



**Cyfoeth
Naturiol**
Cymru
**Natural
Resources**
Wales

Bryophyte Survey and Monitoring at Castlemartin Range SSSI December 2019 – February 2021



Matt Sutton
Wyndrush Wild Ecology

Evidence Report No 518

About Natural Resources Wales

Natural Resources Wales is the organisation responsible for the work carried out by the three former organisations, the Countryside Council for Wales, Environment Agency Wales and Forestry Commission Wales. It is also responsible for some functions previously undertaken by Welsh Government.

Our purpose is to ensure that the natural resources of Wales are sustainably maintained, used and enhanced, now and in the future.

We work for the communities of Wales to protect people and their homes as much as possible from environmental incidents like flooding and pollution. We provide opportunities for people to learn, use and benefit from Wales' natural resources.

We work to support Wales' economy by enabling the sustainable use of natural resources to support jobs and enterprise. We help businesses and developers to understand and consider environmental limits when they make important decisions.

We work to maintain and improve the quality of the environment for everyone and we work towards making the environment and our natural resources more resilient to climate change and other pressures.

Evidence at Natural Resources Wales

Natural Resources Wales is an evidence based organisation. We seek to ensure that our strategy, decisions, operations and advice to Welsh Government and others are underpinned by sound and quality-assured evidence. We recognise that it is critically important to have a good understanding of our changing environment.

We will realise this vision by:

- Maintaining and developing the technical specialist skills of our staff;
- Securing our data and information;
- Having a well resourced proactive programme of evidence work;
- Continuing to review and add to our evidence to ensure it is fit for the challenges facing us; and
- Communicating our evidence in an open and transparent way.

This Evidence Report series serves as a record of work carried out or commissioned by Natural Resources Wales. It also helps us to share and promote use of our evidence by others and develop future collaborations. However, the views and recommendations presented in this report are not necessarily those of NRW and should, therefore, not be attributed to NRW.

Report series: Evidence Reports
Report number: 518
Publication date: March 2021
Contract number:
Contractor: Matt Sutton
Contract Manager: Paul Culyer
Title: Bryophyte Survey and Monitoring at Castlemartin Range
SSSI December 2019 - February 2021
Author(s): **Sutton, MD**
Technical Editor:
Peer Reviewer(s) Sam Bosanquet
Approved By:
Series editor(s):
Restrictions: None

Distribution List (core)

Paul Culyer, NRW Stackpole	1
NRW Library, Bangor	2
National Library of Wales	1
British Library	1
Welsh Government Library	1
Scottish Natural Heritage Library	1
Natural England Library (Electronic Only)	1

Recommended citation for this volume:

Sutton, MD. 2021. *Bryophyte Survey and Monitoring at Castlemartin Range SSSI December 2019 - February 2021*. NRW Evidence Report No: 518, 95 pp, Natural Resources Wales, Bangor

Contents

1. Crynodeb Gweithredol	1
2. Executive Summary	4
3. Introduction.....	6
4. Survey Work December 2019 – January 2020 and August 2020 – March 2021	6
5. Qualifying Species of the Open Calcareous Grassland Assemblage	8
6. Qualifying Species of the Lowland Heathland Assemblage.....	20
7. Qualifying Species of the Coastal Habitats Assemblage	26
8. Qualifying Species of the Dune and Slack Assemblage	31
9. Qualifying Species of the Lowland Calcareous Rock Assemblage.....	33
10. Revised Assemblage Scores and Qualifying SSSI Features.....	36
11. Monitoring and Condition Assessment.....	39
12. Important ‘Bryo-Zones’	42
13. Five Management Actions for Bryophytes.....	49
14. Acknowledgements.....	50
15. References	50
Appendix 1: Important ‘Bryo-zones’	51
Appendix 2: Conservation Objectives for Qualifying Bryophytes and Bryophyte Assemblages at Castlemartin Range SSSI.....	69
2.1 Toothed Threadwort <i>Cephaloziella dentata</i>	69
2.2 Lobed Threadwort <i>Cephaloziella integerrima</i>	74
2.3 Entire Threadwort <i>Cephaloziella calyculata</i>	79
Appendix 3: Results & Annotated Checklist as of January 2021	83

1. Crynodeb Gweithredol

Cynhaliodd Sam Bosanquet yr arolwg manwl cyntaf o fryoffytau ar SoDdGA Maes Tanio Castellmartin yn 2008, gan gynnwys adolygu'r hyn a gofnodwyd eisoes. Heblaw am fonitro'r petal-lys *Petalophyllum ralfsii*, ni fu bryoffytau'n destun unrhyw waith arolygu neu fonitro ers hynny. Mae Bosanquet (2019) yn adolygu cyfosodiadau o fryoffytau ar Safleoedd o Ddiddordeb Gwyddonol Arbennig yng Nghymru, ac mae o'r farn bod SoDdGA Maes Tanio Castellmartin yn bwysig oherwydd cyfosodiad ar 'ddaeear galchaid agored' yn ogystal â chyfosodiad o fryoffytau mewn 'twyni a llaciau twyni'. Mae *Cephaloziella calyculata*, llys yr afu sy'n brin yn genedlaethol, wedi'i nodi fel nodwedd sy'n cymhwyso'r safle ar ei ben ei hun. Ni wnaed asesiad o'r safle ar gyfer cyfosodiadau o fryoffytau ar 'rostir llawr gwlad' (yr unig safle cymwys yng Nghymru ar sail cyfosodiad o'r fath yw SoDdGA Mynydd Preseli). Ni wnaed asesiad ar gyfer 'cyfosodiadau cynefinoedd arfordirol', nac ychwaith ar gyfer cyfosodiadau ar 'graig galchaid ar lawr gwlad'.

Roedd yn ofynnol cynnal yr arolwg cyfredol er mwyn cadarnhau bod rhywogaethau allweddol y cyfosodiadau'n dal i fod yno, ac i gynnig asesiad o gyflwr y nodweddion bryoffytau yn unol ag amcan cadwraeth newydd. Roedd gofyn hefyd am argymhellion ynglŷn â rheoli'r safle ac arolygu a monitro yn y dyfodol.

Treuliwyd pymtheg o ddiwrnodau'n arolygu bryoffytau ledled y Maes Tanio, yn ystod Rhagfyr 2019 – Ionawr 2020 i ddechrau, ac eto ar sawl diwrnod rhwng Awst 2020 a Chwefror 2021. Ar y cychwyn canolbwyntiwyd ar y safleoedd allweddol hysbys ar gyfer y cyfosodiadau, ond wedi hynny aethpwyd ar wasgar

i gofnodi mewn mannau eraill a allai fod o ddiddordeb. Gwnaed gwaith arolygu tebyg yng Ngwarchodfa Natur Genedlaethol Ystafbwl sy'n destun adroddiad ar wahân (Adroddiad Tystiolaeth CNC rhif 414).

Yn ystod yr arolwg cofnodwyd 45 o rywogaethau newydd ar y safle, gan gynnwys deg ohonynt heb eu cofnodi o'r blaen yn yr is-sir a thair heb eu gweld o'r blaen yng Nghymru.

Cadarnhawyd fod holl rywogaethau'r cyfosodiadau ar 'laswelltir calchog agored' yn dal yn bresennol, ac ychwanegwyd saith o rywogaethau newydd at y cyfosodiad hwn. Gellir ystyried SoDdGA Maes Tanio Castellmartin bellach yr ail safle gorau yng Nghymru ar gyfer y cyfosodiad hwn, gydag Ystafbwl ar y brig. Cadarnhawyd fod holl rywogaethau'r cyfosodiadau 'twyni a llaciau twyni' yn dal yn bresennol.

Canfuwyd cyfosodiad cymwys ar 'rostir llawr gwlad' hefyd, gyda chyfanswm uchel o 27 o bwyntiau. Dyma'r safle pwysicaf yng Nghymru am y math hwn o gyfosodiad. Dylid ystyried un o'r rhywogaethau sy'n rhan ohono, sef *Cephaloziella dentata* sy'n brin yn genedlaethol, fel nodwedd sy'n cymhwyso'r safle ar ei ben ei hun. Mae yma lys yr afu arall, *Cephaloziella integerrima*, ac mae'n amlwg bod y boblogaeth yn fwy nag ar y safle arall ble mae'n hysbys ym Morgannwg, a hefyd yn gymwys ar ei ben ei hun.

Gwelwyd cyfosodiad cymwys o 'gynefinoedd arfordirol' hefyd, gyda chyfanswm o 21 o bwyntiau. Mae'r rhain yn cynnwys *Acaulon mediterraneum* a *Fossombronia maritima*, sydd ill dau'n brin yn genedlaethol ac yn newydd i'r safle. Dyma'r trydydd safle pwysicaf yng Nghymru ar gyfer y cyfosodiad hwn.

Gwelwyd cyfosodiad 'craig galchog ar lawr gwlad' a oedd yn gymwys hefyd, gan gyrraedd y trothwy o drwch blewyn.

Ymddengys fod yr holl gyfosodiadau mewn cyflwr ffatriol. Mae dulliau monitro dros dro wedi'u hamlinellu ar gyfer y rhywogaethau *Cephaloziella*. Caiff 'bryobarthau' o bwys eu diffinio a'u disgrifio, a gwneir argymhellion ynghylch camau rheoli fel y bo'r gofyn. Cyflwynir rhestr ddiwygiedig o safleoedd â bryoffytau hefyd.

2. Executive Summary

Sam Bosanquet carried out the first detailed bryophyte survey work at Castlemartin Range SSSI in 2008, together with a review of previous recording. Aside from monitoring of petalwort *Petalophyllum ralfsii*, no bryophyte survey or monitoring work has been carried out since. Bosanquet (2019) reviews Welsh SSSI bryophyte assemblages, and considers Castlemartin Range SSSI to be of importance for both an ‘open calcareous ground’ assemblage and a ‘dune and slack’ bryophyte assemblage. The Nationally Rare liverwort, *Cephaloziella calyculata*, is notified as an independently qualifying feature. The site was not assessed for a ‘lowland heathland’ bryophyte assemblage (the only qualifying site in Wales for this assemblage being Mynydd Preseli SSSI). It was not assessed for a ‘coastal habitats assemblage’, or for a ‘lowland calcareous rock’ assemblage.

The current survey was required to confirm the continued presence of key assemblage species, and to propose a condition assessment for the bryophyte features against a new conservation objective. Site management and future survey and monitoring recommendations were also required.

Fifteen days were spent surveying bryophytes across the Range, initially in December 2019 – January 2020, then again on several dates between August 2020 and February 2021. The initial focus was on the known key locations for assemblage species, but the survey subsequently recorded more widely in other potentially interesting locations. Similar survey work carried out at Stackpole NNR is presented in a separate report (NRW Evidence Report no. 414).

The survey recorded 45 species new to the site, 10 of them new to the vice-county and 3 of them new to Wales.

The continued presence of all 'open calcareous grassland' assemblage species was confirmed, and seven new species were added to this assemblage. Castlemartin Range SSSI can now be considered the second most important site in Wales for this assemblage, behind Stackpole. The continued presence of all 'dune and slack' assemblage species was confirmed.

A qualifying 'lowland heathland' assemblage was also demonstrated, with a high total of 27 points. This is the most important site in Wales for this assemblage. One of the component species, the Nationally Rare *Cephaloziella dentata*, should be considered to be an independently qualifying feature. A second liverwort, *Cephaloziella integerrima*, clearly has a larger population here than at its other known site in Glamorgan, and also independently qualifies.

A qualifying 'coastal habitats' assemblage was also demonstrated, with a total of 21 points. The Nationally Rare *Acaulon mediterraneum* and *Fossombronina maritima*, both new to the site, are included here. This is the third most important site in Wales for this assemblage.

A qualifying 'lowland calcareous rock' assemblage was also demonstrated, just meeting the threshold for selection.

All assemblages appear to be in favourable condition. Provisional monitoring methodologies for the *Cephaloziella* species are outlined. Important 'bryozones' are defined and described, and recommendations given for management actions where required. A revised bryophyte site list is also presented.

3. Introduction

Sam Bosanquet (SDSB) produced the first detailed work on bryophytes at Castlemartin Range in 2008. No further survey or monitoring work was done in the following 12 years, aside from monitoring of the *Petalophyllum* population on Brownslade Burrows (Wilkinson, 2011, 2018)

4. Survey Work December 2019 – January 2020 and August 2020 – March 2021

Survey work for the contract in the first winter entailed a total of 8 field days. This time was spent revisiting known locations of notable species, primarily those of the qualifying 'open calcareous grassland' assemblage, and surveying other locations likely to hold further populations of these species. Locations not visited by Bosanquet (2008) were also targeted. Survey work for the contract in the second winter was intended to concentrate on monitoring of the heathland assemblage, but this proved difficult without a full understanding of the assemblage composition and distribution of key species. Seasonal limitations in monitoring of *Cephaloziella* species also became apparent, with sheep trampling, high water levels and algal growth all making direct monitoring very challenging.

Many additional records were also made in other habitats across the site. Grid references of notable species were recorded to 10 figures where possible, using a Trimble GeoExplorer. Samples of critical species were collected and confirmed microscopically. Tom Ottley determined or confirmed various difficult

specimens, and new vice-county records were confirmed by the national recorders. The latter are now housed in the BBSUK herbarium in Cardiff; other specimens have been retained by the author. 45 species were recorded new to the site, 10 of them new to the vice-county and 3 new to Wales (one of which was also found at Stackpole). New species are listed in Appendix 2. Numerous additional localities were recorded for various locally rare species. Full details of these are provided in the accompanying spreadsheet. The total number of bryophytes reliably recorded from the site now stands at 219 (slightly behind Stackpole NNR which has 229).



Figure 1 Trimble Geo-Explorer used to record *Cephaloziella calyculata* location near Flimston Bay

5. Qualifying Species of the Open Calcareous Grassland Assemblage



Figure 2 *Aloina rigida* location, Flimston Down

Bosanquet (2019) produced a review of bryophyte SSSI features in Wales. This determined that Castlemartin Range SSSI qualified for an 'Open Calcareous Grassland' assemblage. Qualifying species, either Nationally Rare or Nationally Scarce, were scored (6 points for rare species, 3 for scarce) and tabulated. The total of 24 points easily surpassed the threshold of 12 points, and placed Castlemartin Range fifth in Wales in its importance for this assemblage.

The current survey confirmed the continuing presence of all of the original assemblage species. Seven new species were added to the assemblage. The species of the revised assemblage (with UK Red-list 'Threat Categories') are as follows:

NATIONALLY RARE

***Cephaloziella calyculata* ‘Entire Thread-moss’ (EN)**

Previously known from Castlemartin and recently also found at Stackpole NNR (Sutton, 2020). Confirmed from locations found by SDSB at Trevallen Down and St Govans, and found at additional locations at the former. New locations were found in dragline gullies on Linney Down and Bulliber Down, and within open heathland at Mount Sion Down. The discovery of *Cephaloziella integerrima* in various locations on the Range complicates the picture, as both species have angled gemmae, making identification of material without perianths difficult. *Cephaloziella calyculata* or *integerrima* was recorded quite widely in open clay patches within heathland, and also occasionally in open stony soil in dragline gullies. Samples from SDSB’s third locations on Longstone Down were not confirmed to species.

Status: Stable or increasing

***Cephaloziella integerrima* ‘Lobed Thread-moss’ (EN)**

This was discovered on Range West, where it is occasional on open ground within heath and on stony or clay ground within target gullies. The records here and at Stackpole (Sutton, 2019) represent a considerable range expansion for a species principally found in Cornwall, and with only one other Welsh site on Gower. Like *Cephaloziella calyculata*, this species has angled gemmae on some shoot-tips. The two differ in the bract tube around the perianth, but non-fertile specimens cannot be named satisfactorily. *C. integerrima* is listed as a component of the Lowland Heathland and Mine and Quarry assemblages (Bosanquet et al, 2018), and not Open Calcareous Grassland. However, as it

frequently occurs here on the banks of target gullies as well as within the heath, it has been included within both the OCG and Lowland Heathland assemblages.

Status: Newly discovered, trend unknown



Figure 3 *Cephaloziella integerrima* habitat, Mount Sion Down near Blockhouse N

***Didymodon acutus* (sensu stricto) 'Pointed Beardmoss' (DD)**

Following taxonomic reassessment (see under *D. icmadophilus* below), genuine *D. acutus* is thought to be very rare in Britain, known only from three sites in the south of England. The sample confirmed (by S Pilkington) from the trackside in Trevallen valley represents the first Welsh record. It was subsequently found in the heath to the north-west, and in two places on Stackpole NNR. The aggregate species is widespread on the site, and there are likely to be further populations.

NATIONALLY SCARCE

***Aloina ambigua* 'Tall Aloe-moss'**

Recorded new to the site by the track in Trevalen valley, alongside *A. aloides*. Fertile *Aloinas* were examined in various locations across the site, and this species does appear to be genuinely rare. Status: Unknown, newly discovered

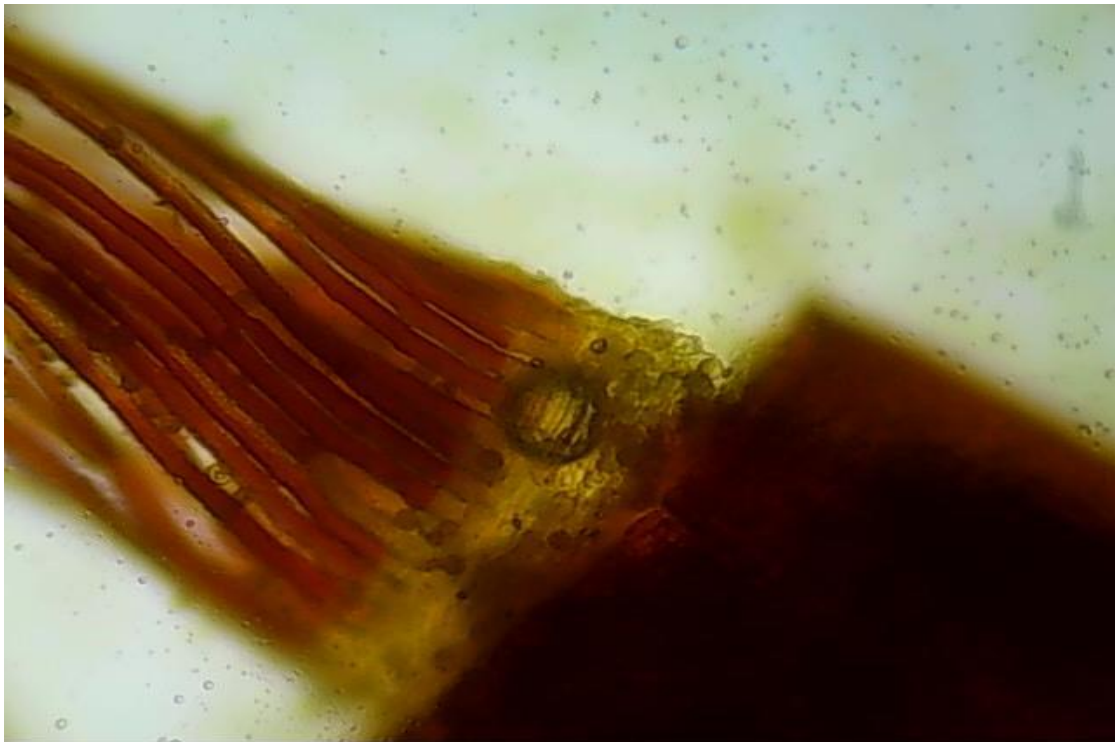


Figure 4 *Aloina ambigua*, showing membrane (yellow)

***Aloina rigida* 'Short-beaked Aloe-moss' (EN)**

This Section 9 species was discovered new to the county in open, stony ground in a dragline gully on Flimstone Down. Searching amongst the common and much more abundant *Aloina aloides* subsequently produced two more localities on track edges here, and a small patch on stony ground within limestone grassland at Blockhouse E. Although generally smaller than *A. aloides*, *A. rigida* is hard to separate in the field from diminutive forms of it. All colonies had ripe capsules. Status: Unknown, newly discovered



Figure 5 *Aloina rigida* near Blockhouse E

***Bryum kunzei* ‘Funk’s Bryum’ (NT)**

Found on the last day of survey, at the seaward end of the south-facing slope of Trevallen valley. Small patches are occasional near the crest of the ridge, alongside the following species. Previously known from the Gower limestone but not Pembrokeshire. Potentially overlooked elsewhere in similar habitat, and subsequently found at both Stackpole NNR and Lydstep Head (SSSI).

***Bryum torquescens* ‘Twisting Threadmoss’**

Not previously recorded on the Range, small patches of this subtle species were found in short, open ground on the crest of coastal slopes at Trevallen Down, St Govan’s Chapel and Bulliber Down. Suspected in the field, but confirmed by dissection of inflorescences.



