

Whiteness Head, Ardersier Port

Ecological Assessment: Lichens

[Redacted]

September 2018



A healthy patch of the Nationally Scarce lichen *Cladonia cariosa* in dune grassland at Whiteness Head

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1 INTRODUCTION

1.1 Background

There is a proposal to dredge a section of the shingle spit at Whiteness Head, c. 8km west of Nairn on the Moray Firth coast. Whiteness Head is a Site of Special Scientific Interest (SSSI) notified for its coastal geomorphology, birds, intertidal marine habitats, saltmarsh, sand dunes and shingle (SNH, 2013a). Whiteness Head is one of the best examples of an active shingle spit in Scotland and it provides an excellent illustration of active coastal processes (SNH, 2013b).

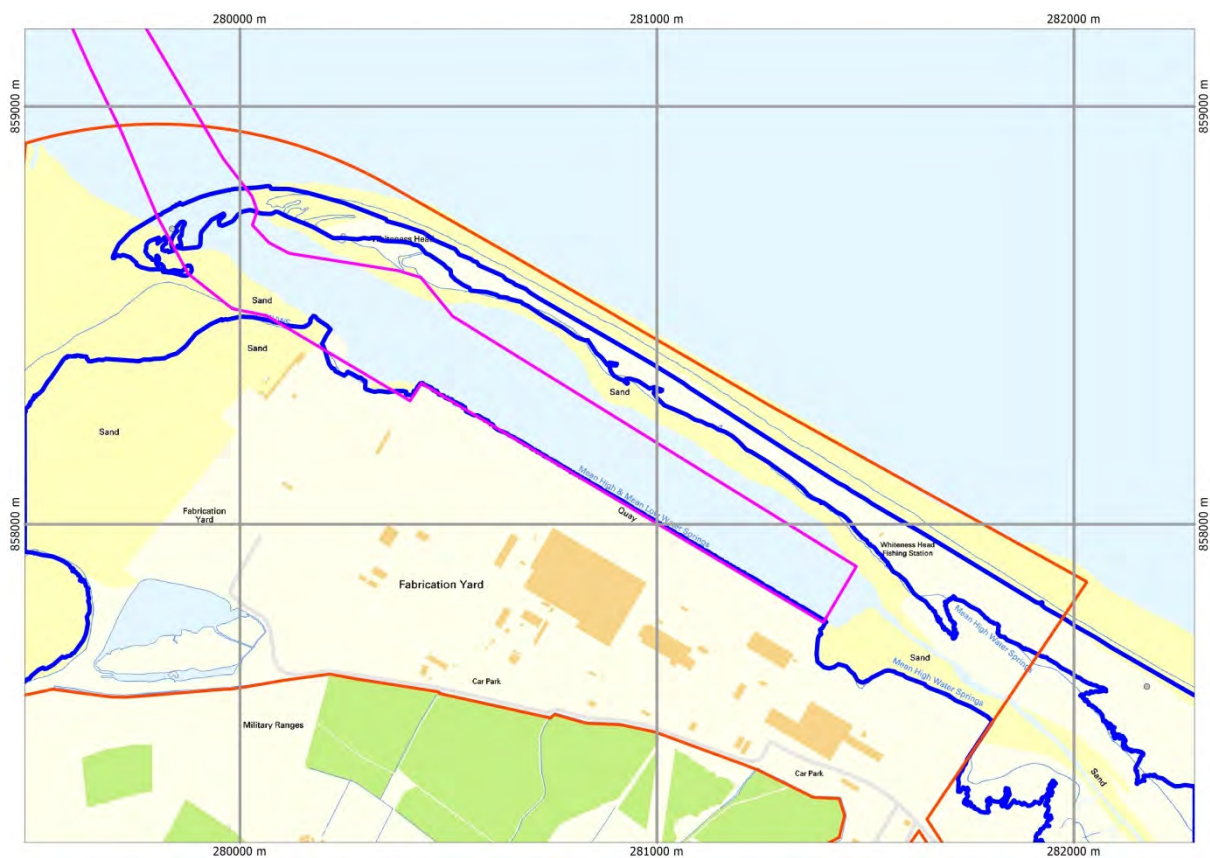
The lichens of the dunes (including dune heath and dune grassland), and shingle habitats of Whiteness Head SSSI are known to support a notable lichen assemblage (SNH 2013b). The lichens have previously been surveyed by Coppins & Coppins (2000, 2005). They recorded 127 lichen taxa including 15 Nationally Scarce, 2 Nationally Rare species, one of which is Red Listed Near Threatened (Coppins & Coppins, 2005). They note that it supports the largest number of shingle species when compared to other coastal SSSIs/National Nature Reserves in eastern Scotland. They conclude that Whiteness Head is of significant importance for lichens, unable to absorb greater human impacts than it is currently subject to, and so should be protected.

In summer 2018, EnviroCentre commissioned a lichen survey of a section of Whiteness Head to enable the likely impact of the proposed dredging on the lichen flora to be assessed. The spit is longer than the original SSSI due to shingle deposition since notification. The area to be dredged is within the newer areas of the spit (i.e. just outwith the SSSI boundary).

1.2 Study site

The study site is shown in Figure 1.

Figure 1. The study site (area within the red line) and the area to be dredged (indicated by the pink line). Note that the lichen survey was restricted to the area of the shingle spit. It did not include the areas to the south of the spit (e.g. the old fabrication yards). The high and low water marks have changed since the original OS basemap was produced. The dark blue line indicates the high water mark based on 2018 survey data provided by EnviroCentre. The basemap is an Ordnance Survey Street View map available under the OS OpenData map dataset and is free to use under the Open Government Licence (OGL). Contains OS data (c) Crown copyright and database right 2018.



2 METHODS

2.1 Field survey

The survey took the form of a walkover survey of the study site. Potential lichen niches within the study site were briefly examined for conspicuous lichens, with a closer inspection where the lichen flora appeared particularly well developed. Taxa recorded included those growing directly on pebbles (saxicolous lichens), on the ground (terricolous lichens growing on soils, 'biotic crusts', decaying vegetation, and bryophytes) and lichenicolous fungi (fungi growing on lichens).

The locations of any conspicuous Nationally Rare, Nationally Scarce or Threatened (e.g. Red List) species that are readily identifiable in the field were recorded with a Garmin eTrex H Global Positioning System (GPS) but there was no systematic attempt to search for additional locations of any notable species found and no systematic attempt to quantify the frequency/abundance of species.

Samples were collected of species that were not readily identifiable to species level in the field for subsequent identification in the laboratory.

2.2 Nomenclature

Nomenclature follows Smith *et al* (2009). Conservation Status follows Woods & Coppins (2012) and a number of their acronyms for Conservation Status are used in this report. The most frequently used are **LC** = Least Concern (i.e. not threatened in GB though it may still be of conservation value); **NT** = Red-listed Near Threatened; **NE** = conservation value Not Evaluated using IUCN criteria, **NS** = Nationally Scarce, **NR** = Nationally Rare, and **SBL** = Scottish Biodiversity List species. For explanations of these terms and other abbreviations refer to Appendices 1 and 2.

