Hedmark)	H.C. Gjerlaug 7604	O L-229272
" <i>neorufescens</i> " 5	OLICH8589	OQ843125	Norway (Hedmark)	H.C. Gjerlaug 7613	O L-229274
" <i>neorufescens</i> " 5		MH758358	Canada (Yukon)	Lendemer 28945	NY 0159332
" <i>neorufescens</i> " 6		MH758365	USA (Oregon)	Stone 8083 1	DUKE 0158517
<i>papuana</i>		MH758366	Papua New Guinea	E Serusiaux 13655	LG
<i>patagonica</i>		MH758226	Argentina	Tibell 17450	UPS 40293
<i>ponojensis</i>	OLICH5972	OQ843123	Slovakia	S. Rui & E. Timdal 16073	O L-204670
<i>ponojensis</i>	OLICH7604	OQ843127	Norway (Sør-Trøndelag)	E. Timdal 18773	O L-227874
<i>ponojensis</i>	OLICH7618	OQ843169	Russia (Dagestan Republic)	G. Urbanavichus	H-9219951
<i>ponojensis</i>	OLICH7872	OQ843138	Norway (Hedmark)	H.C. Gjerlaug 7543	O L-229824

<i>ponojensis</i>	OLICH7885	OQ843098	Norway (Hedmark)	H.C. Gjerlaug 7497	O L-229832
<i>ponojensis</i>	OLICH8214	OQ843149	Norway (Hedmark)	H.C. Gjerlaug 7624	O L-229279
<i>ponojensis</i>	OLICH8215	OQ843092	Norway (Hedmark)	H.C. Gjerlaug 7625	O L-229280
<i>ponojensis</i>	OLICH8221	OQ843082	Norway (Sør-Trøndelag)	A.J. Sørensen 3400i	O L-34449
<i>ponojensis</i>	OLICH8222	OQ843077	Norway (Oppland)	J. Holtan-Hartwig 4300	O L-34450
<i>ponojensis</i>	OLICH8223	OQ843114	Norway (Nordland)	J.E. Nordnes 770b	O L-34451
<i>ponojensis</i>	OLICH8224	OQ843095	Norway (Oslo)	R. Haugan 6700	O L-46317
<i>ponojensis</i>	OLICH8225	OQ843178	Norway (Oppland)	R. Haugan GJ00-1103	O L-89161
<i>ponojensis</i>	OLICH8228	OQ843107	Finland (Kainuu)	O. Vitikainen 16132	BG L-70838
<i>ponojensis</i>	OLICH8230	OQ843100	Norway (Finnmark)	T. Tønnsberg 7156	BG L-40953
<i>ponojensis</i>	OLICH8231	OQ843124	Norway (Finnmark)	T. Tønnsberg 7207	BG L-40958
<i>ponojensis</i>	OLICH8232	OQ843081	Norway (Hordaland)	S. Ekman 3358	BG L-65647
<i>ponojensis</i>	OLICH8544	OQ843083	Norway (Buskerud)	H.C. Gjerlaug 10002	O L-229311
<i>ponojensis</i>	OLICH8556	OQ843120	Norway (Hedmark)	H.C. Gjerlaug 7145	O L-229257
<i>ponojensis</i>	OLICH8557	OQ843130	Norway (Hedmark)	H.C. Gjerlaug 7399	O L-229258
<i>ponojensis</i>	OLICH8560	OQ843136	Norway (Hedmark)	H.C. Gjerlaug 7493	O L-229261
<i>ponojensis</i>	OLICH8561	OQ843117	Norway (Hedmark)	H.C. Gjerlaug 7496	O L-229262
<i>ponojensis</i>	OLICH8562	OQ843176	Norway (Hedmark)	H.C. Gjerlaug 7550	O L-229263
<i>ponojensis/monticola 1a</i>		MH758277	Canada (British Columbia)	Goward 7-187	UBC
<i>ponojensis/monticola 1b</i>		MH758284	USA (Utah)	Truong 4045	DUKE
<i>ponojensis/monticola 2</i>		MH758286	France	Magain s. n.	LG
<i>ponojensis/monticola 3</i>		FJ709039	Canada		
<i>ponojensis/monticola 4</i>		MH758288	USA (Kansas)	Buck 46381	NY 881403
<i>ponojensis/monticola 5a</i>		MH758293	India (Uttarakhand)	Divakar s. n.	MAF
<i>ponojensis/monticola 5b</i>		FJ709040	Canada		
<i>ponojensis/monticola 6</i>		MH758294	Norway	Magain s. n.	LG
<i>ponojensis/monticola 7</i>		MH758296	Norway	Ahti 65831	H
<i>ponojensis/monticola 8</i>		MH758305	Canada (British Columbia)	Goward 5300	UBC

<i>ponojensis/monticola</i> 9		MH758309	Switzerland	Vust s. n.	Vust Coll Pers
<i>ponojensis/monticola</i> 10a		MH758311	USA (California)	Arnold 73 YOSE221393	
<i>ponojensis/monticola</i> 10b		MH758312	USA (Utah)	Truong & N Magain s. n.	DUKE
<i>ponojensis</i> I		LT852981	Estonia		
<i>ponojensis</i> II		LT852991	Estonia		
<i>praetextata</i>	OLICH2044	MK811692	Norway (Buskerud)	S. Rui & E. Timdal 13212	O L-184752
<i>praetextata</i>	OLICH2209	MK811856	Norway (Oslo)	E. Timdal WG1-0464	O L-195837
<i>praetextata</i>	OLICH3880	MK812051	Norway (Akershus)	T. Starholm	O L-201769
<i>praetextata</i>	OLICH4194	MK812578	Norway (Østfold)	S. Rui & E. Timdal WG1-1807	O L-208022
<i>praetextata</i>	OLICH5945	OQ843084	Norway (Akershus)	E. Timdal 16030	O L-208036
<i>praetextata</i>	OLICH6504	OQ843161	Norway (Hordaland)	E. Timdal 16809	O L-225456
<i>praetextata</i>	OLICH7568	OQ843105	Norway (Nordland)	E. Timdal 18704	O L-227806
<i>praetextata</i>	OLICH7870	OQ843148	Norway (Hedmark)	H.C. Gjerlaug 7518	O L-229822
<i>praetextata</i>	OLICH8213	OQ843146	Norway (Hedmark)	H.C. Gjerlaug 7623	O L-229278
<i>praetextata</i>	OLICH8219	OQ843087	Norway (Hedmark)	H.C. Gjerlaug 7635	O L-229284
<i>praetextata</i>	OLICH8518	OQ843160	Norway (Hedmark)	H.C. Gjerlaug 7666	O L-229293
<i>praetextata</i>	OLICH8541	OQ843141	Norway (Hedmark)	H.C. Gjerlaug 7688	O L-229308
<i>praetextata</i>		MH758515	Norway	Magain s. n.	LG
<i>praetextata</i>		MH758516	Norway	Magain s. n.	LG
<i>praetextata</i>		MH758517	Norway	Magain s. n.	LG
<i>retifoveata</i>	OLICH2605	MK811996	Norway (Sør-Trøndelag)	J.T. Klepsland JK14-L424	O L-200533
<i>rufescens</i>	OLICH1888	MK812663	Norway (Oslo)	S. Rui & E. Timdal WG1-0155	O L-196072
<i>rufescens</i>	OLICH1901	MK811858	Norway (Sør-Trøndelag)	E. Timdal WG1-0818	O L-196341
<i>rufescens</i>	OLICH1963	MK812224	Norway (Akershus)	E. Timdal WG1-0938	O L-199989
<i>rufescens</i>	OLICH2733	MK812696	Norway (Oppland)	E. Timdal WG1-1727	O L-201347
<i>rufescens</i>	OLICH7888	OQ843164	Norway (Hedmark)	H.C. Gjerlaug 7513	O L-229835
<i>rufescens</i>	OLICH8216	OQ843078	Norway (Hedmark)	H.C. Gjerlaug 7628	O L-229281
<i>rufescens</i>	OLICH8218	OQ843109	Norway (Hedmark)	H.C. Gjerlaug 7632	O L-229283
<i>rufescens</i>	OLICH8229	OQ843112	Norway (Vest-Agder)	G. Larsen	BG L-6342

<i>rufescens</i>	OLICH8299	OQ843126	Norway (Hedmark)	H.C. Gjerlaug 7691	O L-229641
<i>rufescens</i>	OLICH8517	OQ843143	Norway (Hedmark)	H.C. Gjerlaug 7662	O L-229292
<i>rufescens</i>	OLICH8520	OQ843132	Norway (Hedmark)	H.C. Gjerlaug 7668	O L-229295
<i>rufescens</i>	OLICH8531	OQ843165	Norway (Hedmark)	H.C. Gjerlaug 7671	O L-229298
<i>rufescens</i>	OLICH8532	OQ843091	Norway (Hedmark)	H.C. Gjerlaug 7672	O L-229299
<i>rufescens</i>	OLICH8534	OQ843156	Norway (Hedmark)	H.C. Gjerlaug 7678	O L-229301
<i>rufescens</i>	OLICH8536	OQ843128	Norway (Hedmark)	H.C. Gjerlaug 7681	O L-229303
<i>rufescens</i>	OLICH8537	OQ843106	Norway (Hedmark)	H.C. Gjerlaug 7682	O L-229304
<i>rufescens</i>	OLICH8538	OQ843129	Norway (Hedmark)	H.C. Gjerlaug 7683	O L-229305
<i>rufescens</i>	OLICH8539	OQ843131	Norway (Hedmark)	H.C. Gjerlaug 7686	O L-229306
<i>rufescens</i>	OLICH8563	OQ843094	Norway (Hedmark)	H.C. Gjerlaug 7551	O L-229264
<i>rufescens</i>	OLICH8564	OQ843075	Norway (Hedmark)	H.C. Gjerlaug 7564	O L-229265
<i>rufescens</i>	OLICH8565	OQ843102	Norway (Hedmark)	H.C. Gjerlaug 7576	O L-229266
<i>rufescens</i>	OLICH8566	OQ843074	Norway (Hedmark)	H.C. Gjerlaug 7577	O L-229267
<i>rufescens</i>	OLICH8569	OQ843174	Norway (Hedmark)	H.C. Gjerlaug 7593	O L-229270
<i>rufescens</i>	OLICH8588	OQ843079	Norway (Hedmark)	H.C. Gjerlaug 7606	O L-229273
<i>rufescens</i> 1		MH758368	Denmark	Hansen s. n.	H
<i>rufescens</i> 2		MH758371	Costa Rica	Miadlikowska et al. s. n.	DUKE
<i>rufescentiformis</i>		MH758373	Kenya	Moberg 4324	UPS L-536552
<i>rufescentiformis</i>		MZ385661	Tanzania	UK171068c	
<i>rufescentiformis</i>		MZ385662	Tanzania	UK171165a	
<i>rufescentiformis</i>		MZ385663	Tanzania	UK171284a	
<i>rufescentiformis</i>		MZ385669	Tanzania	UK171391c	
<i>rufescentiformis</i>		MZ385673	Tanzania	UK171458p	
<i>rufescentiformis</i>		MZ385675	Tanzania	UK171562e	
<i>shennongjiana</i>		KT257169	China (Shennongjia)	Guo & Han 20830	
<i>soredians</i>		MH758345	Costa Rica	Miadlikowska et al. s. n.	DUKE
<i>sorediifera</i>		MH758255	Australia (New South Wales)	Streimann 50996	H
sp.	OLICH2355	OQ843163	Norway (Oppland)	J.T. Klepsland JK13-L582	O L-198351
sp. 13		MH758216	China (Yunnan)	Goffinet 9974	CONN

sp. 15		MH758375	Ecuador	Frisch 96/Eq101	H
sp. 16		MH758235	USA (Oregon)	McCune 31966	McCune pers. coll.
sp. 17		MH758315	Ecuador	Truong 3976	DUKE
sp. 18		MH758526	India (Uttarakhand)	P K Divakar s. n.	MAF
sp. 19		MH758530	USA (Oregon)	McCune 30122	McCune pers. coll.
sp. 20		FJ708907	Canada		
sp. 21		MH758525	USA (Arizona)	Miadlikowska et al. s. n.	DUKE
sp. 22		MH758498	Peru	Bennett s. n.	WIS
<i>spuriella</i>		MH758329	Peru		
<i>tereziana</i>		MH758437	New Zealand	Tibell 9563	UPS L-536309
<i>ulcerata</i> 1		MH758259	Chile (Region X)	Wheeler & Nelson 5444	CONC
<i>ulcerata</i> 2		MH758257	Australia (New South Wales)	Elix 35980 H	CBG 9616513
<i>vainioi</i>		MH758267	Colombia	Aguirre & Sipman 5570	B
<i>wulingensis</i>	OLICH5801	MN413901	Norway (Oppland)	R. Haugan 180103	O L-224378
<i>wulingensis</i>	OLICH7834	OQ843170	Norway (Oppland)	E. Timdal 18851	O L-228533
<i>wulingensis</i>	OLICH8421	OQ843108	Norway (Oppland)	R. Haugan 200230	O L-235688
<i>wulingensis</i>	OLICH8428	OQ843118	Norway (Oppland)	R. Haugan 200238	O L-235695
<i>wulingensis</i>		MH758378	Russia (Khabarovsk Territory)	Miadlikowska s. n.	DUKE

species were decided, the matrix was manually inspected for maximum intraspecific distances and minimum interspecific distances. The barcode gap is the latter minus the former, i.e., a species' genetic distance to the closest neighbour minus the variation within the species (see, e.g., Schoch et al. 2012).

