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Habitat patches of green shield-moss (*Buxbaumia viridis*) host diverse set of bryophytes and lichens of conservation concern: case study from hemiboreal Estonia

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Abstract: Green shield-moss *Buxbaumia viridis* is an epixylic forest bryophyte threatened in several European countries. In Estonia, the species belongs to the strictest protection category since 2004 and therefore, around each species localities the habitat patch is delineated and excluded from any logging activity. The aim of the current study was to survey do habitat patches of *B. viridis* entail other species of conservation concern (SPEC) and if they do, to evaluate specificity of such additional protection value. Standardised stand-scale survey of bryophytes and lichens in 12 habitat patches of *B. viridis* revealed in total 60 SPEC species (37 lichen and 23 bryophytes). Woodland indicator species and/or dead-wood specialists dominated among SPEC bryophytes and red-listed epiphytic species among SPEC lichens, but legally protected bryophytes and lichens were scarce. Comparison with the dataset collected with the same survey protocol from 12 forest sites not inhabited by *B. viridis* (but being potentially suitable habitats for the species in terms of forest site type and age) showed lower total SPEC richness (48 species) but no significant difference on mean SPEC number per plot. However, lichens SPEC composition differed between site groups. This indicates, that at least in European hemiboreal region, where clear-felling based forestry is prevailing, logging-free zone around all localities of *B. viridis* can provide simultaneous protection for diverse set of SPEC bryophytes and lichens, which are often inconspicuous and legally not strictly protected at the national level. In the current study also the presence of gemmae of *B. viridis* was confirmed for the first time in Estonia.

Kokkuvõte: Roheline hiidkupar *Buxbaumia viridis* on epiksüülne metsasammal. Ta on ohustatud mitmes Euroopa riigis ning alates 2004. aastast kuulub liik Eestis esimese kaitsekategooria liikide nimekirja. Sellega seoses on kõigis tema piiritletud elupaikades igasugune raietegevus keelatud. Käesoleva töö eesmärgiks oli uurida, kas rohelise hiidkupra elupaigalaikudes esineb ka teisi looduskaitseliselt tähelepanuväärseid (SPEC) liike ja hinnata sellise täiendava kaitseväärtuse erilisust. Rohelise hiidkupra 12 elupaigas puistu tasemel tehtud standardsel sammalde ja samblike inventuuril leiti kokku 60 SPEC liiki (37 samblikku ja 23 sammalt). Neist sammalde hulgas domineerisid metsa vääriselupaiga indikaatorliigid ja/või kõdupuidu spetsialistid ning samblike hulgas punasesse nimekirja kantud epifüütsed liigid. Kaitsealuseid sambla- ja samblikuliike esines aladel vähe. Võrreldes sama inventuurimeetodiga kogutud liigiandmestikuga 12-st metsast, kus rohelist hiidkupart ei leitud (kuid mis on liigile potentsiaalselt sobivad elupaigad metsa kasvukohatüübi ja vanuse poolest), oli SPEC liikide koguarv neis madalam (48 liiki), kuid keskmine liigirikkus prooviala kohta oluliselt ei erinenud. Siiski SPEC samblike kooslus erines hiidkupraga asustatud proovialade omast. See viitab, et Euroopa hemiboreaalses piirkonnas, kus on valdav lageraiepõhine metsandus, võib raie keeld kõigis rohelise hiidkupra leiukohtades pakkuda samaaegset kaitset SPEC sambla- ja samblikuliikidele, mis on sageli silmapaistmatud ning pole enamasti riikliku kaitse all. Käesolev uuring kinnitas esmakordselt, et Eestis esineb rohelisel hiidkupral sigikehasid.

Keywords: cryptogams, forest set-asides, species protection, indicator species, dead-wood specialists

INTRODUCTION

Green shield-moss *Buxbaumia viridis* (Moug. ex Lam. & DC.) Brid. ex Moug. & Nestl. is an epixylic forest bryophyte having narrow niche in terms of substrate and habitat (Guillet et al., 2021; Pantović et al., 2023). It was long known to be scatteredly distributed in Europe and thus considered threatened (ECCB, 1995: Vulnerable) and included in the Annex I of Bern Convention and Annex II of EU Habitats Directive (Anonymous 1979; Anonymous 1992). As a consequence, *B. viridis* has been actively studied in many European countries and it turned out to be more frequent and widespread than previously thought (e.g., Holá et al., 2014; Guillet et al., 2021; Ștefănuț et al., 2023).

In recent decades, notable breakthrough in knowledge about the species substrate use, habitat ecology and distribution has taken place. For example, *B. viridis* can also form long-lived protonema and gemmae (Wolf, 2015; Deme & Csiky, 2021), which belong to the diaspore bank and can form new plants in suitable conditions. Surprisingly, the species preference for well-

decayed coniferous logs and old-growth forests in Sweden and France (Wiklund 2002; Guillet et al., 2021) seems not to be the case in some other regions of Europe (e.g., Deme et al., 2020). Records from various decay stages of logs and tree species (including deciduous trees) and even from ground, are reported (Holá et al., 2014; Deme et al., 2020; Guillet et al., 2021). Moreover, managed forests, including coniferous plantations, can be habitats for the species in Czech Republic, Hungary, Poland and Bulgaria (Holá et al., 2014; Deme et al., 2020; Brewczyński et al., 2021; Natcheva et al., 2024). However, sufficient amount of wood of the advanced decay stages as well as constant humidity seem to be still crucial factors for the species occurrence (Holá et al., 2014; Kropik et al., 2021). In addition, factors like herbivory by young slugs, mice and other unidentified animals (Infante & Heras, 2018; Kropik et al., 2020) or vulnerability to altered precipitation regime (Kropik et al., 2021) could have decisive influence on the species populations.

Although population size of *B. viridis* was severely underestimated in Europe and the species was not evaluated as threatened in the last assessment of European Red List (Hodgetts et al., 2019), it still is evaluated as threatened in several countries (Hodgetts & Lockhart, 2020). In the last Estonian Red List assessment in 2017, *B. viridis* was evaluated as vulnerable (VU) based on 10 known locations (one in mainland and all others in western islands of Estonia) and on continuous decline of habitat quality because of the clear-felling based management and lowering the cutting age of spruce forests (Ingerpuu et al., 2018). The number of localities of the species has risen more than twice during the last few years, including several localities in mainland, mostly due to systematic surveys, especially during the mild and snowless winter in 2020 (Abarenkov et al., 2010; Lõhmus et al., 2020). Despite risen number of localities, the species belongs to the strictest protection category since 2004 (for the background: Estonian protected species are divided into three protected categories, the strictest of which is

Table 1. Characteristics of surveyed habitat patches of *Buxbaumia viridis*. Abbreviations of the dominant tree species: Bet – *Betula* spp., Pop – *Populus tremula*, Pic – *Picea abies*, Pin – *Pinus sylvestris*. Individual is one substrate unit (e.g. log, stump) inhabited by sporophytes of *B. viridis*. In the last column * in the bracket indicates that in the study site substrata with only gemmae of *B. viridis* were found too.

Site ID	County, site name	Habitat patch			No. of individuals within 2 ha plot	
		Size (ha)	Dominant tree species (age, yrs)	Year of registration	In the year of registration	In 2022
1	Hiiumaa, Koidma	7.1	Pop (116)	2011	3	2
2	Hiiumaa, Leluküla	3.7	Pic (106-151)	2013	2	1
3	Läänemaa, Suuremõisa	7.2	Pin (124)	2022	1	2
4	Läänemaa, Rõuma	3.3	Pic (104)	2020	2	2 (*)
5	Raplamaa, Pajaka	4.7	Pic (112)	2021	1	1 (*)
6	Raplamaa, Kastna	2.0	Pin (128)	2021	1	1
7	Raplamaa, Pilli	16.9	Pin (104)	2021	1	1 (*)
8	Saaremaa, Ruhnu	6.2	Pic (186)	2012	3	2
9	Saaremaa, Viki	8.3	Pin (166)	2021	3	3
10	Saaremaa, Võhma	9.5	Pin (100)	2021	8	9 (*)
11	Ida-Virumaa, Oonurme	2.9	Pin (146)	2021	1	1 (*)
12	Harjumaa, Kotka	2.4	Pic (132)	2022	1	1 (*)

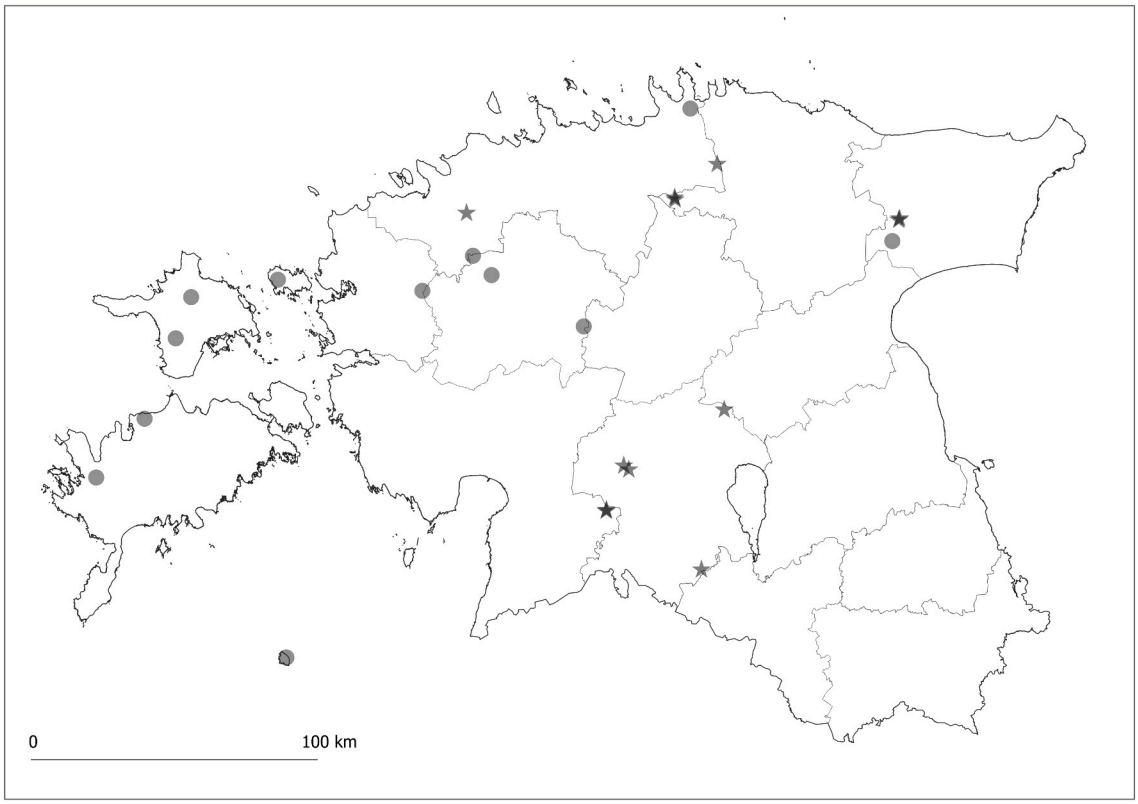

Fig. 1. Locations of study sites inhabited by *B. viridis* (circles) and not inhabited by the species, but being potentially suitable in terms of forest site type and age (stars; some sites situate close to each other). Borderlines of counties in the mainland of Estonia are also shown.

Category I and the least strict is Category III; for details see https://www.keskkonnaamet.ee/en/wildlife-nature-protection/nature-protection/conservation-species). That means all species localities (i.e. habitat patches delineated around substrata inhabited by sporophytes) are registered in the Estonian Nature Information System (https://keskkonnaportaal.ee/et/eelis) and any forestry activity (including logging) is prohibited there in order to ensure continuity of deadwood, both in spatial and temporal perspective.

In Estonia, *B. viridis* grows mainly on coniferous well-decayed logs in old unmanaged or selectively cut managed coniferous dominated forests. In such forests, large-sized dead wood is a valuable substrate not only for *B. viridis*, but can be a biodiversity hotspot for other threatened species, including bryophytes and lichens (Lassauce et al., 2011). In addition, older forests with logs often provide diverse set of other substrata (like snags, windthrows; Lõhmus & Kraut 2010) inhabited by various specialist species (e.g., Palm-Hellenurm et al. 2024; Lõhmus & Lõhmus, 2019). Hence, if all localities of *B. viridis* are strictly protected, like in Estonia, it may entail simultaneous conservation of other rare or threatened epiphytic and epixylic species, being not under strictest protection *per se*. So far, this possibility has not been assessed at the stand scale for bryophytes nor for other cryptogams groups.

