SKOMER ISLAND

Management Plan

Vegetation

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Revised November 2020

SKOMER ISLAND MANAGEMENT PLAN

VEGETATION

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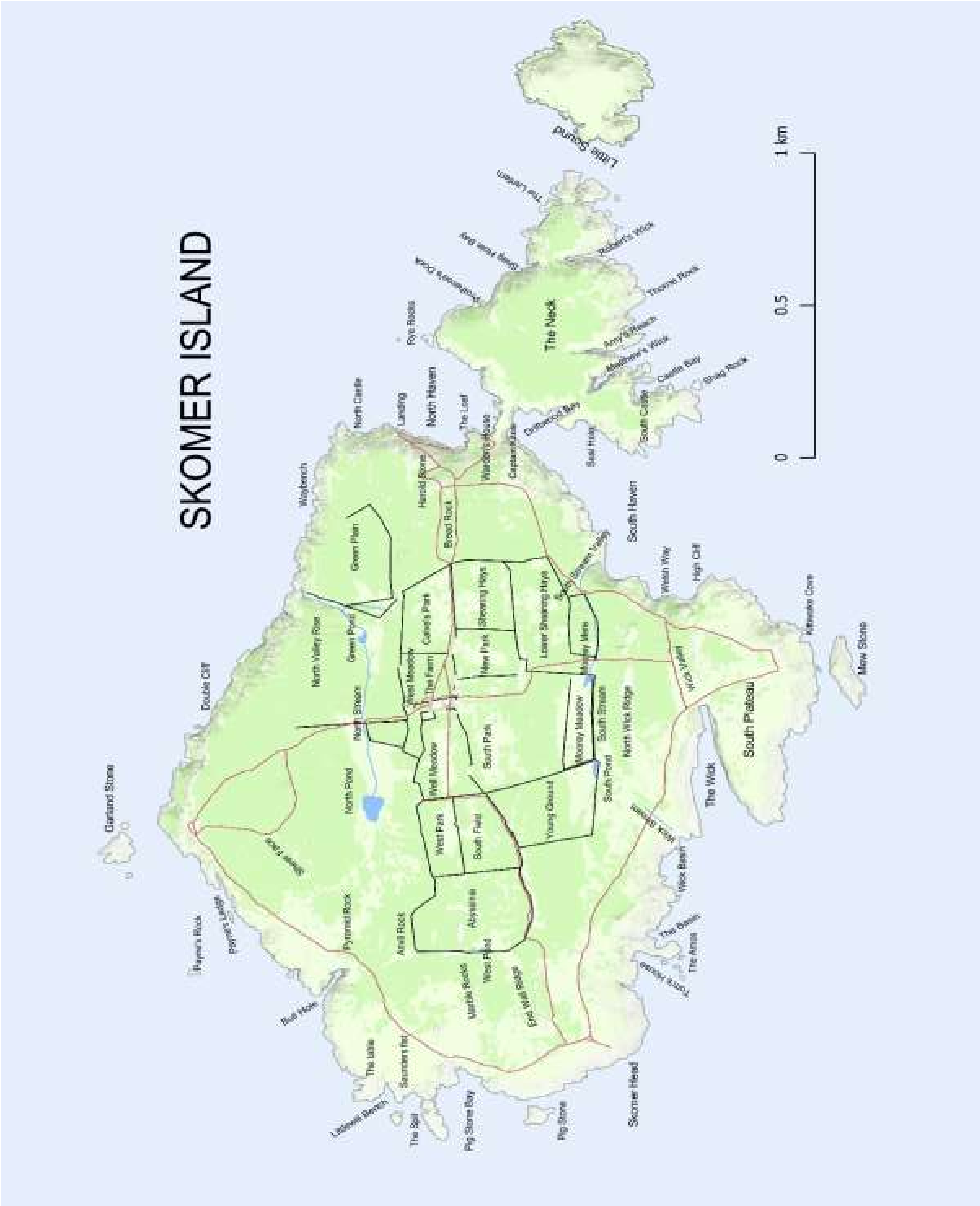
First version January 2014

Complete revision and restructure October 2020

Dates of next reviews

All projects require an annual review.

A full review of the description and objective - 2030.


SKOMER ISLAND
0
0.5
1 km
The Neck
Little Sound
South Plateau
The Wick
South Haven
North Haven
Mew Stone
Garland Stone
Skomer Head
North Pond
South Pond
Green Pond
Green Plain
North Valley Rise
Double Cliff
Waybench
North Castle
Landing
Rye Rocks
The Lantern
Robert's Wick
Thorney Rock
Amy's Reach
Matthew's Wick
Castle Bay
Shag Rock
South Castle
Seal Hole
Driftwood Bay
Captain Kites
Wardens House
The Loaf
Harold Stone
Broad Rock
Shearing Hays
Lower Shearing Hays
Calves Park
New Park
The Farm
West Meadow
North Stream
South Stream
Money Meadow
North Wick Ridge
Wick Valley
South Park
Well Meadow
West Park
South Field
Young Ground
Abyssinia
Anvil Rock
Pyramid Rock
Marble Rocks
West Field
End Wall Ridge
Bull Hole
The Table
Lantern Bench
The Spit
Pig Stone Bay
Pig Stone
Payne's Ledge
Rainy's Rock
High Cliff
Welsh Way
Wick Basin
The Basin
The Anvil
Tom's House

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INTRODUCTION

The original, 2014, vegetation plan was intended for consultation and discussion, there was an emphasis on asking questions and avoiding conclusions. The document did not follow the logic and structure of a management plan. This version is a complete rewrite with significant additional material. It is compliant, as far as appropriate, or necessary, with the Wildlife Trust of South and West Wales and Natural Resources Wales management plan guidelines. This plan will be a public document available to anyone with an interest in Skomer. Some readers may not be familiar with some of the terminology or plan concepts, explanations and background information will be included in the text.

The Vegetation section will include:

- A detailed description of the vegetation, this will include comment on their history and the factors which had a specific impact on the development of the individual communities.
- The key factors (influences), past and present, with an emphasis on the future, are described and discussed.
- The conservation objective with associated monitoring/surveillance and recording projects.
- A management rationale and outline action plan.

The organisation of a plan for a protected site is usually based on the presence of statutory features; the WTSWW plan also includes an evaluation or rationale which identifies other key, but non-statutory, features. A feature is quite simply something which is sufficiently important in the context of the site to merit specific attention in the management plan. Once features have been identified they provide the focus for all the significant planning decisions. With the exception of one of the maritime cliff and crevice communities, and the coastal grasslands, which are SSSI features, the remaining plant communities on Skomer have no legal status. However, it would make little sense to focus on those fragments of the vegetation which happen to possess a sufficient resemblance to their mainland counterpart to warrant legal protection and forget the remainder.

Aside from any legal requirement, the vegetation on Skomer is very special. There may be similarities to vegetation elsewhere, but there is nowhere that is subject to the same range or intensity of influences. The vegetation on Skomer is quite unique and different to anything that exists elsewhere.

Our conclusion, in broad terms, is that we should allow the vegetation on Skomer to develop unhindered by any further human intervention, this means we can have a single objective for all the vegetation on Skomer. We also recognise that management intervention will be minimal and only justified when other important features are threatened. Skomer provides an extremely rare opportunity in Wales for allowing nature to take over responsibility for both management and outcomes. It is also an extremely valuable opportunity for study and research.

1. Legislation and Policy

Skomer is internationally recognised as one of the most important seabird sites in Britain. The seabirds, and a few important terrestrial species, occupy the entire island, and, consequently, the WTSWW incur a responsibility to ensure, regardless of the intrinsic or scientific value of the vegetation, that it is maintained in a condition which meets the needs of the breeding bird populations. The Island is part of the Skomer and Skokholm Special Protected Area (SPA). The UK and Welsh governments currently (2020) meet part of their obligations for the protection and conservation of birds through implementation of the European Bird Directive. One of the main provisions of the directive is the identification and classification of Special Protection Areas (SPAs) for rare or vulnerable species. Together with Special Areas of Conservation designated under the Habitats Directive, SPAs form a network of European protected areas known as Natura 2000.