Figure 6 *Bryum torquescens* at Trevalen Downs

***Cephaloziella stellulifera* ‘Heath Threadwort’ (NT)**

Only conclusively recorded in one location on Mount Sion Down by SDSB. Smooth-gemmaed samples were regularly collected from across the site, but were either not fertile or not pursued. However, determination of fertile samples added five more locations, in coastal turf, dragline gullies and open heathland, and suggested that this species is widespread across the site.

Status: Stable or increasing

***Didymodon icmadophilus* ‘Slender Beardmoss’ (DD)**

SDSB found ‘*Didymodon acutus*’ to be locally abundant in sparsely vegetated ground on the south side of Brownslade Burrows and on the edge of a track across Trevalen Downs. Most British records of *Didymodon acutus* have been reassigned to *Didymodon icmadophilus*, and some trackside samples were

determined by S Pilkington as this during the current survey. The aggregate species is widespread, with numerous new colonies recorded on stony track edges. It occurs in abundance on some tracks, such as those on Bulliber Down near Blockhouse E. Most of these are probably *icmadophilus*, but the Trevalen valley trackside colony is *D. acutus*. A sample from the Mere Pool Valley at Stackpole also proved to be *D. icmadophilus* on re-assessment by the author, and a third county site for the species was found in early 2021 on a shaley forestry track near Mynachlog-ddu.

Status: Stable or increasing



Figure 7 *Didymodon icmadophilus* on track near Winter Pits

***Funaria pulchella* (*Entosthodon pulchellus*) ‘Pretty Cord-moss’ (NT)**

Relocated on the limestone outcrops to the south of Blucks Pool, where SDSB noted several hundred plants in 2008. The population here, between SR8827097003 and SR8899096982, comprises at least 9 patches, many of which were recorded as ‘frequent young shoots’. At the opposite end of the site, a new colony comprising at least 6 small patches was found on soil over limestone ledges on St. Govans Head.

Status: Stable or increasing

***Fossombronia caespitiformis* ssp. *caespitiformis* ‘Spanish Frillwort’ (DD)**

Putative colonies of this sub-species, with rhizoids purple rather than hyaline, were found in dragline gullies on Linney Down and Bulliber Down. There are three other known colonies in south Pembrokeshire (Bosanquet, 2010). The more typically coastal sub-species, *Fossombronia caespitiformis* ssp. *multispira* (*Fossombronia husnotii*) has been included within a ‘coastal habitats’ assemblage, described below.

Status: Unknown, newly discovered

***Gymnostomum viridulum* ‘Luisier’s Tufa-moss’**

This small species is most abundant on the dunes, and forms part of the dune and slack assemblage, described below. It also occurs in disturbed damp ground near Delta Quarry, and in a sparsely vegetated stony ground on Flimston Down. It may have been overlooked elsewhere.

***Microbryum starckeanum* ‘Starke’s Pottia’ (VU)**

In addition to the colonies on the limestone at Blucks Pool, this species grows on the edges of a limestone outcrop at St. Govan’s Head. It will no doubt be more widespread than current records suggest.

Status: Probably stable or increasing

***Pottiopsis caespitosa* ‘Round-fruited Pottia’ (EN)**

Found new to Pembrokeshire in open, stony ground by Blockhouse E. It was subsequently found in several localities on track edges on Flimston Down, on a sheep path across Linney Burrows, and in the quarry above Castle Lady Valley. Elsewhere in Wales, this strong calcicole is only found on the Great Orme.

Status: Unknown, newly discovered



Figure 8 *Pottiopsis caespitosa* location, Flimston Down

ADDITIONAL SPECIES OF INTEREST

***Bryum gemmilucens* ‘Yellow-bud Bryum’ (NT)**

Although Nationally Rare, this species is described in the Atlas as occurring in disturbed soil habitats of varying pH. It was found, new to Wales, in a stony target gully on Flimston Down, but has been excluded from the OCG assemblage as it is not an obligate calcicole (Bosanquet et al 2018 list it as a component species of arable assemblages).

Status: Unknown, newly discovered

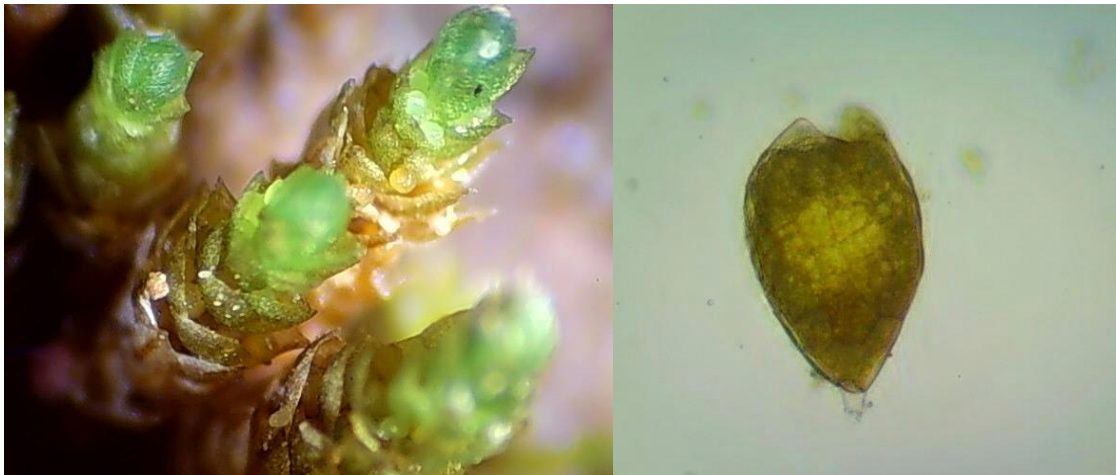


Figure 9 *Bryum gemmilucens* and axillary bulbil

***Brachythecium glareosum* ‘Streaky Feathermoss’**

This locally-rare species was found on the limestone outcrop above Blucks Pool by SDSB; the current survey found it in a second location in open, stony ground near Blockhouse E.

Dicranella howei

Widespread here, as previously noted by Bosanquet (2010), but specifically recorded only on a few occasions. This is soon to be accepted as a British species (Blockeel, pers. comm.) and may be considered Nationally Scarce.

***Ephemerum recurvifolium* ‘Strap-leaved Earthmoss’**

Found, new to Pembrokeshire, in a dragline gully near Pricaston by SDSB, this small, ephemeral species has proven to be more widespread in calcareous ground in the south of the county and is now known from three other sites. The current survey located small patches in open stony ground or soil patches within turf at seven new localities. This moss is no longer classed as Nationally Scarce, but is still very rare in Wales.

Stable or increasing

***Microbryum floerkeanum* ‘Floerke’s Phascum’**

Discovered new to Pembrokeshire by the current survey on the centre of a limestone track at Flimstone Down, alongside *Aloina rigida* and *Pottiopsis caespitosa*. Subsequently found on a stony target gully nearby. Although not Nationally Scarce, it is very rare in Wales (known only from the Gwent Levels and a couple of sites on the north coast). As it is extremely small and only likely to be noticed when fruiting, it may be more widespread on tracks elsewhere on the site.

Status: Unknown, newly discovered

Ephemerum crassinervium* ssp. *sessile was recorded occasionally on patches of clay soil within target gullies, but appears to be more typical of heathland on the site, and has been included only within the Lowland Heathland assemblage. The locally-rare ***Riccia subbifurca*** and ***Tortula protobryoides*** are present in open ground around rocks on coastal slopes. ***Tortula acaulon* var. *papillosa***, a rare variety now recognised as a valid taxon, was found on the south-facing slope of Trevalen valley – this is the first county record.



Figure 10 *Microbryum floerkeanum* and *Pottiopsis caespitosa* track location on Flimston Down



Figure 11 *Microbryum floerkeanum*

6. Qualifying Species of the Lowland Heathland Assemblage



Figure 12 Heath developed over soil-scraped ground on Flimston Down

Bosanquet (2019) commented that “It is uncertain why Welsh heathlands are so relatively poor for *Dicranum* and *Cephaloziella*, or why *Hypnum imponens* is so rare in Wales, but the lowland heathland resources is quite well recorded and the assemblage is unlikely to have been significantly overlooked”. Mynydd Preseli was considered to be the only site in Wales with a qualifying assemblage, scoring 12 points for the Nationally Rare *Fossombronina fimbriata* and the Scarce *Cladopodiella francisci* and *Fossombronina foveolata*.

The current survey revealed the presence of a qualifying Lowland Heathland assemblage on Range West, with the heathlands at Linney Down, Mount Sion Down and Flimston Down holding several rare and scarce species. The component species of the assemblage are as follows:

NATIONALLY RARE

***Cephaloziella dentata* 'Toothed Threadwort' (CR)**

Discovered new to Wales here and at Stackpole. This tiny species was previously only known from the Lizard Peninsula heaths in Cornwall. It is relatively frequent across a small area of Linney Down, and was also found in small quantity in open patches within heath at Flimston Down and Mount Sion Down. It may be more frequent here than the records suggest, but algal growth, saturated ground and sheep trampling made further survey challenging.

Newly discovered, trend unknown



Figure 13 *Cephaloziella dentata* habitat, Linney Down

***Cephaloziella integerrima* ‘Lobed Threadwort’ (EN)**

This was discovered on Range West, where it is occasional on open ground within heath, as well as on stony or clay ground within target gullies as described above. Separation from *C. calyculata* is difficult, and not all samples could be named. However, evidence from the current survey suggests that *calyculata* perhaps favours rocky calcareous turf whilst *integerrima* is more typical of disturbed ground and heathland. They appear to grow in fairly close-proximity on soil-scraped heathland at Trevallen Down though.

Status: Newly discovered, trend unknown



Figure 14 *Cephaloziella integerrima* habitat, Mount Sion Down

NATIONALLY SCARCE

***Acaulon muticum* 'Rounded Pygmy-moss' (VU)**

Although not listed by Pescott (2018), this species is included by Bosanquet, Genney and Cox (2018) as a Nationally Scarce member of the Lowland Heathland assemblage. It was found in anthills in heaths on Mount Sion Down, Linney Down and near Winter Pits.

Status: Newly discovered, trend unknown

***Cephaloziella rubella* 'Red Threadwort' (DD)**

A single *Cephaloziella* sample, from open heath between target line cables on Mount Sion Down, was determined as this species by Nick Hodgetts. There are no other records from the county.

Status: Newly discovered, trend unknown

***Cephaloziella stellulifera* 'Heath Threadwort' (NT)**

This species was found on wet heath on Linney Down, as well as within Open Calcareous Grassland as described above.

Status: Stable or increasing

***Ephemerum crassinervium* ssp. *sessile* (*E. sessile*) 'Sessile Earthmoss' (DD)**

Scattered shoots of this tiny species were found in several heathland locations, on Linney Down and Mount Sion Down, as well as on soil patches on grassy tracks and within target gullies. It was recorded in more locations than by Bosanquet (2008), and the frequency of suitable micro-habitats means that it will be more widespread than records suggest.

Status: Stable or increasing



Figure 15: Typical *Ephemerum crassinervium* ssp. *sessile* location on Mount Sion Down

***Fossombronina foveolata* ‘Pitted Frillwort’ (VU)**

Previously only known from a handful of sites in the north of the county, this scarce species was found in a seasonally wet area of scraped heath on the northern part of Flimston Down. It is perhaps rather rare here, although further searches of the area where it was sampled from were curtailed by high water levels and sheep trampling.

ADDITIONAL SPECIES OF INTEREST

Acaulon mediterraneum, found in heathland on Linney Head, has been included within a Coastal Habitats assemblage. ***Cephaloziella calyculata*** has been included within the Open Calcareous Grassland assemblage, but does

also occur within open heath or soil patches in grassy heath, for example at Trevallen Down.

Campylopus brevipilus is among the more widespread species having, at the county level, notably disjunct populations on the heathland here. Other such species include ***Enthostodon obtusus***, ***Nardia scalaris*** and ***Gymnocolea inflata***. ***Ephemerum serratum*** is typical of pool and reservoir margins in the north of the county, and is occasional on pool edges and wet heath on Linney Down and elsewhere.



Figure 16 *Ephemerum serratum* and *Enthostodon obtusus* grow by this pool on Linney Down

7. Qualifying Species of the Coastal Habitats Assemblage



Figure 17 Shelling produces localised disturbance on some coastal sections

The discovery of *Acaulon mediterraneum* near Linney Head and *Fossombronia maritima* on the coastal belt at Mount Sion Down raises the profile of the coastal vegetation at Castlemartin Range. Although not previously considered for a **Coastal Habitats** assemblage (Bosanquet, 2019), the presence of these two Nationally Rare species, and the Nationally Scarce *Tortula atrovirens*, *Fossombronia caespitiformis* ssp. *multispira* and *Riccia beyrichiana*, is sufficient to characterise a new qualifying assemblage. The component species of the assemblage are as follows:

NATIONALLY RARE

***Acaulon mediterraneum* ‘Spiny-spored Pigmy-moss’ (DD)**

Small patches were found on the lips of two craters in heath near Linney Head. This species, only identifiable with ripe capsules, was not recorded in Wales when selection guidelines were produced by Bosanquet (2019). It has recently been found by the author at two other Pembrokeshire headlands (Marloes Deer Park and St David’s Head) and on the coast in Ceredigion, near Llanrhystud; also by Tom Ottley at Llangrannog.

Status: Newly discovered, trend unknown



Figure 18 *Acaulon mediterraneum* location on edge of crater in foreground

***Fossombronia maritima* 'Sea Frillwort' (VU)**

Found in small quantity in a gully on the southern, coastal part of Mount Sion Down. Not readily identifiable without capsules, and potentially elsewhere in open coastal heath.

Status: Newly discovered, trend unknown

NATIONALLY SCARCE

***Riccia beyrichiana* 'Purple Crystalwort' (VU)**

This Nationally Scarce liverwort is included within the 'coastal' and 'lowland heathland' assemblages in Bosanquet (2019). Previously known from Stackpole but not Castlemartin Range, a small population of this species was found by the present survey on thin soil over limestone outcrops on St. Govan's Head.

Unknown, newly discovered



Figure 19 *Riccia beyrichiana* on St Govan's Head

***Fossombronia caespitiformis* ‘Spanish Frillwort’ (DD)**

Subspecies *multispira*, formerly known as *F. husnotii*, is apparently the more coastal of the two sub-species, and is locally frequent here on rocky slopes at Trevallen and St. Govan’s. It was also recorded near the Stack Rocks car-park, and on heaths away from the cliffs. The form with purple rather than hyaline rhizoids, referred to subspecies *caespitiformis*, was typically found on target gullies, but also occurred above rocks on St Govan’s Head, a location more characteristic of *multispira*.

Status: Stable



Figure 20 *Fossombronia caespitiformis* ssp. *caespitiformis* location, St Govan's Head

***Tortula atrovirens* ‘Rib-leaf Moss’ (VU)**

Found in small quantity on limestone cliff tops in at least six places by SDSB, and again in six places during the current survey.

Status: Stable

ADDITIONAL SPECIES OF INTEREST

Amblystegium serpens* var. *salinum and ***Tortula viridifolia***, are frequent along the cliffs, particularly in more exposed locations. There are good populations of the Nationally Scarce ***Microbryum starckeanum*** on coastal slopes at St Govan’s Head and Bluck’s Pool, but this species has been included in the OCG assemblage. The locally-rare ***Scleropodium touretii*** is in short turf above rocky slopes in a few places, and ***Tortula lanceola*** is rare on cliffs at St Govan’s Head.



Figure 21 Typical *Tortula viridifolia* location, Pen-y-holt Bay

8. Qualifying Species of the Dune and Slack Assemblage



Figure 22 The yellow-green of *Pleurochaete squarrosa* on Brownslade Burrows

Although not the focus of the current survey, part of the extensive dune system of Brownslade and Linney Burrows was visited. Survey effort concentrated on the damper areas on the eastern side of Brownslade, and on thin sand over rock on Linney Burrows. The species of the dune and slack assemblage are as follows:

NATIONALLY SCARCE

***Petalophyllum ralfsii* 'Petalwort' (VU)**

Brownslade is known to have one of the largest populations in Wales, but this species had not been seen recently on Linney Burrows. A handful of thalli were located here during the present survey, but no attempt was made to survey populations elsewhere.

***Pleurochaete squarrosa* ‘Side-fruited Crisp-moss’**

Only very locally abundant on Brownslade and Linney Burrows, on droughted turf around rock outcrops or on dune ridges.

***Gymnostomum viridulum* ‘Luisier’s Tufa-moss’**

Locally-frequent on damp sand in both Linney and Brownslade Burrows, and also in a limestone rock crevice on the latter site. The largest population in the county.

***Didymodon acutus* sensu lato ‘Pointed Beardmoss’ (DD)**

Although more abundant as a member of the OCG assemblage on track edges, one of this species pair is present in several places on Brownslade Burrows, around rocks, pools, track edges and on stony turf. No samples were retained during the survey, but belated assessment (using Jimenez, 2006) of specimens from nearby Broomhill Burrows SSSI and on the warren at Stackpole NNR found these to be *D. acutus* sensu stricto, suggesting that this rarer species is likely to be the one on the dunes here.

ADDITIONAL SPECIES OF INTEREST

The Nationally Scarce ***Pottiopsis caespitosa*** was found in two locations on Linney Burrows, on sheep-paths across damp sand and open turf over broken rock. It is not listed as a dune assemblage species in Bosanquet (2019). The locally-rare ***Didymodon ferrugineus*** grows on damp, compacted sand on the east side of Brownslade Burrows with a ***Distichium***, non-fertile but most resembling ***D. capillaceum*** (not currently known from the county).

9. Qualifying Species of the Lowland Calcareous Rock Assemblage



Figure 23 *Plasteurhynchium striatulum* is on shaded boulders in Castle Lady Valley

Although not the focus of the current survey, some of the limestone outcrops within Castle Lady Valley were visited briefly. Outcrops on the eastern side of St Govan's Head, and the south side of the valley at Trevallen, also hold saxicolous species. The species of the lowland calcareous rock assemblage are as follows:

NATIONALLY SCARCE

***Amblystegium confervoides* 'Tiny Feathermoss'**

A few wisps of this diminutive species were found amongst larger pleurocarpous mosses at the base of a crag on the north-facing Trevallen slope. Found new to the county the previous week by the author at Yerboston Tops SAC.

***Plasteurhynchium striatulum* ‘Lesser Striated Feathermoss’**

Two locations were added to the populations previously found at Mount Sion Covert by SDSB - on shaded outcrops at Slade, and in small quantity on the north-facing slope at Trevallen.



Figure 24 *Amblystegium confervoides* occurs with *Plasteurhynchium striatulum* in the valley at Trevallen Downs, on the left-hand side of this crag

***Platydictya jungermannioides* ‘Spruce’s Leskea’**

This tiny pleurocarpous moss was found, new to Pembrokeshire, in two recesses on crags on St Govan’s Head, and under a boulder nearby. It was also found at the base of a worked limestone face in the old quarry near Pricaston.

ADDITIONAL SPECIES OF INTEREST

The locally-rare *Leptobarbula berica* is still in a single small patch in Pricaston Quarry, where found by SDSB in 2008. *Plagiochila britannica*, not known from elsewhere in the county, was found in an additional location on rock, near to where SDSB found it on a tree base in Mount Sion Covert. A probable shoot of this species was also collected from the limestone ridge south of Bluck's Pool. *Neckera crispa*, a distinctive species locally abundant on the north-facing rocks and scree in the valley at Trevallen, is uncommon elsewhere in the county. *Porella platyphylla* is also on low rocks at the top of the ridge in Trevallen Valley.



Figure 25 *Leptobarbula berica* with the large liverwort *Lunularia cruciata*

10. Revised Assemblage Scores and Qualifying SSSI Features

Based on the presence of Nationally Scarce or Rare species belonging to an 'ecologically coherent' assemblage, Castlemartin Range SSSI previously scored 24 for its **Open Calcareous Grassland** assemblage (Bosanquet, 2019). The addition of all of the newly recorded species described above would give a new score of **51**, making the site the second most important in Wales for this assemblage, behind Stackpole with 66 (following further additions since Sutton, 2019). Lydstep Head to Tenby Burrows SSSI scores 39 with recent finds.

The newly described **Lowland Heathland** assemblage scores **27**, making it clearly the most significant site in Wales for this assemblage.

The newly described **Coastal Habitats** assemblage scores **21**. This places it as the third most important site in Wales, behind Ynys Enlli (with 33) and the St David's Peninsula Coast (which now scores 27 with recent discoveries by the author). There is some overlap with the OCG assemblage through the *Fossombronia caespitiformis* and the *Riccia beyrichiana* which have provisionally been assigned to both.

The score for the **Dune and Slack** assemblage at Castlemartin Cliffs and Dunes SSSI still stands at **12**, which is the threshold score for qualification. This is lower than the recently revised score for Stackpole, which now stands at 15 (Sutton, 2019), although could increase to 15 if *Didymodon acutus* s.s. is sampled and confirmed (this species may be considered an independently qualifying species). No additional assemblage species have been recorded during the current survey, unless the Nationally Scarce *Pottiopsis caespitosa* were to be

included here as well as in the OCG assemblage. Although primarily a chalk grassland species, it has previously been recorded on calcareous sand in north Cornwall (Blockeel et al, 2014).

