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Bryophyte Survey and Monitoring at Stackpole NNR December 2019 / January 2020



Matt Sutton
Wyndrush Wild Ecology

Evidence Report No 414

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1. Crynodeb Gweithredol

Gwnaeth Bosanquet gynnal yr arolygon manwl cyntaf o fryoffytau yn SoDdGA/GNG Ystangbwll yn 2005, ynghyd ag adolygiad o gofnodion blaenorol. Ni chynhaliwyd unrhyw arolygon na gwaith monitro penodol mewn perthynas â bryoffytau ers hynny. Mae Bosanquet (2019) yn adolygu cyfosodiadau o fryoffytau yn SoDdGAau Cymru ac yn ystyried bod Ystangbwll yn bwysig am ei gyfosodiad 'tir calchaid agored'. Roedd angen yr arolwg presennol i gadarnhau presenoldeb parhaol rhywogaethau allweddol yn y cyfosodiad, ac i gynnig asesiad cyflwr ar gyfer statws presennol y nodwedd bryoffyt yn erbyn amcan cadwraeth newydd. Roedd angen hefyd argymhellion o ran rheoli'r safle a chynnal arolygon a gwaith monitro yn y dyfodol.

Treuliwyd naw diwrnod yn arolygu bryoffytau ar draws y Warchodfa Natur Genedlaethol, gan ganolbwyntio'n enwedig ar y lleoliadau allweddol hysbys ar gyfer rhywogaethau'r cyfosodiad, ond hefyd cofnodi'n ehangach mewn lleoliadau eraill o ddiddordeb posib. Cynhaliwyd gwaith arolygu hefyd ym Meysydd Castellmartin, a chaiff data o'r ardal hon ei gyflwyno mewn adroddiad ar wahân.

Gwnaeth yr arolwg gofnodi 27 o rywogaethau na welwyd o'r blaen ar y safle, yr oedd pump ohonynt yn newydd i'r is-sir ac un ohonynt yn newydd i Gymru. Cafodd presenoldeb parhaus pob un ond un o'r rhywogaethau yn y cyfosodiad 'tir calchaid agored' ei gadarnhau, a chafodd chwe rhywogaeth newydd eu hychwanegu i'r cyfosodiad hwn. Gall Ystangbwll bellach gael ei ystyried fel y safle pwysicaf yng Nghymru am y cyfosodiad hwn. Er na chydabyddir fel y

cyfryw gan Bosanquet (2019), mae gan y safle hefyd dri chyfosodiad arall sy'n cymhwyso, sef 'carreg galchaid yr iseldir', 'twyn' ac 'arfordirol'.

Mae'r holl gyfosodiadau mewn cyflwr ffafriol yn ôl pob golwg. Diffinnir a disgrifir 'parthau bryoffytau', a rhoddir argymhellion ar gyfer camau rheoli lle bo angen. Mae rhestr ddiwygiedig o safleoedd bryoffytau hefyd wedi ei chyflwyno.

2. Executive Summary

Sam Bosanquet carried out the first detailed bryophyte survey work at Stackpole SSSI / NNR in 2005, together with a review of previous recording. No specific bryophyte survey or monitoring work has been carried out since. Bosanquet (2019) reviews Welsh SSSI bryophyte assemblages, and considers Stackpole to be of importance for an 'open calcareous ground' assemblage. The current survey was required to confirm the continued presence of key assemblage species, and to propose a condition assessment for the current status of the bryophyte feature against a new conservation objective. Site management and future survey and monitoring recommendations were also required.

Nine days were spent surveying bryophytes across the NNR, focussing particularly on the known key locations for assemblage species, but also recording more widely in other potentially interesting locations. Survey work was also carried out at Castlemartin Ranges, and data from here is to be presented in a separate report.

The survey recorded 27 species new to the site, 5 of them new to the vice-county and 1 of them new to Wales. The continuing presence of all but one of the ‘open calcareous ground’ assemblage species was confirmed, and six new species were added to this assemblage. Stackpole can now be considered the most important site in Wales for this assemblage. Although not recognised as such in Bosanquet (2019), the site also holds three further qualifying assemblages – ‘lowland calcareous rock’, ‘dune’ and ‘coastal’.

All assemblages appear to be in favourable condition. Important ‘bryo-zones’ 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 Stackpole in 2005. Little further survey work was done in the following 15 years, although the present author carried out NVC survey with Ray Woods in 2012 and, with assistance from Sam Bosanquet, re-recorded some of the notable species. Calcareous grassland monitoring by SDSB in 2012 produced a second *Anomobryum concinatum* record, from the settlement area.

4. Survey Work December 2019 – January 2020

Survey work for the present contract entailed a total of 9 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 (2005) were also targeted. 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. 27 species were recorded new to the site, 5 of them new to the vice-county and 1 of them new to Wales. New species are listed in Appendix 1. 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 229.

5. Qualifying Species of the Open Calcareous Grassland Assemblage

Bosanquet (2019) produced a review of bryophyte SSSI features in Wales. This determined that Stackpole 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 36 points easily surpassed the threshold of 12 points, and placed Stackpole second in Wales behind the Gower Coast in its importance for this assemblage.

The current survey confirmed the continuing presence of all but one of the assemblage species. Six new species were added to the assemblage. The species of the revised assemblage are as follows:

NATIONALLY RARE

Southbya tophacea

A rare liverwort found in small quantity alongside the 'fisherman's path' near Griffith Lort's Hole by Sam Bosanquet in 2005. It was described as growing in 8 small patches on vertical soil 'steps' around limestone outcrops (SR99219483). The patches were (a) three of 2x2cm just above the fishermans' path; (b) one of 4x2cm, (c) two of 1x1cm just below the fishermans' path and (d) two of 1x1cm at the top of a rocky gully. The present survey found it in 5 discrete locations, with the main location holding 5 small patches totalling over 50 plants, and the other four locations between them holding at least 60 plants. Some of these may represent different locations to the original finds. Often associated with small outcropping rocks, and sometimes on a hard turf of the dark reddish liverwort *Frullania* (both *F. tamarisci* and the rarer *F. microphylla* were recorded here) where thin soil fringes the rock.

Status: Stable or increasing

Cephaloziella calyculata

Previously known from Castlemartin and perhaps an expected addition to the Stackpole list. Confirmed from Griffith Lort's Hole, where small patches were recorded in four places. As with the *Southbya*, shallow soil around the edges of rocks protruding from short turf is favoured. This or the following species were also recorded on the west side of Saddle Point. Confusion with *Lophozia excisa* is also possible in the field, and the *Lophozia* is frequent in both locations.

Status: Newly discovered, trend unknown

Cephaloziella integerrima

A more surprising addition. It was found to be locally frequent on Castlemartin Range West by the author just prior to the Stackpole find, but these records represent a considerable range expansion for a species principally found in Cornwall, and with only a single recently discovered site on the Gower Peninsula in south Wales. This and the preceding species have distinctively angled gemmae on the shoot-tips. They differ in the bract tube around the perianth, but non-fertile specimens cannot be named satisfactorily. Evidence from Stackpole and Castlemartin suggests that *calyculata* perhaps favours rocky calcareous turf and *integerrima* more disturbed ground, but they appear to grow in fairly close-proximity at Trevallen Down and south of Barafundle, where it was found at the edge of a path where it crosses the stump of an old wall. The latter site was the only confirmed location at Stackpole.

Status: Newly discovered, trend unknown

Cephaloziella dentata

A completely unexpected discovery of a species previously only known from the Lizard Peninsula heaths in Cornwall. A specimen was collected from open rocky ground in short cliff-edge turf on the east side of Stackpole Head. The leaves were not strongly toothed, and the gemmae not strongly tuberculate (perhaps not fully developed), but better material was subsequently collected from Castlemartin Range West and both specimens were confirmed by Nick Hodgetts, the national liverwort recorder. A repeat visit collected ten *Cephaloziella* samples from the cliff edge around here, but all proved to have smooth gemmae and were thus presumed *stellulifera* or *divaricata*. It is perhaps

destined to remain elusive here, unlike at Castlemartin where the population on Linney Down appears fairly strong. It may in any case sit outside of the open calcareous ground assemblage, being more typically a heathland species.