2.3 Constraints

Many lichens are very small and inconspicuous so easily overlooked without thorough searching which can be very time consuming. It is likely that species have been overlooked during this rapid survey, and this could possibly include notable lichens. This is most likely for inconspicuous species with 'look-a-likes'; these require speculative sampling and critical examination in the laboratory (e.g. using microscopes).

Despite the above constraints on balance it is felt that the survey was sufficient to enable an assessment of the lichen flora of the study site.

3 LICHEN HABITATS AND SPECIES

The main lichen habitats examined were associated with shingle (including associated niches such as boulders), driftwood and dune heath and dune grassland. The lichen taxa associated with these habitats are described in sections 3.1 - 3.2.

3.1 Lichen species and related taxa

In total 131 taxa were recorded during the survey including a number of notable species (section 3.2). Seventy six taxa were recorded from within the area that will be lost due to dredging. Ninety six taxa were recorded outwith the area that will be subject to direct impacts from dredging.

The lists of lichen taxa recorded during the survey have been submitted to the Scottish Sites Lichen Database (SSLD) and will be uploaded to the National Biodiversity Network atlas (NBN atlas) and be available at <https://records.nbnatlas.org/>.

3.2 Notable taxa

Seventeen Nationally Scarce (NS) and five Nationally Rare (NR) taxa were recorded during the survey. One of the Nationally Scarce species is a Red-listed, Scottish Biodiversity List species. One of the Nationally Rare species is a very rare endemic species with a very specific niche. Notable lichens, non-lichenized fungi and lichenicolous fungi recorded during the survey are summarised in Table 1. The Table indicates whether species were recorded within or outwith the area to be dredged.

Two notable terricolous species were previously recorded in the 2018 study site but not refound in 2018 – *Peltigera neckeri* (NS) and *Bacidia viridescens* (NS).

Additional notable species known from outwith the 2018 study site (Coppins & Coppins, 2000) but not recorded by Coppins & Coppins (2005) or in 2018 are:

- Four species on old fence posts - *Cyphelium tigilliare* (NT), *Thelomma ocellatum* (NS), *Protoparmelia oleagina* (NS) and *Strangospora moriformis* (NS). This niche was not seen in 2018 (old posts may have been removed – leaving old posts in situ is recommended when renewing fence lines).
- Four species on pebbles: *Lecidea diducens* (NS), *Lecidea plana* (NS), *Pertusaria lactescens* (NS) and *Stereocaulon leucophaeopsis* (NS).
- Three species on *Calluna/Erica*: *Fellhanera bouteillei* (NS), *Lecanora farinaria* (NS) and *Usnea glabrata* (NR).

Table 1. Notable taxa. Most of the taxa are notable because they are Nationally Scarce (**NS**) or Nationally Rare (**NR**) but there is also a Near Threatened (**NT**) Scottish Biodiversity List (**SBL**) species. Most are Least Concern (**LC**) i.e. not nationally threatened according to IUCN criteria, though they may be regionally scarce/threatened. Some species have been included because although they are not Nationally Scarce/Rare, or nationally threatened they are indicators of better quality lichen habitat (e.g. *Cetraria aculeata* and *Cetraria islandica* subsp. *islandica*). Species recorded in the area to be dredged are indicated by red crosses (x).

Taxon name	Status	Outwith 2018 study site	Outwith dredge area	Within area to be dredged	Substrate	Abundance in the study site
<i>Absconditella celata</i>	LC NR		x		On lichen, deadwood	Very rare (recorded once)
<i>Acarospora veronensis</i>	LC NS			x	Pebble, driftwood	Occasional
<i>Agonimia gelatinosa</i>	LC NS		x		Terricolous	Very rare (recorded once)
<i>Arthonia parietinaria</i>	NE NS		x	x	Lichenicolous on <i>Xanthoria parietina</i> on pebble and driftwood	Rare (recorded twice)
<i>Bacidia saxenii</i>	LC NS			x	Driftwood log	Very rare (recorded once)
<i>Caloplaca asserigena</i>	LC NS		x	x	Driftwood (bark), broom	Occasional
<i>Caloplaca cerinelloides</i>	LC NS		x		On <i>Rosa rugosa</i> and broom.	Rare (recorded twice)
<i>Caloplaca phlogina</i>	NE ?NS		x		Terricolous	Very rare (recorded once)
<i>Catillaria atomarioides</i>	LC NS	x	x		Pebble in stabilised shingle	Occasional to locally frequent
<i>Cercidospora epipolytropia</i>	LC NS	x			Lichenicolous on <i>Lecanora polytropia</i>	Recorded once
<i>Cetraria aculeata</i>	LC		x	x	Terricolous	Scarce and very local
<i>Cetraria islandica</i> subsp. <i>islandica</i>	LC	x			Terricolous	Very rare (recorded once)
<i>Cladonia cariosa</i>	LC NS		x		Terricolous	Very rare (recorded once)
<i>Endococcus brachysporus</i>	NE NR		x		Lichenicolous on <i>Porpidia tuberculosa</i> on pebble	Recorded once

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Taxon name	Status	Outwith 2018 study site	Outwith dredge area	Within area to be dredged	Substrate	Abundance in the study site
<i>Heterocephalacria bachmannii</i>	LC NR		x		Lichenicolous on terricolous <i>Cladonia rangiformis</i>	Recorded once
<i>Lecania granulata</i>	Rare, endemic		x		Terricolous	Very rare (recorded at one location)
<i>Lecania subfuscula</i>	LC NS		x		Terricolous	Rare (recorded at two locations)
<i>Lecanora hagenii</i>	NE		x		On broom and driftwood	Recorded twice
<i>Lecanora zosteræ</i>	LC NS		x	x	Driftwood, bone, dead seaweed, terricolous	Occasional to locally frequent
<i>Leptogium palmatum</i>	NT NS SBL		x		Terricolous	Very rare (recorded once)
<i>Lichenodiplis lecanoræ</i>	LC NS		x		Lichenicolous on <i>Lecanora hagenii</i> on driftwood	Recorded once
<i>Micarea coppinsii</i>	LC NS			x	Driftwood	Recorded once
<i>Micarea misella</i>	LC NS			x	Driftwood	Recorded once
<i>Pronectria robergei</i>	NE NR			x	Lichenicolous on terricolous <i>Peltigera didactyla</i> .	Recorded at two locations in the dredge area (locally frequent)
<i>Pyrenidium actinellum</i>	LC NS			x	Lichenicolous on terricolous <i>Peltigera didactyla</i> .	Recorded once

4 EVALUATION

The importance of habitats and species is assessed following the guidelines for ecological impact assessment in the UK and Ireland (CIEEM, 2016). An ecological feature can be important at different geographical scales. Species that are not Scarce, Rare or Threatened at the National scale can be of regional or local value if, for example, they are regionally/locally scarce/ threatened or indicative of good lichen habitat.