The Lowland Calcareous Rock assemblage scores **12** points, which meets the threshold for qualification. This places it joint ninth in terms of its Welsh importance, and amongst other sites which have not been selected for this assemblage (Bosanquet, 2019). Some overlap between this and the OCG assemblage is noted, and it could be argued that, at Castlemartin, *Enthostodon pulchellus* is better placed in the former. Like *Platydictya jungermanniioides*, it grows on a thin layer of soil over rock ledges. Further survey could reveal additional species, such as *Cololejeunea rosettiana* which is present at Stackpole.



Figure 26 *Enthostodon pulchellus* on soil over limestone ledge, St. Govan's Head

The Nationally Rare 'Toothed Threadwort' *Cephaloziella dentata*, should be considered to be an independently qualifying feature – this is the only known population in Wales of a 'Critically Rare' Red-listed species.

The Nationally Rare 'Lobed Threadwort' *Cephaloziella integerrima*, 'Endangered' on the Red-list, clearly has a larger population here than its other known site by an industrial estate in Glamorgan, and also independently qualifies.

The Nationally Rare 'Entire Threadwort' *Cephaloziella calyculata*, 'Endangered' on the Red-list, has a larger population here than at Stackpole. Both populations are larger than at the other Welsh sites - on Gower; in the Southern Down Coast SSSI in Glamorgan, and at Ynys Lochtyn in the Aberath – Carreg Wylan SSSI, Ceredigion. This species also independently qualifies, and is already notified.

The large population of 'Petalwort' *Petalophyllum ralfsii* independently qualifies and is already notified.

11. Monitoring and Condition Assessment



Heathland on Mount Sion Down near Blockhouse N: (top) Optimal open ground for *Cephaloziellas*; (bottom-left) Sub-optimal for *Cephaloziellas* as too open; (bottom-right) Unsuitable for *Cephaloziellas* as too closed.

Common Standards Monitoring guidance (JNCC, 2005) indicates that monitoring of bryophyte assemblages can be carried out based on an assessment of the habitat (indirect monitoring) or of the key bryophyte species (direct monitoring).

Although indirect monitoring could be carried out by a non-specialist, the focus on a few simple structural attributes would not give an accurate monitoring result. Changes in frequency and distribution of species due, for example, to climate change would not necessarily be noticed. However, it could serve to highlight or bring forward a need for direct monitoring. For example, generic indirect monitoring protocols for the Open Calcareous Grassland assemblage suggest that three attributes should be assessed:

Attributes	Targets	Method of Assessment	Comments
Niche Availability	Sufficient area of suitable habitat to maintain populations. 10-25% sparsely vegetated / bare ground within defined areas	Mapping / Visual Assessment	Broadly applicable to 'important bryo-zones' defined below
Vegetation Structure	Turf height <2cm over at least 50% of the area supporting the feature	Mapping / Measurement	Broadly applicable to 'important bryo-zones' defined below
Niche Diversity	Anthills, slippages on slopes, trampled areas to be maintained	Comparison with photos or sketch maps	

A combination of Indirect and Direct monitoring of the qualifying assemblages and species at Castlemartin Range SSSI is recommended. A competent specialist will be required to carry out the work, as many of the component species are small, subtle and difficult to identify. At its simplest, this would involve re-finding the species listed as key for monitoring at some or all of the important bryo-zones described in the following chapter, together with a

comparison of current and previous abundance. There should be no loss of assemblage species from the site as a whole.

Results from the present survey confirmed the continued presence of all of the OCG assemblage species on the site, and numerous new localities for these species were found. Several more species were added to the assemblage. All populations of key species appear to be stable or increasing, although datasets are not directly comparable due to the additional time and geographical coverage achieved by the present survey.

The newly defined Lowland Heathland, Coastal Habitats and Dune and Slack assemblage species were confirmed and appear likely to have stable populations. It provisionally appears that **all bryophyte assemblages at Castlemartin Range SSSI are currently in favourable condition.**



Figure 27 *Bryum kunzei* and *B. torquescens* grow in this optimal condition habitat

12. Important 'Bryo-Zones'

Bosanquet (2008) discussed some key habitats and species for open-country bryophyte conservation, but his survey of the Range was based on limited coverage. Following the more complete coverage provided by the current survey, and with the refined approach to defining assemblages provided by Bosanquet (2019), the following 'bryo-zones' are mapped. Lowland Heathland (LH), Open Calcareous Ground (OCG), Dune and Slack (DS) and Lowland Calcareous Rock (LCR) assemblages are considered separately. Each area has been scored and ranked according to its total of assemblage species, with locations scoring 6 or more points included (ie. at least one Nationally Rare, or two Nationally Scarce assemblage species). Descriptions for each are provided in Appendix 1.

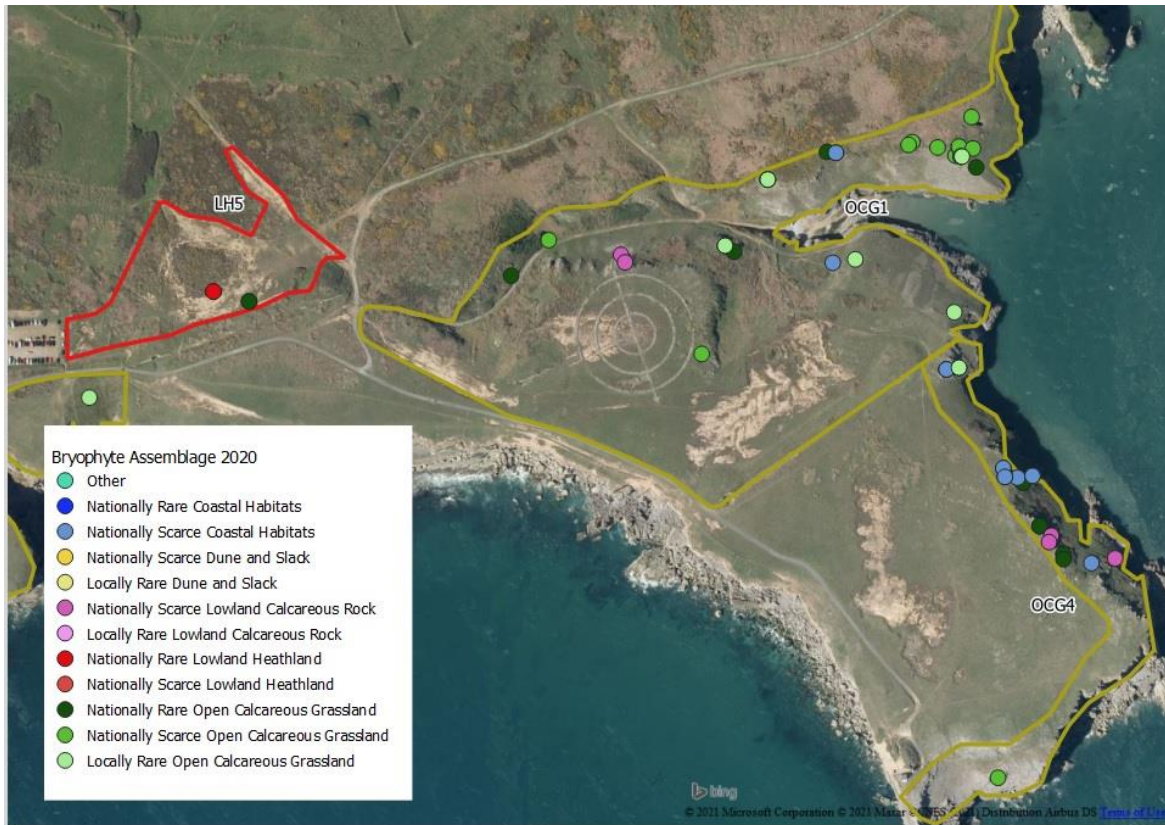


Figure 28 Important 'Bryo-zones' at Castle Martin Range East: OCG1 Trevallen Downs; OCG4 St. Govan's Head; LH5 Trevallen Heathland

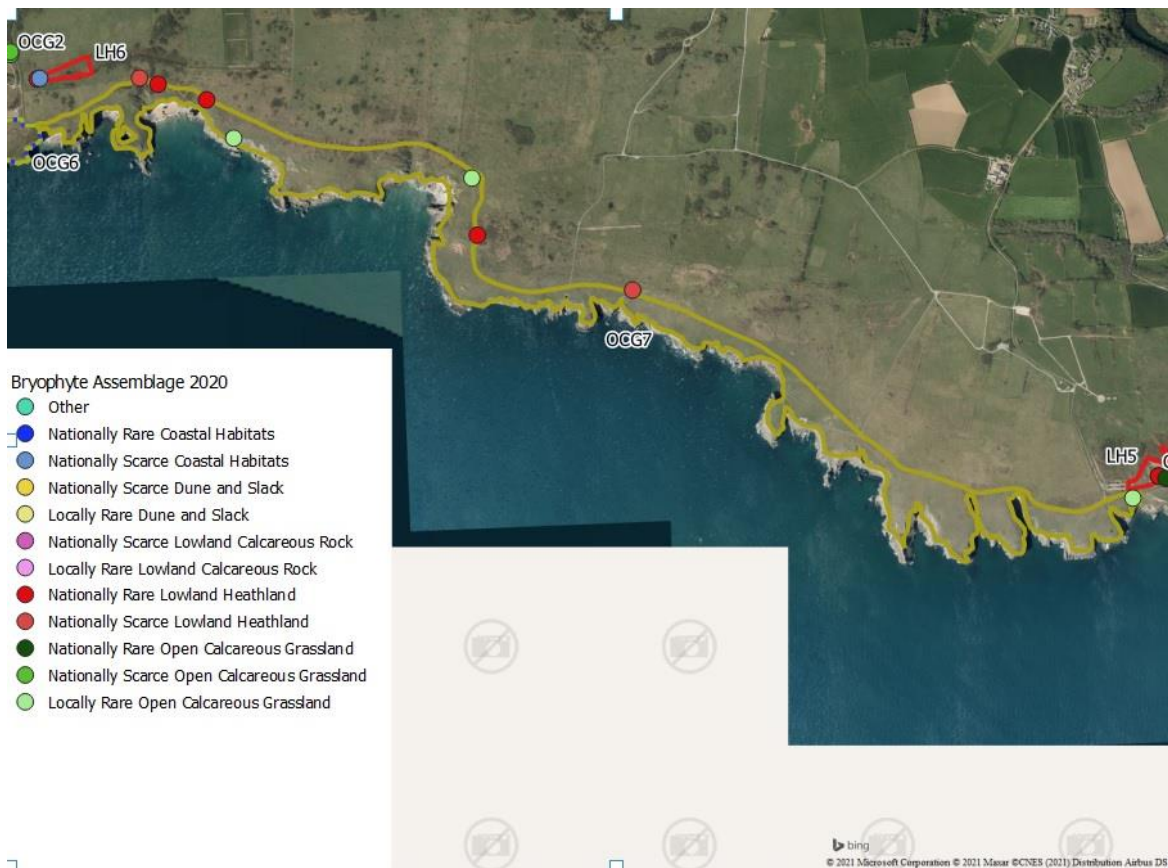


Figure 29 'Important Bryo-zones' at Castle Martin Range East: OCG6 Southern Cliffs in Range East: Stack Rocks to St. Govan's

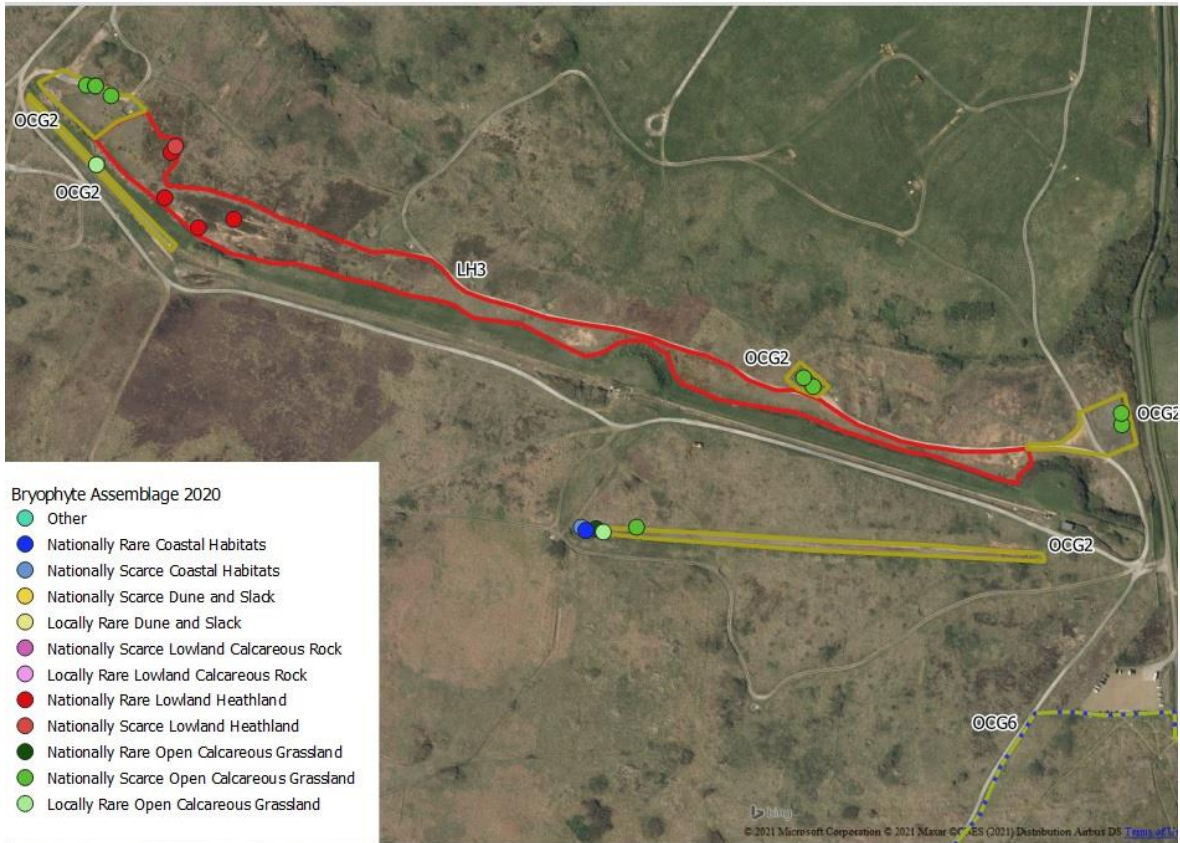


Figure 30 'Important Bryo-zones' at Castlemartin Range West: OCG2 Flimston Down Target Gullies and Track; LH3 Flimston Down heathland

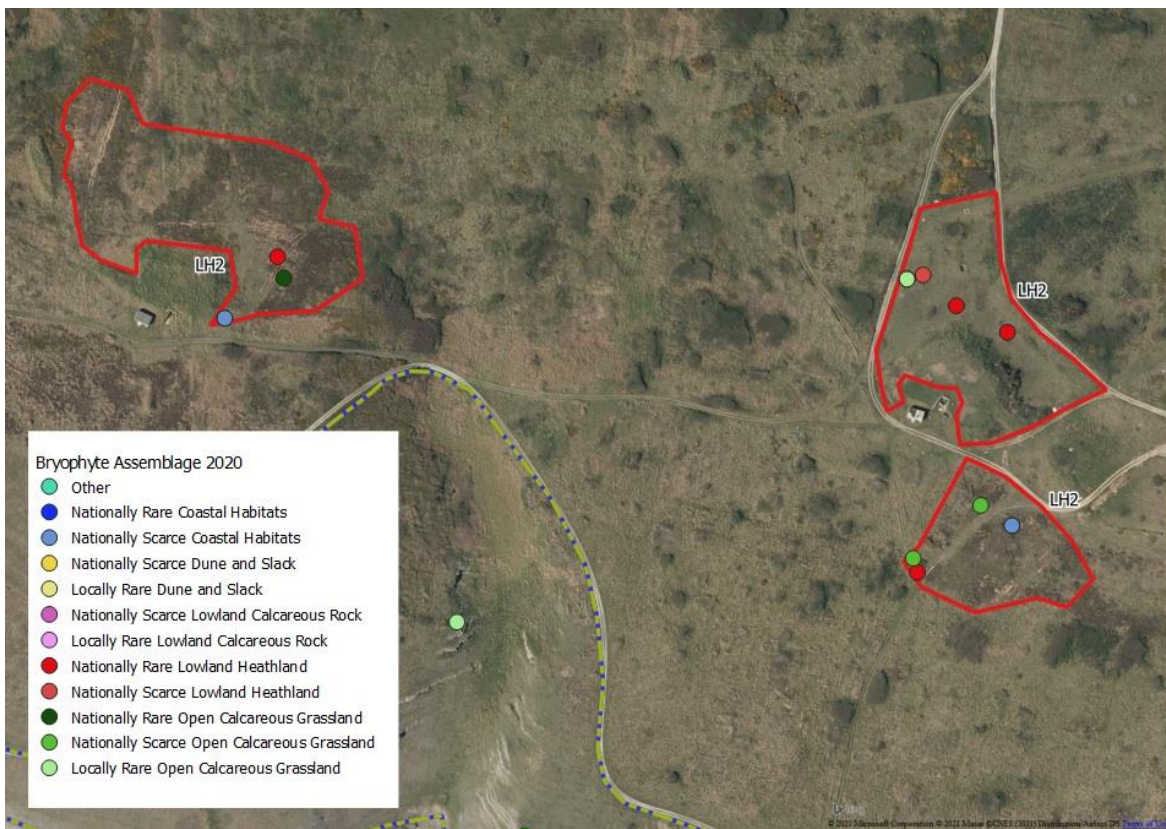


Figure 31 'Important Bryo-zones' at Castlemartin Range West: LH2 Mount Sion Down heathland

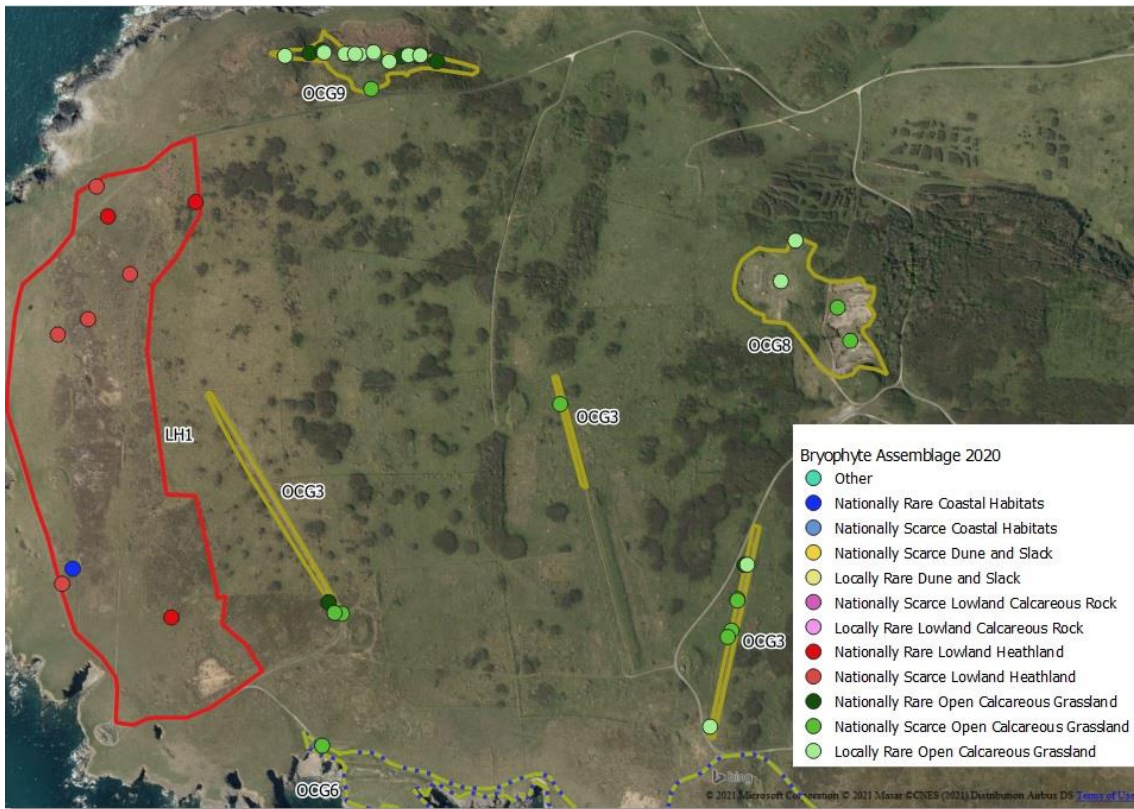


Figure 32 'Important Bryo-zones' at Castle Martin Range West: LH1 Linney Down heathland; OCG3 Linney Down - Pen-y-Holt Down - Bulliber Down Target Gullies; OCG8 Delta Quarry