The aim of the current study was to survey stand scale richness and composition of bryophyte and lichen species of conservation concern (SPEC; includes legally protected, threatened and/or indicator species of woodland key habitats) in habitats of *B. viridis* and to evaluate its specificity if compared to forest sites not inhabited by *B. viridis*, but being potentially

suitable habitats in terms of forest site type and age (i.e. the background). The study focuses both on bryophytes and on lichens as these organism groups share often same microhabitats and substrates in the forests and hence similar conservation practices can be applied.

MATERIALS AND METHODS

The study region, Estonia, is situated in the European hemiboreal vegetation zone (Ahti et al., 1968). The long period (1991–2020) mean air temperature in Estonia is 17.8°C in July and -3.1°C in January; the average precipitation is 600–700 mm yr^{-1}. In the study year, 2022, mean temperature in July was similar to the long period, but January was slightly warmer (-1.5°C) and there was less precipitation on that year (average 530 mm yr^{-1}); however, in July mean precipitation was 106% of the long period mean (https://www.ilmateenistus.ee/kliima/aastakokkuvotted).

The study includes two datasets: one collected from habitats of *B. viridis* and second from comparable forest sites not inhabited by the species (i.e. the background dataset). The study sites of *B. viridis* were selected from the Estonian Nature Information System (https://keskkonnaportaal.ee/et/eelis) in May 2022. In total 213 habitat patches of *B. viridis* (based on sporophyte occurrences only) were registered in the system at that time. The patches were delineated around the substratum (or substrata) inhabited by sporophytes, often with minimum radius of 60 m (i.e. double length of the height of spruces in the canopy layer); however, the shape and size of the patches varied depending on the availability of substrata or distribution of suitable forest stand and it was not directly related to the population size of the species. Average habitat patch size was 3.9 ± 4.8 ha (minimum 0.12 ha and maximum 42.7 ha). All registered habitat patches with size of at least 2 ha (n=113) were preselected for the current study. These 113 habitat patches were distributed over six counties where the species was known in Estonia on that time. For each of these counties 1-3 habitat patches, depending on the species frequency within the county, were selected randomly, summing up 12 study sites (Fig. 1, Table 1; note that plot coordinates are not given due to the legislation that locations of the highest protection category species are not a public information). Because of the limited project budget, it was not possible to rise the sample size, as there was already a high work load related to inventories and species identifications (note, it was done separately for lichens and bryophytes).

Prior the inventory of bryophyte and lichen assemblages, a 2 ha large study plot was delineated on map within the selected habitat patch of *B. viridis*. The plot covered forest compartment with the same forest site type and main tree age as well as included substratum/-ta inhabited by *B. viridis*. Next, the standardised fixed-area-fixed-effort inventory protocol (Lõhmus et al., 2018) was applied in all 12 sites: the full assemblage of bryophytes was inventoried within 2 ha plot for four hours with the primary aim to find as many species as possible. For that, all types of suitable substrates up to 2 m height from the forest floor (e.g.. bark and wood of live and dead trees, pit and mounds of tree uproots, forest floor itself) were checked. For each detected species, a five-point abundance scale was used (1, one record; 2, 2–5 records; 3, 6–15 records; 4, 16–100 records; 5, >100 records). Same protocol was applied hereafter to survey full assemblage of lichens (includes lichenised fungi and saprotrophic or lichenicolous calicioid fungi). Surveys of both organism groups were made by P. Lõhmus between July 11 and August 23, 2022.

The background dataset was formed of already published inventory datasets of 12 forest sites not inhabited by *B. viridis*, but being potentially suitable habitat for the species in terms of forest site type (dry boreal, mesotrophic mixed and drained peatland coniferous forests), dominant tree species (either pine or spruce) and of the stand age and management combination (mature managed or old-growth unmanaged forests; four of them situated in strictly protected areas within nature reserves). This background dataset of bryophytes and lichens was collected from the mainland of Estonia by P. Lõhmus between 2007–2010 and 2014–2016, using the same standardised fixed-area-fixed-effort inventory protocol described above (i.e. full assemblage inventory; Lõhmus et al., 2018) and being a part of published studies of Tullus et al. (2018), Lõhmus & Lõhmus (2019) and Lõhmus et al. (2021). For the better reference purpose, only sites closer to habitat patches of *B. viridis* were

Table 2. List of bryophyte species of conservation concern (SPEC) and their abundance (at 1-5 scale, see methods for details) found at 2 ha study plots. SPEC classification: I, II or III – category of legally protected species (see Introduction); red-listed, categories: EN – endangered, VU – vulnerable, NT – near-threatened; WKH – indicator species of woodland key habitat. * – indicates wood specialist species (growing on logs or stumps).

Basis for SPEC	**Species**	**Site ID/ Abundance on the site**												**Freq.**
		1	2	3	4	5	6	7	8	9	10	11	12	
WKH	*Alleniella complanata*	2									2			**2**
VU	*Atrichum angustatum*	1												**1**
II, NT, WKH	*Bazzania trilobata*								1					**1**
I, VU, WKH	*Buxbaumia viridis**	2	1	2	2	2	1	2	1	2	3	2	2	**12**
III, WKH	*Crossocalyx hellerianus**						1	3				2		**3**
WKH	*Dicranum flagellare**					2							1	**2**
WKH	*Frullania dilatata*	3	3											**2**
III, WKH	*Hamatocaulis vernicosus*					1								**1**
WKH	*Isothecium alopecuroides*							1						**1**
WKH	*Lepidozia reptans**	4	3	2	3	3	4	2	3	3	2	3	2	**12**
III	*Leucobryum glaucum*									1				**1**
WKH	*Liochlaena lanceolata**				1			1						**2**
VU	*Lophozia ascendens**				1			2						**2**
WKH	*Mnium hornum*								4					**1**
III, WKH	*Neckera pennata*		1									1		**2**
WKH	*Nowellia curvifolia**	3	4	3	3	4	4	4	2	4	4	4	3	**12**
WKH	*Odontoschisma denudatum**	3					1			4	1			**4**
NT	*Plagiothecium nemorale*	1							2					**2**
WKH	*Riccardia latifrons**	2			1		2					1		**4**
WKH	*Riccardia palmata**	3											1	**2**
III, NT, WKH	*Scapania apiculata**							3						**1**
III, WKH	*Sphagnum wulfianum*						2							**1**
WKH	*Syzygiella autumnalis**				1	3	2	2				2		**5**
WKH	*Ulota crispa s. lato*	3	3		2	3		1	1		2			**7**
	TOTAL SPEC (*B. viridis* excluded)	*10*	*5*	*2*	*7*	*6*	*7*	*9*	*6*	*4*	*5*	*6*	*4*	***23***
	among SPEC: legally protected	*0*	*1*	*0*	*0*	*1*	*2*	*2*	*1*	*1*	*0*	*2*	*0*	***7***
	red-listed	*2*	*0*	*0*	*1*	*0*	*0*	*2*	*2*	*0*	*0*	*0*	*0*	***5***
	WKH indicators	*8*	*5*	*2*	*6*	*6*	*7*	*8*	*5*	*3*	*5*	*6*	*4*	***19***
	wood specialist	*5*	*2*	*2*	*6*	*4*	*6*	*7*	*2*	*3*	*3*	*5*	*4*	***11***

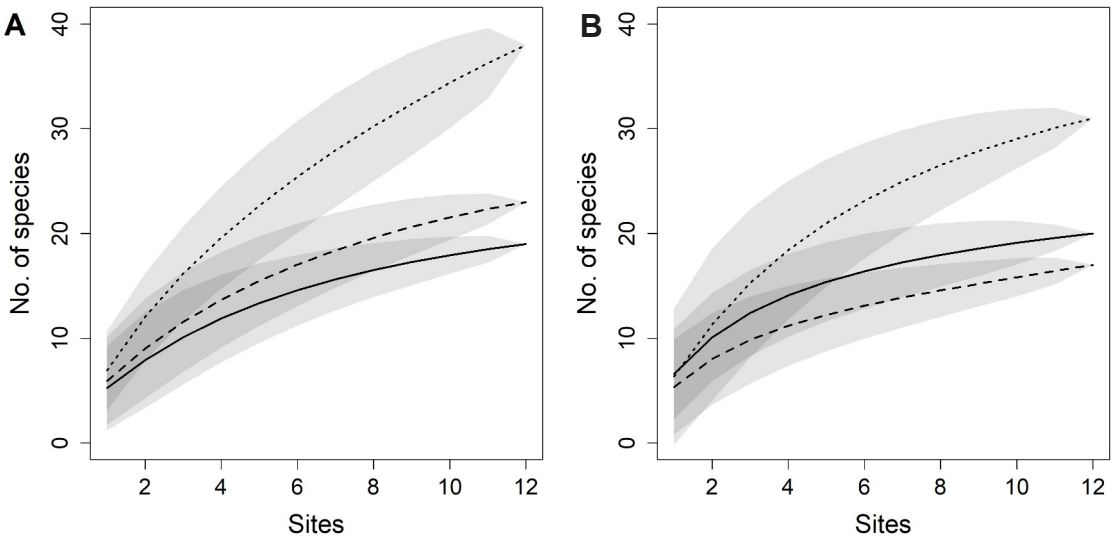

Fig. 2. Rarefaction curve of species of conservation concern for lichens (dotted line), bryophytes (dashed line) and for dead-wood specialist species (straight line; bryophytes and lichens pooled) in the habitat sites of *B. viridis* (A) and in comparative sites not inhabited by *B. viridis* (B). Grey area represents 95% CI (dataset was randomly re-sampled for 100 times). For the analyse, *B. viridis* was excluded from the dataset.

chosen (on average 42 km; Fig. 1), but no comparable datasets were available from western islands.

Where necessary, specimens that could not be identified in the field were collected and examined in the lab (bryophytes by N. Ingerpuu and M. Leis and lichens by P. Lõhmus), using microscope and colour spot tests (to detect lichen compounds). The nomenclature follows Vellak et al. (2015) for bryophytes and Randlane et al. (2019) for lichens. Vouchers of species of particular interest have been deposited in the collections of the University of Tartu Natural History Museum (TU, TUF).

The analysis focused on richness and composition of species of conservation concern (SPEC). SPEC were distinguished as species being legally protected in Estonia, nationally red-listed (threat categories CR, EN, VU and NT), and/or being indicators of woodland key habitats (Anonymous 2017). The national red lists followed the last assessments (Ingerpuu et al., 2018; Lõhmus et al., 2019; Randlane et al., 2019; 2021) and official assessment data from Estonian Nature Information System (https://keskkonnaportaal.ee/et/eelis). Difference on SPEC species numbers between two site groups (inhabited or not inhabited by *B. viridis*) was tested with one-way ANOVA using STATISTICA 7 software (StatSoft; Tulsa, Okla, USA). Difference on assemblage composition of SPEC species was tested using multi-response permutation procedures (MRPP). MRPPs test whether Sørensen (Bray–Curtis) distances between predefined groups exceed those resulting from random assignment of the sample. The species matrix comprised species abundance class (1–5) in each plot. In addition, indicator species analysis (Dufrêne & Legendre, 1997) was carried out to test for characteristic species for the habitat sites of *B. viridis*. All these analyses were carried out in PC-ORD vers. 6.07 (McCune & Mefford, 2011).

RESULTS

In all 2 ha study plots selected from habitat patches of *B. viridis*, sporophytes of *B. viridis* were recorded in the year of the study as well (even in sites where species was first recorded 12 years ago). Only in few plots the species was abundant, occurring on more than five substrate

Table 3. List of lichen species of conservation concern (SPEC), their abundance (at 1-5 scale, see methods for details) and total frequency found on 2 ha plots in 12 habitat patches of *B. viridis*. SPEC classification: II or III – category of legally protected species (see Introduction); red-listed, categories: EN – endangered, VU – vulnerable, NT – near-threatened; WKH – indicator species of woodland key habitat. * – indicates wood specialist species (growing on snags, stumps, logs or windthrows).