Notable taxa recorded at Whiteness are evaluated in section 4.1 and the overall lichen assemblage is evaluated in section 4.2.

4.1 Taxa of conservation importance

The national conservation status of British lichens and related taxa has been assessed by Woods & Coppins, 2012. Table 2 indicates the conservation importance of notable taxa at Whiteness at various geographical scales.

Table 2. The Conservation Importance of Taxa.

Taxon	Conservation importance	Notes on distribution	Habitat/distribution in the study site
<p>INTERNATIONAL CONSERVATION IMPORTANCE</p> <p>A European Protected Species; an IUCN Red Data Book species that is globally Vulnerable, Endangered or Critically Endangered; an internationally important assemblage (e.g. a nationally significant assemblage of Internationally Rare (IR) species), or a nationally significant population of an internationally important species that is nationally rare or threatened in the UK.</p>			
<i>Lecania granulata</i>	Nationally rare, endemic	A globally very rare species only known from islands in northern Scotland (Figure 3). A very rare, endemic species of exposed maritime clifftops on Fair Isle (Figure 4), Foula (Shetland), Hoy (Orkney), North Rona and the Flannan Isles. <i>Lecania granulata</i> was not evaluated by Woods & Coppins (2012) because it has only recently been formally described (Fryday & Coppins, 2012) but if formally evaluated it would be a Red List Vulnerable species (Brian Coppins pers. comm.)	Only found in one location at Whiteness (Figure 2) where it was frequent (but only one fertile thallus was found). Outwith the area affected by proposed dredging, though the impact of dredging could potentially be of concern (section 5). This is the only record for mainland Scotland.

Taxon	Conservation importance	Notes on distribution	Habitat/distribution in the study site
NATIONAL CONSERVATION IMPORTANCE An IUCN Red Data Book species that is Vulnerable, Endangered or Critically Endangered in the UK; a species that is Rare in the UK (<15 10km grid squares); a priority species in the UKBAP; a Schedule 8 species included in the Wildlife and Countryside Act 1981.			
<i>Absconditella celata</i>	LC NR	A species that is probably nationally under-recorded.	Recorded once outwith the dredge zone on deadwood.
<i>Endococcus brachysporus</i>	NE NR	A lichenicolous fungus that is almost certainly nationally under-recorded.	Recorded once outwith the dredge zone.
<i>Heterocephalacria bachmannii</i>	LC NR	A lichenicolous fungus that is almost certainly nationally under-recorded.	Recorded once outwith the dredge zone.
<i>Pronectria robergei</i>	NE NR	A distinctive conspicuous lichenicolous fungus, though still possibly nationally under-recorded. It was found in areas that are developing a terricolous lichen flora (the areas where it was recorded were devoid of lichens in 2005).	Recorded as lichenicolous on <i>Peltigera didactyla</i> at two locations in the area that will be lost due to the proposed dredging (Figure 2).

Taxon	Conservation importance	Notes on distribution	Habitat/distribution in the study site
SCOTTISH CONSERVATION IMPORTANCE Habitats and species of principal importance for biodiversity in Scotland. (e.g. Scottish Biodiversity List species).			
<i>Leptogium palmatum</i>	NT SBL NS	Smith <i>et al.</i> (2009) describe the habitat as 'on mosses amongst boulders, on the ground in old dunes, disused airfields, occasionally on tree trunks; scattered, rare'. I have mostly seen it in dunes with a well-developed terricolous lichen flora where the vegetation is not tall/rank. Note this species is now known as <i>Scytinium palmatum</i> . Grazing and patchy/localised disturbance from rabbit activity appear to be particularly important in maintaining suitable niches for this species.	Very rare. A few poorly developed thalli associated with rabbit scrapes/tracks/rabbit grazed dune grassland on the dunes near the house (Figure 2). Outwith the area affected by proposed dredging.
REGIONAL CONSERVATION IMPORTANCE A species that is Nationally Scarce in the UK (present in 16-100 10km grid squares); a species that is included in the Regional LBAP; an assemblage of regionally scarce species.			
<i>Lecania subfuscula</i>	LC NS	A regionally rare species (NBN Atlas, 2018) that is a notable record from lichen-rich terricolous assemblages of coastal habitats. Lichen-rich dune habitats are a local and threatened habitat in Highland Region.	Very local. Found only in two locations at Whiteness (Figure 2), both outwith the area to be dredged. A key component of the well-developed terricolous flora that supports' the nationally rare endemic <i>Lecania granulata</i> .

Taxon	Conservation importance	Notes on distribution	Habitat/distribution in the study site
<i>Acarospora veronensis</i>	LC NS	Described as on nutrient rich siliceous rocks, coastal pebbles in dunes, roofing tiles; rare' in Smith <i>et al.</i> (2009).	Occasional in the area to be dredged (mostly on pebbles but also on driftwood). Probably overlooked in the area outwith the dredge zone (it was recorded in the eastern section of the SSSI by Coppins & Coppins (2000).
<i>Agonimia gelatinosa</i>	LC NS	Although previously recorded from dune habitats Smith <i>et al.</i> (2009) states that the species has been over-recorded and most confirmed records in Britain are from sub montane and montane habitats. In other countries it is mostly recorded from arctic-alpine habitats.	Recorded once outwith the area affected by proposed dredging (Figure 2).
<i>Arthonia parietinaria</i>	NE NS	A lichenicolous fungus that is almost certainly nationally under-recorded.	Recorded twice. Once outwith the area affected by proposed dredging and once in the dredge zone.
<i>Bacidia saxenii</i>	LC NS	A species that is almost certainly nationally under-recorded.	Recorded on a driftwood log in the dredge zone.
<i>Caloplaca asserigena</i>	LC NS	A species that is almost certainly nationally under-recorded.	Recorded as occasional throughout the study site

Taxon	Conservation importance	Notes on distribution	Habitat/distribution in the study site
<i>Caloplaca cerinelloides</i>	LC NS	A species that is almost certainly nationally under-recorded.	Recorded twice outwith the dredge zone.
<i>Caloplaca phlogina</i>	NE ?NS	A species that is listed as 'rare, declining' in Smith <i>et al.</i> (2009) due to the decline of its main habitat (elm trees).	Rare. Recorded once in the area with a well-developed terricolous flora that supports' the nationally rare endemic <i>Lecania granulata</i> .
<i>Catillaria atomarioides</i>	LC NS	A species that is almost certainly nationally under-recorded.	Occasional to locally frequent on pebbles in stabilised shingle outwith the proposed dredge zone.
<i>Cercidospora epipolytropa</i>	LC NS	A lichenicolous fungus that is probably nationally under-recorded.	Recorded once (outwith the study site).
<i>Cladonia cariosa</i>	LC NS	Considered to be 'rare but widespread', in 'sandy situations, especially moderately calcareous heathland mine-spoil heaps' (Smith et al., 2009). There are very few records in the Highland region and it is only known in the Inverness & Nairn area from Whiteness (NBN Atlas, 2019, Coppins & Coppins, 2005).	A small but very healthy patch outwith the area affected by proposed dredging (Figure 2).
<i>Lecanora hagenii</i>	NE	A species that is almost certainly nationally under-recorded.	Recorded twice, outwith the dredge zone.