For the chemical investigation, 44 specimens of *P. ponojensis* and the newly recognized species were subjected to thin-layer chromatography (TLC), performed in accordance with the methods of Culberson (1972) and Culberson et al. (1981), on aluminium plates in solvent system C. The length of the ascospores were measured in a compound microscope at 100× magnification and the measurements are given as $X \pm 1.5 \times SD$, where X is the arithmetic mean and SD is the sample standard deviation; the breadth varied little and is merely given as estimates.

Results

We generated 133 new ITS sequences (including the 25 already published by Marthinsen et al. 2019 and Haugan & Timdal 2019). The alignment was 974 base pairs long. The BI and ML trees were largely congruent, and the former tree is shown in Fig. 1 with the bootstrap values of the latter added. The tree is largely congruent with the multi-locus tree of Magain et al. (2018); a major incongruence

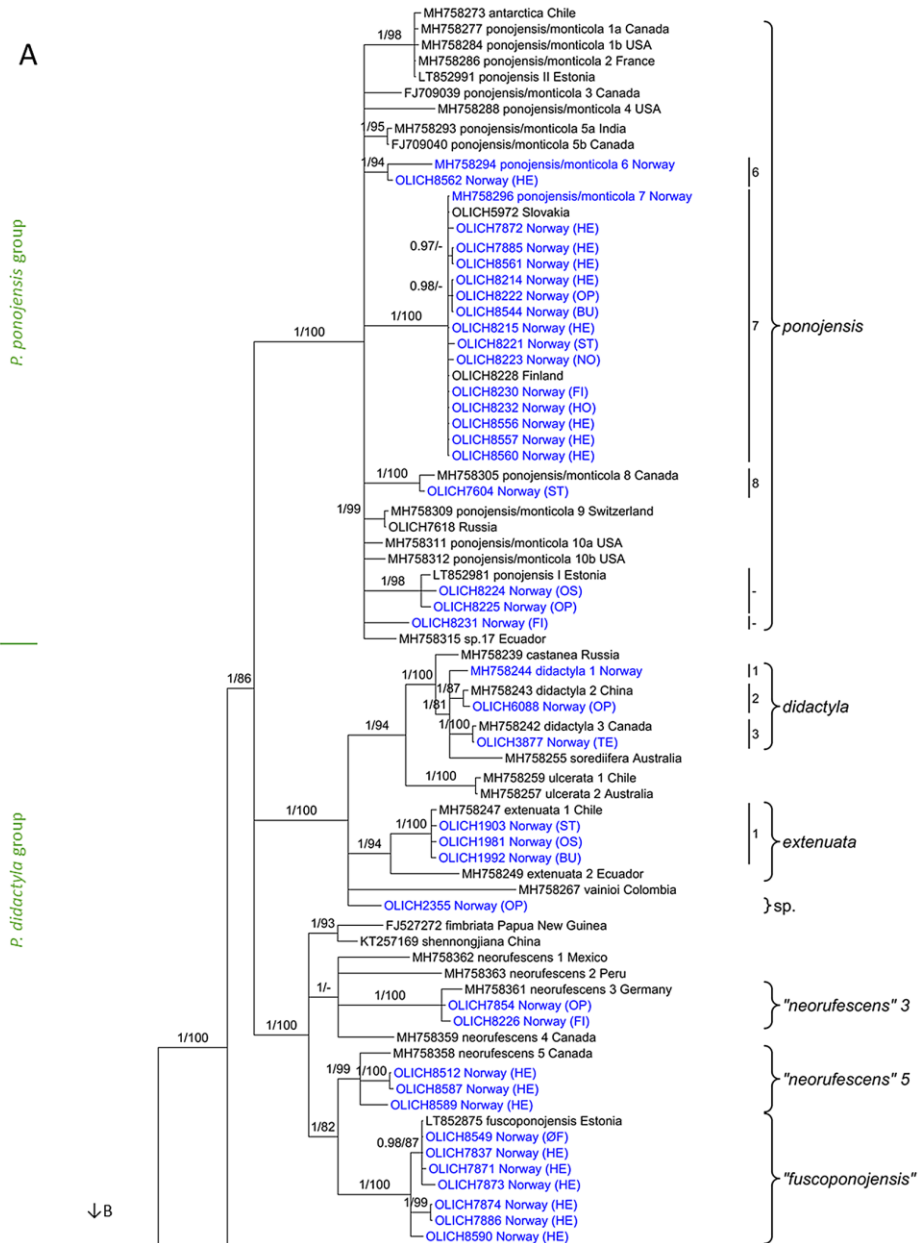


Figure 1 (over three pages). Bayesian 50% majority rule consensus tree, collapsed where PP < 0.95, of all known Norwegian ITS sequences of *Peltigera* sect. *Peltigera* (blue) with additional sequences representing all putative species in Magain et al. (2018) and in subsequent papers (black). Support values for the branches are given as PP/BS (for PP ≥ 0.95/BS ≥ 70%). Names for clades/singletons containing Norwegian taxonomic species are given at braces, and numbers for putative species follow Magain et al. (2018). Names and circumscription of species groups (green) follow Miadlikowska et al. (2003). **A.** The *P. didactyla* and *P. ponojensis* groups. **B.** The *P. degenii* and *P. rufescens* groups. **C.** The *P. canina*, *P. cinnamomea*, and *P. continentalis* groups.

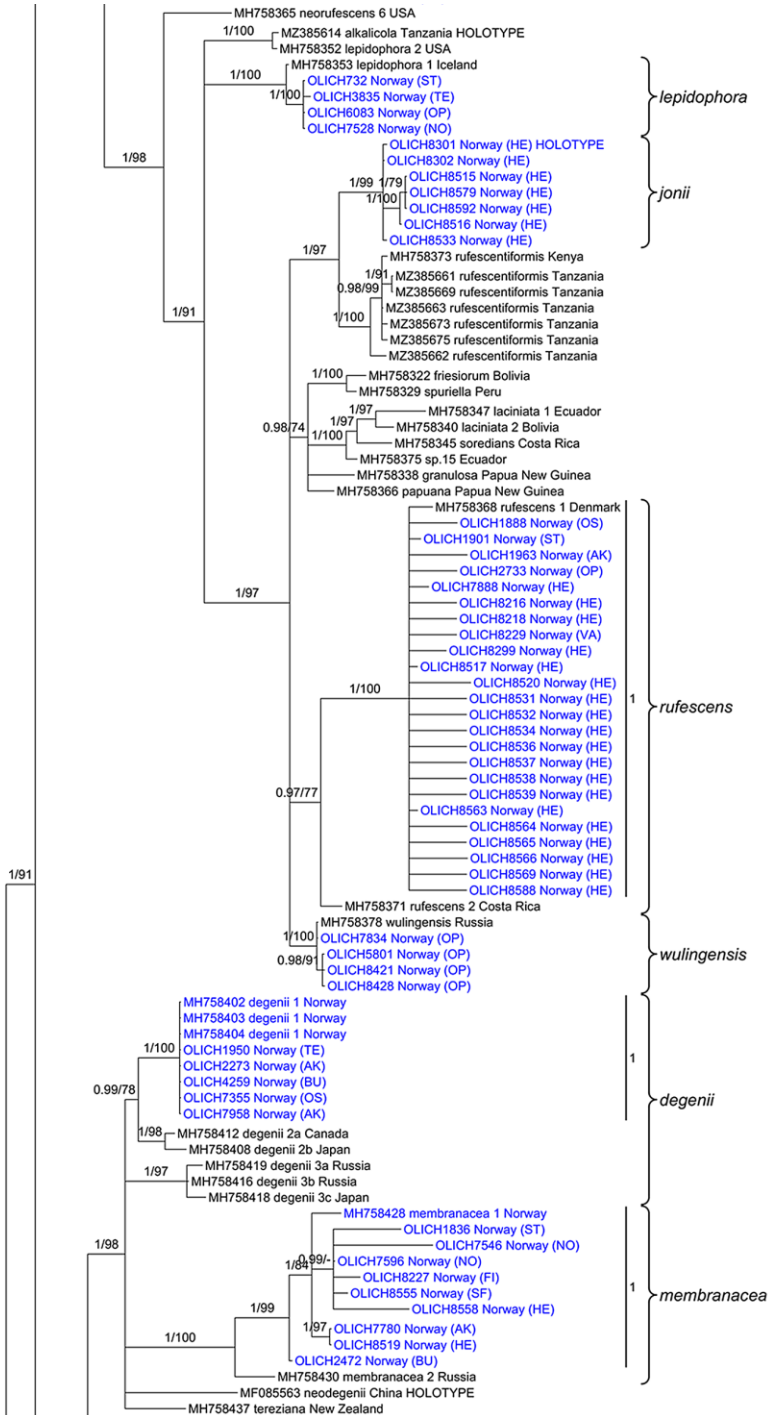
B

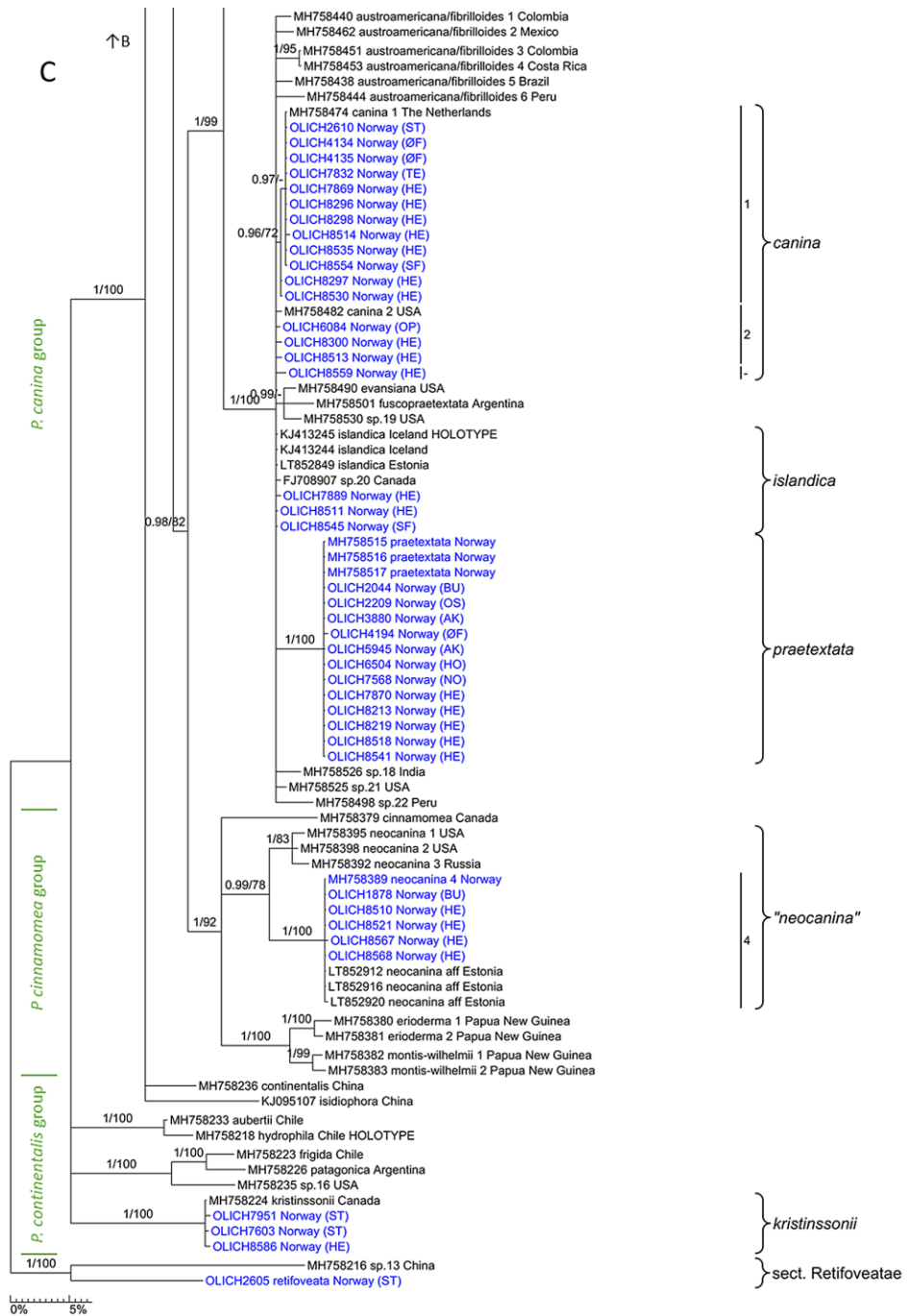
P. rufescens group

P. degenii group

↑A

↓C





being the position of the *P. "neorufescens"* clade which is here recovered in a trichotomy with the *P. didactyla* and *P. ponojensis* clades, but as sister to the *P. rufescens* clade in Magain et al. (2018).