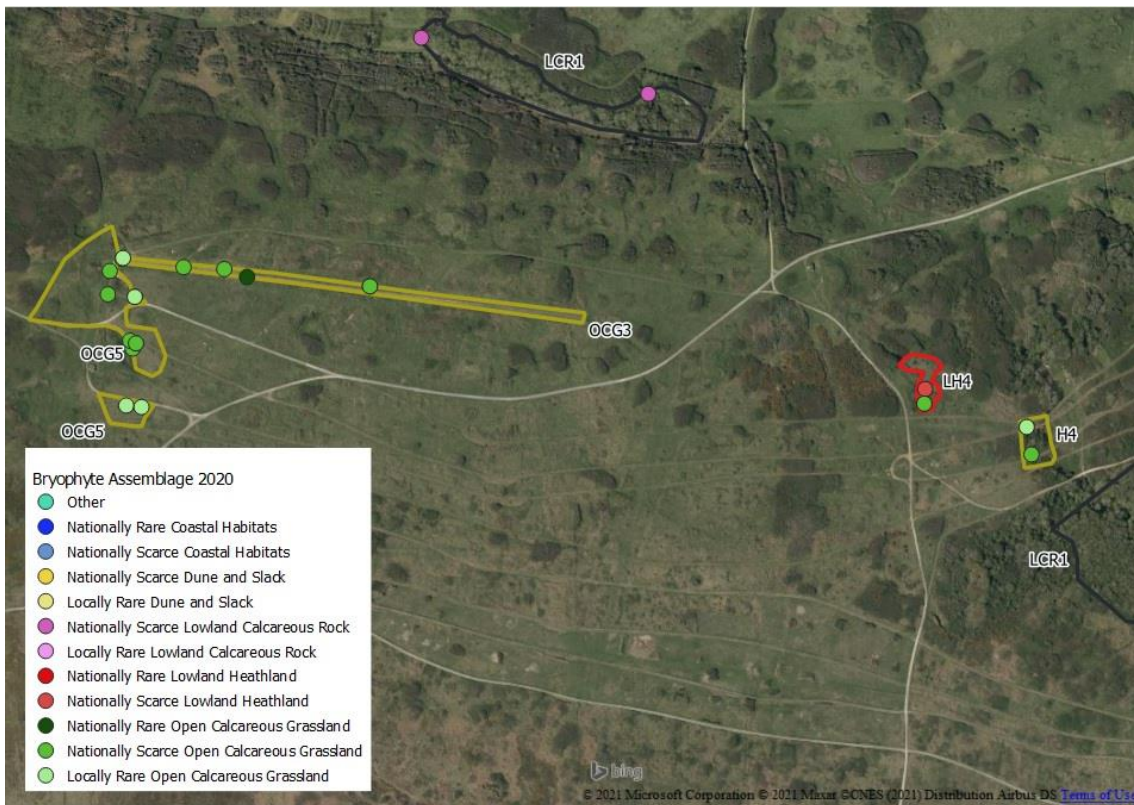


Figure 33 'Important Bryo-zones' at Castle Martin Range West: LH4 West of Winter Pits (heathland); OCG3 Linney Down - Pen-y-Holt Down - Bulliber Down Target Gullies; OCG5 Blockhouse E; LCR1 Castle Lady Valley, Mount Sion Covert and Pricaston Quarry

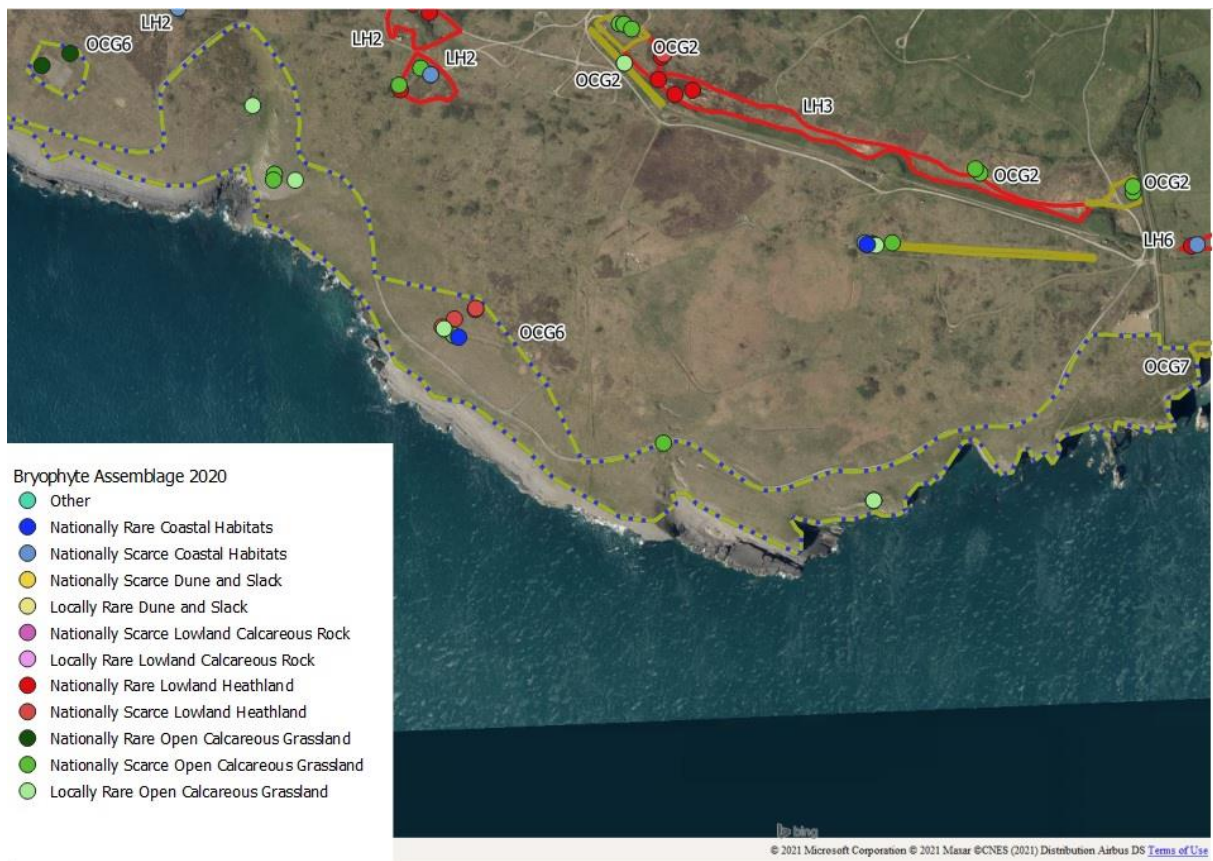


Figure 34 'Important Bryo-zones' at Castlemartin Range West: OCG6 Southern Cliffs in Range West – Linney Head to Stack Rocks; OCG2 Flimston Down Target Gullies and Track; OCG3 Linney Down – Pen-y-Holt Down – Bulliber Down Target Gullies; OCG5 Blockhouse E; LH2 Mount Sion Down heathland; LH3 Flimston Down heathland; LH4 West of Winter Pits; LCR1 Castle Lady Valley, Mount Sion Covert and Pricaston Quarry

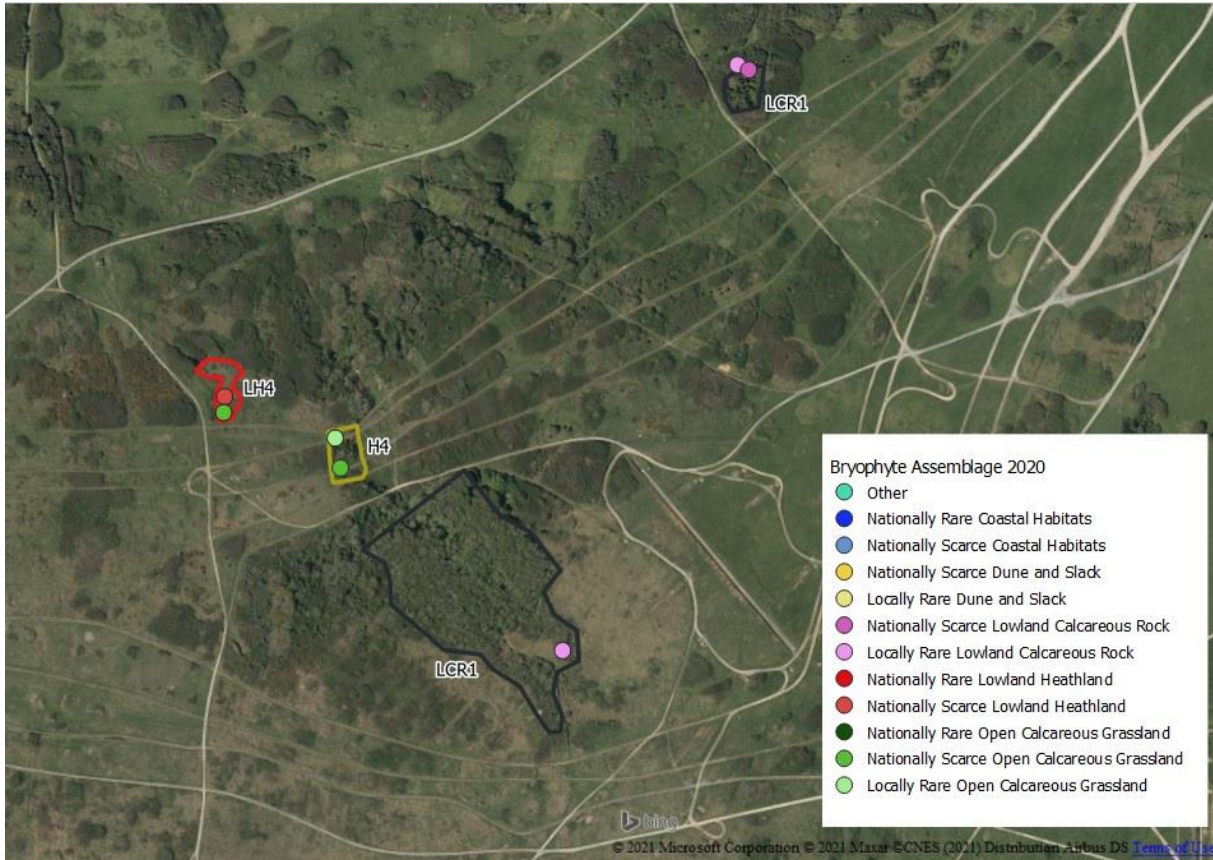


Figure 35 'Important Bryo-zones' at Castlemartin Range West: LH4 West of Winter Pits (tracksides); LCR1 Castle Lady Valley, Mount Sion Covert and Pricaston Quarry

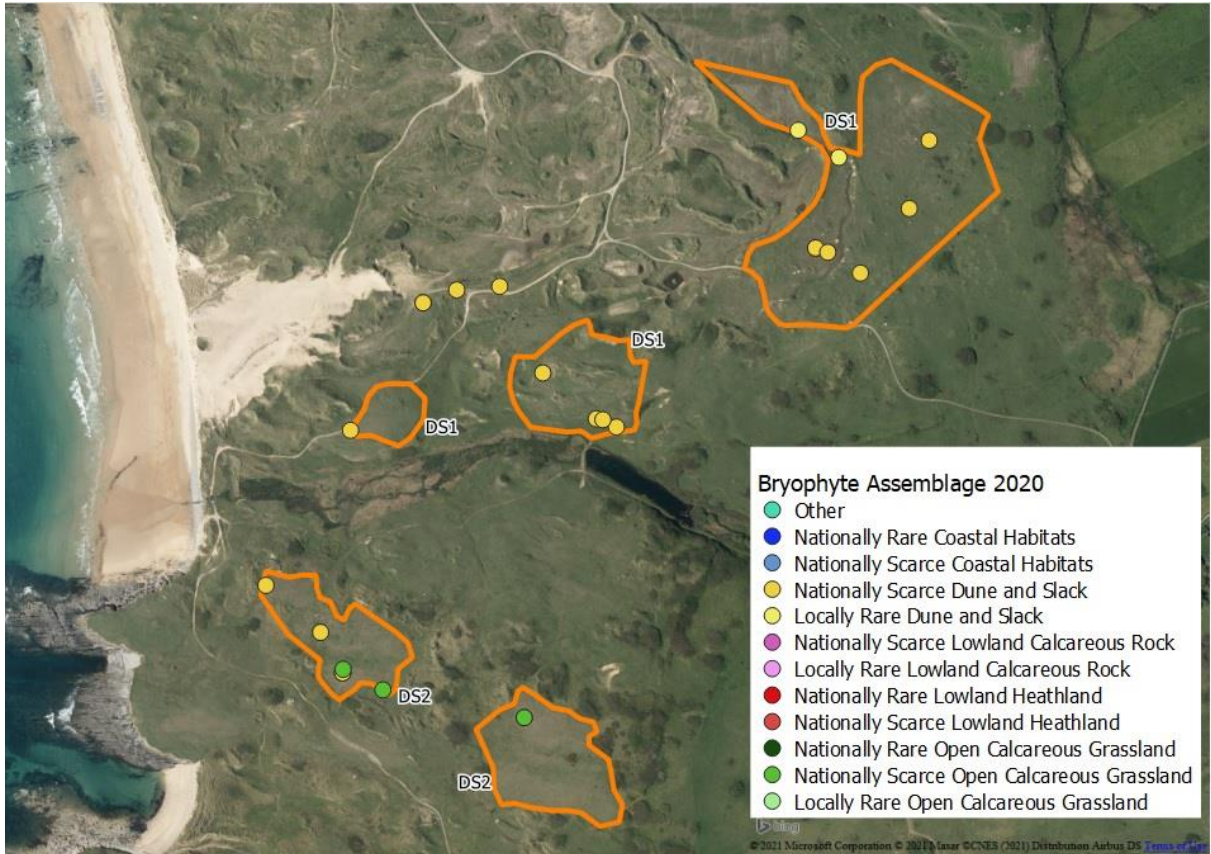


Figure 36 'Important Bryo-zones' at Castlemartin Range West: DS1 Brownslade Burrows; DS2 Linney Burrows (based on partial survey only)

13. Five Management Actions for Bryophytes

1. Partial mowing of blackthorn from base of limestone outcrop south of Bluck's Pool, with *Funaria pulchella*. Moderate works.
2. Removal of gorse from base of target gully on Flimston Down at SR92079481. Minor works.
3. Partial clearance of scrub from around outcrops in Trevallen valley. Moderate or major works.
4. Hard mowing / scalping or scraping of firebreaks or other rank heath areas on Bulliber Down. Major works.
5. Encourage new disturbance eg. gully creation, soil scraping and mound or embankment formation, or unsurfaced track creation, across rank vegetation in Bulliber Down, Mount Sion Down or southern half of Flimston Down. Major works.



Figure 37 clockwise from top-left, locations for Action 2; Action 4, Action 1, Action 5

14. Acknowledgements

Many thanks to Tom Blockeel, Nick Hodgetts, Sharon Pilkington and particularly to Tom Ottley for assisting with specimen determination. Thanks to Paul Culyer and Sam Bosanquet at NRW for their support, and to Range staff for generous access.

15. References

Blockeel, TL, Bosanquet, SDS, Hill, MO & Preston, CD (eds). (2014). *Atlas of British and Irish Bryophytes*. Pisces Publications.

Bosanquet, SDS. (2008). *A Survey and Condition Assessment of the Bryophytes of Castlemartin Range (part of the Limestone Coast of South Wales SAC)*. CCW Staff Science report no. 08/3/1.

Bosanquet, SDS. (2010). *The Mosses and Liverworts of Pembrokeshire*. Privately Published, Dingestow.

Bosanquet, SDS.(2011). *Vice-county bryophyte rarity lists*. Unpublished CCW report.

Bosanquet, SDS. (2019). *A review of non-vascular plant and fungal SSSI features in Wales – Bryophytes*. NRW Evidence Report 368.

Bosanquet, S.D.S., Genney, D.R. and Cox, J.H.S. (2018). *Guidelines for the Selection of Biological SSSIs. Part 2: Detailed Guidelines for Habitats and Species Groups. Chapter 12 Bryophytes*. Joint Nature Conservation Committee, Peterborough.

Callaghan, D.A. and Hodgetts, N.G. In prep. *The Red List of British bryophytes*. Unpublished report for Natural England.

Jimenez, J.A (2006) *Taxonomic Revision of the Genus Didymodon in Europe, North Africa, and South-West and Central Asia*. Journal Hattori Botanical Laboratory 100; 211-292

JNCC. 2005. *CSM Guidance for Bryophytes and Lichens*.

Pescott, O. (2016). *Revised lists of nationally rare and scarce bryophytes for Britain*. Field Bryology 115: 22-30.

Sutton, MD. (2020). *Bryophyte Survey and Monitoring at Stackpole NNR December 2019 / January 2020*. NRW Evidence Report No: 414, 49 pp, Natural Resources Wales, Bangor

Wilkinson, K (2011, 2018) *Survey / Monitoring of Petalophyllum ralfsii at Brownslade Burrows and Linney Burrows*. NRW unpublished filenotes.

Appendix 1: Important 'Bryo-zones'

LH1: Linney Down heathland



(left) Pool in heath, with *Ephemerum serratum*; (right) *Cephaloziella dentata* location

Description: The exposed heathland on Linney Down is dominated by heather, on shallow peat or dark humic soil over clay. An area on the northern side where peat has been scraped off towards the nearby blockhouse shelter has *Cephaloziella dentata* in its key location in Wales. Exposed clay in a small area of open heath on the east side has some *Cephaloziella integerrima*. *Cephaloziella stellulifera* is also present, but much of the sampled *Cephaloziella* appears to be the common *Cephaloziella divaricata*. *Acaulon mediterraneum* was found new to the site on the edge of a bomb crater. *Ephemerum crassinervium* ssp. *sessile* was found in three locations, on disturbed soil on anthills and in a gateway. Pool edges and areas of wet heath have *Ephemerum serratum*, *Drepanocladus polygamus*, and disjunct populations of *Campylopus brevipilus*, *Entosthodon obtusus*, *Gymnocolea inflata* and *Scapania irrigua*.

Total Assemblage Score: Lowland Heathland 24.

Key species for monitoring: *Cephaloziella dentata*, *Acaulon mediterraneum*, *Ephemerum crassinervium* ssp. *sessile*.

Current Condition: Favourable Maintained

Basis of Condition Assessment: The area has not been surveyed before, so no baseline information is available for any of the component species of the assemblage. The rare *Cephaloziella* species are associated with bare or sparsely vegetated clay within dry heath, whilst the *Acaulon mediterraneum* was found with *Ephemerum serratum* on the clay lip of a small crater. Current levels of military activity and sheep grazing appear suitable for these species.

Further Survey Requirements: Further pool edge species could be sought when water levels are lower in the summer.

Threats: The *Cephaloziella dentata* appears to be restricted to a fairly small area, and could be vulnerable to excessive disturbance or successional processes here. *Campylopus introflexus* is rare here, but could spread (for example following burning) and threaten key species.

Management Actions Required: Maintain recent grazing levels. Avoid burning wet heath areas, but maintain tank disturbance and shelling.

LH2: Mount Sion Down heathland



(left) *Cephaloziella integerrima* location on track; (right) *Cephaloziella calyculata* is in open heathland north of the Blockhouse here

Description: The largest area of heathland on the site lies south of the east – west track across Mount Sion Down. Much of this is bryophyte-poor mature heath, but some areas have runnels of sparsely vegetated ground. Tracksides and areas disturbed by tanks also provide micro-habitats for the rare liverworts which characterise most of the heathland bryophyte assemblage. *Cephaloziella dentata* was found here, and *Cephaloziella rubella* was recorded - new to the county - from one area of open, heathy ground under target cables. *Cephaloziella integerrima* was found at the same location, and in two other patches of open heath and track. *Cephaloziella calyculata* was only conclusively recorded from one patch of open heath. Open heath also supports several patches of *Ephemerum crassinervium* ssp. *sessile*. Both sub-species of *Fossombronia caespitifformis* are present. Disjunct populations of other heath species such as *Nardia scalaris*, *Scapania compacta* and *Enthostodon obtusus* occur, whilst anthills within the heath have local species such as *Riccia subbifurca*, *Acaulon muticum* and *Ephemerum serratum*. *Didymodon acutus* is on a stony track edge here, and the locally rare *Weissia longifolia* in a target gully.

Total Assemblage Score: Lowland Heathland 33.

Key species for monitoring: *Cephaloziellas* (indirect monitoring)

Current Condition: Unfavourable?

