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A Lichen Survey of Penwith Moors (2019)

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Foreword

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Background - Ten sites with granite tors within West Penwith, Cornwall were visited in 2019 to determine the extent and quality of the Non-montane Acid Rock Assemblage of lichens, previously identified as a potentially significant lichen feature of the area. This was to collect evidence supporting designation of a Site of Special Scientific Interest (SSSI). Sites were assessed individually and collectively by the Threatened, Near Threatened and Notable species of the Assemblage. Thirteen species belonging to the Assemblage were found, including *Parmelinopsis horrescens* (Near Threatened), *Sarcogyne clavus* (Near Threatened) and *Usnea subscabrosa* (Vulnerable). Individual sites scored from 4 to 15, with only one failing to achieve the threshold of 6 for consideration for SSSI status. All sites together scored 18, well above the threshold. *Melaspilea interjecta* was recorded new to England. Four additional notable species were recorded, which do not belong to the Non-montane Acid Rock Assemblage, including *Rinodina ericina* recorded new to England, and the second record for Great Britain.

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Further information
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A Lichen Survey of Penwith Moors

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Report to Natural England, September 2019

Abstract

Ten sites with granite tors within West Penwith, Cornwall were visited in 2019 to determine the extent and quality of the Non-montane Acid Rock Assemblage of lichens, previously identified as a potentially significant lichen feature of the area. This was to collect evidence supporting designation of a Site of Special Scientific Interest (SSSI). Sites were assessed individually and collectively by the Threatened, Near-Threatened and Notable species of the Assemblage. Thirteen species belonging to the Assemblage were found, including *Parmelinopsis horrescens* (Near Threatened), *Sarcogyne clavus* (Near Threatened) and *Usnea subscabrosa* (Vulnerable). Individual sites scored from 4 to 15, with only one failing to achieve the threshold of 6 for consideration for SSSI status. All sites together scored 18, well above the threshold. *Melaspilea interjecta* was recorded new to England. Four additional notable species were recorded, which do not belong to the Non-montane Acid Rock Assemblage, including *Rinodina ericina* recorded new to England, and the second record for Great Britain.

Contents

Introduction

Land within West Penwith, Cornwall (between Land's End and St Ives), is being considered for designation as a Site of Special Scientific Interest (SSSI) under the Wildlife & Countryside Act 1981. Much supporting evidence for the proposed designation has already been collected. Lichens are being considered as potential designated features and have already been subject to assessment in 2013 based upon field survey undertaken by Neil Sanderson. A lichen feature has been identified associated with the granite outcrops of the area, namely the Non-montane Acid Rock assemblage. Sanderson (2013) stated that 'The occurrence of woodland oceanic species on shaded rock appears to be special feature of the low-lying granite of West Penwith Moors, not as well developed in more upland granite outcrops in the South West.' This assessment was based upon fieldwork from just 3 locations: Carn Galver (SW42.36), Rosewall Hill (SW49.39) and Trencrom Hill (SW51.36).

The present survey was commissioned to determine to what extent the non-montane acid rock assemblage is distributed within the proposed SSSI and to determine the diversity and quality of the assemblage, and also to identify any other lichen features which might be considered worthy of SSSI status.

Methods

Ten sites were included in the survey. Trencrom Hill had already been visited by Sanderson in 2013, but was considered worthy of a second visit.

The following sites were visited (with approximate area and location), listed below in approximate order from west to east:

Sites visited

site	abbreviation	grid ref. of centre, or main tor	1 km squares	altitude (m)
Carn Kenidjack	CK	SW387.329	SW38.32	190-203
Carn Downs	CD	SW410.346	SW40.34, 41.34	180-204
Watch Croft	WC	SW420.357	SW41.35, 42.35	225-252
Boswarva Carn	BC	SW428.326	SW42.32	175-196
Hannibal's Carn	HC	SW431.363	SW43.36, (43.35)	170-232
Zennor Hill	ZH	SW461.385	SW46.38	190-220
Logan Stone	LS	SW463.381	SW46.38	200-237
Sperris Quoit	SQ	SW470.383	SW46.38, 47.38	220-238
Trendrine Hill	TdH	SW478.387	SW47.38, 47.39	180-247
Trencrom Hill	TcH	SW517.362	SW51.36	145-176

All sites are in the botanical vice-county of West Cornwall (V.C. 1).

Sites were visited in July and August 2019, in warm, dry weather. The project specification suggested that 'the contractor should undertake a brief assessment of the suitability of the site to support lichens of non-montane acid rock and, if suitable, begin to record species present'. However, the sites were all broadly similar in character, in that they all comprised granite tors and boulders with no tree cover, mainly surrounded by heathland or bracken. The significant species were often found only after extensive searching. In practice, all lichens were recorded at each site, as far as possible. Lichenicolous fungi were mostly ignored, and only one was recorded.

A number of quadrats were recorded to help understand the range of microhabitats and assemblages present; this method is also a good way of focusing attention on scarce or inconspicuous species. Hierarchical agglomerative clustering of the quadrat data was carried out in Primer 7, using abundance of each species expressed on the Domin scale for quadrat recording. Quadrat samples were clustered using the Bray-Curtis similarity matrix (on square-root transformed data), species were clustered using Whittaker's index of association on untransformed data.

Temporary field numbers (target notes) were recorded occasionally, and used to record locations of species (Appendix 4); they do not necessarily denote the location of a notable species. Location was by means of a hand-held GPS receiver.

A number of specimens were collected for identification in the laboratory, and some will be permanently retained as vouchers.

Nomenclature follows Smith *et al*. (2009) for lichens, with Orange (2018) for *Trapelia*, and Blockeel *et al*. (2014) for bryophytes.

The conservation status of lichens was assessed using 'Guidelines for the Selection of Biological SSSIs: Chapter 13 Lichens and associated microfungi' (Sanderson *et al*. 2018). The method uses habitat-based 'ecologically coherent lichen assemblages', of which Non-montane Acid Rock is appropriate to Penwith Moors. No list of indicator species has been developed for this assemblage, and scoring is by the Threatened, Near Threatened, and Notable (TNTN) method. Each species in the assemblage is assigned a score in the spreadsheet accompanying Chapter 13 of the Guidelines. The assemblage is said to be for collective assessments of outcrops at a landscape scale, using 'outcrops of similar spatial, geological or climatic character, e.g. The Dartmoor Tors ... Sites with ecologically coherent assemblages for groups of outcrops scoring 10 or over should be considered for notification.
Individual outcrops scoring 6 or over can be selected as notified features' (Sanderson *et al*. 2018, TNTN Assemblages + Thresholds sheet of Chapter 13 spreadsheet).

A species is referred to as 'Notable' if it meets the following criteria in the Chapter 13 spreadsheet:

- International Responsibility (IR) but neither Threatened nor NT; or
- Nationally Rare (NR) but neither Threatened nor NT; or
- Nationally Scarce (NS) but neither Threatened nor NT.

In discussions of individual sites or of Penwith Moors as a whole, statements of abundance such as 'rare' or 'frequent' refer to the site in question, and not to the national status of the species, unless specifically stated.

Results

General

The tors throughout the site support very similar lichen communities. Particularly abundant or frequent species include *Cladonia cervicornis*, *Fuscidea cyathoides*, *Lecanora intricata*, *Parmelia omphalodes*, and *Pertusaria pseudocorallina*. There is a maritime element at most sites, found especially on high parts of the tors, and sometimes apparently encouraged by enrichment from bird-perching, including *Amandinea pelidna* (rare), *Anaptychia runcinata*, *Aspicilia leprosescens* (rare), *Lecanora praepostera* (very rare), *Ramalina siliquosa*, *Rinodina atrocinerea*, *R. richardii* (very rare) and *Xanthoparmelia loxodes* (Figs. 11, 61). Lichens indicating slightly calcareous conditions are very rare, including *Gyalecta jenensis* and *Ochrolechia parella*. A number of species are more typical of woodland conditions, and these are mostly restricted to rock faces sheltered from much direct sun, and often near to the ground. These include *Dimerella lutea*, *Herteliana gagei*, *Parmeliella parvula* (very rare, two sites), *Parmelinopsis horrescens*, *P. minarum* and *Thelotrema lepadinum* (very rare on rock, at one site). These species tend to be very local at each site, often on northerly faces, and sometimes on small ledges a short distance from the ground (Figs. 6, 17, 43). Rain-sheltered faces support a limited number of species including *Lepraria incana*, *Haematomma ochroleucum* (rare), *Opegrapha gyrocarpa* and *O. saxigena*. Lichens growing on soil are rare, and mostly confined to very thin soil at the edges of gently sloping rocks; the heathland surrounding the tors is generally much too densely vegetated to support lichens.

Some results of the quadrat analysis are presented in Appendix 3.

Number of species and TNTN scores

A total of 123 lichen species and one additional variety was recorded, and one lichenicolous fungus (Table 1). Totals of 39–69 species (average 57) were found at each site. Sites considered to have received good coverage in the field had totals of 51–69 species per site.

Thirteen species are listed in the Non-montane Acid Rock Assemblage, of which *Parmelinopsis horrescens* and *Sarcogyne clavu*s are Near Threatened (TNTN score 2) and *Usnea subscabrosa* is Vulnerable (score 4), giving a total score for Penwith Moors of 18, above the threshold of 10 at a landscape scale for SSSI selection recommended in Sanderson *et al*. (2018) (Table 2). *Melaspilea interjecta* is new to England.

Individual sites score 4 to 15 on the Non-montane Acid Rock Assemblage; only Carn Downs did not achieve the lower threshold of 6 for SSSI selection of individual sites (Table 3).

Four additional species are Notable, but are not listed as part of the Non-montane Acid Rock Assemblage (Table 2). Thus they do not add to the site scores, but they are part of the lichen interest, and can be regarded as additional evidence for notification. *Lecanora praepostera* is listed on the Maritime Rock and Coastal Slope Index (MRCSI); *Parmeliella parvula* is listed in the Southern Oceanic Woodland Index (Sanderson *et al*. 2018). *Micarea xanthonica* is not listed on any assemblage or index in Sanderson *et al*., and is primarily a woodland species, usually on bark. *Rinodina ericina* is also not listed; the Penwith record is the second British record, and the first record for England.

Bryoria fuscescens does not achieve a TNTN score, but it is considered here as of interest, as it has greatly declined in England and Wales, due partly to air-borne reactive nitrogen compounds.

One of the sites visited in 2019, Trencrom Hill, was also visited by Sanderson in 2013. The aggregate TNTN score for both visits was 8. Two other sites in the proposed SSSI were visited by Sanderson, Rosewall and Carn Galver, and these both achieved a TNTN score of 8 (excluding *Cladonia azorica*).

Images and British distribution maps for some of the notable species are shown in Appendix 2.

Management and threats

Controlled burning is the traditional management of the heathland, but signs of recent burning were seen at few sites. The owner of Trendrine Hill said that there had not been a burn there for at least 25 years. At some sites parts of some boulders appeared bare of lichens; it is likely that these areas were previously shaded by tall gorse or heather, which were subsequently burnt away; recent examples were seen at Boswarva Carn (Figs. 12, 24). The loss of lichens is therefore due primarily to tall growth of shrubs, rather than the fire itself. Gorse will closely cover a boulder and block out all light. Burning is likely to be generally favourable to lichens by preventing an even taller growth of shrubs. It is possible that some terricolous species would benefit after several years from the creation of open ground, but no examples were seen during the survey. Rocks which have been denuded of lichens by shading and then re-exposed support a number of pioneer species that are often rare on long-exposed surfaces, including the Notable species *Melaspilea interjecta* and *Sarcogyne clavus* (Fig. 25).

Ivy is a serious threat to lichens on trees and rocks in many parts of Britain, especially where grazing has been withdrawn. However, although ivy is locally abundant on the Penwith tors, it does not seem to be a serious threat at the moment. At Hannibal's Carn for instance, some rocks are overtopped by ivy bushes and thus have no significant lichen flora, but this does not seem to be a very recent development (Fig. 30). At this site one ivy bush was seen to have collapsed and peeled away from the rock under its own weight, and in places dead ivy stems were seen on rocks, although it is not clear if this is due to fire or natural die back. At Watch Croft, some ivy colonies also seem to be fairly long-standing, unlike the aggressive young shoots that can be found in some parts of the country; possibly the exposure and lack of shade are limiting. The abundance of ivy should be monitored, but it seemed less aggressive than might have been expected.

Scrub development with *Salix cinerea* (sallow) is beginning around some tors, in response to light grazing and lack of burning. Scrub adjacent to rock faces would usually cause excessive shade and moss growth. Some of the notable species including *Parmelinopsis minarum* occur at the bases of north-facing rocks, but the shade here is not deep, and although the species often occurs in mossy places, it cannot compete with vigorous moss colonies.

Alien shrubs apparently derived from seed introduced by birds from local gardens were found in a few places. Only small quantities were seen, but they are a potential serious threat. Not only do these species have no place in this landscape, but they are capable of smothering rocks completely. Only the smallest saplings can be pulled up by hand, and cutting is ineffective as

a means of control. A small but sturdy bush of *Cotoneaster horizontalis* was seen at Zennor Hill, and *Berberis darwinii* is well-established at the north ends of Zennor Hill and Sperris Quoit, and spreading by seed and suckers (Fig. 34). *Croscosmia* × *crocosmiiflora* is established along an old track from the road to a derelict house east of Logan Stone; this is currently distant from rock outcrops, but would damage the character of the heathland if it spread; a colony also occurs at Trencrom Hill (Fig. 59).

Some of the tors are heavily visited by the public, especially Trencrom Hill, and clambering on rocks inevitably occurs. All the tors are only short distances from roads and footpaths, but some are relatively little-visited due partly to the surrounding dense gorse and bracken, and partly to limited parking. It was not possible to determine that clambering has significantly changed the lichen flora at any site, but it would damage colonies of macrolichens (including *Bryoria* and *Usnea* spp.) if these were present.

Taxonomic notes

Species below which belong to the Non-montane Acid Rock Assemblage (NMAR) are indicated.

Bryoria bicolor/smithii (NMAR)

Two small colonies of a *Bryoria* which was either *B. bicolor* or *B. smithii* were found on top of a slab at Hannibal's Carn. A small fragment was removed to test the chemistry, but was later mislaid. For scoring purposes it is assumed that the material was *B. bicolor*, which has a lower TNTN score than *B. smithii*. Note that *B. smithii* is Critically Endangered in Britain (Woods & Coppins 2012) and a Section 41 priority species (NERC Act 2006).

Cladonia azorica (NMAR)

This species is listed as Notable in the Non-montane Acid Rock assemblage (score = 1), but unfortunately it has been convincingly shown to be a synonym of the widespread *C. portentosa* by Pino-Bodas *et al*. (2016), and consequently is not included in the TNTN scoring system in this report. The main, or only, difference from *C. portentosa* is the presence of fumarprotocetraric acid in the thallus, shown by the PD + red reaction. Material of this sort was seen at Hannibal's Carn.

Lecanora alboflavida (NMAR)

This is a local species with a distinctly south and west distribution in Britain, and it is most often recorded on trees in old woodland. The frequent occurrence on sunny granite at Penwith seemed unusual, but an ITS sequence confirmed that the Penwith material was conspecific with a specimen from bark in Scotland.

Lecanora intricata

This species and *L. polytropa* are both rather variable and can be confused. Sanderson evidently regarded *L. polytropa* as the common species at Penwith, but nearly all material seen in the present survey was *L. intricata*. The thallus was always relatively well-developed, although apothecia were often sessile and only rarely with any blue colouration. *Lecanora polytropa*

was found only rarely, usually as a coloniser of denuded rock, with at most a very scanty thallus. These are widespread species, and do not affect the site scores.

Lecanora gangaleoides

This common species is easily confused with *Tephromela atra* in the field, though it is typically found on steeper surfaces than *T. atra*. At Penwith numerous samples were checked at the beginning of the survey, but only *L. gangaleoides* was found. *Tephromela atra* appears to be almost absent, though it was found at Boswarva Carn, where it looked slightly different in the field. These are widespread species, and do not affect the site scores.

Lecidea fuscoatra

This species was occasional at Penwith, but in small quantities and often poorly developed, with a thin thallus and sometimes almost sessile apothecia, though the normal condition of immersed apothecia can be seen in small parts of some colonies. Some collections have small spores, and would key out as *L. siderolithica*, a poorly known species. An ITS sequence placed a collection in *L. fuscoatra*, though there is variation in the publicly available sequences; no sequences named as *L. siderolithica* are available. The material does not belong to the related *L. grisella*. This species does not affect site scores.

***Lecidea* sp.**

A specimen from Sperris Quoit has (*Orange* 24547) contained confluentic acid and ?gyrophoric acid by TLC. An ITS sequence suggests it may belong in the *Lecidea fuscoatra* group, but it may be undescribed or at least new to Britain. Until the material is identified it cannot be regarded as part of the lichen interest.

Mycoblastus caesius

This species is usually found on bark, but material on rock at Penwith agreed in the blue-grey soralia, and the UV + thallus (perlatolic acid by thin-layer chromatography). This species does not affect site scores.

Rinodina ericina

This is a very rare species reported from *Calluna* stems, but at Hannibal's Carn it grew on rock. It differs from the related *R. occulta* by the inspersed hymenium and presence of diploicin by thin-layer chromatography. This species is Not Evaluated in the Red Data Book and does not affect site scores, but is part of the lichen interest.

Sarcogyne clavus (NMAR)

The traditional recognition of two species of *Sarcogyne* on acid rock in Britain is followed here, but a revision may be necessary. The Penwith material strongly resembles the description and figure of *Sarcogyne hypophaeoides* in Westburg *et al*. (2015). However, ITS sequences from two Penwith specimens do not closely match any publicly available sequences of *Sarcogyne*, including those named as *S. clavus*, *S. privigna*, *S. hypophaea* and *S. hypophaeoides*.

Usnea cornuta

Considerable genetic variation was found in this species by Gerlach *et al*. (2019). One of the lineages found in the study was given the provisional name of 'cornuta-6' and is probably a separate species. One specimen from Penwith (*Orange* 24518 from Carn Kenidjack) was sequenced and the ITS matched this lineage. *Orange* 24523 from Penwith was *Usnea cornuta* in the narrow sense, and the few other available sequences from Britain are also of *U. cornuta s.s*. This species does not affect site scores, and there is no information about the abundance or distribution of this lineage in Britain.

Table 1. Lichen species recorded during the 2019 survey.

	no of Penwith sites	Notes
Abrothallus usneae [LF]	1	On *Usnea cornuta*, very rare or overlooked.
Acarospora fuscata	10	Exposed rocks, frequent.
Amandinea pelidna	3	Nutrient-enriched rocks at bird perches, rare and in small quantities. A mainly coastal species in Britain.
Anaptychia runcinata	7	Exposed rocks, very local at each site. Mainly coastal in Britain.
Aspicilia caesiocinerea	6	Nutrient-enriched rocks at bird perches, in small quantities.
Aspicilia leproscescens	2	Nutrient-enriched rocks at bird perches, in very small quantities, poorly developed.
Bryoria fuscescens	3	Exposed rocks, very rare.
Bryoria bicolor/smithii	1	Very rare at one site (HC). Identity uncertain.
Buelia ocellata	2	Rare and in small quantities.
Buellia aethalea	3	Rare and in small quantities; all material .
Buellia subdisciformis	1	Below a bird perch at one site.
Candelariella coralliza	2	Bird-perches, very rare.
Candelariella vitellina	4	Rare and in small quantities where there is slight nutrient-enrichment.
Catillaria atomarioides	2	Very rare and in small quantity.
Catillaria chalybeia var. *chalybeia*	1	Very rare.
Chrysothrix candelaris	1	Very rare on shaded rocks, usually found on bark in Britain.
Cladonia cervicornis	9	Frequent and abundant on rocks.
Cladonia chlorophaea	3	On soil and mossy rocks, rare.
Cladonia ciliata var. *ciliata*	1	Thin soil around rocks, rare.
Cladonia coccifera	5	On soil and mossy rocks, rare.
Cladonia crispata ssp. *cetrariiformis*	1	Soil around rocks, very rare.
Cladonia cyathomorpha	7	Mossy rocks in shade, very small quantities at each site.
Cladonia floerkeana	2	Mossy rocks, rare.
Cladonia furcata	8	Thin soil around rocks, small quantities.
Cladonia gracilis	2	Thin soil around rocks, small quantities.
Cladonia luteoalba	1	Thin soil amongst moss, very rare.
Cladonia polydactyla	5	Mossy rocks, rare.
Cladonia portentosa	5	Thin soil around rocks, rare and in small quantities.
Cladonia ramulosa	2	Mossy rocks, very rare.
Cladonia squamosa var. *squamosa*	1	Shaded mossy rocks, very rare.
Cladonia squamosa var. *subsquamosa*	3	Shaded mossy rocks, rare.
Cystocoleus ebeneus	1	Rain-sheltered rocks, very rare.

Dimerella lutea	4	Rare and in small quantities on shaded rocks.
Enterographa zonata	2	On shaded rocks, very rare.
Flavoparmelia caperata	9	Rocks, frequent.
Fuscidea cyathoides	10	Abundant on exposed rocks.
Gyalecta jenensis	1	Very rare and in small quantity on a shaded and slightly calcareous face.
Haeomatomma ochroleucum var. *porphyrium*	3	Rare on rain-sheltered and shaded rocks.
Herteliana gagei	7	On shaded or north-facing rocks, in very small quantities at each site.
Hypogymnia physodes	7	On exposed rocks, rare at each site.
Hypogymnia tubulosa	1	On exposed rocks, very rare.
Hypotrachyna afrorevoluta	1	On rocks, very rare.
Hypotrachyna britannica	8	Occasional on rocks where there is a little shade or shelter.
Lecanora alboflavida	10	On exposed rocks, frequent in small quantities.
Lecanora campestris	1	Very rare, on one slightly calcareous face.
Lecanora gangaleoides	10	Frequent on rocks.
Lecanora intricata	10	Frequent on rocks.
Lecanora orosthea	2	On rain-sheltered steep faces, very rare.
Lecanora polytropa	6	On rocks, especially where recently denuded, rare.
Lecanora praepostera	1	On one face, very rare.
Lecanora rupicola	4	Rare on tops of rocks where there is slight enrichment or poor drainage.
Lecidea fuliginosa	2	On exposed rocks, rare.
Lecidea fuscoatra	5	Occasional in small quantity, inconspicuous.
Lecidea sp. (*Orange* 24547)	1	On rocks, very rare. Contains confluentic acid.
Lecidella scabra	2	On rocks, very rare.
Lepraria caesioalba	7	On rocks, occasional.
Lepraria ecorticata	1	On deeply rain-sheltered rock, rare at one site only.
Lepraria incana	9	Frequent on rain-sheltered steep faces and below overhangs.
Lepraria lobificans	1	Rain-sheltered rock, very rare.
Massalongia carnosa	1	On shaded mossy rocks, very rare at one site only.
Melanelixia fuliginosa	9	Frequent on rocks.
Melaspilea interjecta	7	Occasional on rocks, especially where recently denuded. New to England.
Micarea lignaria var. *lignaria*	1	Rocks, very rare.
Micarea prasina s.l.	2	On shaded or north-facing rocks, very rare.

Micarea viridileprosa	1	On shaded rocks, very rare at one site only.
Micarea xanthonica	1	On shaded rocks, very rare at one site only.
Mycoblastus caesius	2	On north-facing rocks, very rare.
Ochrolechia androgyna	3	On rocks, very rare.
Ochrolechia parella	6	On rocks, rare and in small quantity.
Ochrolechia tartarea	4	Rocks, rare.
Opegrapha gyrocarpa	5	Rain-sheltered faces, rare,
Opegrapha saxigena	10	Rain-sheltered faces, occasional.
Parmelia omphalodes	10	Frequent and often abundant on exposed rocks.
Parmelia saxatilis	9	Frequent on exposed rocks.
Parmelia sulcata	6	Occasional, often on tops which are slightly nutrient-enriched.
Parmeliella parvula	2	Very rare on moss or young ivy stems on north-facing rocks.
Parmelinopsis horrescens	3	On shaded and often mossy rocks, rare.
Parmelinopsis minarum	8	On shaded and often mossy rocks, very local at each site.
Parmotrema crinitum	1	On shaded high on a high face, very rare.
Parmotrema perlatum	10	On more sheltered or shaded rocks, frequent.
Parmotrema reticulatum	1	On rocks, very rare.
Peltigera hymenina	7	Mossy rocks and thin soil, rare.
Peltigera membranacea	2	Mossy rocks and thin soil, rare.
Pertusaria amara	6	On exposed rocks, occasional.
Pertusaria aspergilla	9	On exposed rocks, occasional.
Pertusaria corallina	10	On exposed rocks, occasional.
Pertusaria excludens	9	On exposed rocks, occasional.
Pertusaria flavicans	5	Rare and in small quantity, often on steep or shaded faces.
Pertusaria monogona	4	Exposed rocks, occasional to frequent at a few sites.
Pertusaria pseudocorallina	10	Abundant on exposed rocks.
Phlyctis argena	3	Shaded rocks, rare and in small quantity.
Placynthiella icmalea	1	Mossy boulder, very rare.
Platismatia glauca	2	Rocks, very rare.
Porina chlorotica	6	Shaded faces, rare and in small quantity.
Porina lectissima	5	Shaded faces, especially where there is slight run-off, in small quantity.
Porpidia cinereoatra	9	Occasional on exposed rocks, but often inconspicuous.
Porpidia irrigua	4	Small quantities on rocks, especially where there is impeded drainage or a minor rain-track.
Porpidia platycarpoides	8	Occasional in small quantity.

Porpidia tuberculosa	9	Occasional in small quantity, inconspicuous.
Ramalina siliquosa	10	Locally frequent, especially on high rocks which probably intercept salty winds.
Ramalina subfarinacea	9	Occasional on exposed rocks.
Rhizocarpon geographicum	5	Rare and local on rocks.
Rhizocarpon reductum	10	Occasional on rocks in small quantities.
Rhizocarpon richardii	2	On rocks with poor drainage, rare.
Rinodina atrocinerea	10	Occasional to frequent on rocks, especially on surfaces with poor drainage.
Rinodina ericina	1	Very rare on one shaded face.
Sarcogyne clavus	8	Occasional on exposed rocks.
Sphaerophorus globosus	7	Rare on low rocks.
Stereocaulon evolutum	3	Rare on rocks.
Tephromela atra	2	Very rare on rocks.
Thelotrema lepadinum	1	Very rare on one shaded face.
Trapelia coarctata/elacista	1	Very rare on rocks.
Trapelia involuta	9	Occasional on rock, especially where recently denuded.
Trapelia placodioides	1	Very rare on rocks.
Trapeliopsis granulosa	2	Very rare on shaded rocks.
Tylothallia biformigera	5	Rare and in small quantity, especially on steep faces.
Usnea cornuta	5	Occasional on rocks, perhaps slightly overlooked for *U. flammea*.
Usnea flammea	10	Frequent on rocks, but mostly as small thalli.
Usnea subscabrosa	1	Very rare at one site.
Verrucaria fusconigrescens	6	Rare and in small quantity on bird perches or in rain tracks.
Xanthoparmelia conspersa	8	Occasional, especially on poorly drained rocks.
Xanthoparmelia loxodes	8	Occasional on exposed rocks.
Xanthoparmelia mougeotii	1	Very rare on rocks at one site.
Xanthoparmelia verruculifera	6	Occasional on exposed rocks.
Xanthoria candelaria	6	Rare on bird perches.