The features of Special Scientific Interest are:

Maritime cliff and crevice community:

Rock sea-spurrey cliff crevice community, *NVC MC1 Crithmum maritimum – Spergularia rupicola maritime rock crevice community.*

Sea cliff grasslands:

Chickweed bird cliff community*, NVC MC7 Stellaria media-Rumex acetosa seabird community*

Fescue / thrift cliff grassland, *NVC MC8 Festuca rubra – Armeria maritima maritime grassland.* (an independently qualifying SSSI feature)

Yorkshire fog cliff grassland, *NVC MC9 Festuca rubra – Holcus lanatus maritime grassland.*

Bluebell cliff grassland, *NVC MC12 b Festuca rubra-Hyacinthoides non-scripta maritime bluebell community, Armeria maritima sub-community.*

Bent-fescue grassland, *NVC U1 Festuca ovina – Agrostis capillaris - Rumex acetosella grassland.*

Species:

Golden hair lichen, *Teloschistes flavicans*

Assemblages:

Assemblage of nationally rare and scarce lichens. The great majority of lichens within this assemblage are saxicolous coastal species.

Assemblage of four nationally rare and scarce vascular plants. Rock Sea-lavender, *Limonium bineryosum,* Three-lobed crowfoot *Ranunculus tripartitus,* lanceolate spleenwort, *Asplenium obovatum*, and Portland spurge *Euphorbia portlandica.*

2. DESCRIPTION

The following description is best regarded as a collation exercise, locating, and bringing together, filtering and summarising all the relevant information about the vegetation on Skomer. The description is very much larger and detailed than is necessary or justifiable for most plans, there are a number of reasons for this:

- The plan was prepared by a volunteer, there was no demand on Wildlife Trust resources.
- This is the only current description of the vegetation on Skomer Island.
- The collation and processing of information contained in the description was an essential prelude to making decisions about the conservation objective.
- The bulk of the information could have been stored elsewhere and replaced with a succinct summary in the plan. But this plan has two main purposes, a working guide to managing the site and a public document which is intended as a demonstration and explanation of the planning process.

"The associations, consociations and societies merge into one another, and become entangled in such an intricate fashion as to defy all attempts at a straight forward method of mapping or recording." (Sadd 1947) This is a wonderful quote that succinctly describes the complexity of Skomer's vegetation, but perhaps it requires some explanation. In Sadd's time the language used to describe plant communities was different to today's: an association was a relatively stable, fully developed plant community, having one dominant species; a consociation was a subdivision of an association; a society was a local concentration, inside an association, of a species other than the dominant species of that association. (Tansley 1920)

The vegetation on Skomer is complex, though probably no more so than comparable places on the mainland. This complexity is mainly the consequence of a range of natural and anthropogenic factors, some of which are unpredictable, impacting on the various plant communities. Wilberforce (1999) suggests that the main environmental variables (factors) are soil (pH, moisture, depth) and vegetation height. In many ways, the most significant anthropogenic factor is past agricultural management and later abandonment. The key to understanding the vegetation is to recognise that it is changing quite rapidly. After many hundreds of years of human utilisation nature is trying to reassert her influence. This is why we place such emphasis on describing the factors and the consequential recent history of change.

The National Vegetation Classification (NVC) will be referred to throughout this section of the plan. The NVC is a classification scheme to help us identify and understand vegetation types encountered in the field. It provides, in Britain, a common and widely understood language for describing plant communities. A plant community is an assemblage of plants with a distinct and unique composition and structure. The community contains species which coincide in space and time and have a shared an overlapping dependence on determining environmental factors, for example, climate, soil, biotic impacts, and management. (Rodwell 2006) The NVC is published in five volumes. It is strongly recommend that anyone wishing to gain an insight into NVC reads 'National Vegetation Classification users handbook' published by JNCC in 2006.

SOURCES OF INFORMATION:

1. The description of the island flora produced by Dr W. J. L. Sladen, a report on field work carried out during 1946 and published in 'Island of Skomer' (Buxton & Lockley 1950). This was based mainly on casual observation and was not a systematic survey. However, the author and contributors were some of the most experienced and competent botanist of their day. The chapter on flora was read by Sir Arthur Tansley, one of the most respected British botanists at that time.

2. 'A Preliminary Vegetation Survey of Skomer Island Pembrokeshire' 1947, by J. Sadd. Joe Sadd was an undergraduate student from Aberystwyth University. He spent his summer vacation on Skomer preparing for his honours botany thesis. Sadd's thesis provides an extraordinary account of the island's vegetation at a time when farming, and in particular stock rearing, was coming to an end on the island. The vegetation maps from this period are quite confusing. The map published in the 'Island of Skomer' (Buxton & Lockley 1950) was originally produced by Sadd in 1947. A version of this map was also included in Sadd's thesis (1947), but this is not entirely consistent with the published version. Unfortunately, the only copy of the map which survives is a 'photostat' from the 1940s, and it has oxidised to a point where it is barely legible. The situation is further complicated because Sadd also included an annotated sketch map in his thesis which described the vegetation in the central fields, but there are significant differences between this and the other maps. We suspect that the version published in 'Island of Skomer' was 'tidied up', and much of the original text was omitted. Unfortunately, these are the only vegetation maps from this period.

3. The 'Skomer botanical survey' (Bray 1981) was the result of research carried out during 1979 and 1980 by Graham Bray, a post graduate student from the Department of Zoology, University College Cardiff. This was the first, and only, detailed systematic survey of the vegetation. Bray's survey was based on sampling 270 quadrats. The quadrat distribution was biased towards ensuring that all the plant communities were included. The island was divided into distinct compartments with the quadrats randomly dispersed within these. At the end of the survey, 90 quadrats were 'permanently' marked. His descriptions are invaluable and provide an essential source of information used in this entire section.

4. The Pembrokeshire lowland heathland survey 1996 by M. V. Prosser and H. L. Wallace, an unpublished report to the Countryside Council for Wales. During this survey the heathland on Skomer was mapped and the various NVC heath communities were identified. Unfortunately, they did not produce a site description or comment on the condition of the heath. The sketch map is indicative of the location of the various heath and other communities that they mapped but does not provide particularly accurate boundaries.

5. 'Some Vegetation-Environment Relationships on Skomer Island NNR, Pembrokeshire 1997-1998'. This is an undergraduate dissertation by Elizabeth Wilberforce, a student at the Institute of Biological Sciences, University of Wales, Aberystwyth. This study was undertaken with the aim of re-recording the permanent quadrats established by Bray (1981) and explaining some of the changes observed in the data between 1978 and 1998. Many of the metal posts used to mark the original locations had been lost, but 65 of the original 'permanent' quadrats were relocated and sampled. This smaller sample included only very few quadrats in the cliff edge grasslands. This was the consequence of lost markers and the distribution of the original 90 quadrats. Despite the smaller number of samples, this is the most up to date, relevant and informative detailed study.

6. 'Skomer - Some future prospects for the vegetation' 2004 and 'The edge of the Picture' by Professor John Rodwell (2008). These reports on the vegetation of Skomer and other Welsh islands

were commissioned by the Countryside Council for Wales. In addition to his general comments on the vegetation, John Rodwell was also asked for his view on the need for an NVC survey.
His opinion was: *'There is no urgent need for a complete NVC survey of Skomer. The definition of the vegetation types in Bray (1981) is certainly not very crisp but most of them can be related, at least in part, to particular NVC communities. Coverage in that survey is not complete, so additional relevés might be collected of vegetation types omitted from the original work.'* (Rodwell was not aware of the dissertation prepared by Wilberforce)

7. The description in the SSSI schedule. This is rather generic and not particularly informative. It is quite difficult to understand the background to, and reasons for, the designation of the vegetation.

8. The National Vegetation Classification.

9. The low-level high-resolution photographic surveys of the island carried out in 2017.

10. A wide range of additional published and unpublished material. (A full bibliography has been prepared for Skomer, and this lists all the relevant botanical papers. These were all reviewed. The full bibliography is appended to this plan, and the papers referred to in this text are given in the references at the end of this section.)

STRUCTURE

In order to bring some structure to this document, the vegetation is described using a combination of both statutory features, previously recognised plant communities and species:

- Maritime cliff and crevice communities.
  Rock sea-spurrey cliff crevice community, *NVC MC1 Crithmum maritimum – Spergularia rupicola maritime rock crevice community.* This is an independently qualifying SSSI feature.