Twenty clades/singletons containing Norwegian sequences match putative species in Magain et al. (2018), two additional clades match additional putative species in Jürriado et al. (2017; *P. "fuscoponojensis"* and *P. ponojensis* I), and four clades/singletons are new in our material (*P. jonii*, *P. sp.*, a singleton in *P. canina* s. lat., and a singleton in *P. ponojensis* s. lat.). From these 26 putative species, we recognize 18 taxonomic species, and their maximum intraspecific distances, minimum interspecific distances, and barcode gaps are shown in Table 2. No lichen substances were found in the TLC investigation.

Discussion

Based on the ITS marker, we recognize 26 putative species in the Norwegian material, 20 of them matching species hypotheses in the global, multi-locus analysis of Magain et al. (2018). Still we accept only 18 as taxonomic species. This lack of taxonomic recognition for eight putative species is partly due to clades having short branch lengths, small number of examined specimens, lack of known morphological or chemical distinguishing features, and/or uncertainties regarding the placement of species names. Hence, *P. canina* (three putative species), *P. didactyla* (three putative species), and *P. ponojensis* (five Norwegian putative species, 16 globally) are here accepted in a broad sense as single taxonomic species. *Peltigera ponojensis* 7 should perhaps have been accepted as a taxonomic species, based on the highly supported (PP=1, BS=100%), long-branched clade which contains 15 Norwegian specimens with short internal branches (the maximum internal distance is 0.5%). If accepted as a species, the remaining *P. ponojensis* s. lat. would be paraphyletic, however. Also, considering the uncertainty in the placement of *P. monticola* and *P. ponojensis* s. str., we prefer to accept *P. ponojensis* in a broad sense.

We hence report six taxonomic species as new to Norway (and Fennoscandia). Unfortunately, three of them have merely provisional names (*P. "fuscoponojensis"*, *P. "neorufescens"* 3, and *P. "neorufescens"* 5), and so has the previously reported *P. "neocanina"*. The three other species new to Norway are *P. islandica* Goward & Manoharan-Basil, the here described *P. jonii*, and an unnamed *P. sp.* Clearly, nomenclature is a major problem in sect. *Peltigera*, as few names in the published phylogenies are represented by sequenced type material. Vitikainen (1994) listed, e.g., the synonyms *P. plittii* Gyeln. (= *P. ponojensis*), *P. spongiosa* (Tuck.) M. Choisy (= *P. canina*), *P. subcanina* Gyeln. (= *P. praetextata*), *P. suomensis* Gyeln. (= *P. canina*), and *P. szatalae* Gyeln. (= *P. praetextata*), names that may be applicable to some of the unnamed putative species.

Most of the 18 Norwegian taxonomic species accepted here show a positive barcode gap, i.e., their genetic distance to the nearest neighbour exceeds their maximum intraspecific distance (Table 2). The exceptions are *P. canina*, *P. islandica*, *P. membranacea*, and *P. ponojensis*. Similar results, i.e., that the majority of the species in a genus are showing a positive barcode gap, have been demonstrated for, e.g., *Usnea* (Kelly et al. 2011), brown *Parmelia* s. lat. (Leavitt et al. 2014), *Parmelia* s. str. (Divakar et al. 2016), and *Ramalina* and *Umbilicaria* (Marthinsen et al. 2019). However, in other genera, many species do not show a positive barcode gap, e.g., *Cladonia* (Pino-Bodas et al. 2013, Marthinsen et al. 2019). In cases of negative barcode gaps, BLAST results must be treated carefully since a list sorted on similarity will include neighbouring species intermingled with the correct one. Although positive barcode gaps may support species hypotheses, we regard them more as indications of the usability of the barcode for species identification within a genus.

The species here reported as new to Norway are, in our opinion, difficult or impossible to recognize morphologically or chemically, i.e., close to being morphologically cryptic species. There

Table 2. Genetic distances within and between the Norwegian species of *Peltigera* sect. *Peltigera*, based on the Norwegian ITS sequences.

Species	Number of sequences	Maximum intraspecific distance (%)	Minimum distance to nearest neighbour (%)	Barcode gap (percentage points)	Nearest neighbour
<i>P. canina</i>	16	2.2	0.2	-2	<i>P. islandica</i>
<i>P. degenii</i>	8	0	4.8	4.8	<i>P. islandica</i>
<i>P. didactyla</i>	3	2.5	5.1	2.6	<i>P. sp.</i>
<i>P. extenuata</i>	3	0.3	4.8	4.5	<i>P. sp.</i>
<i>P. "fuscoponojensis"</i>	7	2.1	3.6	1.5	<i>P. "neorufescens" 5</i>
<i>P. islandica</i>	3	0.2	0.2	0	<i>P. canina</i>
<i>P. jonii</i>	7	0.9	4	3.1	<i>P. rufescens</i>
<i>P. kristinssonii</i>	3	0.4	9.6	9.2	<i>P. islandica</i>
<i>P. lepidophora</i>	4	1.5	6	4.5	<i>P. wulingensis</i>
<i>P. membranacea</i>	10	9.6	8.9	-0.7	<i>P. canina</i>
<i>P. "neocanina"</i>	6	0.2	6.8	6.6	<i>P. islandica</i>
<i>P. "neorufescens" 3</i>	2	0.2	6.1	5.9	<i>P. "fuscoponojensis"</i>
<i>P. "neorufescens" 5</i>	3	1.7	3.6	1.9	<i>P. "fuscoponojensis"</i>
<i>P. ponojensis</i>	21	7.1	6.5	-0.6	<i>P. rufescens</i>
<i>P. praetextata</i>	15	0.2	0.9	0.7	<i>P. islandica</i>
<i>P. rufescens</i>	24	1.2	2.7	1.5	<i>P. wulingensis</i>
<i>P. sp.</i>	1	n/a	4.8	4.8	<i>P. extenuata</i>
<i>P. wulingensis</i>	4	0.2	2.7	2.5	<i>P. rufescens</i>

are some trends, however, that may help in ruling out species during identification: E.g., narrow, downy, dark veins almost to the lobe ends are characteristic of *P. "fuscoponojensis"*, *P. jonii*, and *P. "neocanina"* (Fig 2A), whereas broad veins turning pale towards the lobe ends are characteristic of *P. islandica*, *P. "neorufescens" 3* and *5* (Fig. 2B). There are also trends in the colour of the thallus, shape of the lobes, direction of the lobe margin, and hairiness of the upper surface; details are given under the descriptions of the species. But in most cases, we would refrain from identification of the newly recognized species without a DNA sequence.

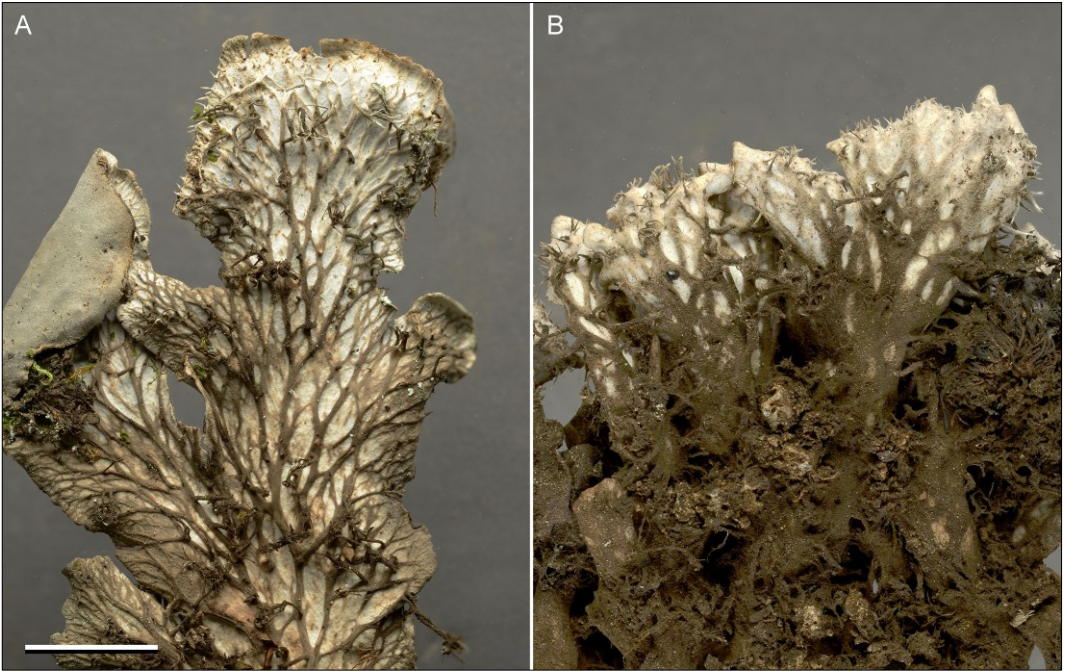


Figure 2. Lower side of lobes. **A.** *Peltigera* “*neocanina*”, OLICH8568 (O L-229269). **B.** *Peltigera* “*neorufescens*” 5, OLICH8587 (O L-229272). Scale bar = 10 mm.

The Species

1. *Peltigera canina* (L.) Willd.

Nomenclature and description: Vitikainen (2007).

Taxonomic notes: The Norwegian specimens are recovered within the two putative species *P. canina* 1 and 2 of Magain et al. (2018), except for one (OLICH8559) which may be regarded as a new putative species (Fig. 1C). Those of *P. canina* 1 (12 Norwegian specimens) form a well-supported (PP: 0.97, BS: 72%) clade, whereas those of *P. canina* 2 (3 Norwegian specimens) do not form a supported clade but are recognized as belonging to *P. canina* 2 by their sequence resemblance. In the Norwegian material, the shortest genetic distance between *P. canina* 1 and 2 is 0.6%, and the distances from OLICH8559 to *P. canina* 1 and 2 are 0.9% and 1.1%, respectively. The maximum distance within *P. canina* 1 is 0.4% and within *P. canina* 2 0.3%. Considering the short branch length of the *P. canina* 1 clade (Fig. 1), the lack of support for the *P. canina* 2 clade, and the small maximum genetic distances in the group as a whole (2.2%, Table 2), we prefer to regard *P. canina* as single taxonomic species. *Peltigera islandica* is the most similar species, with a genetic distance of 0.2% and a barcode gap of -2 percentage points (Table 2); see that species for taxonomic discussion.