Basis for SPEC	Species	Site ID/ Abundance on the site												Freq.
		1	2	3	4	5	6	7	8	9	10	11	12	
WKH	*Acrocordia cavata/gemmata*	2												**1**
WKH	*Arthonia leucopellaea*								1				1	**2**
NT	*Arthonia spadicea*	3	2		1	2	1	1	3					**7**
NT, WKH	*Arthonia vinosa*				2		1	2		1				**4**
NT	*Biatora chrysantha*				1			1						**2**
NT	*Biatora ocelliformis*					1		1						**2**
II, VU	*Biatoridium monasteriense*	2												**1**
II, VU, WKH	*Carbonicola anthracophila**											1		**1**
WKH	*Chaenotheca brachypoda**	1			2		2							**3**
NT	*Chaenotheca chlorella**	1	1	2	1									**4**
VU, WKH	*Chaenotheca phaeocephala**			1										**1**
NT	*Chaenothecopsis consociata*			2			1							**2**
NT	*Chrysothrix candelaris*								1					**1**
NT	*Chrysothrix flavovirens*		1	4					2	2				**4**
NT	*Cladonia gray*							1		1				**2**
VU	*Cliostomum flavidulum*			2		1			2	2	2	1		**6**
NT	*Cliostomum griffithii*										2			**1**
VU	*Cliostomum leprosum*					2								**1**
VU	*Fellhanera bouteillei*												1	**1**
NT, WKH	*Hypogymnia farinacea*	1												**1**
WKH	*Lecanactis abietina*	3	4	4	2	1			4	2	3		3	**9**
NT	*Lecanora farinarea*												1	**1**
VU	*Lecidea leprarioides*			1		2					1			**3**
III, VU	*Leptogium saturninum*											1		**1**
III, VU	*Lobaria pulmonaria*						1							**1**
III, VU	*Megalaria grossa*	2												**1**
NT	*Melanelixia glabratula*	2	2		1	1			1	2				**6**
EN	*Micarea myriocarpa**											1		**1**
VU	*Micarea tomentosa**												1	**1**
NT	*Microcalicium disseminatum*					1			2					**2**

Table 3. Continued.

Basis for SPEC	Species	Site ID/ Abundance on the site												Freq.
		1	2	3	4	5	6	7	8	9	10	11	12	
EN	*Peltigera neopolydactyla*												1	**1**
NT	*Pertusaria coronata*	1												**1**
NT	*Psilolechia lucida**						1							**1**
II, VU	*Scytinium teretiusculum*					1								**1**
III, VU, WKH	*Thelotrema lepadinum*		2											**1**
III, NT	*Usnea barbata*												1	**1**
NT	*Xylopsora friesii**					1				1				**2**
	TOTAL SPEC	**10**	**6**	**7**	**7**	**10**	**6**	**5**	**8**	**7**	**4**	**4**	**7**	**37**
	among SPEC: legally protected	*2*	*1*	*0*	*0*	*1*	*1*	*0*	*0*	*0*	*0*	*2*	*1*	***8***
	red-listed	*7*	*5*	*6*	*5*	*9*	*5*	*5*	*6*	*6*	*3*	*4*	*5*	***33***
	WKH indicators	*4*	*2*	*2*	*3*	*1*	*2*	*1*	*2*	*2*	*1*	*1*	*2*	***9***
	wood specialist	*2*	*1*	*2*	*2*	*1*	*2*	*0*	*0*	*1*	*0*	*2*	*1*	***8***

units. For the first time in Estonia, gemmae of *B. viridis* were searched and found (Table 1; see photos of the specimen TU162181, https://elurikkus.ee/app/occurrences/occurrence/21569913).

In total, 122 bryophyte and 149 lichen species were found in 12 study plots inhabited by *B. viridis* (Appendix 1), out of them 60 species (37 lichen and 23 bryophytes, *B. viridis* not included) were of conservation concern (SPEC). Mean number of bryophyte SPEC species per plot was 4.9 (±2.29 SD) and of lichens 6.7 (±2.0 SD) species. Within SPEC species, woodland indicator species and/or epixylic species dominated among bryophytes and epiphytic red-listed species among lichens (Table 2 and 3). Most protected or red-listed bryophytes occurred only in one or two plots and in low abundances (e.g., *Atrichum angustatum*, *Bazzania trilobata, Hamatocaulis vernicosus*, *Leucobryum glaucum*, Table 2). Legally protected lichens were scarce and in low abundances too, but notable was the occurrence of three epiphytic cyanolichens (*Lobaria pulmonaria, Leptogium saturninum*, *Scytinium teretiusculum*) and some crustose lichens related to old aspens and/or broad-leaved trees (e.g., *Biatoridium monasteriense*, *Megalaria grossa*; Table 3).

Based on the affinity on dead wood, half of SPEC bryophytes found in habitat patches of *B. viridis* can be considered as dead-wood specialists (on average there were 4.1±1.7 SD of such species per plot). They grew mainly on decayed logs (e.g., *Lophozia ascendens*, *Odontoschisma denudatum*, *Scapania apiculata*), but only few of them (e.g., *Nowellia curvifolia*) had high abundance per plot (Table 2). Among lichen SPEC, proportion of wood dwelling specialists was relatively low (on average 1.2±0.8 SD species per plot), however, they inhabited other types of dead wood, like snags (e.g., *Chaenotheca brachypoda* and *C. chlorella*), windthrows (e.g. *Psilolechia lucida*) or charred wood (e.g. *Carbonicola anthracophila*) (Table 3).

Comparison of SPEC richness between site groups (inhabited vs not inhabited by *B. viridis*) revealed no difference on mean SPEC number per plot, both in case of bryophytes ($F=0.066$, $p=0.800$) and lichens ($F=0.136$, $p=0.716$) (Appendix 2). Still, unlike to bryophyte SPEC, lichens SPEC number did not approach plateau if more habitat patches of *B. viridis* were sampled (Fig. 2) and according to MRPP test, only lichens SPEC composition differed between site groups ($A=0.05$, $p<0.001$). However, indicator species analysis showed only three species that had significant and relatively high (>30) indicator value for habitat sites of *B. viridis* (they

were epiphytic red-listed lichens *Cliostomum flavidulum* and *Melanelixia glabratula,* and epixylic bryophyte *Nowellia curvifolia*), while no such indicator species were distinguished for the background dataset (Appendix 3).

DISCUSSION

Current study showed that strictly protected habitat patches of *B. viridis*, sampled over its all known distributional area in Estonia, can host simultaneously diverse set of other bryophyte and lichen species of conservation concern (SPEC), especially dead wood specialists and/or woodland key habitat indicator species among bryophytes, and epiphytic red-listed species among lichens. This result can be linked directly with the affinity of *B. viridis* to grow on (large) well-decayed logs in our region (Wiklund 2002; P. Lõhmus unpublished data). If such logs have been inhabited by *B. viridis* in the stand, there must have been enough substrate patches in different decay stages in order to ensure the continuous presence of the population. This situation favours other obligate epixylic bryophyte species (Holá et al., 2014), like *Crossocalyx hellerianus, Lophozia ascendens* and *Odontochisma denundatum* in the current study. In addition, for the presence and accumulation of logs in the stand, other dead wood types, like snags, stumps and windthrows as well as old live trees are prerequisite (e.g. Lõhmus & Kraut, 2010). All they are substratum types providing at the same time their own microhabitat heterogeneity (e.g. various decay stages, size, bark texture, moisture conditions) for habitat-specialized and/or dispersal limited bryophytes and lichens (e.g., Ellis, 2012; Zemanová et al., 2017; Palm-Hellenurm et al., 2024). Such are SPEC lichens *Cliostomum griffithii* and *Usnea barbata* on old spruces and SPEC bryophyte *Atrichum angustatum* on windthrows.

In hemiboreal forests, at the stand scale, total lichen richness as well as number of SPEC species is higher than that of bryophytes (Remm et al., 2013; Lõhmus et al., 2021). Therefore, by expectation, lichens rarefaction curve was steeper than that of bryophytes (Fig. 2). In addition, the occurrence of old aspens and nemoral broad-leaved trees (ashes, maples) in coniferous dominated forests contribute different sets of sensitive or infrequent lichen species (Lõhmus & Lõhmus, 2019), like in the current study the occurrence of epiphytic cyanolichens (e.g. *Lobaria pulmonaria*) and microlichens growing on broad-leaved trees (e.g., *Biatoridium monasteriense*, *Megalaria grossa, Thelotrema lepadinum*). The fact that rarefaction curve did not approach the plateau if more habitats of *B. viridis* were sampled, unlike to comparable sites not inhabited by *B. viridis*, indicates that habitats of *B. viridis* tend to contribute more different sets of SPEC species compared to the background (the result was supported by MRPP test too). Indicator species analysis revealed three species with affinity to habitats of *B. viridis*, but in case of crustose microlichen *Cliostomum flavidulum* it is more as a result of increased survey quality of researcher to recognize the species in the field. However, the occurrence of *Nowellia curvifolia* in all habitats of *B. viridis* and in high abundance (opposite to the background dataset) can be linked with higher volume of decayed logs, as have shown before (Dahlerup, 2010).

It is shown that old-growth forest dependent cryptogam species can be effectively protected by large nature reserves, but rare (red-listed) species depend more on setting aside their scattered localities (Perhans et al., 2007; Lõhmus & Lõhmus 2019). Indeed, being known from a handful of localities two decades ago in Estonia, *B. viridis* was attributed then to the highest category of legally protected species and strict protection in all habitat patches (including on private lands) was applied. Systematic surveys have risen number of new finds explosively (Lõhmus et al. 2020) and in the species core area (i.e. western islands) it has been found also from selectively cut managed forests (P. Lõhmus, unpublished data), pointing to the need to re-evaluate its red-list status (currently as "Vulnerable"), like has been done elsewhere in Europe (e.g. Natcheva et al., 2024).

For the oncoming new national red-list assessment it is important to estimate the trend of the national population size (application of criterium A2c) not based solely on the changed number of locations, but on the extent of decreased area of suitable habitat for the species (i.e. the proxy of the habitat quality; Maes et al., 2015). The last approach is essential, because clear-felling based intensive forestry is prevailing in Estonia

(even on nature reserves), not continuous cover forestry, that is prevailing in many other European countries (Mason et al., 2022). The latter has been reported to be effective for the maintenance of the populations of *B. viridis* in production forests (Deme et al., 2020; Natcheva et al., 2024).

In conclusion, current study highlights that having logging-free zone around all localities of *B. viridis* can be valuable conservation tool not only for the species itself, but for other SPEC populations among epixylic bryophytes and epiphytic lichens, especially for inconspicuous (e.g., hepatics and microlichens) and legally unprotected species at the national level.

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Appendix 1. List and abundance of bryophyte (BRY) and lichen (LICH) species found in habitat patches of *Buxbaumia viridis* (B. vir +) and in the comparable reference sites not inhabited with *B. viridis* (B.vir -). Plot size is 2 ha for all sites. Abundance classes: 1, one record/substratum unit; 2, 2–5 records; 3, 6–15 records; 4, 16–100 records; 5, >100 records). SPEC classification: I, II or III – category of legally protected species; red-listed, categories: EN – endangered, VU – vulnerable, NT – near-threatened; WKH – indicator species of woodland key habitat. * – indicates wood-dwelling species (growing on snags, logs, stumps, windthrows).

Organism group	Species	Basis for SPEC / Site ID	Site group B. vir +													Site group B. vir -											
			1	2	3	4	5	6	7	8	9	10	11	12	To-tal	2	3	4	5	6	7	8	9	10	11	12	To-tal
LICH	*Absconditella lignicola*		0	1	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	2	0	1	0	0	0	0	**2**
LICH	*Acrocordia cavata/gemmata*	WKH	2	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	1	1	1	0	0	0	0	0	**3**
LICH	*Anaptychia ciliaris*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	2	0	0	0	0	**2**
LICH	*Arthonia leucopellaea*	WKH	0	0	0	0	0	0	0	1	0	0	0	1	**2**	0	0	2	3	0	4	2	3	0	0	0	0	**5**
LICH	*Arthonia mediella*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	1	0	0	0	0	0	0	0	0	1	**2**
LICH	*Arthonia patellulata*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
LICH	*Arthonia punctiformis*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
LICH	*Arthonia radiata*		0	0	0	2	0	0	0	3	0	0	0	0	**2**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
LICH	*Arthonia spadicea*	NT	3	2	0	1	2	1	1	3	0	0	0	0	**7**	0	0	0	0	0	1	0	2	0	0	0	0	**2**
LICH	*Arthonia vinosa*	NT, WKH	0	0	0	2	0	1	2	0	1	0	0	0	**4**	0	0	0	0	0	0	1	0	1	0	0	1	**3**
LICH	*Arthothelium ruanum*		0	1	0	3	2	0	0	0	0	1	4	0	**5**	0	0	0	0	1	1	0	2	0	0	0	0	**3**
LICH	*Bacidia arceutina + sp*		0	0	0	2	0	3	1	0	0	1	2	1	**6**	1	0	0	1	0	1	0	0	0	0	0	0	**3**
LICH	*Bacidia fraxinea*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
LICH	*Bacidia globulosa*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	1	0	**1**
LICH	*Bacidia incompta*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	1	0	0	0	**1**
LICH	*Bacidia laurocerasi*	II, VU	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	2	0	0	0	0	0	0	**1**
LICH	*Bacidia polychroa*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
LICH	*Bacidia subincompta*		2	0	0	0	1	0	0	0	0	0	2	0	**3**	0	0	0	0	2	2	0	0	0	0	1	0	**3**
LICH	*Bacidina arnoldiana*		1	0	0	0	2	1	0	0	0	0	0	0	**3**	0	0	0	0	0	2	0	0	0	0	0	0	**1**
LICH	*Biatora chrysantha*	NT	0	0	0	1	0	0	1	0	0	0	0	0	**2**	0	0	0	1	0	0	0	0	0	0	1	0	**2**
LICH	*Biatora efflorescens*		3	1	1	3	2	3	2	1	2	1	2	0	**11**	0	0	2	1	2	3	2	2	2	0	3	2	**9**
LICH	*Biatora helvola*		1	0	0	0	0	0	0	0	0	0	3	2	**3**	0	0	2	0	0	2	0	0	0	0	2	2	**4**
LICH	*Biatora ocelliformis*	NT	0	0	0	0	1	0	1	0	0	0	0	0	**2**	0	0	1	0	1	2	0	1	0	0	0	0	**4**
LICH	*Biatoridium monasteriense*	II, VU	2	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Bryoria capillaris*		0	0	4	0	2	4	1	0	2	2	0	4	**7**	2	2	1	3	0	3	0	0	4	1	0	4	**8**
LICH	*Bryoria fuscescens*		0	0	0	0	0	1	0	0	0	2	0	1	**3**	0	2	2	1	0	1	0	0	3	0	3	3	**7**
LICH	*Buellia disciformis*		1	0	0	0	0	0	0	0	0	0	0	0	**1**	0	1	0	0	0	1	0	0	0	0	0	0	**2**
LICH	*Buellia erubescens*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	2	0	0	0	0	0	0	0	**1**
LICH	*Buellia griseovirens*		2	3	0	2	2	2	0	0	0	0	3	0	**6**	1	2	2	1	3	3	0	2	2	4	1	2	**11**
LICH	*Calicium glaucellum*		0	0	2	0	1	1	1	0	1	0	2	1	**7**	2	3	0	3	0	0	0	2	1	3	2	2	**8**
LICH	*Calicium parvum*		0	0	3	0	0	0	0	0	0	0	0	0	**1**	1	0	0	0	1	0	1	0	0	0	0	1	**4**
LICH	*Calicium pinastri*	VU	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	1	0	0	0	0	1	0	0	**2**
LICH	*Calicium salicinum*		0	0	0	0	1	1	0	0	0	0	0	0	**2**	0	0	0	1	0	0	0	1	0	0	0	0	**2**
LICH	*Calicium trabinellum**	NT	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	2	0	0	**1**
LICH	*Calicium viride*		0	0	0	0	1	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Caloplaca flavorubescens*		1	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	1	2	0	1	0	0	0	0	**3**
LICH	*Candelariella vitellina*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**