- Coastal rocky slopes.
  Thrift - sea mouse-ear cliff top community, *NVC MC5 Armeria maritima – Cerastium diffusum ssp. diffusum maritime therophyte community.*

- Bird Cliff communities.
  Orache bird-cliff community, *NVC MC6 Atriplex prostrata-Beta vulgaris ssp.maritima sea-bird cliff community.*

- Sea cliff grasslands – five NVC communities and two unclassified communities.
  Chickweed bird cliff community*, NVC MC7 Stellaria media-Rumex acetosa seabird community*

  Fescue / thrift cliff grassland, *NVC MC8 Festuca rubra – Armeria maritima maritime grassland.* (an independently qualifying SSSI feature)

  Yorkshire fog cliff grassland, *NVC MC9 Festuca rubra – Holcus lanatus maritime grassland.*

Bluebell cliff grassland, *NVC MC12 b Festuca rubra-Hyacinthoides non-scripta maritime bluebell community, Armeria maritima sub-community.*

Bent-fescue grassland, *NVC U1 Festuca ovina – Agrostis capillaris - Rumex acetosella grassland.*

Cliff footpath community

Sheltered north-facing coast grassland

- Coastal springs and flushes

- Maritime, dry & wet heath

  Squill clifftop heath, *NVC H7 Calluna vulgaris - Scilla verna* heath.

  Western gorse dry heath, *NVC H8a Calluna vulgaris – Ulex gallii* heath, species-poor sub-community.

  Lowland wet heath, *NVC M16a Erica tetralix – Sphagnum compactum* wet heath, typical sub-community.

  Fescue dry heath, *NVC H1 Calluna* Vulgaris-Festuca ovina heath.

- Inland rock outcrops

- Grasslands of the central fields

  Bent-fescue pasture, *NVC U4 Festuca-Agrostis-Galium grassland*.

- Marshy grassland

  Purple moor-grass sward, NVC *M25 Molinia-Potentilla mire.*

  Sharp-flowered rush pasture, NVC *M23 Juncus effusus-Gallium palustre rush pasture.*

- Bracken

  Bracken-bedstraw *NVC U20c Pteridium aquilinum - Galium saxatile.*

  Bracken-bramble under-scrub, *NVC W25 Pteridium aquilinum-Rubis fruticosus underscrub.*

  Bracken with Bluebells and Red Campion

- Scrub, shrubs and trees

  Gorse scrub, *NVC W23 Ulex europaeus - Rubis fruticosus scrub*

- Valleys streams and associated wetlands, and ponds
- Additional miscellaneous features

    The farm walls and limekiln

    Ferns

    Common ragwort

    Foxgloves
- Rare higher plants and ferns

Maritime cliff and crevice community

Maritime cliff and crevice community

Apart from notification, this community has not received any significant attention. It was not described by Bray (1981), but he did point out in his discussion that the cliff-slope communities were under-sampled and that *'a detailed separate survey would be desirable'*. There have been no further surveys since that time. Wilberforce (1999) re-surveyed Bray's quadrats and consequently she did not record this community.

The rock samphire cliff crevice community, NVC *MC1 Crithmum maritimum – Spergularia rupicola maritime rock crevice community.* This is an independently qualifying SSSI feature.

There is not a great deal that can be said about this community apart, perhaps, from celebrating its robust naturalness. It is the community that, along with a spectacular assembly of lichens, defines the most exposed Atlantic cliffs. It occupies the extreme maritime vegetation zone on the rocky cliffs, the areas that are battered by gales, frequently saturated with salt sea spray, and desiccated by sun and wind. It is mainly restricted to the crevices and narrow ledges on the cliff faces, and is limited within the area that lies above the grey lichen-covered splash zone, just above high-water mark, and below the red fescue *Festuca rubra* maritime grassland zone.

On the extremely exposed western edge of the island, it tends to climb over the top of the vertical cliffs and, in places, it extends over quite large areas of exposed rock. In the more sheltered areas, particularly on the least exposed north coast, it barely exists and is quickly replaced by much lusher vegetation growing in the soils that have accumulated on these cliffs.

Sea campion on the rocky slopes above the Amos on the south coast of Skomer.

Of the two species that give their names to this community, rock samphire *Crithmum maritimum* is not common on Skomer. It has a quite restricted distribution, and is mainly confined to the western

edge of the Neck, between Driftwood Bay and Amy's Reach, and the south west coast of South Plateau. Rock sea-spurrey *Spergularia* rupicol is much more common and widespread. The most obvious and frequent species are thrift *Armeria maritima*, sea campion *Silene uniflora* and buck's-horn plantain *Plantago coronopus.* The small fern, sea spleenwort *Asplenium marinum*, is often found in the more sheltered areas. These areas are not generally influenced by grazing. There may be occasional, very limited, rabbit grazing, but the main species that comprise the community are not palatable to rabbits. Any variation in the community will be the consequence of natural factors, particularly enrichment from sea bird droppings.

Rock samphire on an exposed Skomer cliff at the western tip of the Wick

Sea spleenwort, the only fern on Skomer which thrives in the sea-splashed zone.

Rock sea-spurrey

BIRD CLIFF COMMUNITY

There is one additional maritime cliff and crevice community found on Skomer. This is the vegetation that occurs around and below the cliff nesting seabird colonies: the rich green patches found on even the smallest ledges and in crevices on the cliff face. The distribution is easily predicted: the most obvious places are, for example, South Stream Cliff, High Cliff and The Wick. The community can also occur on the top of the cliffs directly above the bird colonies and occasionally in the areas favoured by Puffins. Because these places are accessible to rabbits, the very palatable spear-leaved orache *Atriplex prostrata-Beta vulgaris ssp*, the species which gives this community its name, is most often absent. However, nothing is predictable on Skomer. In 2018 the vegetation on the inland edge of the Wick, the most popular Puffin viewing site on the island, became dominated by spear-leaved orache.

This is a neglected community. It has never been surveyed or sampled and there are no descriptions. It probably the NVC MC6 *Atriplex prostrata-Beta vulgaris ssp. maritima* sea bird cliff community. This is the highly fertilised version of NVC MC1, described as being very variable in its floristics and appearance. It is not included as a component of the SSSI feature, presumably because it has been dismissed by JNCC as having 'limited botanical interest'.