Status: Newly discovered, trend unknown

NATIONALLY SCARCE

Cephaloziella stellulifera

Only conclusively recorded in two coastal turf locations by Sam Bosanquet (locations not given). Smooth-gemmaed samples were regularly collected from across the site, but were either not fertile or not pursued. However, determination of samples by Tom Ottley added three more locations and suggested that this species is the commonest *Cephaloziella* on the site.

Status: Stable or Increasing

Anomobryum concinatum

Originally noted in a single location by Sam Bosanquet below an outcrop behind Barafundle, this small but distinctive species could not be refound there. However, it was found widely over compacted or leached sand, with a strong population across the settlement area and scattered shoots in around ten other locations. As Sam suggested, identification as *concinatum* or *julaceum* seems somewhat equivocal, but the long costa seems to indicate the former species. Not all specimens were examined closely, and it is possible that both species could occur here as they sometimes do on other sites (Ottley, pers. comm.). Although unobtrusive, the species is distinctive and the apparently dramatic

increase since the 2005 survey is likely, at least in part, to be real, and perhaps related to recent summer droughts.

Status: Increasing

Bryum canariense

Described by Bosanquet (2005) as 'the most abundant *Bryum* on thin soil overlying limestone at Stackpole, as near the Settlement (SR976945), near the Mere Pool Valley (SR976943), on the east shore of the lake (SR977957) and elsewhere. It is also locally frequent on calcareous sand in the Warren'. The present survey saw but rarely recorded this clearly widespread component of the assemblage.

Status: presumed Stable

Bryum torquescens

Recorded new to the site during a brief walkover of the Warren prior to the start of the survey contract. A single tuft was collected from open sandy vegetation at the edge of the main blowout, and confirmed by Tom Ottley following dissection of the inflorescence. A second specimen was collected from near Griffith Lort's Hole, beside a path over low rocks. Previously known in the county only from West Williamston.

Status: Unknown, newly discovered

Didymodon acutus

Bosanquet describes a strong population of this species in the settlement area, although the given grid references place the site to the south of Lady Margaret's Seat. The population was presumably overlooked in the latter site during the

current survey, but the population in Compartment 41b, between Broadhaven and Sandy Pit, was found. It appears to be widespread and locally frequent here, from the steps up from the beach through to the cliffs above Box Bay. New, smaller populations were noted in damp ground by the track and near a seasonal flood in the Mere Pool Valley and on the slope west of Saddle Point. Taxonomic issues mean it is unclear at present whether the plants here belong to *Didymodon acutus* sensu stricto, or to *Didymodon icmadophilus* which is now thought to encompass many of the British records of *Didymodon acutus*. They do not appear to have the long excurrent nerve of *icmadophilus*, which may be a plant of more ruderal habitats.

Status: Stable or increasing

***Funaria pulchella* (*Entosthodon pulchellus*)**

Relocated below the outcrop at the seaward end of the Mere Pool Valley, where it has apparently increased since 2005 when only 15 plants were found in a single tuft. The population here, between SR9766094271 and SR9767694271, now comprises at least 10 small patches, mostly less than 4x2cm. However, the population of c.30 plants recorded by Sam Bosanquet on an outcrop by the eastern arm of the lakes may have succumbed to scrub invasion, and was not located.

Status: Overall increase but potential range contraction

Fissidens crispus

As with the preceding species, this was recorded in 2005 on an outcrop by the eastern arm, which was not accessed during the current survey. It may have

been lost to scrub encroachment, but further populations may have been overlooked elsewhere.

Status: Apparently declining or lost

***Fossombronia caespitiformis* ssp. *multispira* (*Fossombronia husnotii*)**

Three small colonies were found by Sam in 2005, by the fisherman's path at Griffith Lort's Hole, on cliff tops south of Broadhaven, and on the outcrop by the eastern arm. As with the preceding species, it is presumed lost from the latter location, but a few scattered thalli were refound at Griffith Lort's Hole. It is likely to persist on the cliffs south of Broadhaven, and was found also to be scattered along the top of the ridge west of Saddle Point.

Status: Probably stable

Gymnostomum viridulum

Described in 2005 as 'one of the regular, if minor, components of the moss-rich turf where the lichen *Fulgensia fulgens* grows', the current survey recorded small patches more widely, for example in the settlement area, Griffith Lort's Hole, by Lady Margaret's Seat and the Mere Pool Valley. It may have increased, but is easily overlooked.

Status: Stable or Increasing

Microbryum curvicollum

Discovered new to Pembrokeshire on the top of the cliff at the back of Box Bay. The small patch is only visible by lying down and looking over the cliff edge, so will have been missed by previous surveyors. The population may extend on

friable soil down and along the cliff, but rope access would be needed to determine the extent.

Status: Unknown, newly discovered

Microbryum starckeanum

One of the two populations noted by Sam, on the north side of the south arm of the lake (SR97269462), was refound – it currently comprises 4 tiny patches. A second population on cliffs south of Broadhaven was not located, but occasional checking of ripe *Microbryum* capsules with a peristome found further small populations at Griffith Lort's Hole and west of Saddle Point. It will no doubt be more widespread than current records suggest.

Status: Probably stable or increasing

Pleurochaete squarrosa

The current survey found this species to be widespread and abundant, as it was in 2005. As a result, it was not consistently recorded and the mapped locations are only a sample of the true extent.

Status: Stable

Scapania cuspiduligera

Discovered new to Pembrokeshire by the current survey at Griffith Lort's Hole, but a *Scapania* likely to have been this was recorded nearby by Sam Bosanquet in 2005. *Scapania aspera* is frequent in the area, and plants of *cuspiduligera* are best determined by the brown gemmae which may not always be present. This makes the extent of the population difficult to ascertain. A repeat visit to the

location to collect a better sample for the BBS herbarium failed to find any, and it seems likely to be a rare species on site.

Status: Unknown, newly discovered



Figure 1 Microbryum curvicolium (left) and location behind Box Bay arrowed (right)

6. Heathland Species or ‘Honorary Members’ of the Open Calcareous Grassland Assemblage

Two more nationally scarce liverworts are not tabulated in the open calcareous grassland assemblage in Bosanquet (2005). They may be more typically associated with heathland or coastal habitats, but perhaps help to characterise the open calcareous grassland here. *Riccia beyrichiana* was not relocated on the lakeside outcrop at SR97269462, but was instead found in quantity on the slope west of Saddle Point from SR9800294098 to at least SR980329408 where it particularly favours a sheepwalk along the middle of the slope. *Ephemerum sessile* (*E. crassinervium* ssp. *sessile*) was found new to the site on the same slope, but on a lower fisherman’s path below a patch of heath. A moss, *Dicranella howei*, was recorded new to the site from the Settlement area and is likely to be widespread here as it is at Castlemartin (Bosanquet, 2010) – this

is soon to be accepted as a British species (Blockeel, pers. comm.) and may be considered Nationally Scarce.

7. Revised Assemblage Scores

Based on the presence of Nationally Scarce or Rare species belonging to an 'ecologically coherent' assemblage, Stackpole SSSI previously scored 36 for its **Open Calcareous Grassland** assemblage. The addition of all of the newly recorded species described above would give a new score of **54**, making the site the most important in Wales for this assemblage.

Although not recognised as such in Bosanquet (2019), the Mere Pool valley (if wooded areas are included) also appears to hold a qualifying **Lowland Calcareous Rock** assemblage, characterised by *Grimmia orbicularis*, *Seligeria* sp., *Cololejeunea rosettiana* and *Eurynchium striatulum*. The total score is **12**. A further potential assemblage species, *Platydictya jungermannioides*, was found new to the county at St Govan's Head at the end of the present survey, and may have gone undetected at Stackpole.