Appendix 1. Continued.

Organism group	Species	Basis for SPEC / Site ID	Site group B. vir +													Site group B. vir -											
			1	2	3	4	5	6	7	8	9	10	11	12	To-tal	1	2	3	4	5	6	7	8	9	10	11	12	To-tal
LICH	*Carbonicola anthracophila**	II, VU, WKH	0	0	0	0	0	0	0	0	0	0	1	0	**1**	3	1	0	2	0	1	1	0	0	0	0	0	**5**
LICH	*Cetraria islandica*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	1	3	0	0	0	0	0	0	0	0	0	0	**2**
LICH	*Cetraria sepincola*		0	0	0	0	0	1	0	0	0	0	0	0	**1**	0	2	0	0	0	0	1	0	0	0	0	0	**2**
LICH	*Chaenotheca brachypoda**	WKH	1	0	0	2	0	2	0	0	0	0	0	0	**3**	0	0	0	1	1	2	0	2	0	1	0	1	**6**
LICH	*Chaenotheca brunneola*		0	0	0	0	1	0	1	0	2	0	1	1	**5**	1	0	0	2	0	0	0	2	2	2	1	3	7
LICH	*Chaenotheca chlorella**	NT	1	1	2	1	0	0	0	0	0	0	0	0	**4**	0	0	0	2	0	1	0	0	0	0	0	0	**2**
LICH	*Chaenotheca chrysocephala*		1	1	3	2	3	2	2	2	2	3	2	2	**12**	3	0	2	3	2	3	0	3	3	2	2	3	**10**
LICH	*Chaenotheca ferruginea*		0	0	2	0	2	2	0	4	2	1	2	2	**8**	3	3	2	3	3	3	2	3	3	2	2	2	**12**
LICH	*Chaenotheca furfuracea*		2	0	1	2	2	0	2	0	1	1	2	2	**9**	0	0	1	0	0	3	0	3	0	0	2	3	**5**
LICH	*Chaenotheca gracillima**	NT	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	1	0	1	**2**
LICH	*Chaenotheca phaeocephala**	VU, WKH	0	0	1	0	0	0	0	0	0	0	0	0	**1**	0	0	0	1	0	0	0	0	0	0	0	0	**1**
LICH	*Chaenotheca stemonea*		1	1	1	0	2	3	0	1	0	0	2	2	**8**	0	0	0	2	1	1	0	1	2	0	1	2	**7**
LICH	*Chaenotheca trichialis*		1	0	2	1	2	2	0	2	0	0	2	0	**7**	0	0	0	2	0	0	2	1	3	0	1	0	**5**
LICH	*Chaenotheca xyloxena*		0	0	0	1	0	1	0	0	1	0	1	1	**5**	0	1	2	3	2	1	0	2	1	2	2	0	**9**
LICH	*Chaenothecopsis consociata*	NT	0	0	2	0	0	1	0	0	0	0	0	0	**2**	0	0	0	0	0	0	0	0	1	0	0	0	**1**
LICH	*Chaenothecopsis haematopus**	NT	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	1	0	0	0	0	1	0	0	**2**
LICH	*Chaenothecopsis nigra*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	1	0	0	0	0	0	0	0	0	0	0	**1**
LICH	*Chaenothecopsis pusilla*		0	0	1	0	0	0	0	0	0	0	0	0	**1**	0	0	0	2	1	2	0	0	0	0	0	0	**3**
LICH	*Chaenothecopsis pusiola*		0	0	0	0	0	1	0	0	0	0	0	0	**1**	0	1	0	2	2	0	0	0	0	2	2	1	**6**
LICH	*Chaenothecopsis savonica*		0	0	0	0	0	0	0	0	0	0	1	0	**1**	0	0	0	2	1	0	0	0	0	0	1	0	**3**
LICH	*Chaenothricha cilians**		0	0	0	0	1	2	0	0	0	1	0	1	**4**	0	0	0	0	0	0	0	0	0	1	0	1	**2**
LICH	*Chrysothrix candelaris*	NT	0	0	0	0	0	0	0	1	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Chrysothrix flavovirens*	NT	0	1	4	0	0	0	0	2	2	0	0	0	**4**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Cladonia bacilliformis*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	2	0	1	3	0	0	0	0	0	1	0	0	**4**
LICH	*Cladonia botrytes*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	1	0	0	0	0	0	0	0	0	**1**
LICH	*Cladonia cenotea*		2	1	2	0	0	1	2	0	2	2	0	2	**8**	3	2	3	3	4	3	3	2	2	3	2	3	**12**
LICH	*Cladonia chlorophaea*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	1	1	0	1	2	2	1	1	0	0	0	0	**7**
LICH	*Cladonia coniocraea*		3	4	4	4	4	4	4	0	3	3	3	3	**11**	2	2	3	2	4	4	4	3	3	3	2	3	**12**
LICH	*Cladonia cornuta*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	1	2	0	2	0	0	0	0	0	1	0	1	**5**
LICH	*Cladonia crispata*		1	0	0	0	0	0	0	0	0	0	0	0	**1**	0	1	0	0	0	0	0	0	0	0	0	0	**1**
LICH	*Cladonia deformis*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	1	1	0	1	0	0	0	0	0	0	0	0	**3**
LICH	*Cladonia digitata*		3	3	3	2	2	3	4	3	4	3	3	3	**12**	3	3	4	4	2	4	3	3	3	3	2	3	**12**
LICH	*Cladonia fimbriata*		2	0	3	2	3	2	3	0	2	3	2	3	**10**	3	2	3	3	3	3	3	3	3	2	3	3	**12**
LICH	*Cladonia furcata*		0	0	2	0	0	0	1	0	2	2	0	2	**5**	0	0	0	0	0	0	0	0	1	0	0	0	**1**
LICH	*Cladonia gracilis*		0	0	0	0	0	0	0	0	0	0	0	1	**1**	0	2	0	0	0	0	0	1	0	0	0	0	**2**
LICH	*Cladonia gray*	NT	0	0	0	0	0	0	1	0	1	0	0	0	**2**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Cladonia macilenta*		0	0	0	0	0	2	0	0	2	0	0	0	**2**	2	2	1	1	0	0	2	0	0	2	1	1	**8**
LICH	*Cladonia mitis/arbuscula*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	2	3	0	2	0	0	0	0	0	0	0	0	**3**
LICH	*Cladonia norvegica*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	1	0	2	0	3	0	0	0	0	0	**3**
LICH	*Cladonia ochrochlora*		1	1	2	0	0	2	0	0	0	0	2	3	**6**	1	1	0	0	0	2	0	1	0	2	3	2	**7**
LICH	*Cladonia parasitica*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	2	0	1	0	0	0	0	0	0	0	0	**2**
LICH	*Cladonia pyxidata*		0	0	1	0	0	0	0	0	0	0	0	0	**1**	2	1	0	1	0	0	0	1	0	0	0	0	**4**
LICH	*Cladonia rangiferina*		0	0	0	0	0	0	0	0	0	0	0	2	**1**	4	2	0	3	0	0	0	0	1	0	0	0	**4**

Appendix 1. Continued.

Organism group	Species	Basis for SPEC / Site ID	Site group B. vir +													Site group B. vir -											
			1	2	3	4	5	6	7	8	9	10	11	12	To-tal	1	2	3	4	5	6	7	8	9	10	11	12	To-tal
LICH	*Cladonia rangiformis*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	1	0	0	0	0	0	0	0	0	0	0	0	**1**
LICH	*Cladonia stellaris*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	2	4	0	2	0	0	0	0	0	0	0	0	**3**
LICH	*Cladonia stygia*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	2	3	0	1	0	0	0	0	0	0	0	0	**3**
LICH	*Cladonia sulphurina*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	1	1	0	0	0	0	0	0	0	0	0	0	**2**
LICH	*Cladonia uncialis*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	3	0	0	0	0	0	0	0	0	0	0	**1**
LICH	*Cliostomum flavidulum*	VU	0	0	2	0	1	0	0	2	2	2	1	0	**6**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Cliostomum griffithii*	NT	0	0	0	0	0	0	0	0	0	2	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Cliostomum leprosum*	VU	0	0	0	0	2	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	1	0	0	0	**1**
LICH	*Coenogonium pineti*		3	3	3	4	4	4	2	3	3	4	1	2	**12**	0	0	0	1	2	1	2	2	0	0	3	2	**7**
LICH	*Evernia divaricata*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	2	0	0	0	0	0	0	0	0	0	**1**
LICH	*Evernia prunastri*		2	0	2	0	1	3	0	2	0	2	2	2	**8**	2	2	2	0	0	1	0	1	4	0	2	2	**8**
LICH	*Fellhanera bouteillei*	VU	0	0	0	0	0	0	0	0	0	0	0	1	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Fellhaneropsis vezdae*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
LICH	*Fuscidea pusilla*		0	0	0	0	1	3	0	0	0	0	2	0	**3**	0	0	0	0	1	2	0	0	3	2	0	0	**4**
LICH	*Graphis scripta*		2	2	0	4	4	0	0	3	0	1	4	0	**7**	0	0	1	0	2	3	2	3	2	0	0	0	**6**
LICH	*Gyalecta truncigena*		0	0	0	0	1	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Hertelidea botryosa*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	1	0	0	0	0	0	0	0	0	0	0	**1**
LICH	*Hypocenomyce scalaris*		0	1	2	0	0	1	2	0	2	0	0	1	**6**	3	3	2	4	2	1	2	2	1	1	0	0	**10**
LICH	*Hypogymnia farinacea*	NT, WKH	1	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	1	1	0	1	0	0	0	0	0	0	**3**
LICH	*Hypogymnia physodes*		4	4	5	4	4	5	5	3	4	5	4	5	**12**	5	4	5	5	5	5	5	4	5	5	5	5	**12**
LICH	*Hypogymnia tubulosa*		2	2	4	3	2	3	0	0	2	2	3	3	**10**	3	2	3	3	0	2	2	2	4	3	3	3	**11**
LICH	*Imshaugia aleurites*		0	0	0	0	1	2	0	0	1	0	0	0	**3**	0	2	0	3	0	0	0	0	0	2	2	0	**4**
LICH	*Lecanactis abietina*	WKH	3	4	4	2	1	0	0	4	2	3	0	3	**9**	0	0	2	3	0	2	1	4	0	0	0	0	**5**
LICH	*Lecania cyrtella*		0	0	0	0	0	0	1	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Lecanora albella*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	1	0	0	0	0	0	0	0	0	0	0	**1**
LICH	*Lecanora allophana*		2	1	0	0	1	0	0	0	0	0	1	0	**4**	0	0	0	0	2	1	0	1	0	0	0	0	**3**
LICH	*Lecanora argentata*		1	2	0	0	0	1	0	0	0	0	0	0	**3**	0	0	2	0	1	2	2	2	0	0	0	0	**5**
LICH	*Lecanora carpinea/leptyrodes*		0	0	0	0	0	0	0	0	0	0	3	0	**1**	0	0	0	0	1	2	0	0	0	0	0	0	**2**
LICH	*Lecanora chlarotera*		0	0	0	0	0	0	0	0	0	0	1	0	**1**	0	0	1	0	3	0	2	2	0	0	0	0	**4**
LICH	*Lecanora expallens/stanislai/ compallens*		3	2	3	1	3	2	3	2	0	3	2	3	**11**	0	0	0	0	0	0	0	1	2	0	1	1	**4**
LICH	*Lecanora farinarea*	NT	0	0	0	0	0	0	0	0	0	0	0	1	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Lecanora norvegica*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	2	0	1	0	0	0	0	0	0	1	0	**3**
LICH	*Lecanora pulicaris*		2	0	2	0	0	2	0	0	0	2	0	0	**4**	3	3	2	2	2	2	2	2	1	3	2	1	**12**
LICH	*Lecanora rugosella*		0	0	0	0	0	2	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Lecanora symmicta*		0	0	0	0	0	0	1	0	0	0	0	1	**2**	0	0	1	0	0	0	0	0	0	0	0	1	**2**
LICH	*Lecanora thysanophora*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
LICH	*Lecidea albohyalina*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	1	0	0	1	0	0	0	0	**2**
LICH	*Lecidea leprarioides*	VU	0	0	1	0	2	0	0	0	0	1	0	0	**3**	0	0	0	0	0	0	0	0	0	0	0	1	**1**
LICH	*Lecidea nylanderi*		2	0	3	4	3	4	4	0	3	2	4	2	**10**	5	4	3	4	5	2	5	4	4	5	4	3	**12**
LICH	*Lecidea turgidula*		0	0	2	0	1	2	1	0	0	0	2	1	**6**	3	0	3	2	3	1	0	2	1	2	0	2	**9**
LICH	*Lecidella elaeochroma/ euphorea*		2	0	0	1	1	2	0	0	0	0	4	1	**6**	0	0	0	0	1	2	2	2	1	0	0	0	**5**