Specimens examined: **Norway.** Hedmark: Eidskog, N of Klanderud, E of Nessjoen, 59.99°N, 12.25°E, alt. 170 m, over moser på berg ved vegen, 2021-06-10, H.C. Gjerlaug 7452 (O L-229821); Folldal, Einunndalen, v brua V f Fallsetra, 62.27°N, 10.17°E, alt. 890 m, på mosekledd stein ved elva, 2021-07-05, H.C. Gjerlaug 7484 (O

L-229260); Nord-Odal, Mo kirke, 60.43°N, 11.64°E, alt. 130 m, blant moser på stein ved brufundament, 2022-09-09, H.C. Gjerlaug 7689 (O L-229640); Nord-Odal, V f Juråa ca 1,7 km N f Skyrud, 60.51°N, 11.61°E, alt. 230 m, blant moser på betongtrapp på skogskoie, 2022-09-09, H.C. Gjerlaug 7693 (O L-229642); Rendalen, N f Andråstøa Ø f Storsjøen, 61.57°N, 11.23°E, alt. 270 m, over moser på berg ved veg, 2022-08-23, H.C. Gjerlaug 7680 (O L-229302); Stor-Elvdal, Myklebysetra, 61.35°N, 11.01°E, alt. 730 m, blant moser på sand på stein ved brukar, 2022-08-11, H.C. Gjerlaug 7657 (O L-229288); Stor-Elvdal, Kongeveien S f Hammaren, 61.56°N, 11.04°E, alt. 300 m, blant moser på steinblokk i rik skog, 2022-08-11, H.C. Gjerlaug 7658 (O L-229289); Stor-Elvdal, ca. 1 km N f Landet Ø f Glåma, 61.52°N, 11.06°E, alt. 270 m, over moser på bergvegg ved veg, 2022-08-12, H.C. Gjerlaug 7670 (O L-229297); Tolga, Orvdalen, ca. 1,5 km NV f Orvdalssetra, 62.19°N, 11.41°E, alt. 790 m, blant moser på berg i rik fjellbjørkeskog, 2022-07-27, H.C. Gjerlaug 7636 (O L-229638); Tolga, Hodalen, v Trangdal bru, 62.30°N, 11.34°E, alt. 750 m, på grus i vegkant, 2022-07-29, H.C. Gjerlaug 7652 (O L-229639); *Oppland*: Øystre Slidre, E end of lake Øvre Heimdalsvatn, Osbue, 61.4193°N, 8.8923°E, alt. 1100 m, on the ground in pasture, 2016-08-31, E. Timdal 16260 (O L-201452); *Sogn og Fjordane*: Aurland, Vassbygdevatnet, nordenden, 60.87°N, 7.21°E, alt. 60 m, på bakken i graskledd vegfylling, 2022-07-20, H.C. Gjerlaug 10004 (O L-229313); *Sør-Trøndelag*: Oppdal, Nordre Knutshø V (Drivdalen), 62.3300°N, 9.6278°E, alt. 1000 m, i tykt mosedecke på og mellom stein. Urterik bjørkeskog i vestvendt dalside., 2014-07-09, J.T. Klepsland JK14-L448 (O L-200554); *Telemark*: Vinje, Grungedal church, 59.7232°N, 7.6978°E, alt. 550 m, old stone wall surrounding churchyard, 2021-07-09, S. Rui & E. Timdal 18846 (O L-228528); *Østfold*: Indre Østfold, Hobøl, Bjerve, 100 m nord for gården, 59.6049°N, 10.9039°E, alt. 85 m, på eikestamme i skogen, 0,3 m over bakken, 2012-01-03, K.A. Lye 34098 (O L-206918); Indre Østfold, Hobøl, nedafor Granrud, ca. 250 m nord for brua ved Bakkneset, 59.5647°N, 10.8857°E, alt. 70 m, på berg i snauhagd granskog, 2012-02-23, K.A. Lye 34191 (O L-206873).

2. *Peltigera degenii* Gyeln.

Nomenclature and description: Vitikainen (2007).

Taxonomic notes: The eight Norwegian specimens are recovered within *P. degenii* 1 of Magain et al. (2018) (Fig. 1B). The sequences are identical. The nearest neighbour is *P. islandica*, with a barcode gap of 4.8 percentage points (Table 2).

Specimens examined: **Norway**. *Akershus*: Enebakk, along the road 130 m SW of Bjørnholt, 59.7532°N, 11.0192°E, alt. 190 m, on rock wall in the roadside, 2014-08-30, S. Rui & E. Timdal WG1-0794 (O L-196335); Frogne, S of Knardal, 59.7218°N, 10.6977°E, alt. 140 m, on mossy rock in open conifer forest, 2020-11-18, S. Rui & E. Timdal 18803 (O L-228398); *Buskerud*: Ringerike, Prestemoen, 60.1418°N, 10.224°E, alt. 195 m, on the ground in spruce forest, 2016-04-17, S. Rui & E. Timdal 16017 (O L-208031); *Oslo*: Østmarka, Langbrudalen, 59.8608°N, 10.8507°E, alt. 409 m, on mossy rock wall by forest road, 2017-09-09, E. Timdal 16625 (O L-225418); *Telemark*: Vinje, Vinjevatn, Revasanden, 59.5925°N, 7.8818°E, alt. 470 m, on the ground in dense spruce forest, steep slope, 2014-09-06, E. Timdal 13516 (O L-196276).

3. *Peltigera didactyla* (With.) J.R. Laundon

Nomenclature and description: Vitikainen (2007).

Taxonomic notes: The three Norwegian sequences (one was retrieved from GenBank) are recovered within putative species *P. didactyla* 1, 2, and 3 of Magain et al. (2018), respectively (Fig. 1A). The maximum distance between the three sequences is 2.5% (Table 2), and considering the relatively short branch lengths in the *P. didactyla* clade, we prefer to regard it as a single taxonomic species.

Specimens examined: **Norway**. *Oppland*: Vågå, Ridderspranget, E of the river, 61.6818°N, 9.0783°E, alt. 720 m, on the ground in pine forest, 2016-08-31, E. Timdal 16269 (O L-201461); *Telemark*: Vinje, Grungedal, the church, 59.723°N, 7.6975°E, alt. 550 m, on soil on top of churchyard wall, 2015-08-23, E. Timdal WG3-768 (O L-208003).



Figure 3. *Peltigera* “*fuscoponjensis*”, Norway, OLICh7871 (O L-229823). Ruler division = 1 mm.

4. *Peltigera extenuata* (Nyl. ex Vain.) Lojka

Nomenclature and description: Vitikainen (2007).

Taxonomic notes: The three Norwegian sequences are recovered within *P. extenuata* 1 of Magain et al. (2018) (Fig. 1A). The sequences are identical except for a single transition (A↔G in ITS1; OLICh1992 vs the two others), hence the maximum intraspecific distance is 0.3% (Table 2).

Specimens examined: **Norway.** *Buskerud:* Sigdal, base of Mt Urdaåsen, 60.161°N, 9.4148°E, alt. 180 m, on mossy rock, 2014-10-26, S. Rui & E. Timdal WG1-0981 (O L-200018); *Oslo:* the parking lot at Sandbakken, 59.8265°N, 10.9088°E, alt. 150 m, steep rock wall in edge of forest, 2014-09-28, E. Timdal WG1-0963 (O L-200007); *Sør-Trøndelag:* Oppdal, Kongsvoll, 62.3027°N, 9.6058°E, alt. 900 m, on mossy, vertical rock wall in the subalpine region, 2014-09-03, E. Timdal WG1-0820 (O L-196343).

5. *Peltigera* “*fuscoponjensis*” ined.

Fig. 3

Nomenclature: Provisional name introduced by Miadlikowska & Lutzoni (2000) but never validated and the species never described.

Description: Thallus 8–12 cm in diameter. Lobes 0.5–1.5 cm wide and 2–5 cm long, mostly rounded, sometimes imbricate or irregular. Margins flat or more often turned upwards, occasionally somewhat involute. Upper surface grey and tomentose, becoming glabrous towards the centre and there sometimes brownish. Lower surface pale with narrow, downy, dark brown or blackish veins almost to the margins; interstices oblong or oval. Rhizines dark, mostly fasciculate or bush-shaped.

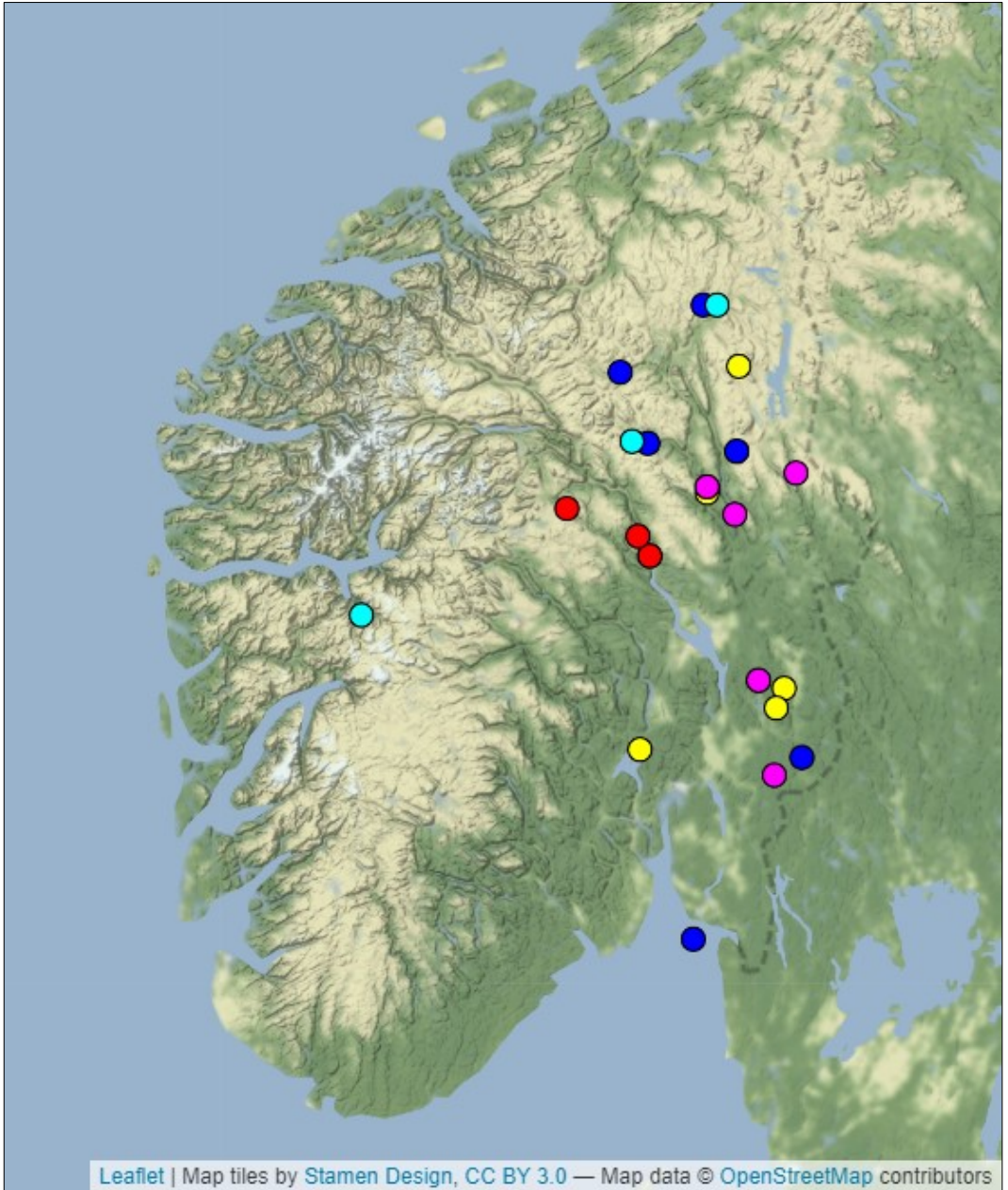


Figure 4. Norwegian distribution of *Peltigera* “*fuscoponojensis*” (●), *P. islandica* (●), *P. jonii* (●), *P. “neocanina”* (●), and *P. wulingensis* (●).

Apothecia (found in one of six specimens) saddle- or finger-shaped; disc black, 4–6 mm in diameter, on elongated, canaliculate lobes. Ascospores not found. Pycnidia, soralia, isidia, and phyllidia not seen.

Chemistry: No lichen products were demonstrated by TLC (n=6).

Taxonomic notes: The long branch of the *P. “fuscoponojensis”* clade (minimum distance to the nearest neighbour and phylogenetic sister in the Norwegian material, *P. “neorufescens 5”*: 3.6%; Fig. 1A, Table 2) and the short branches within the clade (maximum intraspecific distance: 2.1%), suggest that this clade should be given species rank.

Distribution and habitat: New to Fennoscandia. Previously known from Canada (Miadlikowska & Lutzoni 2000), Iceland (Manoharan-Basil et al. 2016; as *P. “neorufescens”* but from the GenBank sequences here identified as *P. “fuscoponojensis”* in a separate analysis), and Estonia (Jüriado et al. 2017).

Two Norwegian specimens were found on gravelly, subalpine roadsides on calcareous bedrock, one grew on stone in an old bridge in the northern boreal zone, two specimens were found on calcareous slate in a coniferous forest in the middle boreal zone, one was found on concrete in a railway bridge in the southern boreal zone, and the last one on granite in a coastal heath in the boreonemoral zone. This may indicate that the taxon has a wide distribution in Southeast Norway (Fig. 4) and occurs on substrates ranging from acidic to basic.

Specimens examined: **Norway**. Hedmark: Eidskog, V f Søndre Åklangen, S of Eidsbrua, 60.09°N, 12.11°E, alt. 140 m, på betongmur ved jernbaneundergang, 2021-06-16, H.C. Gjerlaug 7461 (O L-229823); Follidal, S f nordre Geiteryggruva, 62.15°N, 10.09°E, alt. 960 m, på bakken i gruset vegkant, 2022-07-08, H.C. Gjerlaug 7615 (O L-229275); Os, 100 m W of Gammelvolltjønnå, 62.5012°N, 11.0073°E, alt. 750 m, on the ground in roadside; birch forest, 2021-07-28, S. Rui & E. Timdal 18869 (O L-228547); Rendalen, Renåfallet S f Mistra, 61.74°N, 11.38°E, alt. 550 m, blant moser på skifrig berg ved elva, 2021-08-11, H.C. Gjerlaug 7507 (O L-229826); Rendalen; Renåfallet S f Mistra, 61.74°N, 11.38°E, alt. 550 m, blant moser på skifrig berg ved elva, 2021-08-11, H.C. Gjerlaug 7508 (O L-229833); Stor-Elvdal, Sollia, v Djupdalsbekken NV f riksvegen, 61.78°N, 10.39°E, alt. 760 m, over moser på stein i gammel bru, 2021-08-17, H.C. Gjerlaug 7519 (O L-229825); Østfold: Hvaler, Spjørøy, Spjørholmen, W side, 59.0645°N, 10.9053°E, alt. 15 m, in depression in sloping rock, coastal heath, 2022-08-01, E. Timdal 19648 (O L-229345).