[LF] = lichenicolous fungus.

Table 2. Lichen species with a TNTN score

	RDB GB	RDB Eng	NR/ NS	IR	RDB /Nb	score	no of Penwith sites	sites
Non-montane Acid Rock Assemblage								
*Bryoria bicolor/smithii**	-	-	NS		Nb	1	1	HC
Cladonia cyathomorpha	-	NT	NS		Nb	1	7	WC, TdH, HC, CK, LS, SQ, ZH
Herteliana gagei	-	NT	NS		Nb	1	7	WC, TdH, HC, CK, LS, ZH, BC
Lecanora alboflavida	-	-	NS		Nb	1	10	CD, WC, TdH, HC, CK, TcH, LS, SQ, ZH, BC
Lecidea fuliginosa	-	-	NS		Nb	1	2	LS, ZH
Melaspilea interjecta	DD	-	NR	IR	Nb	1	7	CD, TdH, TcH, LS, SQ, ZH, BC
Opegrapha saxigena	-	-	NS	IR	Nb	1	10	CD, WC, TdH, HC, CK, TcH, LS, SQ, ZH, BC
Parmelinopsis horrescens	NT	NT	NS	IR	Nb	2	3	TdH, HC, CK
Parmelinopsis minarum▽	-	-	NS		Nb	1	8	W, TdH, CK, TcH, LS, SQ, ZH, BC
Pertusaria excludens	-	-	NS		Nb	1	9	CD, WC, TdH, HC, TcH, LS, SQ, ZH, BC
Pertusaria monogona	-	-	NS		Nb	1	4	TdH, HC, CK, LS
Sarcogyne clavus	NT	NT	NS		NT	2	8	TdH, HC, CK, TcH, LS, SQ, ZH, BC
Usnea subscabrosa	VU	VU	NR		RDB	4	1	HC
TNTN Score for Penwith Moors:						**18**		
Other TNTN species								
Lecanora praepostera	-	-	NS		Nb	1	1	TcH
Micarea xanthonica	-	-	NS	IR	Nb	1	1	HC
Parmeliella parvula	-	NT		IR	Nb	1	2	TdH, ZH
Rinodina ericina	NE	-	NR		Nb	1	1	HC

RDB GB = Red Data Book Great Britain (Woods & Coppins 2012), RDB Eng = provisional unpublished red data list for England, NR/NS = Nationally Rare/Nationally Scarce, IR = International Responsibility, Nb = Notable (according to Sanderson et al. 2018). NT = Near Threatened, VU = Vulnerable, DD = Data Deficient (not a threat category), NE = not evaluated..

*A *Bryoria* at Hannibal's Carn was either *B. bicolor* or *B. smithii*; for scoring purposes the score of the lowest-scoring of the two species (*B. bicolor*) is used. *B. smithii* is Critically Endangered (GB and England), Nationally Rare, TNTN score 4.

▽Schedule 8 species (listed as Parmelia minarum) Wildlife & Countryside Act 1981 (as amended)

Table 3. TNTN species at individual sites

	TNTN score	Carn Kenidjack	Carn Downs	Watch Croft	Boswarva Carn	Hannibal's Carn	Zennor Hill	Logan Stone	Sperris Quoit	Trendrine Hill	Trencrom Hill
		CK	**CD**	**WC**	**BC**	**HC**	**ZH**	**LS**	**SQ**	**TdH**	**TcH**
Non-montane Acid Rock											
Bryoria bicolor/smithii	1					1					
Cladonia cyathomorpha	1	1		1		1	1	1	1	1	
Herteliana gagei	1	1		1	1	1	1	1		1	
Lecanora alboflavida	1	1	1	1	1	1	1	1	1	1	1
Lecidea fuliginosa	1						1	1			
Melaspilea interjecta	1		1		1		1	1	1	1	1
Opegrapha saxigena	1	1	1	1	1	1	1	1	1	1	1
Parmelinopsis horrescens	1	2				2				2	
Parmelinopsis minarum	1	1		1	1		1	1	1	1	1
Pertusaria excludens	1		1	1	1	1	1	1	1	1	1
Pertusaria monogona	1	1				1		1		1	
Sarcogyne clavus	2	2			2	2	2	2	2	2	2
Usnea subscabrosa	4					4					
Score for individual sites:		**10**	**4**	**6**	**8**	**15**	**10**	**11**	**8**	**12**	**7**
Score for all sites:	**18**										
Other TNTN species											
Lecanora praepostera	1										1
Micarea xanthonica	1					1					
Parmeliella parvula	1						1			1	
Rinodina ericina	1					1					

Discussion

The 2019 survey showed that all but one (Carn Downs) of the 10 sites achieved the threshold score for individual sites on the Non-montane Acid Rock assemblage. All sites together achieved a score of 18, well over the landscape scale threshold of 10. Many of the sites are fairly complex, and additional searching would probably reveal extra species, including some belonging to the Non-montane Acid Rock Assemblage. Carn Downs is not different in character from the other sites. All the sites should be considered as parts of a single feature at a landscape scale, namely granite tors. None of the tors supports all of the notable species, and some species are limited to single sites, according to the survey results.

One site, Trencrom Hill, has been visited by two different surveyors. In 2013 Neil Sanderson recorded 69 species, with a TNTN score of 6, and in 2019 the present survey reported 55 species, also with a score of 6. However, together the surveys recorded 88 species, and a TNTN score of 8. Among other differences, the 2013 survey reported many more *Cladonia* species, and the 2019 survey reported additional crustose species on rock. This sort of difference between surveys is the norm, and generally reflects differences of focus between surveyors, as well as the impossibility of searching every part of a large site. In this case the 2019 survey focused on saxicolous communities and on the NMAR assemblage in particular, while the earlier survey had a wider remit.

Acknowledgments

Thank you to all the landowners who freely granted permission to carry out surveys. Ingrid Juettner is thanked for running the Primer analysis.

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Appendix 1. Accounts of individual sites

1. Carn Kenidjack

Non-montane Acid Rock assemblage, TNTN score: 10.

This is a tall and fairly compact tor, in heathland and bracken. Public footpaths cross the site and the rocks are frequently visited, with signs of trampling.

Pertusaria monogona was frequent, on sloping sunny surfaces. *Lecanora alboflavida* was occasional on sunny surfaces.

Parmelinopsis minarum occurred in several places on N or NE faces, sometimes with additional shading from sparse bracken; faces are often steep but it also occurs on ledges. It clearly needs some shade, at least from the side. The shaded conditions also encourage the mosses *Hypnum andoi* and *Isothecium myosuroides*, but these are mostly still patchy, as conditions are still rather dry. *P. minarum* can occur associated with these mosses, but can also occur on bare rock. *P. minarum* is local at the site, limited by the availability of shaded rock.

Species recorded at Carn Kenidjack	
Acarospora fuscata	CK: occasional.
Anaptychia runcinata	CK: rare. 44.
Aspicilia caesiocinerea	CK: rare. 51.
Candelariella coralliza	CK: bird perch. 44.
Cladonia cervicornis	CK: occasional.
Cladonia chlorophaea	CK: very rare. 50 shaded face.
Cladonia cyathomorpha	CK: rare. 46 on moss on shaded ledge.
Cladonia floerkeana	CK: 55.
Cladonia furcata	CK: rare. 53.
Cladonia polydactyla	CK: rare on shaded rocks. 47.
Dimerella lutea	CK: rare on shaded face. 49.
Flavoparmelia caperata	CK: occasional to frequent.
Fuscidea cyathoides	CK: abundant.
Herteliana gagei	CK: 45 shaded rocks near to the ground, rare; 47 shaded rocks, rare, 50 shaded rocks.
Hypotrachyna britannica	CK: frequent, often in some shade. 43.
Lecanora alboflavida	CK: occasional to frequent in small quantities on sunny rocks. 43, 47, 50, 54.
Lecanora gangaleoides	CK: frequent on sunny rocks.
Lecanora intricata	CK: frequent.
Lecanora rupicola	CK: on gently sloping tops, occasional. 44, 54, 55.
Lepraria caesioalba	CK: very rare. 55.
Lepraria incana	CK: locally frequent. 44.
Melanelixia fuliginosa	CK: frequent in fairly small quantities.
Micarea lignaria var. lignaria	CK: very rare. 50 shaded face.
Mycoblastus caesius	CK: 50 N face, rare; 52 SW face.
Ochrolechia parella	CK: rare. 44.

Opegrapha gyrocarpa	CK: occasional on shaded rain-sheltered faces. 44.
Opegrapha saxigena	CK: occasional on rain-sheltered N or NE surfaces. 47, 49.
Parmelia omphalodes	CK: frequent.
Parmelia saxatilis	CK: occasional.
Parmelia sulcata	CK: occasional. 43.
Parmelinopsis horrescens	CK: 47 shady mossy rocks, rare.
Parmelinopsis minarum	CK: local on shaded faces and small ledges near ground. 45 c.fr., 46, 47, 49, 50, 53.
Parmotrema perlatum	CK: occasional.
Parmotrema reticulatum	CK: 50 rare.
Peltigera hymenina	CK: rare on thin soil.
Pertusaria amara	CK: rare.
Pertusaria aspergilla	CK: rare.
Pertusaria corallina	CK: occasional.
Pertusaria monogona	CK: frequent on sloping, sunny rocks.
Pertusaria pseudocorallina	CK: abundant.
Phlyctis argena	CK: 45 shaded rocks near to the ground, rare.
Platismatia glauca	CK: very rare. 53 on shaded face near ground.
Porina chlorotica	CK: rare on shaded faces. 49, 53.
Porpidia cinereoatra	CK: occasional in small quantities.
Porpidia platycarpoides	CK: rare. 53.
Porpidia tuberculosa	CK: occasional, in small amounts.
Ramalina siliquosa	CK: locally frequent on high rocks.
Ramalina subfarinacea	CK: occasional. 43,
Rhizocarpon geographicum	CK: rare and local, on rock of differing lithology. After 50.
Rhizocarpon reductum	CK: rare. 53.
Rinodina atrocinerea	CK: occasional. 44, 53.
Sarcogyne clavus	CK: occasional, 43, 47, 51, 52.
Sphaerophorus globosus	CK: rare on low rocks. 49.
Tephromela atra	CK: 44 rocks near bird perch.
Trapelia involuta	CK: rare.
Trapelia placodioides	CK: very rare. 53 gently sloping low rocks shaded by Calluna.
Usnea cornuta	CK: 48 steep rocks. Orange 24518 is Usnea 'cornuta-6'.
Usnea flammea	CK: frequent.
Verrucaria fusconigrescens	CK: occasional on tops, especially by a bird perch. 44.
Xanthoparmelia conspersa	CK: frequent.
Xanthoparmelia loxodes	CK: occasional on gently sloping sunny tops of rocks. 43.

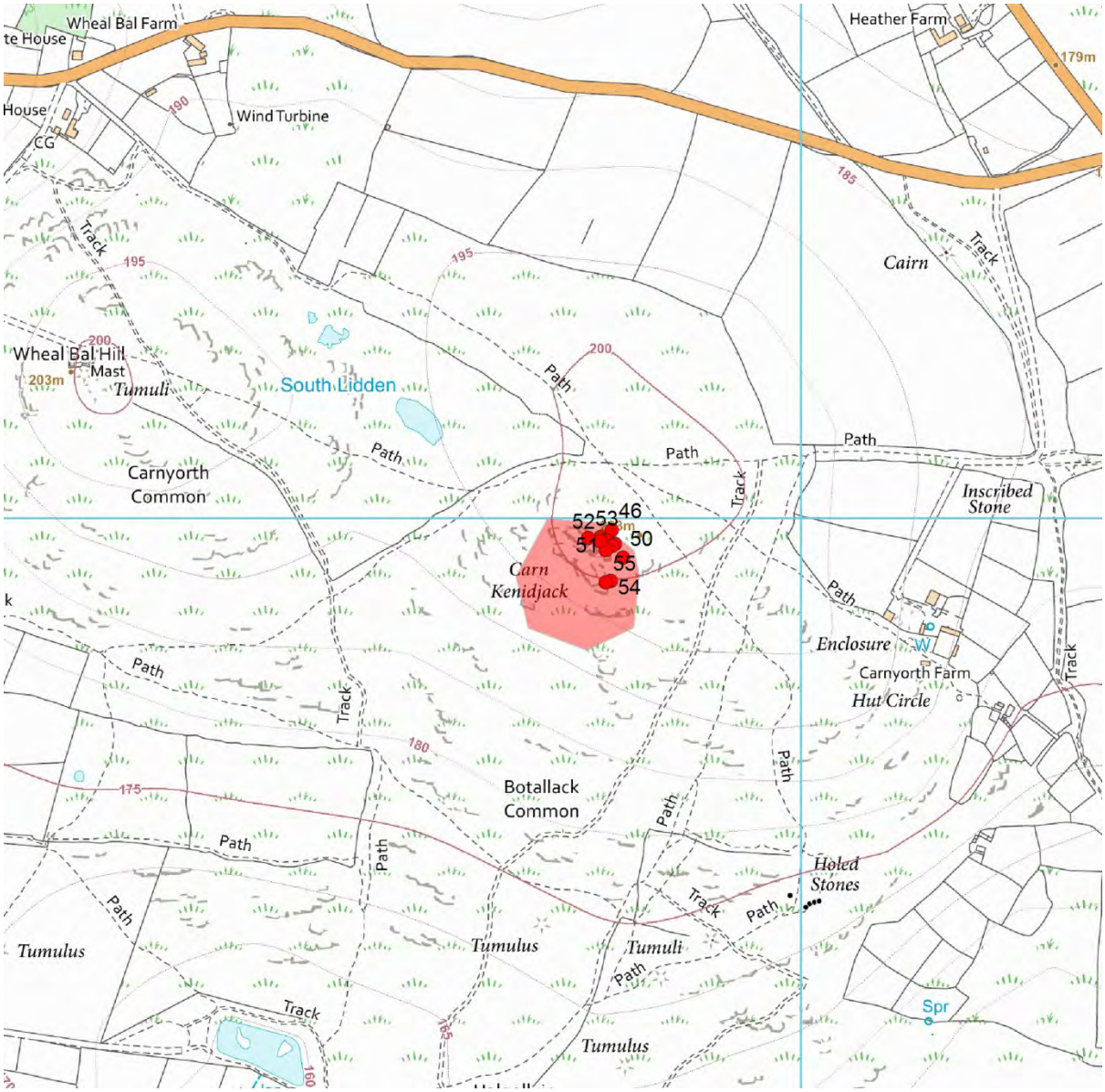


Fig. 1. Carn Kenidjack. Location; red polygon shows area suggested for survey.

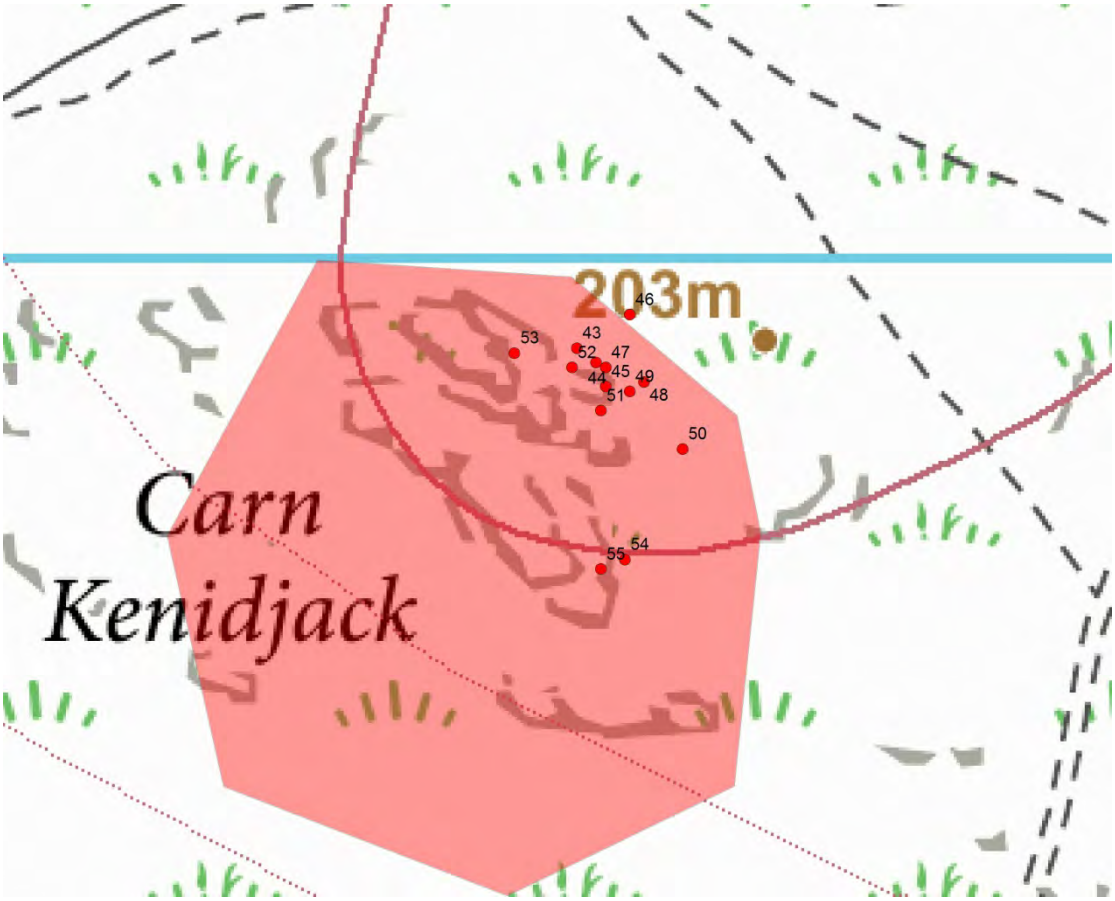


Fig. 2 Carn Kenidjack. Location of target notes.


Fig. 3. Carn Kenidjack.

Fig. 4. Carn Kenidjack, Locality 46. Location of *Parmelinopsis minarum* (see next photograph).

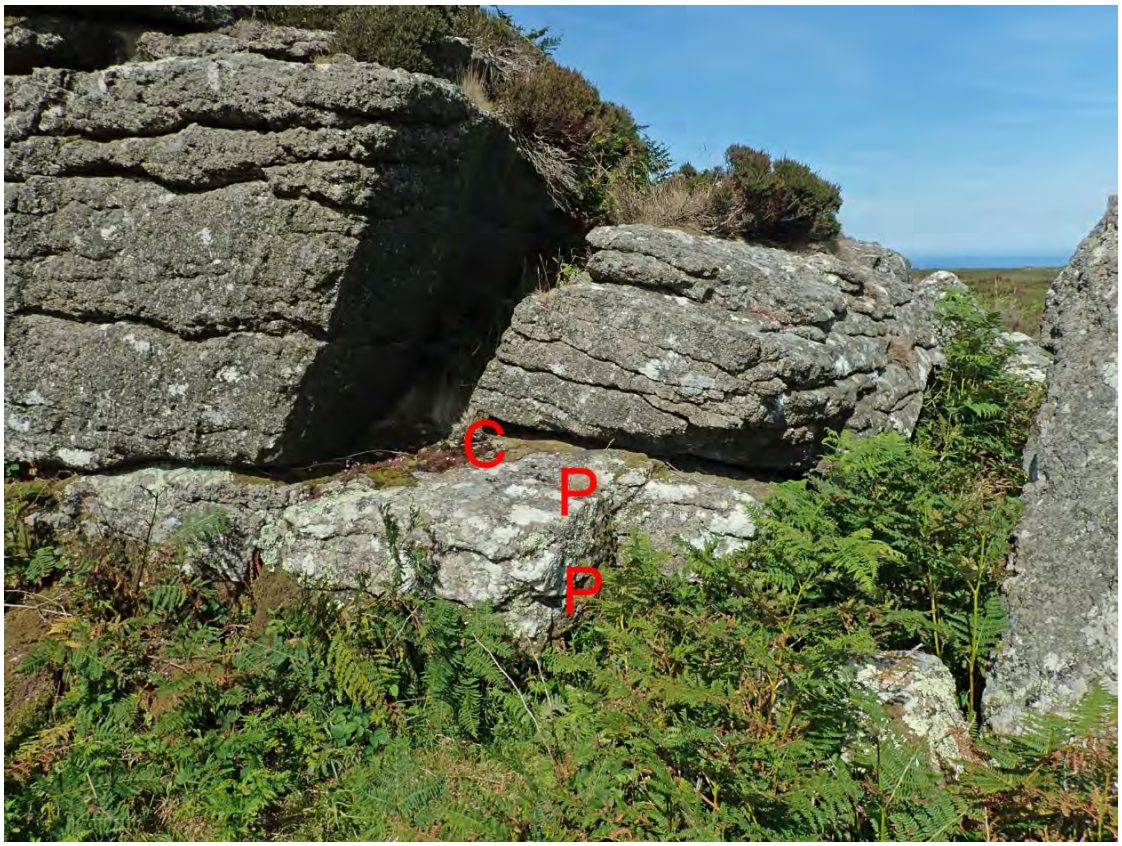


Fig. 5. Carn Kenidjack, Locality 46. Location of *Parmelinopsis minarum* (P) and *Cladonia cyathomorpha* (C), see previous photograph.

Fig. 6. Carn Kenidjack, Locality 50. *Parmelinopsis minarum* (P) at base of rock faces, all the way to the back of the cavity.

Fig. 7. Carn Kenidjack, Locality 53. Location of *Parmelinopsis minarum* (P) on low rock face.

2. Carn Downs

Non-montane Acid Rock assemblage, TNTN score: 4.

There are two main tors, together with a wider area of scattered boulders, amongst bracken and *Ulex gallii-Agrostis curtisii* heath. Particularly abundant species include *Fuscidea cyathoides*, *Lecanora gangaleoides*, *Parmelia omphalodes* and *Pertusaria pseudocorallina*. Locally there is a strong representation of coastal species on exposed tors, including *Anaptychia runcinata*, *Ramalina siliquosa*, *Rhizocarpon atrocinerea* and *Verrucaria fusconigrescens*. Foliose species are fairly abundant in more sheltered spots, including *Hypotrachyna britannica*, *Parmelia omphalodes*, *Parmelia saxatilis* and *Xanthoparmelia conspersa*. Very locally there is nutrient enrichment from bird-perching, indicated by *Xanthoria candelaria*. Rain-sheltered stands are poorly developed, with *Opegrapha saxigena* on steep faces, though mostly mixed with *Fuscidea* and *Pertusaria* spp., and a little *Lepraria incana* in crevices. One boulder had a community dominated by *Sarcogyne clavus*, with prominent *Trapelia involuta*; this appears to represent a pioneer community on a surface perhaps denuded of lichens by shading or fire at some point.

Notable species include *Lecanora alboflavida*, which occurs on both large and smaller outcrops, and *Pertusaria excludens*, which often but not always occurs on fairly steep faces. Both are occasional at the site, and could potentially occur on any sizeable outcrop or boulder. Both are common enough that individual sites could not all be photographed.

The site is apparently sometimes cattle grazed. Ivy occurs on the lee side of some outcrops, but is not yet a threat. A small burned area had some small boulders which were bare of lichens, but it is likely that these were already engulfed by gorse previous to the fire. The shading or even burial by gorse bushes is likely to be as damaging as fire itself.

Species recorded at Carn Downs	
Acarospora fuscata	CD: frequent. 1, 2.
Anaptychia runcinata	CD: occasional on usually the taller rocks. 1, 5, 6.
Aspicilia caesiocinerea	CD: on low rocks, rare. 6.
Buellia aethalea	CD: 1 (K + red).
Buellia subdisciformis	CD: 6 top of tor below bird perch.
Cladonia cervicornis	CD: occasional. 1.
Cladonia coccifera	CD: thin soil, rare. 1.
Cladonia furcata	CD: occasional on very thin soil. 1, 2.
Cladonia luteoalba	CD: thin soil amongst moss, rare. 1.
Cladonia polydactyla	CD: on thin soil, rare 1.
Cladonia portentosa	CD: thin soil amongst moss, very rare. 1.
Cladonia ramulosa	CD: 2.
Flavoparmelia caperata	CD: frequent. 1, 2, 6.
Fuscidea cyathoides	CD: abundant. 1, 2, 3, 5.
Hypogymnia physodes	CD: occasional. 1, 2, 9.
Hypotrachyna britannica	CD: on more sheltered surfaces, occasional. 2, 3, 4.
Lecanora alboflavida	CD: occasional to locally frequent in small quantities. 1, 2, 5, 8.
Lecanora gangaleoides	CD: frequent on steep and sloping faces. 1.
Lecanora intricata	CD: frequent in small quantities. 2, 5.

Lecanora orosthea	CD: steep surfaces, rare. 1
Lecanora polytropa	CD: rare. 1.
Lecidea fuscoatra	CD: 9, 10, 12.
Lepraria caesioalba	CD: on moss on rocks, rare. 11.
Lepraria incana	CD: rain-sheltered crevices, rare. 1.
Melanelixia fuliginosa	CD: frequent. 1, 2.
Melaspilea interjecta	CD: 3, 12.
Ochrolechia parella	CD: rare. 1.
Opegrapha saxigena	CD: occasional on steep faces. 1, 3, 5.
Parmelia omphalodes	CD: abundant. 1, 2.
Parmelia saxatilis	CD: frequent. 8.
Parmotrema perlatum	CD: frequent on more sheltered surfaces. 1, 2, 5.
Peltigera hymenina	CD: thin soil amongst moss, rare. 1.
Pertusaria aspergilla	CD: occasional. 1, 2, 7.
Pertusaria corallina	CD: occasional. 2.
Pertusaria excludens	CD: occasional in small quantities. 1, 2, 3, 5, 8, 11.
Pertusaria pseudocorallina	CD: abundant. 1, 2, 3, 5.
Placynthiella icmalea	CD: 2 low mossy rock.
Porpidia cinereoatra	CD: occasional. 1, 2, 3, 7, 11.
Porpidia platycarpoides	CD: occasional in small quantity. 1 (K + yellow), 2, 9, 10, 11.
Porpidia tuberculosa	CD: occasional, in rather small quantities. 1, 2, 9.
Ramalina siliquosa	CD: locally frequent on larger rocks. 1, 5, 6, 13.
Ramalina subfarinacea	CD: occasional. 3, 4.
Rhizocarpon reductum	CD: 1 gently sloping top of tor, 2 low rocks, 9, 10, 11.
Rinodina atrocinerea	CD: frequent. 1, 2, 8, 13.
Trapelia involuta	CD: on fairly recently exposed surfaces, occasional. 2, 12.
Trapeliopsis granulosa	CD: in crevice or on thin soil, rare. 1.
Tylothallia biformigera	CD: rare. 3.
Usnea flammea	CD: locally frequent, though usually only as small thalli. 1, 2, 9.
Verrucaria fusconigrescens	CD: typically on tops of rocks, rare. 1, 6.
Xanthoparmelia conspersa	CD: poorly-drained surfaces, frequent. 1, 6, 10.
Xanthoparmelia loxodes	CD: rare. 4, 6.
Xanthoria candelaria	CD: by bird-perches, rare. 6.