Appendix 1. Continued.

Organism group	Species	Basis for SPEC / Site ID	Site group B. vir +													Site group B. vir -											
			1	2	3	4	5	6	7	8	9	10	11	12	To-tal	1	2	3	4	5	6	7	8	9	10	11	12	To-tal
LICH	*Lecidella subviridis*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	1	0	0	0	0	0	0	0	**1**
LICH	*Lepraria eburnea*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	1	0	0	0	0	1	0	0	0	0	0	**2**
LICH	*Lepraria elobata*	NT	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	2	1	0	0	0	0	0	**2**
LICH	*Lepraria incana/sp*		4	5	5	5	5	5	5	5	5	5	0	1	**11**	0	1	5	5	2	2	2	3	5	0	5	5	**10**
LICH	*Lepraria jackii*		0	0	1	0	0	1	0	0	0	0	4	0	**3**	2	2	0	0	3	1	2	1	2	5	3	3	**10**
LICH	*Lepraria lobificans*		3	3	0	0	0	0	0	4	0	0	0	0	**3**	0	0	0	0	2	3	2	3	0	0	0	0	**4**
LICH	*Leptogium saturninum*	III, VU	0	0	0	0	0	0	0	0	0	0	1	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Lobaria pulmonaria*	III, VU	0	0	0	0	0	1	0	0	0	0	0	0	**1**	0	0	0	0	0	2	0	0	0	0	0	0	**1**
LICH	*Lopadium disciforme*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
LICH	*Loxospora elatina*		3	4	4	2	0	3	1	0	2	1	3	2	**10**	1	3	4	2	3	3	4	3	0	2	3	3	**11**
LICH	*Megalaria grossa*	III, VU	2	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Melanelixia fuliginosa*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	1	0	0	0	2	0	2	3	0	0	0	**4**
LICH	*Melanelixia glabratula*	NT	2	2	0	1	1	0	0	1	2	0	0	0	**6**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Melanelixia subaurifera*		2	2	2	0	0	2	0	0	0	1	0	1	**6**	0	0	0	0	0	0	0	0	1	0	0	1	0	**2**
LICH	*Melanohalea exasperata*		1	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	1	0	0	**1**
LICH	*Melanohalea exasperatula*		0	0	0	0	1	1	0	2	0	0	0	1	**4**	2	1	3	3	1	0	1	1	0	0	2	0	**8**
LICH	*Melanohalea olivacea*		0	0	0	0	0	2	0	0	0	0	0	0	**1**	0	0	0	0	1	1	1	0	1	0	0	1	**5**
LICH	*Micarea denigrata*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	3	0	2	0	0	0	0	1	0	0	0	1	**4**
LICH	*Micarea elachista*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	1	0	0	0	0	0	1	0	0	**2**
LICH	*Micarea melaena*		0	0	1	1	0	2	2	0	0	0	3	1	**6**	2	2	4	3	3	2	3	2	0	1	2	2	**11**
LICH	*Micarea misella*		1	0	0	0	0	0	0	0	0	0	0	1	**2**	1	2	0	0	0	0	0	1	0	0	0	0	**3**
LICH	*Micarea myriocarpa**	EN	0	0	0	0	0	0	0	0	0	0	1	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Micarea peliocarpa*		1	0	0	2	0	0	0	0	1	0	0	0	**3**	0	1	0	0	1	0	3	0	0	2	0	0	**4**
LICH	*Micarea prasina/micrococca*		3	4	3	4	2	4	3	2	2	3	2	3	**12**	1	0	3	2	3	2	3	3	3	2	2	3	**11**
LICH	*Micarea tomentosa**	VU	0	0	0	0	0	0	0	0	0	0	0	1	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Microcalicium disseminatum*	NT	0	0	0	0	1	0	0	2	0	0	0	0	**2**	0	0	0	0	1	0	0	0	1	0	1	0	**3**
LICH	*Multiclavula mucida*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	2	0	0	0	0	0	0	**1**
LICH	*Mycobilimbia carneoalbida*		1	0	0	0	0	0	0	0	0	0	2	0	**2**	0	0	0	0	1	2	0	0	0	0	0	0	**2**
LICH	*Mycobilimbia epixanthoides*		1	1	0	0	1	0	1	0	0	0	0	0	**4**	0	0	0	0	2	2	2	1	0	0	0	0	**4**
LICH	*Mycoblastus sanguinarius*	WKH	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	2	1	0	0	0	0	0	0	0	**2**
LICH	*Mycocalicium subtile*		0	1	2	1	2	0	2	0	2	2	2	2	**9**	2	3	2	3	2	2	2	2	2	1	0	3	**11**
LICH	*Normandina acroglypta*	NT	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	1	0	0	0	**1**
LICH	*Ochrolechia alboflavescens*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	2	0	2	0	0	0	0	0	2	0	0	**3**
LICH	*Ochrolechia androgyna*		1	1	0	0	0	1	0	0	0	0	0	2	**4**	0	1	2	0	1	2	1	2	2	0	0	2	**8**
LICH	*Ochrolechia arborea*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	0	0	0	0	0	**1**
LICH	*Ochrolechia microstictoides*		0	0	2	0	1	2	3	0	1	2	3	0	**7**	3	1	3	3	3	0	1	0	0	3	1	3	**9**
LICH	*Omphalina umbellifera*		2	0	0	0	2	3	0	0	0	0	0	0	**3**	0	1	0	0	0	0	0	0	0	0	0	0	**1**
LICH	*Opegrapha rufescens*		0	1	0	0	0	0	0	3	1	0	0	0	**3**	0	0	0	0	0	1	0	2	0	0	0	0	**2**
LICH	*Opegrapha varia*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	2	0	1	0	0	0	0	**2**
LICH	*Opegrapha vulgata*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
LICH	*Parmelia saxatilis s lato*		1	0	0	0	1	2	1	0	0	0	0	0	**4**	0	0	0	0	0	0	0	3	3	0	0	1	**3**
LICH	*Parmelia sulcata*		3	3	3	3	4	4	3	2	2	3	3	4	**12**	2	2	2	2	4	3	2	2	4	4	4	4	**12**
LICH	*Parmeliella triptophylla*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**

Appendix 1. Continued.

Organism group	Species	Basis for SPEC / Site ID	Site group B. vir +													Site group B. vir -											
			1	2	3	4	5	6	7	8	9	10	11	12	Total	1	2	3	4	5	6	7	8	9	10	11	12	Total
LICH	*Parmeliopsis ambigua*		1	0	2	1	2	2	4	0	3	3	3	0	**9**	3	4	3	3	3	1	2	2	2	3	3	3	**12**
LICH	*Parmeliopsis hyperopta*		0	0	0	0	0	2	0	0	0	0	0	0	**1**	2	1	2	2	0	0	0	0	1	2	1	2	**8**
LICH	*Peltigera canina*		0	0	0	0	1	0	1	0	0	0	1	0	**3**	0	1	0	0	0	1	0	1	0	0	0	0	**3**
LICH	*Peltigera membranacea*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
LICH	*Peltigera neopolydactyla*	EN	0	0	0	0	0	0	0	0	0	0	0	1	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Peltigera polydactylon*		0	0	0	2	0	1	1	0	0	1	1	1	**6**	0	0	0	0	1	2	0	2	2	0	0	0	**4**
LICH	*Peltigera praetextata*		2	1	0	0	2	2	0	0	0	0	2	1	**6**	0	0	0	0	3	3	2	2	2	0	0	0	**5**
LICH	*Pertusaria albescens*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	1	0	0	1	1	0	2	0	0	0	0	**4**
LICH	*Pertusaria amara*		2	2	3	1	2	5	2	0	2	0	2	2	**10**	0	2	2	2	2	3	2	3	3	3	0	2	**10**
LICH	*Pertusaria coccodes*		2	0	0	0	0	1	0	0	0	0	0	0	**2**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Pertusaria coronata*	NT	1	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Pertusaria leioplaca*		1	1	0	0	0	0	0	0	0	0	0	0	**2**	0	0	0	0	1	1	0	0	0	0	0	0	**2**
LICH	*Pertusaria pupillaris*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	2	0	0	0	0	0	0	0	0	0	**1**
LICH	*Phlyctis agelaea*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	2	0	0	0	0	0	0	**1**
LICH	*Phlyctis argena*		4	4	4	4	4	4	5	4	4	3	4	4	**12**	0	2	2	0	5	4	4	4	5	0	3	4	**9**
LICH	*Physcia aipolia*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	1	0	0	0	0	**2**
LICH	*Physcia stellaris*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
LICH	*Physcia tenella*		1	0	0	0	0	0	0	0	0	0	2	1	**3**	0	0	0	0	0	2	0	0	0	0	0	0	**1**
LICH	*Physconia distorta*		1	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	2	0	0	0	0	0	0	**1**
LICH	*Placynthiella dasaea*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	1	1	0	0	0	0	0	0	0	2	**3**
LICH	*Placynthiella icmalea*		2	2	2	2	1	2	2	2	1	2	1	2	**12**	2	3	3	2	3	3	3	3	1	2	3	2	**12**
LICH	*Placynthiella oligotropha*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	2	0	0	0	0	0	0	0	0	0	0	**1**
LICH	*Placynthiella uliginosa*		0	0	0	0	0	0	0	0	0	1	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Platismatia glauca*		3	0	4	4	4	4	4	0	4	4	2	4	**10**	4	3	5	4	2	3	4	3	5	5	4	5	**12**
LICH	*Polycauliona polycarpa*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	2	0	0	0	0	0	0	**1**
LICH	*Pseudevernia furfuracea*		3	3	4	4	4	4	4	0	3	3	3	0	**10**	4	3	3	4	2	3	3	3	4	5	4	4	**12**
LICH	*Psilolechia clavulifera*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	2	0	1	0	0	1	0	**3**
LICH	*Psilolechia lucida**	NT	0	0	0	0	0	1	0	0	0	0	0	0	**1**	0	1	0	0	0	0	0	0	0	0	0	0	**1**
LICH	*Pycnora sorophora*		0	0	0	0	0	0	0	0	1	0	2	0	**2**	3	4	3	2	0	0	0	0	0	1	2	1	**7**
LICH	*Pyrrhospora quernea*		0	0	0	0	0	0	0	1	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Ramalina farinacea*		2	0	0	0	1	2	0	2	2	2	3	2	**8**	0	2	1	0	2	3	0	3	2	0	1	0	**7**
LICH	*Ramalina fraxinea*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
LICH	*Rinodina exigua*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
LICH	*Ropalospora viridis*		2	2	0	2	3	0	3	0	0	0	0	1	**6**	0	1	2	0	4	2	1	2	2	2	3	2	**10**
LICH	*Scoliciosporum chlorococcum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	2	0	0	0	0	0	0	**1**
LICH	*Scytinium teretiusculum*	II, VU	0	0	0	0	1	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	1	**1**
LICH	*Stenocybe pullatula*		0	0	0	1	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Strangospora moriformis*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	1	0	0	**1**
LICH	*Thelotrema lepadinum*	III, VU, WKH	0	2	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Trapeliopsis flexuosa*		0	0	0	0	0	1	1	0	0	0	0	2	**3**	2	2	2	2	1	1	0	1	2	0	1	2	**10**
LICH	*Trapeliopsis glaucolepidea*		0	0	0	0	0	0	0	1	0	2	0	1	**3**	0	0	1	0	0	0	0	0	0	0	0	0	**1**
LICH	*Trapeliopsis granulosa*		0	0	1	0	0	2	1	0	1	0	1	3	**6**	0	2	0	3	0	1	0	0	0	2	0	1	**5**
LICH	*Tuckermannopsis chlorophylla*		0	0	1	0	0	2	0	1	0	0	0	0	**3**	2	2	2	2	1	2	0	0	1	0	0	1	**8**

Appendix 1. Continued.