6. *Peltigera islandica* Goward & Manoharan-Basil

Fig. 5

Description and nomenclature: Manoharan-Basil et al. (2016).

Description of the Norwegian material: Thallus up to 20 cm in diameter. Lobes 1.5–3.0 cm wide and 2–5 cm long, mostly rounded and rather irregularly incised. Margins most often turned upwards, in one specimen moderately involute, in another specimen rather crisped. Upper surface tomentose, grey, darker and less hairy in the centre, not greenish when moistened. Lower surface pale, with veins of different kinds. The specimen with involute lobes has narrow pale veins, darkening in the centre. The two other specimens have broader, dark brown veins with oblong, whitish interstices, veins narrower and pale in a broad marginal zone. Rhizines dark brown to black, thick, fasciculate to fibrillose. Apothecia, pycnidia, soralia, isidia, and phyllidia not seen.

Chemistry: No lichen products were demonstrated by TLC (n=3).

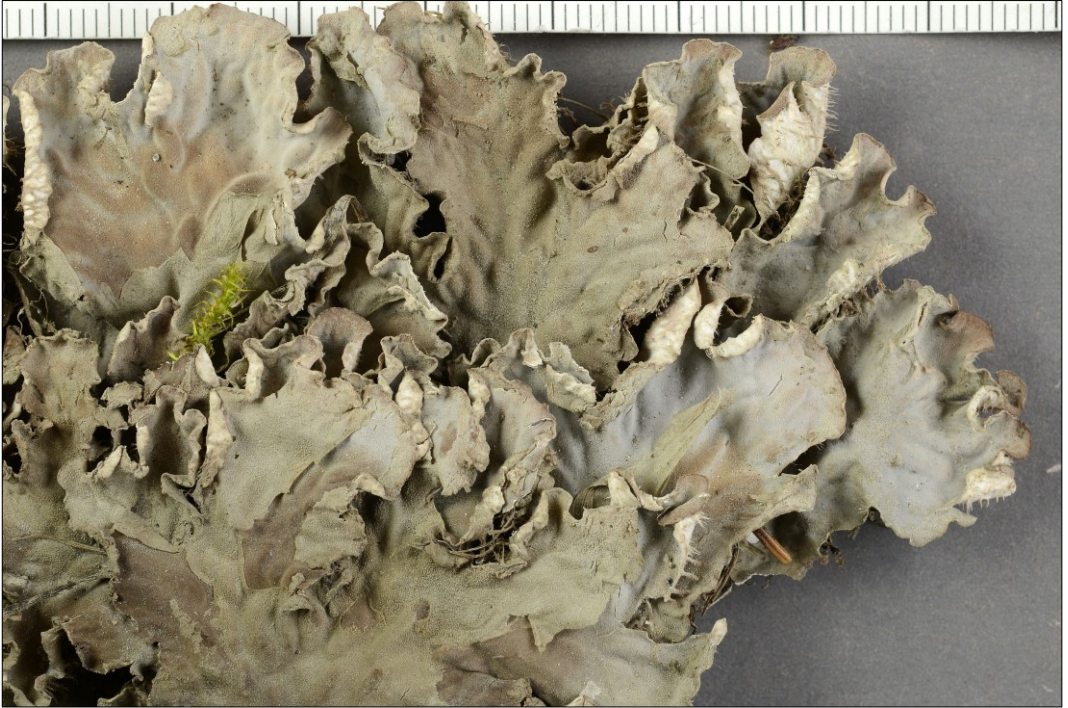


Figure 5. *Peltigera islandica*, Norway, Olich8511 (O L-229286). Ruler division = 1 mm.

Taxonomic notes: The seven ITS sequences of *P. islandica* (including the holotype from Iceland and all material from Estonia and Norway) and that of *P. sp. 20* (from Canada) in Fig. 1 are identical, with the exception of a single transition (G→A) in Olich7889 and a single transversion (C→G) in *P. sp. 20*. The latter putative species was recognized by Magain et al. (2018) but regarded as synonymous with *P. islandica* by Manoharan-Basil et al. (2016) and McMullin & Miadlikowska (2022). Still, the sequences do not form a supported clade in our phylogeny (Fig. 1C), but are rather recovered in a long polytomy together with, e.g., *P. canina*. That species does not show a barcode gap from *P. islandica* (Table 2). The five identical *P. islandica* sequences differ from the most similar ITS genotype of *P. canina*, *P. canina* 2, in two deletions in the ITS1 region (a G and a C), a transition in the ITS2 region (A→G), and a long deletion (CGGTTTGGCTTCAACTTTTTCTTTTT TGGGGT) in the ITS1 region. This deleted segment is flanked by GGGTT and CGTATGTGCC, giving *P. islandica* the diagnostic motif GGGTTCGTATGTGCC highlighted by McMullin & Miadlikowska (2022).

Morphologically, there are some differences between the Norwegian specimens and the specimens described from Iceland by Manoharan-Basil et al. (2016). The Icelandic specimens are said to be «usually small, 1.5–3.0 cm across», the lobe tips to be «predominantly downturned», and the upper surface to be «bright emerald green to apparently rarely khaki green (moist)». Our specimens are larger, most often with the margin turned upwards, and have a grey upper surface, not turning green when moistened.

Distribution and habitat: New to Fennoscandia. The species is previously known from Canada (Manoharan-Basil et al. 2016, McMullin & Miadlikowska 2022, Haughland et al. 2022), Iceland (Manoharan-Basil et al. 2016), and Estonia (Juriado et al. 2017).

All the three Norwegian specimens were collected next to state roads. One specimen was found on a gravelly roadside close to a bridge, another in a moist, mossy and grassy road ditch, both in the northern boreal zone; the third specimen was found among mosses on a small rock face in a road cutting in the subalpine zone (Fig. 4).

Specimens examined: **Norway.** *Hedmark:* Os, v riksvegbru over Vangrøfta, 62.50°N, 11.16°E, alt. 590 m, på grusete bakke ved brukar, 2022-07-29, H.C. Gjerlaug 7654 (O L-229286); Stor-Elvdal, ca. 500 m N f Enden, 61.79°N, 10.22°E, alt. 780 m, blant moser i fuktig grøftkant, 2019-07-22, H.C. Gjerlaug 7349 (O L-229836); *Sogn og Fjordane:* Aurland, Ø f Øyestølsvatnet, nær vegbom, 60.87°N, 7.21°E, alt. 970 m, blant moser på bergvegg ved riksvegen, 2022-07-20, H.C. Gjerlaug 10003 (O L-229312).

7. *Peltigera jonii* Timdal & Gjerlaug n. sp.

Fig. 6

Mycobank: MB848349.

Diagnosis: Differs morphologically from its phylogenetic sister species *P. rufescentiformis* (Gyeln.) C.W. Dodge in forming a thin tomentum on the upper side, mainly in the lobe ends, having ascending lobe margins, and lacking marginal phyllidia. Differs genetically from all *Peltigera* species in having the motif TTGACGTTGT in the ITS1 region.

Type: Norway, Hedmark, Nord-Odal, V f Juråa ca. 1.7 km N f Skyrud, 60.5080°N, 11.6134°E, alt. 230 m, over moser på grasbakke ved skogskoie, 2022-09-09, H.C. Gjerlaug 7694 (O L-229643 holotype; ITS: OLICH8301 = OQ843172).

Etymology: The species is named in honour of Jon Holtan-Hartwig for his contribution to the taxonomy and chemistry of *Peltigera*.

Description: Thallus 8–12 cm in diameter, rather thin and fragile, often partitioned, firmly attached to the substrate. Lobes 0.8–1.5 cm wide and 1.5–3 cm long, sometimes irregular, roundish or more often angulate. Margins turned upwards, occasionally a little crispy. Upper surface tomentose near the lobe tips, mostly smooth and dull, grey or brownish when dry, not greenish when moistened. Lower surface pale with narrow, raised, downy, dark brown veins nearly to the margins and oblong interstices. Rhizines dark, fasciculate to bush-shaped. Apothecia seen in 2 of 7 specimens; disc dark brown, 5–7 mm in diameter, saddle-shaped on elongated lobes. Ascospores acicular, 3-septate, 45–63 × 3–5 µm (n=55). Pycnidia, soralia, isidia, and phyllidia not seen.

Chemistry: No lichen products were demonstrated by TLC (n=7).

Taxonomic notes: *Peltigera jonii* belongs in the *P. rufescens* group and is the strongly supported phylogenetic sister of the East African species *P. rufescentiformis* (Fig. 1B). That species differs, compared to the diagnosis above, in having a thick, densely compacted tomentum over most of the upper side, partly revolute lobe margins, and often phyllidia along the margin (Swinscow & Krog 1988). *Peltigera jonii* is similar to *P. rufescens*, but possibly differs in forming thinner, more fragile thalli with more rounded lobes. *Peltigera rufescens* is also the genetically most similar species with a barcode gap of 3.1 percentage points (Table 2). *Peltigera wulingensis* belongs in the same group, but differ in forming phyllidia along the lobe margin. The unique motif in the ITS1 region (Fig. 7) starts at position 91 (when ITS is trimmed to CATTA).



Figure 6. *Peltigera jonii*, Norway, Olich8301, (O L-229643, holotype). Ruler division = 1 mm.

Distribution and habitat: All the specimens were collected in culturally influenced localities, six in small grasslands, the last among mosses on a stone. One was found on an old campfire, one near an old hydroelectric power plant, two on roadsides, two along trails, and the last one by a cabin in coniferous forest. All these localities are in the southern or middle boreal zone in the former Hedmark county (Fig. 4).

After completion of this manuscript, a BLASTn search in GenBank identified sequence KF617381 from an “uncultured fungus” as belonging to *P. jonii*. The sequence represents operational taxonomic unit SEOTU12907 in Taylor et al. (2014) and originates from a soil sample from a *Picea mariana* forest at Bonanza Creek (64.9148°N, 147.8298°W) near Fairbanks, Alaska, USA. The sequence contains the diagnostic motif of *P. jonii* (Fig. 7) and differs from the most similar Norwegian sequence (OLICH8301) in two substitutions and one deletion in the ITS1 region.

Additional specimens examined: Norway. Hedmark: Eidskog, Ø f Haveråa ved utløpet fra Havsjøen, 60.00°N, 11.81°E, alt. 220 m, på bålplass nær elva, 2020-08-14, H.C. Gjerlaug 7392 (O L-229256); Engerdal, Basdalen Ø f Hylleråsen, 61.63°N, 12.05°E, alt. 610 m, på bakken i graskledd kjerreveg i granskog, 2022-07-12, H.C. Gjerlaug 7619 (O L-229277); Nord-Odal, Holtslåtten V f Juråa, 60.51°N, 11.61°E, alt. 230 m, på jorddekt stein i grøftkant, 2022-09-09, H.C. Gjerlaug 7696 (O L-229644); Stor-Elvdal, Kongeveien S f Hammaren, 61.56°N, 11.04°E, alt. 280 m, på grasbakke ved Kjemåa kraftverk, 2022-08-11, H.C. Gjerlaug 7659 (O L-229290); Stor-Elvdal, Kongeveien S f Hammaren, 61.56°N, 11.04°E, alt. 280 m, på svaberg i grasmark Ø f Kjemåa kraftverk, 2022-08-11, H.C. Gjerlaug 7660 (O L-229291); Åmot, S f Glesåtnet Ø f Rena elv, 61.41°N, 11.35°E, alt. 250 m, på graskledd bakke i grusetete vegkant, 2022-08-23, H.C. Gjerlaug 7674 (O L-229300).

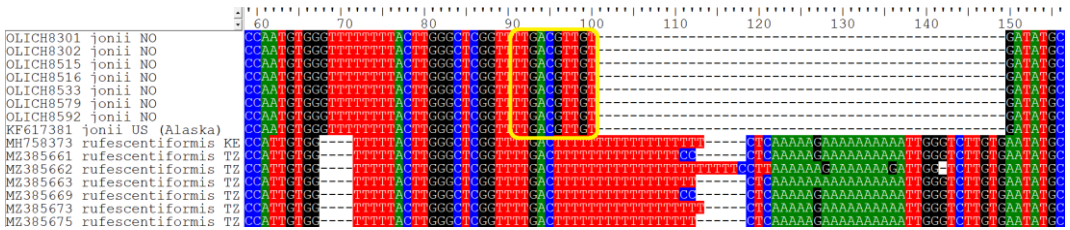


Figure 7. Part of an alignment of the sequences of *P. jonii* and *P. rufescentiformis*. Yellow box indicates the unique motif in the former, from position 91 to 100 in the ITS1 region.