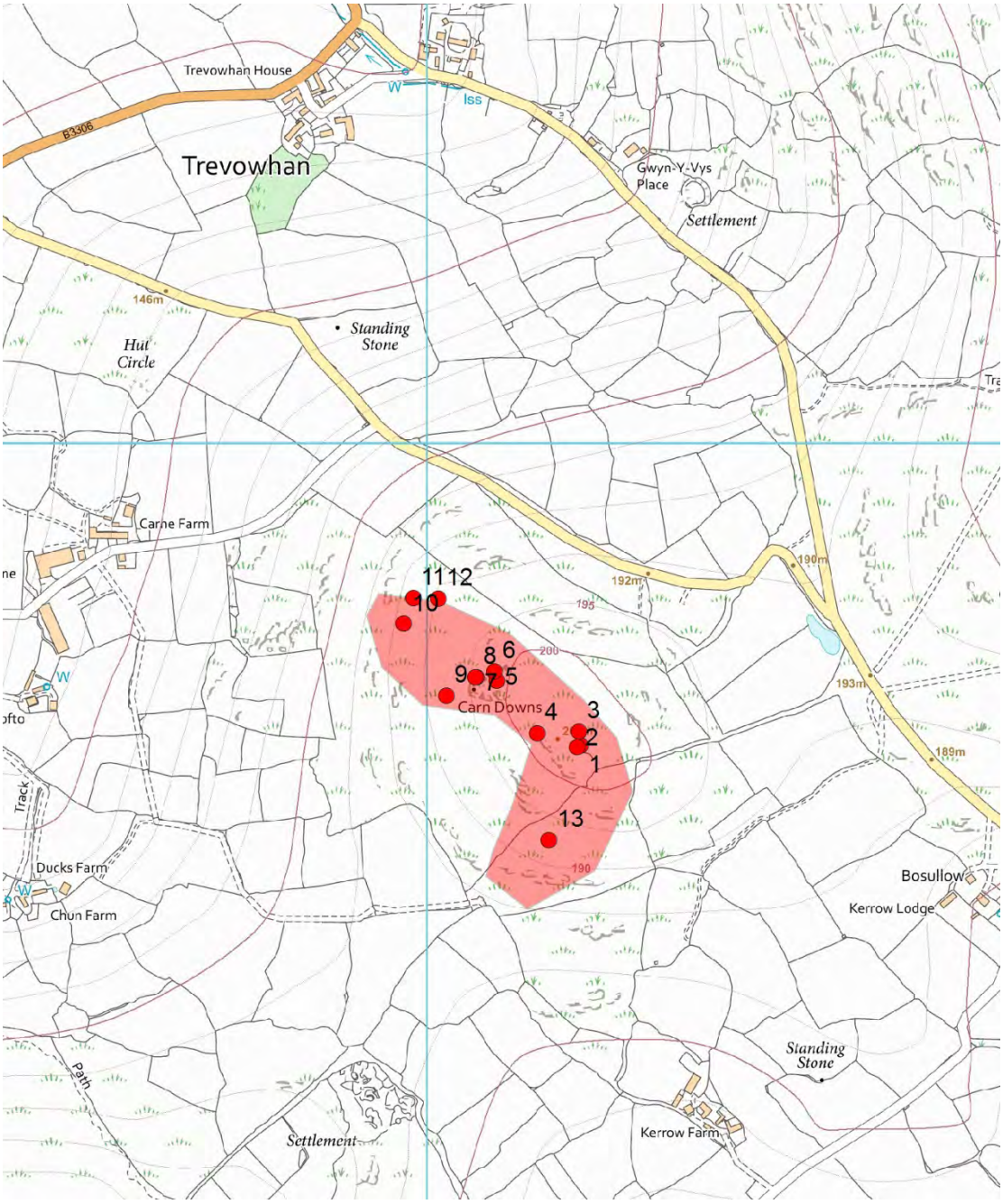


Fig. 8. Carn Downs. Location; red polygon shows area suggested for survey.

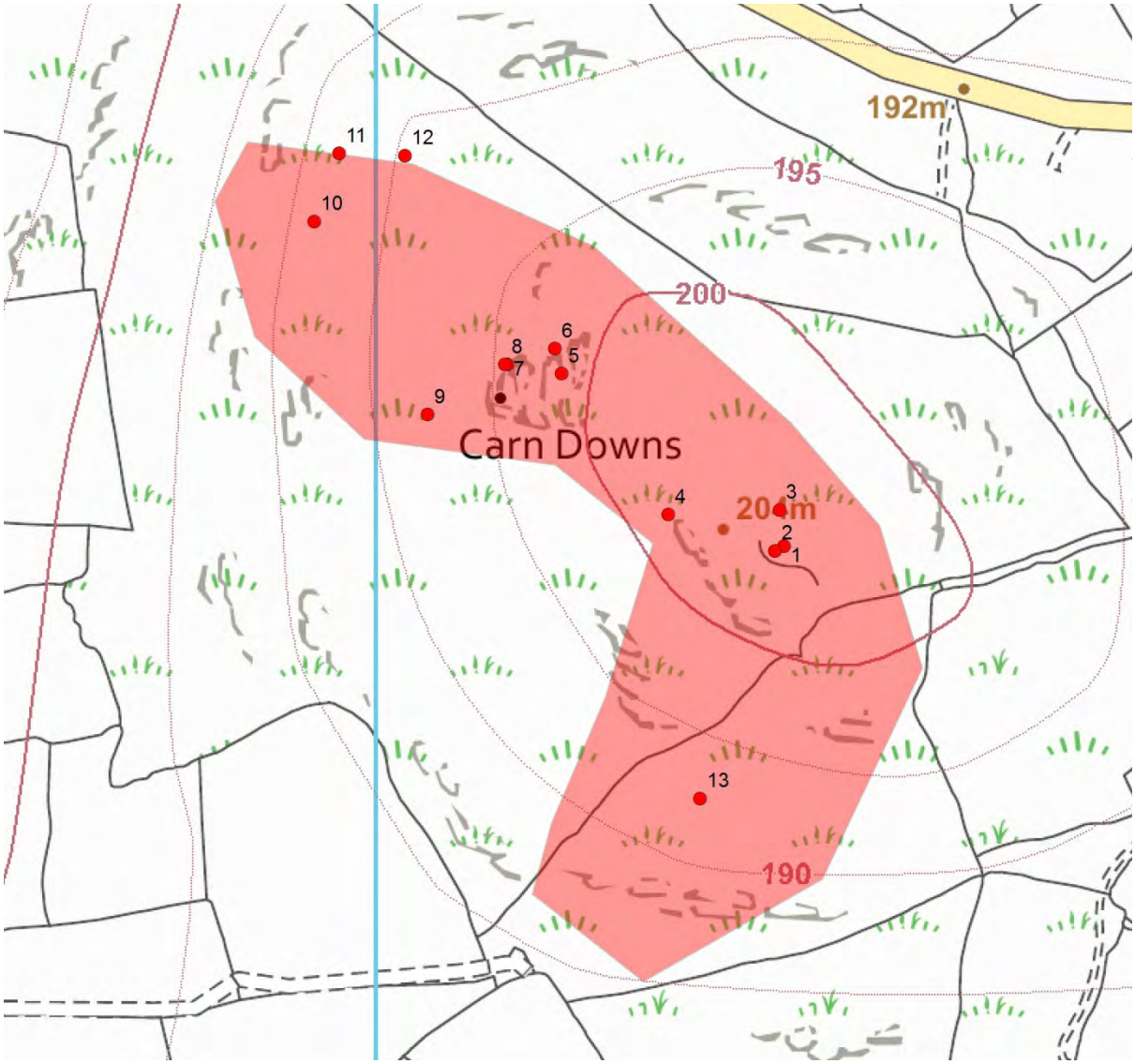


Fig. 9. Carn Downs. Location of target notes.

Fig. 10. Carn Downs, Locality 1.

Fig. 11. Carn Downs, Locality 6. Tor with maritime species: grey shrubby *Ramalina siliquosa* on top three slabs, and brown *Anaptychia runcinata* on right of central slab.

Fig. 12. Carn Downs. Boulders overtopped by burnt *Ulex europaeus*; the litter remaining on the boulders shows they were smothered by vegetation before the fire.

3. Watch Croft

Non-montane Acid Rock assemblage, TNTN score: 6.

There is one main tor, and approximately two smaller ones, together with scattered boulders. The main tor is low on the uphill side, so is inconspicuous from the top of the hill near the triangulation point. The area comprises mixtures of *Ulex gallii*, *Erica tetralix* and bracken, with some low bramble. The *Ulex* is tall and walking through it is difficult. In places *Salix cinerea* is invading. Ivy occurs on some low rocks and on some larger outcrops, but is not yet a serious problem. Some of the ivy appears of fairly long-standing, unlike the aggressive young shoots that can be found in some parts of the country; possibly the exposure and lack of shade are limiting.

Exposed rock surfaces have a similar general flora to Carn Downs, with *Fuscidea cyathoides* and *Pertusaria pseudocorallina* particularly abundant. *Lecanora alboflavida* was seen on a number of surfaces including a very low rock, and it seems that it can occur in many well-lit places in small quantities. *Pertusaria excludens* was apparently uncommon. The main tor had a north-facing recess between tall blocks, where surfaces receive little direct sunlight. Near the bases of west-facing rock faces here were *Parmelinopsis minarum* and *Herteliana gagei*, and *Cladonia cyathomorpha* occurred on moss on a ledge. This is an unusual situation on tors, and these species were not noted on smaller outcrops even where there was shade. It is ironic that these notable species are atypical of the sunny, exposed tor habitat.

Sarcogyne clavus was present on a bare-looking side of a boulder which had probably been denuded of lichens at some time by shade from *Ulex*, or by fire.

Species recorded at Watch Croft	
Acarospora fuscata	WC: frequent. 14, 15.
Amandinea pelidna	WC: 16 bird perch.
Cladonia cervicornis	WC: frequent. 15.
Cladonia cyathomorpha	WC: 20: on Hypnum andoi in N-facing recess on main tor, small quantities.
Cladonia furcata	WC: rare. 15.
Dimerella lutea	WC: 20: on shaded E-facing rocks, small quantity. 25: dead ivy of E-facing face, small quantity.
Flavoparmelia caperata	WC: occasional. 14.
Fuscidea cyathoides	WC: abundant.
Haeomatomma ochroleucum var. *porphyrium*	WC: rare: tall, rain-sheltered E-facing rock face. 23.
Herteliana gagei	WC: rare: bases of rocks out of direct sunlight on N side of tor. 20.
Lecanora alboflavida	WC: occasional in small quantities on various sizes and aspect of outcrop. 14, 15, 18, 20, 25, 26.
Lecanora gangaleoides	WC: occasional. 17, 23.
Lecanora intricata	WC: frequent. 16.
Lecanora polytropa	WC: rare to occasional. 17.
Lecidea fuscoatra	WC: 17.

Lepraria incana	WC: occasional on rain-sheltered surfaces, sometimes containing parietin. 15.
Opegrapha gyrocarpa	WC: rare. 25.
Opegrapha saxigena	WC: rain-sheltered and east-facing surfaces, occasional. 20, 23, 25.
Parmelia omphalodes	WC: abundant.
Parmelia saxatilis	WC: frequent. 16.
Parmelinopsis minarum	WC: rare: bases of rocks out of direct sunlight on N side of tor. 20.
Parmotrema perlatum	WC: occasional. 15.
Pertusaria amara	WC: rare. 15.
Pertusaria corallina	WC: occasional. 14.
Pertusaria excludens	WC: apparently rare. 17.
Pertusaria pseudocorallina	WC: abundant.
Porina lectissima	WC: rare. 25: shaded and rain-sheltered rocks on E-face of small tor, receiving run-off from a ledge.
Porpidia cinereoatra	WC: 17.
Porpidia platycarpoides	WC: occasional. 19, 25.
Ramalina siliquosa	WC: locally abundant. 14, 16, 20.
Ramalina subfarinacea	WC: occasional. 14.
Rhizocarpon reductum	WC: 15, 18.
Rinodina atrocinerea	WC: probably occasional. 16.
Sphaerophorus globosus	WC: rare; only on rocks shaded by E-facing rocks. 19.
Trapelia involuta	WC: rare. 20.
Tylothallia biformigera	WC: 25 E face in shade.
Usnea flammea	WC: occasional. 14, 25.
Verrucaria fusconigrescens	WC: on minor bird perches, rare. 17, 22.
Xanthoria candelaria	WC: rare. 16.

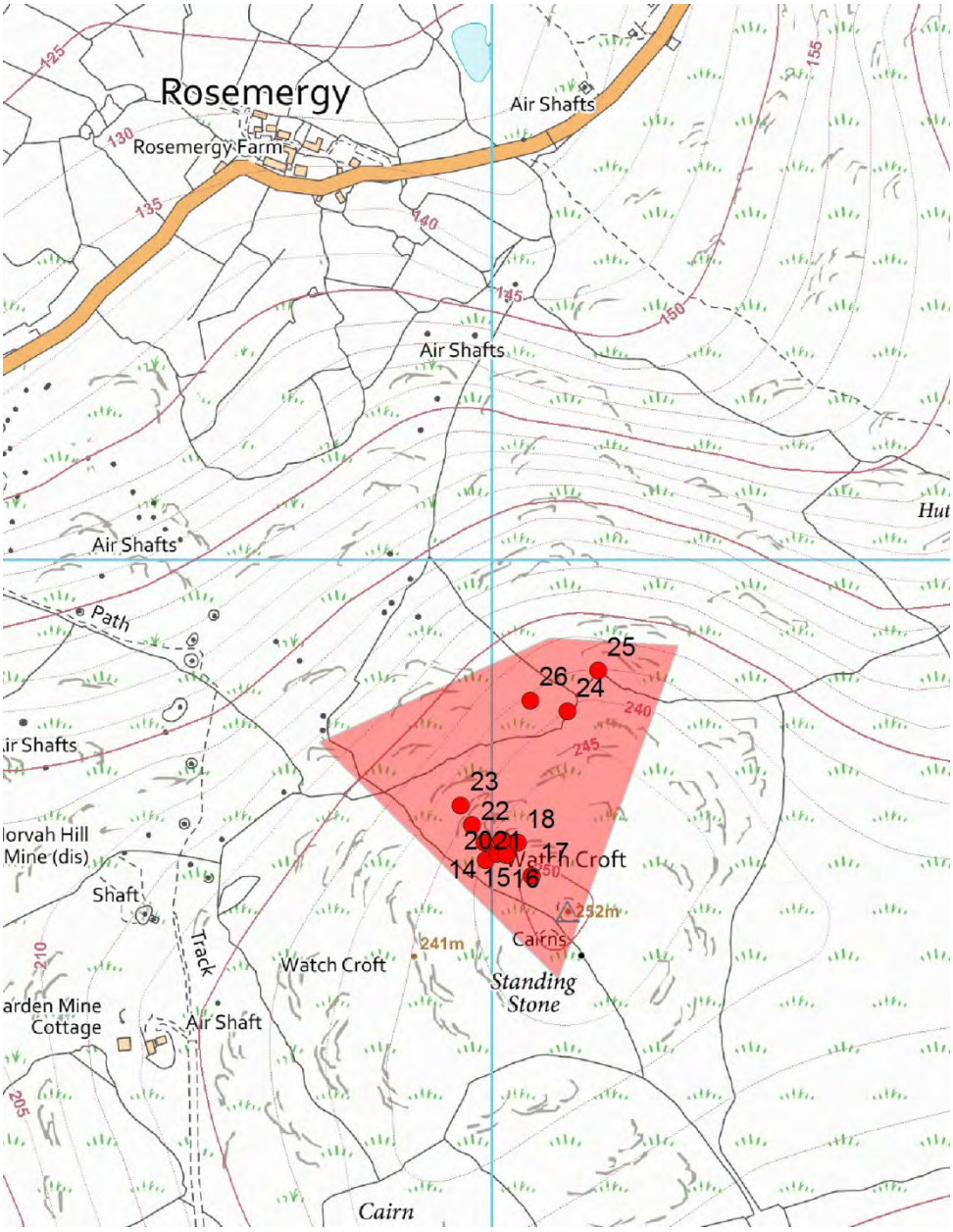


Fig. 13. Watch Croft. Location; red polygon shows area suggested for survey.

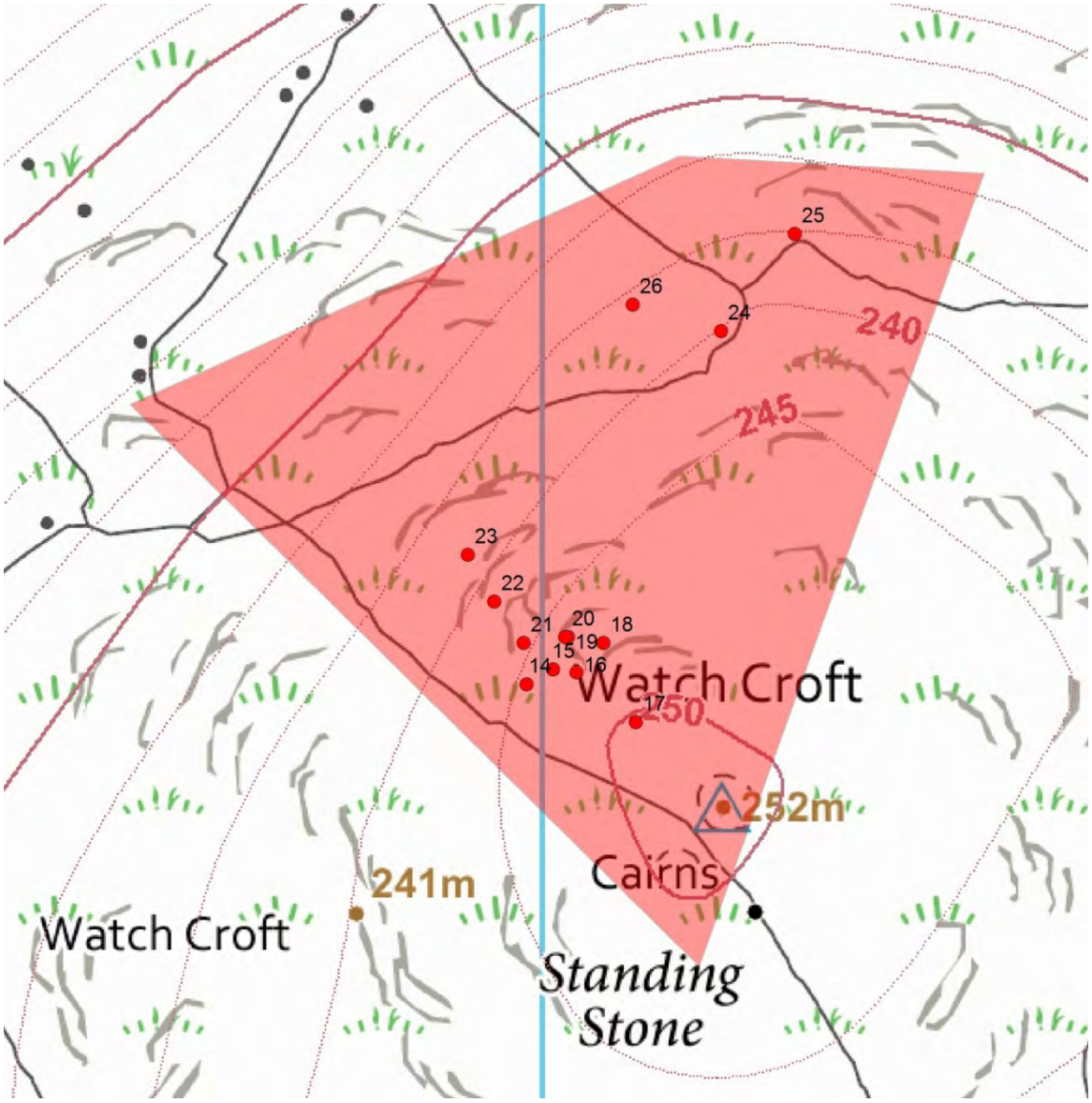


Fig. 14. Watch Croft. Location of target notes.

Fig. 15. Watch Croft, Locality 16.

Fig. 16. Watch Croft. A tor at Locality 25.

Fig. 17. Watch Croft, Locality 20. Tor with north-facing recess with *Parmelinopsis minarum* and others.

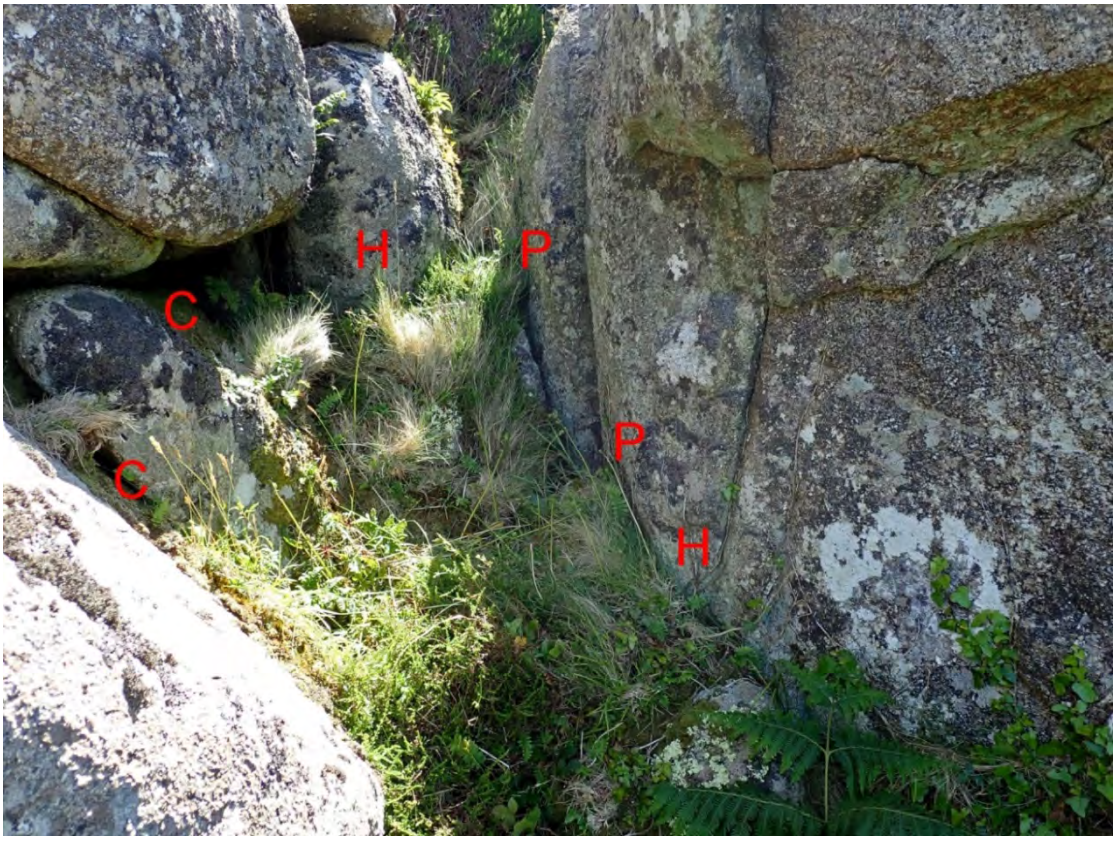


Fig. 18. Watch Croft, Locality 20. Recess shown in previous photograph, with approximate positions of *Cladonia cyathomorpha* (C), *Herteliana gagei* (H) and *Parmelinopsis minarum* (P).

4. Boswarva Carn

Non-montane Acid Rock assemblage, TNTN score: 8.

The site comprises only one small, but beautiful, tor, together with numerous boulders up to *c*. 1.5 m high. The site has *Erica cinerea-Ulex gallii-Agrostis curtisii* heath and a perhaps larger area of bracken. At least the heathy areas have evidently been burnt relatively recently, and *Agrostis curtisii* is often abundant in *Ulex gallii-Agrostis curtisii* heath (NVC H4a) (the fresh blue-green of the *Agrostis* together with the purple *Erica* is beautiful). Some areas of bracken have burnt stems of *Ulex europaeus* projecting from the canopy. At least in one area NE of the tor there are low boulders which show little sign of loss of vegetation, even though they are surrounded by heath. It appears that here the shrubs have not been allowed to become too tall. Grazing is currently by horses.

The tor has *Parmelinopsis minarum*, mainly at the base of some faces shaded by bracken. The burnt areas at the north end of the surveyed area have many bare-looking boulders, evidently where tall shrubs have shaded the rock before being burnt. It is the tall growth rather than the burning itself which damages the lichen cover. Some bare-looking faces are being recolonised by lichens, with species including *Lecidea fuscoatra*, *Lecanora polytropa* (in contrast to the abundant *L. intricata* on most rocks in the Penwith Moors), and *Melaspilea interjecta*. However, tall shrubs are not compatible with *Parmelinopsis* growing near the ground, both because of the shade and because of the effects of burning.

The land to the west of the tor is also heathland, so at least on an overcast day the site appears pleasantly wild and traditional.

One very small shrub of *Rhododendron ponticum* was seen.

Species recorded at Boswarva Carn	
Acarospora fuscata	BC: frequent.
Amandinea pelidna	BC: rare on bird perches. 150, 155.
Anaptychia runcinata	BC: very rare. 147 adjacent to Verrucaria fusconigrescens colony.
Buellia ocellata	BC: very rare. 156.
Candelariella coralliza	BC: rare. 150 bird perch (fairly convincing material, not placodioid, sterile).
Candelariella vitellina	BC: rare. 147, 155.
Cladonia chlorophaea	BC: rare, on ground. 153.
Fuscidea cyathoides	BC: abundant.
Herteliana gagei	BC: very rare. 149 base of rock face.
Hypogymnia physodes	BC: rare. 148 low rocks.
Hypotrachyna britannica	BC: occasional in small quantity. 148.
Lecanora alboflavida	BC: occasional in small quantity. 148, 152.
Lecanora gangaleoides	BC: frequent.
Lecanora intricata	BC: abundant.
Lecanora polytropa	BC: occasional on recently denuded rock. 152, 154.
Lecidea fuscoatra	BC: 152.
Lecidella scabra	BC: very rare. 155 bird perch.