Organism group	Species	Basis for SPEC / Site ID	Site group B. vir +													Site group B. vir -											
			1	2	3	4	5	6	7	8	9	10	11	12	To-tal	1	2	3	4	5	6	7	8	9	10	11	12	To-tal
LICH	*Usnea barbata*	III, NT	0	0	0	0	0	0	0	0	0	0	0	1	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Usnea dasopoga*		0	0	0	0	0	2	0	0	0	0	0	3	**2**	2	1	2	2	0	2	0	0	0	0	1	0	**6**
LICH	*Usnea glabrescens*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	1	0	0	0	0	0	0	0	0	0	0	0	**1**
LICH	*Usnea hirta*		0	0	3	0	0	3	0	0	1	2	2	3	**6**	2	2	2	2	0	0	0	0	3	2	2	2	**8**
LICH	*Usnea subfloridana*		0	0	2	0	0	2	0	0	0	0	0	4	**3**	1	0	0	2	0	2	0	0	0	0	2	2	**5**
LICH	*Vezdaea aestivalis*	VU	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	0	0	0	0	0	**1**
LICH	*Violella fucata*		0	1	3	4	2	4	4	1	4	4	4	0	**10**	2	2	4	1	2	2	2	2	3	3	3	3	**12**
LICH	*Vulpicida pinastri*		0	0	0	0	2	2	2	0	0	1	2	2	**6**	3	2	3	3	3	2	3	2	1	3	2	3	**12**
LICH	*Xanthoria parietina*		1	0	0	0	0	0	0	0	0	0	0	1	**2**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LICH	*Xylographa parallela**	EN	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	1	1	0	2	0	0	0	1	**4**
LICH	*Xylopsora caradocensis**	EN	0	0	0	0	0	0	0	0	0	0	0	0	**0**	1	2	0	2	0	0	0	0	0	0	0	0	**3**
LICH	*Xylopsora friesii**	NT	0	0	0	0	1	0	0	0	1	0	0	0	**2**	0	1	1	0	1	0	0	2	0	0	0	3	**5**
BRY	*Alleniella complanata*	WKH	2	0	0	0	0	0	0	0	0	2	0	0	**2**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Amblystegium riparium*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
BRY	*Amblystegium serpens*		0	0	0	2	0	0	0	0	0	0	1	0	**2**	1	0	1	1	3	2	1	1	1	0	0	0	**8**
BRY	*Amblystegium subtile*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	2	2	1	2	0	0	0	0	**4**
BRY	*Aneura pinguis*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	1	0	2	0	**2**
BRY	*Anomodon longifolius*	WKH	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	1	0	0	0	0	0	0	0	**1**
BRY	*Atrichum angustatum*	VU	1	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Atrichum tenellum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	1	0	0	0	1	**3**
BRY	*Atrichum undulatum*		0	0	0	2	2	2	2	1	2	2	2	2	**9**	0	0	0	0	2	2	0	2	3	0	3	3	**6**
BRY	*Aulacomnium androgynum*		0	0	1	0	0	1	0	0	0	1	0	0	**3**	0	0	0	0	0	0	1	0	0	0	0	0	**1**
BRY	*Aulacomnium palustre*		2	0	0	0	0	2	2	0	0	0	0	0	**3**	3	2	0	1	0	0	0	0	3	3	2	2	**7**
BRY	*Barbilophozia barbata*		0	0	0	0	0	0	2	0	1	0	0	0	**2**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Barbilophozia lycopodioides*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	1	0	0	**1**
BRY	*Bazzania trilobata*	II, NT, WKH	0	0	0	0	0	0	0	1	0	0	0	0	**1**	0	0	0	0	0	0	0	1	0	0	0	0	**1**
BRY	*Blasia pusilla*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	1	0	0	0	0	**1**
BRY	*Blepharostoma trichophyllum*		3	1	0	3	3	2	2	0	2	3	2	0	**9**	1	0	1	1	1	2	3	3	2	2	0	2	**10**
BRY	*Brachytheciastrum velutinum*		0	0	2	2	1	1	2	0	1	1	1	0	**8**	1	2	1	0	3	1	3	2	1	0	2	0	**9**
BRY	*Brachythecium rivulare*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	2	0	0	0	0	**2**
BRY	*Brachythecium rutabulum*		2	1	0	3	4	2	4	1	1	0	1	0	**9**	0	0	0	1	2	3	2	2	1	0	0	0	**6**
BRY	*Brachythecium salebrosum*		1	3	2	1	0	0	0	0	0	2	2	0	**6**	1	0	2	0	2	0	2	3	2	1	2	2	**9**
BRY	*Breidleria pratensis*		0	0	0	0	0	0	0	0	0	0	1	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Bryum flaccidum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	1	0	0	0	0	**2**
BRY	*Bryum moravicum*		0	0	0	0	0	0	2	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	2	0	2	1	**3**
BRY	*Buxbaumia viridis**	I, VU, WKH	2	1	2	2	2	1	2	1	2	3	2	2	**12**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Callicladium haldanianum*		0	0	0	0	0	0	0	1	0	0	1	0	**2**	0	0	0	0	2	2	0	1	0	0	0	0	**3**
BRY	*Calliergon cordifolium*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	2	0	1	2	0	1	**5**
BRY	*Calliergonella cuspidata*		2	1	0	0	0	0	0	0	0	0	1	0	**3**	0	0	0	0	0	0	2	2	2	0	0	4	**4**
BRY	*Calypogeia fissa*		0	0	0	0	0	1	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Calypogeia integristipula*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	1	0	0	1	0	0	0	0	1	2	0	**4**
BRY	*Calypogeia muelleriana*		3	1	0	2	2	3	2	1	2	3	3	1	**11**	0	0	1	0	0	2	0	0	4	3	3	3	**6**
BRY	*Calypogeia neesiana*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0	1	**1**

Appendix 1. Continued.

Organism group	Species	Basis for SPEC / Site ID	Site group B. vir +													Site group B. vir -											
			1	2	3	4	5	6	7	8	9	10	11	12	Total	1	2	3	4	5	6	7	8	9	10	11	12	Total
BRY	*Calypogeia suecica*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	1	0	0	0	0	**2**
BRY	*Campyliadelphus chrysophyllus*		0	0	0	0	0	0	0	0	1	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Campylium halleri*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	2	0	0	0	0	**2**
BRY	*Campylium stellatum*		0	0	0	0	1	0	0	0	0	0	1	0	**2**	0	0	0	0	0	0	2	1	0	0	0	0	**2**
BRY	*Campylophyllum sommerfeltii/sp.*		0	0	0	1	0	0	1	0	0	0	0	0	**2**	0	0	0	0	2	0	1	1	1	0	0	2	**5**
BRY	*Cephalozia bicuspidata*		1	0	0	0	0	2	0	0	1	1	0	0	**4**	0	1	0	0	1	2	0	1	2	1	0	3	**7**
BRY	*Cephalozia connivens*		0	0	0	0	0	2	0	1	0	0	0	0	**2**	0	0	0	0	0	0	0	0	0	0	1	0	**1**
BRY	*Cephalozia lunulifolia*		0	0	0	0	0	0	0	1	0	0	2	1	**3**	0	0	0	0	1	0	2	1	0	1	0	1	**5**
BRY	*Cephalozia pleniceps*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0	2	**1**
BRY	*Cephaloziella hampeana*		0	0	0	0	0	0	1	0	0	0	0	0	**1**	1	0	0	0	0	0	0	0	0	0	0	0	**1**
BRY	*Cephaloziella rubella/sp.*		0	0	0	1	0	0	1	0	0	0	0	0	**2**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Ceratodon purpureus*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	2	0	1	0	0	0	1	2	0	0	2	0	**5**
BRY	*Chiloscyphus pallescens*		1	0	0	0	0	0	0	0	0	0	1	0	**2**	0	0	0	0	0	0	1	0	0	0	0	1	**2**
BRY	*Chiloscyphus polyanthos*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	1	0	0	1	0	1	1	0	2	2	**6**
BRY	*Cirriphyllum piliferum*		3	1	0	0	0	0	0	2	0	0	0	1	**4**	0	0	1	0	1	2	2	2	2	1	2	3	**9**
BRY	*Climacium dendroides*		3	0	0	0	0	0	0	0	0	0	1	0	**2**	0	0	0	0	2	2	0	2	3	0	0	3	**5**
BRY	*Conocephalum conicum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	1	0	**1**
BRY	*Crossocalyx hellerianus**	III, WKH	0	0	0	0	0	1	3	0	0	0	2	0	**3**	0	1	1	2	0	0	0	0	0	3	4	2	**6**
BRY	*Dicranella cerviculata*		0	0	0	0	0	1	0	0	0	0	0	0	**1**	0	1	0	0	0	0	0	0	0	0	0	0	**1**
BRY	*Dicranella heteromalla*		0	0	0	0	0	2	0	0	0	0	0	0	**1**	0	0	0	0	2	3	1	1	0	0	0	2	**5**
BRY	*Dicranum drummondii*		0	0	1	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Dicranum flagellare**	WKH	0	0	0	0	2	0	0	0	0	0	0	1	**2**	0	0	2	0	2	0	0	0	0	0	0	0	**2**
BRY	*Dicranum flexicaule*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	1	0	0	0	0	**1**
BRY	*Dicranum fuscescens*		0	0	0	0	1	2	0	0	0	0	0	0	**2**	0	1	2	2	0	2	0	0	1	0	0	0	**5**
BRY	*Dicranum majus*		0	0	0	0	0	2	0	3	1	0	0	1	**4**	0	0	3	2	3	3	1	2	2	3	3	2	**10**
BRY	*Dicranum montanum*		4	4	4	3	2	4	3	1	0	0	4	3	**10**	2	3	3	3	4	4	4	4	3	3	4	3	**12**
BRY	*Dicranum polysetum*		0	0	1	0	1	0	3	0	2	2	2	3	**7**	5	5	3	4	2	1	2	3	3	5	4	3	**12**
BRY	*Dicranum scoparium*		4	4	4	4	4	4	4	3	4	4	4	4	**12**	3	4	3	3	4	4	4	3	3	2	4	3	**12**
BRY	*Dicranum spurium*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	1	0	1	0	0	0	0	0	0	0	0	**2**
BRY	*Didymodon fallax*		0	0	1	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Distichium capillaceum*		0	0	0	0	0	0	0	0	1	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Encalypta streptocarpa*		0	0	0	0	1	0	1	0	3	2	0	0	**4**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Eurhynchiastrum pulchellum*		1	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	1	1	2	0	0	0	0	0	**3**
BRY	*Eurhynchium angustirete*		2	3	1	5	5	0	2	2	0	1	2	2	**10**	0	0	0	0	2	3	4	4	3	1	0	0	**6**
BRY	*Eurhynchium praelongum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	0	1	0	0	0	**2**
BRY	*Fissidens adianthoides*		2	2	0	3	2	1	2	0	3	0	2	0	**8**	0	0	0	0	2	1	3	0	2	0	2	0	**5**
BRY	*Fissidens bryoides*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	1	1	0	0	0	**2**
BRY	*Fissidens osmundoides*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	1	0	0	0	0	**1**
BRY	*Frullania dilatata*	WKH	3	3	0	0	0	0	0	0	0	0	0	0	**2**	0	0	0	0	1	2	2	3	0	0	0	0	**4**
BRY	*Funaria hygrometrica*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	0	0	0	0	0	**1**
BRY	*Geocalyx graveolens*		0	0	0	1	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Hamatocaulis vernicosus*	III, WKH	0	0	0	0	1	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Appendix 1. Continued.