The hollows in the dune system on the Warren are not wet enough for classic slack vegetation, and were not considered for a qualifying **Dune and Slack** assemblage in Bosanquet (2019). The discovery of the nationally scarce *Bryum torquescens* and *Anomobryum concinatum* in addition to the frequent or abundant *Bryum canariense*, *Pleurochaete squarrosa* and *Gymnostomum viridulum*, and occasional *Didymodon acutus*, suggests that the site is more important for dune vegetation than previously considered. The total score for the

dune and slack assemblage now stands at **15**, exceeding the threshold score of 12. In comparison, the assemblage score for the dune and slack vegetation at Castlemartin Cliffs and Dunes SSSI stood at 12 (Bosanquet, 2019), but the recent addition of a *Distichium* species increases it to 15.

The discovery of *Cephaloziella dentata* on Stackpole Head raises the profile of the cliff-edge vegetation at Stackpole. Although not previously considered for a **Coastal Habitats** assemblage (Bosanquet, 2019), the presence of the nationally rare *Cephaloziella* and the nationally scarce *Tortula atrovirens*, *Fossombronia caespitiformis* ssp. *multispira* and *Riccia beyrichiana* gives a score of **15**. There would be some overlap with the OCG assemblage through the *Fossombronia*, and the *Riccia* which could perhaps be assigned to either.

8. Monitoring and Condition Assessment

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	

Direct monitoring of all four qualifying assemblages at Stackpole is recommended. A competent specialist will be required to carry out the work, as many of the assemblage 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 but one of the OCG Assemblage species on the site, and found them all to be stable or increasing. A single outcrop alongside the eastern lake arm is unfavourable / lost, but all other key locations for assemblage species are in favourable condition. LCR, Dune and Coastal Assemblage species were confirmed and appeared to have stable populations. It appears that **all bryophyte assemblages at Stackpole NNR are currently in favourable condition.**

9. Important 'Bryo-Zones'

Bosanquet (2005) mapped areas considered to be key for open-country bryophyte conservation. Building on this approach, and with the refined approach to defining the assemblage provided by Bosanquet (2019), the following 'bryo-zones' are mapped. Each area has been scored and ranked according to its total of assemblage species. Descriptions for each are provided in Appendix 1.



Figure 2 Important 'Bryo-zones' at Stackpole NNR: 1. Griffith Lort's Hole and Adjoining Slopes; 2. Saddle Point West; 3. Mere Pool Valley; 4. Lakeside Outcrops; 5. Broadhaven to Sandy Pit; 6. Settlement Area and Devil's Quoit Field western edge; 7. Stackpole Head; 8. Stackpole Warren Dune Hollows; 9. Coast South of Broadhaven; 10. Limestone Ridge behind Barafundle.

10. Five Management Actions for Bryophytes

1. Clearance of privet and other scrub from base of outcrop with *Funaria pulchella*, seaward end of Mere Pool Valley at SR97679427. Minor works.
2. Clearance of cotoneaster (and some gorse) from Lakeside outcrop at near *Anomobryum concinatum* at SR97189464. Moderate works.
3. Clearance of scrub from around outcrops on eastern side of lake above the eight arch bridge. Major works.
4. Clearance of some gorse from base of outcrops in western part of Mere Pool Valley. Moderate works.
5. Increase grazing pressure on western side of Stackpole Warren.



Figure 3 Action 1 location (left); Action 2 location (right)

11. References

Bosanquet, SDS. 2005. *A Survey of the Bryophytes of Stackpole SSSI/NNR and Review of Previous Bryophyte Recording at Stackpole*. Unpublished CCW report.

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Appendix 1: Important 'Bryo-zones'

1. Griffith Lort's Hole and adjoining slopes



(left) Fisherman's path with *Southbya* location by main outcrop on right; (right) *Southbya* and *Anomobryum* location

Description: The slopes south of Barafundle are Pembrokeshire limestone's stand-out bryophyte location. *Southbya tophacea*, the rare liverwort found by Sam Bosanquet, is now in a few more small patches than during his 2005 survey. Two more nationally rare liverworts have been added by the present survey – *Cephaloziella calyculata* and *Cephaloziella integerrima*. The Nationally Scarce liverwort *Scapania cuspiduligera* was found in tiny quantity, new to the county. Other Nationally Scarce species characterising the 'open calcareous ground' assemblage here are *Bryum torquescens*, *Anomobryum concinnatum*, *Microbryum starckeanum*, *Fossombronina caespitiformis* ssp. *multispira*, *Gymnostomum viridulum* and *Riccia subbifurca*. The total assemblage score makes it individually the best location for the assemblage in Wales, above the whole of the Gower Limestone coast. There is a diverse supporting cast of locally uncommon species including *Hypnum lindbergii*, *Frullania fragilifolia*, *Plagiochila bifaria*, *Acaulon muticum*, *Scleropodium touretii* and *Scapania aspera*.

Total Assemblage Score: 42+

Key species for monitoring: *Southbya tophacea*, *Cephaloziella calyculata*, *Cephaloziella integerrima*, *Scapania cuspiduligera*.

Current Condition: Favourable Maintained

Basis of Condition Assessment: *Southbya tophacea* appears to be stable or increasing. Most other assemblage species here are newly recorded, so no baseline information available. The key species are associated with trampling or tight-grazing, and the area is well-maintained by both of these. Recent summer droughts may well have benefitted key species.

Further Survey Requirements: The frequency of *Scapania cuspiduligera* requires assessment, and collection of a good voucher specimen for the BBS herbarium is desirable. *Encalypta vulgaris* may have been recorded here by Alan Orange in the 1980s – relocation of this locally rare species would be desirable. Rope access to the cliff-sides in the fault could reveal further interesting species.

Threats: The 'fisherman's path' is edged by scrub, but this is unlikely to advance much over the rock. Current trampling levels seem ideal. Recent summer droughts may well have benefitted key species.

Management Actions Required: Maintain recent grazing levels.

2. Saddle Point West



(left) *Riccia subbifurca* and *Fossombronia caespitiformis* location at top of slope; (right) path with *Didymodon acutus*, *Tortula protobryoides* and *Ephemerums*

Description: The south-west facing slope between Saddle Point and the path up from Broadhaven mostly comprises a mixture of limestone outcrops and short turf over broken rock. There are also areas of heathy grassland and open *Calluna* heath. The nationally rare liverwort *Cephaloziella calyculata* is found around low rocks at the northern end, although the lack of fertile material meant that the rarer *Cephaloziella integerrima* could not be ruled out. *Cephaloziella stellulifera* is also present. There is a large population of *Riccia beyrichiana* on mid-slopes at the northern end, and *Riccia subbifurca* and *Fossombronia caespitiformis* ssp. *multispira* are occasional along the top of the slope. A narrow path cutting down the slope to the point has *Didymodon acutus*, the tiny *Ephemerum crassinervium* ssp. *sessile* (and *Ephemerum serratum*), as well as *Tortula protobryoides* alongside. The heath above has the only *Entosthodon obtusus* on site, and is somewhat reminiscent of the heaths on Castlemartin Range West. *Tortula lanceola* is present alongside the lichen *Fulgensia fulgens* on the rock platform near the beach. *Tortula viridifolia*, *Microbryum starckeanum* and *Microbryum rectum* are also present.

Total Assemblage Score: 27

Key species for monitoring: *Cephaloziella calyculata*, *Riccia beyrichiana*, *Fossombronia caespitiformis* ssp. *multispira*

Current Condition: Favourable Maintained

Basis of Condition Assessment: This area appears not to have been surveyed by Bosanquet (2005). Most key species newly recorded here are occasional or locally frequent, and the habitat is generally short and open.

Further Survey Requirements: Confirmation of the identification of *Cephaloziella calyculata* is required. The *Weissia* populations could be checked for rare species in late winter.

Threats: None noted.

Management Actions Required: Maintain recent winter sheep grazing levels. Do not allow spread of the small gorse patches over the *Riccia beyrichiana* population.