8. *Peltigera kristinssonii* Vitik.

Nomenclature and description: Vitikainen (2007).

Taxonomic notes: The three Norwegian sequences are at most 0.4% different and the species shows the largest barcode gap in our material, 9.2 percentage point from *P. islandica* (Table 2).

Specimens examined: **Norway.** *Hedmark:* Ringsaker, Bergetranget NØ f Åsta, 61.11°N, 10.99°E, alt. 580 m, blant moser på berg ved elva, 2022-06-14, H.C. Gjleraug 7594 (O L-229271); *Sør-Trøndelag:* Oppdal, Sondre Knutshø, Blesebekken, 62.2962°N, 9.6266°E, alt. 1110-1150 m, on the ground in the low-alpine region, 2005-10-04, E. Timdal 10661 (O L-149348); Oppdal, along the brook Blæsebekken, at the trail from Kongsvold to Knutshø, 62.2960°N, 9.6075°E, alt. 990 m, on soil near river, 2020-08-15, E. Timdal 18772 (O L-227873).

9. *Peltigera lepidophora* (Vain.) Bitter

Nomenclature and description: Vitikainen (2007).

Taxonomic notes: The four Norwegian sequences are recovered within *P. lepidophora* 1 of Magain et al. (2018) (Fig. 1B). Their maximum intraspecific distance is 1.5%, and the distance to the nearest neighbour, *P. wulingensis*, is 6% (Table 2). *Peltigera lepidophora* 2 is apparently synonymous with *P. alkalicola* (Kaasalainen et al. 2022). Both species belong in the *P. rufescens* group. A specimen originally identified as *P. lepidophora* (OLICH2355) was recovered in the *P. didactyla* group, however, and is believed to represent an undescribed species (see *P. sp.*, below).

Specimens examined: **Norway.** *Nordland:* Saltdal, Evenesdalen, the old road just below the new bridge, 66.9448°N, 15.3965°E, alt. 180 m, on top of an old concrete road fence, 2020-08-07, E. Timdal 18664 (O L-227765); *Oppland:* Øystre Slidre, E end of lake Øvre Heimdalsvatn, Osbue, 61.4193°N, 8.8932°E, alt. 1100 m, on stone on the ground in the subalpine region, 2016-08-31, E. Timdal 16259 (O L-201451); *Sør-Trøndelag:* Oppdal, Vårstigen, 62.3314°N, 9.622°E, alt. 830 m, on soil, 2013-08-22, E. Timdal 13117 (O L-184530); *Telemark:* Vinje, Grungedal, Rui, 59.7097°N, 7.7677°E, alt. 550 m, on cement road fence, 2015-06-14, S. Rui & E. Timdal WG3-600 (O L-200874).

10. *Peltigera membranacea* (Ach.) Nyl.

Nomenclature and description: Vitikainen (2007).

Taxonomic notes: The ten sequences are recovered within *P. membranacea* 1 of Magain et al. (2018) (Fig. 1B). It is the genetically most heterogeneous species in our material, with a maximum intraspecific distance of 9.6% (Table 2). The clade is well supported and long-branched, though. *Peltigera canina* is the nearest Norwegian neighbour, and their barcode gap is negative: -0.7 percentage points.

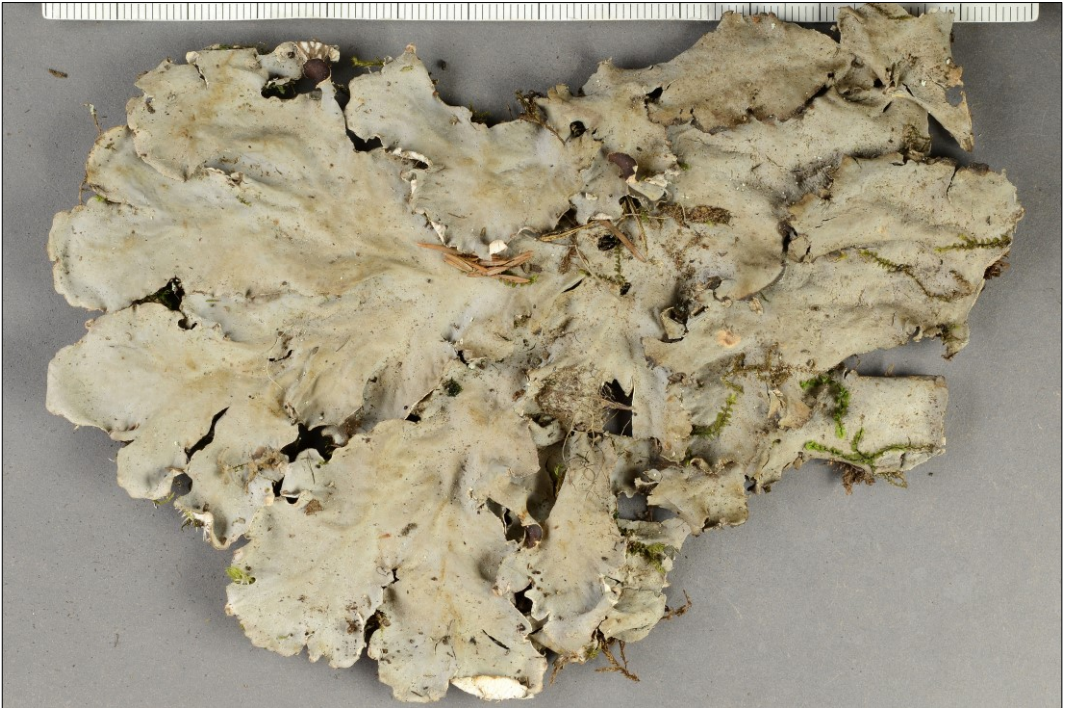


Figure 8. *Peltigera* “*neocanina*”, Norway, Olich8568 (O L-229269). Ruler division = 1 mm.

Specimens examined: **Norway.** *Akershus:* Frogn, S of Knardal, 59.722°N, 10.698°E, alt. 140 m, on mossy rock in open conifer forest, 2020-11-18, S. Rui & E. Timdal (O L-229838); *Buskerud:* Sigdal, base of Mt Urdaåsen, 60.1607°N, 9.4155°E, alt. 180 m, on mossy rock in shady spruce forest, 2014-10-26, S. Rui & E. Timdal WG1-0987 (O L-200024); *Finnmark:* Porsanger, Kolvik, 70.2926°N, 25.117°E, alt. 2 m, over mose på berg innunder steinblokk. Beitet strandeng., 2019-07-12, J.T. Klepsland JK19-130 (O L-227399); *Hedmark:* Stor-Elvdal, SØ f Sørhovden, 61.48°N, 11.17°E, alt. 670 m, på bakken på graskledd vegkant, 2022-08-12, H.C. Gjerlaug 7667 (O L-229294); Åmot, Osdalen, V f Osa NØ f Gardberget, 61.40°N, 11.74°E, alt. 510 m, på jord i grasdekt kjerreveg i barskog, 2020-09-21, H.C. Gjerlaug 7408 (O L-229259); *Nordland:* Saltdal, Storengdalen, N slope of Mt Satertind, near Kvitbekkhumpen, 66.9165°N, 15.539°E, alt. 580 m, on the ground in open subalpine birch forest, 2020-08-08, E. Timdal 18690 (O L-227792); Sømna, by the road to Kåsskjæret, 65.3507°N, 12.1418°E, alt. 5 m, mossy rock in mixed forest, 2020-08-12, E. Timdal 18759 (O L-227860); *Sogn og Fjordane:* Aurland, Flåm, V f Fretheim hotell, alt. 10 m, blant moser på bergvegg ved gangveg, 2022-07-20, H.C. Gjerlaug 10005 (O L-229314); *Sør-Trøndelag:* Ørland, Storfosna, Haugan, 63.6683°N, 9.4045°E, alt. 17 m, on the ground in meadow, 2014-08-06, R. Haugan WG3-0095 (O L-195991).

11. *Peltigera* “*neocanina*” ined.

Figs 2A, 8

Nomenclature: Provisional name introduced by Miadlikowska & Lutzoni (2000) but never validated and the species never described.

Description: Thallus 15–20 cm in diameter, partly wavy or bullate. Lobes 1.2–2.0 cm wide and 2–5 cm long. Margins mostly rounded and turned upwards or flat. Upper surface tomentose at the lobe ends, becoming less tomentose, smooth and dull in the centre, grey or brown when dry, not greenish when moistened. Lower surface pale with a dense network of narrow, raised, mostly downy veins,

dark nearly to the margins. Rhizines simple to fasciculate, blackish, pale at the margins. Apothecia 3–8 mm in diameter; disc dark brown, saddle- to finger-shaped, on elongated, canaliculate lobes. Ascospores acicular, 3-septate, $36\text{--}52 \times 3\text{--}5 \mu\text{m}$ ($n=56$). Pycnidia, soralia, isidia, and phyllidia not seen.

Chemistry: No lichen products were demonstrated by TLC ($n=5$).

Taxonomic notes: The six Norwegian sequences are recovered within *P. "neocanina"* 4 of Magain et al. (2018) (Fig. 1C). The sequences are identical, except for a single transition (A↔G) in the ITS1 region, thus the maximum intraspecific distance is 0.2% (Table 2). The barcode gap to the nearest Norwegian neighbour, *P. islandica*, is 6.6 percentage points.

Distribution and habitat: In Fennoscandia, the species has previously been reported from two localities in Norway by Magain et al. (2018; precise locality unknown) and Marthinsen et al. (2019; collected by us), respectively. We here report four additional Norwegian localities (Fig. 4).

Our five specimens were all collected over and among mosses on small rock faces in forests. One of the specimens was found in a rich, mixed spruce/deciduous forest in the boreonemoral zone, two in mesotrophic spruce forests in the middle boreal zone, one in a rich subalpine birch forest, and the last one in a road-cutting in a coniferous forest in the middle boreal zone. The habitats of these specimens are in good agreement with the situation in Estonia where the specimens were confined to sheltered forest environments (Jüriado et al. 2017).

Specimens examined: **Norway**. *Buskerud*: Ringerike, Burudåsen, 60.1307°N, 10.3065°E, alt. 140 m, on the ground in mixed forest, 2014-06-15, R. Haugan & E. Timdal WG1-0128 (O L-196062); *Hedmark*: Grue, Revklintens Ø-side V f Risberget, 60.46°N, 11.90°E, alt. 410 m, over moser på bergvegg i barskog, 2022-06-09, H.C. Gjerlaug 7581 (O L-229269); Stor-Elvdal, ca. 1 km N f Landet Ø f Glåma, 61.52°N, 11.06°E, alt. 270 m, over moser på bergvegg ved veg, 2022-08-12, H.C. Gjerlaug 7669 (O L-229296); Sør-Odal, N-sida av Hokjølen Ø f Storsjøen, 60.36°N, 11.82°E, alt. 460 m, over moser på N-vendt bergvegg i granskog, 2022-05-16, H.C. Gjerlaug 7569 (O L-229268); Tolga, Orvdalen, ca. 1,5 km NV f Orvaldssetra, 62.19°N, 11.41°E, alt. 800 m, over moser på bergvegg i rik fjellbjørkeskog, 2022-07-27, H.C. Gjerlaug 7642 (O L-229285).

12. *Peltigera "neorufescens"* 3 ined.

Fig. 9

Nomenclature: *Peltigera "neorufescens"* is a provisional name introduced by Miadlikowska & Lutzoni (2000) but never validated and the species never described.

Description: Thallus small, 2–3 cm in diameter, rather similar to fertile specimens of *P. didactyla*. Lobes 0.5–1.0 cm wide and 1–2 cm long; margins mostly turned upwards. Upper surface grey and tomentose; lower surface with dark, downy veins and dark, brush-shaped rhizines. Apothecia numerous, 8–10 mm in diameter, disc blackish brown, on elongated lobes. Ascospores acicular, 3-septate, $46\text{--}70 \times 3\text{--}5 \mu\text{m}$ ($n=20$). Pycnidia, soralia, isidia, and phyllidia not seen.

Chemistry: No lichen products were demonstrated by TLC ($n=1$).