Melanelixia fuliginosa	BC: occasional.
Melaspilea interjecta	BC: occasional on small or larger patches of denuded rock. 152, 154, 156.
Opegrapha saxigena	BC: occasional. 151.
Parmelia omphalodes	BC: abundant.
Parmelia sulcata	BC: occasional on tops of boulders.
Parmelinopsis minarum	BC: rare. 148 low rock, 149 base of steep rock face shaded by bracken.
Parmotrema perlatum	BC: occasional.
Pertusaria amara	BC: rare. 148 low rock.
Pertusaria aspergilla	BC: occasional. 148.
Pertusaria corallina	BC: occasional.
Pertusaria excludens	BC: occasional. 147, 149.
Pertusaria pseudocorallina	BC: frequent.
Porpidia tuberculosa	BC: occasional.
Ramalina siliquosa	BC: locally frequent, on various surfaces, including low rocks when they receive run-off from taller rocks. 147.
Ramalina subfarinacea	BC: occasional.
Rhizocarpon reductum	BC: occasional.
Rinodina atrocinerea	BC: occasional. 148, 150, 155.
Sarcogyne clavus	BC: rare, 148.
Tephromela atra	BC: rare. 148, 151.
Trapelia involuta	BC: rare on recently denuded rock. 152.
Usnea cornuta	BC: 148 low rocks.
Usnea flammea	BC: occasional.
Verrucaria fusconigrescens	BC: rare. 147 very locally abundant in rain track below top of tor.
Xanthoparmelia conspersa	BC: frequent, especially on poorly drained surfaces.
Xanthoparmelia loxodes	BC: occasional. 147, 148, 150.
Xanthoparmelia verruculifera	BC: occasional. 147.

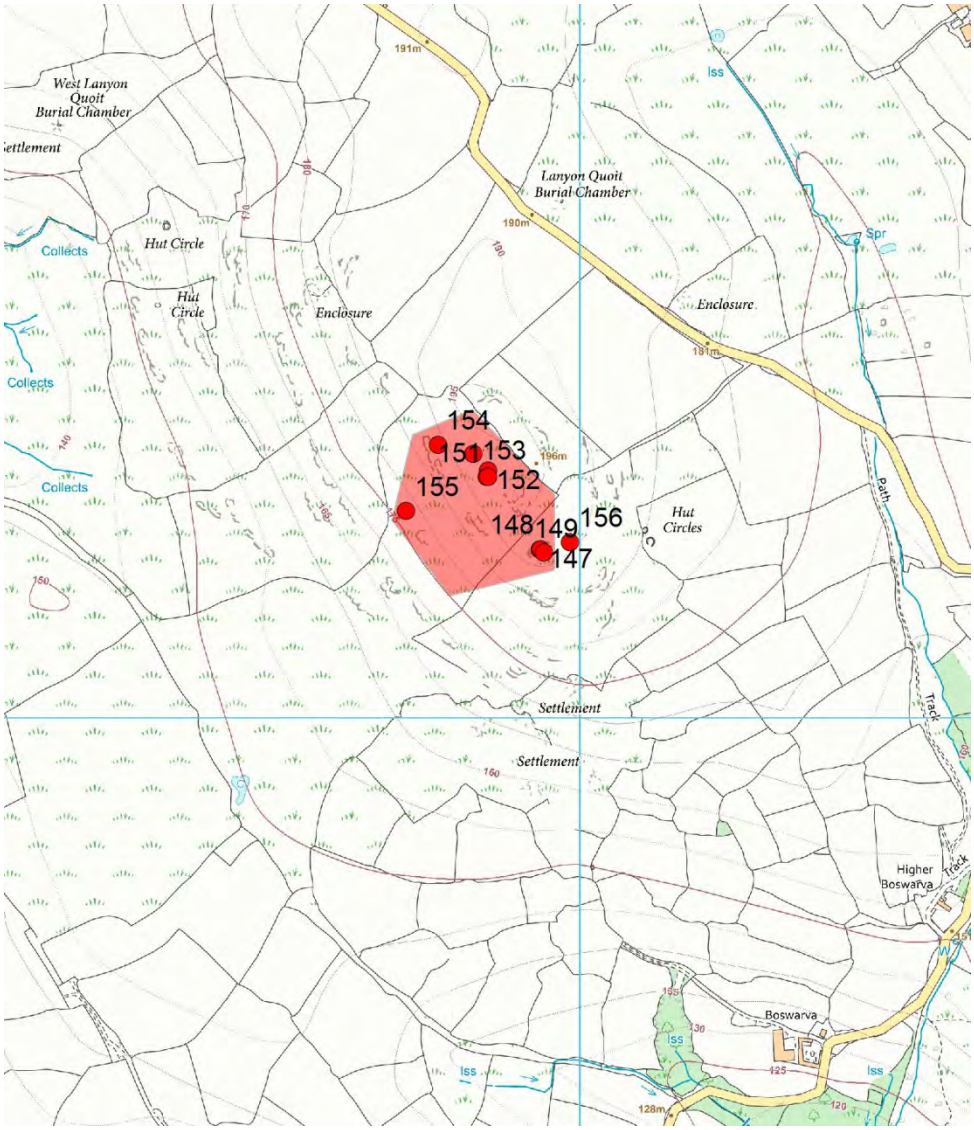


Fig. 19. Boswarva Carn. Location; red polygon shows area suggested for survey.

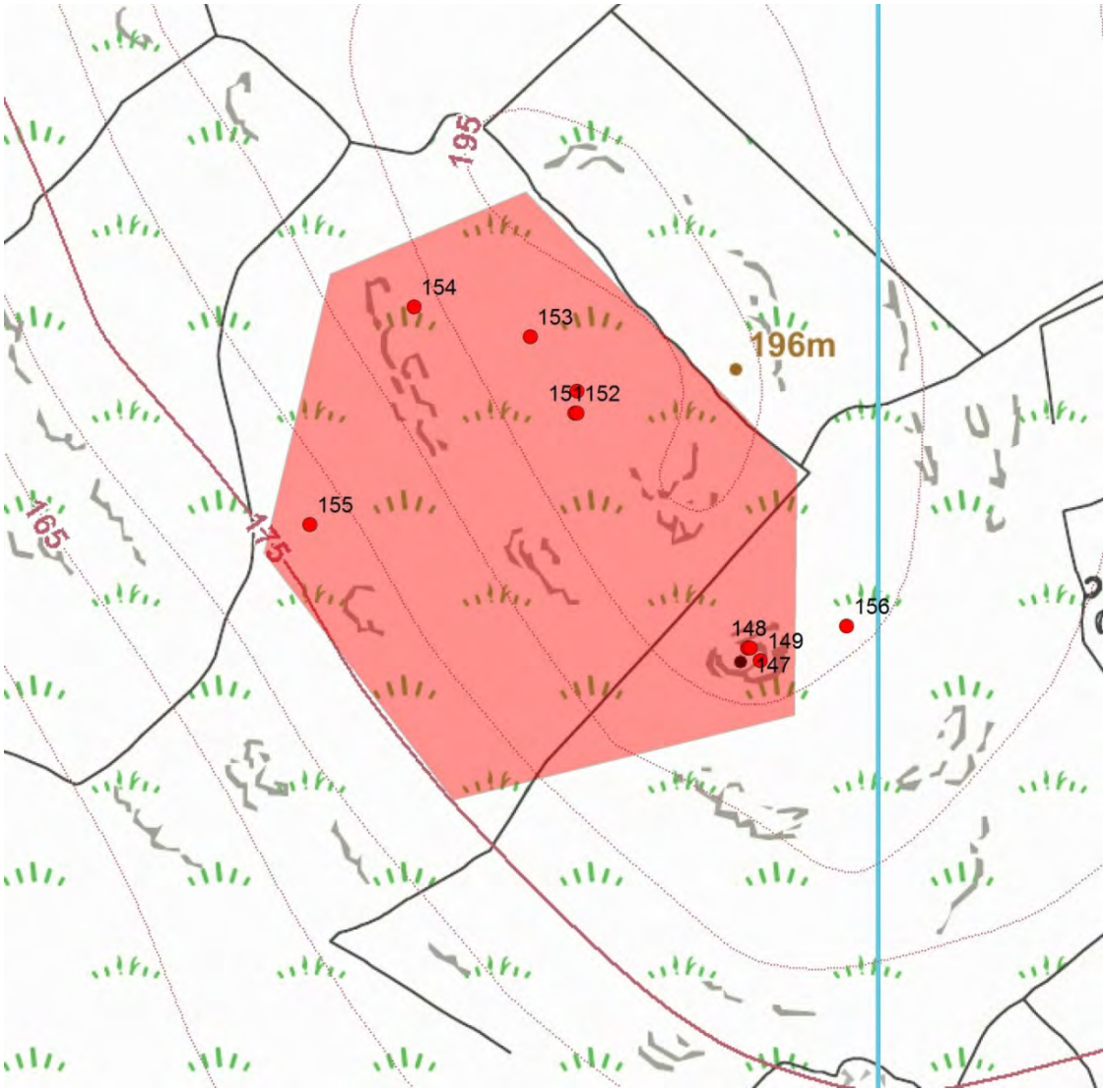


Fig. 20. Boswarva Carn. Location of target notes.

Fig. 21. Boswarva Carn, Locality 147.

Fig. 22. Boswarva Carn, scattered boulders with main tor on skyline.

Fig. 23. Boswarva Carn, Locality 153. The abundance of *Agrostis curtisii* in H4a suggests recent burning.

Fig. 24. Boswarva Carn, Locality 154. Numerous boulders apparently previously smothered by vegetation, exposed by a recent burn.

Fig. 25. Boswarva Carn, Locality 152. The right half of this low boulder has a mature lichen community with *Xanthoparmelia conspersa*, *Parmelia omphalodes* and *Fuscidea cyathoides*; the left half has evidently been exposed by burning of vegetation, though not recently, and has *Lecidea fuscoatra*, *Lecanora polytropa* and *Melaspilea interjecta*.

5. Hannibal's Carn

Non-montane Acid Rock assemblage, TNTN score: 15.

A series of tors set amongst bracken and *Ulex gallii* heathland. There are numerous shaded surfaces with frequent *Opegrapha saxigena*, and rare *Parmelinopsis horrescens*. *Lecanora alboflavida* and *Pertusaria monogona* are occasional on mainly sunny surfaces. There were two small colonies of *Bryoria bicolor/smithii* on the top of one of the northernmost tors, but this species was not detected elsewhere despite searching. *Cladonia cyathomorpha* was rare on one north-east face. The notable *Rinodina ericina* occurred here, at its only Penwith site; this is the first record for England and second for Britain.

Maritime species are not well-developed.

Ivy is abundant, and some rocks are overtopped by ivy bushes, although this is not particularly a problem at the moment, as it is local. One ivy bush was seen to have collapsed and peeled away from the rock under its own weight, and in places dead ivy stems were seen on rocks, although it is not clear if this is due to fire or natural die back.

Species recorded at Hannibal's Carn	
Acarospora fuscata	HC: frequent.
Anaptychia runcinata	HC: rare. 40 one small colony.
Bryoria bicolor/smithii	HC: rare. 40 two small colonies on gently sloping top of tor.
Catillaria chalybeia var. chalybeia	HC: very rare. 38 on slightly calcareous face.
Chrysothrix candelaris	HC: very rare. 62 small quantities on bryophytes on shady ENE face.
Cladonia cervicornis	HC: abundant.
Cladonia ciliata var. ciliata	HC: thin soil around rocks, rare. 58.
Cladonia cyathomorpha	HC: rare. 59 W face with ivy stems.
Cladonia furcata	HC: 42, 68.
Cladonia polydactyla	HC: rare on mossy faces. 64.
Cladonia portentosa	HC: rare. 63 thin soil over rocks (PD +).
Cladonia squamosa var. subsquamosa	HC: shaded mossy faces, rare. 59, 60.
Dimerella lutea	HC: rare and in small quantity on shaded faces. 56, 64.
Flavoparmelia caperata	HC: frequent.
Fuscidea cyathoides	HC: abundant.
Gyalecta jenensis	HC: rare. 38 on shaded steep face.
Haeomatomma ochroleucum var. porphyrium	HC: rare, on rain-sheltered shady faces. 39, 42, 64.
Herteliana gagei	HC: rare. 38 on shaded steep face. 42 below boulder, and on N facing rock, 64.
Hypogymnia physodes	HC: rare, on sunny rocks. 63.
Lecanora alboflavida	HC: 41 sunny face, 66.
Lecanora campestris	HC: rare. 38 slightly calcareous face.
Lecanora gangaleoides	HC: frequent.
Lecanora intricata	HC: frequent.
Lepraria ecorticata	HC: very rare. 64: strongly rain-sheltered surface.

Lepraria incana	HC: frequent on rain-sheltered rock; sometimes containing parietin.
Melanelixia fuliginosa	HC: occasional.
Micarea prasina s.l.	HC: 42 below boulder.
Micarea viridileprosa	HC: 64 shady NNE facing rocks.
Micarea xanthonica	HC: 60 shaded face.
Ochrolechia androgyna	HC: rare. 60 NW face.
Ochrolechia parella	HC: rare. 38 slightly calcareous face.
Opegrapha gyrocarpa	HC: occasional on shady rain-sheltered faces. 61.
Opegrapha saxigena	HC: locally frequent on shaded faces. 38, 57, 61, 64, 68.
Parmelia omphalodes	HC: abundant.
Parmelia saxatilis	HC: 41.
Parmelinopsis horrescens	HC: rare on steep shady faces. 64, 65.
Parmotrema perlatum	HC: occasional.
Peltigera hymenina	HC: rare on mossy rocks. 58.
Pertusaria amara	HC: 42 below boulder.
Pertusaria aspergilla	HC: occasional. 57, 60.
Pertusaria corallina	HC: occasional. 41, 56.
Pertusaria excludens	HC: occasional. 38, 41, 57.
Pertusaria flavicans	HC: rare, on one face only. 56 NE facing rock.
Pertusaria monogona	HC: 63.
Pertusaria pseudocorallina	HC: abundant.
Porina chlorotica	HC: rare on shaded faces. 38, 60, 68.
Porina lectissima	HC: very rare. 61 shady face below boulder.
Porpidia cinereoatra	HC: occasional in small quantities. 63, 67.
Porpidia irrigua	HC: 67.
Porpidia platycarpoides	HC: rare in small quantity. 63, 65.
Porpidia tuberculosa	HC: occasional in small quantity. 57.
Ramalina siliquosa	HC: on tops of tors, occasional. 40.
Ramalina subfarinacea	HC: occasional. 40, 63, 66.
Rhizocarpon reductum	HC: rare in small quantity. 38, 63, 67.
Rinodina atrocinerea	HC: occasional, on steep or gently sloping rocks. 58, 59, 63, 66.
Rinodina ericina	HC: 62 on ENE face, rare.
Sarcogyne clavus	HC: 42.
Sphaerophorus globosus	HC: occasional on both sunny and more sheltered rocks. 42 small colony on top of tor, 65.
Thelotrema lepadinum	HC: very rare. 62 small quantity on shady ENE face.
Trapelia involuta	HC: occasional. 38, 42, 63.
Tylothallia biformigera	HC: very rare. 38.
Usnea cornuta	HC: 65.
Usnea flammea	HC: frequent on sunny rocks.
Usnea subscabrosa	HC: 58 on ground amongst flattened Calluna stems.
Verrucaria fusconigrescens	HC: rare. 58 bird perch.
Xanthoparmelia loxodes	HC: 40 top of tor.
Xanthoria candelaria	HC: very rare. 58 tiny colony on bird perch.

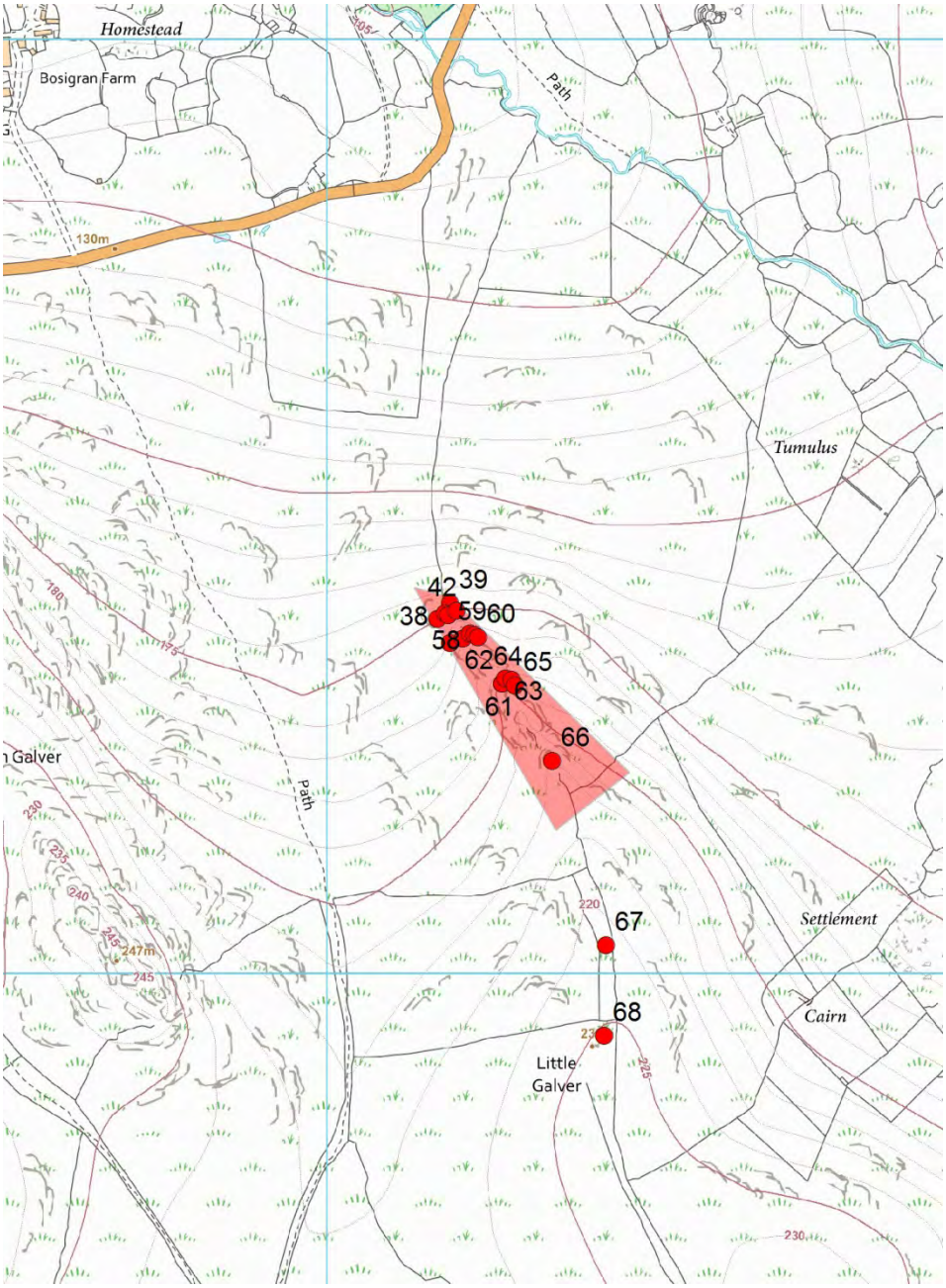


Fig. 26. Hannibal's Carn. Location; red polygon shows area suggested for survey.

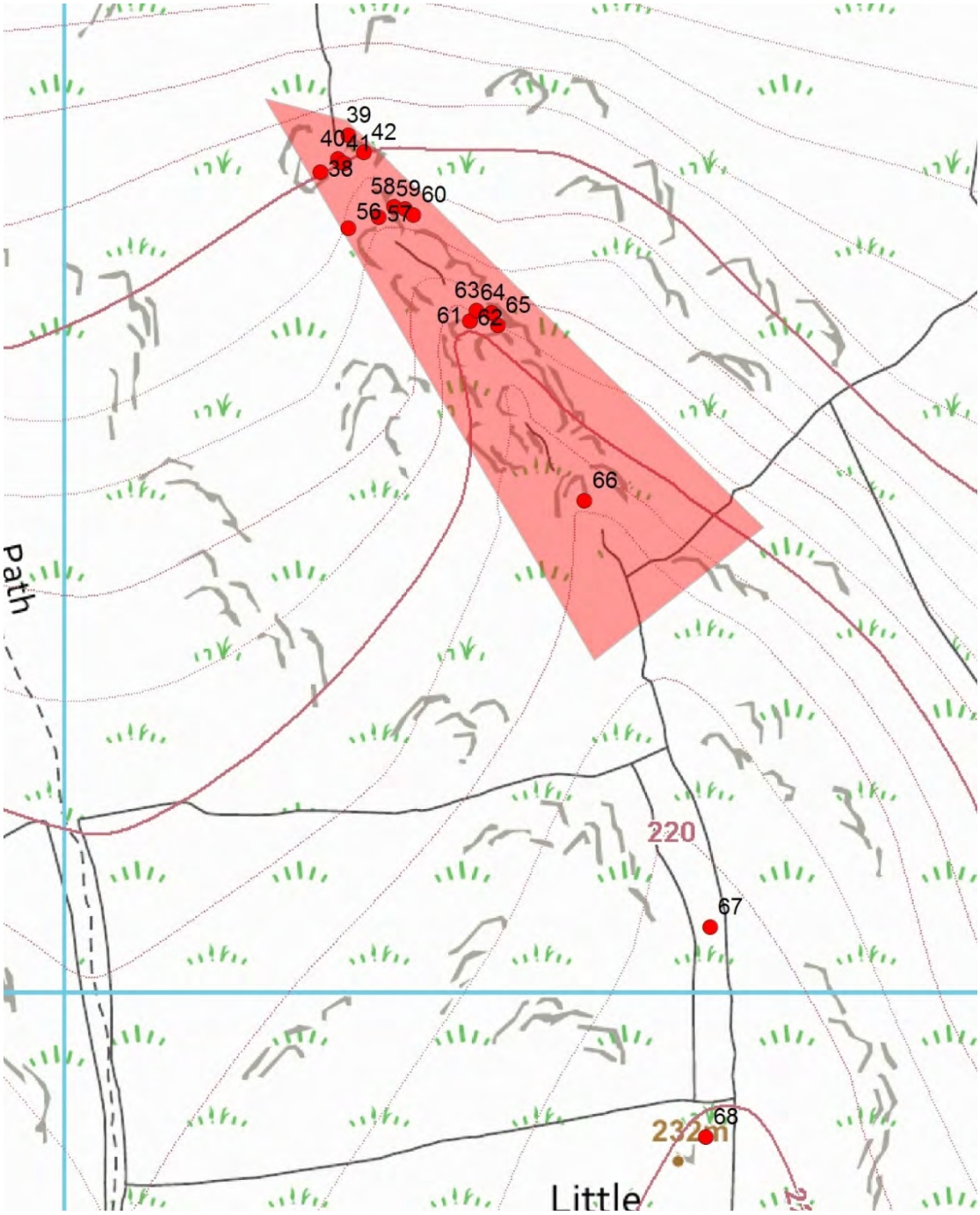


Fig. 27. Hannibal's Carn. Location of target notes.

Fig. 28. Hannibal's Carn, Locality 40. Location of *Bryoria bicolor/ smithii* on top slab of a tor.

Fig. 29. Hannibal's Carn,Locality 38. Open-topped gully between rocks, with sufficient shade for extensive *Herteliana gagei*.

Fig. 30. Hannibal’s Carn, Locality 42. Ivy covering tall rocks.

6. Zennor Hill

Non-montane Acid Rock assemblage, TNTN score: 10.

Similar to other sites, maybe a little less *Pertusaria excludens* than some. *Lecanora alboflavida* occasional. Not many maritime species. *Ramalina siliquosa* strongly favours the top stones of tors, probably influenced by interception of salt winds rather than any bird-perching.

Parmeliella parvula in very small quantity on a mossy rock on the shaded side of an outcrop. *Parmelinopsis minarum* rare, maybe not enough suitable ledges. The site is fairly extensive and not all boulders were visited. Acess is rather difficult: there are no paths and one has to wade through tall bracken or heath, both mixed with some gorse or bramble.

Berberis darwinii is well-established at the north end of the site, and is a serious threat for the future, although it is possible that it would be destroyed by burning, except for shrubs amongst the rocks. Numerous shrubs, some forming diffuse colonies and maybe suckering, one clump 2.5 m tall. One low but sturdy *Cotoneaster horizontalis* seen.

Species recorded at Zennor Hill.	
Abrothallus usneae [LF]	ZH: 139 on Usnea cornuta.
Acarospora fuscata	ZH: frequent.
Aspicilia caesiocinerea	ZH: rare on ledges rceiving some run-off. 126, 129.
Bryoria fuscescens	ZH: rare amongst macrolichens. 134 gently sloping NW face, 2 small colonies; 139 small quantity on slightly shaded rocks with N aspect.
Buellia ocellata	ZH: very rare. 126 on slightly rain-sheltered ledge.
Buellia aethalea	ZH: rare. 125.
Candelariella vitellina	ZH: rare.
Catillaria atomarioides	ZH: very rare. 127.
Cladonia cervicornis	ZH: frequent.
Cladonia coccifera	ZH: rare. 139.
Cladonia cyathomorpha	ZH: rare. 137 low mossy rock.
Cladonia furcata	ZH: rare.
Cladonia squamosa var. squamosa	ZH: rare. 139 on low rock.
Flavoparmelia caperata	ZH: frequent.
Fuscidea cyathoides	ZH: abundant.
Herteliana gagei	ZH: moist faces and ledges on shaded sides of outcrops, rare. 126, 139, 143, 144.
Hypogymnia physodes	ZH: rare. 139.
Hypotrachyna afrorevoluta	ZH: rare. 133 shaded N side of tor on low rock.
Hypotrachyna britannica	ZH: occasional.
Lecanora alboflavida	ZH: occasional. 127, 128, 142, 143, 146.
Lecanora gangaleoides	ZH: frequent.
Lecanora intricata	ZH: abundant.
Lecanora orosthea	ZH: very rare. 146 small quantity on rain-sheltered face.
Lecanora rupicola	ZH: rare to occasional, often on level and perhaps slightly enriched tops of tors. 127, 131.,
Lecidea fuliginosa	ZH: very rare on sunny rock. 128.

Lecidea fuscoatra	ZH: rare. 125, 127.
Lecidella scabra	ZH: very rare. 131 minor bird perch.
Lepraria caesioalba	ZH: occasional in small quantities on moister surfaces.
Lepraria incana	ZH: frequent.
Massalongia carnosa	ZH: 143 very rare on mossy NW face.
Melanelixia fuliginosa	ZH: frequent.
Melaspilea interjecta	ZH: occasional, 125, 140.
Ochrolechia parella	ZH: rare. 130.
Ochrolechia tartarea	ZH: rare. 133.
Opegrapha saxigena	ZH: occasional on N faces. 127, 133, 144.
Parmelia omphalodes	ZH: abundant.
Parmelia saxatilis	ZH: occasional, much less frequent than P. omphalodes.
Parmelia sulcata	ZH: occasional, especially slightly enriched tops. 127.
Parmeliella parvula	ZH: very rare. 143 small quantity on low mossy rock on NW side of outcrops.
Parmelinopsis minarum	ZH: rare. 130 on ledge in rain-shelter.
Parmotrema perlatum	ZH: occasional on low rocks and faces near the ground.
Peltigera hymenina	ZH: rare. 143 low mossy rock.
Peltigera membranacea	ZH: rare. 138 grassy turf adjacent to rocks.
Pertusaria aspergilla	ZH: occasional.
Pertusaria corallina	ZH: occasional in small quantities.
Pertusaria excludens	ZH: occasional. 126, 130, 141, 146.
Pertusaria flavicans	ZH: very rare. 126 small quantity on E face.
Pertusaria pseudocorallina	ZH: abundant.
Porina chlorotica	ZH: rare. 126 overhanging face.
Porina lectissima	ZH: shaded moist faces under overhangs, rare. 142.
Porpidia cinereoatra	ZH: ccasional to frequent.
Porpidia platycarpoides	ZH: 133 (K + yellow; pruinose apothecia), 146 (K + red).
Porpidia tuberculosa	ZH: frequent in small quantities, especially on moister surfaces.
Ramalina siliquosa	ZH: local on tops of tors. 126.
Ramalina subfarinacea	ZH: frequent.
Rhizocarpon geographicum	ZH: occasional. 126, 127.
Rhizocarpon reductum	ZH: frequent in small quantities.
Rinodina atrocinerea	ZH: occasional on moister surfaces. 127.
Sarcogyne clavus	ZH: 129.
Sphaerophorus globosus	ZH: rare on low rocks. 133.
Trapelia involuta	ZH: rare on denuded rock on seasonally moist surfaces. 125, 133, 143.
Usnea cornuta	ZH: occasional on low rocks. 133, 138.
Usnea flammea	ZH: frequent.
Xanthoparmelia conspersa	ZH: frequent.
Xanthoparmelia mougeotii	ZH: very rare. 127 on low rock.
Xanthoparmelia verruculifera	ZH: occasional. 130.