Basis of Condition Assessment: No baseline survey information exists. Available aerial photography datasets do not allow an assessment of change in open ground distribution. Prior to the establishment of the Range, there may have been little disturbance under livestock grazing only. However, given the current limited areas of suitable open ground as a proportion of the overall heathland resource, it seems appropriate to frame an objective which encourages further disturbance and open ground creation.

Further Survey Requirements: Extent of *Cephaloziella dentata* population.

Threats: Under-grazing. Excessive burning. Open areas are often associated with past soil removal around Blockhouses, and will be prone to successional changes.

Management Actions Required: Encourage new ground disturbance to expose clay where appropriate and compatible with other objectives. Harder mowing and ‘scalping’ of firebreaks here and on Bulliber Down, if practical, would potentially increase bryophyte habitat. Maintain or increase recent levels of grazing.

LH3: Flimston Down heathland



(left) Heathland over scraped clay soil; (right) *Cephaloziella calyculata* or *integerrima* location in open heath

Description: The key area of heathland at Flimston Down lies along the northern edge, where topsoil has previously been scraped off to form a long embankment with associated mounds. The early successional heath here contrasts with the rank heath to the south, and the sparsely-vegetated clay patches within it support *Cephaloziella dentata*, *C. integerrima* and possibly also *C. calyculata*. The scarce *Fossombronina foveolata* was found in damp ground here. Elsewhere, there are also disjunct populations of *Calypogeia muelleriana*, *Enthostodon obtusus* and *Weissia controversa* var. *densifolia*, the latter on contaminated ground within the rank heath.

Total Assemblage Score: Lowland Heathland 15 (or 21 if *C. calyculata* present)

Key species for monitoring: *Cephaloziellas* (indirect monitoring)

Current Condition: Unfavourable

Basis of Condition Assessment: The *Cephaloziella dentata* was not relocated following initial collection, so no assessment of the population size is currently possible. It is probably in small quantity. *Cephaloziella integerrima* (and perhaps also *C. calyculata*) is present in at least four locations within the northern heathland strip. However, as at Mount Sion Down, the ratio of suitable habitat to unsuitable habitat is low,

Further Survey Requirements: Re-location and full assessment of the *Cephaloziella dentata* would be advisable – this should be done in autumn before sheep disturbance, algal growth and high water levels make survey difficult.

Threats: No new ground is being exposed to ensure a continuation of early-successional stage heathland. The existing open heathland would be vulnerable to successional processes under reduced grazing. Burning has taken place recently – no rare species were found in the initial regrowth, and it is uncertain whether they will colonise or whether more competitive species such as *Campylopus introflexus* could increase instead.

Management Actions Required: Maintain or increase recent levels of grazing. Encourage new ground disturbance to expose clay where appropriate and compatible with other objectives. Harder mowing and ‘scalping’ of firebreaks here, if practical, would potentially increase bryophyte habitat.

LH4: West of Winter Pits



(left) Heathland area west of Winter Pits; (right) track near Winter Pits

Description: Parallel tracks have locally abundant *Didymodon icmadophilus*, and some *Ephemerum recurvifolium* in grassland alongside. There is a small area of heathland, with some *Cephaloziella integerrima* or *calyculata*, and a few patches of the locally uncommon *Calliergonella lindbergii*.

Total Assemblage Score: Lowland Heathland 6 (Open Calcareous Grassland 3)

Key species for monitoring: *Cephaloziellas* (indirect monitoring)

Current Condition: Unfavourable

Basis of Condition Assessment: The *Cephaloziella* was present in small quantity, threatened by gorse scrub, and the ratio of suitable habitat to unsuitable habitat is low.

Further Survey Requirements: None.

Threats: No new ground is being exposed to ensure a continuation of early-successional stage heathland. The existing open heathland is vulnerable to successional processes.

Management Actions Required: Maintain or increase recent levels of grazing. Encourage new ground disturbance to expose clay where appropriate and compatible with other objectives. Track populations of *Didymodon acutus* are well-maintained by vehicle disturbance.

LH5: Trevallen heathland



(left) Heathland in stone rings to the south of Trevallen Down; (right) scraped heath to the east of St Govan's car park

Description: The scraped area of heathland to the east of the St Govan's car-park has some *Cephaloziella integerrima*, and a non-fertile *Fossombronia* with purple rhizoids, potentially *F. caespitiformis* ssp. *caespitiformis*.

Total Assemblage Score: Lowland Heathland 6 or 9

Key species for monitoring: *Cephaloziellas* (indirect monitoring)

Current Condition: Unfavourable

Basis of Condition Assessment: The *Cephaloziella* was present in small quantity in the northern area, threatened by gorse scrub, and the ratio of suitable habitat to unsuitable habitat is low here. The southern area is more extensive, but much is heavily eroded and apparently less suitable for rare *Cephaloziellas* as a result.

Further Survey Requirements: Identification of *Cephaloziella* and *Fossombronia* to species. The southern area looks suitable for *Cephaloziella dentata*, and further searches for this species could be made here.

Threats: Parts of the existing open heathland are perhaps too heavily grazed by livestock.

Management Actions Required: Expand open areas through selective gorse management.

OCG1: Trevallen Down



(left) *Cephaloziella calyculata*, *Weissia angustifolia* and *Fossombronia caespitiformis* ssp. *multispira* are on a path along the top of the slope here; (right) *Cephaloziella calyculata* location

Description: There are interesting bryophytes in and either side of the valley at Trevallen. Small populations of *Cephaloziella calyculata* on upper parts of the ridge on both sides continue round on to St Govan's Head. *Cephaloziella* cf. *stellulifera* is also in short turf here. Some *Fossombronia caespitiformis* ssp. *multispira* is on the ridge on both sides, as are tiny patches of the locally-rare *Weissia angustifolia*. *Bryum kunzei* was found new to the county, alongside *B. torquescens*, at the eastern end of the northern slope. The locally uncommon *Porella platyphylla* and plentiful *Scorpiurium circinatum* are also here, together with some *Tortula acaulon* var. *papillosa*. A small patch of *Plasteurhynchium striatulum*, with some *Amblystegium confervoides* and an abundance of the locally-rare *Neckera crispa* are on north-facing rocks on the south side of the valley. The only *Aloina ambigua* on the site was found by the track on the valley bottom, with *Aloina aloides* and some *Didymodon acutus* – the first confirmed Welsh record of the segregate species.

Total Assemblage Score: Open Calcareous Ground 27; Lowland Calcareous Rock 6

Key species for monitoring: *Cephaloziella calyculata*

Current Condition: Favourable Maintained.

Basis of Condition Assessment: *Cephaloziella calyculata* and *Fossombronia caespitiformis* ssp. *multispira* were found in more locations than by SDSB in 2008. Areas of open ground are maintained by grazing and exposure.

Further Survey Requirements: Potential survey for *Weissia levieri* in early spring

Threats: Growth of scrub threatens could potentially shade populations of key species on some outcrops.

Management Actions Required: Maintain grazing and undertake localised scrub control where appropriate.

OCG2: Flimston Down Target Gullies and Track



(left) *Pottiopsis caespitosa* location on Flimston Down; *Aloina rigida* location in gully on Flimston Down

Description: There is one long target gully alongside the embankment on the northern side of Flimston Down and a shorter one to the south-east. The long one is generally dry and stony, but has *Bryum gemmilucens* and *Microbryum floerkeanum*, the former Nationally Rare and new to Wales, although not classed as a calcicole; the latter not Nationally Scarce but new to the county and very rare in Wales. The shorter gully has damp clay dominated by *Trichostomum crispulum*, but with locally abundant patches of *Aloina* including a small amount of *Aloina rigida*. *Cephaloziella integerrima*, *Fossombronia caespitiformis* ssp. *multispira* and the locally-uncommon *F. incurva* were also found here, as well as some possible *F. maritima*. A short section of limestone track has a vegetated centre with *Pottiopsis caespitosa* and *Microbryum floerkeanum*; the former was also found at a second track edge location towards Ermigate Lane. *Didymodon acutus* is on stony ground near the latter. *Cephaloziella* cf. *stellulifera* was found on the edge of a short, unused gully near the coast.

Total Assemblage Score: Open Calcareous Ground 21 with *Cephaloziella stellulifera*

Key species for monitoring: *Aloina rigida*, *Pottiopsis caespitosa* (indirect monitoring)

Current Condition: Favourable Maintained

Basis of Condition Assessment: These features appear to be well maintained in an open state by sheep grazing and disturbance from army activities. The main target gully looks to be regularly strimmed; the shorter one is mostly open.

Further Survey Requirements: None

Threats: None noted, although the eastern part of the main target gully is concrete based so unsuited to bryophytes as a result.

Management Actions Required: Maintain recent levels of grazing and vehicular disturbance. Continue regular clearance of encroaching vegetation such as gorse from the target gullies, even where not used. Encourage new disturbance.

OCG3: Linney Down - Pen-y-Holt Down - Bulliber Down Target Gullies



(left) Target gully on Pen-y-Holt Down; (right) *Fossombronia caespitifformis* location on Bulliber Down

Description: There are several target gullies across the western part of the Range, which vary in their aspect and degree of use. Most are stony with clay patches, and kept open by regular use and maintenance. Some are derelict and more vegetated as a result. Most have *Cephaloziella integerrima* and *Cephaloziella* cf. *stellulifera*. There is a large population of *Fossombronia caespitifformis* ssp. *caespitifformis* on a gully on Pen-y-Holt Down, and a smaller one on Bulliber Down. The westernmost gully near Linney Down has a small amount of *Aloina rigida*. *Ephemerum crassinervium* ssp. *sessile* is in a gully on Bulliber Down, and in a disused one on Pen-y-Holt Down. The local rarities *Weissia longifolia*, *Ephemerum recurvifolium* and *Tortula protobryoides* were also noted, and other less common species on the site include *Encalypta streptocarpa* and *Rhynchostegiella megapolitanum*. *Didymodon actus* was found on an adjoining track.

Total Assemblage Score: Open Calcareous Ground 21 (including *Ephemerum crassinervium* ssp. *sessile*)

Key species for monitoring: *Aloina rigida*, *Cephaloziella integerrima* (indirect monitoring).

Current Condition: Favourable Maintained.

Basis of Condition Assessment: There are several target gullies with good populations of key species. Most are kept suitably short and open.

Further Survey Requirements: None

Threats: Disused gullies become grassy and the bryophyte flora dominated by more robust common species. Herbicide application or surfacing clay areas with stone or concrete would impact negatively.

Management Actions Required: Maintain recent levels of grazing and activity, and strimming where necessary. Encourage new disturbance where appropriate.

OCG4: St Govan's Head



(left) *Entosthodon pulchellus* is found in small quantity at the base of these crags; (right) *Fossombronia caespitiformis* s.s. is in sheep-trampled turf at the top of this slope

Description: The key Castlemartin Range population of *Cephaloziella calyculata* is on and above the cliffs on the eastern side of St Govan's Head. There are small patches of *Entosthodon pulchellus* on the crags here, and *Platydictya jungermannioides* in at least a couple of recesses. *Riccia beyrichiana* and *R. subbifurca* are on soil covered ledges and anthills here. There is a large population of *Microbryum starckeanum* on the rocky slope towards the point, and scattered colonies of the locally-rare *Bryum donianum*. *Fossombronia caespitiformis* ssp. *caespitiformis* and *Tortula atrovirens* are on sheep-trampled turf above an outcrop. *Weissia angustifolia* is around outcrops near the chapel.

Total Assemblage Score: Open Calcareous Ground 18; Lowland Calcareous Rock 3

Key species for monitoring: *Cephaloziella calyculata*

Current Condition: Favourable Maintained.

Basis of Condition Assessment: *Cephaloziella calyculata* was found in more locations than by SDSB in 2008. *Microbryum starckeanum* is frequent in suitable habitat. The small populations of *Entosthodon pulchellus*, *Riccia beyrichiana* and *Platydictya jungermannioides* are newly discovered, so no information on trends is available.

Further Survey Requirements: Possible survey for rare *Weissia* species in late winter.

Threats: No obvious current threats.

Management Actions Required: Maintain recent levels of grazing on the head.

OCG5: Blockhouse E



(left) *Didymodon actus* is abundant on the track here, with a small amount of *Pottiopsis caespitosa*; (right) open patches here have some *Pottiopsis caespitosa* and *Aloina rigida*

Description: Some of the ground scraped to generate soil for the mound around Blockhouse E now has sparsely-vegetated, stony grassland. *Pottiopsis caespitosa*, *Aloina rigida* and the locally-rare *Brachythecium glareosum* are in small quantity here, and the former is on a little-used, mossy track nearby with an abundance of *Didymodon acutus* and the locally-rare *Tortula protobryoides*. The uncommon *Ephemerum recurvifolium* is in open grassland to the south.

Total Assemblage Score: Open Calcareous Ground 9

Key species for monitoring: *Pottiopsis caespitosa*, *Didymodon acutus*

Current Condition: Favourable

Basis of Condition Assessment: *Didymodon acutus* is notably abundant on several lengths of track to the north-east of the blockhouse. *Pottiopsis caespitosa* was noted in two places, and small areas of suitable habitat elsewhere could also support this species. *Aloina rigida* was only found in small quantity in one location, but again has the potential to be found elsewhere. Current levels of grazing and vehicle disturbance are suited to these species.

Further Survey Requirements: Further survey for *Aloina rigida* would be desirable.

Threats: Re-surfacing of tracks leading to the target-gully would impact on a large population of *Didymodon acutus*.

Management Actions Required: Maintain recent levels of grazing and activity. Encourage new disturbance where appropriate.

OCG6: Southern Cliffs in Range West (Linney Head to Stack Rocks)



(left) Shelling disturbance on Mount Sion Down (right) *Tortula protobryoides* location, Mount Sion Down

Description: The cliff land on Range West is rather exposed and bryophyte-poor towards Linney Head, but has a more diverse array of calcicoles around the crest of the slopes further east. *Cephaloziella stellulifera*, *Tortula atrovirens* and *Microbryum starckeanum* are occasionally found in open areas, and *Bryum torquescens* was found in one place. The Nationally Rare *Fossombronia maritima*, new to the south of the county, was found in an area of open heath in a gully near the coast on Mount Sion Down, and *Ephemerum crassinervium* ssp. *sessile* is in grassland here. The locally-rare *Weissia angustifolia*, *Tortula protobryoides* and *Riccia subbifurca* appear in open turf in a small number of locations.

Total Assemblage Score: Open Calcareous Ground 9; Coastal Habitats 9

Key species for monitoring: None

Current Condition: Favourable Maintained.

Basis of Condition Assessment: *Cephaloziella stellulifera* is at least as frequent as when recorded by SDSB in 2008; *Microbryum starckeanum* is likely to be similarly locally abundant, and *Bryum torquescens* was not previously recorded.

Further Survey Requirements: None

Threats: No obvious current threats. Shelling disturbance is generally small scale, and creates bare patches potentially suitable for pioneer species such as *Ephemerum crassinervium*. Grazing pressure is high, but the potentially negative impacts of sheep trampling and dung are outweighed by the positive impacts of sward reduction and open ground creation.

Management Actions Required: Maintain recent levels of grazing.

OCG7: Southern Cliffs in Range East (Stack Rocks to St Govan's)



(left) Open heath near Bullslaughter Bay; (right) *Cephaloziella calyculata* location near Flimston Bay

Description: The key interest on the coast south of the main track here is *Cephaloziella calyculata*, which is occasionally found in small pockets of open heath, or small bare patches within heathy grassland. There is also some *Bryum torquescens* near St Govan's chapel, *Tortula atrovirens*, and the locally-rare *Weissia angustifolia*, *Tortula lanceola* and *Tortula protobryoides*. Little time was spent on this section during the current survey.

Total Assemblage Score: Open Calcareous Ground 9 / Lowland Heathland 6

Key species for monitoring: *Cephaloziella calyculata*

Current Condition: Open Calcareous Ground - Favourable Maintained.

Basis of Condition Assessment: *Cephaloziella calyculata* was found in more locations than recorded by SDSB, and appears likely to be fairly well distributed along the coast here (nb. Fertile populations were not recorded during the current survey, and *C. integerrima* could not be ruled out). Grazing and other disturbance is maintaining open ground within heath and calcareous grassland suitable for the *Cephaloziella* and potentially other notable species.

Further Survey Requirements: *Cephaloziella dentata* could possibly be found here with further survey effort.

Threats: No obvious threats noted. Scrub encroachment appears limited at present.

Management Actions Required: Maintain recent levels of grazing.

LH6: Range East, near Stack Rocks Car Park



(left) bank formed by past soil-scraping; (right) *Cephaloziella* location

Description: Soil has been scraped to form the embankment along the southern edge of this strip. The heathy grassland developed over the infertile clay left has some locally-frequent *Cephaloziella calyculata* or *integerrima* and *Fossombronina caespitifformis* ssp. *multispira*.

Total Assemblage Score: Open Calcareous Ground / Lowland Heathland 9

Key species for monitoring: *Cephaloziella calyculata* / *integerrima*

Current Condition: Unknown.

Basis of Condition Assessment: *Cephaloziellas* would potentially have been more abundant here at an earlier successional stage following initial scraping. No prior survey information exists to determine trends.

Further Survey Requirements: Determination of *Cephaloziella* from fertile specimen.

Threats: Succession to closed grassland with insufficient bare ground for *Cephaloziellas*.

Management Actions Required: Maintain grazing and potentially increase disturbance levels in closed sward areas.

OCG8: Delta Quarry, south of Castle Lady Valley



(left) *Bryum pallescens* is on the nearest of the old tanks; (right) *Ephemerum recurvifolium* location

Description: The worked quarry face has abundant *Aloina aloides* and no notable species were found. Damp open ground in the quarry to the west has a small amount of *Pottiopsis caespitosa* and *Gymnostomum viridulum*. The locally-rare *Ephemerum recurvifolium* and *Weissia longifolia* are in stony turf around the old tanks to the west, and the uncommon metal-tolerant *Bryum pallescens* is on one of the tanks.

Total Assemblage Score: 6

Key species for monitoring: None

Current Condition: Favourable Maintained

Basis of Condition Assessment: This area appears to be well grazed and regularly disturbed. Key species are apparently in small quantity, but the habitat is generally favourable for them.

Further Survey Requirements: None

Threats: The quarry is used for demolitions, and as such, the main part of it is polluted with metal and other debris and presumably toxic chemicals. The ground around the tanks has a lighter degree of disturbance, and no specific threats were noted here.

Management Actions Required: Maintain recent levels of grazing and disturbance.

OCG9: Limestone Ridge south of Blucks Pool



(left) *Enthostodon pulchellus* location on outcrop; (right) *Enthostodon pulchellus*, *Reboulia hemispherica* and *Rhodobryum roseum* are locally-frequent along the outcrop here.

Description: The ridge of exposed limestone here was noted as a key location by SDSB, who found *Enthostodon pulchellus*, *Pleurochaete squarrosa* and the locally-rare *Rhodobryum roseum*, *Brachythecium glareosum* and *Reboulia hemispherica*. All of these species were found by the present survey, and the uncommon *Riccia subbifurca*, *Tortula protobryoides*, *Scorpiurium circinatum* and *Zygodon viridissimus* var. *stirtonii* were also noted. The bryophyte assemblage on the grassland above, with species such as *Frullania tamarisci*, *Ctenidium molluscum* and *Fissidens dubius*, appears to conform to the scarce 'Scapanietum asperae'.

Total Assemblage Score: Open Calcareous Grassland 6

Key species for monitoring: *Enthostodon pulchellus*

Current Condition: Favourable Maintained

Basis of Condition Assessment: .

Further Survey Requirements: None

Threats: Blackthorn scrub poses a threat by shading the lower parts of the ridge, but also protects them by creating a barrier to sheep and people, both of which could cause excessive disturbance to the sensitive ledges. Burning of scrub here could be damaging.

Management Actions Required: Maintain recent winter sheep grazing levels. Mowing of a swathe of blackthorn near at least parts of the ridge could be desirable.

LCR1: Castle Lady Valley, Mount Sion Covert and Pricaston Quarry



(left) Pricaston Quarry; (right) *Leptobarbula berica* location

Description: Shaded outcrops of limestone occur in a few places in the Castle Lady Valley and Mount Sion Covert woodlands, and in the old quarry near Pricaston. *Plasteurhynchium striatulum* has been found in three locations, and may be more widespread. *Platydictya jungermannioides* was recorded by the current survey in Pricaston Quarry, after being found new to the county on the more exposed limestone of St Govan's Head. Two local rarities are also present - *Plagiochila britannica* occurs on tree bases and outcrops in two places, and there is a tiny patch of *Leptobarbula berica* in the quarry. The snail *Ena obscura* was also found here, new to the county.

Total Assemblage Score: Lowland Calcareous Rock: 6

Key species for monitoring: Not required.

Current Condition: N/a

Basis of Condition Assessment: The feature does not currently score highly enough to qualify.

Further Survey Requirements: Additional scarce species such as *Amblystegium confervoides* and *Cololejeunea rosettiana* could conceivably be present and could be looked for, but a qualifying assemblage is unlikely to be present.