Taxon	Conservation importance	Notes on distribution	Habitat/distribution in the study site
<i>Lecanora zosterae</i>	LC NS	A species that is almost certainly nationally under-recorded.	Recorded as occasional to locally frequent throughout the study site on a range of substrata (as terricolous, also on driftwood, bone, dead seaweed).
<i>Lichenodiplis lecanorae</i>	LC NS	A lichenicolous fungus that is almost certainly nationally under-recorded.	Recorded once on driftwood outwith the dredge zone
<i>Micarea coppinsii</i>	LC NS	A species that is almost certainly nationally under-recorded.	Recorded once on driftwood in the dredge area.
<i>Micarea misella</i>	LC NS	A species that is almost certainly nationally under-recorded.	Recorded once on driftwood in the dredge area.
<i>Pronectria robergei</i>	Nationally Scarce	A distinctive conspicuous lichenicolous fungus, it is listed as NR in Woods & Coppins (2012) but is now known to be Nationally Scarce (NBN Atlas, 2018) and still possibly nationally under-recorded to some degree. It was found in areas that are developing a terricolous lichen flora (the areas where it was recorded were devoid of lichens in 2005).	Recorded as lichenicolous on <i>Peltigera didactyla</i> at two locations in the area that will be lost due to the proposed dredging (Figure 2).
<i>Pyrenidium actinellum</i>	LC NS	A lichenicolous fungus that is almost certainly nationally under-recorded.	Recorded once on in the dredge area.

Taxon	Conservation importance	Notes on distribution	Habitat/distribution in the study site
<p>COUNTY / METROPOLITAN CONSERVATION IMPORTANCE</p> <p>A species that is included in the County LBAP ; an assemblage of species that are scarce at the county level.</p>			
<p>No species were recorded that are specifically mentioned in the in the county BAP. The Inverness and Nairn BAP does however state that a key feature of the coastal biodiversity is the 'exceptional variety of coastal plant communities, with a large number of rare or local plants'. The lichen assemblage is certainly a key component of the biodiversity of these coastal communities (section 4.2).</p>			
<p>LOCAL CONSERVATION IMPORTANCE</p> <p>Important component species of lichen assemblages of those semi-natural habitats that are important in the local area.</p>			
<i>Cetraria aculeata</i>	LC	Usually found where the terricolous lichen heath habitat is well-developed.	Very rare in dredge area (recorded once), Very local outwith dredge area. For locations see (Figure 2).
<i>Cetraria islandica</i> <i>subsp. islandica</i>	LC	A good habitat indicator of well-developed terricolous lichen flora of heath. Although not rare in the Highland region, it is usually more restricted to well-developed terricolous lichen floras of sub-montane/montane heaths. It is scarce in dune heaths in Highland region. Lichen-rich dune habitats heaths are a local and threatened habitat in Highland Region.	Very rare. Recorded outwith the study site boundary (at NH83585 57005, Figures 14, 15).

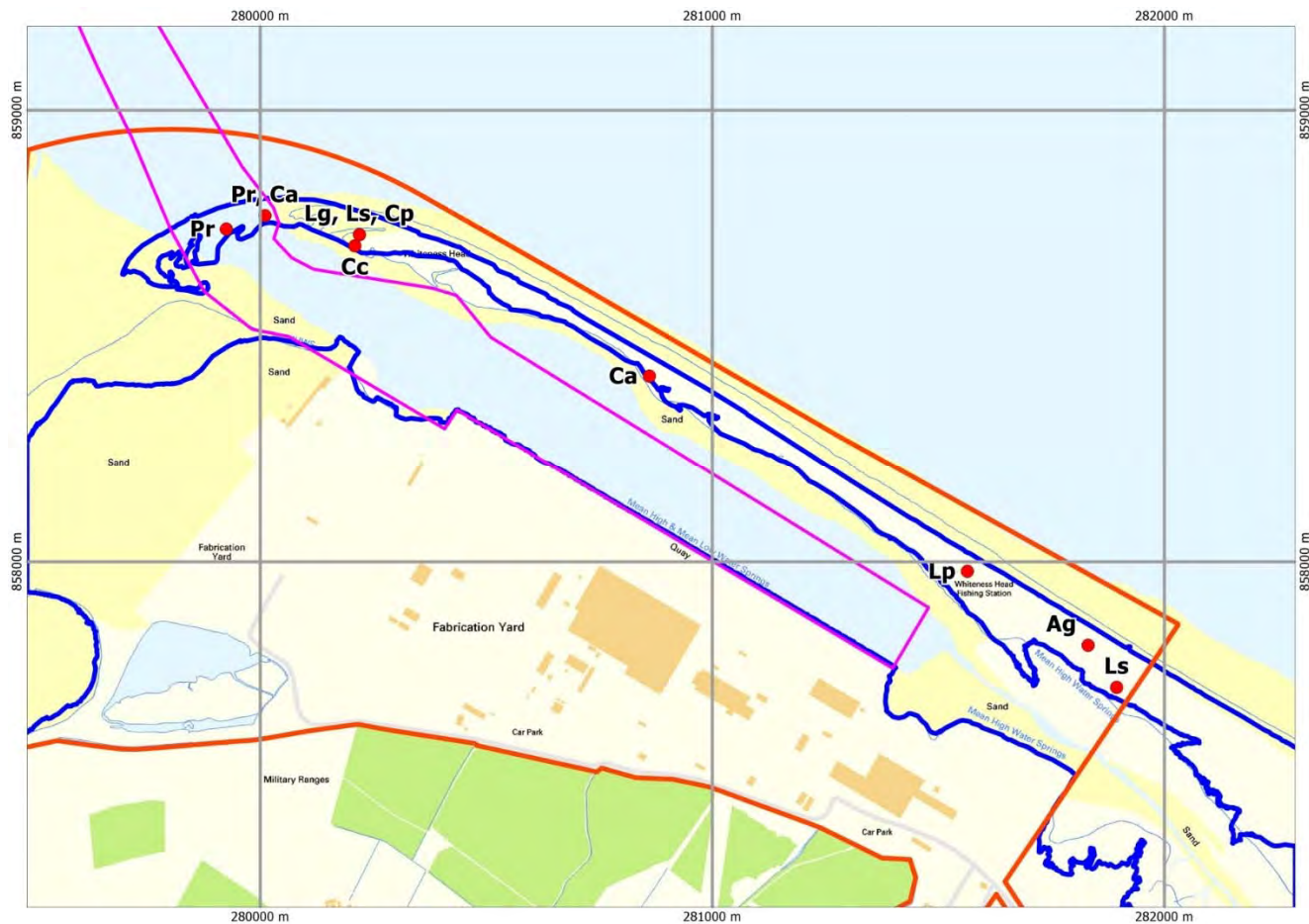


Figure 2. The locations of some of the notable species. The map is based on the data in Appendix 3 where **Ag**= *Agonimia gelatinosa*, **Ca**= *Cetraria aculeata*, **Cc**= *Cladonia cariosa*, **Cp**= *Caloplaca phlogina*, **Lg**= *Lecania granulata*, **Ls** = *Lecania subfuscula*, **Pr**= *Pronectria robergei*. The basemap is an Ordnance Survey Street View map available under the OS OpenData map dataset and is free to use under the Open Government Licence (OGL). Contains OS data (c) Crown copyright and database right 2018.