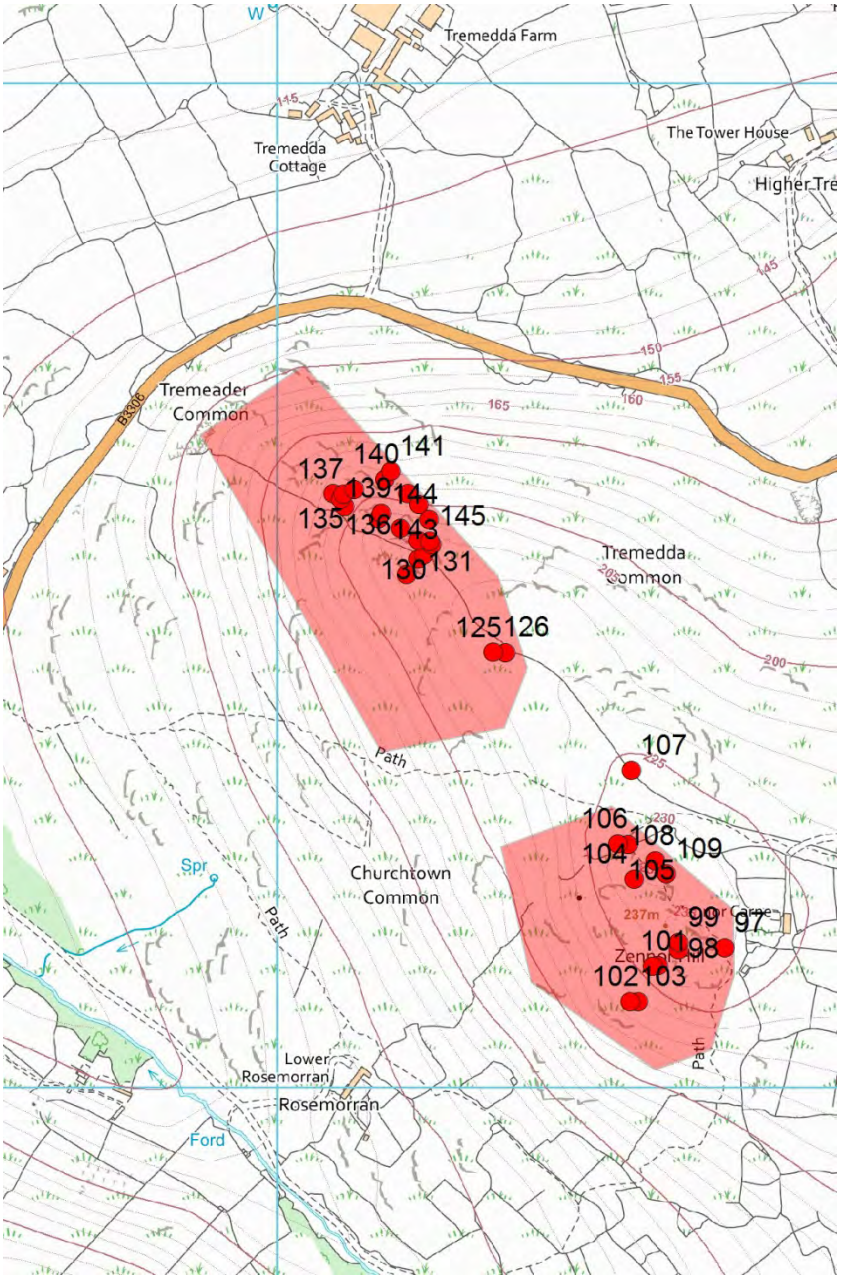


Fig. 31. Zennor Hill (top) and Logan Stone (below) Location; red polygon shows area suggested for survey.

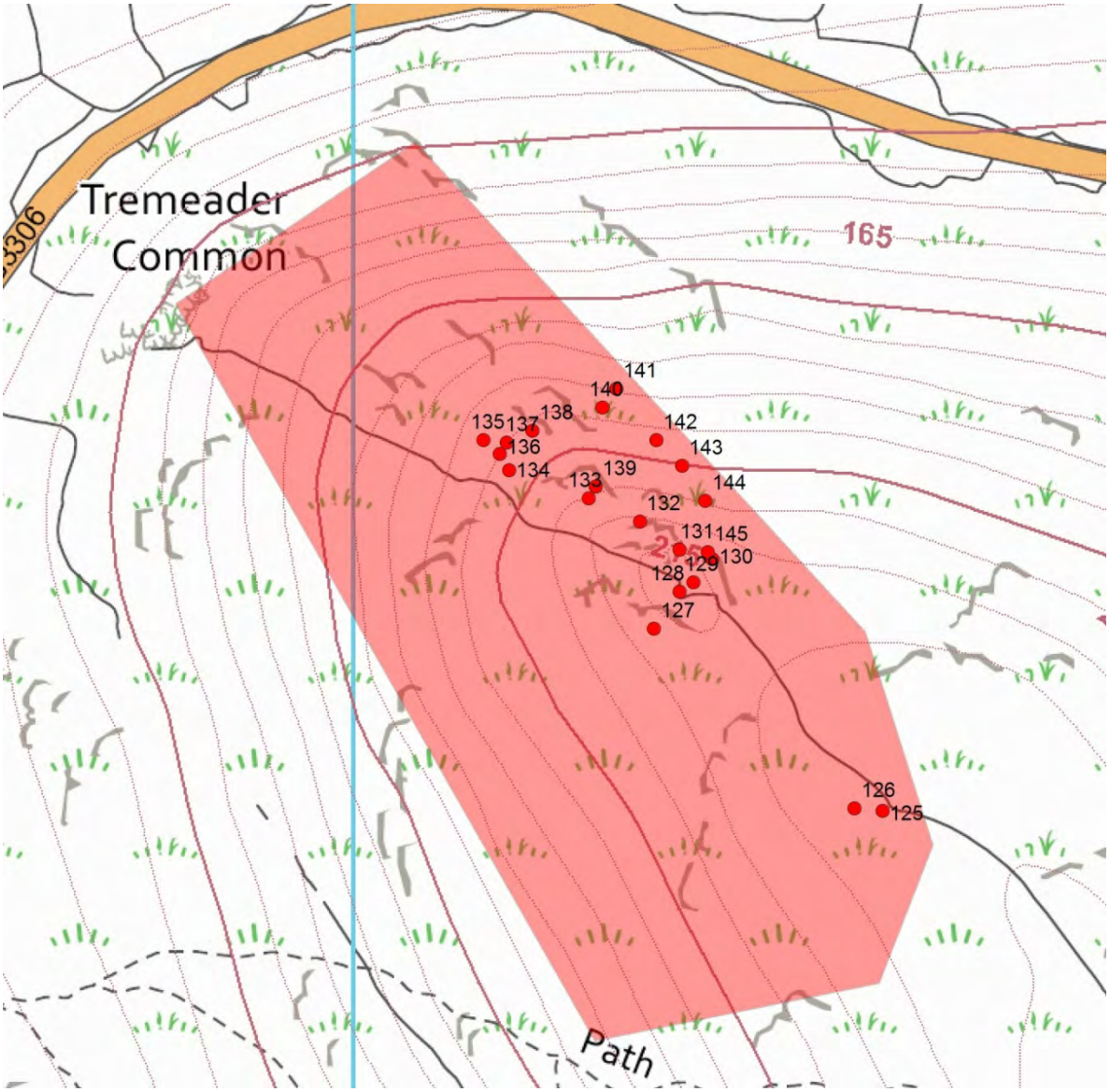


Fig. 32. Zennor Hill. Location of target notes.

Fig. 33. Zennor Hill, Locality 134. Location of *Bryoria fuscescens*.

Fig. 34. Zennor Hill, Locality 135. A thicket of *Berberis darwinii*.

7. Logan Stone

Non-montane Acid Rock assemblage, TNTN score: 11.

A fairly extensive area of tors, including some high blocks that could not be examined. Bracken with low brambles, and some *Ulex gallii-Callun-Erica cinerea* heath, grazed by cattle at present.

Rhizocarpon geographicum was locally frequent, though not ubiquitous. *Lecidea fuliginosa* was seen in several places, and maybe the two indicate some change of lithology. *R. geographicum* did not show very conspicuously in some places, and in one quadrat some of the normally bright yellow thalli were actually paling to grey. *Parmelinopsis minarum* was apparently occasional on steep faces close to the ground, in the company of other parmelioid lichens, and often some weakly grown *Isothecium myosuroides* or *Hypnum andoi*. The species needs shade provided by aspect or from overhanging rocks. Ledges near to the ground seem favoured. There are stands near to the ground with *Isothecium*, *Parmotrema perlatum* and *Flavoparmelia*, but these species are more tolerant than *P. minarum* and more widespread. Doubtless more *P. minarum* could be found by careful searching. *Parmotrema crinitum* occurred in good quantity in a shaded angle below high rocks.

Sarcogyne clavus was occasional, often apparently on rocks with few other lichens, though may be present elsewhere in very small patches.

For location, see map under Zennor Hill.

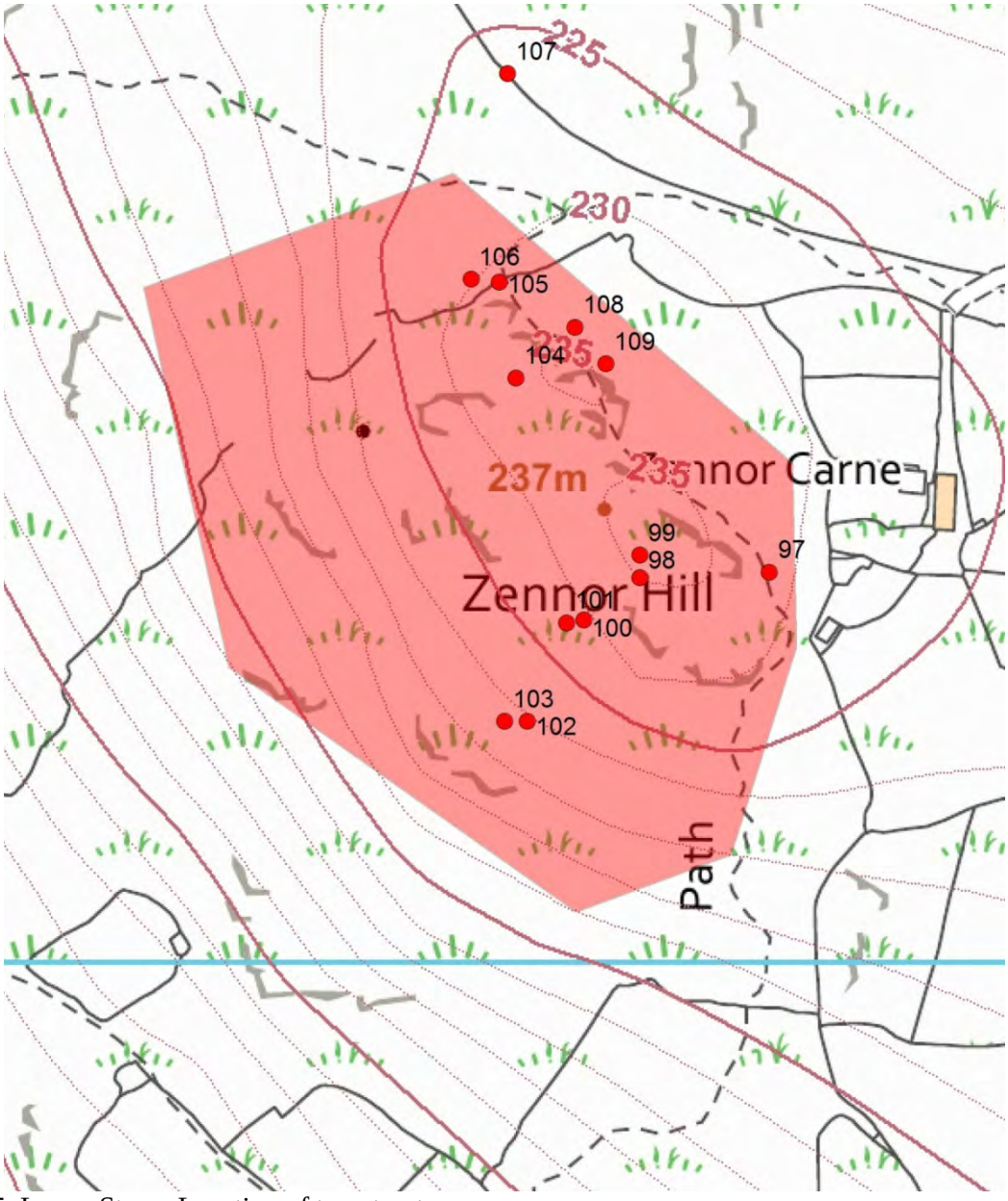


Fig. 35. Logan Stone. Location of target notes.

Species recorded at Logan Stone.	
Acarospora fuscata	LS: frequent.
Aspicilia caesiocinerea	LS: rare.
Cladonia cervicornis	LS: frequent.
Cladonia chlorophaea	LS: very rare.
Cladonia coccifera	LS: rare, 97, 103.
Cladonia crispata ssp. cetrariiformis	LS: rare. 102.
Cladonia cyathomorpha	LS: rare. 103 small quantity on moss.
Cladonia floerkeana	LS: rare, 97.
Cladonia furcata	LS: rare, 97.
Cladonia gracilis	LS: rare, 97, 103.
Cladonia polydactyla	LS: rare.
Cladonia portentosa	LS: rare. 102 (PD-).
Cladonia squamosa var. subsquamosa	LS: rare, 97.
Enterographa zonata	LS: rare.
Flavoparmelia caperata	LS: frequent.
Fuscidea cyathoides	LS: abundant.
Herteliana gagei	LS: rare. 103.
Hypogymnia physodes	LS: occasional, only seen a few times. 100, 108.
Hypotrachyna britannica	LS: occasional.
Lecanora alboflavida	LS: frequent in small quantities. 99, 100, 102, 104.
Lecanora gangaleoides	LS: frequent.
Lecanora intricata	LS: abundant.
Lecidea fuliginosa	LS: occasional on sunny sloping rocks. 97, 98, 104.
Lepraria caesioalba	LS: occasional.
Lepraria incana	LS: frequent.
Lepraria lobificans	LS: rare. 103.
Melanelixia fuliginosa	LS: frequent.
Melaspilea interjecta	LS: 97, 100.
Ochrolechia parella	LS: rare.
Ochrolechia tartarea	LS: rare. 99.
Opegrapha gyrocarpa	LS: rare to occasional.
Opegrapha saxigena	LS: occasional on sheltered and shaded faces. 100, 107, 108.
Parmelia omphalodes	LS: abundant.
Parmelia saxatilis	LS: frequent.
Parmelia sulcata	LS: occasional.
Parmelinopsis minarum	LS: occasional on shaded steep rocks, often on ledges near ground. 103, 105, 106, 109.
Parmotrema crinitum	LS: rare. 103 good quantity on shaded rocks below high face.
Parmotrema perlatum	LS: frequent.
Peltigera hymenina	LS: occasional on mossy rocks.
Pertusaria aspergilla	LS: occasional.
Pertusaria corallina	LS: occasional.
Pertusaria excludens	LS: 97, 100, 108.
Pertusaria monogona	LS: occasional. 101.
Pertusaria pseudocorallina	LS: frequent.

Phlyctis argena	LS: rare. 109 shaded rock.
Porina chlorotica	LS: rare on shady faces. 103, 106.
Porpidia cinereoatra	LS: occasional.
Porpidia tuberculosa	LS: occasional, mostly in small quantities.
Ramalina siliquosa	LS: locally frequent, but not abundant.
Ramalina subfarinacea	LS: occasional.
Rhizocarpon geographicum	LS: locally frequent. 97.
Rhizocarpon reductum	LS: occasional in small quantities.
Rinodina atrocinerea	LS: rare to occasional. 101.
Sarcogyne clavus	LS: 100.
Sphaerophorus globosus	LS: occasional.
Stereocaulon evolutum	LS: occasional.
Trapelia involuta	LS: occasional.
Usnea flammea	LS: frequent.
Xanthoparmelia conspersa	LS: frequent.
Xanthoparmelia loxodes	LS: occasional.
Xanthoparmelia verruculifera	LS: rare, 97.

Fig. 36. Logan Stone, Locality 104, facing north.

Fig. 37. Logan Stone, Locality 103. *Parmotrema crinitum* occurred in a cleft between rocks (P).


Fig. 38. Logan Stone, Locality 105. Location of *Parmelinopsis minarum* (arrow).

Fig. 39. Logan Stone, Locality 105. Location of *Parmelinopsis minarum* (arrow), outcrop is to right in previous photograph.

Fig. 40. Logan Stone, Locality 106. *Parmelinopsis minarum* occurs in cavity below lowest slab of main outcrop (see next photograph).

Fig. 41. Logan Stone, Locality 106. *Parmelinopsis minarum* on rain-sheltered block below lowest slab of main outcrop (see previous photograph). Main colony indicated by 'P', other small colonies left and above this.


Fig. 42. Logan Stone, Locality 109. Colony of *Parmelinopsis minarum* indicated.

Fig. 43. Logan Stone, Locality 109. Ledge with *Parmelinopsis minarum* (see previous photograph). This type of small ledge close to the ground is often suitable for this species.

8. Sperris Quoit

Non-montane Acid Rock assemblage, TNTN score: 8.

The general flora much resembles other sites. *Pertusaria excludens* and *Lecanora alboflavida* are probably both occasional. *Parmelinopsis minarum* was rare, usually in places with some shelter, but rarely a single thallus on more open rocks. *Bryoria fuscescens* was found on a single vertical face amongst *Parmelia omphalodes*.

The tors are surrounded by bracken and gorse which is difficult to walk through. At the northern end *Berberis darwinii* is becoming established, and at least ten bushes were seen.

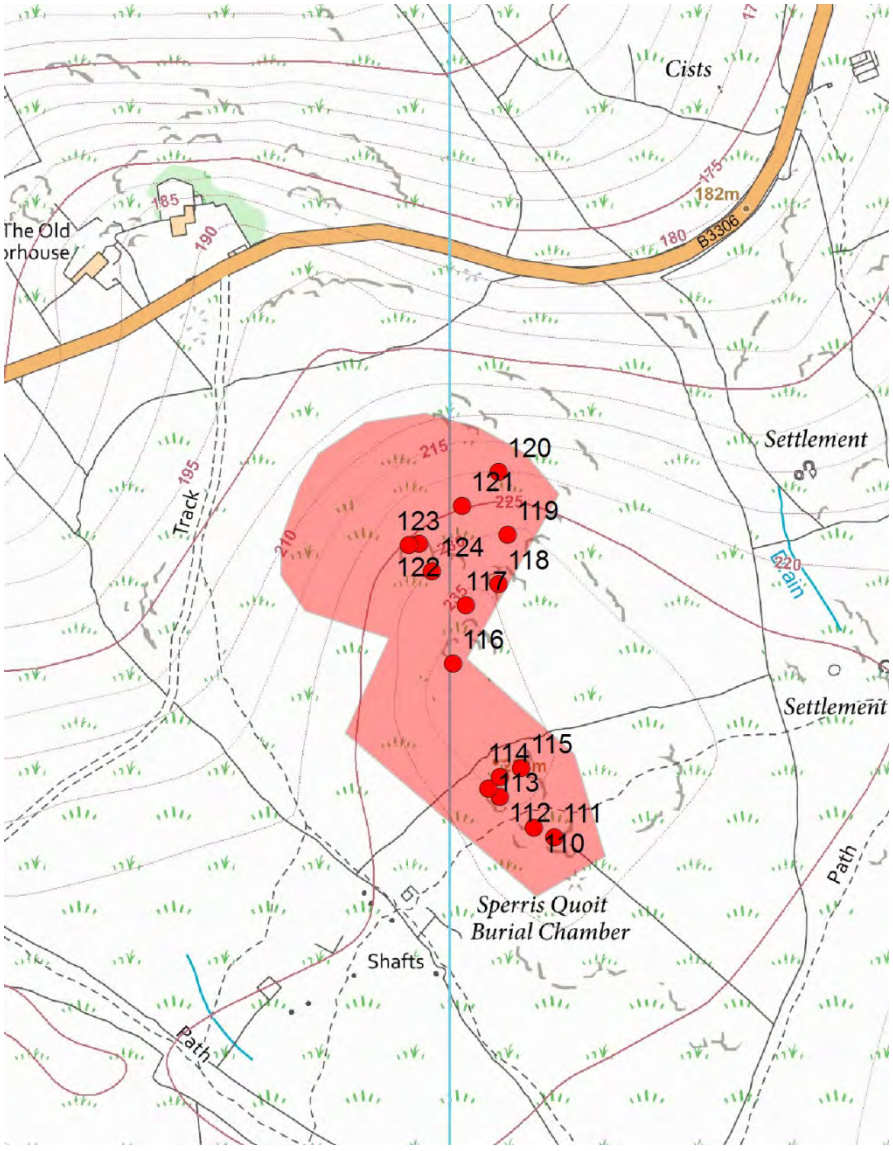


Fig. 44. Sperris Quoit. Location; red polygon shows area suggested for survey.

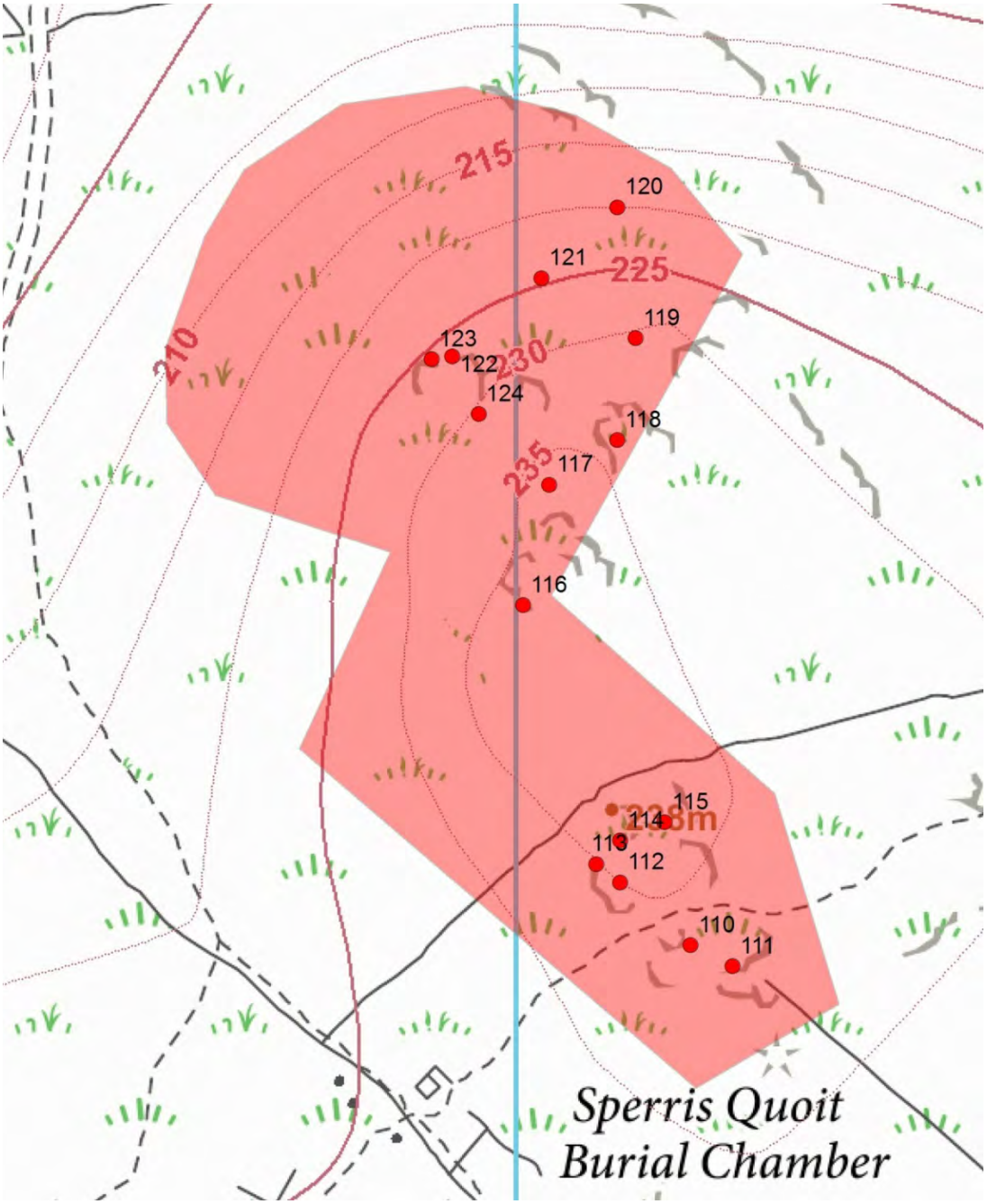


Fig. 45. Sperris Quoit. Location of target notes.