3. Mere Pool Valley



(left) view of outcrops looking seawards; (right) *Tortula lanceola* location

Description: The south-facing outcrops on the north side of the Mere Pool Valley hold a selection of open calcareous grassland species on shallow soil over rock, most notably a small population of the nationally scarce *Entosthodon pulchellus*, but also some *Pleurochaete squarrosa*, *Gymnostomum viridulum* and *Riccia subbifurca* and the locally rare *Reboulia hemisphaerica* and *Tortula lanceola*. Although not recognised as such in Bosanquet (2019), the valley (if wooded areas are included) also appears to hold a qualifying 'lowland calcareous rock' assemblage, characterised by *Grimmia orbicularis*, *Seligeria* sp., *Cololejeunea rosettiana* and *Eurynchium striatulum*. The locally rare *Taxiphyllum wisgrillii* was also seen on woodland outcrops, and the main outcrop at the seaward end holds the only *Eucladium verticillatum* on site.

Total Assemblage Score: 27 (Open Calcareous Grassland 15, Lowland Calcareous Rock 12)

Key species for monitoring: *Entosthodon pulchellus*, *Grimmia orbicularis*, *Seligeria* sp.

Current Condition: Open Calcareous Grassland - Favourable Maintained, Lowland Calcareous Rock – unassessed.

Basis of Condition Assessment: The small population of *Entosthodon pulchellus* appears to number more plants and patches than reported by Bosanquet (2005). No OCG assemblage species have been lost, and the local rarity *Tortula lanceola* was recorded from additional outcrops. The LCR assemblage was not fully assessed – *Grimmia orbicularis* appears to be still frequent on the rock-face near the lake outlet but was not counted; the small *Seligeria* population could not be relocated. *Cololejeunea rosettiana* was noted on 3 outcrops in the wooded area, but *Eurynchium striatulum* was not searched for.

Further Survey Requirements: Relocation of the *Seligeria* (and identification to species if fruiting) would be desirable.

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

Management Actions Required: Maintain or increase recent levels of grazing in the valley. Targeted removal of privet from the base of the slope with *Entosthodon pulchellus* at SR97669427 could allow the *Entosthodon* to expand on to currently shaded ledges. Removal of some gorse scrub from below the western outcrop at SR97309425 would be desirable to allow expansion of the small *Tortula lanceola* population here.

4. Lakeside Outcrops



(left) *Microbryum starckeanum* on lower part of largest outcrop; (right) *Tortula protobryoides* location

Description: The largest outcrop is above the western lake arm, and this holds the nationally scarce *Microbryum starckeanum* as well as the local rarities *Tortula lanceola*, *Reboulia hemisphaerica* and *Microbryum rectum*. *Riccia beyrichiana* was not refound here during the recent survey, but *Anomobryum concinatum* was added from the top edge of the outcrop. A small outcrop above the junction of western and eastern arms holds a single tuft of the locally rare *Tortula protobryoides*. An outcrop by the eastern lake arm above the eight arch bridge held *Entosthodon pulchellus*, *Fissidens crispus*, *Fossombronia caespitiformis* ssp. *multispira*, *Riccia subbifurca* and *Bryum canariense* at the time of Bosanquet's 2005 survey, but was not visited during the present survey as it appeared to be scrub covered.

Total Assemblage Score: 27 (12 during current survey)

Key species for monitoring: *Entosthodon pulchellus*

Current Condition: Unfavourable

Basis of Condition Assessment: The outcrop with a small population of *Entosthodon pulchellus* and other assemblage species appears now to be surrounded by or covered with scrub. Populations of other key species are small and vulnerable to scrub encroachment.

Further Survey Requirements: Relocation of the *Entosthodon* would be desirable.

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

Management Actions Required: Recovery management is needed around the outcrop above the eight arch bridge, with scrub removal from on and around any outcrops. In the absence of grazing, periodic removal of scrub from on and around all of these outcrops is required to maintain the assemblage. Cotoneaster is directly threatening the small *Anomobryum concinatum* population above the main outcrop, and should be eradicated from this location and elsewhere.

5. Broadhaven to Sandy Pit



(left) short turf notable for *Fulgensia fulgens*, but also supporting frequent *Didymodon acutus*; (right) Box Bay cliffs looking towards Sandy Pit

Description: The swathe of short turf over compacted sandy ground and rocks between Broadhaven and Sandy Pit is notable for the lichen *Fulgensia fulgens*, but is also the best location on the site for the nationally scarce moss *Didymodon acutus*. Small patches of *Gymnostomum viridulum* are found alongside, and *Pleurochaete squarrosa* is abundant. *Bryum canariense* is frequent on rock outcrops. The nationally scarce *Microbryum curvicolium* was found on the cliff top behind Box Bay. The cliff edge here also has *Anomobryum concinnatum*, *Brachythecium glareosum* and *Scleropodium touretii*.

Total Assemblage Score: 18

Key species for monitoring: *Didymodon acutus*, *Microbryum curvicolium*

Current Condition: Favourable Maintained

Basis of Condition Assessment: This area appears to be unchanged over the last 10-15 years, and *Didymodon acutus* is locally frequent. Monitoring of *Fulgensia fulgens* may provide an approximate surrogate for the *Didymodon*, as the habitat requirements appear similar. Current trampling levels seem ideal. Recent summer droughts may well have benefitted key species.

Further Survey Requirements: An old record of *Aloina rigida* from the Box Bay area has not been refound, and small *Aloina aloides* alongside the *Microbryum curvicolium* may call this record into question. Rope access survey of the Box Bay cliffs would be needed to search for this species, as well as establishing the extent of the *Microbryum* population and potentially revealing other rarities such as *Pterygoneurum ovatum*.

Threats: None noted.

Management Actions Required: Maintain recent levels of grazing.

6. Settlement Area and Devil's Quoit Field western edge



(left) *Anomobryum concinnatum* is frequent around the old wall here; (right) *Jungermannia* location on recently mown northern slope

Description: The leached dune grassland here generally has a closed turf, but shallow soil around the rock walls of the old structures and the more open slope to the north provide habitat for the largest population of *Anomobryum concinnatum* on the site. *Gymnostomum viridulum* is present in small quantity, whilst *Pleurochaete squarrosa*, *Bryum canariense* and *Dicranella howei* are also noted. A *Jungermannia* species with affinities to *J. borealis* is being assessed by Nick Hodgetts. The *Anomobryum* population extends through into the Devil's Quoit field, Compartment 43, where strongly leached sandy soil over shallow rock exposures has an unusual abundance of *Racomitrium lanuginosum*, more typically associated with upland areas. The locally rare *Tortula lanceola* is present in small quantity around rocks here.

Total Assemblage Score: 12

Key species for monitoring: *Anomobryum concinnatum*

Current Condition: Favourable Maintained

Basis of Condition Assessment: This area appears to be well maintained in an open state by sheep grazing, scrub control and mower-collecting. *Anomobryum* was not noted by the 2005 survey, but is fairly frequent here, with at least 15 patches recorded.

Further Survey Requirements: None

Threats: Holm oak and other woody vegetation is a continual threat to the open grassland habitats here and elsewhere.

Management Actions Required: Maintain recent levels of grazing. Continue regular clearance of holm oak, gorse and other woody vegetation. Where compatible with archaeological interest, ensure that mower-collector cuts as low as possible, scalping the ground and creating small bare patches.

7. Stackpole Head



(left) Thin soil over rock at the cliff edge supports *Tortula atrovirens*; (right) *Cephaloziella dentata* was collected from rocky turf at the cliff edge

Description: The exposed Stackpole Head appears not to support the open calcareous grassland assemblage species, but a narrow band of cliff edge vegetation on the north side of the Head is notable for the first Welsh record of the nationally rare *Cephaloziella dentata*. The salt-sprayed vegetation also holds the nationally scarce *Tortula atrovirens*, as well as the more widespread *Amblystegium serpens* var. *salinum*, *Tortula viridifolia*, *Hennediella heimii* and *Lophozia excisa*.

Total Assemblage Score: Coastal Assemblage – 9.

Key species for monitoring: *Cephaloziella dentata*

Current Condition: Unknown

Basis of Condition Assessment: The *Cephaloziella* has not been relocated following initial collection, and no assessment of the population size is currently possible.

Further Survey Requirements: Re-location and assessment of the *Cephaloziella* is required.