Figure 3. World distribution of *Lecania granulata* (indicated by the yellow dots) from the Global Biodiversity Information Facility (GBIF) at <https://www.gbif.org/>. Note this map does not show the record from the Flannan Isles.



Figure 4. Typical habitat of *Lecania granulata* on Scottish islands – here showing exposed clifftop broken sward with well-developed terricolous lichen flora at Malcolm's Head, Fair Isle.



Figure 5. The shallow depression at NH80219 58725 referred to as a 'gully' in Coppins & Coppins. This area has a well-developed terricolous flora with good populations of *Lecania granulata* (a very rare endemic species and the only record for mainland Scotland), *Caloplaca chlorina* and *Lecania subfuscula* (**NS**), as well as records for *Caloplaca phlogina* (**NS**), *Arthonia parietinaria* (**NS**), *Lecanora zosterae* (**NS**) and *Bacidia viridescens* (the latter recorded here in 2005).



4.2 Overall evaluation of the lichen assemblage

Stabilised shingle, dune grassland and dune heaths with a well-developed lichen flora are very scarce and local habitats in Britain. The shingle in the study site supports a range of notable species including species of International, National (UK), National (Scottish), Regional, and Local conservation importance (Table 2).

The Heathland, Moorland and Coastal Heath Index (HMCI) has been recently developed to help assess the lichen flora of non-montane heaths, non-montane moorland, coastal heathland, acid dunes and comparable habitats (Sanderson *et al*, 2018). The index is based on the presence of a range of specific lichen taxa (mostly terricolous species) and is intended to be used of sites of about 100ha or more. Sanderson *et al*, 2018 recommend that sites with a score of 20 or more should be considered for notification as SSSIs based on the lichen flora.

Following the guidelines in Sanderson *et al*, 2018 HMCI indices have been calculated as follows:

HMCI score for study site = **18**¹

HMCI score for Whiteness SSSI = **25**²

¹ Based on 15 *Cladonia* species plus 3 other index species (*Bryoria fuscescens*, *Cetraria aculeata* and *Leptogium palmatum*. Note this score includes *Cladonia subulata* recorded in 2005 that was not recorded 2018 (but is likely to still be present).

² This includes an extra 7 index species recorded in Coppins & Coppins 2000 (5 *Cladonia* species, and also *Cetraria islandica* and *Ochrolechia frigida*).

Coppins & Coppins (2005) concluded that the SSSI was of 'significant importance for lichens and should be protected'. The 2018 survey recorded a number of notable species as new to the site – most notably *Lecania granulata* a species of International conservation importance (Table 2) so provides additional support for their assessment.

5 ECOLOGICAL IMPACTS

The main issues and concerns relate to the direct loss of lichen habitat, lichens and associated microfungi, during dredging. The main habitat affected by dredging will be shingle (lichens on pebbles) and associated terricolous niches and driftwood (Figure 6). Locally, some of these niches support well-developed lichen assemblages including a number of notable taxa (Table 1). This report does not consider any impact from accesses etc. It is assumed no vehicles/heavy machinery will access the spit itself outwith the official 'dredging zone'.

The proposed dredging will impact on one species of Local Conservation Importance (*Cetraria aculeata*) and 9 species of Regional Conservation Importance: *Acarospora veronensis* (**NS**), *Arthonia parietinaria* (**NS**), *Bacidia saxenii* (**NS**), *Caloplaca asserigena* (**NS**), *Lecanora zosterae* (**NS**), *Micarea coppinsii* (**NS**), *Micarea misella* (**NS**), *Pyrenidium actinellum* (**NS**) and the Nationally Scarce *Pronectria robergei*. All of the species of Regional value are nationally under recorded (Table 2). *Arthonia parietinaria*, *C. asserigena*, *C. aculeata* and *zosterae* were recorded elsewhere in the study site (outwith the dredge zone). *Acarospora veronensis*, *B. saxenii*, *M. coppinsii*, *M. misella*, *P. robergei* and *P. actinellum* were only recorded in the proposed area to be dredged. Of these *B. saxenii* is a pioneer species, the *Micarea* spp. are tiny, generally overlooked species, *P. actinellum* is a common and widespread lichenicolous fungus (pers. obs.) The lichenicolous *Pronectria robergii* is found on *Peltigera didactyla*, a widespread lichen of recently disturbed sites and dunes. Although listed as NR in Woods & Coppins (2012) it is now known from 48 hectads in the UK (NBN Atlas) and is still probably nationally under-recorded to some degree (Table 2). *A. veronensis* is almost certainly present on pebbles outwith the dredge zone (there is plenty of suitable shingle habitat and it was probably overlooked).

As well as the loss of species currently present, the loss of potential future habitat is also of concern as the area that is to be dredged is clearly currently colonising well with terricolous lichens and saxicolous lichens (on pebbles). This is discussed further in section 7.

Perhaps of greater concern than direct loss of is the potential loss of some key lichen areas (especially the area supporting *Lecania granulata*) should the dredging affect the geomorphological dynamics of the spit. The authors noted a considerable change in the spit since 2005 (section 7) but are not qualified to comment on the long term effects on the spit of dredging activities.

Figure 6. Photo from the eastern edge of the proposed dredge zone to show the area of the spit that will be lost.



6 MINIMISING THE IMPACT OF PROPOSED DREDGING

The SNH Objectives for Management (and key factors influencing the condition of natural features) include 'To maintain habitats and conditions suitable for rare and scarce plants and invertebrates associated with the sandflats, saltmarsh and shingle spit by managing pedestrian and vehicular access to these areas' (SNH 2013a) and although not notified for lichens or mentioned specifically in the SSSI citation (SNH2013a), the presence of notable lichens is mentioned in the Site Management Statement (SNH, 2013b).

The following guidelines should be adopted to help ensure negative impacts are minimised:

- The dredging should be confined to the proposed area.
- A geomorphologist should continue to assess the likelihood that the dredging (including any future dredging) will impact on shingle structures outwith the dredging zone and thus potentially increase negative impact on the lichen flora.

- The SSSI Site Management Statement (SNH, 2013) states that ‘appropriate ‘sediment husbandry’ via an appropriate dredge and spit management plan should mitigate concerns [re. shingle mobility] without compromising the designated interests’. Lichens are not notified feature of the site so could potentially be overlooked. Given their importance at Whiteness SSSI, and for the avoidance of all doubt, they should be explicitly incorporated into a management plan.
- Vehicles should only be permitted to access the house (the old fishing station c. NH 815 579) via the existing tracks and there should be no vehicular access beyond the house (recent vehicle tracks were seen to be disturbing the shingle beyond the house).
- The findings of this report should be communicated to SNH specifically the locations of the notable lichens for inclusion in the SSSI Citation Site Management Statement when it is updated.