Organism group	Species	Basis for SPEC / Site ID	Site group B. vir +													Site group B. vir -											
			1	2	3	4	5	6	7	8	9	10	11	12	To-tal	1	2	3	4	5	6	7	8	9	10	11	12	To-tal
BRY	*Herzogiella seligeri*		4	3	0	3	3	3	0	3	3	3	1	1	**10**	2	1	0	0	2	2	3	4	3	2	3	2	**10**
BRY	*Homalia trichomanoides*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	1	3	1	3	0	0	0	0	**4**
BRY	*Hylocomium splendens*		4	3	5	4	2	5	5	5	4	5	4	4	**12**	5	5	5	5	5	4	5	4	5	5	5	5	**12**
BRY	*Hypnum cupressiforme*		4	4	2	4	4	2	3	4	4	4	2	3	**12**	0	0	2	2	2	2	3	5	3	2	2	3	**10**
BRY	*Hypnum pallescens*		0	1	0	2	3	1	2	0	0	0	0	1	**6**	1	0	0	0	2	1	2	1	0	0	2	1	**7**
BRY	*Isothecium alopecuroides*	WKH	0	0	0	0	0	0	1	0	0	0	0	0	**1**	0	0	0	0	0	0	0	1	0	0	0	0	**1**
BRY	*Lepidozia reptans**	WKH	4	3	2	3	3	4	2	3	3	2	3	2	**12**	0	2	2	2	3	3	3	3	3	3	4	3	**11**
BRY	*Leptobryum pyriforme*		0	0	0	0	0	1	0	0	0	0	1	0	**2**	0	0	0	0	0	0	1	1	1	0	0	2	**4**
BRY	*Leucobryum glaucum*	III	0	0	0	0	0	0	0	0	1	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Leucodon sciuroides*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	1	0	0	0	**1**
BRY	*Liochlaena lanceolata**	WKH	0	0	0	1	0	0	1	0	0	0	0	0	**2**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Lophocolea bidentata*		0	0	0	0	0	0	1	0	0	0	1	0	**2**	0	0	0	0	0	0	0	0	0	0	0	2	**1**
BRY	*Lophocolea heterophylla*		2	2	3	3	2	3	3	2	3	2	4	4	**12**	3	2	3	2	3	3	2	3	4	2	3	2	**12**
BRY	*Lophozia ascendens**	VU	0	0	0	1	0	0	2	0	0	0	0	0	**2**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Lophozia longiflora*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	1	1	1	0	1	0	0	0	2	3	1	**7**
BRY	*Lophozia ventricosa*		0	0	0	0	0	0	1	0	0	0	2	0	**2**	0	0	0	1	0	0	0	0	0	2	0	1	**3**
BRY	*Lophoziopsis longidens*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	1	0	**1**
BRY	*Marchantia polymorpha*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	1	2	**2**
BRY	*Metzgeria furcata*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	1	0	0	0	0	**1**
BRY	*Mnium hornum*	WKH	0	0	0	0	0	0	0	4	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Mnium stellare*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	0	0	0	0	0	**1**
BRY	*Neckera pennata*	III, WKH	0	1	0	0	0	0	0	0	0	0	1	0	**2**	0	0	0	0	2	3	0	3	2	0	0	0	**4**
BRY	*Neoorthocaulis attenuatus*		0	0	0	0	0	1	0	0	2	0	0	0	**2**	0	0	0	1	0	1	0	0	0	0	2	0	**3**
BRY	*Nowellia curvifolia**	WKH	3	4	3	3	4	4	4	2	4	4	4	3	**12**	2	2	0	2	1	0	3	3	3	4	4	2	**10**
BRY	*Odontoschisma denudatum**	WKH	3	0	0	0	0	1	0	0	4	1	0	0	**4**	0	0	0	0	0	0	0	0	0	1	0	0	**1**
BRY	*Orthotrichum speciosum (+sp.)*		2	2	0	2	3	3	1	0	1	2	3	3	**10**	1	1	2	1	3	2	2	1	3	0	0	0	**9**
BRY	*Oxyrrhynchium hians/ Eurhynchium spp*		0	0	0	0	0	0	0	0	0	0	1	0	**1**	0	0	1	0	0	0	0	1	2	0	0	2	**4**
BRY	*Pellia epiphylla/sp.*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	2	0	1	0	0	0	2	**3**
BRY	*Pellia neesiana*		0	0	0	0	0	2	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	1	0	**1**
BRY	*Plagiochila asplenioides*		4	3	0	3	1	0	0	4	2	0	2	4	**8**	0	0	0	0	0	2	3	2	5	0	4	3	**6**
BRY	*Plagiochila porelloides*		1	0	0	2	0	0	1	0	0	0	0	0	**3**	0	0	0	0	0	2	0	2	2	0	2	0	**4**
BRY	*Plagiomnium cuspidatum/ affine*		4	3	2	0	0	2	3	0	3	3	3	2	**9**	0	0	2	0	1	3	3	4	2	2	2	2	**9**
BRY	*Plagiomnium elatum*		1	0	0	0	0	0	0	0	0	0	2	0	**2**	0	0	0	0	0	1	1	2	0	0	2	2	**5**
BRY	*Plagiomnium ellipticum*		1	0	1	2	1	0	1	1	0	1	0	0	**7**	0	0	2	0	0	2	2	1	2	0	0	2	**6**
BRY	*Plagiomnium undulatum*		3	2	0	1	1	0	0	2	0	3	0	0	**6**	0	0	0	0	0	0	2	0	3	0	0	0	**2**
BRY	*Plagiothecium cavifolium*		0	1	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	1	0	0	1	0	0	0	**2**
BRY	*Plagiothecium curvifolium*		0	2	3	0	0	2	1	0	3	3	2	2	**8**	0	1	3	1	2	1	2	2	2	2	4	3	**11**
BRY	*Plagiothecium denticulatum*		0	0	0	0	0	0	2	0	1	0	1	3	**4**	1	0	0	0	0	0	1	0	0	0	0	0	**2**
BRY	*Plagiothecium laetum*		3	2	0	3	4	3	3	0	0	3	2	1	**9**	2	2	3	3	4	3	2	2	0	2	0	0	**9**
BRY	*Plagiothecium latebricola*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	1	0	0	0	1	0	2	0	0	0	0	**3**

Appendix 1. Continued.

Organism group	Species	Basis for SPEC / Site ID	Site group B. vir +													Site group B. vir -											
			1	2	3	4	5	6	7	8	9	10	11	12	Total-1	2	3	4	5	6	7	8	9	10	11	12	Total
BRY	*Plagiothecium nemorale*	NT	1	0	0	0	0	0	0	2	0	0	0	0	**2**	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Plagiothecium succulentum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	2	2	0	0	0	**3**
BRY	*Platygyrium repens*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	0	0	2	0	0	**2**
BRY	*Pleurozium schreberi*		3	3	4	4	3	4	3	1	4	5	4	4	**12**	5	5	5	5	5	4	5	3	4	5	5	**12**
BRY	*Pogonatum dentatum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	1	**1**
BRY	*Pohlia nutans + sp.*		0	0	0	0	0	2	0	0	0	0	1	2	**3**	2	2	2	2	2	1	2	1	0	2	2	**11**
BRY	*Polytrichastrum formosum*		0	0	0	0	0	3	2	3	2	1	1	2	**7**	0	0	0	0	0	0	1	2	0	0	2	1	**4**
BRY	*Polytrichastrum longisetum*		0	0	0	0	0	0	0	0	0	2	1	0	**2**	0	1	0	0	2	1	2	0	0	2	2	1	**7**
BRY	*Polytrichum commune*		2	1	2	0	0	3	0	3	2	2	1	3	**9**	0	2	0	0	1	2	2	0	1	2	3	1	**8**
BRY	*Polytrichum juniperinum*		0	0	0	0	0	0	2	0	0	2	0	1	**3**	2	3	2	2	2	3	1	1	0	0	0	1	**9**
BRY	*Polytrichum piliferum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	0	1	**1**
BRY	*Polytrichum strictum*		0	0	0	0	0	2	0	0	0	0	0	0	**1**	0	1	0	0	0	0	0	0	2	4	2	2	**5**
BRY	*Pseudobryum cinclidioides*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	1	0	0	0	0	**1**
BRY	*Pseudoscleropodium purum*		0	0	0	1	0	0	0	3	4	2	0	0	**4**	0	0	0	0	0	0	0	0	**2**	0	0	0	**1**
BRY	*Ptilidium ciliare*		0	0	0	0	0	0	2	0	0	0	0	0	**1**	0	1	1	0	0	0	0	0	0	1	1	0	**4**
BRY	*Ptilidium pulcherrimum*		3	3	3	3	3	3	4	0	3	4	3	4	**11**	3	3	4	3	4	3	2	4	4	4	5	4	**12**
BRY	*Ptilium crista-castrensis*		3	2	3	1	0	0	2	0	3	2	2	2	**9**	5	3	3	4	1	2	2	2	3	4	4	3	**12**
BRY	*Pylaisia polyantha*		1	1	0	0	1	1	1	0	0	0	2	2	**7**	0	0	0	1	3	2	3	3	1	1	0	0	7
BRY	*Radula complanata*		3	4	2	4	4	3	1	0	4	3	4	1	**11**	0	0	2	0	3	3	4	3	4	0	0	0	**6**
BRY	*Rhizomnium pseudopunctatum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	0	0	0	0	0	**1**
BRY	*Rhizomnium punctatum*		1	1	0	2	0	0	0	0	0	0	1	0	**4**	0	0	0	0	0	3	0	2	3	0	2	3	**5**
BRY	*Rhodobryum roseum*		2	2	0	2	2	0	2	2	0	2	0	3	**8**	0	0	0	0	2	0	2	1	4	2	3	3	**7**
BRY	*Rhytidiadelphus squarrosus*		2	0	0	0	0	0	0	2	0	0	0	0	**2**	0	0	0	0	0	0	1	0	5	0	0	0	**2**
BRY	*Rhytidiadelphus triquetrus*		4	5	5	5	4	2	3	4	4	3	3	3	**12**	0	1	2	1	3	4	5	5	0	0	3	4	**9**
BRY	*Riccardia latifrons**	WKH	2	0	0	1	0	2	0	0	0	0	1	0	**4**	0	0	0	0	0	0	1	1	1	0	0	3	**4**
BRY	*Riccardia multifida*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	1	0	**1**
BRY	*Riccardia palmata**	WKH	3	0	0	0	0	0	0	0	0	0	0	1	**2**	0	0	0	0	0	0	0	1	2	1	2	0	**4**
BRY	*Sanionia uncinata*		4	3	2	2	3	3	0	3	0	0	3	3	**9**	2	2	3	2	4	4	3	4	4	2	3	3	**12**
BRY	*Scapania apiculata**	III, NT, WKH	0	0	0	0	0	0	3	0	0	0	0	0	**1**	0	0	0	0	1	0	0	0	0	0	0	0	**1**
BRY	*Schistidium trichodon*		0	0	0	0	0	0	0	0	0	1	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Schistostega pennata*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	1	2	0	0	0	0	0	0	**2**
BRY	*Sciuro-hypnum oedipodium*		0	0	1	0	0	3	2	0	0	0	4	2	**5**	2	0	3	2	2	2	3	2	3	3	5	4	**11**
BRY	*Sciuro-hypnum populeum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	1	0	0	0	**1**
BRY	*Sciuro-hypnum reflexum*		0	0	0	0	1	0	0	0	0	0	0	4	**2**	0	0	0	0	3	2	2	2	0	1	1	0	**6**
BRY	*Sciuro-hypnum starkei*		2	0	0	0	0	0	0	0	0	0	0	1	**2**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Sphagnum angustifolium*		0	0	0	0	0	1	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Sphagnum capillifolium*		0	0	0	0	1	2	0	0	0	1	0	1	**4**	0	2	2	0	0	0	1	0	0	0	0	0	**3**
BRY	*Sphagnum centrale*		0	0	0	0	0	2	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Sphagnum fallax*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	2	0	0	0	0	2	0	0	0	0	0	**2**
BRY	*Sphagnum flexuosum*		0	0	0	0	0	3	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Sphagnum girgensohnii*		0	0	0	0	0	0	0	0	0	0	2	2	**2**	0	0	0	0	3	2	0	0	0	0	0	0	**2**
BRY	*Sphagnum magellanicum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	2	0	0	0	0	1	0	0	4	3	4	**5**

Appendix 1. Continued.