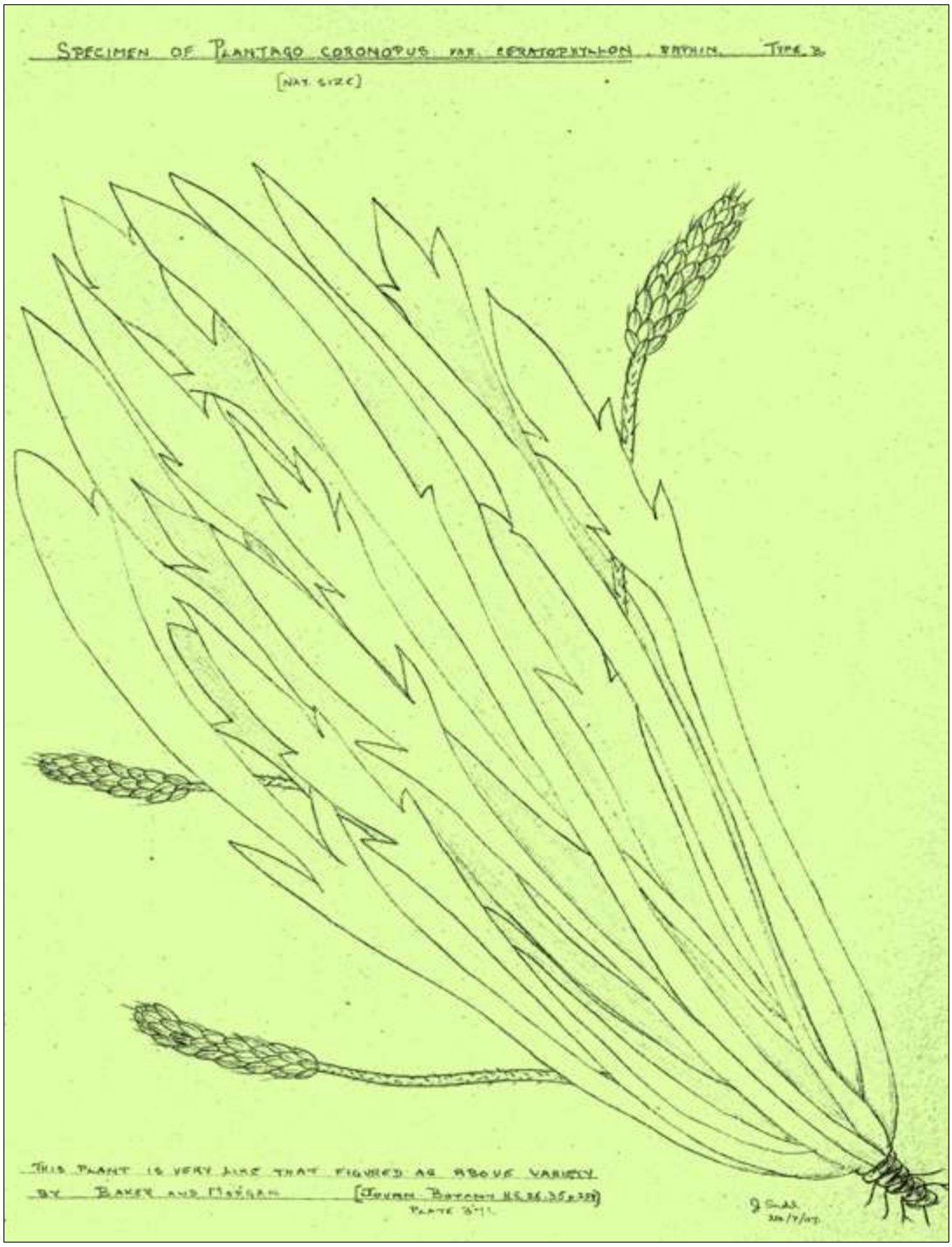
Seabird cliff vegetation

This community is home to a fleshy, succulent, and very large type of buck's-horn plantain *Plantago coronopus,* which has leaves occasionally over 20 cm long. These plants created considerable interest during the 1946 expedition, and specimens were sent to Kew, where they were identified as *Plantago coronopus var. maritima,* but there was some general confusion concerning the varieties of buck's-horn plantain at that time. Sadd, in his 1947 thesis, provided a sketch of a variety that he

identified as *ceratophylla*. He found specimens on the cliff faces of the Wick, Bull Hole and the Basin. It also occurs on High Cliff and South Stream Cliff. These varieties are now believed to be within the normal range of variation for this species and sometimes recognised as a coastal ecotype. Ecotypes display adaptations to the specific environments in which they grow, so perhaps it is not surprising that there is such a difference between the small, recumbent forms found in the drier, rabbit-grazed areas and the very much larger succulent form found on the damp, guano-laden cliff ledges.

A large succulent form of ***buck's-horn*** *plantain Plantago coronopus.*

Buck's-horn plantain Plantago coronopus on grazed cliff edge grassland.



A Sketch of the variety of buck's-horn plantain 'Plantago coronopus var. ceratophylla', from J Sadd's 1947 thesis on the vegetation of Skomer.

COASTAL ROCKY SLOPES

This is probably the NVC MC5 *Armeria maritima – Cerastium diffusum ssp. diffusum* maritime therophyte community. The English name for this community is 'Sea mouse-ear rock top'; it occupies one of the more inhospitable zones: the exposed cliff tops and some of the inland rocky outcrops - places where salt is often in the air and where the soils are very shallow to non-existent and free draining. These are the places that burn out and turn yellow even during the briefest of dry periods. Many of the species are therophytes: annual plants that complete their life cycle in a short period when conditions are favourable and survive harsh conditions as seeds. The community forms a mosaic with the other maritime grasslands and the cliff and crevice community.

MC5 has not been confirmed on Skomer. However, Bray (1981) describes a similar community: coastal grasslands - rocky slopes and inland outcrops. Bray suggests that this community is similar to a community described by Malloch (1972), 'found on the very shallow soils over rocks and in dry, exposed crevices'. Bray describes this as a 'maritime therophyte community'. The typical species of this community are almost identical to those of MC5, as is the physiognomy (appearance and structure).

On Skomer, the species capable of tolerating these extreme conditions include: sea storksbill *Erodium maritimum*, sea campion *Silene maritima,* English stonecrop *Sedum anglicum,* procumbent pearlwort *Sagina procumbens* and common bent *Agrostis capilliaris.* In common with the sea cliff community, this also exists in the absence of any human intervention. Its composition, structure and distribution are almost entirely determined by natural factors.

SEA CLIFF GRASSLANDS

These are generally described as the 'closed' perennial communities of grasses and herbs on the less spray-splashed cliff tops and ledges. Closed implies a lack of open, or bare, ground within the community, and this is how they usually appear on the mainland cliffs, but Skomer is different. Here the cliff communities are most often open, with sometimes large patches of bare ground. These are mainly a consequence of rabbit grazing.

The maritime or sea cliff grasslands comprise six communities four which are approximations of NVC:

- MC7 *Stellaria media-Rumex acetosa* sea bird community. (Chickweed bird cliff community)
- MC8 *Festuca rubra – Armeria maritima* maritime grassland. (Sea-pink grassland)
- MC9 *Festuca rubra – Holcus lanatus* maritime grassland. (Yorkshire fog cliff grassland)
- MC12 b *Festuca rubra-Hyacinthoides non-scripta* maritime bluebell community, *Armeria maritima* sub-community. (Bluebell cliff grassland)

There are two additional communities, which have not been described using NVC categorisation.

- Cliff footpath community
- The cliff community found only along the most sheltered north-facing coast.

For convenience, the grassland has been subdivided by grouping the NVC fescue communities MC7, MC8 and MC9. The remaining three communities, MC12b, the cliff footpath community and the sheltered cliff grassland will be dealt with individually.

Sea-pink (Thrift) grassland forming a fescue mattress on the nearby mainland east of Musselwick

The fescue coastal grasslands

Bray (1981) described and mapped two maritime grassland communities:

a) Coastal grassland - western slopes. This is the vegetation of the extremely exposed south western coasts: the zone between the rocky sea-cliff vegetation and the more sheltered 'northern slopes grassland'. The key localities are the western edge of the Table, Skomer Head, Wick Basin, the western section of South Plateau and the south west tip of the Neck. Rodwell (2008) suggests that these generally resemble MC8 in the more spray splashed zone. This community was not recorded by Wilberforce (1999) but it would appear from her map of quadrat locations that she probably did not sample any of the areas containing this community.

b) Coastal grassland - northern slopes. Bray's name for this community is somewhat misleading. In fact, its distribution follows, more or less, the inland, or slightly less exposed edge of the 'western slopes grassland'. The northern slopes grassland extends along the entire west and southwest coast in a narrow band from above the Garland Stone around the Table, and in a much wider zone from above Pigstone Bay to the Wick and much of the exposed areas of South Plateau. It reappears at the isthmus and then extends around the entire south and west coast of the Neck.

(On Skomer, this community is a mix of NVC MC7 and NVC MC9. It merges in some places into the coastal bluebell community, probably NVC MC12).

Wilberforce (1990) identified MC7, MC9 and MC12, and Rodwell (2008) confirmed the presence of MC9. Some doubt remains about the identity of these communities, and, clearly, further survey would resolve these issues, but our current inability to confirm the identity of these communities will not influence management decisions.

The MC8 *Festuca rubra - Armeria maritima* community develops into an extremely dense mattress of fescue, with only occasional occurrences of other species. It is usually found on very exposed cliff-tops, in areas where grazing is absent or at low levels. Examples of this community, which are completely dominated by fescue, are found on the exposed, small offshore Pembrokeshire islands. Gillham (1953) recalls the dense fescue mattress on Grassholm, and identical vegetation is also present on North Bishop. Closer to Skomer, the cliffs between Musselwick and St Brides have excellent areas of a more diverse fescue mattress. As we move a very short distance, into slightly less exposed areas, the fescue sward is in some places invaded by Yorkshire fog *Holcus lanantus*, along with a few additional species. This is occasionally MC9 NVC *Festuca rubra – Holcus lanatus* maritime grassland. But the more frequent community in these areas is MC7 Stellaria media-Rumex acetosa sea bird community.

Before considering the extremely exposed maritime grasslands on Skomer, it is important to remember that these are very different to their equivalents found elsewhere in Pembrokeshire. This has not always been the case. Sadd (1947) wrote of the 'unfenced grasslands'. These were the areas outside the enclosed central fields which were grazed periodically by stock. He describes the grassland as: *'...biotic climaxes i.e. they are prevented from developing into Pteridetum by the action of grazing beasts. ... The most extensive of these areas is the Festuco-Armerietum found in a band of varying width around most of the south and west cliffs of the island. ...This region is honeycombed by burrows most of which are occupied by seabirds. These areas of Festuco-Armerietum are usually grazed by six large beef cattle.'* It is worth mentioning that these extreme coastal grasslands are

some of the very few areas that remain almost free of bracken *Pteridium aquilinum.* Even though it may occasionally invade, it rarely, if ever, persists.