7 DISCUSSION AND OTHER RECOMMENDATIONS

The habitat in the area that will be impacted by dredging is relatively recently established and was devoid of lichens 13 years ago in 2005 (Figures 7, 8). This should *not* be interpreted to mean that the lichen flora of the shingle here is recently established and thus of little value. The presence of areas such as this are important due to the dynamic nature of such coastal ecosystems. A balance of a range of successional stages is important. For lichens the best development of the lichens is generally seen on stabilised shingle/dune where vascular plants are patchy or otherwise restricted/suppressed by extreme conditions (drought, exposure, rabbit grazing etc.) Particularly important lichen patches can persist where vascular plants are suppressed long term (e.g., in the depression shown in Figure 5). If there is succession and vascular plants (e.g. grasses, or subshrubs/shrubs) become dominant the lichens tend to reduce in diversity and some subsequent disturbance to the sward can be beneficial to lichen flora (if followed by a suitably long period of stability). Clearly a balance is needed for long term viability of a rich lichen flora – too much disturbance will lead to loss of lichens (and habitat with low suitability for successful colonisation), and too little can lead to a rank vascular sward (of much lower low suitability for lichens as they tend to be outcompeted/smothered).

The area to be dredged also represents an important early successional stage that is starting to develop a nice terricolous/saxicolous lichen flora. If left undisturbed it would be likely to develop a good (though likely patchy) lichen flora over time. No comparable areas of more stable/stabilising that are starting to develop a nice lichen flora were observed elsewhere on site. Other shingle patches are either very mobile and devoid of lichens or limited to small patches amongst larger areas of later successional stages of ranker vegetation. It remains to be seen if the more mobile areas stabilise sufficiently for lichen colonization and remain stable enough for development of a well-developed terricolous/saxicolous lichen flora. There has already been a significant loss of the rich terricolous

sward since 2005 due to disturbance from natural processes (Figures 9-12), and the dredging will add to the cumulative impact.

One of the main ongoing threats to the shingle and dune heath habitat is expansion of gorse in the east of the site (e.g., Figure 13). Gorse removal (and follow up control) would be suitable mitigation to offset the loss of shingle habitat due to dredging. Care should be taken to avoid damage to the patches of stabilised, exposed shingle and dune heath between the gorse patches (most notably the *Cetraria islandica* patches in Figures 14, 15 but also numerous other patches) as these will act as sources for lichen colonisation. Removal of invasive *Rosa rugosa* should also be undertaken (e.g. Figure 16).

Figure 7. The western end of the shingle spit in 2005 (Figure 22 in Coppins & Coppins, 2005) showing non-stabilised shingle devoid of lichens. In 2005 Coppins & Coppins note there were no lichens beyond NH80077 58760 (their GPS14).



Figure 8. The western end of the spit in 2018 clearly showing colonisation of more stable areas of shingle by vegetation since 2005. The area that is well vegetated (in the distance) will be lost due to the proposed dredging. This is a crop of photo shown in Figure 6.



Figure 9. An area of non-stabilised shingle devoid of lichens. In 2005 this area was stabilised shingle and supported frequent lichen-rich terricolous patches including locally frequent large patches of *Cetraria aculeata*, and well-formed cushions of *Cladonia* spp. including *C. arbuscula*, *C. portentosa*, *C. ciliata* var. *tenuis* and *C. ciliata* var. *ciliata*. This area corresponds to 'Area F' in Coppins & Coppins 2005 as defined by their GPS locations GPS, 3, 4, 5 and 5a. Brian stands at NH80928 58389 (GPS 5). The lichen-rich stabilised shingle has been lost since 2005 – apparently being disturbed (presumably by winter storms). It would be fascinating to monitor any recovery of the lichen flora in this area. Only one tiny fragment with *C. aculeata* now remains (see Fig. 10). Photo looking northwest along the spit.



Figure 10. Small outlier remnant (c. 6m x 3m) of the lichen rich Area F of Coppins & Coppins (2005) with a healthy patch of *Cetraria aculeata* (now scarce and very local in the study site) as well as the more ubiquitous *Cladonia rangiformis*. Photo looking along towards the western end of the spit.



Figure 11. Stabilised shingle with mats of terricolous lichens at NH80954 58387 in Area F in 2005 (GPS 4 in Coppins & Coppins 2005). This is Figure 8 of Coppins & Coppins, 2005.



Figure 12. The same area in 2018 was bare, mobile shingle, with no lichens. (Brian is standing at GPS4 NH80954 58387).





Figure 13. Dense gorse and broom in the eastern section of the site (and wider SSSI). The gorse has clearly spread since 2005 (pers. obs.) with reduction in available dune heath, dune grassland and shingle habitats for lichens.



Figure 14. An area of *Cetraria islandica* in the eastern section of the SSSI in a gorse 'glade'. The gorse here could potentially rapidly smother the lichen habitat. The gorse here should be carefully monitored to ensure it does not encroach on the *Cetraria islandica* habitat.



Figure 15. Closer view with Brian surveying the *Cetraria islandica*. The dark green patches are *Empetrum nigrum*.

Figure 16. Dense stands of *Rosa rugosa* near the old fishing station.



8 RESIDUAL EFFECTS

EnviroCentre are currently undertaking a coastal modelling assessment and anticipate that there is a low risk of disturbance to the non-dredged parts of the spit as an indirect result of the proposed dredging (Karen Couper pers. comm.) If the recommendations in section 6 and 7 are followed, and the modelling is correct, then the long term residual effects of the proposed dredging are anticipated to be significant at the local level.

Monitoring of the impact of shingle mobility on shingle areas highlighted in this report is recommended especially the areas at the northern section of the spit supporting *Cladonia cariosa* and *Lecania granulata*.

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APPENDIX 1 GLOSSARY OF ECOLOGICAL TERMS

Assemblage	The lichen assemblage at a location refers to the lichen communities and lichen species present.
Bryicolous	Growing on bryophytes (mosses or liverworts).
Community	A group of species characteristically found in the same location due to the similarity of their habitat or micro-habitat requirements.
Direct impact	An outcome that is directly attributable to a defined action.
Disturbance	Any event that alters or stresses an environment's structure and/or function.
Ecological continuity	Habitats with a high degree of ecological continuity are those which have existed in a more natural state for longer. For example, ancient woodland.
Habitat	A place in which a particular plant or animal lives. Often used in the wider sense referring to major assemblages of plants and animals found together.
Least Concern	An IUCN Red List category for a taxon that has been evaluated against the IUCN criteria but does not qualify for Critically Endangered, Endangered, or Vulnerable. The category also excludes Near Threatened species (see below). This category includes species that are widespread and abundant but can also include species that are of conservation value. For example a species listed as LC may be of regional, local or very local (site-based) conservation value.
Lichenicolous	Growing on lichens.
Mitigation	Measures taken to reduce adverse impacts e.g. modifications or additions to the design of the development.
Nationally Rare	Occurring in 15 or fewer hectads (10 x 10 km squares) in Great Britain.
Nationally Scarce	Occurring in 16-100 hectads (10 x 10 km squares) in Great Britain.
Non-lichenized fungi	A fungus that has been traditionally recorded by lichenologists but is not strictly a lichen as it has no photobiont (algal partner).