Species recorded at Sperris Quoit	
Acarospora fuscata	SQ: frequent.
Anaptychia runcinata	SQ: rare. 116.
Aspicilia caesiocinerea	SQ: rare. 11 in a rain track.
Bryoria fuscescens	SQ: rare. 110 small quantities on vertical NW face amongst *Parmelia omphalodes*.
Candelariella vitellina	SQ: rare. 112.
Catillaria atomarioides	SQ: very rare. 112.
Cladonia cervicornis	SQ: frequent.
Cladonia coccifera	SQ: rare.
Cladonia cyathomorpha	SQ: rare and in small quantities on moister surfaces. 110, 121.
Cladonia furcata	SQ: rare. 117 mossy rocks.
Cladonia polydactyla	SQ: rare.
Flavoparmelia caperata	SQ: frequent.
Fuscidea cyathoides	SQ: abundant.
Hypogymnia physodes	SQ: rare. 110.
Hypogymnia tubulosa	SQ: rare. 110.
Hypotrachyna britannica	SQ: frequent on surfaces with a little shelter from wind and sun.
Lecanora alboflavida	SQ: occasional. 111.
Lecanora gangaleoides	SQ: frequent.
Lecanora intricata	SQ: abundant.
Lecanora polytropa	SQ: occasional.
Lecidea fuscoatra	SQ: 110.
Lepraria caesioalba	SQ: occasional on moister surfaces.
Lecidea sp. (*Orange* 24547)	SQ: 121 rock.
Lepraria incana	SQ: frequent.
Melanelixia fuliginosa	SQ: occasional.
Melaspilea interjecta	SQ: occasional where there are patches of denuded rock. 113, 114 NE face were *Hypnum* has fallen off, 115, 121.
Ochrolechia androgyna	SQ: occasional. 110, 112, 119.
Ochrolechia tartarea	SQ: rare, 112.
Opegrapha saxigena	SQ: occasional. 110, 120.
Parmelia omphalodes	SQ: abundant.
Parmelia saxatilis	SQ: occasional.
Parmelia sulcata	SQ: rare. 116.
Parmelinopsis minarum	SQ: occasional, often on shaded and sheltered faces. 114 dry ledge 50 cm from ground on NE face with some Hypnum; 116 lightly shaded and strongly rain-sheltered surface below rock, near ground; 119 one thallus on gently sloping exposed rock.
Parmotrema perlatum	SQ: occasional on shaded surfaces.
Peltigera hymenina	SQ: rare on low, mossy rocks.
Pertusaria aspergilla	SQ: occasional.
Pertusaria corallina	SQ: occasional.
Pertusaria excludens	SQ: occasional. 110, 112 with apothecia and soralia.
Pertusaria flavicans	SQ: very rare. 117 small quantity on steep E face.

Pertusaria pseudocorallina	SQ: abundant.
Platismatia glauca	SQ: rare. 116, 123.
Porina chlorotica	SQ: rare. 117 steep E face.
Porina lectissima	SQ: occasional on shaded ledges where there is some run-off.
Porpidia cinereoatra	SQ: occasional.
Porpidia irrigua	SQ: 11, 121.
Porpidia platycarpoides	SQ: seen once. 110.
Porpidia tuberculosa	SQ: occasional in small quantities.
Ramalina siliquosa	SQ: locally frequent.
Ramalina subfarinacea	SQ: frequent.
Rhizocarpon geographicum	SQ: rare . 110, 117.
Rhizocarpon richardii	SQ: rare, 112.
Rhizocarpon reductum	SQ: occasional in small quantities.
Rinodina atrocinerea	SQ: frequent in small quantities. 111.
Sarcogyne clavus	SQ: frequent on sunny surfaces, 110, 111, 112, 113.
Sphaerophorus globosus	SQ: rare on low rocks. 110, 123.
Stereocaulon evolutum	SQ: local on moister surfaces. 111, 113.
Trapeliopsis granulosa	SQ: rare.
Tylothallia biformigera	SQ: rare. 110 flat top of rocks.
Usnea cornuta	SQ: rare.
Usnea flammea	SQ: frequent.
Xanthoparmelia conspersa	SQ: frequent.
Xanthoparmelia loxodes	SQ: locally frequent.
Xanthoparmelia verruculifera	SQ: occasional. 112.
Xanthoria candelaria	SQ: rare. 116 bird perch.

9. Trendrine Hill

Non-montane Acid Rock assemblage, TNTN score: 12.

Two main tors of modest size occur in the polygon. They are set amongst *Ulex gallii* with *Erica tetralix* and *Calluna*, forming a lowish heath which is nevertheless difficult to walk through; there is bracken in places. The owner said that there had not been a burn for at least 25 years. There is *Ulex europaeus* in places, forming taller bushes. The owner is by no means against burning, and agreed that this was the traditional management. He keeps cattle on the hill during some of the winter, though their diet is supplemented. He said they would eat off the *Calluna* shoots amongst the *Ulex*.

The carns have the standard flora, and *Pertusaria excludens* and *Lecanora alboflavida* are occasional. *Sarcogyne clavus* was local in small quantities, sometimes on faces which are probably periodically and locally denuded by growth and death of moss or ivy, but it also occurs on sunny rocks. *Parmelinopsis minarum* was found in one small area of the western tor; most was on a steep face with moss and ivy, more or less east-facing, but otherwise an unremarkable face and not very strongly shaded. One other colony was on a small ledge where it gets some shade from rocks. Other faces of similar aspect had no *Parmelinopsis*, possibly on some the moss was too dominant. *Hypnum* and perhaps later *Isothecium myosuroides* enter where there is a little shade. However, there are many moss-free shady faces. As at other sites, there is some ivy, but it does not seem to be especially aggressive.

Opegrapha saxigena was occasional on steep, east-facing rocks, often in smallish colonies, and looking like a black speckling.

Northerly tors:

These were outside the polygon suggested for survey. *Parmelinopsis horrescens* and *P. minarum* occurred very locally at the mouth of a cavity formed by a large block resting on two lower blocks. This situation gives some shade without too-abundant bryophyte growth. Elsewhere on the tors northerly faces have some development of mosses, but have no *Parmelinopsis*. *Opegrapha saxigena* was frequent on rain-sheltered faces; *Lecanora alboflavida* rather frequent in small quantities on sunny faces. *Pertusaria excludens* occasional on sloping sunny faces, not as abundant as some other sites. One small shaded angle between rock faces had mosses and macrolichens developed in response to the northerly aspect and elevated moisture from run-off; here were some small quantities of the ‘old-forest’ lichen *Parmeliella parvula*, growing on weak *Hypnum andoi* on thin ivy stems, in slight rain shelter, which prevents the moss from being too vigorous.

Maritime lichens were not well-developed compared to some sites; *Ramalina siliquosa* grew mainly on low, sheltered parts of outcrops, with one stand on top of a tor at a bird perch, where it grew with *Rinodina atrocinerea*.

Vegetation near north tors mainly varies from *Ulex gallii* heath (H8a at one place, tall, species-poor heath) to bracken with an understorey of low bramble.

Species recorded at Trendrine Hill. Localities 69 onwards are the north tors.	
Acarospora fuscata	TdH: frequent.
Anaptychia runcinata	TdH: locally frequent. 30 top of tor.
Aspicilia leprosescens	TdH: rare. 30: on bird perch.
Cladonia cervicornis	TdH: frequent.
Cladonia coccifera	TdH: North tors: rare.
Cladonia cyathomorpha	TdH: rare. 32 on low mossy face.
Cladonia furcata	TdH: rare. 33. North tors: rare. 76.
Cladonia gracilis	TdH: North tors: rare. 75 mossy gently sloping rocks.
Cladonia portentosa	TdH: rare. 27 (PD–), 33.
Cladonia ramulosa	TdH: North tors: rare. 73 mossy north-facing rocks.
Cladonia squamosa var. subsquamosa	TdH: rare. 28: shady face with Scapania gracilis. North tors: rare on shady faces. 74.
Cystocoleus ebeneus	TdH: rare, 28.
Dimerella lutea	TdH: rare. 28 on dead moss.
Enterographa zonata	TdH: rare on shady east faces. 31. North tors: rare. 76.
Flavoparmelia caperata	TdH: occasional. North tors: 69.
Fuscidea cyathoides	TdH: abundant. North tors: abundant.
Haeomatomma ochroleucum var. porphyrium	TdH: rare. 33.
Herteliana gagei	TdH: rare. 34 small quantity on N face of outcrops.
Hypotrachyna britannica	TdH: occasional. North tors: occasional on moister or more shaded surfaces. 70, 75, 77, 78.
Lecanora alboflavida	TdH: occasional on sunny rocks. 31. North tors: occasional to frequent. 69, 70, 77.
Lecanora gangaleoides	TdH: frequent, never forming large colonies.
Lecanora intricata	TdH: occasional. North tors: abundant.
Lecanora polytropa	TdH: occasional.
Lecanora rupicola	TdH: rare, gently sloping surfaces probably receiving run-off and maybe some enrichment. 69.
Lepraria caesioalba	TdH: occasional. 27, 30, 35. North tors: rare on moister surfaces. 70, 75, 78.
Lepraria incana	TdH: North tors: frequent.
Melanelixia fuliginosa	TdH: occasional. North tors: frequent.
Melaspilea interjecta	TdH: 32.
Micarea prasina s.l.	TdH: 28 shaded rocks (micareic acid, granular, dull green).
Mycoblastus caesius	TdH: 28 rare.
Opegrapha gyrocarpa	TdH: rare. 27. North tors: rare. 69.
Opegrapha saxigena	TdH: on shady east faces, occasional. 27, 29, 32, 35. North tors: frequent. 69, 71, 76, 80.
Parmelia omphalodes	TdH: frequent. North tors: abundant. 69.
Parmelia saxatilis	TdH: North tors: frequent.
Parmelia sulcata	TdH: rare. 30 on bird perch. North tors: occasional.
Parmeliella parvula	TdH: North tors: very rare. 74 ivy stems on northerly shaded rock face.
Parmelinopsis horrescens	TdH: rare. 75 rock face and boulder at mouth of cavity amongst blocks.
Parmelinopsis minarum	TdH: rare. 32 ESE face with some moss and ivy. North tors: rare. 75 rock face at mouth of cavity between blocks.

Parmotrema perlatum	TdH: occasional. North tors: occasional on more sheltered and shaded faces.
Peltigera hymenina	TdH: rare. 28 low rocks.
Pertusaria amara	TdH: rare. 28, 30.
Pertusaria aspergilla	TdH: rare. 27. North tors: occasional. 69.
Pertusaria corallina	TdH: occasional; c.fr. North tors: occasional. 69.
Pertusaria excludens	TdH: occasional. 28, 29, 30, 31, 32, 34, 69, 78, 80.
Pertusaria flavicans	TdH: North tors: rare on slightly sheltered ± north facing rocks. 71, 73.
Pertusaria monogona	TdH: North tors: occasional. 71, 78, 80.
Pertusaria pseudocorallina	TdH: abundant.
Phlyctis argena	TdH: North tors: very rare. 75 shaded rock face.
Porina chlorotica	TdH: North tors: occasional on shaded north faces. 75.
Porina lectissima	TdH: locally frequent on shady faces receiving run off from ledges. 31.
Porpidia cinereoatra	TdH: occasional, inconspicuous. North tors: occasional, inconspicuous.
Porpidia irrigua	TdH: 70.
Porpidia platycarpoides	TdH: 33 N face, 34 N side of outcrop.
Porpidia tuberculosa	TdH: frequent in fairly small quantities. North tors: frequent in small quantities.
Ramalina siliquosa	TdH: local. North tors: local, mainly low on blocks, on one tor top by a bird perch.
Ramalina subfarinacea	TdH: rare. 30. North tors: occasional.
Rhizocarpon reductum	TdH: North tors: occasional in small quantities. 33.
Rhizocarpon richardii	TdH: 30 rare on gently sloping slab.
Rinodina atrocinerea	TdH: occasional. 29. North tors: occasional. 69, 72, 79.
Sarcogyne clavus	TdH: 30.
Sphaerophorus globosus	TdH: North tors: occasional. 70.
Stereocaulon evolutum	TdH: rare. 29 gently sloping top of tor slabs. North tors: rare. 75 gently sloping rock.
Trapelia involuta	TdH: rare. 28, 32.
Tylothallia biformigera	TdH: 80 gently sloping NNW face.
Usnea flammea	TdH: occasional. 69.
Verrucaria fusconigrescens	TdH: rare on bird perches. 30.
Xanthoparmelia conspersa	TdH: occasional. North tors: occasional.
Xanthoparmelia loxodes	TdH: locally frequent. 30.
Xanthoparmelia verruculifera	TdH: rare. 27.
Xanthoria candelaria	TdH: rare in small quantity. 30.

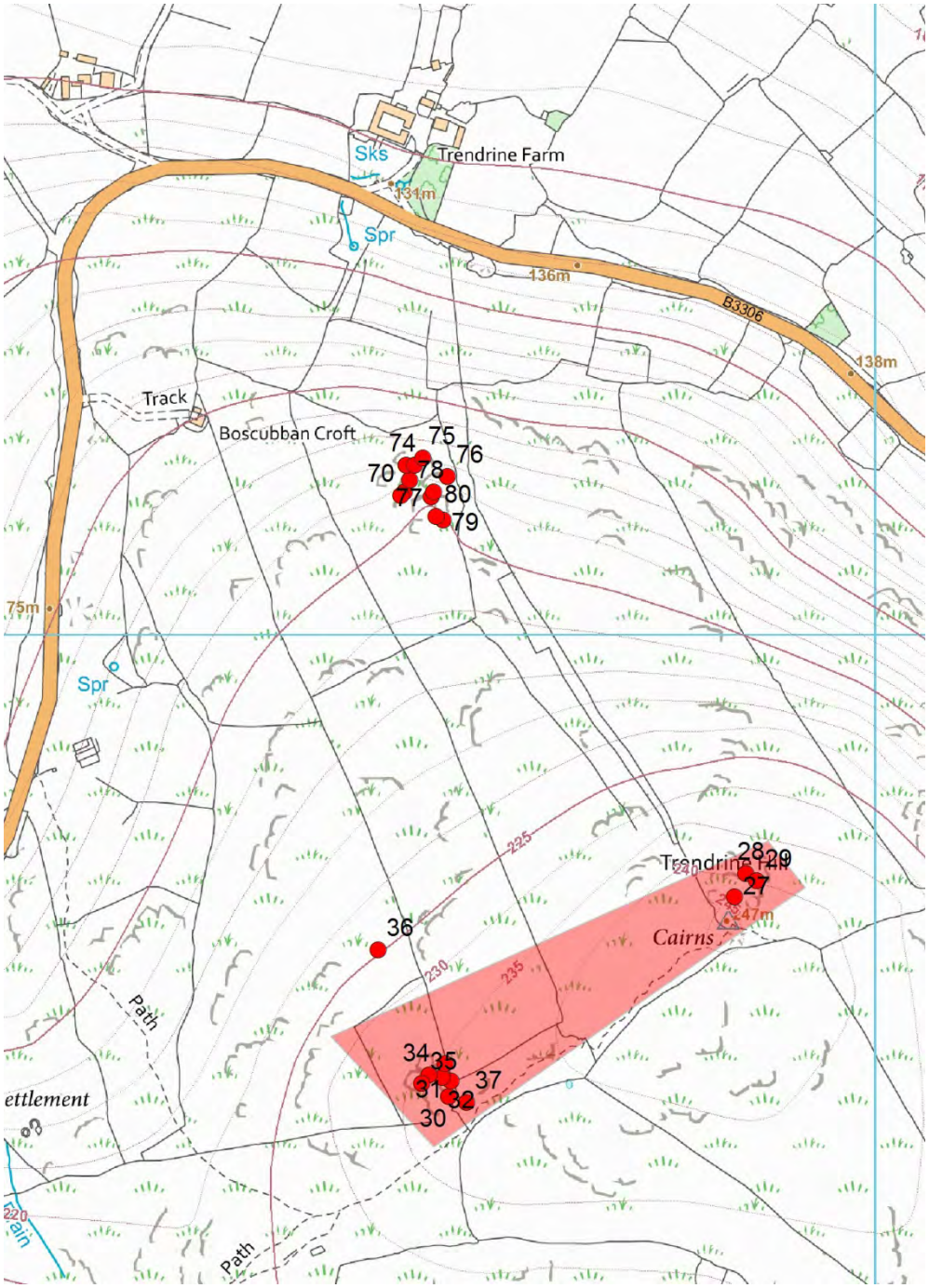
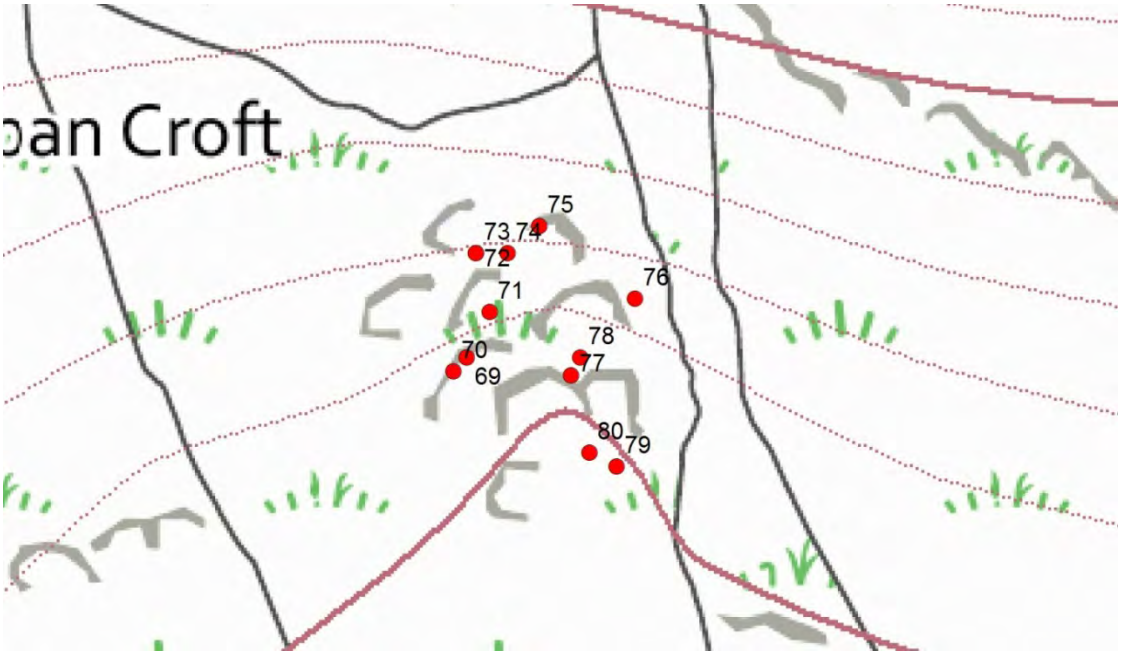


Fig. 46. Trendrine Hill. Location; red polygon shows area suggested for survey.



Trendrine Hill: north tors. Location of target notes.

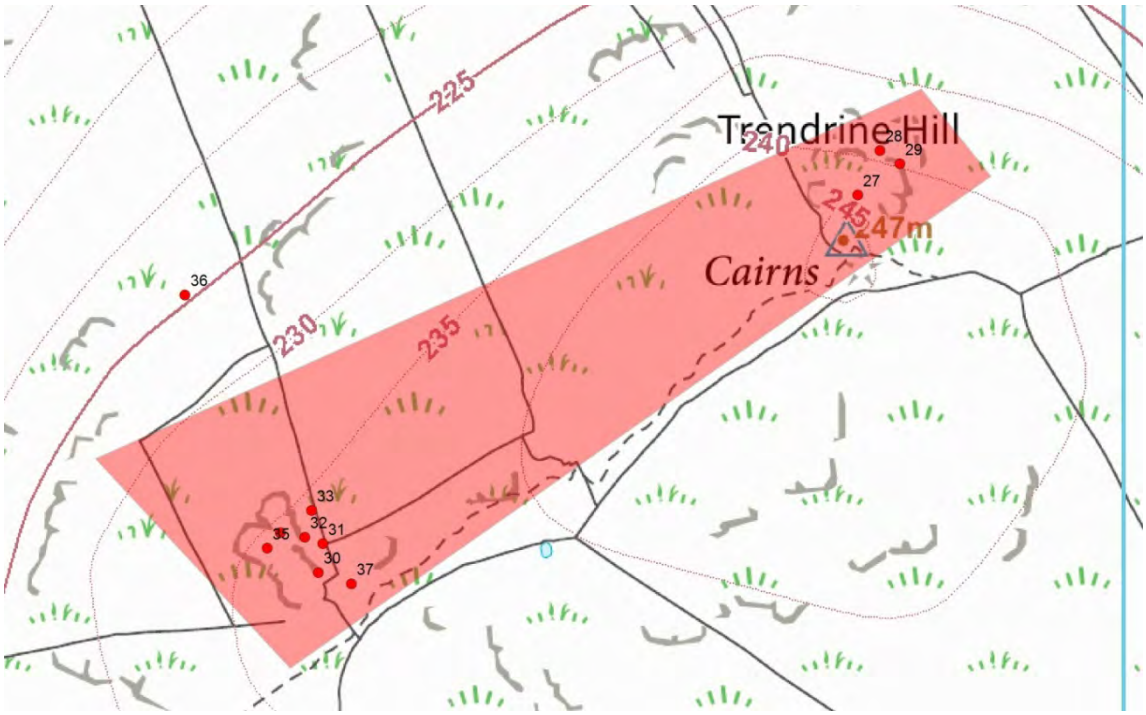


Fig. 47. Trendrine Hill: south tors. Location of target notes.

Fig. 48. Trendrine Hill.

Fig. 49. Trendrine Hill, Locality 28. A cool and shady gully between rocks, with the woodland liverwort *Scapania gracilis*, but no notable lichens.

Fig. 50. Trendrine Hill, Locality 32. Location of *Parmelinopsis minarum* on an ESE face (arrow).

Fig. 51. Trendrine Hill, Locality 34. North-facing outcrops support small amounts of *Herteliana gagei* (arrow).

10. Trencrom Hill

Non-montane Acid Rock assemblage, TNTN score: 7.

A relatively extensive site, much used by the public. In contrast to other sites there is a much greater extent of low, seasonally irrigated surfaces, in addition to tors and boulders.

Lecanora alboflavida is ocasional. *Pertusaria excludens* is occasional. *Lecanora praepostera* occurred on slightly rain-sheltered rock on one high face. *Bryoria fuscescens* occurred in small amount on the crest of a block *c*. 1.5 m high, but was not seen elsewhere, although the microhabitat did not seem different to other rocks.

Parmelinopsis minarum was found in small amounts on a few steep faces close to the ground, where there is evidently a little shade or some relief from direct sunlight due to the aspect or to shade from adjacent rocks. It did not occur on gently sloping faces which supported mosses and macrolichens.

A little trampling is evident on the rocks, but at most this probably decreases the cover of some macrolichens. Trampling would damage *Bryoria*, but the rarity of this species at the site is probably due to other factors.

Species recorded at Trencrom Hill	
Acarospora fuscata	TcH: frequent. 81.
Amandinea pelidna	TcH: 92 bird perch.
Anaptychia runcinata	TcH: rare. 81, 89.
Aspicilia caesiocinerea	TcH: occasional, on poorly drained surfaces. 81.
Aspicilia leproscescens	TcH: rare. On a bird perching rock. 82.
Bryoria fuscescens	TcH: very rare. 91 crest of low boulder amongst low tors.
Buellia aethalea	TcH: rare. 89, 96. Material is K + red.
Candelariella vitellina	TcH: rare to occasional, mainly on bird perching rocks. 81, 82. (Material belongs here and not in *C. coralliza*).
Cladonia cervicornis	TcH: frequent.
Cladonia portentosa	TcH: rare on thin soil over rocks. 93 (PD–).
Flavoparmelia caperata	TcH: frequent. 81.
Fuscidea cyathoides	TcH: abundant.
Hypogymnia physodes	TcH: rare.
Hypotrachyna britannica	TcH: occasional. 82.
Lecanora alboflavida	TcH: occasional to frequent in small quantities. 81, 85, 89, 93,
Lecanora gangaleoides	TcH: frequent in fairly small quantity.
Lecanora intricata	TcH: frequent. 81.
Lecanora polytropa	TcH: rare. 96 seasonally irrigated rocks.
Lecanora praepostera	TcH: rare. 87 rain-sheltered rock on high WSW face.
Lecanora rupicola	TcH: rare. 96.
Lepraria caesioalba	TcH: occasional, especially over mosses on poorly drained surfaces.
Lepraria incana	TcH: locally frequent.
Melanelixia fuliginosa	TcH: frequent in small quantities.
Melaspilea interjecta	TcH: 90.

Ochrolechia androgyna	TcH: occasional on poorly drained rocks. 90, 93.
Ochrolechia parella	TcH: rare. 81.
Ochrolechia tartarea	TcH: rare.
Opegrapha saxigena	TcH: occasional on rain-sheltered surfaces. 85, 87.
Parmelia omphalodes	TcH: abundant.
Parmelia saxatilis	TcH: frequent. 81.
Parmelinopsis minarum	TcH: rare on somewhat shaded steep surfaces near the ground, in small quantities. 83, 87, 94.
Parmotrema perlatum	TcH: occasional.
Peltigera membranacea	TcH: rare. 89 low rocks.
Pertusaria amara	TcH: rare. 83.
Pertusaria aspergilla	TcH: occasional.
Pertusaria corallina	TcH: occasional.
Pertusaria excludens	TcH: occasional. 88, 89, 90, 91, 93.
Pertusaria flavicans	TcH: rare. 88.
Pertusaria pseudocorallina	TcH: abundant.
Porpidia cinereoatra	TcH: occasional. 81.
Porpidia irrigua	TcH: 85.
Porpidia platycarpoides	TcH: rare. 85.
Porpidia tuberculosa	TcH; occasional in small quantities.
Ramalina siliquosa	TcH: locally frequent.
Rhizocarpon geographicum	TcH: very rare. 96 abundant on a single rock face.
Rhizocarpon reductum	TcH: occasional in small quantities. .
Rinodina atrocinerea	TcH: frequent, especially on poorly drained surfaces. 81, 83, 86, 90, 92.
Sarcogyne clavus	TcH: rare on possibly recently exposed surfaces, 95.
Trapelia coarctata/elacista	TcH: rare. 87.
Trapelia involuta	TcH: occasional.
Usnea flammea	TcH: frequent.
Xanthoparmelia conspersa	TcH: frequent, on poorly drained surfaces.
Xanthoparmelia loxodes	TcH: frequent. 81, 83, 89, 91.
Xanthoparmelia verruculifera	TcH: occasional. 86.
Xanthoria candelaria	TcH: rare on bird perches. 81, 82.