Threats: None noted. If management of trees / ash dieback occurs, brash should not be piled against outcrops.

Management Actions Required: Maintain lack of disturbance.

DS1: Brownslade Burrows



(left) *Distichium cf. capillaceum* location; (right) *Pleurochaete squarrosa* and *Didymodon acutus* around outcropping rock

Description: The extensive dune system was not surveyed in detail. Much of the fixed dune grassland has a limited range of common bryophytes, but there are pockets of interest on damp or compacted sand, or small outcrops of limestone. *Didymodon acutus* was found in four such locations, in addition to the one noted by SDSB. *Pleurochaete squarrosa* is very locally frequent, and *Gymnostomum viridulum* was noted twice. *Petalophyllum ralfsii* was occasionally seen. Several local rarities were also noted. *Distichium cf. capillaceum* was found on short-grazed compacted dune amongst *Trichostomum viridulum*. *Didymodon ferrugineus* was found in damp ground towards the back of the dunes. *Preissia quadrata* is locally frequent in one area of flushed ground.

Total Assemblage Score: Dune and Slack: 12

Key species for monitoring: Indirect monitoring of assemblage. Monitoring of *Petalophyllum ralfsii* as independently qualifying feature.

Current Condition: Assemblage is probably Favourable Maintained.

Basis of Condition Assessment: Assemblage species (and local rarities) are associated with short-grazed turf over damp or hard-compacted sand. Annual heavy sheep-grazing is maintaining this habitat in the patchily-distributed locations where it naturally occurs.

Further Survey Requirements:

Threats: Part of the fen area in the north-eastern part of the burrows supporting *Preissia quadrata* was heavily cattle poached; cattle were being fed with a ring-feeder on the adjoining dune. Impacts on higher plant and invertebrate interest may be more significant than on the limited bryophyte interest here.

Management Actions Required: Maintain winter sheep grazing.

DS2: Linney Burrows



(left) shallow sandy ground over rock at Linney Burrows with *Gymnostomum viridulum*; (right) *Fossombronia incurva* was found in small quantity in the foreground, and *Pottiopsis caespitosa* on the edge of the stony area in the background.

Description: The smaller dune system at Linney Burrows has an abundance of *Gymnostomum viridulum* in short, damp turf. *Petalophyllum ralfsii* is rarer here than on Brownslade Burrows, but a few thalli were refound during the current survey. *Pleurochaete squarrosa* is occasional. *Pottiopsis caespitosa* was found in two locations on sheepwalks through short-turf (one near a population of *Fulgensia fulgens* on stony ground, and the other near *Petalophyllum* in a slack area). *Cephaloziella* cf. *stellulifera* was noted in one location. The locally-rare *Fossombronia incurva* was found in small quantity.

Total Assemblage Score: Dune and Slack: 9 (12 with *Pottiopsis*, Nationally Scarce but not listed as a dune species in Bosanquet, 2019)

Key species for monitoring: Indirect monitoring of assemblage. Monitoring of *Petalophyllum ralfsii* as independently qualifying feature.

Current Condition: Assemblage is probably Favourable Maintained. *Petallophyllum* is presumed Unfavorable.

Basis of Condition Assessment: Assemblage species (and local rarities) are associated with short-grazed turf over damp sand, or thin sand over rocky ground. Annual heavy sheep-grazing is maintaining this habitat in the patchily-distributed locations where it naturally occurs. Shelling in the dune slack area is creating bare depressions which may benefit *Gymostomum viridulum* and *Petallophyllum*.

Further Survey Requirements: None specific

Threats: None noted

Management Actions Required: Maintain winter sheep grazing.

Appendix 2: Conservation Objectives for Qualifying Bryophytes and Bryophyte Assemblages at Castlemartin Range SSSI

2.1 Toothed Threadwort *Cephaloziella dentata*



Figure 38 *Cephaloziella dentata* in an algal film over soil, with sand grains for scale

Vision for Toothed Threadwort *Cephaloziella dentata*

Cephaloziella dentata will continue to be found at at least three heathland areas within the SSSI, (currently Linney Down, Mount Sion Down & Flimston Down). The populations will occur at least occasionally across open heathland, developed over previously stripped soils.

- *Cephaloziella dentata* has a continued presence at Castlemartin Range SSSI.
- *Cephaloziella dentata* occurs on at least three downs, currently Linney Down, Mount Sion Down and Flimston Down.
- At all three downs there are areas of short, open heathland with patches of exposed soil present.
- Exposed soil occurs frequently in small or moderately large patches, occupying between 10% and 40% of the heathland vegetation in some parts of the Downs.

- The Downs continue to be winter grazed by cattle and sheep, which is helping to maintain the short heath and open conditions required by *Cephaloziella dentata*.
- The heathland areas are subject to a degree of soil disturbance, such as that currently provided by military training activities.

Performance indicators for Toothed Threadwort *Cephaloziella dentata*

The performance indicators are part of the conservation objective, not a substitute for it. Assessment of plans and projects must be based on the entire conservation objective, not just the performance indicators.

Performance indicators for feature condition		
Attribute	Attribute rationale and other comments	Specified limits
A1. Distribution and population size	Based upon Bryophyte Survey outlined in the current report.	Upper limit: None set Lower limit: Continued presence in 3 discrete heathland areas is confirmed by sampling. <i>Cephaloziellas</i> are found to be at least occasional within the key <i>C. dentata</i> location on Linney Down, and at least 2 out of 20 small samples prove to be <i>C. dentata</i> on microscopical examination.
A2. Habitat Condition	Based upon observations made during the Bryophyte Survey. Heathland Vegetation: cover of ericoids is at least 25%. Potentially suitable <i>Cephaloziella dentata</i> habitat: heathland where bare or very sparsely vegetated mineral soil is present. Optimum <i>Cephaloziella dentata</i> habitat: heathland over previously soil-stripped ground where bare or very sparsely vegetated soil is present at between 10% and 40% cover within a 1m radius.	Upper limit: None set Lower limit: <i>Cephaloziella dentata</i> will be in favourable condition when: <ul style="list-style-type: none"> • 40% of the vegetation within defined areas on the 3 downs are referable to optimal or potentially suitable <i>Cephaloziella dentata</i> habitat, • A minimum of 10% of the potentially suitable habitat is referable to optimal <i>Cephaloziella dentata</i> habitat • <i>Cephaloziella dentata</i> is associated with the optimal/potentially suitable habitat • Non-native/alien species including <i>Campylopus introflexus</i> are rare or absent



Figure 39 Optimal *Cephaloziella dentata* habitat on Linney Down

Performance indicators for factors affecting the feature		
Factor	Factor Rational and Other Comments	Operational Limits
Past Major Soil Disturbance	<p>The locations where <i>Cephaloziella dentata</i> have been found are all in heathland associated with past topsoil removal. The topsoil was used to create embankments or mounds around blockhouses. This exposed nutrient poor clay-rich subsoil, which appears to be suitable for this tiny, non-competitive liverwort.</p> <p>No similarly major groundworks appear to have been carried out in the last decade or more.</p>	<p>Upper limit: Any major new soil disturbance to avoid impacting on known <i>C. dentata</i> populations</p> <p>Lower limit: Some renewed soil scraping in areas of rank heath may expand the area of suitable habitat for <i>C. dentata</i>, if compatible with other feature objectives.</p>
Ongoing Minor Soil Disturbance	<p>Within these areas of past soil-removal, <i>C. dentata</i> appears to be reliant on maintenance of continued exposed ground, through a combination of exposure, disturbance by military vehicles and other training activities, and livestock grazing. Larger patches / areas of excessively bare ground appear to be less suitable than those</p>	<p>Upper limit: Military activities should maintain exposed ground and habitat quality within the parameters defined above</p> <p>Lower limit: Some disturbance through military activities may be</p>

	within a smaller-scale mosaic of ericoid vegetation, but it was not found on areas of more humic soil below plants.	required to supplement grazing and maintain required exposed ground
Livestock Grazing / Mowing	The more exposed heathland on Linney Down is maintained in part by 'natural' environmental factors – including exposure to salt spray, thin soils and climatic extremes. In the sites further away from the coastal strip, the heathland vegetation has been maintained by traditional grazing practices. Without an appropriate grazing regime, successional processes would proceed more rapidly, and suitable heathland habitat would become rank and turn to gorse scrub. Maintenance of current traditional practice of winter sheep grazing, and ideally additional light cattle grazing at other times, is beneficial. However, there is a short-term impact of trampling and perhaps dunging, in obscuring the tiny shoots of the liverwort in some areas.	Upper limit: The grazing pressure must not be so high as to break down the vegetation structure completely and leave large areas prone to wind or sheetwash erosion. Lower limit: Heathland must be subject to sufficient grazing to halt succession.
Burning	No areas of recently burned heath were found to support <i>C. dentata</i> . Species of <i>Bryum</i> , <i>Campylopus</i> , etc seem instead to lead the succession in such areas. Burning should be avoided as both a restoration tool and as ongoing management. Accidental fires caused by military activities occur, but a firebreak network in some areas such as Bulliber Down is maintained to stop these becoming large scale.	Upper limit: no burning of heath on Linney Down Accidental burns from military activities on Flimston Down and Mount Sion Down, affecting no more than 5% of the potential <i>C. dentata</i> habitat per year, are acceptable Lower limit: none set
Invasive Non-Native Species	The introduction or spread of highly invasive or alien plants could pose a threat to the species. The moss <i>Campylopus introflexus</i> is the only INNS on the heaths at present, and this is currently rare and nowhere threatening the <i>Cephaloziella</i> . The non-native heathland liverwort <i>Lophocolea semiteres</i> is still rare in the county and was not found on site.	Upper limit: Any potentially invasive alien species on site should be monitored, and early control carried out if appropriate Lower limit: None set
Climate Change	Impacts of extreme weather events may benefit the <i>Cephaloziella</i> , by limiting growth of more competitive plant species.	Upper limit: None set Lower limit: None set

	Growth of algae across bare soil areas was noted – it is unclear to what extent this is encouraged by warmer temperatures here, and to what extent it may impact on the <i>Cephaloziella</i> . It does make locating and monitoring the species harder.	
Pollution	The species could be affected by airborne pollutants such as nitrous oxides from vehicle exhausts, for example through increased algal growth as described above.	Upper limit: Levels of pollutants must not exceed critical thresholds for vegetation types according to JNCC guidance Lower limit: None set



Figure 40 Gemmae of *Cephaloziella dentata*

2.2 Lobed Threadwort *Cephaloziella integerrima*



Figure 41 *Cephaloziella integerrima* habitat, target gully on Pen-y-Holt Down

Vision for Lobed Threadwort *Cephaloziella integerrima*

Cephaloziella integerrima will continue to be found in at least four locations within the SSSI, (currently Linney Down, Flimston Down, Mount Sion Down & Pen-y-Holt Down). The populations will occur at least occasionally across open heathland, target gullies, or similar habitats.

- *Cephaloziella integerrima* has a continued presence at Castlemartin Range SSSI.
- *Cephaloziella integerrima* occurs in at least four locations, currently Linney Down, Mount Sion Down, Pen-y-Holt Down and Flimston Down.
- At all four locations, there are areas of open heathland with patches of exposed soil present, or target gullies with mostly sparsely-vegetated floors and sides.
- Exposed soil occurs frequently in small or moderately large patches, occupying between 10% and 40% of the heathland vegetation in some parts of the sites. Floors and south-facing sides of target gullies are more than 50% dominated by vegetation where exposed soil and acrocarpous mosses are more prominent than higher plants.

- The sites continue to be winter grazed by cattle and sheep, which is helping to maintain the short heath and open conditions required by *Cephaloziella integerrima*.
- The heathland areas are subject to a degree of soil disturbance, such as that currently provided by military training activities.

Performance indicators for Lobed Threadwort *Cephaloziella integerrima*

The performance indicators are part of the conservation objective, not a substitute for it. Assessment of plans and projects must be based on the entire conservation objective, not just the performance indicators.

Performance indicators for feature condition		
Attribute	Attribute rationale and other comments	Specified limits
A1. Distribution and population size	Based upon Bryophyte Survey outlined in the current report.	Upper limit: None set Lower limit: Continued presence in 4 discrete heathland or target gully areas is confirmed by sampling. <i>Cephaloziellas</i> are found to be at least occasional at a sample of previously recorded <i>C. integerrima</i> locations, and at least 1 out of 5 small samples prove to be <i>C. integerrima</i> on microscopical examination.
A2. Habitat Condition	Based upon observations made during the Bryophyte Survey. Heathland Vegetation: cover of ericoids is at least 25%. Potentially suitable <i>Cephaloziella integerrima</i> habitat: heathland where bare or very sparsely vegetated mineral soil is present, or target gullies where acrocarpous mosses, exposed soil or stones are dominant and higher plants are at less than 50% cover.	Upper limit: None set Lower limit: <i>Cephaloziella integerrima</i> will be in favourable condition when: <ul style="list-style-type: none"> • 40% of the vegetation within defined areas at 4 locations are referable to potentially suitable <i>Cephaloziella integerrima</i> habitat, • <i>Cephaloziella integerrima</i> is associated with the potentially suitable habitat • Non-native/alien species including <i>Campylopus introflexus</i> are no more than occasional



Figure 42 Optimal *Cephaloziella integerrima* habitat, target gully on Flimston Down

Performance indicators for factors affecting the feature		
Factor	Factor Rational and Other Comments	Operational Limits
Past Major Soil Disturbance	<p>The locations where <i>Cephaloziella integerrima</i> have been found are all either in target gullies, or in heathland associated with past topsoil removal. The topsoil was used to create embankments or mounds around blockhouses. This exposed nutrient-poor clay-rich subsoil, which appears to be suitable for this tiny, non-competitive liverwort. Target gullies have exposures of similarly infertile, stony or clay-rich subsoil.</p> <p>No similarly major groundworks appear to have been carried out in the last decade or more.</p>	<p>Upper limit: Any major new soil disturbance to avoid impacting on known <i>C. integerrima</i> populations</p> <p>Lower limit: Some renewed soil scraping in areas of rank heath may expand the area of suitable habitat for <i>C. integerrima</i>, if compatible with other feature objectives.</p>
Ongoing Minor Soil Disturbance	<p>Within these areas of past soil-removal, <i>C. integerrima</i> appears to be reliant on maintenance of continued exposed ground, through a combination of exposure, disturbance by military vehicles and other training activities,</p>	<p>Upper limit: Military activities should maintain exposed ground and habitat quality within the parameters defined above</p>

	and livestock grazing. Larger patches / areas of excessively bare ground appear to be less suitable than those within a smaller-scale mosaic of ericoid vegetation, but it was not found on areas of more humic soil below plants.	Lower limit: Some disturbance through military activities may be required to supplement grazing and maintain required exposed ground
Livestock Grazing / Mowing	The heathland vegetation has been maintained by traditional grazing practices. Without an appropriate grazing regime, successional processes would proceed more rapidly, and suitable heathland habitat would become rank and turn to gorse scrub. Maintenance of current traditional practice of winter sheep grazing, and ideally additional light cattle grazing at other times, is beneficial. However, there is a short-term impact of trampling and perhaps dunging, in obscuring the tiny shoots of the liverwort in some areas. Active target gullies appear to be maintained by regular strimming, and this creates ideal conditions	Upper limit: The grazing pressure must not be so high as to break down the vegetation structure completely and leave large areas prone to wind or sheetwash erosion. Lower limit: Heathlands and target gullies must be subject to sufficient grazing to halt succession; strimming should continue in the latter.
Burning	No areas of recently burned heath were found to support <i>C. integerrima</i> . <i>Campylopus introflexus</i> could be favoured by heathland fires. Burning should be avoided as both a restoration tool and as ongoing management. Accidental fires caused by military activities occur, but a firebreak network in some areas such as Bulliber Down is maintained to stop these becoming large scale.	Upper limit: no intentional burning of heath within defined 'Important Bryophyte Areas'. Accidental burns from military activities on Flimston Down, Linney Down, Pen-y-Holt Down and Mount Sion Down, affecting no more than 10% of the potential <i>C. integerrima</i> habitat per year, are acceptable Lower limit: none set
Invasive Non-Native Species	The introduction or spread of highly invasive or alien plants could pose a threat to the species. The moss <i>Campylopus introflexus</i> is the only INNS on the heaths at present, and this is currently rare and nowhere threatening the <i>Cephaloziella</i> . The non-native heathland liverwort <i>Lophocolea semiteres</i> is still rare in the county and was not found on site.	Upper limit: Any potentially invasive alien species on site should be monitored, and early control carried out if appropriate Lower limit: None set
Climate Change	Impacts of extreme weather events may benefit the <i>Cephaloziella</i> , by limiting	Upper limit: None set

	<p>growth of more competitive plant species.</p> <p>Growth of algae across bare soil areas was noted – it is unclear to what extent this is encouraged by warmer temperatures here, and to what extent it may impact on the <i>Cephaloziella</i>. It does make locating and monitoring the species harder.</p>	Lower limit: None set
Pollution	The species could be affected by airborne pollutants such as nitrous oxides from vehicle exhausts, for example through increased algal growth as described above.	<p>Upper limit: Levels of pollutants must not exceed critical thresholds for vegetation types according to JNCC guidance</p> <p>Lower limit: None set</p>

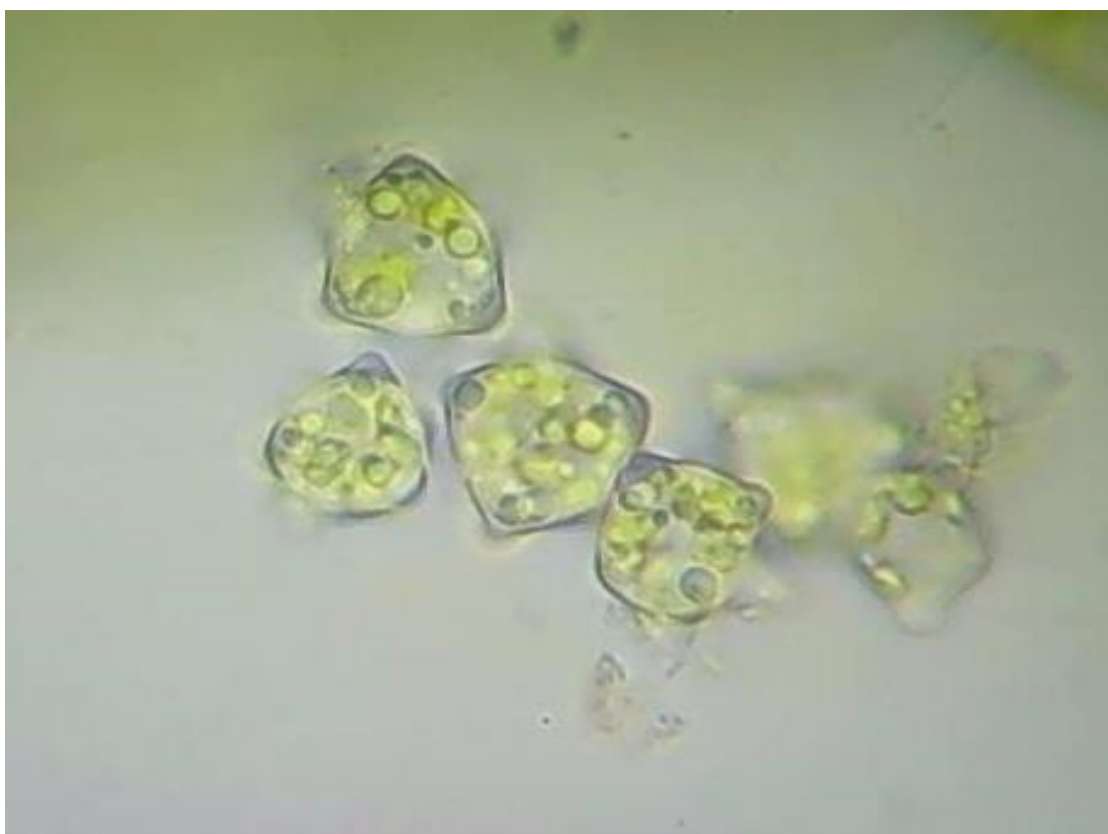


Figure 43 Gemmae of *Cephaloziella integerrima*

2.3 Entire Threadwort *Cephaloziella calyculata*



Figure 44 *Cephaloziella calyculata* habitat, sheep-walk south of Trevallen

Vision for Entire Threadwort *Cephaloziella calyculata*

Cephaloziella calyculata will continue to be found in at least three open calcareous grassland locations within the SSSI, (currently St Govan's Head, Trevallen Down & Bulliber Down). Further populations of *Cephaloziella calyculata* or *C. integerrima* will occur at least occasionally within heathland or heathy grassland across the site.