Bray suggested that the most exposed coastal grassland communities are 'grazed derivatives of the fescue mattress'. This was confirmed by current and earlier exclosures at Skomer Head, which clearly demonstrated the impact of rabbit grazing. Within a few years of establishing the exclosures, they contained a vibrant, deep, dense mattress of fescue. After several decades the vigour appears to diminish, dead patches appear, and these are usually colonised by Yorkshire fog *Holcus lanatus*.

Fescue inside the Skomer Head exclosure

Bray writes of 'grazed derivatives', and grazing is the overwhelming factor, but we need to include another significant factor - bird droppings and increased soil fertility. The areas occupied by these communities are the most important places on the island for nesting seabirds. Mary Gillham (1956) points to another factor, the impact of burrowing birds and rabbits. It is also important that the underlying climatic factors are not ignored. Skomer is often battered by extreme gales and occasionally suffers quite prolonged periods of drought, although, more recently, there has been a succession of wet summers. The combined impact of all these factors has delivered visually spectacular and dynamic communities in place of the fescue mattress.

Rabbits will be discussed in detail later in this section. Their impact is considerable, and, for a variety of reasons, the population has been unstable and given to extreme fluctuations. The consequence is that, over time, these quite abrupt variations in the rabbit population, in combination with other factors such as higher or lower than average rainfall, can trigger startling variations in the vegetation. It would probably be inaccurate to describe these changes as cyclical, although they can give that impression. The following sequence of photographs, taken at the Wick on the south west coast, is a clear indication of these changes from 1980 to the present time. These are not fixed-point photographs, the locations from which the photographs were taken vary, the focal length of the lenses that were used also varied. This is why the images are indicative of change and not a precise record of change.

Thrift Armeria maritima 1980

Sea campion Silene uniflora 1999

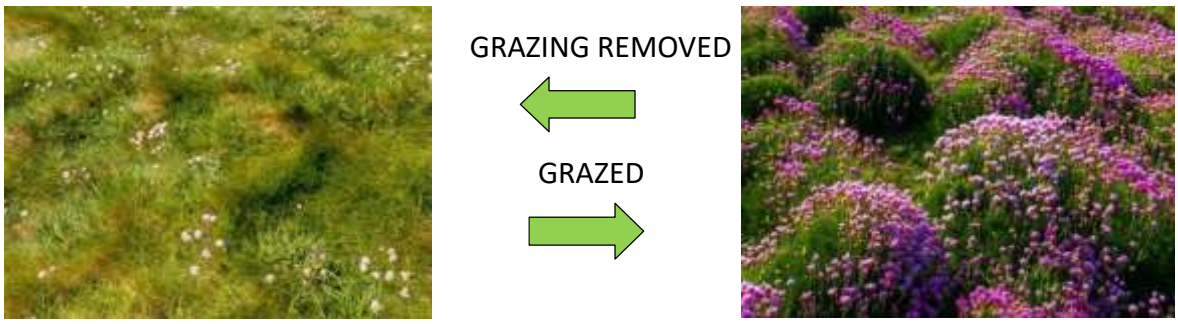
Yorkshire fog Holcus lanatus *2008 (this followed several years of high annual rainfall)*

The preceding photographs also demonstrate the speed of change. Some areas of Yorkshire fog and sorrel, shown in the third photograph, had been replaced with a dense mat of sea mayweed *Tripleurospermum maritimum* by August 2012.

In the early 1950s, Mary Gillham spent six years studying the vegetation on neighbouring Skokholm Island (Gillham 1954, 1955, 1956). Although Skokholm is different in many ways to Skomer, the most significant natural and anthropogenic influences are the same, although varying, perhaps, in intensity and impact. She describes, and explains, the sequential changes in Skokholm's vegetation, and these are similar to the changes on Skomer.

In considering Gillham's work, it is helpful to remember that, in her time, botanists talked about climatic climax communities. Vegetation would evolve to a stable state where the presence of individual species would be dependent on the combined impact of the full range of natural factors, edaphic and climatic. This equilibrium paradigm, the belief that habitats and ecosystems evolve to a balanced or stable state which would be maintained indefinitely, has been replaced by the non-equilibrium paradigm, which recognises that systems or habitats do not exist in a single, internally-regulated, stable state. Plant communities are dynamic and continually changing in response to the influence of a range of natural factors. Sprugel (1990) argues that vegetation would not be stable over long periods of time even without human influence: *'One must recognise that there are often several communities that could be the 'natural' vegetation for any given time'*.

Gillham's starting point was a community that she described as *'the biotic subclimax Armerietum maritimae'*, a community that, in its 'pure' form, was composed almost entirely of thrift *Armeria maritima.* This community, give or take a few additional species, was abundant along the exposed southern and western coastal fringe of Skokholm. She suggested that the presence of *Armerietum* was the consequence of the impact of grazing, by rabbits, sheep and goats, on 'the natural climax of *Festucetum*' (this is the MC8 *Festuca rubra – Armeria maritima* maritime grassland). *Festucetum* barely existed on Skokholm in the early 1950s. The only exceptions were very small areas which were inaccessible to grazing animals. Gillham used the small, remote island of Grassholm, where there is no grazing, as a convenient reference for the community, and confirmed its potential on Skokholm when 'Festucetum' developed, 'in a few months or sometimes after several years', within rabbit proof exclosures. The change from *Festucetum* to *Armerietum* is readily understood: red fescue is extremely palatable while thrift is largely ignored by rabbits. There was a slight complication: in 1951 there were a flock of 96 Soay sheep, 5 goats and a pony on Skokholm. The Soay sheep, introduced to Skokholm in 1939 by Ronald Lockley, apparently grazed thrift. However, Gillham does not focus on this, presumably, their impact was very significant. Sheep and cattle were also kept on Skomer during the same period.



The impact of grazing on thrift grassland

The burrowing activities birds and rabbits will have some influence on these communities. Turning once again to Mary Gillham, in 1955 she published a paper on the effects of treading and burrowing by birds and mammals. The impact of treading is relatively minor and probably not a significant factor but, clearly, it is of academic interest. Gillham considers a wide range of impacts arising from

burrowing: erosion, soil moisture content (i.e. drainage), the relative humidity of air in the burrows and light penetration. She argues convincingly that when *Armerietum* is riddled with burrows (*Armerietum* is one of the more favoured areas for burrowing birds) the thrift tussocks disintegrate and deep-rooted species, pre-eminently common sorrel *Rumex acetosa* and sheep's sorrel *Rumex acetosella,* gain an advantage. She also suggests that the structure of this community - the distinctive thrift tussocks - are also a consequence of the burrows. This view is, to some extent, contradicted on Skomer where there are, or were, some large areas of thrift tussocks in the absence of any burrows.

Ninnes (1997) also concluded that clumps of thrift had been destroyed by rabbits, Shearwaters and Puffins. His surveys showed that in some places thrift was overgrown directly by sea campion, but he also noted that thrift had died in other areas without any obvious cause. There are many areas on Skomer where thrift has been replaced by sea campion. However, on Skomer, the decline of thrift has not been confined to these 'grassland' areas: thrift is in decline everywhere, even in the maritime rock crevice community.

Sea campion invading an area of thrift 1995. (Note the absence of burrows)

Spectacular and extensive areas of thrift were a feature of Skomer in the 1980s

Thrift on a rock outcrop above South Haven in 1980. By 2013 the thrift had disappeared from this location.

The best surviving area of thrift in 2013

Skomer Head exclosure in 1984. Inside, a fescue mattress; outside, bare ground with clumps of sea campion.

The 'new exclosure', constructed in 1977, photographed in June 2013. Note the replacement of red fescue by Yorkshire fog, and, somehow, bittersweet Solanum dulcamara has also appeared.

A carpet of sea campion at Skomer Head in June 2013.

Sea mayweed Tripleurospermum maritimum is usually the first species to colonise bare ground.

Weather, and particularly the extremes of weather: major storms, drought and wet summers has had a significant impact on the development of the vegetation. The south and west facing sea cliffs, the Atlantic cliffs, on Skomer must represent some of the most extremely exposed parts of the Welsh coast. Gales are frequent and can occur at any time of the year, though there are generally fewer in summer. Storms are infrequent, but their impact can have the most dramatic effect on the vegetation. One of the most severe events was recorded in the warden's report for 1975: *'The vegetation on the West coast, especially in the Skomer Head area, severely burned by salt in the autumn gales last year, has not regenerated. There is cause for concern as the dry mattress is beginning to break up'*.

An extensive area to the north of Skomer head remained bare, almost devoid of any stable vegetation, for almost 10 years. During this period there were a few years when the area was carpeted with sea mayweed, *Tripleurospermum maritimum*, but it did not persist. It was not until 1983 that significant areas of sea campion began to colonise the area. The exception was the exclosure at Skomer Head where a dense mattress of red fescue had survived.