Threats: Current exposure, grazing and trampling seem to be maintaining the open cliff-edge. Trampling may be too heavy in localised areas around climbing rope attachment points, but these are not significant.

Management Actions Required: Maintain or increase recent levels of grazing. Undercliffs further west on the Head, and the main plateau area of the Head itself are under-grazed and bryophyte-poor – mower-collecting or heathland re-creation work here would potentially increase bryophyte habitat.

8. Stackpole Warren Dune Hollows



(left) Blowout with *Bryum torquescens* location in foreground; (right) small hollow with potential *Bryum creberrimum*

Description: The hollows in the dune system on the Warren hold small populations of the nationally scarce *Bryum torquescens* and *Anomobryum concinatum*. In addition, *Bryum canariense*, *Pleurochaete squarrosa* and *Gymnostomum viridulum*, are frequent or abundant, whilst *Didymodon acutus* and the locally rare *Didymodon ferrugineus* are also present here, and *Leiocolea badensis* was found new to the county by the present survey. A potential specimen of the nationally rare *Bryum creberrimum* was sent to the *Bryum* referee David Holyoak, but he was unable to confirm the identification from the limited amount of material.

Total Assemblage Score: Dune and Slack Assemblage – 21.

Key species for monitoring: *Bryum torquescens*

Current Condition: Unknown

Basis of Condition Assessment: The key species were found in small quantity by the current survey, and the extent of and trend in their populations is not known. The Warren as a whole is currently under-grazed, but the hollows appear to be receiving adequate grazing, backed up by mowing in some areas.

Further Survey Requirements: Potential *Bryum creberrimum* would require collecting in late summer when more mature capsules are present. Survey of the extent of the *Bryum* populations would be required before any monitoring could be implemented.

Threats: was only found in a single square metre of dune hollow and would be vulnerable to, for example, an illicit campfire. Under-grazing is a general threat to the open dune grassland; conversely, concentration of sheep dunging in sheltered hollows could impact on sensitive species.

Management Actions Required: Maintain or increase winter sheep-grazing. Continue rank vegetation and scrub management through mower-collecting but cut lower, scalping the ground wherever possible.

Additional Localities Considered



Limestone ridge behind Barafundle

The **Coastline South of Broadhaven (9)** has *Riccia subbifurca*, *Microbryum starckeanum* and *Fossombronia caespitiformis* ssp. *multispira* as well as the locally rare *Weissia longifolia* var. *angustifolia*. Not surveyed in detail during the present survey, it presumably also has *Pleurochaete squarrosa* which would give it a qualifying assemblage score of 12.

The **Limestone Ridge behind Barafundle (10)** has significant outcrops with *Pleurochaete squarrosa*, but apparently lacking other assemblage species. The original *Anomobryum concinnatum* location recorded by Sam Bosanquet in 2005 was not relocated during the current survey. *Bryum canariense* is likely to be present, but the assemblage score would be 9 at most.

Appendix 2: Results & Annotated Checklist as of January 2020

This checklist is updated from Bosanquet (2005). Species are listed alphabetically, with mosses and liverworts in separate sections. Taxonomy and nomenclature follow the 1998 *Census Catalogus*; more recent 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 Bosanquet (2011). Underlined species are additions to the Stackpole bryophyte flora made during the current survey by MDS. All records are by SDSB unless indicated with a recorder in brackets (AH: Alan Hale; AO: Alan Orange; EFW: E.F. Warburg; FR: Francis Rose; MEN: Martha Newton; ST: NCC Survey Team, MDS: Matt Sutton). Comments such as “scarce in woods” in the annotated checklist relate to the status of taxa at Stackpole rather than their national status.

Mosses

Acaulon muticum – found by MDS on a track and rut at the back of the Warren, and on an anthill at Griffith Lort’s Hole. The latter specimen was small but not the hoped for *A. mediterraneum*.

Aloina (aloides var.) aloides - scarce on the SSSI in comparison to Castlemartin Ranges, growing on thin on seasonally damp soil and cliffs in the Mere Pool Valley (AH & MEN, MDS), at Barafundle Bay (SDSB, MDS), Box Bay Cliffs (MDS), Griffith Lort’s Hole (MDS) and Broadhaven (MDS).

Aloina (aloides var.) ambigua **Nationally Scarce, Locally Rare** - the first Pembrokeshire record comes from the Mere Pool Valley (MEN 1997). Subsequently found at a sand quarry in the north of the county, and by the current survey at Castlemartin (Trevallen).

Amblystegium serpens var. *salinum* - scattered on salt-sprayed coastal turf and on stable dunes.

Amblystegium serpens var. *serpens* - occasional as an epiphyte on ash, elder and willow or on limestone.

Anomobryum concinnatum **Nationally Scarce, Locally Rare** – first found by SDSB on blown sand over limestone behind Barafundle Bay, this small but distinctive species was found by MDS to be fairly widespread on thin sandy soil over rock at Box Bay, Griffith Lort’s Hole, Lady Margaret’s Seat, the Settlement Area, Compts 21, 43 and 47a.

Anomodon viticulosus - locally frequent on limestone outcrops in woodland.

Archidium alterniflorum – abundant at Castlemartin but surprisingly not on the Stackpole list prior to MDS's survey. Frequent on path sides around Griffith Lort's Hole and also noted on the west side of Saddle Point. Most abundant on the inundated lower edge of the stripped heathland plot on the back of the Warren.

Atrichum undulatum var. *undulatum* - scarce in woods and under scrub, also at edge of stripped heathland plot in Compt 48b.

Barbula convoluta - noted occasionally on tracks and other bare ground. A series of records from shallow calcareous soil by the Survey Team (1977) are much more likely to be *Gymnostomum viridulum*, which is locally frequent in such areas but was not described as a British species until the 1980s.

Barbula unguiculata - occasional on tracks and on calcareous soil.

Brachythecium albicans - locally abundant in stable dune grassland.

Brachythecium glareosum **Locally Rare** – a tiny patch found by MDS on the cliff-edge behind Box Bay (SR9825994314). Superficially like the abundant *Homalothecium lutescens* and perhaps overlooked elsewhere.

Brachythecium (Sciuro-hypnum) populeum - recorded once as an epiphyte in the Mere Pool Valley; possibly overlooked.

Brachythecium rutabulum - frequent on the woodland floor, under scrub, on decaying logs and on path-sides; occasional in more open situations.

Bryoerythrophyllum recurvirostrum - recorded by FR on limestone and by AO on soil in woods; more recently by MDS west of Lattice Windows and at edge of seasonal flood in Mere Pool Valley.

Bryum algovicum var. *rutheanum* - ripe capsules (present in late summer) are needed for identification. Identified by MEN (1997) in the Mere Pool Valley but probably elsewhere in the dunes.

Bryum argenteum - noted on a track through a clearing in compartment 63 (AO 1984), and near the holding pen at the back of the Warren by MDS.

Bryum canariense **Nationally Scarce, Locally Rare** - locally abundant on blown sand over limestone in compartment 61 and frequent in similar conditions in 04b, 41b, 47a and doubtless elsewhere.

Bryum capillare var. *capillare* - a frequent epiphyte; occasional in other habitats.

Bryum cf. creberrimum – a few shoots with ripe capsules were collected by MDS from a small dune hollow on the Warren (SR98519457). Previously recorded from various places on the Warren but considered by Bosanquet to be in error. DT Holyoak, the *Bryum* referee, was unable to rule out the similar *Bryum pallescens* from the limited material available. Spore sizes appear to suggest *creberrimum*, whilst endostome process perforation measurements were suggestive of *pallescens*.

Bryum dichotomum (*B. bicolor*) - widespread on bare ground.

Bryum dichotomum 'dunense' (*B. dunense*) - present in bare, salt-sprayed turf on the cliff-tops of 47a, and recorded by MDS in 03 and 43.

Bryum donianum - on soil amongst limestone outcrops in several places.

Bryum pallescens - recorded from dunes by AO in 1986. Found by MDS in trampled turf in 48a. See also *Bryum creberrimum*.

Bryum pseudotriquetrum - present in dune slacks in the Mere Pool Valley, and in short turf in 43.