- *Cephaloziella calyculata* has a continued presence at Castlemartin Range SSSI.
- *Cephaloziella calyculata* occurs in at least three locations, currently St Govan's Head, Trevallen Down and Bulliber Down (further populations of non-fertile *Cephaloziella* with angled gemmae, referable to *C. calyculata* or *C. integerrima*, are recorded more widely within open heathland and target gullies across the site)
- At all three sites there are areas of short, open calcareous grassland with patches of exposed soil present.
- Exposed soil occurs frequently in small or moderately large patches, occupying between 5% and 30% of the grassland vegetation in some parts of the sites.

- The Range continues to be winter grazed by cattle and/or sheep, which is helping to maintain the short grassland, heath and open conditions required by *Cephaloziella calyculata*.
- The grassland and heathland areas are subject to a degree of soil disturbance, such as that currently provided by military training activities.

Performance indicators for Entire Threadwort *Cephaloziella calyculata*

The performance indicators are part of the conservation objective, not a substitute for it. Assessment of plans and projects must be based on the entire conservation objective, not just the performance indicators.

Performance indicators for feature condition		
Attribute	Attribute rationale and other comments	Specified limits
A1. Distribution and population size	Based upon Bryophyte Survey outlined in the current report.	Upper limit: None set Lower limit: Continued presence in 3 discrete grassland areas is confirmed by sampling.
A2. Habitat Condition	Based upon observations made during the Bryophyte Survey. Open Calcareous Grassland Vegetation: small acrocarpous mosses are prominent in short vegetation with calcicolous higher plants. Small outcropping rocks, stones, or patches of clay soil are visible within the sward. Potentially suitable <i>Cephaloziella calyculata</i> habitat: open calcareous grassland where outcropping rock, bare or very sparsely vegetated mineral soil, or patches of <i>Frullania tamarisci</i> are present.	Upper limit: None set Lower limit: <i>Cephaloziella calyculata</i> will be in favourable condition when: <ul style="list-style-type: none"> • 40% of the vegetation within the 3 defined areas is referable to potentially suitable <i>Cephaloziella calyculata</i> habitat OR suitable habitat is present along linear features • <i>Cephaloziella calyculata</i> is associated with the potentially suitable habitat • Non-native/alien species are rare or absent



Figure 45 *Cephaloziella cf. calyculata* habitat, heathy grassland near Flimston Bay

Performance indicators for factors affecting the feature		
Factor	Factor Rational and Other Comments	Operational Limits
Livestock Grazing / Mowing	The more exposed areas of open calcareous grassland are maintained in part by 'natural' environmental factors – including exposure to salt spray, thin soils and climatic extremes. Further away from the cliff edges, the grassland vegetation has been maintained by traditional grazing practices, supplemented by rabbit activity, and also trampling by livestock and people. Without an appropriate grazing regime, successional processes would proceed more rapidly, and suitable grassland habitat would become rank and turn to scrub. Maintenance of current traditional practice of winter sheep grazing, and ideally additional light cattle grazing at other times, is beneficial. However, there is a short-term impact of trampling and perhaps dunging, in obscuring the tiny shoots of the liverwort in some areas.	Upper limit: The grazing and trampling pressure must not be so high as to break down the vegetation structure completely and leave large areas prone to wind or sheetwash erosion. Lower limit: Open calcareous grasslands and heathlands must be subject to sufficient grazing and/or trampling to halt succession.

Invasive Non-Native Species	The introduction or spread of highly invasive or alien plants, such as hottentot fig, could pose a threat to the species.	Upper limit: Any potentially invasive alien species on site should be monitored, and early control carried out Lower limit: None set
Climate Change	Impacts of extreme weather events may benefit the <i>Cephaloziella</i> , by limiting growth of more competitive plant species.	Upper limit: None set Lower limit: None set



Figure 46 *Cephaloziella calyculata* within turf of small acrocarpous mosses

Appendix 3: Results & Annotated Checklist as of January 2021



Figure 47 *Bryum kunzei* from Trevallen

This checklist is updated from Bosanquet (2008). Species are listed alphabetically, with mosses and liverworts in separate sections. Taxonomy and nomenclature follow the recently updated *Census Catalogue*; former synonyms are given in brackets. Nationally Rare (recorded in 15 or fewer 10km squares) and Scarce species (16 to 100 10km squares) are listed by Pescott (2016), whilst local rarities (recorded in 3 or fewer sites in Pembrokeshire) are listed by Sutton (in prep). Underlined species are additions to the Castlemartin Range bryophyte flora made during the current survey by MDS. All records are by MDS unless indicated with a recorder in brackets (SDSB – Sam Bosanquet; DH - David Holyoak; EJ - E.W. Jones; EW - E.F. Warburg; JH - Jean Hambly; MP - M.C.F. Proctor; RH - Bob Haycock). Comments such as “scarce on damp gravelly ground” in the annotated checklist relate to the status of taxa at Castlemartin rather than their national status.

Mosses

Acaulon mediterraneum **Nationally Rare** – found on the edges of two small craters on Linney Head, this southern species was recently discovered new to Wales in Pembrokeshire, and is now known from the three main western headlands – Linney, Marloes Deer Park and St David's Head.

Acaulon muticum Occasional on anthills across Range West, and on the edge of a limestone outcrop at St. Govan's.

Aloina aloides - widespread and locally frequent on damp, gravelly ground, the floors of target gullies, and on thin soil on limestone ledges.

Aloina ambigua **Nationally Scarce** – in small quantity by the track in the valley at Trevalen.

Aloina rigida **Nationally Scarce** – found new to the county in a target gully on Flimston Down, then subsequently in two trackside locations on Flimston Down, and in stony ground within short turf by Blockhouse E, Mount Sion Down. Often mixed with more abundant *A. aloides* and maybe more frequent than the records indicate.

Amblystegium confervoides **Nationally Scarce** – found in small quantity amongst larger pleurocarpous mosses alongside the *Plasteurhynchium striatulum* on the south side of Trevalen valley. Potentially present at the base of other shaded outcrops.

Amblystegium serpens var. *salinum* - scattered along the coast and in dune turf.

Amblystegium serpens var. *serpens* - in small quantity in sheltered places, especially Castle Lady Valley.

Anomodon viticulosus - locally abundant on natural limestone in Mount Sion Covert (SDSB), an old wall in Castle Lady Valley, and in Southrow Quarry in Range East.

Archidium alternifolium – regularly encountered in damp clay ground on heaths and tracks on Range West; also recorded from salt-sprayed cliff-top turf and heathy hollows in Range East (SDSB) and in the Trevalen heathland.

Atrichum undulatum var. *undulatum* - occasional under *Prunus* scrub and in woodland. Locally frequent on banks in Mount Sion Covert (SDSB).

Barbula convoluta - both varieties occur on sand and tracks at Brownslade Burrows; var. *convoluta* was also recorded on a track in Range East (SDSB).

Barbula unguiculata - frequent on damp, gravelly ground and on tracks; occasional on thin soil on limestone ledges.

Brachythecium albicans - co-dominant with *Syntrichia ruraliformis* on some tarmac laybys (SDSB), also in short turf above St. Govan's chapel.

Brachythecium glareosum **locally rare** - one large patch on the limestone south of Blucks Pool (SDSB); one patch in open stony ground near Blockhouse E.

Brachythecium mildeanum - occasional on tarmac and gravel tracks (SDSB).

Brachythecium rivulare - abundant under *Juncus subnodulosus* in Brownslade and Frainslake fens.

Brachythecium rutabulum - frequent except on the most exposed coastal areas.

Bryoerythrophyllum recurvirostrum - noted twice by SDSB, and five times during the present survey. Habitats included stony track edges, a sandstone boulder, a limestone ledge, damp dune slack and open clay in heath.

Bryum algovicum - recorded by JH (1991) in Brownslade Burrows. *Bryum* spp. with young fruits were noted in this area by SDSB in 2007, but could not be identified without ripe capsules.

Bryum argenteum - scattered across the site on tarmac, concrete and gravel tracks.

Bryum cf. caespiticium – on a target gully on Flimston Down; unripe fruits so identification not possible.

Bryum capillare var. *capillare* - unusually scarce; in calcareous turf, on tarmac and on a ruined building (SDSB).

Bryum dichotomum (*B. bicolor*) - frequent on tracks, laybys and damp, gravelly ground, as well as on cliff tops and dune slacks. The '*dunense*' form was recorded by SDSB from thin soil over limestone on the Longstone Down coast and St Govan's Head, and from dune sand at Linney Burrows.

Bryum donianum - patches are scattered through turf along the top of the cliffs on St Govan's Head (SDSB). There is also a small colony on the limestone south of Blucks Pool, noted by SDSB and the present survey.

Bryum gemmiferum **locally rare** - recorded by DH in 2002 in Brownslade Burrows.

Bryum gemmilucens **Nationally Rare** – found January 2021 on a stony target gully on Flimston Down (specimen in BBSUK herbarium).

Bryum kunzei **Nationally Scarce** – found January 2021 at the seaward end of the south-facing slope in Trevallen Valley, where it is locally frequent along the ridge top.

Bryum pallens - recorded by DH in 2002 in Brownslade Burrows; an uncommon species in the county.

Bryum pallescens – on a rusting tank near the demolition quarry.

Bryum pseudotriquetrum - frequent on damp sand in the Brownslade Burrows sand quarry, also in wet ground near the demolition quarry

Bryum radiculosum - grows with *Tortula muralis* on a ruined building on Crickmail Down and with *Weissia* and *Trichostomum* spp. on limestone in the valley on Trevallen Downs (SDSB)

Bryum rubens – noted twice on anthills.

Bryum subapiculatum – noted twice by SDSB and five times during the current survey, from habitats including soil on limestone ledges, anthills, and open heath.

Bryum torquescens **Nationally Scarce** - found in short, open ground on the crest of coastal slopes at Trevallen Down, St Govan's Chapel and Bulliber Down. Developing capsules on the former population in January 2021.

Calliergonella cuspidata - common wherever the ground is damp and lime-rich; rarer in dry grassland.

Calliergonella lindbergii – frequent over a small area of open heath to the west of Winter Pits.

Campyliadelphus chrysophyllus - widespread and often abundant on damp gravelly ground and grassland.

Campylium protensum – on damp dune grassland in both Linney and Brownslade Burrows, and in open stony grassland on Flimston Down and Mount Sion Down.

Campylium stellatum – locally abundant in fen channel on Brownslade Burrows, and in wet ground west of Delta Quarry.

Campylopus brevipilus – in wet heath runnels on Linney Down. A notably disjunct population, otherwise restricted in the county to a few sites in the north.

Campylopus fragilis - rare on sloping ground on the north-east side of St Govan's Head (SDSB and during the current survey).

Campylopus introflexus - occasionally on damp ground in heathland, noted on Flimston Down, Linney Down and Mount Sion Down but never in abundance.

Campylopus pyriformis – on wet heath on Linney Down

Ceratodon purpureus - scattered in the Brownslade and Linney Burrows dunes and on salt-sprayed cliff tops, also in more ruderal situations such as on target gullies.

Cratoneuron filicinum - scarce on track edges and target gullies, also in the dunes.

Cryphaea heteromalla - abundant on a few trees in sheltered sites, including Castle Lady Valley and the Pricaston area.

Ctenidium molluscum var. *molluscum* - locally abundant, with sporophytes, on limestone in Mount Sion Covert; occasional on other limestone outcrops and in turf.

Dicranella heteromalla – found twice, on a trackside, and on clay soil around the rootplate of a fallen tree in Pricaston Quarry (both atypical but conf. Tom Ottley)

Dicranella howeii – not previously recognised in Britain and only recently split from the following species. Found by SDSB to be locally frequent on the coastal track in Range West, where it grows with *Microbryum starckeanum* '*commutata*', and rather rare in Range East. Found on target gullies on Mount Sion Down and Flimston Down by the current survey

Dicranella varia - frequent on disturbed calcareous soil across the range. Locally abundant as dense carpets in the main sand quarry.

Dicranum bonjeanii - noted in calcareous turf at the top of the south side of the Trevalen Downs valley.

Dicranum scoparium - occasional in calcareous turf, especially on the outcrop above Blucks Pool.

Didymodon acutus **Nationally Rare** and *Didymodon icmadophilus* **Nationally Scarce** - Recorded 18 times during the present survey, on dunes and track edges. Particularly abundant on unsurfaced tracks near Blockhouse E on Bulliber Down. A considerable increase on the two locations noted by SDSB. A sample from Trevalen Down proved to be *D. acutus* (new to Wales) rather than *D. icmadophilus*, which most UK populations have apparently been re-assigned to. The latter species was confirmed from tracks near Winter Pits and Blockhouse E, but many populations have yet to be sampled and assigned.

Didymodon fallax - widespread and generally abundant on disturbed calcareous soil.

Didymodon ferrugineus – found in small quantity on damp dune grassland on Brownslade Burrows.

Didymodon insulanus - noted on a boundary bank east of Pricaston (SDSB).

Didymodon luridus - recorded once on damp gravelly ground south of Castle Lady Valley (SDSB) and once in Brownslade Burrows by JH in 1991.

Didymodon nicholsonii - present on shaded tarmac in Castle Lady Valley and on exposed tarmac on a track across Longstone Down (SDSB).

Didymodon rigidulus – on stony ground, sparsely vegetated clay and soil on limestone ledges in several places; not habitually recorded and probably quite widespread

Didymodon sinuosus - rare on natural limestone outcrops in Mount Sion Covert, but more abundant on shaded tarmac in Castle Lady Valley (SDSB).

Didymodon tophaceus - locally abundant in Brownslade Burrows and in lesser abundance on damp calcareous cliff tops (SDSB). Also in damp clay in a target gully on Pen-y-Holt down, and on open heath near the stone rings on Trevalen Down.

Didymodon vinealis – in small quantity on limestone crags and thin soil on St Govan's Head.

Distichium cf. capillaceum – found in compacted dune turf on Brownslade Burrows; no capsules present so identification to species is equivocal.

Ditrichum cylindricum - rare on damp acid soil on Mount Sion Down (SDSB).

Ditrichum gracile - occasional on dry calcareous sand in Brownslade and Linney Burrows, also in turf near the limestone ridge south of Bluck's Pool.

Drepanocladus aduncus - locally frequent in the wettest parts of Brownslade Burrows sand quarry and also present in a pool near the Stack Rocks road (SDSB).

Drepanocladus polygamus - rare in damp hollows by the track across Crickmail Down (SDSB), on Linney Head, and near the stone rings on Trevalen Down.

Encalypta streptocarpa – locally frequent on the eastern part of Brownslade Burrows, and a patch on a stony-based target gully on Bulliber Down

Entosthodon obtusus – frequent on wet peath on Linney Down, and on bare clay within open heath across Range West and East. Notably disjunct, more typical of north Pembrokeshire.

Ephemerum crassinervium ssp. *sessile* (*Ephemerum sessile*) **Nationally Scarce** - collected by SDSB in October 2005 new to Pembrokeshire from a damp track across Mount Sion Down, where it grew in abundance over a small area. A second, smaller colony, comprising 11 sporophytes in two tiny patches, was found on a similar damp track across Pen-y-holt Down in 2007. The present survey found it to be occasional in stony turf, disturbed heathland and target gullies – a total of twelve records were made.

Ephemerum minutissimum – occasionally recorded on anthills in grassland and heath, and on a sheepwalk above outcrops on St Govan's Head. Probably fairly frequent.

Ephemerum recurvifolium - the first known colony in south Wales was found by SDSB on thin clay overlying limestone in a target gully north of Pricaston in

December 2007. It has since been found in three other sites in south Pembrokeshire. The present survey recorded it at seven locations in Range West, in soil gaps in open, stony grassland and in target gullies.

Ephemerum serratum – generally in wetter locations than *E. minutissimum*, and recorded from seasonal pool edges on Linney Head and Flimston Down. Also in open heathland on Mount Sion Down, and occasionally on anthills (where it might have been confused with *minutissimum*).

Eurhynchium hians – mostly restricted to inland areas, where it is scarce on tracks and banks. A form with crowded short branches similar to the very rare *E. meridionale* grows on the crag on the east side of St. Govan's Head

Eurhynchium praelongum - widespread in turf, in woodland and under scrub, but absent from the most exposed ground.

Eurhynchium pumilum - abundant on one boundary bank east of Pricaston and present in small quantity on the side of the hollow in Crickmail Down (SDSB). Recorded by the present survey in two places on shaded limestone rocks and walls in Castle Lady Valley.

Eurhynchium speciosum - noted on a poached stream edge in the Frainslake Cottage valley and a poached pond margin near the Stack Rocks road (SDSB).

Eurhynchium striatum - present on limestone outcrops in three areas (SDSB); noted on St Govan's Head during the current survey where plants seem to have the crowded branches and habit of the rare *E. meridionale*, but lack the obviously rounded alar cells.

Fissidens adianthoides - present in damp dune slacks in Brownslade Burrows, where also noted by JH in 1991. Also recorded on damp gravelly ground on Mount Sion Down (SDSB).

Fissidens dubius - frequent in calcareous turf and on limestone outcrops.

Fissidens exilis – recorded on disturbed clay within grassland near Delta Quarry.

Fissidens incurvus - typical forms are present in small quantity on banks throughout inland areas of the Range. A tall form with narrow sterile shoots that appears to conform to the Mediterranean taxon *F. incurvus* var. *tamarindifolius* was collected from a low bank by the track across Pen-y-holt Down and a damp track on Longstone Down. This taxon is not officially recognised in Britain, but its taxonomy is confused and similar-looking plants have been collected from damp, calcareous clay at several sites in the south-west recently (SDSB).

Fissidens taxifolius var. *taxifolius* - scattered on banks in sheltered inland areas.

Fissidens viridulus - recorded from two banks in Castle Lady Valley (SDSB) and in five locations by the present survey.

Fontinalis antipyretica var. *antipyretica* - locally abundant on walls in Frain's Lake. Relatively large, but probably not striking enough to be var. *gigantea* (SDSB)

Funaria hygrometrica - noted on the cliff tops at Buckspool Down in 2003 (SDSB); locally frequent in a stony target gully on Flimston Down, and on burnt anthills on Mount Sion Down.

Funaria pulchella **Nationally Rare** - a strong colony occurs on thin soil on limestone ledges south of Blucks Pool, recorded by SDSB and perhaps increasing. A new

population was recorded by the current survey on St Govan's Head, where scattered small patches were found on several soil covered ledges.

Grimmia pulvinata var. *pulvinata* - rare on natural limestone in sheltered places, as well as on a concrete track on Flimston Down.

Gymnostomum viridulum **Nationally Scarce** - present on damp, calcareous sand in the southern part of Brownslade Burrows and in the same habitat in Linney Burrows. Also in a crevice on a limestone rock in the former site, and in damp stony ground near the Delta Quarry and on Flimston Down.

Hennediella heimii - there are two small colonies of this salt-tolerant moss on cliff tops on Buckspool Down and one above Flimston Bay; it also grows on track sides at Linney Head (SDSB)

Homalothecium lutescens - locally abundant on dry lime-rich soil and in drier parts of the dune system.

Homalothecium sericeum - widespread in small quantity in sheltered areas, especially on limestone.

Hygroamblystegium tenax – on a concrete block by the Frainslake outlet.

Hypnum cupressiforme - a common epiphyte in sheltered areas.

Hypnum jutlandicum - occasional in damp heathy ground on Flimston Down and Trevallen Downs.

Hypnum lacunosum - widespread and often abundant in dunes and calcareous turf.

Hypnum resupinatum - a common epiphyte, especially on ash trunks.

Isothecium myosuroides var. *myosuroides* - this acidophile is restricted to Castle Lady Valley, Mount Sion Covert and the hollow on Crickmail Down, where it grows in small quantity on trees.

Leptobarbula berica **Nationally Scarce** - the first Pembrokeshire record came from a limestone quarry east of Pricaston (SDSB) in 2008. Still present in small quantity in 2020; now known from one other site in the county.

Leptodictyum riparium - recorded on a wall in Frain's Lake and willow bases in a pool by the Stack Rocks road.

Microbryum davallianum (*Pottia davalliana*) - the 'conica' form, which is the common *M. davallianum* in Britain but is rather scarce in Pembrokeshire, occurs in small quantity on gravel tracks on inland parts of the Range, including north of Mount Sion Covert and east of Pricaston. The Mediterranean 'commutata' form, which has prominent peristome teeth, is locally abundant on the coastal track through Range West and Range East.

Microbryum floerkeanum – found new to Pembrokeshire in two places on Flimston Down – a track centre, and in the centre of a stony target gully.

Microbryum rectum (*Pottia recta*) – SDSB noted several small colonies on damp, calcareous gravelly ground across the Range. Found in numerous locations during the current survey, and clearly frequent in suitable open habitats.

Microbryum starckeanum (*Pottia starckeana*) **Nationally Scarce** – abundant on the coast south of Blucks Pool and at St Govan's Head. Noted in smaller quantity by

SDSB on the coast at Stack Rocks and Longstone Down, and by the present survey on the coast at Flimston Down.

Mnium hornum - this common moss avoids lime, so is rare on the Range and restricted to a few banks (SDSB).