Not Evaluated	A taxon is Not Evaluated when it has not been assessed against IUCN criteria.
Population	A collection of individuals (plants or animals), all of the same species and in a defined geographical area.
Red-listed species	A taxon that has been evaluated against IUCN criteria and qualifies as threatened (Critically Endangered, Endangered, or Vulnerable).
Restoration	The re-establishment of a damaged or degraded system or habitat to a close approximation of its pre-degraded condition.
Saxicolous	Growing on rock.
Scottish Biodiversity List	A list of animals, plants and habitats that Scottish Ministers consider to be the highest priority for biodiversity conservation in Scotland
Terricolous	Growing on the ground. Includes those species growing on soils, decaying vegetation, and low mats of bryophytes and occasionally spreading to overgrow the bases of vegetation at ground level.
Viability	Given that the intrinsic quality of the vegetation in the habitat is acceptable, its area must be large enough to be viable so that the habitat and its flora and fauna can resist edge effects, typical/expected levels of periodic/localised disturbance, and the loss of species and/or colonisation by inappropriate species.

APPENDIX 2 ABBREVIATIONS USED IN THE TEXT

BLS	British Lichen Society
IUCN	International Union for the Conservation of Nature and natural resources
JNCC	Joint Nature Conservation Committee.
LC	Least Concern (as defined by Woods & Coppins, 2012)
NBN	National Biodiversity Network
NE	Not Evaluated according to IUCN Red List criteria
NR	Nationally Rare
NS	Nationally Scarce
NT	Near Threatened (as defined by Woods & Coppins, 2012)
SBL	Scottish Biodiversity List
SNH	Scottish Natural Heritage
SSSI	Site of Special Scientific Interest

APPENDIX 3 LOCATIONS OF SOME NOTABLE SPECIES

Table 3. The locations and substrata of the notable species are given below. The locations of some of the notable species (listed in red text) were used to generate the map in Figure 2. Only a selection of species is shown to make the map legible. A number of species are not shown on the map because grid references for all locations were not collected (for example because they were observed to be, or suspected to be, widespread on site) and/or Nationally under-recorded, or the precise grid reference is unknown (some are chance or speculative collections and many were only identified with certainty back in the laboratory). A digital shape file of all records in this table accompanies this report.

Taxon name	Status	Easting	Northing	Label
<i>Absconditella celata</i>	LC NR	281	857	Ace
<i>Acarospora veronensis</i>	LC NS	279995	858760	Av
<i>Acarospora veronensis</i>	LC NS	279999	858752	Av
<i>Agonimia gelatinosa</i>	LC NS	281831	857816	Ag
<i>Arthonia parietinaria</i>	NE NS	280	858	Ap
<i>Arthonia parietinaria</i>	NE NS	280219	858725	Ap
<i>Bacidia saxenii</i>	LC NS	279989	858737	Bs
<i>Caloplaca asserigena</i>	LC NS	28187	85774	Cas
<i>Caloplaca asserigena</i>	LC NS	279876	858744	Cas
<i>Caloplaca cerinelloides</i>	LC NS	28187	85774	Cce
<i>Caloplaca cerinelloides</i>	LC NS	281612	857954	Cce
<i>Caloplaca phlogina</i>	NE ?NS	280219	858725	Cp
<i>Catillaria atomarioides</i>	LC NS	281812	857834	Cat
<i>Catillaria atomarioides</i>	LC NS	281970	857734	Cat
<i>Cercidospora epipolytropia</i>	LC NS	281970	857734	Cep
<i>Cetraria aculeata</i>	LC	280010	858767	Ca
<i>Cetraria aculeata</i>	LC	280861	858412	Ca
<i>Cetraria islandica</i> subsp. <i>islandica</i>	LC	283585	857005	Ci
<i>Cladonia cariosa</i>	LC NS	280209	858700	Cc
<i>Endococcus brachysporus</i>	NE NR	281812	857834	Eb
<i>Heterocephalacria bachmannii</i>	LC NR	280215	858734	Hb
<i>Lecania granulata</i>	NE	280219	858725	Lg
<i>Lecania subfuscata</i>	LC NS	280219	858725	Ls
<i>Lecania subfuscata</i>	LC NS	281894	857723	Ls
<i>Lecanora hagenii</i>	NE	281784	857850	Lh
<i>Lecanora zosteræ</i>	LC NS	2799	8587	Lz
<i>Lecanora zosteræ</i>	LC NS	279900	858741	Lz
<i>Lecanora zosteræ</i>	LC NS	280219	858725	Lz
<i>Lecanora zosteræ</i>	LC NS	281784	857850	Lz
<i>Lecanora zosteræ</i>	LC NS	281881	857793	Lz
<i>Lecanora zosteræ</i>	LC NS	281894	857723	Lz
<i>Leptogium palmatum</i>	NT NS	281564	857979	Lp
	Sc			

Whiteness Head, Ardersier Port
Ecological assessment: lichens. [Redacted]

Taxon name	Status	Easting	Northing	Label
<i>Lichenodiplis lecanorae</i>	LC NS	281784	857850	LI
<i>Micarea coppinsii</i>	LC NS	279999	858752	Mc
<i>Micarea misella</i>	LC NS	279907	858734	Mm
<i>Pronectria robergei</i>	NE NR	279925	858737	Pr
<i>Pronectria robergei</i>	NE NR	280010	858767	Pr
<i>Pyrenidium actinellum</i>	LC NS	279995	858760	Pa

APPENDIX 4 SPECIES LIST

Table 4. The full list of taxa recorded is listed below. Conservation Status according to Woods & Coppins (2012) where LC= Least concern; NE= Not Evaluated; NS= Nationally Scarce; NR= Nationally Rare; NT = Near Threatened; Sc= Scottish Biodiversity List species.