Bryum radiculosum - on soil overlying limestone in 80s.

Bryum rubens - present on a track in 63 (AO 1984) and on anthills in 80s. The ST 1977 record from 48 may be correct, but it may be the result of confusion with the tubers of *B. canariense*.

Bryum ruderale - rare on soil among limestone outcrops in 84.

Bryum subapiculatum – on a soil gap and an anthill near Griffith Lort's Hole and in Compartment 16.

Bryum torquescens – **Nationally Scarce, Locally Rare** - previously known in the county only from West Williamston, this was found by MDS on a path over rocks near Griffith Lort's Hole, and on open sand at the edge of the large blowout on the Warren. Confirmed by Tom Ottley.

Bryum violaceum - recorded on sandy soil of a track in 63 (AO 1984).

Calliergonella cuspidata - widespread in damp or humid calcareous situations. Abundant in slacks in the Mere Pool Valley.

Campyliadelphus chrysophyllus - frequent in calcareous turf and on blown sand.

Campylium stellatum var. *protensum* - present on the damp sand of seasonal slacks in 04b.

Campylium stellatum var. *stellatum* - reported from dune slacks in the Mere Pool Valley (MEN 1997). Only var. *protensum* was seen in 2005, but the record may be correct.

Campylopus pilifer var. *brevirameus* – a *Campylopus* with straight hair points in rocky short turf near Griffith Lort's Hole showed only 1 cell-high lamellae so may correspond to this intermediate between *pilifer* and *introflexus* noted in Bosanquet (2010).

Campylopus flexuosus – this calcifuge was found by MDS in one place on the heathy slope on the west side of Saddle Point.

Campylopus fragilis - dense turfs on soil slumps in 17 and scattered at cliff edges at Griffith Lort's Hole.

Campylopus introflexus - scattered on rotting logs, a stripped heathland plot and similar acidic substrates.

Ceratodon purpureus - present in compartments 03, 43, 51, west of Lattice Windows and occasionally on tracks.

Cirriphyllum piliferum - locally frequent on woodland banks.

Cratoneuron filicinum - present on lake-side soil in 61 (AO 1984) and on a damp track in 80n.

Cryphaea heteromalla - a moderately frequent epiphyte on ash, elder and sycamore.

Ctenidium molluscum var. *molluscum* - locally frequent around limestone outcrops and in woodland.

Dicranella heteromalla - an acidophile noted in woodland in compartment 61 (AO 1984) and (rather improbably) in dune turf in 48 (ST 1977). Recorded by MDS from edge of stripped heath plot.

Dicranella howei **Locally Rare** – recorded by SDSB along the Castlemartin Coast, but apparently not at Stackpole, this split from *Dicranella varia* is about to be admitted to the British list and is no doubt more widespread at Stackpole than the single MDS record from the Settlement Area, confirmed by Tom Blockeel, suggests.

Dicranella schreberiana - present on a damp track in woodland in 80n.

Dicranella varia - on bare calcareous soil by paths in woodland.

Dicranum bonjeanii - on three anthills in 48b.

Dicranum scoparium - widespread in turf, heathland, on rotting logs etc., but seldom in quantity.

Didymodon acutus **Nationally Scarce** - first noted by AH in 41a (Quadrat 56).
Locally frequent in bryophyte-dominated patches on blown sand in 10, 40, 41b, 47a, 61, Settlement area and Mere Pool Valley.

Didymodon fallax - widespread on bare calcareous soil.

Didymodon insulanus - occasional in woodland; also on *Salix* in 61 (AO 1984).

Didymodon luridus - noted by MEN (1997).

Didymodon rigidulus - occasional on walls, also in rocky turf near Griffith Lort's Hole.

Didymodon sinuosus - on limestone outcrops in woodland in 88.

Didymodon tophaceus - recorded by FR in 1965, AP in 1973 and by MDS in 2019 in Mere Pool Valley.

Didymodon vinealis - soil on cliff top, Mere Pool Valley (AO 1984).

Ditrichum gracile (*D. flexicaule/crispatissimum*) **Locally Rare** - frequent in calcareous turf, especially in 41b and 61.

Drepanocladus aduncus - locally abundant in slacks and pools in the Mere Pool Valley.

Drepanocladus polygamus – this fairly widespread coastal species was noted by MDS in turf at SR97849505.

Encalypta streptocarpa - frequent in moss-rich calcareous turf, especially in 41b and 61.

Encalypta vulgaris **Locally Rare** - noted by AO (1984) in compartment 48.

Entosthodon obtusus – found by MDS on the west side of Saddle Point in a similar habitat to which it is frequent on Castlemartin Ranges, bare clay soil between *Calluna* in open heathland (SR9807294025 and SR9814493993).

Ephemerum sessile (*E. crassinervium* ssp. *sessile*) **Nationally Scarce** – known from Castlemartin and found by MDS on bare clay west of Saddle Point. Patches were found in two places on the narrow fisherman's path below the heath (SR9811993984 and SR9812693902).

Ephemerum minutissimum – found by MDS on a single anthill at Griffith Lort's Hole (SR9919894827).

Ephemerum serratum – along the same path as the *E. sessile* at SR9810393999 (MDS, 2020). Described by Bosanquet (2010) as a plant of inundation zones but also found on anthills at Castlemartin during recent survey work.

Eucladium verticillatum - present on damp limestone outcrops in the Mere Pool Valley.

Eurhynchium crassinervium - recorded by MEN in 1996 and in 80s by SDSB.

Eurhynchium (*Oxyrrhynchium*) *hians* - scattered on bare calcareous soil on woodland floors.

Eurhynchium (*Kindbergia*) *praelongum* - widespread in turf and in woodland.

Eurhynchium (*Oxyrrhynchium*) *pumilum* - on steep soil banks in woodland in several places. A small species so overlooked previously.

Eurhynchium (*Oxyrrhynchium*) *speciosum* - rather unusually, this moss of fen, carr and coastal flushes grows in the slacks in the Mere Pool Valley.

Eurhynchium (*Eurhynchiastrum*) *striatulum* **Nationally Scarce** - first recorded by FR (1965). Rare on limestone in the wooded Mere Pool Valley.

Eurhynchium striatum - locally frequent on woodland floors; occasional in N-facing coastal turf.

Fissidens adianthoides - several tufts grow in slacks in the Mere Pool Valley.

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

Fissidens incurvus - occasional on calcareous soil, especially in woodlands.

Fissidens crispus (*limbatus*) **Nationally Scarce, Locally Rare** - on thin soil on a limestone outcrop in 80s.

Fissidens taxifolius var. *taxifolius* - scattered in turf and woodland.

Fissidens viridulus - occasional on woodland banks.

Fontinalis antipyretica var. *gigantea* **Locally Rare** - locally abundant in the Lake.

Funaria hygrometrica - on tracks in woodlands, and on a bonfire site in the Mere Pool Valley and a dune hollow behind Barafundle

Funaria pulchella **Nationally Scarce, Locally Rare** - two small colonies on limestone outcrops in 04b and 80s.

Grimmia orbicularis **Nationally Scarce, Locally Rare** - 80+ tufts on one limestone face in 04b, the only Pembrokeshire site.

Grimmia pulvinata var. *pulvinata* - scattered on limestone and walls.

Gymnostomum viridulum **Nationally Scarce** - locally frequent in damp, acrocarp-rich soil or blown sand in several places.

Henediella heimii - recorded on a salt-sprayed cliff-top in 48a by SDSB in 2004.

Homalia trichomanoides - only seen on one ash bole in 63, but probably scattered elsewhere.

Homalothecium lutescens - occasional in dry calcareous turf.

Homalothecium sericeum - frequent on limestone and as an epiphyte.

Hypnum andoi - described as widespread on trees by AO (1984), certainly locally frequent in woodland.

Hypnum cupressiforme - locally frequent on ash bases, rotting logs etc. in woodland.

Hypnum jutlandicum - a scarce acidophile in north-facing coastal turf, in heathland and on rotting logs.

Hypnum (cupressiforme var.) *lacunosum* - widespread and usually abundant in dunes and turf.