It is clear from the Skomer Head experience that, even following the most extreme storms, fescue grassland can make a very rapid recovery. However, grazing completely inhibits recovery of fescue and delays colonisation by other species. The ephemeral sea mayweed community is often the first to appear, and the area eventually became covered with a carpet of sea campion.

Periods of drought are not uncommon on Skomer. There have been many summers (1974 and 1976 were notable examples) when the drought was so prolonged that the vegetation was burned out on all but the deepest soils. The cliff edge grassland, particularly the well-drained and more salt exposed slopes, is usually the first to suffer. Drought alone is such a powerful factor but when combined with salt deposition the impact on the vegetation can be extreme. At the end of November 1974 Stephen Evans, wrote: *'What a disastrous summer, we had seven weeks of drought in the early part, then from the beginning of August onwards we seem to have had one long storm'.* Stephen records a visit to Skomer in August 1974, just before the great storm but following the drought. At the Skomer Head exclosure, originally constructed in 1973, he recorded that sea campion *Silene uniflora* and sea mayweed *Tripleurospermum maritimum*, the only species resistant to rabbits, birds, drought, and high salt, were doing well outside fence. There was also much die back of the red fescue *Festuca rubra* mattress outside the exclosure. Inside the exclosure the mattress was not as seriously affected but it was not flowering.

The 1974 storm was much more damaging to fescue because it followed a prolonged period of drought. Salt levels in the soil were so high that red fescue could not obtain any moisture by osmosis. The situation was further complicated by the deeply burrowed, free-draining mattress. There was a clear difference between the 'mattress' and fescue growing on the shallower, damper soils along the footpath: much of the latter survived.

Occasionally, bare areas persist for several years after the extreme events. Ninnes (1997), writing about thrift on Skokholm, noted: *'The colonisation of new areas seems to have occurred where drought killed off grasses and forbs, leaving bare ground. This suggests that thrift requires bare ground to become established.'* This may be the way in which some of the very large areas of thrift, frequent in earlier years (i.e. the latter half of the 20th century) became established. The length of time that rabbits have occupied Skomer, combined with the impact of grazing by domestic stock up until 1959, would suggest that the original fescue grassland probably disappeared a very long time ago. Whatever the process that enables re-colonisation by thrift, with only very occasional minor exceptions it is not currently happening on Skomer.

Higher than average rainfall is also an important issue. The total annual rainfall, particularly the summer rainfall, was significantly higher from the late 1990s to the present time (2020), than in the preceding 30 years. This has been reflected by an increase in ground cover in the coastal 'grassland'. The most notable change was a very spectacular increase of Yorkshire fog.

South Plateau July 2019 with Yorkshire fog, Holcucs lanatus in flower

Coastal Bluebells

An approximation of the MC12 maritime bluebell *Hyacinthoides non-scriptus* community occurs in several areas of deeper, moist, more fertile soils. These are mainly in the relatively sheltered, shaded damp areas, sometimes forming a mosaic with the other maritime 'grassland' communities. It also occasionally occupies sheltered gullies, even on the most exposed west coast. Bracken is usually absent or sparse. There is a particularly good example of this community thriving in a surprisingly sheltered hollow above Pigstone Bay on an otherwise extremely exposed section of cliff. On the mainland, the community usually comprises a lush carpet of fescue *Festuca rubra* with bluebells *Hyacinthoides non-scriptus,* thrift *Armeria maritima,* sea campion *Silene uniflora,* Yorkshire fog *Holcucs lanatus*, common scurvy grass *Cohlearia officinalis* and common sorrel *Rumex acetosa.* The community above the spit is an excellent match: all the species mentioned above are present with, of course, the exception of fescue, which is either absent or suppressed. Later in the year, after the bluebells have flowered, this particular hollow is filled with wood sage *Teucrium scorodonia* and occasionally invaded by ragwort *Senecio jacobaea*.

Maritime bluebell community above the Spit

Maritime bluebell community late summer

Common scurvy grass, Cohlearia officinalis, above the Spit on the west coast.

Primroses, Primula vulgaris growing among common scurvy grass, Cohlearia officinalis on a sheltered north facing slope at Bull Hole, there are similar patches of primrose above Driftwood Bay in South Haven.

Bent-fescue-sorrel grassland

The bent-fescue-sorrel grassland, NVC U1 *Festuca ovina – Agrostis capillaris - Rumex acetosella* grassland, was recorded in 10 quadrats by Wilberforce. These are the rabbit-grazed grassy patches which often form a mosaic in areas which are, or were once, heath. They occupy both the coastal zone between the 'coastal grasslands' and the dense inland bracken areas and also occur in exposed areas of thinner summer-parched soils in the central fields. The community takes its name from sheep's fescue *Festuca ovina*, which is no longer a common species on Skomer. The NVC description states that, '*Festuca ovina is only very locally replaced by F. rubra'*. The two grasses which are most frequent on Skomer are red fescue *Festuca rubra* and common bent *Agrostis capillaris*, but, as a consequence of rabbit grazing, both are extremely suppressed. The community on Skomer is nearly always dominated by sheep's sorrel *Rumex acetosella.*

Between 1979 and 1988 four exclosures were established and recorded in this grassland community on South Plateau. The most obvious change was a rapid increase in the grasses and in particular red fescue which became the dominant species in all the exclosures. The most spectacular change was the increase in biomass and build-up of peat in the more exposed exclosures and an increase in soil humus is the more sheltered eastern exclosure. (Bellamy 1992)

Bent-fescue-sorrel grassland

Cliff footpath vegetation

The thrift–red fescue coastal grassland is a community which exists as a response to mainly natural influences, in particular, exposure to sea spray. As the consequence of another significant influence - trampling by people and possibly livestock - the grassland will change: it becomes the buck's horn plantain sub-community of the thrift grassland. This is a sub-community which is frequently encountered along much of the Pembrokeshire Coast footpath. It can be found almost everywhere where footpaths pass through thrift-red fescue grassland, and there can be substantial areas around popular viewpoints where people congregate. There are well-defined examples along the more exposed south and west coasts of the Deer Park.

The impact of human trampling on Skomer is limited almost entirely to the system of narrow footpaths. This is a deliberate and strictly applied policy to protect the fragile sea bird burrows. When the width of the footpaths is tightly constrained, and people-pressure is concentrated, the vegetation stands no chance: the footpaths can become bare soil. As the paths become wider, most obviously on the thinner soils of the west coast of the island, the buck's horn plantain sub-community appears, but it is different to the mainland version. As a consequence of rabbit grazing, red fescue and all other grasses are very rare, or entirely absent, and, in the most exposed areas, the community most often comprises just three species: tiny rosettes of buck's horn plantain, often much smaller than a 5p coin, interspersed with impossibly small thrifts and red fescue. The plantain rosettes are very flat and pressed close to the soil, and they rarely flower unless rabbit grazing pressure is reduced. When this happens, the same plants are capable of producing upright leaves and flowers. A fourth species, sea stork's-bill, appears in all but the most exposed areas. As exposure reduces, stork's-bill becomes one of the most common species alongside the footpaths. It is very abundant in and around the old farmyard and almost everywhere where people walk. In these heavily grazed situations, stork's-bill does not bear flowers. It sends out creeping stems from the basal rosette, but, once again, when grazing is reduced the stems become raised. Low-growing

rosette plants are not only less vulnerable to attack by mammals but are able to compete more effectively in unfavourable circumstances because of the ability of the expanding rosettes to smother the surrounding vegetation. Very occasionally, in October, when the autumn rabbit population is low and the grasses have produced seed, the bare paths flush bright green velvet as the grasses germinate; sadly, this rarely survives the winter.

Tiny rosettes of buck's horn plantain alongside a rabbit grazed footpath above the Spit.

Sheltered north facing coast grassland

This must not be confused with the community described by Bray as 'coastal grassland - northern slopes'. This community occupies the coastal slopes, ledges and terraces which extend east from the cliffs above the Garland Stone to North Haven. This is by far the most sheltered part of Skomer, free of the westerly and southerly gales. Severe and prolonged northerly gales are relatively infrequent and, more significantly, that part of the coast is not often exposed to the heavy Atlantic swells or drenched with salt water. It is also the wettest part of the island: moisture is retained in the shaded slopes, which only ever see the early morning and late evening summer sun. The vegetation, which remains green even during the worst summer droughts, is very different to almost everything else on the island's cliffs. It is tall, robust, verdant and lush; bracken is present but not dominant. This is the domain of the burrowing shearwaters, and the soils have been enriched by their droppings. During the 1940s, the ledges were grazed by cattle, and this was one of the favourite pastures. Reuben Codd, who farmed Skomer at that time, had difficulty keeping them away from this sheltered and rich grazing. There were several losses as heavy animals slipped when trying to turn on the steep, narrow ledges.