Neckera complanata - on limestone south of Blucks Pool, the east side of St. Govan's Head, and on ash trees in sheltered woodland.

Neckera crispa - locally abundant on north-facing limestone in the valley at Trevalen Downs.

Orthotrichum affine - rare on elder in a quarry south-east of Pricaston. This species is common in inland Pembrokeshire but avoids the coastal fringe.

Orthotrichum anomalum - noted just once: on a sandstone boulder on Crickmail Down.

Orthotrichum diaphanum - rare on willow, elder and ash on inland parts of the Range.

Orthotrichum tenellum - only recorded from two trees in Castle Lady Valley.

Physcomitrium pyriforme - present in its typical habitat: a poached stream bank at Frainslake Cottage (SDSB).

Plagiomnium affine - in small quantity mixed with *Rhodobryum roseum* in calcareous turf on the outcrop south of Blucks Pool, as well as in turf on Trevalen Downs and Linney Burrows (SDSB), and an outcrop at Slade.

Plagiomnium ellipticum - abundant in Brownslade Fen (SR969931) and occasional in Frainslake Fen (SR894976), below a dense canopy of *Juncus subnodulosus* (SDSB) These are highly disjunct colonies: the nearest known sites with *P. ellipticum* are over 20 km away in north Pembrokeshire.

Plagiomnium rostratum - one patch on limestone on the outcrop south of Blucks Pool (SDSB), on soil below a small outcrop on Flimston Down and on St Govan's Head.

Plagiomnium undulatum - scattered across the site in small quantity, but locally frequent under blackthorn scrub and in Brownslade Fen.

Plasteurhynchium striatulum (*Eurhynchium striatulum*) **Nationally Scarce** - locally abundant, with sporophytes, on natural limestone outcrops in Mount Sion Covert (SDSB), Recorded by the current survey on shaded outcrops at Slade, and in small quantity on the north-facing slope at Trevalen.

Platydictya jungermannioides **Nationally Scarce** – found new to the county in three recesses on the cliffs on the east side of St. Govan's Head, then subsequently in the old quarry near Pricaston.

Pleuridium acuminatum - rare on heathland soil on Longstone Down (SDSB) and on anthills on Flimston Down and Mount Sion Down.

Pleuridium subulatum – rare in a target gully on the northern part of Range West, on an anthill in heath near Winter Pits, and in Castle Lady Valley.

Pleurochaete squarrosa **Nationally Scarce** - abundant in calcareous turf in a hollow by the road south of Blucks Pool, locally frequent in fixed dune turf at Linney Burrows, and scattered on Brownslade Burrows, but much less abundant at Castlemartin than at Stackpole.

Pohlia melanodon - noted on a stream bank at Frainslake Cottage (SDSB) and in three places during the current survey on limestone – on the limestone ledges south of Bluck's Pool, on Flimston Down, and near Pen-y-Holt quarry.

Polytrichum juniperinum - present in small quantity on thin soil overlying limestone just inland of Bullslaughter Bay (SDSB). Occasional on Flimston Down, and also noted near Stack Rocks car park, on limestone in the trackside hollow south of Bluck's Pool and at the seaward end of the Trevallen valley.

Polytrichum piliferum - frequent in a hollow in heathland on Crickmail Down (SDSB).

Pottiopsis caespitosa **Nationally Scarce** – a rare calcicole in Wales, this was found new to the county on stony ground and a track near Blockhouse E then subsequently in six other locations – on tracks on Flimston Down, on open damp ground in Delta Quarry, and in two locations on Linney Burrows.

Pseudocrossidium hornschuchianum - frequent on tracks, calcareous sand and damp, gravelly ground.

Pseudocrossidium revolutum - present in small quantity with *Gymnostomum viridulum* in the *Fulgensia* area on the south side of Brownslade Burrows (SDSB).

Rhodobryum roseum **locally rare** - a colony on the limestone outcrop south of Blucks Pool is the only one currently known in Pembrokeshire.

Rhynchostegiella tenella - frequent on limestone outcrops and lime kilns.

Rhynchostegium confertum - a scarce epiphyte in sheltered areas.

Rhynchostegium megapolitanum - occasional on dry sand in Brownslade and Linney Burrows, in a disused target gully on Pen-y-Holt Down, and in several places on Trevallen Down / St. Govan's Head.

Rhynchostegium riparioides - only noted by JH (1991) in Brownslade Burrows, presumably in a suitably wet habitat.

Rhytidiadelphus squarrosus - a single small patch was noted in grassland on Crickmail Down and another was on the south side of the Trevallen Downs valley. It appears that most of the Range is too calcareous, exposed, sandy or rank for this otherwise common moss.

Rhytidiadelphus triquetrus - present on steep, calcareous turf in the valley at Trevallen Downs, also on a dune at Brownslade Burrows.

Schistidium crassipilum - rare on a concrete track on Flimston Down (SDSB), on a limestone rock in Linney Burrows, and, rather surprisingly, on stony clay soil in a target gully on Flimston Down as well as on the concrete pad below.

Scleropodium purum - locally abundant in calcareous grassland and locally frequent on damp, gravelly areas.

Scleropodium tourettii - scattered in several places in short turf on the north-east side of St Govan's Head and also frequent over ca. 30x30 cm of thin soil over limestone behind Bullslaughter Bay.

Scorpiurium circinatum - rare on limestone and in turf at opposite ends of the site, at Trevallen Downs, St Govan's Head and above Blucks Pool. More abundant in a disused quarry in Castle Lady Valley, and on an outcrop at Slade.

Syntrichia intermedia - much less common on limestone than it is at Stackpole, maybe because of exposure. Also recorded once on tarmac.

Syntrichia laevipila var. *laevipila* - on ash branches east of Pricaston and in Mount Sion Covert and Slade on ash and willow.

Syntrichia ruraliformis - abundant in dunes at Brownslade Burrows and extending eastwards on tarmac laybys all the way to the Pricaston area.

Syntrichia ruralis - occasional on tracks and dry dune turf. Plants conforming to *Syntrichia calcicola* were collected by SDSB from thin soil on a limestone ledge at the east end of Buliber Down (SR910951), calcareous turf around limestone pavement on Longstone Down (SR93439453) and nearby in a limestone crevice at SR9431394353. This taxon is split as a separate species in southern Europe, but is not considered different in Britain (Smith, A.J.E., 2004).

Thamnobryum alopecurum - scarce on limestone and ash trunks in and near Castle Lady Valley, and in the hollow on Crickmail Down (SDSB); also abundant in Southrow Quarry.

Thuidium delicatulum/philibertii - two tiny, scrappy plants found in dry dune turf on Linney Burrows by SDSB had a few leaf tips conforming to *T. philibertii*, which would have been new for Pembrokeshire, but were in too poor condition for conclusive identification.

Thuidium tamariscinum - remarkably scarce, presumably because of exposure. Recorded in Mount Sion Covert (SDSB) and the valley at Trevalen Down.

Tortella flavovirens - var. *flavovirens* is scattered around the coast, whilst var. *glareicola* occurs on Brownslade Burrows.

Tortella nitida - present on limestone in just three places, in contrast to its frequency at Stackpole.

Tortula acaulon (*Phascum cuspidatum*) – found on anthills in grassland near Delta Quarry, and on the bank of a target gully north of Castle Lady Valley. Var. *papillosa*, presumed **Nationally Rare**, was found in small quantity on the seaward end of the south-facing Trevalen slope. Var. *pilifera* **Nationally Scarce** - a few plants were found on soil in a limestone crevice on the Longstone Down coast by SDSB.

Tortula atrovirens **Nationally Scarce** - found on limestone cliff tops in at least six places by SDSB, and in six places during the current survey.

Tortula lanceola - collected from thin soil over limestone on the north-east side of St Govan's Head (SDSB) and also seen there and by St Govan's chapel during the current survey.

Tortula marginata ? – collected from a shaded limestone rock low down on the rock face at Slade SR91019639, but misplaced before critical examination. Two old county records but none from this site.

Tortula modica - a few plants were noted on an anthill on St Govan's Head by SDSB. Found several times on anthills on Mount Sion Down by the present survey, as well as on anthills near Delta Quarry and Winter Pits, on soil amongst rocks near Linney Head, and in an old pit near Brownslade Farm.

Tortula muralis var. *muralis* - rare on limestone, kilns, ruined buildings and concrete.

Tortula protobryoides (*Protobryum bryoides*) **locally rare** - six colonies were located by SDSB on thin soil over coastal limestone, distributed almost all the way around the coast. Five of these or similar were found during the current survey, and inland colonies were found on a track near Blockhouse E, on a target gully on Pen-y-Holt Down and on the limestone outcrop south of Bluck's Pool.

Tortula truncata - scattered on soil on Crickmail Down and inland of Flimston Bay (SDSB); occasionally seen by the current survey but not recorded.

Tortula viridifolia - locally frequent in damp depressions on the cliff tops at Buckspool Down and St Govan's Head; abundant on cliffs west of Pen-y-Holt Bay and occasionally found elsewhere on the coast.

Trichostomum brachydontium - abundant on the coast and frequent on inland rock. Noted with sporophytes on a boundary bank in Mount Sion Covert by SDSB.

Trichostomum crispulum - plentiful on lime-rich damp, gravelly ground, damp dune soil and on soil on limestone ledges, often fruiting.

Ulota bruchii - a rare epiphyte in Castle Lady Valley and by the pool next to Stack Rocks road.

Ulota phyllantha - uncommon as an epiphyte in sheltered areas.

Weissia angustifolia **locally rare** – found by SDSB to be locally frequent on the cliff-top above St Govan's Chapel, and rare in calcareous turf on a steep slope on the north-east side of Flimston Fort. Found on the top of the slopes on both sides of the Trevalen valley by the current survey.

Weissia brachycarpa var. *obliqua* - confirmed from east of Stack Rocks in April 2003. *Weissia* spp. with plane leaf margins and unripe capsules on long setae were recorded widely in December 2007 on damp, sparsely vegetated ground and on tracks. These are likely to be either *W. brachycarpa* var. *obliqua* or *W. rutilans*, but need ripe capsules for confirmation (SDSB)

Weissia controversa var. *controversa* - only recorded on the steep clay bank of a target gully north of Pricaston (SDSB)

Weissia controversa var. *densifolia* – in two large 'tank size' patches on Flimston Down, presumably associated with contamination from scrap tanks nearby.

Weissia controversa var. *crispata* **Nationally Scarce** - frequent in crevices in limestone around the coast.

Weissia longifolia var. *longifolia* **locally rare** – SDSB found three plants growing with *Ephemerum sessile* on the damp track across Penyholt Down and one on a damp path just inland of Flimston Fort. The current survey found a few small patches in stony ground on target gullies on Bulliber Down and Mount Sion Down, and in disturbed soil at the latter and near Delta Quarry.

Zygodon viridissimus var. *stirtonii* - occasional on limestone south of Blucks Pool and rare on limestone in Mount Sion Covert.

Zygodon viridissimus var. *viridissimus* - a relatively abundant epiphyte in Castle Lady Valley and other inland areas.

Liverworts

Aneura pinguis – found by SDSB to be frequent on damp sand in Brownslade Burrows and in the nearby fen; also on damp clay of a target gully north of Pricaston. Recorded more widely by the present survey, in slacks, damp heath and target gullies.

Calypogeia muelleriana – on the sides of an old gully in heath on Flimston Down.

Cephalozia bicuspidata – in heathland on Mount Sion Down and Linney Down.

Cephaloziella calyculata **Nationally Rare** - collected by SDSB new to Pembrokeshire from damp soil in heathland at Trevalen Downs in 2004 and found further west, on Longstone Down, the following year. Relocated by him in two places on Longstone Down in 2007, but not on Trevalen Downs. The 2007 survey also revealed locally abundant *C. calyculata* on calcareous slopes on the north-east side of St Govan's Head. Refound in all of these locations during the current survey, as well as in further locations on Mount Sion Down and Bulliber Down. Indeterminate *calyculata* / *integerrima* was also occasionally recorded.

Cephaloziella dentata **Nationally Rare** – recorded new to Wales here and at Stackpole. Found initially to be occasional over a limited area of Linney Down, then subsequently in small quantity on bare clay within heathland on Mount Sion Down and Linney Down.

Cephaloziella divaricata - only identified from Buckspool Down and Crickmail Down by SDSB and from Linney Down during the current survey, but probably present elsewhere on damp ground and in heathland as non-fertile *Cephaloziella* sp. is widespread.

Cephaloziella integerrima **Nationally Rare** – recorded new to west Wales and found to be reasonably widespread in small quantity across Range West, in target gullies and open heath. Also on the heathland on Trevalen Downs, Range East.

Cephaloziella rubella **Nationally Scarce** – identified by Nick Hodgetts from a sample from Mount Sion Down.

Cephaloziella stellulifera **Nationally Scarce** - only identified from Mount Sion Down by SDSB, but considered to be probably present elsewhere. Identified from Trevalen and five locations across Range West by the current survey, and similar plants were regularly encountered – this is probably the 'default' *Cephaloziella* on the site.

Cololejeunea minutissima - an epiphyte on ash, blackthorn, sycamore and willow in sheltered areas.

Conocephalum conicum - typical large, shiny plants of *C. conicum* grow in the Crickmail Down hollow (SDSB).

Fossombronia caespitiformis ssp. *caespitiformis* **Nationally Scarce** The form with purple rhizoids grows in abundance in a target gully on Pen-y-Holt Down, and is locally frequent in similar habitats on Bulliber Down and Linney Down. It was also noted on St Govan's Head, on a sheepwalk across the top of a rocky slope.

Fossombronia caespitiformis ssp. *multispira* (*F. husnotii*) **Nationally Scarce** – SDSB found the form with hyaline rhizoids to be locally abundant in three patches of seasonally damp calcareous turf on the north-east side of St Govan's Head, and present in smaller quantity on a track across Trevalen Downs. The current survey

recorded it in both of these locations, and also in target gullies and heaths at Flimston Down, Mount Sion Down and near the Stack Rocks car park.

Fossombronia foveolata **Nationally Scarce** – on wet clay around a seasonal pool in scraped heath on Flimston Down.

Fossombronia incurva – found in small quantity on open ground on Linney Burrows, and in a target gully on Flimston Down.

Fossombronia maritima **Nationally Rare** – on open patches of heath on Mount Sion Down, possibly also in a target gully on Flimston Down.

Fossombronia pusilla - fruiting on a bank by the track across Pen-y-holt Down (SDSB).

Frullania dilatata - a common epiphyte in inland areas of the Range.

Frullania tamarisci - locally frequent in calcareous turf on limestone outcrops south of Blucks Pool and in the valley on Trevallen Downs. Very rare as an epiphyte on willows by the Stack Rocks road.

Gymnocolea inflata – abundant in and by seasonal pools in wet heath on Linney Down.

Jungermannia sp. – a single non-fertile plant was found on a clay ditch side in fen on Brownslade Burrows.

Jungermannia pumila – a tiny patch was found on a path over limestone rocks in the valley at Trevallen (det. Tom Ottley)

Leiocolea turbinata - present in small quantity on damp limestone in the Crickmail Down hollow (SDSB), abundant on clay ditch side in fen on Brownslade burrows.

Lejeunea cavifolia - recorded in small quantity on limestone in the valley on Trevallen Downs (SDSB).

Lejeunea lamacerina – on willow in streamside wet wood near Frainslake Mill.

Lophocolea bidentata - widely scattered in small quantity in turf, on banks and in woodland. Plants on a track edge on Pen-y-holt Down were checked critically by SDSB in case they might have been the introduced *L. bispinosa*, which occurs on a few MOD Ranges in England but has not yet been recorded in Wales. MDS also checked some samples.

Lophocolea heterophylla - recorded on one log in Mount Sion Covert.

Lophozia excisa - the south coast limestone is the headquarters of this uncommon liverwort in Pembrokeshire. SDSB recorded it in small quantity on damp, gravelly ground; the current survey found it only once in a target gully on Linney Down.

Lunularia cruciata - present on banks in four sheltered places (SDSB); abundant in Pricaston Quarry.

Marchesinia mackaii - abundant in the only four places with sheltered, unquarried limestone: south of Blucks Pool, in Mount Sion Covert, in the hollow at Crickmail Down and in the valley at Trevallen Downs. Also abundant as an epiphyte of ash in the Crickmail Down hollow (SDSB).

Metzgeria fruticulosa - only recorded on a sycamore in a quarry east of Pricaston (SDSB), and on sycamore in Castle Lady Valley.

Metzgeria furcata - a frequent epiphyte in sheltered areas, but also present in turf on the limestone outcrop south of Blucks Pool.

Nardia scalaris – in small quantity in heathland on Linney Down and Mount Sion Down. Although a common heathland species, notably disjunct from other Pembrokeshire populations.

Pellia endiviifolia - common in the fens at Brownslade and Frainslake, on a stream bank at Frainslake Cottage and on the sides of the Crickmail Down hollow (SDSB). Also found by the current survey on pit sides on Mount Sion Down and Flimston Down.

Petalophyllum ralfsii **Nationally Scarce; Schedule 8** - well studied at Brownslade and Linney Burrows, where first recorded by EJ in 1950, relocated by RH in 1999 and surveyed in detail by DH in 2002. SDSB noted scattered plants in the sand quarry in 2007, but made no attempt to repeat DH's 2002 estimate of 400,000 thalli. The current survey noted 5 thalli on a sheepwalk across Linney Burrows, and 2 in damp ground near the old tanks there.

Plagiochila asplenioides - grows in two habitats: woodland at Mount Sion Covert and sheltered turf above Blucks Pool and in the valley at Trevalen Downs.

Plagiochila britannica **locally rare** - collected by SDSB from two small, mossy tree stumps below the natural limestone outcrop in Mount Sion Covert; found by the present survey on one outcrop in the woods nearby. A specimen likely to have been this was also collected from the limestone ridge south of Bluck's Pool.

Plagiochila porelloides - restricted to natural limestone in Mount Sion Covert, the Crickmail Down hollow, Trevalen Downs and in turf on the east side of St Govan's Head.

Porella platyphylla - in reasonable quantity on natural limestone in Mount Sion Covert, and also on ash trunks there (SDSB); also in small quantity on a ridge at the eastern end of the south-facing slope of Trevalen Valley, with *Scorpiurium circinatum*

Preissia quadrata **locally rare** – fairly frequent in flush and ditch sides on the fen in Brownslade Burrows.

Radula complanata - rare on ash in Castle Lady Valley and Mount Sion Covert.

Reboulia hemisphaerica - this uncommon liverwort is present on thin soil on ledges along the length of the limestone outcrop above Blucks Pool.

Riccardia chamedryfolia - noted by SDSB on damp, gravelly ground in two areas, in a coastal gully behind Bullslaughter Bay and on a boundary bank on Crickmail Down. The current survey found it to be frequent on the north-facing banks of various target gullies, and occasional on damp clay within heaths.

Riccia sorocarpa – Noted by SDSB on thin soil on limestone ledges in five places; noted six times during the current survey.

Riccia subbifurca – found in five places, on anthills in heath at Mount Sion Down, on shallow soil on a south-facing coastal slope there and at Trevalen, and on soil over outcrops at St Govan's Head and the Bluck's Pool limestone.

Saccogyna viticulosa - present in sheltered turf below limestone outcrops south of Blucks Pool and in the Trevalen Downs valley.

Scapania aspera - only recorded on the limestone in the Trevallen Downs Valley and adjacent parts of St Govan's Head, but locally frequent there.

Scapania compacta – occasional or locally frequent in runnels in wet heath on Linney Down and Mount Sion Down.

Scapania irrigua – found by SDSB to be rare on damp ground in heathland at Longstone Down, Crickmail Down and Trevallen Downs. The current survey found it occasionally in damp heath at Linney Down, Bullslaughter Bay, near the Stack Rocks car park, and near Winter Pits. Like other heathland species here, disjunct from other Pembrokeshire locations.

Solenostoma gracillimum – found in tiny quantity on a path at Trevallen.

Totals

During the 2019-21 survey, 154 moss and 47 liverwort taxa (total 169 taxa) were recorded on the Range, taking the range totals to **169** mosses and **50** liverworts (total **219** taxa). These scores are now almost on a par with the 229 taxa recorded at the ecologically similar but more sheltered Stackpole SSSI/NNR (Sutton, 2019).

Data Archive Appendix

Data outputs associated with this project are archived on server-based storage at Natural Resources Wales.

The data archive contains:

The final report in Microsoft Word and Adobe PDF formats

An Excel spreadsheet of records from the survey titled *Sutton 2019-2021 Bryo Records Stackpole and Castlemartin*



**Cyfoeth
Naturiol**
Cymru
**Natural
Resources**
Wales

Published by:
Natural Resources Wales
Maes y Ffynnon
Penrhosgarnedd
Bangor

0000 000 000

© Natural Resources Wales 2020

All rights reserved. This document may be reproduced with prior permission of
Natural Resources Wales

Further copies of this report are available from:

Email: library@cyfoethnaturiolcymru.gov.uk