Hypnum (cupressiforme var.) *resupinatum* - one of the commonest epiphytes, especially on ash and sycamore.

Hypnum (Calliergonella) lindbergii – a patch found by MDS on clay soil at the edge of a gully west of Lattice Windows (SR99249480).

Isothecium alopecuroides - recorded on ash boles in woodland.

Isothecium myosuroides var. *myosuroides* - locally frequent on tree bases and logs in woodland.

Leptodictyum riparium - noted by AO (1984) on wood by the lake in 27.

Leptodon smithii **Nationally Scarce, Locally Rare** - known since at least 1995 on a tree by the Bosherton carpark (MEN). Confirmed as also present in the adjacent part of the SSSI.

Microbryum curvicolium - **Nationally Scarce, Locally Rare** - a small patch found by MDS at the top of the cliff face at the back of Box Bay (SR9827694327). **New to Pembs.**

Microbryum davallianum - scarce on damp soil, especially coastal paths.

Microbryum rectum – scattered in small quantity across the site on or around outcrops.

Microbryum starkeanum **Nationally Scarce** - scarce on damp calcareous soil over limestone.

Mnium hornum - a calcifuge that is occasional in woods, especially on rotting logs.

Mnium stellare - a calcicole, noted by AO (1984) on a rocky bank in woodland at the east end of 63.

Neckera complanata - locally frequent on limestone outcrops and as an epiphyte.

Neckera crispa - rare on limestone outcrops on the south side of the lake.

Neckera pumila - an occasional epiphyte in woodland.

Orthodontium lineare - a few tufts on a rotting log in 63. This invasive non-native is still rare in west Wales and does not appear to be a threat here.

Orthotrichum affine - occasional as an epiphyte on ash, elder and elm.

Orthotrichum anomalum - rare on limestone outcrops and walls.

Orthotrichum diaphanum - occasional as an epiphyte on elder.

Orthotrichum lyellii - recorded once by Ray Woods in compartment 61.

Orthotrichum pulchellum - rather a scarce epiphyte on sycamore and willow in the north of the SSSI.

Orthotrichum striatum - only seen on the trunk of an ash in 80s; generally uncommon in Pems.

Orthotrichum tenellum - the most frequent *Orthotrichum* at Stackpole, usually on ash or sycamore.

Physcomitrium pyriforme - on clay soil by a pool in 80n.

Plagiomnium affine - scattered in turf, on anthills and in woodlands.

Plagiomnium rostratum - rare in woodland in 61 and 63. ST records from dune turf are likely to be errors for *P. affine*.

Plagiomnium undulatum - scarce on the woodland floor or on rotting logs.

Pleuridium subulatum - recorded on anthills in 80s.

Pleurochaete squarrosa **Nationally Scarce** - locally abundant in dry calcareous turf and in the dunes.

Pogonatum aloides - recorded by MEN (1996).

Pohlia melanodon - on damp tracks in woodland.

Polytrichum (Polytrichastrum) formosum - only seen on a woodland bank south of the lake.

Polytrichum juniperinum - present in small quantity in stony leached turf in various places.

Pseudocrossidium hornschuchianum - recorded by the Survey Team (1977) in turf in 41 and 52; surprisingly overlooked by SDSB.

Racomitrium lanuginosum - rare in moss-rich turf near the settlement in compartment 61; locally abundant on lower slopes of Compt 43.

Rhynchostegiella tenella - frequent on limestone outcrops and walls.

Rhynchostegium confertum - a frequent epiphyte.

Rhynchostegium megapolitanum - on semi-stable dunes behind Broad Haven and possibly elsewhere.

Rhynchostegium murale - rare on a wall south of the lake.

Rhynchostegium (Platyhypnidium) riparioides - occasional on rocks in the lake and in its outflow stream.

Rhytidiadelphus squarrosus - widespread but rarely abundant in turf; rare on woodland banks.

Rhytidiadelphus triquetrus - very locally abundant on the woodland floor in 63, otherwise widely scattered in turf and woodland.

Schistidium crassipilum - rare on limestone and walls.

Scleropodium cespitans - on a willow base by the lake near compartment 27 (AO 1984).

Scleropodium (Pseudoscleropodium) purum - often abundant in stable dune turf and frequent elsewhere.

Scleropodium tourettii - occasional on thin soil overlying rock outcrops on the coast.

Scorpiurium circinatum - abundant on a few limestone outcrops and in turf.

Seligeria sp. **Nationally Scarce** – SDSB recorded bright green patches of leaves of a non-fertile *Seligeria* in a crevice in limestone in 04b; not relocated by MDS in 2019.

Syntrichia intermedia (montana) - locally frequent on insolated limestone.

Syntrichia laevipila var. *laevipila* - a moderately frequent epiphyte, especially on ash.

Syntrichia laevipila var. *laevipilaeformis* - recorded by MEN (1995).

Syntrichia (ruralis var.) *ruraliformis* - abundant on semi-stable sand dunes.

Syntrichia (ruralis var.) *ruralis* - widespread but less abundant than *S. ruraliformis* in dunes.

Taxiphyllum wissgrillii **Locally Rare** - rare on limestone in the Mere Pool Valley woodland; also recorded by MDS just outside the NNR on rocks in improved grassland south of Wall Clump.

Tetraphis pellucida - noted on logs in woodland at Warren Strip East / compartment 61 (AO 1984, SDSB 2006).

Thamnobryum alopecurum - locally frequent on woodland floors and shaded limestone outcrops.

Thuidium tamariscinum - uncommon in turf and woodlands.

Tortella flavovirens - abundant in some parts of the dunes, especially 47a.

Tortella nitida - frequent as dense tufts on insolated limestone.

Tortella tortuosa - rare on blown sand in 61; possibly recorded in error by DHD (1965) in 53, on outcrop in Mere Pool Valley woodland (MDS, 2019).

Tortula acaulon var. *acaulon* (*Phascum cuspidatum*) - on anthills in 80s and disturbed soil in 63 (AO).

Tortula atrovirens **Nationally Scarce** - soil on rocky cliff in 10 (AO 1984), Stackpole Head (MDS, 2019).

Tortula lanceola **Locally Rare** - several colonies on thin soil over limestone.

Tortula modica - identified from a collection by ST (1977) from 53; recorded from Griffith Lort's Hole by SDSB and Stackpole Head by MDS.

Tortula muralis var. *muralis* - rather scarce on limestone outcrops; often abundant on walls. Perhaps unusually, small hoary cushions on top of soft cliffs at Box Bay, near the *Microbryum curvicollum*.

Tortula protobryoides – **Locally Rare** - single tufts found by MDS west of Saddle Point around rocks below a fisherman's path (SR9803994036) and on a lakeside outcrop (SR9750994703). Occasional on the Castlemartin Coast and at Lydstep Head.

Tortula truncata - on anthills in 80s and a track in 80n.

Tortula viridifolia - locally frequent in coastal turf on Stackpole Head and elsewhere.

Trichostomum brachydontium - the most abundant moss in thin turf and dunes across the site; occasional in woodland, though locally abundant on path-side banks.

Trichostomum crispulum - recorded in a few places, such as in thin coastal turf or damp ground in the Mere Pool Valley.

Ulota bruchii - an occasional epiphyte, more common than *U. crispa*.

Ulota crispa - a scarce epiphyte, though possibly under-recorded for *U. bruchii*.

Ulota phyllantha - frequent to abundant on ash, sycamore and other trees throughout.

Weissia brachycarpa var. *obliqua* - uncommon on thin soil overlying limestone, but confused with *W. controversa*.

Weissia controversa var. *controversa* - only recorded on damp clay in 51 and on banks in woodland in 63 and 84.

Weissia controversa var. *crispata* - abundant on thin soil overlying limestone across the site.

Weissia longifolia var. *angustifolia* **Locally Rare** - rare in calcareous turf in compartment 18.

Weissia longifolia var. *longifolia* - one patch on an anthill in 80s.

Zygodon conoideus - on willows in wet woodland in 80n.