BLS no.	Taxon name	Conservation Status
0001	<i>Absconditella celata</i>	LC NR
0030	<i>Acarospora veronensis</i>	LC NS
1155	<i>Agonimia gelatinosa</i>	LC NS
0038	<i>Agonimia tristicula</i>	LC
1611	<i>Agyrium rufum</i>	LC
0212	<i>Amandinea punctata</i>	LC
2683	<i>Arthonia parietinaria</i>	NE NS
0069	<i>Arthonia radiata</i>	LC
0131	<i>Bacidia arceutina</i>	LC
1593	<i>Bacidia saxenii</i>	LC NS
0192	<i>Bryoria fuscescens</i>	LC
0200	<i>Buellia aethalea</i>	LC
2371	<i>Caloplaca asserigena</i>	LC NS
0279	<i>Caloplaca cerinelloides</i>	LC NS
0263	<i>Caloplaca chlorina</i>	LC
0253	<i>Caloplaca crenularia</i>	LC
0261	<i>Caloplaca holocarpa s. lat.</i>	LC
2527	<i>Caloplaca holocarpa s. str.</i>	LC
0267	<i>Caloplaca marina</i>	LC
2317	<i>Caloplaca phlogina</i>	NE ?NS
0298	<i>Candelariella vitellina f. vitellina</i>	LC
1609	<i>Catillaria atomarioides</i>	LC NS
2025	<i>Cercidospora epipolytropia</i>	LC NS
0430	<i>Cetraria aculeata</i>	LC
0333	<i>Cetraria islandica subsp. islandica</i>	LC
0360	<i>Cladonia arbuscula subsp. squarrosa</i>	LC
0366	<i>Cladonia cariosa</i>	LC NS
0371	<i>Cladonia chlorophaea s. lat.</i>	LC
0372	<i>Cladonia ciliata var. ciliata</i>	LC
0373	<i>Cladonia ciliata var. tenuis</i>	LC
0375	<i>Cladonia coniocraea</i>	LC
0384	<i>Cladonia fimbriata</i>	LC
0389	<i>Cladonia furcata subsp. furcata</i>	LC
0391	<i>Cladonia glauca</i>	LC
0376	<i>Cladonia humilis</i>	LC
0409	<i>Cladonia portentosa</i>	LC
0359	<i>Cladonia ramulosa</i>	LC
0412	<i>Cladonia rangiformis</i>	LC
0415	<i>Cladonia scabriuscula</i>	LC
0751	<i>Clauzadea monticola</i>	LC

BLS no.	Taxon name	Conservation Status
0085	<i>Collembopsidium foveolatum</i>	LC
2295	<i>Endococcus brachysporus</i>	NE NR
0511	<i>Evernia prunastri</i>	LC
2239	<i>Heterocephalacria bachmannii</i>	LC NR
0582	<i>Hypogymnia physodes</i>	LC
0583	<i>Hypogymnia tubulosa</i>	LC
2575	<i>Lecania granulata</i>	NE
0159	<i>Lecania naegelii</i>	LC
0167	<i>Lecania subfuscula</i>	LC NS
0636	<i>Lecanora carpineae</i>	LC
0639	<i>Lecanora chlorotera</i>	LC
0641	<i>Lecanora confusa</i>	LC
0646	<i>Lecanora dispersa</i>	LC
0649	<i>Lecanora expallens</i>	LC
0621	<i>Lecanora hagenii</i>	NE
0656	<i>Lecanora intricata</i>	LC
0667	<i>Lecanora polytropae</i>	LC
0672	<i>Lecanora pulicaris</i>	LC
0674	<i>Lecanora rupicola</i> var. <i>rupicola</i>	LC
0675	<i>Lecanora saligna</i>	LC
0688	<i>Lecanora symmicta</i>	LC
2287	<i>Lecanora zosterae</i>	LC NS
2583	<i>Lecidea fuscoatra</i> s. str.	
2474	<i>Lecidea grisella</i>	LC
0804	<i>Lecidella asema</i>	LC
0796	<i>Lecidella carpathica</i>	LC
0797	<i>Lecidella elaeochroma</i> f. <i>elaeochroma</i>	LC
0802	<i>Lecidella scabra</i>	LC
0842	<i>Leptogium palmatum</i>	NT NS SBL
2530	<i>Leptogium pulvinatum</i>	LC
2096	<i>Lichenodiplis lecanorae</i>	LC NS
0998	<i>Melanelixia fuliginosa</i>	LC
0997	<i>Melanelixia glabrata</i>	LC
1020	<i>Melanelixia subaurifera</i>	LC
0995	<i>Melanohalea exasperata</i>	LC
1720	<i>Micarea coppinsii</i>	LC NS
0877	<i>Micarea denigrata</i>	LC
0719	<i>Micarea erratica</i>	LC
0883	<i>Micarea melaena</i>	LC
0884	<i>Micarea misella</i>	LC NS
0886	<i>Micarea peliocarpa</i>	LC
2116	<i>Muellerella lichenicola</i>	LC
0025	<i>Myriospora smaragdula</i>	LC
0926	<i>Ochrolechia parella</i>	LC
1015	<i>Parmelia saxatilis</i> s. lat.	LC
1022	<i>Parmelia sulcata</i>	LC
1053	<i>Peltigera didactyla</i>	LC

BLS no.	Taxon name	Conservation Status
1043	<i>Peltigera hymenina</i>	LC
1047	<i>Peltigera membranacea</i>	LC
1051	<i>Peltigera rufescens</i>	LC
1112	<i>Physcia adscendens</i>	LC
1113	<i>Physcia aipolia</i>	LC
1114	<i>Physcia caesia</i>	LC
1119	<i>Physcia stellaris</i>	LC
1120	<i>Physcia tenella</i>	LC
1735	<i>Placynthiella dasaea</i>	LC
0732	<i>Placynthiella icmalea</i>	LC
1145	<i>Platismatia glauca</i>	LC
1171	<i>Porina chlorotica</i> f. <i>chlorotica</i>	LC
0564	<i>Porpidia crustulata</i>	LC
1690	<i>Porpidia soledizodes</i>	LC
0572	<i>Porpidia tuberculosa</i>	LC
2173	<i>Pronectria robergei</i>	NE NR
0633	<i>Protoparmelia badia</i>	LC
1193	<i>Pseudevernia furfuracea</i> var. <i>ceratea</i>	LC
2179	<i>Pyrenidium actinellum</i>	LC NS
1234	<i>Ramalina farinacea</i>	LC
1235	<i>Ramalina fastigiata</i>	LC
1251	<i>Rhizocarpon distinctum</i>	LC
1257	<i>Rhizocarpon geographicum</i>	LC
1266	<i>Rhizocarpon reductum</i>	LC
1250	<i>Rhizocarpon richardii</i>	LC
1289	<i>Rinodina oleae</i>	LC
1298	<i>Rinodina sophodes</i>	LC
1322	<i>Scoliciosporum umbrinum</i>	LC
2232	<i>Stigmidium peltideae</i>	LC NS
0630	<i>Tephromela atra</i> var. <i>atra</i>	LC
1434	<i>Trapelia obtegens</i>	LC
0692	<i>Trapeliopsis flexuosa</i>	LC
0327	<i>Tuckermannopsis chlorophylla</i>	LC
1468	<i>Usnea hirta</i>	LC
1471	<i>Usnea subfloridana</i>	LC
1507	<i>Verrucaria muralis</i>	LC
1005	<i>Xanthoparmelia mougeotii</i>	LC
1538	<i>Xanthoria aureola</i>	LC
2364	<i>Xanthoria candelaria</i> s. str.	LC
1530	<i>Xanthoria parietina</i>	LC
1531	<i>Xanthoria polycarpa</i>	LC
2272	<i>Xanthoriicola physciae</i>	LC
1532	<i>Xylographa parallela</i>	LC