Organism group	Species	Basis for SPEC / Site ID	Site group B. vir +													Site group B. vir -											
			1	2	3	4	5	6	7	8	9	10	11	12	Total	1	2	3	4	5	6	7	8	9	10	11	12	Total
BRY	*Sphagnum palustre*		0	0	0	0	0	0	0	0	0	0	1	0	**1**	0	0	0	0	0	2	0	0	4	4	3	4	**5**
BRY	*Sphagnum russowii*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	2	0	0	0	0	0	0	0	0	0	0	0	**1**
BRY	*Sphagnum squarrosum*		0	0	0	0	0	2	0	0	0	0	3	0	**2**	0	0	0	1	0	2	0	0	0	0	2	3	**4**
BRY	*Sphagnum subnitens*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	1	0	0	0	0	0	**1**
BRY	*Sphagnum teres*		2	0	0	0	0	1	0	0	0	0	0	0	**2**	0	0	0	0	0	1	0	0	0	0	0	0	**1**
BRY	*Sphagnum wulfianum*	III, WKH	0	0	0	0	0	2	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	1	**1**
BRY	*Splachnum ampullaceum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	2	0	0	**1**
BRY	*Syzygiella autumnalis**	WKH	0	0	0	1	3	2	2	0	0	0	2	0	**5**	0	0	0	1	1	3	3	1	2	3	3	0	**8**
BRY	*Tetraphis pellucida*		3	2	2	2	3	5	2	3	3	2	2	3	**12**	2	3	2	2	3	3	4	4	4	4	3	3	**12**
BRY	*Thuidium assimile*		0	0	0	0	0	0	0	0	0	0	1	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Thuidium delicatulum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	2	1	2	0	0	0	0	**3**
BRY	*Thuidium philibertii/ Thuidium spp*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	1	0	0	1	1	0	0	0	**3**
BRY	*Thuidium recognitum*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	1	0	0	0	0	**1**
BRY	*Thuidium tamariscinum*		2	0	0	0	0	0	0	2	0	0	0	0	**2**	0	0	0	0	0	0	0	1	0	0	0	0	**1**
BRY	*Tortella tortuosa*		0	0	0	0	0	0	2	0	1	0	0	0	**2**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Trichocolea tomentella*	WKH	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	1	0	**1**
BRY	*Ulota crispa s. lato*	WKH	3	3	0	2	3	0	1	1	0	2	0	0	**7**	0	0	0	0	0	0	1	2	2	2	0	0	**4**
BRY	*Warnstorfia exannulata*		0	0	0	0	0	2	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Weissia controversa*		0	0	0	1	0	0	2	0	0	0	0	0	**2**	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BRY	*Zygodon viridissimus*		0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	1	0	0	0	0	**1**
BRY	(excl. *B. viridis*)	**TOTAL**	**52**	**38**	**26**	**43**	**39**	**55**	**53**	**34**	**38**	**40**	**58**	**42**	**122**	**27**	**36**	**38**	**34**	**59**	**72**	**74**	**84**	**64**	**47**	**60**	**65**	**147**
BRY	(excl. *B. viridis*)	SPEC	10	5	2	7	6	7	9	6	4	5	6	4	**23**	1	3	3	4	8	4	7	9	7	7	6	5	**17**
BRY	(excl. *B. viridis*)	legally protected	0	1	0	0	1	2	2	1	1	0	2	0	**7**	0	1	1	1	2	1	1	1	1	1	1	2	**5**
BRY	(excl. *B. viridis*)	red-listed	2	0	0	1	0	0	2	2	0	0	0	0	**5**	0	0	0	0	1	0	1	0	0	0	0	0	**2**
BRY	(excl. *B. viridis*)	WKH	8	5	2	6	6	7	8	5	3	5	6	4	**19**	1	3	3	4	8	4	7	9	7	7	6	5	**17**
BRY	(excl. *B. viridis*)	dead wood specialists	5	2	2	6	4	6	7	2	3	3	5	4	**11**	1	3	3	4	5	2	4	5	5	6	5	4	**9**
LICH		**TOTAL**	**66**	**42**	**53**	**43**	**63**	**74**	**47**	**33**	**46**	**45**	**60**	**64**	**149**	**59**	**79**	**63**	**77**	**75**	**110**	**55**	**80**	**59**	**54**	**55**	**70**	**193**
LICH		SPEC	10	6	7	7	10	6	5	8	7	4	4	7	37	2	4	5	10	9	13	7	7	5	5	1	8	**31**
LICH		legally protected	2	1	0	0	1	1	0	0	0	0	2	1	8	1	1	0	1	0	3	1	0	0	0	0	1	**4**
LICH		red-listed	7	5	6	5	9	5	5	6	6	3	4	5	33	2	4	3	6	6	9	4	4	5	4	1	7	**26**
LICH		WKH	4	2	2	3	1	2	1	2	2	1	1	2	9	1	1	3	7	3	6	5	3	1	1	0	2	**9**
LICH		dead wood specialists	2	1	2	2	1	2	0	0	1	0	2	1	8	2	4	1	5	4	4	1	3	0	4	0	4	**11**

Appendix 2. Comparison of full assemblages and SPEC richness between site groups (inhabited vs not inhabited by *Buxbaumia viridis*).

	***B. viridis* +**		***B. viridis* –**		
	Mean	±SD	Mean	±SD	ANOVA (df=1)
	N=12		N=12		
Bryophytes					
Full assemblage	43.2	9.5	55.0	18.2	F=3.977, p=0.059
SPEC	4.9	2.2	5.3	2.4	F=0.198, p=0.660
Legally protected	0.8	0.8	1.1	0.5	F=0.780, p=0.387
Red listed	0.6	0.9	0.2	0.4	F=2.165, p=0.155
WKH indicators	5.4	1.8	5.3	2.4	F=0.009, p=0.924
Wood dependent	4.1	1.7	3.9	1.4	F=0.066, p=0.800
Lichens					
Full assemblage	53.0	12.2	69.7	16.1	F=8.147, **p=0.009**
SPEC	6.8	2.0	6.3	3.4	F=0.136, p=0.716
Legally protected	0.7	0.8	0.7	0.9	F=0.000, p=1.000
Red listed	5.5	1.5	4.6	2.2	F=1.424, p=0.246
WKH indicators	1.9	0.9	2.8	2.2	F=1.451, p=0.241
Wood dependent	1.2	0.8	2.7	1.8	F=7.016, **p=0.015**

Appendix 3. Indicator values (and it's significance) of lichen and bryophyte species to the habitat group (inhabited or not inhabited by *Buxbaumia viridis*).

Species	**Group**	**Indicator Value (IV)**	**Mean**	**S.Dev**	**p ***
Acrocordia gemmata	B.vir +	8.3	8.3	0.12	1
Arthonia spadicea	B.vir +	47.4	28.5	8.28	0.052
Arthonia vinosa	B.vir +	22.2	24.2	8	0.5523
Atrichum angustatum	B.vir +	8.3	8.3	0.12	1
Bazzania trilobata	B.vir +	4.2	10.1	6.25	1
Biatora chrysantha	B.vir +	8.3	15.9	7.57	1
Biatora ocelliformis	B.vir +	16.7	10.2	6.25	0.4837
Biatoridium monasteriense	B.vir +	8.3	8.3	0.12	1
Chaenotheca chlorella	B.vir +	20.8	21.5	8.22	0.6071
Chaenotheca phaeocephala	B.vir +	8.3	8.3	0.12	1
Chaenothecopsis consociata	B.vir +	12.5	14.1	5.97	0.7393
Chrysothrix candelaris	B.vir +	8.3	8.3	0.12	1
Chrysothrix flavovirens	B.vir +	33.3	16.8	7	0.0944
Cliostomum flavidulum	B.vir +	50	21.2	7.85	**0.0132**
Cliostomum griffithii	B.vir +	8.3	8.3	0.12	1
Cliostomum leprosum	B.vir +	5.6	10.7	5.54	1
Fellhanera bouteillei	B.vir +	8.3	8.3	0.12	1
Hamatocaulis vernicosus	B.vir +	8.3	8.3	0.12	1
Isothecium alopecuroides	B.vir +	8.3	8.3	0.12	1
Lecanactis abietina	B.vir +	51.3	38.5	7.76	0.0908
Lecidea leprarioides	B.vir +	20	16.7	7.08	0.4793
Lepidozia reptans	B.vir +	52.3	52.2	2.38	0.5983
Leptogium saturninum	B.vir +	8.3	8.3	0.12	1

Appendix 3. Continued.

Species	Group	Indicator Value (IV)	Mean	S.Dev	p *
Leucobryum glaucum	B.vir +	8.3	8.3	0.12	1
Liochlaena lanceolata	B.vir +	16.7	10.3	6.25	0.4887
Lobaria pulmonaria	B.vir +	8.3	8.3	0.12	1
Lophozia ascendens	B.vir +	16.7	11	5.56	0.4887
Megalaria grossa	B.vir +	8.3	8.3	0.12	1
Melanelixia glabratula	B.vir +	50	21.5	7.55	**0.0126**
Micarea myriocarpa	B.vir +	8.3	8.3	0.12	1
Micarea tomentosa	B.vir +	8.3	8.3	0.12	1
Mnium hornum	B.vir +	8.3	8.3	0.12	1
Neckera complanata	B.vir +	16.7	10	6.24	0.4671
Nowellia curvifolia	B.vir +	61.8	51.1	4.11	**0.0094**
Odontoschisma denudatum	B.vir +	30	19.6	7.46	0.2016
Peltigera neopolydactyla	B.vir +	8.3	8.3	0.12	1
Pertusaria coronata	B.vir +	8.3	8.3	0.12	1
Plagiothecium nemorale	B.vir +	16.7	10.8	5.55	0.4755
Psilolechia lucida	B.vir +	8.3	8.3	0.12	1
Riccardia latifrons	B.vir +	16.7	26.3	8.1	1
Scapania apiculata	B.vir +	6.2	11	5.19	1
Scytinium teretiusculum	B.vir +	4.2	10.3	6.25	1
Sphagnum wulfianum	B.vir +	5.6	10.9	5.55	1
Thelocarpon epibolum	B.vir +	16.7	10.2	6.25	0.4795
Thelotrema lepadinum	B.vir +	8.3	8.3	0.12	1
Ulota crispa	B.vir +	39.8	32.5	7.91	0.1982
Usnea barbata	B.vir +	8.3	8.3	0.12	1
Acrocordia cavata	B.vir -	25	14.1	5.7	0.2138
Anomodon longifolius	B.vir -	8.3	8.3	0.12	1
Arthonia leucopellaea	B.vir -	36.5	24.1	7.97	0.0824
Bacidia laurocerasi	B.vir -	8.3	8.3	0.12	1
Calicium parvum	B.vir -	8.3	8.3	0.12	1
Calicium pinastri	B.vir -	16.7	10.2	6.25	0.4841
Calicium trabinellum	B.vir -	16.7	10.3	6.25	0.4887
Callicladium haldanianum	B.vir -	25	14.1	5.9	0.2182
Carbonicola anthracophila	B.vir -	27.8	19.3	7.08	0.2603
Chaenotheca brachypoda	B.vir -	30.8	28.5	7.96	0.3885
Chaenotheca brunneola	B.vir -	33.3	16.5	7.19	0.097
Chaenotheca gracillima	B.vir -	16.7	10.2	6.25	0.4837
Chaenothecopsis haematopus	B.vir -	16.7	10.2	6.25	0.4841
Cladonia norvegica	B.vir -	25	14	6.03	0.2108
Crossocalyx hellerianus	B.vir -	34.2	28.6	8.33	0.2599
Dicranum flagellare	B.vir -	9.5	16.5	7.15	1
Frullania dilatata	B.vir -	19	21.4	7.77	0.6397
Hypogymnia farinacea	B.vir -	18.8	15.8	7.41	0.5927
Lepraria elobata	B.vir -	16.7	10.9	5.55	0.4779
Microcalicium disseminatum	B.vir -	12.5	19.4	7.26	1
Mycoblastus sanguinarius	B.vir -	16.7	10.9	5.55	0.4779
Neckera pennata	B.vir -	27.8	21.5	7.9	0.189
Normandina acroglypta	B.vir -	8.3	8.3	0.12	1

Appendix 3. Continued.

Species	Group	Indicator Value (IV)	Mean	S.Dev	p *
Plagiothecium latebricola	B.vir -	25	14.2	6.03	0.222
Riccardia palmata	B.vir -	20	21.2	7.55	0.5663
Syzygiella autumnalis	B.vir -	42.9	36.8	7.93	0.2296
Trichocolea tomentella	B.vir -	8.3	8.3	0.12	1
Vezdaea aestivalis	B.vir -	8.3	8.3	0.12	1
Xylographa parallela	B.vir -	8.3	8.3	0.12	1
Xylopsora caradocensis	B.vir -	16.7	10.1	6.24	0.4757
Xylopsora friesii	B.vir -	33.3	24.4	8.07	0.22