Zygodon viridissimus var. *stirtonii* - rare on limestone outcrops in woodland.

Zygodon viridissimus var. *viridissimus* - a frequent epiphyte on ash, elder, elm and sycamore.

Liverworts

Aneura pinguis - noted by SDSB only in one damp hollow in 41a, and by MDS in several places on Stackpole Warren. Also seen somewhere by MEN.

Calypogeia fissa - a calcifuge of bare soil in woodland south of the lake.

Cephaloziella calyculata **Nationally Rare, Locally Rare** - on the west side of Saddle Point, and near the *Southbya tophacea* at Griffith Lort's Hole (MDS, 2019).

Cephaloziella dentata **Nationally Rare, Locally Rare** – cliff edge on the north side of Stackpole Head (MDS, 2019).

Cephaloziella divaricata - recorded by AO (1984) in stony ground in compartments 41, 50, 52 & 53. Non-fertile *Cephaloziella* sp. occur frequently and some are likely to be *C. divaricata*. Specimen from stripped heath plot on the Warren confirmed by SDSB in 2006.

Cephaloziella integerrima **Nationally Rare, Locally Rare** – on the path west of Lattice Windows (MDS, 2019).

Cephaloziella stellulifera **Nationally Scarce** - present in small quantity in damp calcareous coastal turf in two places (SDSB, 2006) and three further locations (MDS, 2019). Many of the non-fertile samples locally frequent on the coastal strip are likely to be this.

Chiloscyphus polyanthos - recorded by MEN (1995), presumably on rocks in the lake.

Cololejeunea minutissima - an occasional epiphyte on ash, willow and sycamore.

Cololejeunea rossettiana **Nationally Scarce, Locally Rare** - frequent on several shaded limestone outcrops in the Mere Pool Valley woodland.

Conocephalum conicum - AO (1984) noted this large liverwort on the lake margin in 61.

Fossombronia (caespitifformis var. multispira) husnotii **Nationally Scarce, Locally Rare** - three colonies were found on thin soil over limestone in 17, 18 & 80s.

Frullania dilatata - common epiphytically on ash, willow and sycamore.

Frullania fragilifolia – noted by MDS in turf around rocks at Griffith Lort's Hole (SR99229482)

Frullania tamarisci - locally frequent in calcareous turf, in dunes and on north-facing coastal slopes. Rather scarce as an epiphyte on ash.

Jungermannia atrovirens - on calcareous clay by the path along the south side of the lake. There are few Pembs records of *J. atrovirens*, most of them from the coastal limestone.

Jungermannia pumila / borealis – a couple of plants collected by MDS in the settlement area at SR9787194821 were determined as probably the former species

by Tom Ottley. It is more characteristic of rocks in north Pembrokeshire (Bosanquet, 2010). Nick Hodgetts thought it wasn't the former, but possibly the latter although the habitat would be unlikely and the species would be new to the county.

Leiocolea badensis **Locally Rare** - found **new to Pembrokeshire** by MDS in two places in dune hollows on the Warren (SR98299444 and SR98369444) but an unobtrusive liverwort and perhaps thinly scattered elsewhere in dune turf. Declining on Welsh dunes (Bosanquet, pers. comm.).

Leiocolea turbinata - in small quantity on soil slumps in the collapsed cave at Sandy Pit, compt. 47a, and by Griffith Lort's Hole.

Lejeunea cavifolia - scarce on limestone outcrops or ash trunks, usually growing over other mosses.

Lejeunea lamacerina - rare on the limestone south of the lake and on the south side of Barafundle Bay.

Lepidozia reptans - locally abundant on a few logs in 61 (AO) and 63.

Lophocolea bidentata - scattered in woods and turf throughout.

Lophocolea heterophylla - local on logs in woodland (61 & 63) and under scrub in 48b.

Lophozia excisa - locally frequent in damp, bryophyte-rich turf near the Settlement (61); rare in similar habitat on blown sand behind Barafundle Bay and in stony short turf from Griffith Lort's Hole to Stackpole Head.

Lophozia ventricosa – at Griffith Lort's Hole (SR99219482) along with the more frequent *L. excisa*.

Lunularia cruciata - sandy banks in woods in 61 (AO 1984).

Marchesinia mackaii - this black liverwort is locally abundant on limestone outcrops in woodland.

Metzgeria conjugata **Locally rare** - several patches on an outcrop in woodland south of the lake.

Metzgeria fruticulosa (*violacea*) - an occasional epiphyte on sycamore.

Metzgeria furcata - frequent epiphyte on ash, elder, elm, sycamore and willow.

Metzgeria temperata (consanguinea) - rare epiphyte on ash south of the lake.

Microlejeunea ulicina - occasional epiphyte in woodland.

Nowellia curvifolia - locally abundant on large logs in 61 (AO) and 63, turning them red.

Pellia endiviifolia - damp calcareous clay by the path south of the lake.

Plagiochila asplenioides - occasional among bulky mosses on the woodland floor.

Plagiochila bifaria – west of Lattice Windows on trampled turf around the rocks of an old wall at SR9922794759 (MDS, 2019).

Plagiochila porelloides - rare on limestone outcrops and rocky banks in woodland.

Porella cordeana **Locally rare** - recorded by EFW “on limestone by the lily ponds”.

Porella platyphylla - scattered on limestone outcrops, both in woodland and in the open; there is a strong colony at the seaward end of the Mere Pool Valley. Further north and east, there are a few tufts on ash boles.

Radula complanata - a scarce epiphyte, mainly on ash.

Reboulia hemisphaerica - rare on thin soil over ledges on limestone outcrops in 21, 63 and 80s, on soil on a rocky bank in 63 (AO 1984) and reported from further west by FR 1965.

Riccardia chamedryfolia - rare in north-facing coastal turf.

Riccia beyrichiana **Nationally Scarce** - a few plants on thin soil over limestone on the north side of the southern arm of the lake (SDSB, 2005); abundant on slope west of Saddle Point (MDS, 2020) – specimens from the latter population have been sent to Switzerland for inclusion in a taxonomic reassessment.

Riccia cavernosa **Locally Rare** - locally abundant on mud by the eastern arm in 1984 (AO).

Riccia sorocarpa - rare with *R. subbifurca* in coastal turf.

Riccia subbifurca - rare on thin soil over limestone and in coastal turf.

Saccogyna viticulosa - a humidity-demander that is locally frequent in bryophyte-rich north-facing coastal grassland.

Scapania aspera **Locally Rare** - widespread as small plants in moss-rich calcareous turf on the warren and elsewhere. Large tufts grow with *Saccogyna* on north-facing limestone in 66.

Scapania cuspiduligera **Nationally Scarce, Locally Rare** - a single shoot of this tiny *Scapania* with brown gemmae was collected by MDS from rocky turf at Griffith Lort's Hole (SR99219482). Identified by Tom Ottley and confirmed by Nick Hodgetts, although hesitantly due to the size of the sample. Sam Bosanquet had collected a specimen which he thought potentially this from nearby in 2005.

Southbya tophacea **Nationally Rare** - 8 small patches on bare soil in coastal grassland in 17.

Totals

During the survey by Bosanquet (2005), 139 moss and 37 liverwort taxa (total 176 taxa) were recorded in the SSSI, of which 116 mosses and 28 liverworts (total 144 taxa) were seen in the NNR. Of these, 47 mosses and 17 liverworts had not been reported from Stackpole SSSI previously. Of the 138 bryophytes known from the SSSI prior to this survey, 33 were not relocated in 2005. 26 of these, discussed above, are considered to be based on sound records, whilst the remainder are thought more likely to be identification errors. In all, by 2005, 160 moss and 42 liverwort taxa (total 202 bryophyte taxa) had been recorded reliably on the SSSI, of which 141 mosses and 36 liverworts (total 177 taxa) had been noted in the NNR. The present survey by MDS added 27 new bryophyte taxa, taking the SSSI total to **229** and the NNR total to **204**.

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 Bryo Records Stackpole and Castlemartin*

An Excel spreadsheet of all known bryophyte records from Stackpole titled *Stackpole Bryophyte Records to 2020*



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