Taxonomic notes: Magain et al. (2018) indicated five putative species under the name *P. "neorufescens"*. Our material falls into two of them, i.e., species 3 and 5. In our phylogeny, species 3 and 5 seem well separated as they are recovered as long-branched clades with relatively short internal branches and are not even sister species (Fig. 1A). *Peltigera "neorufescens"* 3 forms a polytomy with species 1, 2, and 4. The sister species of *P. "neorufescens"* 5 is *P. "fuscoponojensis"*, a species included in the phylogeny of Miadlikowska et al. (2003) and Jüriado et al. (2017) but not in Magain et al. (2018). Among the Norwegian species, *P. "fuscoponojensis"* is the nearest



Figure 9. *Peltigera* “*neorufescens*” 3, Norway, Olich8226 (O L-123259).

neighbour of both *P. “neorufescens”* 3 and 5, showing a barcode gap of 5.9 and 1.9 percentage points to them, respectively (Table 2).

Distribution and habitat: New to Fennoscandia. In Europe, previously known from Germany (Magain et al. 2018) and Estonia [Jüriado et al. 2017; as *Peltigera* sp. (*P. “neorufescens”* agg.); their sequences are here identified as *P. “neorufescens”* 3 in a separate analysis].

The Norwegian specimens were found on the ground in open pine forests, at one site near an old fireplace in the northern boreal zone in Northern Norway, and at the other site in a west facing slope near a road close to a house in the middle boreal zone in Southern Norway (Fig.10).

Specimens examined: **Norway.** *Finnmark:* Kautokeino, Suohpajjeakkejávri, 68.9124°N, 23.1085°E, alt. 340 m, on the ground in open pine forest, near fireplace, 2003-08-15, E. Timdal 9735 (O L-123259); *Oppland:* Sør-Fron, Espedal, Øvre Verket, 61.4403°N, 9.4957°E, alt. 745 m, on the ground in W facing slope near road/house in pine forest, 2021-07-13, E. Timdal 18856 (O L-228536).

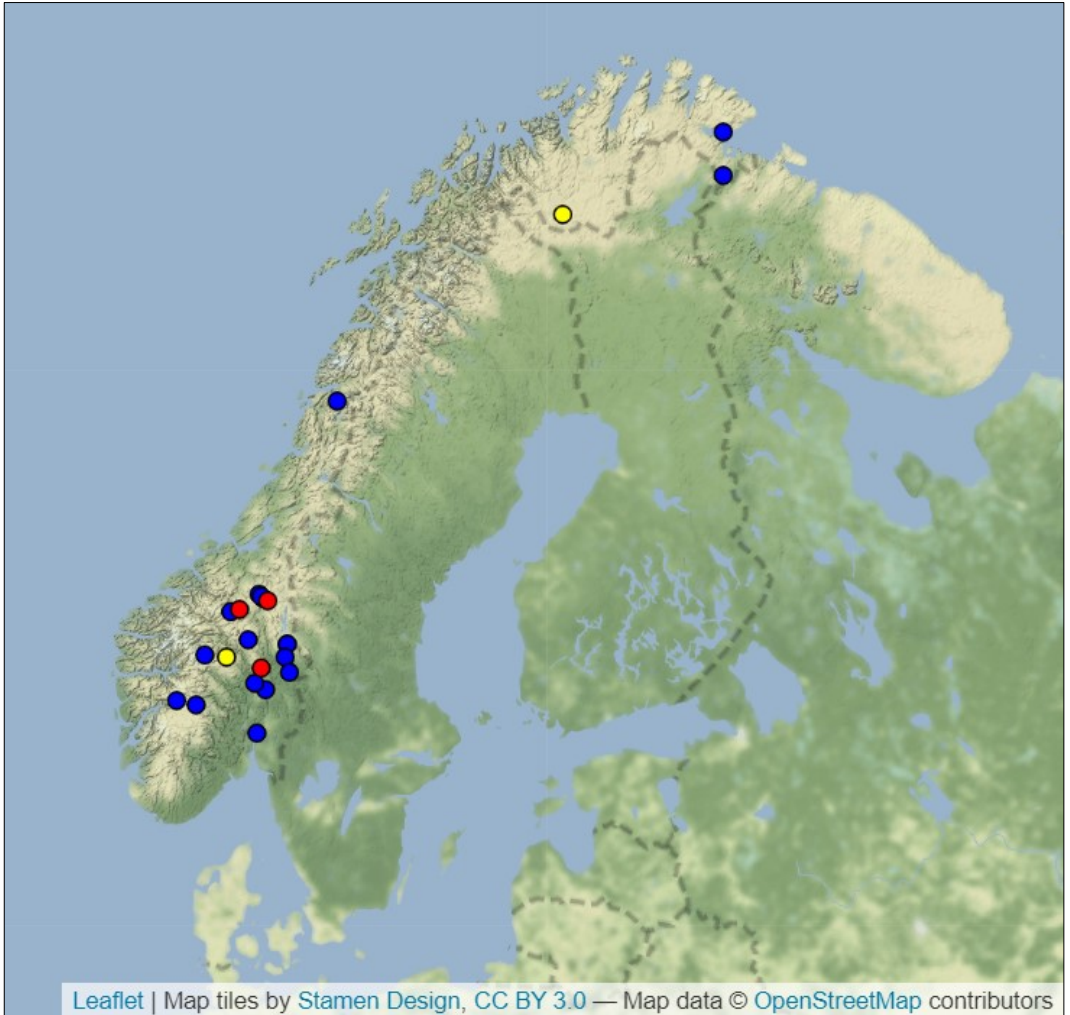


Figure 10. Norwegian distribution of *Peltigera* “*neorufescens*” 3 (●), *P.* “*neorufescens*” 5 (●), and *P.* *ponojensis* (●).

13. *Peltigera* “*neorufescens*” 5 ined.

Figs 2B, 11

Nomenclature: *Peltigera* “*neorufescens*” is a provisional name introduced by Miadlikowska & Lutzoni (2000) but never validated and the species never described.

Description: Thallus 8–15 cm in diameter. Lobes 0.8–1.5 cm wide and 1.5–4 cm long, mostly irregularly incised, rounded or sometimes angulate. Margins turned upwards, somewhat flexuose, in one specimen crisped. Upper surface tomentose, grey or grey with a brownish tinge, darker, dull, and less hairy in the centre, not greenish when moistened. Lower surface pale with a distinct network of dark brown, moderately raised, downy, broad, partly anastomosing veins and numerous pale, ovale interstices. Rhizines dark brown to black, mostly fibrillose. Apothecium seen in one specimen,



Figure 11. *Peltigera* “*neorufescens*” 5, Norway, Olich8512 (O L-229287). Ruler division = 1 mm.

8 mm in diameter, saddle-shaped, on elongated lobes; disc dark brown. Ascospores acicular, 3-septate, $43\text{--}61 \times 3\text{--}5 \mu\text{m}$ ($n=20$). Pycnidia, soralia, isidia, and phyllidia not seen.

Chemistry: No lichen products were demonstrated by TLC ($n=3$).

Taxonomic notes: See *P.* “*neorufescens*” 3 for taxonomic discussion.

Distribution and habitat: New to Fennoscandia. In Europe, previously known from Estonia (Jüriado et al. 2017; as *P.* “*neorufescens*”); their sequences are here identified as *P.* “*neorufescens*” 5 in a separate analysis).

The three Norwegian specimens were all collected in the cultural landscape (Fig. 10). One specimen was found on concrete in a road bridge over a little river, another over mosses on calcareous rock near the dam of an old hydroelectric power plant near a little waterfall. Both localities are situated in the agricultural landscape in the northern boreal zone. The third specimen was growing in a grassy, low-alpine roadside near a mountain dairy farm in an area with calcareous bedrock. The habitats of these specimens are in accordance with the situation in Estonia where the taxon was said to prefer calcareous nutrient-rich soils (Jüriado et al. 2017).

Specimens examined: Norway. Hedmark: Folldal, Settdalen, N f Småbakkan, 62.35°N , 9.99°E , alt. 1000 m, på bakken i graskledd vegkant, 2022-07-07, H.C. Gjerlaug 7613 (O L-229274); Os, v Brufossen i Vangrøfta, 62.52°N , 11.15°E , alt. 600 m, over moser på berg ved fossen, 2022-07-29, H.C. Gjerlaug 7655 (O L-229287); Ringsaker, bru over Åsta SV f Skvaldra, 61.21°N , 10.87°E , alt. 680 m, på betong i brufundament, 2022-06-14, H.C. Gjerlaug 7604 (O L-229272).

14. *P. ponojensis* Gyeln.

Fig. 12

Nomenclature: Vitikainen (2007; as *P. ponojensis* and *P. monticola*).

Description: Thallus 5–12 cm in diameter. Lobes 1.0–2.5 cm wide and 2–4 cm long, mostly rounded, sometimes partly imbricate. Margins turned upwards, occasionally involute. Upper surface densely tomentose at the lobe ends and less so in the centre, or more often sparingly tomentose at the lobe ends and smooth and dull in the centre, light grey, medium grey, brownish grey, or dark greyish brown. Lower surface pale, most often with raised, pale veins, sometimes with pale veins darkening in the centre or with dark veins nearly to the margins. Rhizines pale or occasionally dark, simple to fasciculate. Apothecia seen in 11 of 19 specimens; disc dark brown, 3–10 mm in diameter, saddle-shaped on elongated lobes. Ascospores not examined. Pycnidia, soralia, isidia, and phyllidia not seen.

Chemistry: No lichen products were demonstrated by TLC (n=19).

Taxonomic notes: Magain et al. (2018) recognized 14 putative species within the *P. ponojensis/monticola* complex. The Norwegian material is partly recovered within three of them (putative species 6, 7, and 8), partly within *P. ponojensis* I of Jüriado et al. (2017), and partly form a previously not recognized lineage (Fig. 1A). The maximum genetic distance in the Norwegian material is 7.1% (Table 2). The complex seems insufficiently understood for taxonomic conclusions and we prefer to treat it as a single taxonomic species. It is not clear where *P. ponojensis* s. str. and *P. monticola* fit into the phylogeny, although Magain et al. (2018) indicates that the former may be putative species 2 and the latter 7.

Distribution and habitat: The Norwegian specimens were found on slate in the boreonemoral zone, among mosses on stones or on the ground in rich coniferous forests, on concrete walls in the north and middle boreal zones, on subalpine slate and gravelly roadsides, and on stones and the ground in the low alpine zone in districts with calcareous bedrock. This may indicate that the taxon has a wide distribution in Norway on neutral or basic substrates (Fig. 10).

Specimens examined: **Norway**. *Buskerud*: Hol, Skurdalen, Lio NV f Hovde, 6.07°N, 10.60°E, alt. 940 m, på gammel bålplass i lyngrik furuskog, 2022-07-19, H.C. Gjerlaug 10002 (O L-229311); *Finnmark*: Sør-Varanger, W of lake Store Sametti, near lakelet 110, 69.482°N, 29.595°E, on the ground, partly over pieces of burnt wood of *Pinus sylvestris*, 1982-07-20, T. Tønberg 7156 (BG L-40953); Vadsø, just W of Vadsø, between rivulets Bergelva and Tomaselva, 70.092°N, 29.645°E, on the ground, 1982-07-22, T. Tønberg 7207 (BG L-40958); *Hedmark*: Engerdal, v Kansbekken V f Nordstrand N f Heggeriset, 61.68°N, 11.98°E, alt. 560 m, blant moser på stein i granskog, 2022-07-13, H.C. Gjerlaug 7624 (O L-229279); Engerdal, v Kansbekken V f Nordstrand N f Heggeriset, 61.68°N, 11.98°E, alt. 580 m, blant moser på stein i granskog, 2022-07-13, H.C. Gjerlaug 7625 (O L-229280); Os, Snuddalen, Sotthaugberga S f Snudda, 62.64°N, 10.80°E, alt. 960 m, blant moser på stein i lavalpin høgstaudemark, 2021-07-21, H.C. Gjerlaug 7493 (O L-229261); Os, Fossgruva S f Vangrøftdalen, 62.56°N, 10.96°E, alt. 810 m, over moser på skifrig bergvegg, 2021-07-22, H.C. Gjerlaug 7497 (O L-229832); Os, Vangrøftdalen, Jotvollen V f Kløftåsen, 62.59°N, 10.90°E, alt. 770 m, rikelig på grus i graskledd vegkant, 2021-07-22, H.C. Gjerlaug 7496 (O L-229262); Stange, Ottestad, Tokstad, 60.78°N, 11.10°E, alt. 130 m, over moser på kalkrik stein i blandingsskog, 2022-04-22, H.C. Gjerlaug 7550 (O L-229263); Stor-Elvdal, Sollia, v Djupdalsbekken NV f riksvegen, 61.78°N, 10.39°E, alt. 760 m, over moser på stein ved gammel bru, 2020-09-05, H.C. Gjerlaug 7399 (O L-229258); Trysil, Svartåsetra Ø f Blekufjellet, 61.45°N, 11.90°E, alt. 660 m, over moser på gammel steinmur, 2016-08-24, H.C. Gjerlaug 7145 (O L-229257); Trysil, Fjell V f Fjellbu, 61.15°N, 12.07°E, alt. 570 m, blant moser på jorddekt betong i låvebru, 2021-09-08, H.C. Gjerlaug 7543 (O L-229824); *Hordaland*: Ulvik, Finse, roadside at Rallarvegen close to the railway station, 60.600°N, 7.507°E, on soil on top of small boulder, 1998-08-02, S. Ekman 3358 (BG L-65647); *Nordland*: Hemnes, Innerdalen, 66.02°N, 13.95°E, alt. Ca. 400 m, subalpin bjørkeskog, 1983-06-27, J.E. Nordnes 770b (O L-34451); *Oppland*: Gjøvik,



Figure 12. *Peltigera ponojensis*, Norway, Olich8224 (O L-46317). Ruler division = 1 mm.