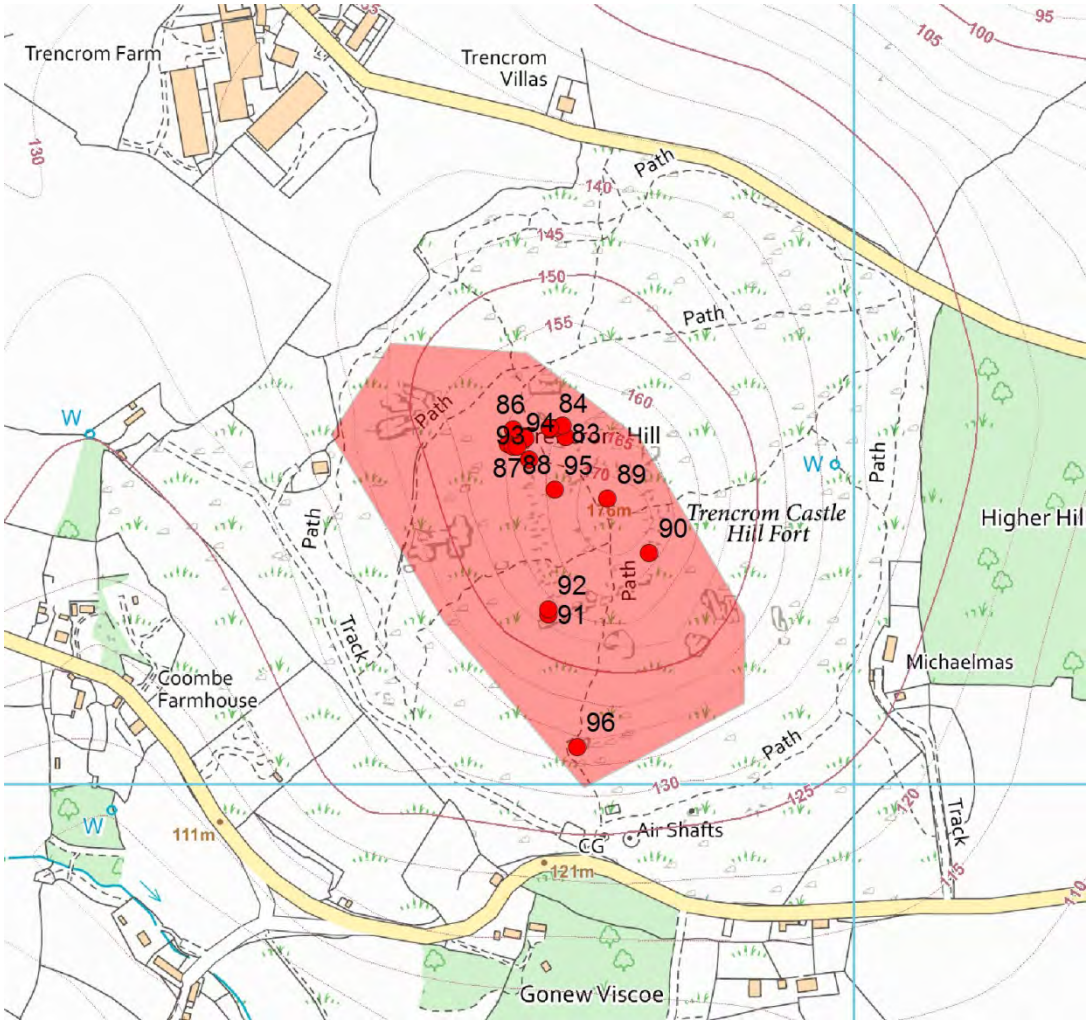


Fig. 52. Trencrom Hill. Location; red polygon shows area suggested for survey.

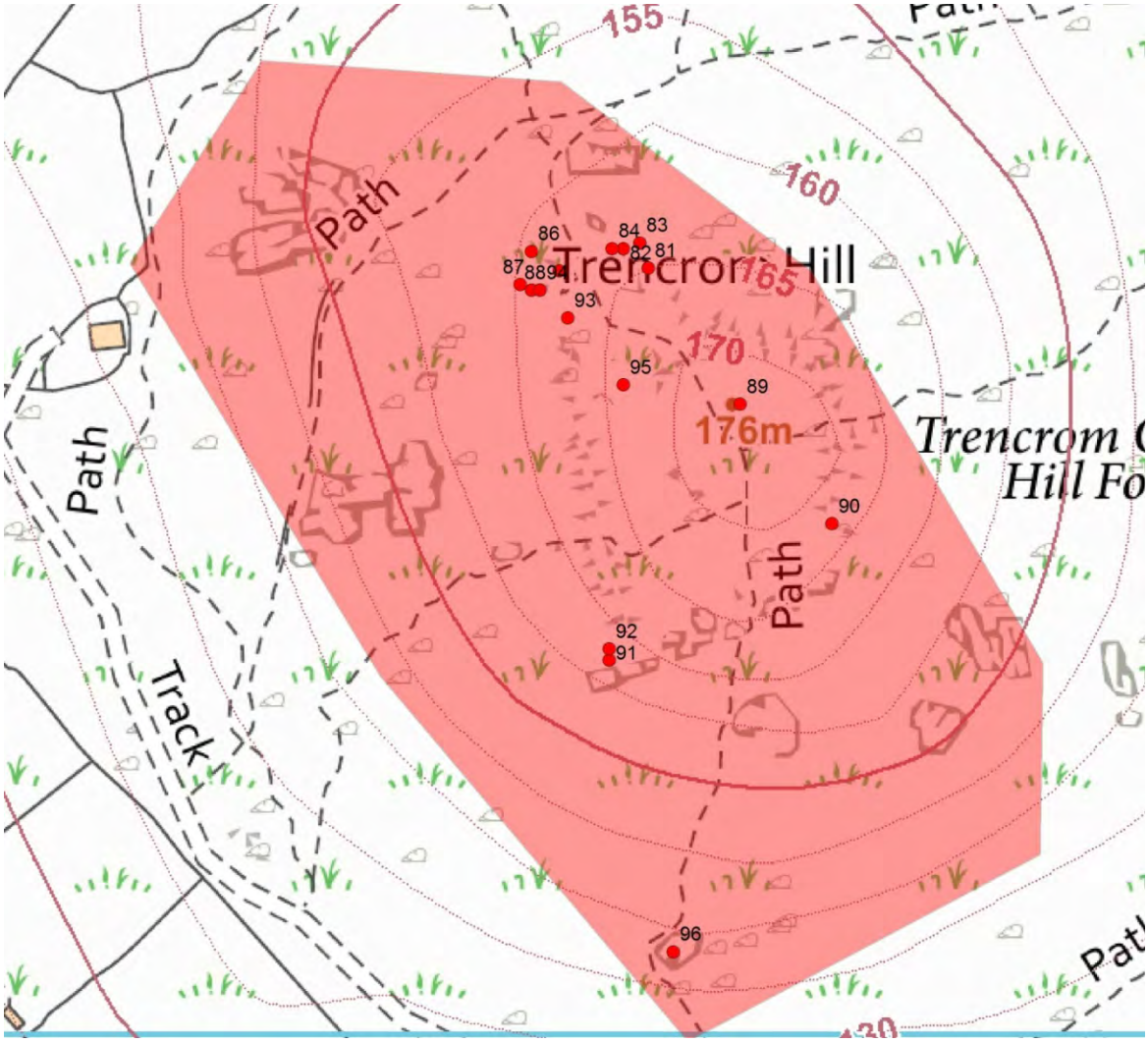


Fig. 53. Trencrom Hill. Location of target notes.

Fig. 54. Trencrom Hill. View near top of hill.

Fig. 55. Trencrom Hill, Locality 83. Position of a colony of *Parmelinopsis minarum*.

Fig. 56. Trencrom Hill, Locality 83. Position of another colony of *Parmelinopsis minarum*, to right of previous photograph

Fig. 57. Trencrom Hill, Locality 94. Position of *Parmelinopsis minarum* colonies.

Fig. 58. Trencrom Hill, Locality 91. Location of *Bryoria fuscescens* colony.

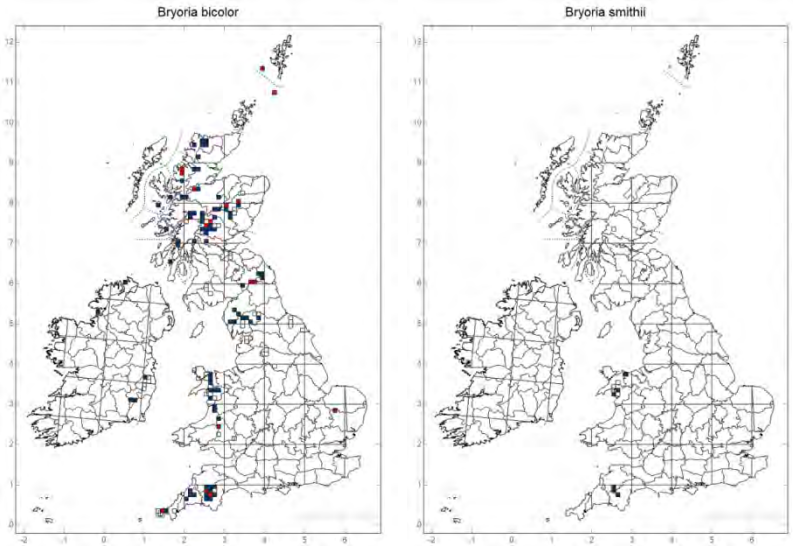
Fig. 59. Trencrom Hill, Locality 87. Location of *Lecanora praepostera*.

Fig. 60. Trencrom Hill, Locality 90. *Melaspilea interjecta* occurs on the downhill side of rocks at ground level, where bare rock is exposed by shrinkage of the turf.

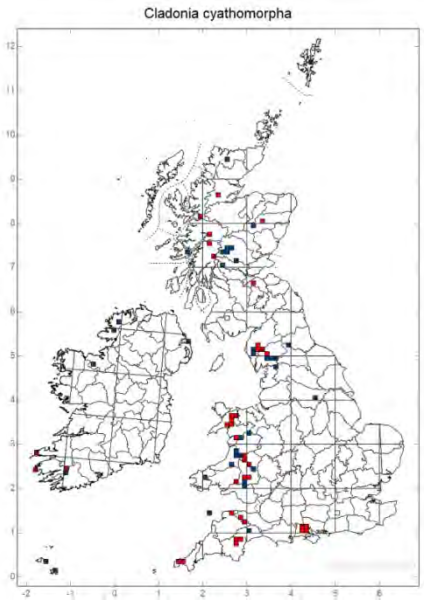
Appendix 2. Details of notable species

Bryoria bicolor/smithii

Both species are rare and declining.

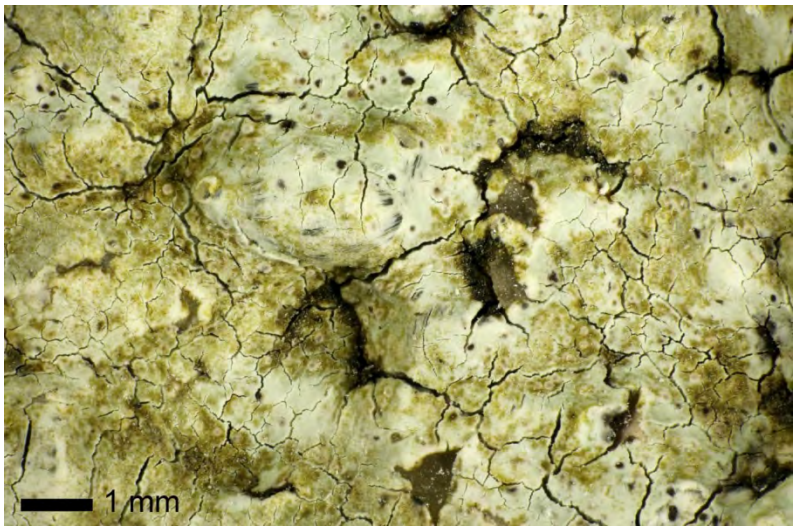


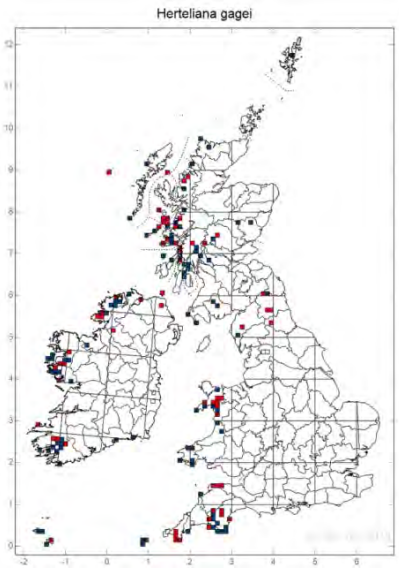
Cladonia cyathomorpha



This cup-lichen differs from *Cladonia pyxidata* by the well-developed, rather large squamules. Often on mossy rocks, sometimes where slightly irrigated. Occasional in upland areas, possibly a little under-recorded.

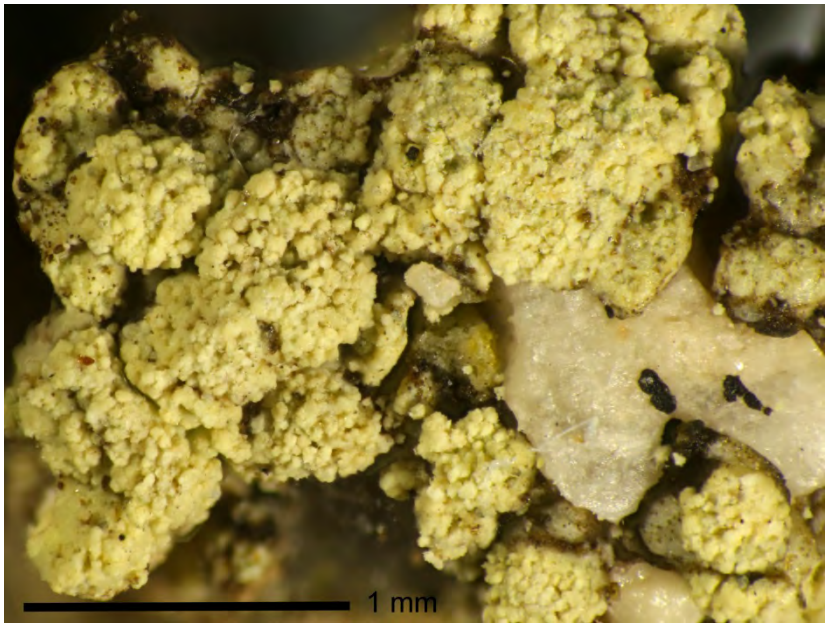
Herteliana gagei

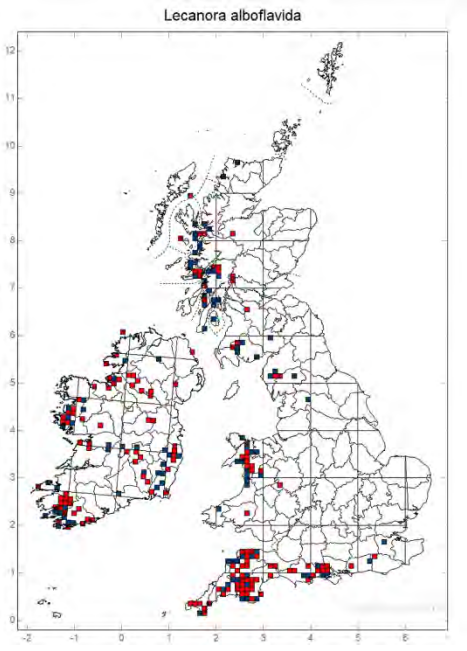




When sterile, recognisable by the smooth grey thallus (discoloured in the photograph) with black dots. A very western, oceanic species of moist or shaded rocks, especially in woodland.

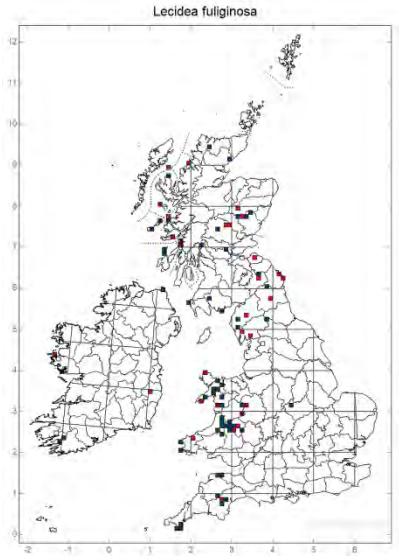
Lecanora alboflavida



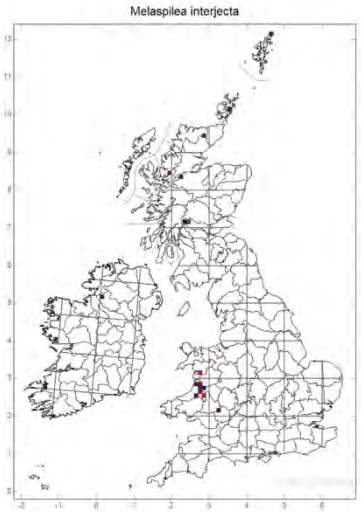


A southern and western species, often on trees. Recognisable by the thin thallus with abundant pale yellow granular soralia.

Lecidea fuliginosa

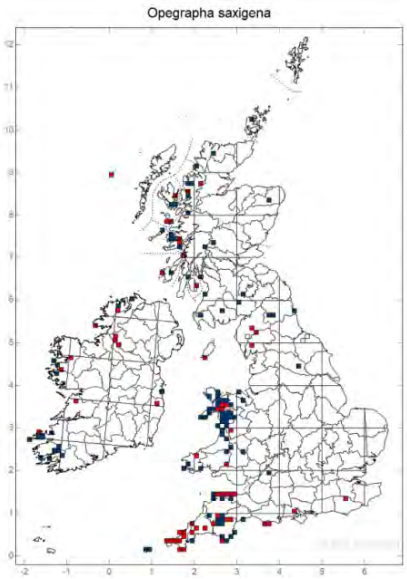


Melaspilea interjecta



The apothecia have a slit-like disc and become contorted, forming rather conspicuous black specks. A rare species of siliceous rocks, at Penwith occurring mainly on surfaces that have become exposed relatively recently.

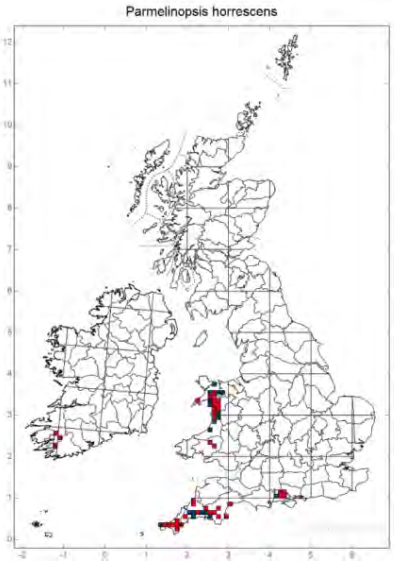
Opegrapha saxigena



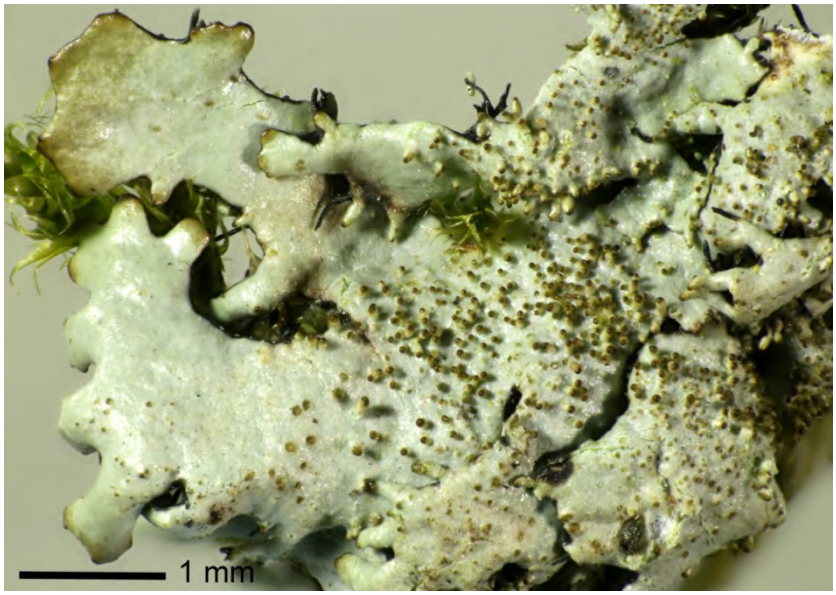
Apothecia elongated, with a slit-like disc, but much smaller and less conspicuous than in *Melaspilea interjecta*. The thallus is often continuous, but is hardly visible at Penwith.

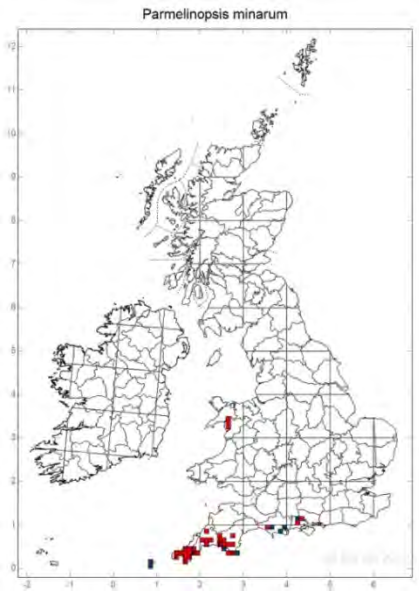
A species of shaded and rain-sheltered rock, often in woodland. Frequent at Penwith on rain-sheltered faces.

Parmelinopsis horrescens



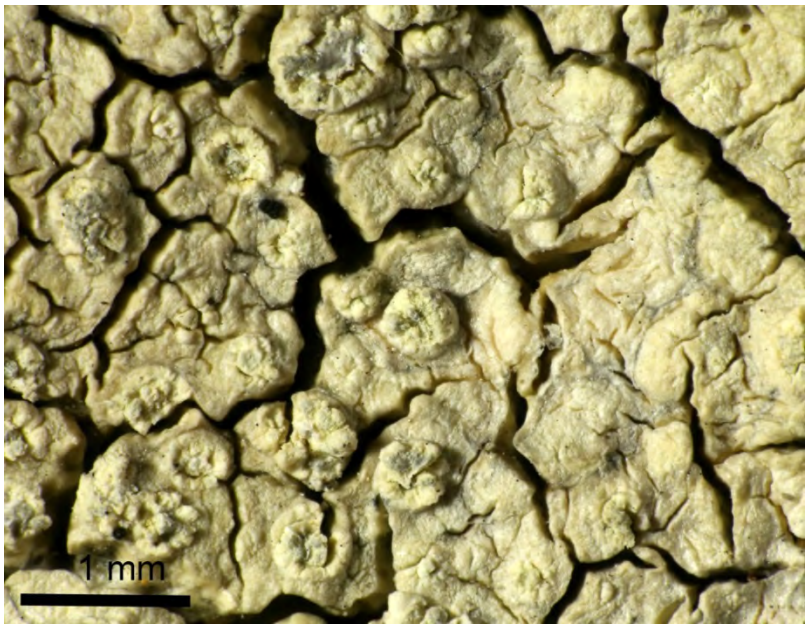
Parmelinopsis minarum

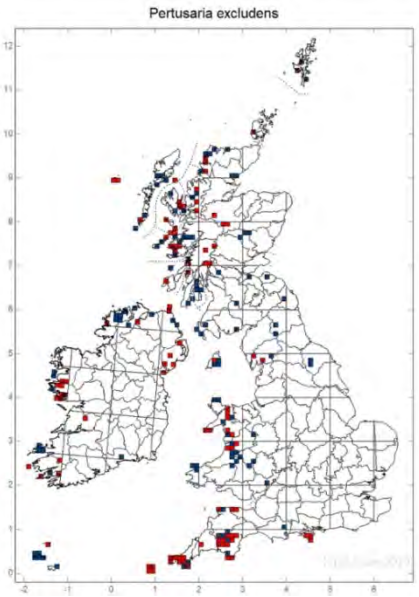




A relatively small leafy lichen, with numerous elongate outgrowths on the upper surface (isidia), and a C + red medulla. Very south-western in distribution. At Penwith it usually requires some shelter from direct sun and occurs on northerly or shaded surfaces, often with other macrolichens and some moss cover, although it cannot compete with vigorous moss.

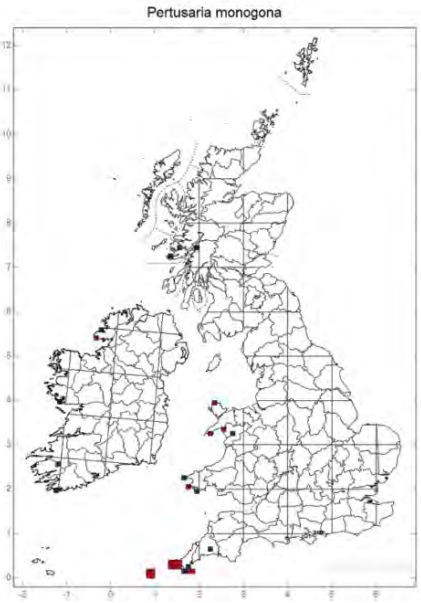
Pertusaria excludens





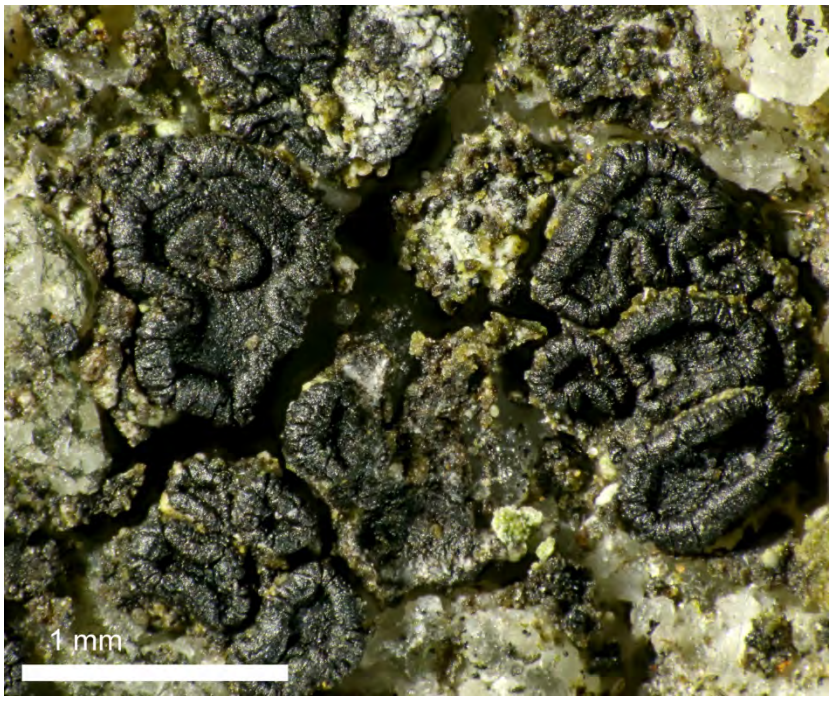
A well-developed crust which is K + red, and which always has coarsely granular areas (soralia) which produce granular propagules. A mainly western species of sunny rocks. Occasional to frequent at Penwith on exposed rocks.

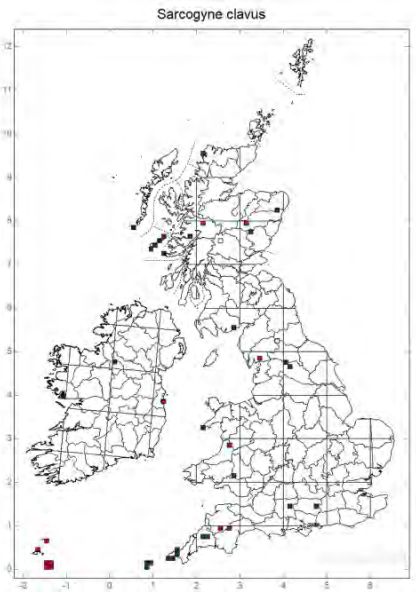
Pertusaria monogona



This is possibly the fertile conterpart of *Pertusaria excludens*, but their relationship has not been investigated. The apothecia are in warts and have a rough, whitish surface, and thus could be mistaken for soralia as in *P. excludens*. Sunny rocks, rarer at Penwith than *P. excludens*.