This is probably the least visited part of the island. It was not described by Bray, but Sladden (Buxton 1950) gave it significant attention and provided a wonderful description:

'These delightful cliff-gardens of Skomer'.... These moist and fertile ledges support in spring concentrations of red campion, sea campion, bluebells, scurvy grass, and chickweed, the last named selecting the bare nitrogenous patches trodden by gulls and other birds. These are followed by flowering orpine, Sedum telephium, honeysuckle, sea beet, buck's-horn plantain, sea plantain. Ivy Hedera helix, blackthorn, Prunus spinosa, blackberry with some elder cover the steeper faults..... Among plants of rank growth noted here were woody nightshade, hogweed, hemp agrimony, figwort, foxgloves and ferns: lady fern Athyrium filix-femina and male fern Dryopteris filix-mass'.

The overall appearance is much the same today, and most of the species are present, if not abundant. The area is grazed by rabbits and, in common with everywhere else on the island, the more palatable species have almost disappeared. There are many isolated ledges and banks, inaccessible to rabbits and people: these are the places where there has been the least change and where species lost elsewhere may survive. This is an area which would reward further investigation.

'These delightful cliff-gardens of Skomer.'

Coastal springs and flushes

Skomer is rather like a very large bowl with small fractures around its rim. Water seeps through these fractures along the cliff edges from above Bull Hole around the exposed western cliffs to the south coast at the entrance to the Wick. These we recognise as a series of small springs or flushes. Perhaps the most important spring of all, though not from a botanical perspective, is the above the warden's house in North Haven. This provides water for the house and indeed is the main factor which made it possible for the house to be built in this location.

The largest spring is Wick Stream, at the extreme western end of south valley. The spring flows into a small pond created by an ancient dam or wall which has been maintained over the years. It then trickles through a series of very small, ancient, derelict dams and flows into the sea above Wick Basin. The stream is particularly important for one of Skomer's rare plants, three-lobed crowfoot *Ranunculus tripartitus.* This is one of a small assemblage of four nationally scarce plants which qualify as a SSSI feature. It is also on the GB Red List (2005) as endangered. Pembrokeshire has some of the biggest populations of this species in Britain and it is found on all 3 seabird islands. The population has, unfortunately, declined in recent years.

The only other spring which once attracted botanical interest is on the edge of the cliff above Pigstone Bay. In the 1970s yellow-eyed grass *Sisyrinchium californicum,* a coastal plant native of the west coast of the USA, appeared on the edge of the spring. This species, popular with some gardeners, has naturalised and is now regarded as a troublesome invasive. There were suggestions that it reached Skomer 'on wildfowl', but it is more likely that this was human introduction, deliberate or accidental. Fortunately, it did not survive.

Wick Stream and pond

Bog pimpernel Anagallis tenella growing in the wet area around Wick stream.

Silverweed, Potentilla anserina growing in the damp flush areas along the south coast. Prior to the arrival of the potato in 1500s the starchy roots of Silverweed made an essential contribution to the diet of the Western Isles. Is there a possibility that it was also cultivated at one time on Skomer?

Angelica, Angelica sylvestris above Bull Hole

There is one other notable flush, where the western extreme of North Valley approaches the cliffs above Bull Hole. The slighter wetter and enriched conditions here provide an opportunity for tall vigorous vegetation dominated by wild angelica *Angelica sylvestris* and surrounded by nettles *Urtica dioica* and brambles *Rubis fruticosus agg*. There is a similar patch of angelica on the south eastern flank of South Valley.

There are two factors - persistently high soil moisture combined with enrichment from seabird guano - that occasionally have a localised impact on the coastal grassland. Most of the fresh water springs which emerge at intervals around most of the coast, are quite well defined, for example, at the west end of the Wick. But there are other places (Pigstone Bay, on the exposed west coast, is the best example) where water percolates through a large area of exposed seaward slope and reduces the salt content of the soil. These are also some of the areas long preferred by shearwaters, and their input has produced highly enriched, fertile soils. At first glance, the plant community has the appearance of something that we might find in an undisturbed corner near the dung heap in an old-fashioned farm yard. This is the Chickweed bird-cliff community, probably the *NVC MC7 Stellaria media-Rumex acetosa seabird community*
The dominant species are common chickweed *Stellaria media*, scarlet pimpernel *Anagallis arvensis*, sea mayweed *Tripleurospernum maritimum* and sea campion *Silene uniflora*, with occasional corn sow-thistle *Sonchus arvensis* but very little else. To describe this as yet another grazed derivative of the fescue sward is perhaps counter intuitive, and yet it occupies the zone which would have been dominated by fescue and is clearly mapped as coastal grassland - western slopes by Bray (1981).

Chickweed bird-cliff community above Pigstone Bay.

MARITIME, DRY AND WET HEATH

This is not a SSSI qualifying feature. Heath has been given so much attention on Skomer, including quite significant management intervention, that there is no choice other than to include it as a feature for discussion in this plan.

The NVC communities, identified in the 'The Pembrokeshire lowland heathland survey' Prosser and Wallace (1996) are:

- Squill clifftop heath, H7 *Calluna vulgaris - Scilla verna* heath.
- Western gorse dry heath, H8a *Calluna vulgaris – Ulex gallii* heath, species-poor sub-community.
- Lowland wet heath, M16a *Erica tetralix – Sphagnum compactum* wet heath, typical sub-community.

Wilberforce (1999) also identified:

- Fescue dry heath, H1 Calluna Vulgaris-Festuca ovina heath.

Bray (1981) applied different divisions:

- Coastal grasslands - maritime heath
- Calluna vulgaris - dominated heathland
- Mixed heath

This is an extract from 'The Edge of the Picture', written by John Rodwell in 2008. It provides an extremely useful summary of the NVC heath communities:

'Most of the vegetation on the better-drained brown earths and rankers of Skomer that has convincingly been called heath in more recent surveys (Prosser & Wallace 1996) and which exists at the present time, is closest to H8 Calluna-Ulex gallii heath, though the gorse itself is very scarce and Pteridium can be quite abundant. Maritime heath was explicitly recorded by Bray (1981), mostly on the cliff tops above The Table, Bull Hole and opposite the Garland Stone, but Prosser & Wallace (1996) noted it only above Wick Basin (where some of the best was in an exclosure) and on Gorse Hill. However, the samples in both these surveys had only sparse records for species such as Armeria maritima and Silene vulgaris ssp. maritima and approximate poorly to the H7 Calluna-Scilla heath. Other vegetation with Calluna and occasionally Erica tetralix on the wetter gleys and stagnogleys alongside the main streams (Jenkins & Owen 1995) would be classified in the NVC as heathy stands of M25 Molinia-Potentilla mire (Rodwell 1991 et seq.); or as heathy M16 Erica tetralix-Sphagnum compactum wet heath typical of seasonally waterlogged shallow peats and humic soils (Rodwell 1991b). These vegetation types were recorded by Prosser & Wallace (1996) and still survived in 2007 with much dead big Calluna bushes but with vigorous regeneration in a patchy carpet in unenclosed stands.'

Skomer has 4 NVC heath communities, but, although they may be quite different communities, all the factors, the discussion and any future management will be common to all areas of heath on the

island. To avoid unnecessary repetition in the plan, these communities will be aggregated as a single feature. The total area given for this habitat in the SSSI schedule was 5.4 Ha, with wet heath covering less than 0.2 Ha (date?). By 2008, the total area of heath was 3.1 Ha.

There is no purpose in providing a detailed description of the NVC heath communities found elsewhere in Pembrokeshire, but two photographs are included simply as a reminder of what coastal heath can look like. There is no suggestion that this could ever be obtained on Skomer. It is important that we adopt a strategic approach to managing the Pembrokeshire islands. We do not need everything everywhere, Skomer and Skokholm are internationally important seabird islands, Ramsey is one of the best places in Wales for maritime heath.