Kremmerodden nature reserve, 60.9497°N, 10.6431°E, alt. 125-130 m, calcareous rock outcrops along shore. Calcareous meadow, 2000-11-13, R. Haugan GJ00-1103 (O L-89161); Lom, Jotunheimen, ca. 3 km VNV for Memurubu, 61.49°N, 8.58°E, alt. 1160 m, på humus i stikant; heivevegetasjon, 1984-06-24, J. Holtan-Hartwig 4300 (O L-34450); Oslo: Sagene, Gustav Jensens gate, Vøienvollen, 59.9357°N, 10.7546°E, alt. 80 m, mossy rocks, 2000-03-15, R. Haugan 6700 (O L-46317); Sør-Trøndelag: Oppdal, landskapsvernområdet ved Kongsvoll, 62.31°N, 9.63°E, alt. 1050 m, på humusdekket stein, 1978-07-28, A.J. Sørensen 3400i (O L-34449); Oppdal, along the brook Blåsebekken, at the trail from Kongsvold to Knutshø, 62.2953°N, 9.6262°E, alt. 1120 m, on soil in alpine heath, 2020-08-15, E. Timdal 18773 (O L-227874).

15. *Peltigera praetextata* (Flörke ex Sommerf.) Zopf

Nomenclature and description: Vitikainen (2007).

Taxonomic notes: The 15 Norwegian sequences are identical except for a transition (T→C) in ITS2 in Olich4194; the maximum intraspecific distance is hence only 0.2% (Table 2).

Specimens examined: Norway. Akershus: Asker, along the brook N of lake Åstaddammen, 59.872°N, 10.4628°E, alt. 50 m, at the base of tree trunk in swamp forest, 2016-05-05, E. Timdal 16030 (O L-208036); Lillestrøm, Skedsmo, Kopperud, 59.9812°N, 11.1485°E, fuktig bergskrent v/vei, 2009-09-17, T. Starholm (O L-201769); Buskerud: Sigdal, E side of Mt Urdaåsen, 60.1622°N, 9.4135°E, alt. 200 m, on the ground in steep slope, shady forest, 2013-10-01, S. Rui & E. Timdal 13212 (O L-184752); Hedmark: Engerdal, v Kansbekken V f Nordstrand N f Heggeriset, 61.68°N, 12.00°E, alt. 520 m, blant moser på stein i granskog, 2022-07-13, H.C. Gjerlaug 7623 (O L-229278); Stor-Elvdal, Sollia, v Djupdalsbekken NV f riksvegen, 61.78°N, 10.39°E, alt. 760 m, over moser på stein i gammel bru, 2021-08-17, H.C. Gjerlaug 7518 (O L-229822); Stor-Elvdal,

Sørhovdens Ø-side, 61.48°N, 11.17°E, alt. 710 m, blant moser på stein i rik granskog, 2022-08-12, H.C. Gjerlaug 7666 (O L-229293); Tolga, Orvdalen, ca. 1,5 km NV f Orvdalssetra, 62.19°N, 11.41°E, alt. 790 m, over moser på graskledd vegkant, 2022-07-27, H.C. Gjerlaug 7635 (O L-229284); Åmot, S f Vivelstad SV f Rena, 61.11°N, 11.29°E, alt. 380 m, blant moser på steingjerde ved veg, 2022-08-24, H.C. Gjerlaug 7688 (O L-229308); *Hordaland*: Stord, hill E of Øvrabø, 59.7673°N, 5.4102°E, alt. 50 m, on the base of deciduous tree in humid forest, 2018-04-28, E. Timdal 16809 (O L-225456); *Nordland*: Saltdal, along the old road towards Sweden E of Graddis fjellstue, 66.7413°N, 15.757°E, alt. 470 m, on the rotten log in subalpine birch forest, 2020-08-09, E. Timdal 18704 (O L-227806); *Oslo*: Brattlikollen, Østli, along footpath towards Ryen, 59.8892°N, 10.8057°E, alt. 140 m, on rock wall in mixed forest, 2014-08-02, E. Timdal WG1-0464 (O L-195837); *Østfold*: Moss, Jeløya, between Alby and Albystranda, 59.4210°N, 10.6022°E, alt. 10 m, rock wall in deciduous forest, 2016-03-23, S. Rui & E. Timdal WG1-1807 (O L-208022).

16. *Peltigera rufescens* (Weiss) Humb.

Nomenclature and description: Vitikainen (2007).

Taxonomic notes: The 24 Norwegian sequences are recovered within *P. rufescens* 1 of Magain et al. (2018) (Fig. 1B).

Specimens examined: **Norway**. *Akershus*: Nordre Follo, Kråkstad church, 59.6767°N, 10.8808°E, alt. 120 m, on stone wall, churchyard, 2014-09-28, E. Timdal WG1-0938 (O L-199989); *Hedmark*: Eidskog, Børli N f store Børen, 60.06°N, 11.87°E, alt. 260 m, over moser på stein i jordekant, 2022-04-30, H.C. Gjerlaug 7551 (O L-229264); Engerdal, Ø f Engeren v Hyllas utløp, 61.66°N, 12.03°E, alt. 480 m, på humusdekt stein i lauvlund N f elva, 2022-07-13, H.C. Gjerlaug 7628 (O L-229281); Kongsvinger, Norsfossen V f Glomma SV f Fosseid, 60.34°N, 12.03°E, alt. 150 m, blant moser på svaberg ved elva, 2022-05-23, H.C. Gjerlaug 7576 (O L-229266); Kongsvinger, Norsfossen V f Glomma SV f Fosseid, 60.34°N, 12.03°E, alt. 150 m, blant moser på svaberg ved elva, 2022-05-23, H.C. Gjerlaug 7577 (O L-229267); Nord-Odal, V f Skyrud N f Knapper, 60.50°N, 11.61°E, alt. 230 m, over moser på betongdekke på industritomt, 2022-09-09, H.C. Gjerlaug 7691 (O L-229641); Rendalen, Renåvangen ved Renåa, 61.73°N, 11.39°E, alt. 610 m, blant moser på stein ved elva, 2021-08-11, H.C. Gjerlaug 7513 (O L-229835); Rendalen, Sjøli, vegbru over Møra, 61.48°N, 11.32°E, alt. 310 m, blant moser på grus i vegkant, 2022-08-23, H.C. Gjerlaug 7678 (O L-229301); Rendalen, v Flenas utløp i Storsjøen, 61.66°N, 11.22°E, alt. 260 m, på grus ved brufundament, 2022-08-23, H.C. Gjerlaug 7681 (O L-229303); Rendalen, S f Sagbakkens utløp i Storsjøen, 61.67°N, 11.22°E, alt. 260 m, blant moser på grus på industritomt, 2022-08-23, H.C. Gjerlaug 7682 (O L-229304); Rendalen, N f Røbekken V f Sveen, 61.89°N, 11.06°E, alt. 410 m, blant moser på grus i vegkant, 2022-08-24, H.C. Gjerlaug 7683 (O L-229305); Rendalen, Bergset, V f Sveen, 61.89°N, 11.06°E, alt. 410 m, blant moser på bakken på gammel steintipp, 2022-08-24, H.C. Gjerlaug 7686 (O L-229306); Ringsaker, Bergetranget NØ f Åsta, 61.11°N, 10.99°E, alt. 580 m, blant moser på berg ved elva, 2022-06-14, H.C. Gjerlaug 7593 (O L-229270); Ringsaker, Åstdalen, bru over Aksjøbekken, 61.20°N, 10.87°E, alt. 680 m, på sand i vegkant, 2022-06-14, H.C. Gjerlaug 7606 (O L-229273); Stor-Elvdal, Koppanghammerens S-side, 61.56°N, 11.04°E, alt. 330 m, blant moser på bergvegg i rik skog, 2022-08-11, H.C. Gjerlaug 7662 (O L-229292); Stor-Elvdal, ca. 1 km N f Landet Ø f Glåma, 61.52°N, 11.06°E, alt. 270 m, over moser på bergvegg ved veg, 2022-08-12, H.C. Gjerlaug 7668 (O L-229295); Stor-Elvdal, Stai stasjon, 61.49°N, 11.06°E, alt. 260 m, på grus ved jernbanespor, 2022-08-12, H.C. Gjerlaug 7671 (O L-229298); Sør-Odal, N f Vangen v Storsjøens S-ende, 60.30°N, 11.72°E, alt. 140 m, over moser på berg ved sjøen, 2022-05-06, H.C. Gjerlaug 7564 (O L-229265); Tolga, Orvdalen, Orvdalssetra, 62.18°N, 11.43°E, alt. 840 m, på jordekant stein i steinroys, 2022-07-27, H.C. Gjerlaug 7632 (O L-229283); Åmot, Nordre Løset v riksveg, 61.40°N, 11.37°E, alt. 270 m, på gruset bakke ved gårdsavkjørsel, 2022-08-23, H.C. Gjerlaug 7672 (O L-229299); *Oppland*: Vang, along Vennisvegen, SW of Sandvike, 61.1483°N, 8.5958°E, alt. 500 m, on the ground in roadside, 2015-09-07, E. Timdal WG1-1727 (O L-201347); *Oslo*: Tormods vei 19B, 59.8817°N, 10.7987°E, alt. 170 m, on rock outcrop in garden, 2014-06-15, S. Rui & E. Timdal WG1-0155 (O L-196072); *Sør-Trøndelag*: Oppdal, Kongsvoll, 62.3027°N, 9.6063°E, alt. 900 m, on the ground in grassy slope, 2014-09-03, E. Timdal WG1-0818 (O L-196341); *Vest-Agder*: Farsund, Lista, Kviljø, 58.071°N, 6.691°E, 1975-07-21, G. Larsen (BG L-6342).

17. *Peltigera wulingensis* L.F. Han & S.Y. Guo

Nomenclature and description: Han et al. (2013).

Taxonomic notes: The four Norwegian sequences show a maximum intraspecific distance of 0.2% and a distance to the nearest Norwegian neighbour (*P. rufescens*) of 2.5% (Table 2).

Distribution and habitat: The species was described from China by Han et al. (2013) and has later been reported from Canada and Russia by Magain et al. (2018) and from Norway by Haugan & Timdal (2019). The single Norwegian locality of Haugan & Timdal (2019) is now supplemented by three additional collections from two localities (Fig. 4). Two of the Norwegian localities are in open habitat along the shore of a major river (Gudbrandsdalslågen), the third on sand/gravel in open pine forest.

Specimens examined: Norway. Oppland: Lillehammer, W bank of river Gudbrandsdalslågen N of Styggølet, 61.1868°N, 10.4139°E, alt. 130 m, mossy schistose rock outcrop along river; regularly flooded, 2020-05-28, R. Haugan 200230 (O L-235688); Lillehammer, W bank of river Gudbrandsdalslågen near Styggølet, 61.1870°N, 10.4136°E, alt. 130 m, top of mossy rock outcrop along large river, 2020-05-28, R. Haugan 200238 (O L-235695); Sør-Fron, Espedal, Valdresvika, 61.4373°N, 9.4895°E, alt. 730 m, on sand/gravel in S facing slope in open area in pine forest, 2021-07-12, E. Timdal 18851 (O L-228533); Øyer, Hovdfossen, eastern bank of river Lågen, 61.2900°N, 10.2811°E, alt. 190 m, horizontal, mossy rock close to river, 2018-05-09, R. Haugan 180103 (O L-224378).

18. *Peltigera* sp.

Taxonomic notes: This single specimen, which resembles *P. lepidophora* morphologically, is recovered in the *P. didactyla* group (Fig. 1A), i.e., distant from *P. lepidophora* 1 and 2 of Magain et al. 2018 (= *P. lepidophora* s. str. and *P. alkalicola*) in the *P. rufescens* group (Fig. 1B). More material is needed before taxonomic conclusions can be made.

Specimens examined: Norway. Oppland: Dovre, Kattuglehøe S, 62.0748°N, 9.5749°E, alt. 1330 m, på fyllittsandjord i tørrbakke. S-vendt skrent i alpin sone., 2013-08-04, J.T. Klepsland JK13-L582 (O L-198351).

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