Sarcogyne clavus





Usnea subscabrosa

A very rare south-western species. Smith *et al*. (2009) mention a locality at The Lizard, but this does not appear on the distribution map.

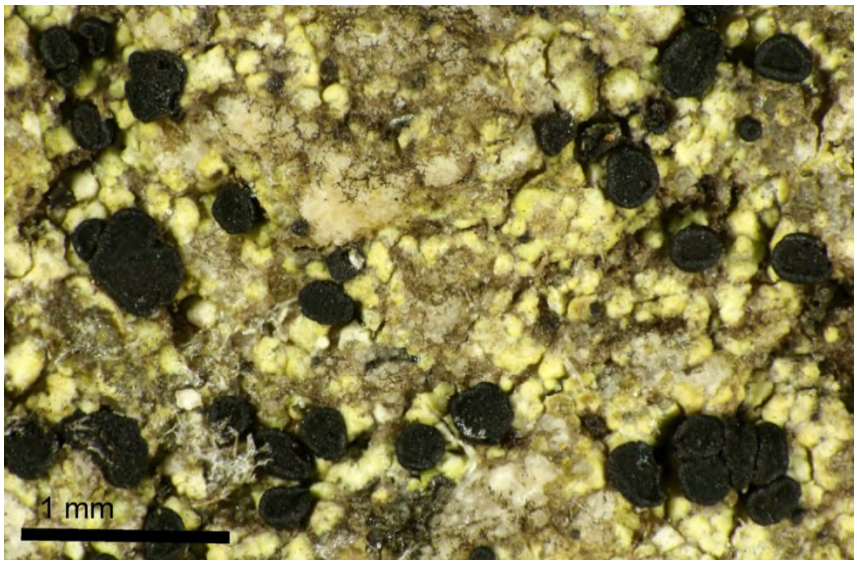
Other TNTN species

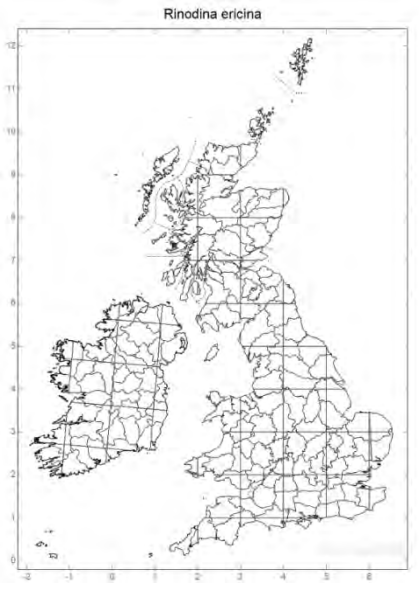
Lecanora praepostera

Micarea xanthonica

Parmeliella parvula

Rinodina ericina





An apparently very rare species reported from western Scotland and western Ireland. It differs from *Rinodina occulta* in the presence of oil droplets in the hymenium, and the presence of diploicin and atranorin in the thallus.

Appendix 3. Analysis of quadrat data

The Primer analysis distinguished 20 divisions of the quadrat samples with statistical support. The divisions, or combinations of divisions, are illustrated here, ordered as tables of percentage frequency, and minimum and maximum Domin value. Only 2 divisions, with only 2 and 1 quadrats respectively, are omitted here.

Non-montane Acid Rock species are shown in red. Species occurring in the division at <10% frequency are omitted.

Divisions 2-9. Shaded or more or less north-facing rocks, with frequent bryophytes and macrolichens.			
	samples:	27	
	frequency	min	max
Hypnum andoi	70	1	8
Usnea flammea	56	1	4
Parmelia saxatilis	48	1	5
Flavoparmelia caperata	44	2	5
Parmelia omphalodes	44	1	5
Parmelinopsis minarum	44	1	7
Parmotrema perlatum	44	1	5
Lepraria incana	41	1	2
Isothecium myosuroides	37	2	5
Pertusaria pseudcorallina	37	2	5
Frullania tamarisci	33	1	6
Herteliana gagei	30	1	7
Camplylopus flexuosus	26	1	4
Dicranum scoparium	26	2	6
Microlejeunea ulicina	26	2	3
Hyotrachyna britannica	22	1	6
Trapelia involuta	22	1	2
Cladonia polydactyla	19	2	4
Fuscidea cyathoides	19	1	5
Scapania gracilis	19	5	8
Cladonia cervicornis	15	1	5
Dimerella lutea	15	1	2
Melanelixia fuliginosa	15	1	2
Parmelinopsis horrescens	15	1	5
Racomitrium heterostichum	15	1	4
Ramalina siliquosa	15	1	5
Cladonia coccifera	11	1	3
Cladonia furcata	11	1	4
Cladonia squamosa	11	4	4
Lecanora alboflavida	11	1	1
Lecanora intricata	11	3	3
Pertusaria aspergilla	11	1	4

Phlyctis argena	11	2	4
Porina chlorotica	11	1	2
Rhizocarpon reductum	11	1	2
Sphaerophorus globosus	11	1	5

Divisions 10-11. Rock surfaces which have become exposed fairly recently.

	Samples:	5	
	f	min	max
Melaspilea interjecta	100	2	7
Trapelia involuta	80	1	4
Acarospora fuscata	60	1	2
Lecanora intricata	60	1	2
Cladonia cervicornis	40	2	2
Lecanora polytropa	40	3	4
Lecidea fuscoatra	40	2	6
Polytrichum piliferum	40	1	2
Racomitrium heterostichum	40	1	6
Xanthoparmelia conspersa	40	1	1
Xanthoparmelia loxodes	40	2	3
Aspicilia caesiocinerea	20	5	5
Buellia ocellata	20	1	1
Buellia aethalea	20	1	1
Campylopus introflexus	20	4	4
Grimmia trichophylla	20	4	4
Pertusaria pseudocorallina	20	2	2
Porpidia cinereoatra	20	2	2
Porpidia tuberculosa	20	1	1
Rhizocarpon reductum	20	3	3
Rinodina atrocinerea	20	1	1
Sarcogyne clavus	20	4	4
Stereocaulon evolutum	20	6	6

Division 12. Moist or poorly drained, mostly well-lit, surfaces.			
	samples:	18	
	frequency	min	max
Xanthoparmelia conspersa	94	1	7
Pertusaria pseudocorallina	83	1	8
Cladonia cervicornis	67	1	5
Racomitrium heterostichum	67	1	6
Lepraria caesioalba	61	1	6
Rinodina atrocinerea	56	1	7
Fuscidea cyathoides	44	1	4
Rhizocarpon reductum	44	2	5
Xanthoparmelia loxodes	44	1	5
Parmelia omphalodes	39	2	5
Porpidia cinereoatra	39	1	4
Lecanora gangaleoides	33	1	5
Pertusaria corallina	28	1	2
Grimmia trichophylla	22	1	6
Hypnum andoi	22	2	6
Hypotrachyna britannica	22	1	2
Lecanora intricata	22	1	2
Melaspilea interjecta	22	1	4
Parmelia saxatilis	22	1	4
Petusaria excludens	22	1	2
Trapelia involuta	22	1	2
Xanthoparmelia verruculifera	22	1	4
Cladonia cyathomorpha	17	1	4
Melanelixia fuliginosa	17	1	2
Pertusaria aspergilla	17	1	4
Porpidia tuberculosa	17	2	5
Sarcogyne clavus	17	1	3
Stereocaulon evolutum	17	1	2
Acarospora fuscata	11	2	2
Aspicilia caesiocinerea	11	1	2
Cladonia coccifera	11	1	4
Cladonia gracilis	11	2	2
Cladonia squamosa	11	1	4
Dicranum scoparium	11	4	4
Flavoparmelia caperata	11	4	5
Frullania tamarisci	11	4	4
Hypnum cupressiforme	11	2	4
Lecanora polytropa	11	1	3
Ochrolechia androgyna	11	1	2
Porpidia irrigua	11	2	4
Porpidia platycarpoides	11	2	3

Divisions 14-17. Well-drained, well-lit rock.			
	samples:	46	
	frequency	min	max
Fuscidea cyathoides	98	2	8
Pertusaria pseudocorallina	87	1	6
Lecanora intricata	76	1	5
Lecanora gangaleoides	59	1	7
Parmelia omphalodes	57	1	6
Acarospora fuscata	48	1	5
Porpidia tuberculosa	46	1	5
Rhizocarpon reductum	41	1	4
Usnea flammea	37	1	4
Melanelixia fuliginosa	35	1	4
Pertusaria excludens	35	1	6
Lecanoa alboflavida	33	1	4
Ramalina subfarinacea	30	1	2
Xanthoparmelia conspersa	26	1	8
Pertusaria aspergila	24	1	5
Porpidia cinereoatra	24	1	4
Parmelia saxatilis	22	1	5
Flavoparmelia caperata	20	1	5
Cladonia cervicornis	17	1	4
Hypotrachyna britannica	17	1	2
Pertusaria corallina	17	1	5
Rhizocarpongeographicum	15	1	7
Lepraria caesioalba	13	1	2
Opegrapha saxigena	13	2	7
Lecidea fuscoatra	11	2	4
Sarcogyne clavus	11	1	5
Tylothallia biformigera	11	1	4
Xanthoparmelia loxodes	11	1	5

Divisions 18-19. Bird-perches and salt-influenced rocks.			
	samples:	20	
	frequency	min	max
Pertusaria pseudocorallina	90	2	8
Ramalina siliquosa	80	1	8
Lecanora intricata	70	2	4
Flavoparmelia caperata	60	1	5
Parmelia omphalodes	60	1	7
Rinodina atrocinerea	60	2	6
Lecanora gangaleoides	45	1	5
Ramalina subfarinacea	45	1	5
Verrucaria fusconigrescens	30	3	9
Xanthoria candelaria	30	1	5
Parmelia sulcata	25	1	4
Xanthoparmelia conspersa	25	1	2
Amandinea pelidna	20	1	5
Anaptychia runcinata	20	1	6
Xanthoparmelia loxodes	20	1	7
Aspicilia leproscescens	15	2	5
Candelariella vitellina	15	2	3
Melanelixia fuliginosa	15	1	4
Usnea flammea	15	1	4
Cladonia cervicornis	10	2	4
Lecanora rupicola	10	2	4
Parmeotrema perlatum	10	1	1
Rhizocarpon reductum	10	1	2
Xanthoparmelia verruculifera	10	4	4

Division 20. Rain-sheltered surfaces.			
	Samples:	8	
	f	min	max
Lepraria incana	88	2	9
Opegrapha saxigena	75	5	8
Lecanora gangaleoides	63	2	4
Haematomma ochroleucum	38	1	8
Ramalina siliquosa	25	1	1
Fuscidea cyathoides	25	4	4
Opegrapha gyrocarpa	25	5	5
Pertusaria pseudocorallina	25	4	5
Frullania tamarisci	13	2	2
Porina chlorotica	13	5	5
Porina lectissima	13	1	1
Porpidia tuberculosa	13	5	5
Omitting Quadrat 183 which belongs with bird-perching rocks.			

The analysis reflects the observation that the individual Notable species prefer particular microhabitats. The table below shows that there is a 'woodland' group including *Herteliana gagei* and *Parmelinopsis* spp., that *Melaspilea interjecta* favours recently-exposed surfaces (which can also be found in small quantity on mature rock faces, when larger lichens and mosses are lost), and that *Lecanora alboflavida* and *Pertusaria excludens* are abundant on well-drained, sunny surfaces (the most frequent microhabitat on the tors).

Occurrence of Notable species in main divisions of Primer analysis							
	all	2-9	10-11	12	14-17	18-19	20
		shaded and N-facing rocks	Recently exposed surfaces	Moist or poorly drained surfaces	Well-drained, well-lit rock	Bird-perches and salt-influenced rocks	Rain-sheltered surfaces
Bryoria bicolor/smithii	1					1	
Cladonia cyathomorpha	3			3			
Herteliana gagei	9	8			1		
Lecanora alboflavida	19	3			15		
Lecanora praepostera	0						
Lecidea fuliginosa	3				2	1	
Melaspilea interjecta	12	3	5	4	2		
Micarea xanthonica	1	1					
Opegrapha saxigena	13	1			6		6
Parmeliella parvula	1	1					
Parmelinopsis horrescens	4	4					
Parmelinopsis minarum	16	12			4		
Pertusaria excludens	22	2		4	16		
Pertusaria monogona	5				4	1	
Rinodina ericina	0						
Sarcogyne clavus	10	6	1	3			
Usnea subscabrosa	0						

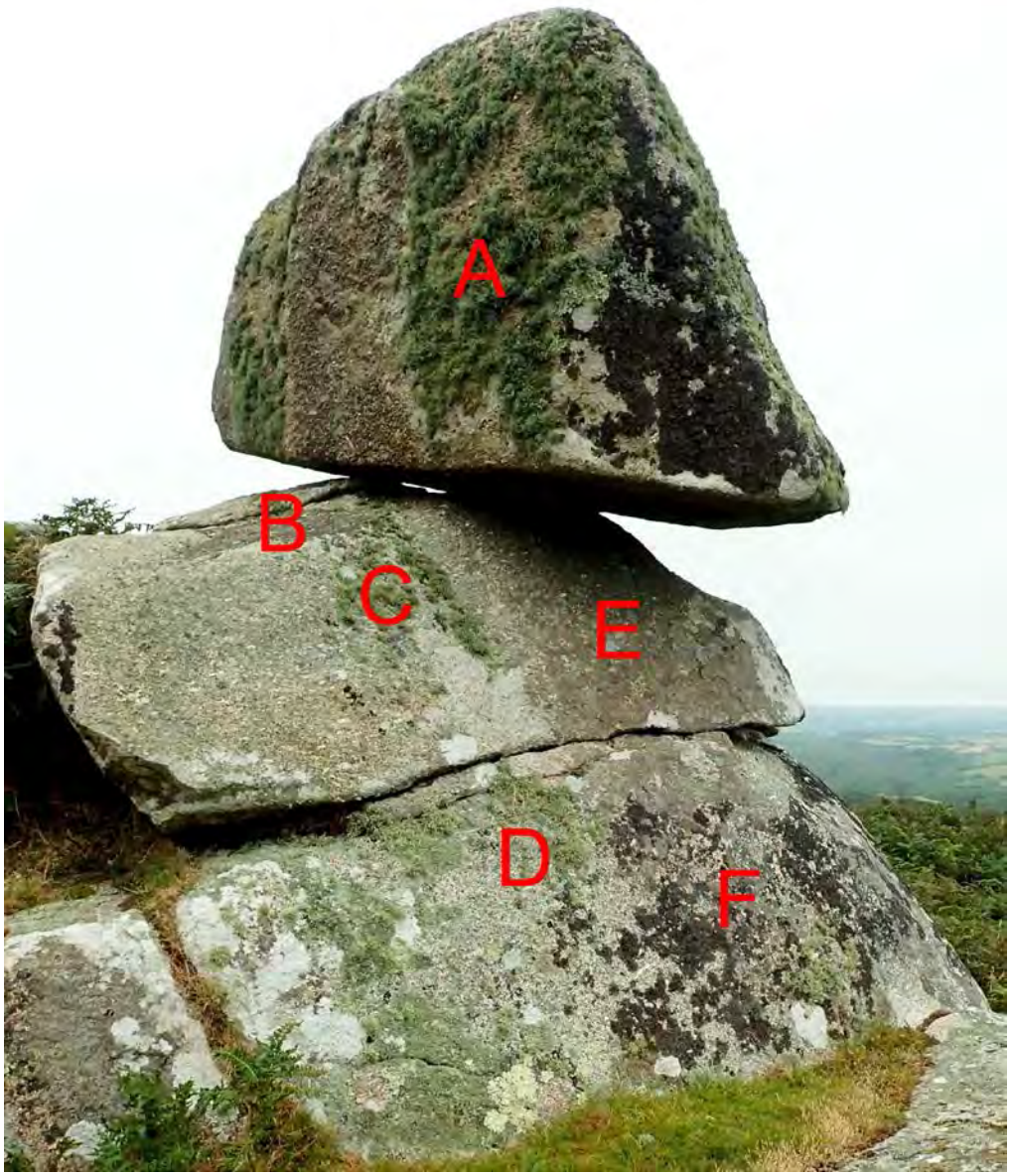


Fig. 61. Example of communities on rock in response to exposure and run-off, Boswarva Carn. Quadrats were recorded at locations A, B, E and F.

A: dominant *Ramalina siliquosa* with a little *Verrucaria fusconigrescens* on a vertical face, receiving run-off froma bird-perch on the top of the rock, and there may also be salt deposition from sea winds; Division 19 of the analysis.

B: dominant *Verrucaria fusconigrescens* with a little *Ramalina siliquosa*, on a gently sloping surface receiving run-off from the top of the rock; Division 18 of the analysis.

C: a small fan of *Ramalina siliquosa* below A.

D: local *Ramalina siliquosa* on a face which is also slightly flushed from run-off.

E: dominant *Fuscidea cyathoides* with smaller amounts of *Lecanora gangaleoides* and *Porpidia tuberculosa*, on a rain-sheltered face not receiving the run-off from the top of the rock; Division 14 of the analysis.

F: dominated by *Fuscidea cyathoides* and the macrolichen *Parmelia omphalodes*, the latter favoured by wetter conditions than in E, but also avoiding nutrient-rich run-off from above; also Division 14 of the analysis.

Appendix 4. Localities (target notes) recorded in field

locality	grid ref	site	date
1	SW41179.34647	Carn Downs	2019 07 01
2	SW41175.34645	Carn Downs	2019 07 01
3	SW41177.34663	Carn Downs	2019 07 01
4	SW41128.34661	Carn Downs	2019 07 01
5	SW41081.34723	Carn Downs	2019 07 01
6	SW41078.34734	Carn Downs	2019 07 01
7	SW41057.34727	Carn Downs	2019 07 01
8	SW41056.34727	Carn Downs	2019 07 01
9	SW41022.34705	Carn Downs	2019 07 01
10	SW40972.34790	Carn Downs	2019 07 01
11	SW40983.34820	Carn Downs	2019 07 01
12	SW41012.34819	Carn Downs	2019 07 01
13	SW41142.34536	Carn Downs	2019 07 01
14	SW41994.35759	Watch Croft	2019 07 02
15	SW42003.35764	Watch Croft	2019 07 02
16	SW42011.35763	Watch Croft	2019 07 02
17	SW42031.35746	Watch Croft	2019 07 02
18	SW42020.35773	Watch Croft	2019 07 02
19	SW42008.35775	Watch Croft	2019 07 02
20	SW42007.35775	Watch Croft	2019 07 02
21	SW41993.35773	Watch Croft	2019 07 02
22	SW41983.35787	Watch Croft	2019 07 02
23	SW41974.35803	Watch Croft	2019 07 02
24	SW42060.35879	Watch Croft	2019 07 02
25	SW42085.35912	Watch Croft	2019 07 02
26	SW42030.35888	Watch Croft	2019 07 02
27	SW47879.38777	Trendrine Hill	2019 07 03
28	SW47889.38797	Trendrine Hill	2019 07 03
29	SW47898.38791	Trendrine Hill	2019 07 03
30	SW47636.38607	Trendrine Hill	2019 07 03
31	SW47638.38620	Trendrine Hill	2019 07 03
32	SW47630.38623	Trendrine Hill	2019 07 03
33	SW47633.38635	Trendrine Hill	2019 07 03
34	SW47619.38625	Trendrine Hill	2019 07 03
35	SW47613.38618	Trendrine Hill	2019 07 03
38	SW43117.36381	Hannibal's Carn	2019 07 05
39	SW43130.36398	Hannibal's Carn	2019 07 05
40	SW43125.36387	Hannibal's Carn	2019 07 05
41	SW43128.36385	Hannibal's Carn	2019 07 05
42	SW43137.36390	Hannibal's Carn	2019 07 05
43	SW38797.32982	Carn Kenidjack	2019 07 08
44	SW38801.32979	Carn Kenidjack	2019 07 08
45	SW38803.32974	Carn Kenidjack	2019 07 08
46	SW38808.32989	Carn Kenidjack	2019 07 08

47	SW38803.32978	Carn Kenidjack	2019 07 08
48	SW38811.32975	Carn Kenidjack	2019 07 08
49	SW38808.32973	Carn Kenidjack	2019 07 08
50	SW38819.32961	Carn Kenidjack	2019 07 08
51	SW38802.32969	Carn Kenidjack	2019 07 08
52	SW38796.32978	Carn Kenidjack	2019 07 08
53	SW38784.32981	Carn Kenidjack	2019 07 08
54	SW38807.32938	Carn Kenidjack	2019 07 08
55	SW38802.32936	Carn Kenidjack	2019 07 08
56	SW43130.36355	Hannibal's Carn	2019 07 09
57	SW43144.36360	Hannibal's Carn	2019 07 09
58	SW43151.36365	Hannibal's Carn	2019 07 09
59	SW43156.36364	Hannibal's Carn	2019 07 09
60	SW43160.36361	Hannibal's Carn	2019 07 09
61	SW43186.36312	Hannibal's Carn	2019 07 09
62	SW43186.36312	Hannibal's Carn	2019 07 09
63	SW43189.36317	Hannibal's Carn	2019 07 09
64	SW43196.36316	Hannibal's Carn	2019 07 09
65	SW43199.36310	Hannibal's Carn	2019 07 09
66	SW43239.36229	Hannibal's Carn	2019 07 09
67	SW43297.36032	Hannibal's Carn	2019 07 09
68	SW43295.35935	Hannibal's Carn	2019 07 09
69	SW47598.39122	Trendrine Hill	2019 07 10
70	SW47595.39119	Trendrine Hill	2019 07 10
71	SW47603.39132	Trendrine Hill	2019 07 10
72	SW47600.39145	Trendrine Hill	2019 07 10
73	SW47600.39145	Trendrine Hill	2019 07 10
74	SW47607.39145	Trendrine Hill	2019 07 10
75	SW47614.39151	Trendrine Hill	2019 07 10
76	SW47635.39135	Trendrine Hill	2019 07 10
77	SW47621.39118	Trendrine Hill	2019 07 10
78	SW47623.39122	Trendrine Hill	2019 07 10
79	SW47631.39098	Trendrine Hill	2019 07 10
80	SW47625.39101	Trendrine Hill	2019 07 10
81	SW51771.36277	Trencrom Hill	2019 07 11
82	SW51762.36284	Trencrom Hill	2019 07 11
83	SW51768.36286	Trencrom Hill	2019 07 11
84	SW51758.36284	Trencrom Hill	2019 07 11
85	SW51739.36276	Trencrom Hill	2019 07 11
86	SW51729.36283	Trencrom Hill	2019 07 11
87	SW51725.36271	Trencrom Hill	2019 07 11
88	SW51729.36269	Trencrom Hill	2019 07 11
89	SW51804.36228	Trencrom Hill	2019 07 11
90	SW51837.36185	Trencrom Hill	2019 07 11
91	SW51757.36136	Trencrom Hill	2019 07 11
92	SW51757.36140	Trencrom Hill	2019 07 11
93	SW51742.36259	Trencrom Hill	2019 07 11
94	SW51732.36269	Trencrom Hill	2019 07 11

95	SW51762.36235	Trencrom Hill	2019 07 11
96	SW51780.36031	Trencrom Hill	2019 07 11
97	SW46444.38139	Logan Stone	2019 07 12
98	SW46398.38137	Logan Stone	2019 07 12
99	SW46398.38145	Logan Stone	2019 07 12
100	SW46378.38122	Logan Stone	2019 07 12
101	SW46372.38121	Logan Stone	2019 07 12
102	SW46358.38086	Logan Stone	2019 07 12
103	SW46350.38086	Logan Stone	2019 07 12
104	SW46354.38208	Logan Stone	2019 07 12
105	SW46348.38242	Logan Stone	2019 07 12
106	SW46338.38243	Logan Stone	2019 07 12
107	SW46351.38316	Logan Stone	2019 07 12
108	SW46375.38226	Logan Stone	2019 07 12
109	SW46386.38213	Logan Stone	2019 07 12
110	SW47066.38297	Sperris Quoit	2019 08 05
111	SW47082.38289	Sperris Quoit	2019 08 05
112	SW47039.38321	Sperris Quoit	2019 08 05
113	SW47030.38328	Sperris Quoit	2019 08 05
114	SW47039.38337	Sperris Quoit	2019 08 05
115	SW47056.38344	Sperris Quoit	2019 08 05
116	SW47002.38427	Sperris Quoit	2019 08 05
117	SW47012.38473	Sperris Quoit	2019 08 05
118	SW47038.38490	Sperris Quoit	2019 08 05
119	SW47045.38529	Sperris Quoit	2019 08 05
120	SW47038.38579	Sperris Quoit	2019 08 05
121	SW47009.38552	Sperris Quoit	2019 08 05
122	SW46975.38522	Sperris Quoit	2019 08 05
123	SW46967.38521	Sperris Quoit	2019 08 05
124	SW46985.38500	Sperris Quoit	2019 08 05
125	SW46226.38433	Zennor Hill	2019 08 07
126	SW46214.38434	Zennor Hill	2019 08 07
127	SW46128.38511	Zennor Hill	2019 08 07
128	SW46139.38527	Zennor Hill	2019 08 07
129	SW46145.38531	Zennor Hill	2019 08 07
130	SW46153.38541	Zennor Hill	2019 08 07
131	SW46139.38545	Zennor Hill	2019 08 07
132	SW46122.38557	Zennor Hill	2019 08 07
133	SW46100.38567	Zennor Hill	2019 08 07
134	SW46066.38579	Zennor Hill	2019 08 07
135	SW46055.38592	Zennor Hill	2019 08 07
136	SW46062.38586	Zennor Hill	2019 08 07
137	SW46065.38591	Zennor Hill	2019 08 07
138	SW46076.38596	Zennor Hill	2019 08 07
139	SW46103.38572	Zennor Hill	2019 08 07
140	SW46106.38606	Zennor Hill	2019 08 07
141	SW46112.38614	Zennor Hill	2019 08 07
142	SW46129.38592	Zennor Hill	2019 08 07

143	SW46140.38581	Zennor Hill	2019 08 07
144	SW46150.38566	Zennor Hill	2019 08 07
145	SW46151.38544	Zennor Hill	2019 08 07
146	?	Zennor Hill	2019 08 07
147	SW42946.33224	Boswarva Carn	2019 08 08
148	SW42947.33224	Boswarva Carn	2019 08 08
149	SW42951.33219	Boswarva Carn	2019 08 08
150	SW42877.33328	Boswarva Carn	2019 08 08
151	SW42876.33319	Boswarva Carn	2019 08 08
152	SW42877.33319	Boswarva Carn	2019 08 08
153	SW42858.33350	Boswarva Carn	2019 08 08
154	SW42811.33362	Boswarva Carn	2019 08 08
155	SW42769.33274	Boswarva Carn	2019 08 08
156	SW42986.33233	Boswarva Carn	2019 08 08