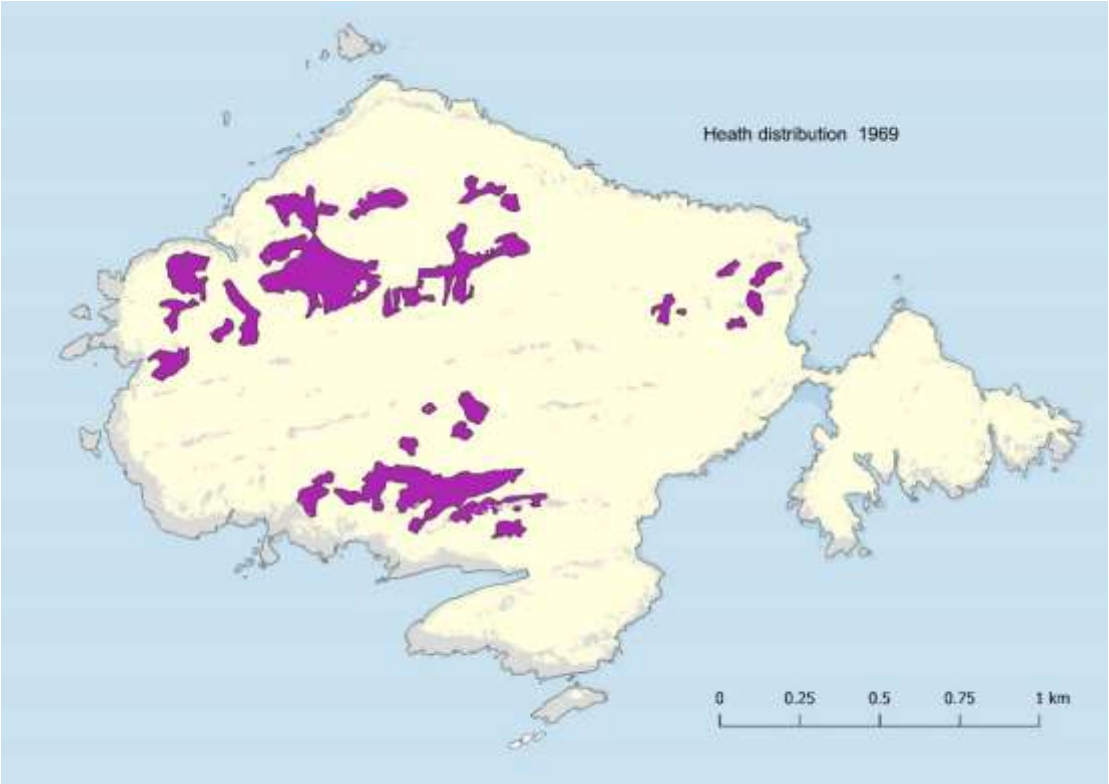
Heath on Ramsey island

Heath on the south coast of Ramsey island

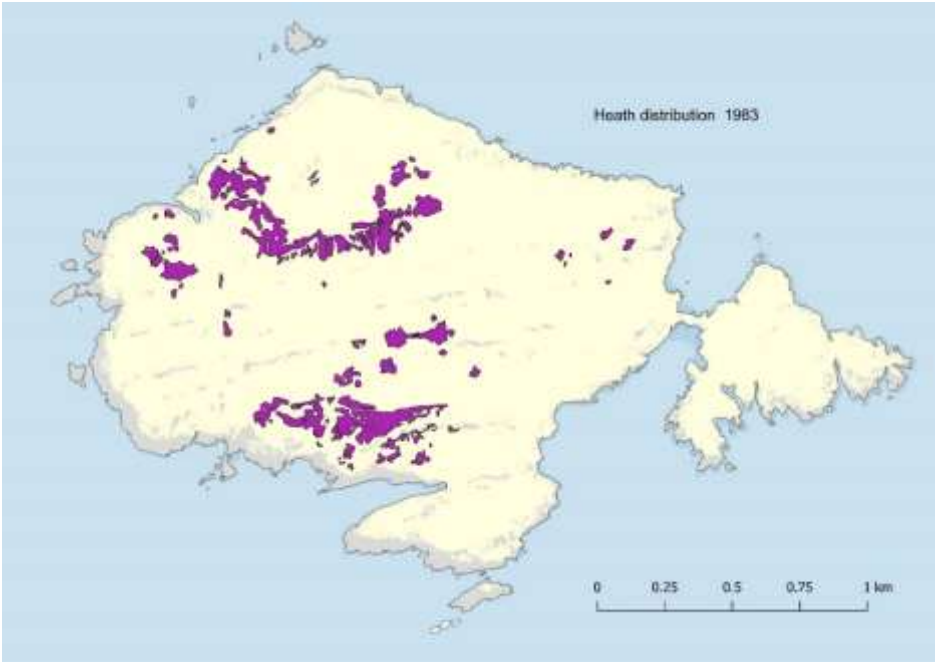
Changes in the distribution of heather on Skomer Island NNR since 1947

In 2008, an attempt was made to locate all existing vegetation maps for Skomer (Alexander et al. 2008). The earliest known map was prepared by J. Sadd in July 1947 and published in 'Island of Skomer' (Buxton and Lockley 1950). (In 1995 a 'definitive' set of vegetation maps was produced by Countryside Council for Wales, these were digitised copies of earlier sketch maps, they are inaccurate and misleading copies, consequently they have not been included this discussion.) The comparisons in this note are based on the following information:

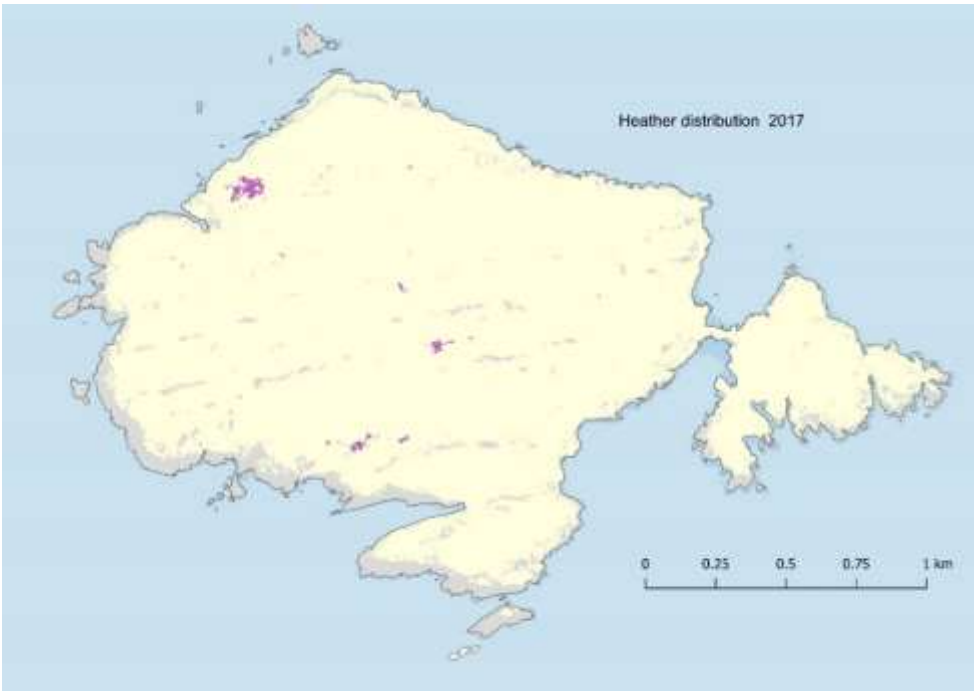
In July 1947, Joe Sadd prepared the first description of the heath on Skomer: his dissertation contained the earliest map of the Skomer vegetation. He used '*Callunetum*' to describe the heath communities, and, although he mapped it as 'one association', he recognised a division between wet heath and dry heath. His sketch map is perhaps indicative of the distribution of the vegetation, but his delineations of both bracken and heath are vague. Unfortunately, the distribution of heath on the map bears little resemblance to Joe Sadd's written description of the vegetation. There is good evidence from his text that heath was much more abundant and widespread than depicted on the map. He wrote, 'The *Callunetum* appears to occur fairly evenly over the whole island'. It is also clear from the text in 'Island of Skomer' that there was considerably more heath, or areas containing heather, than shown on the 1947 map. We have to recognise that the area of heath shown on the map must be an under representation.



1969 heath map, this was based on aerial photographs and field survey. It is the most accurate and reliable of the historical maps and provides a good reference point.



1983 heath map This map was based on a large collection of low-level aerial photographs. Although not a commercial flight, the photographs were taken at several different times during the year and clearly show the distribution of heath. The aerial photographs were supplemented with a collection of ground photographs.



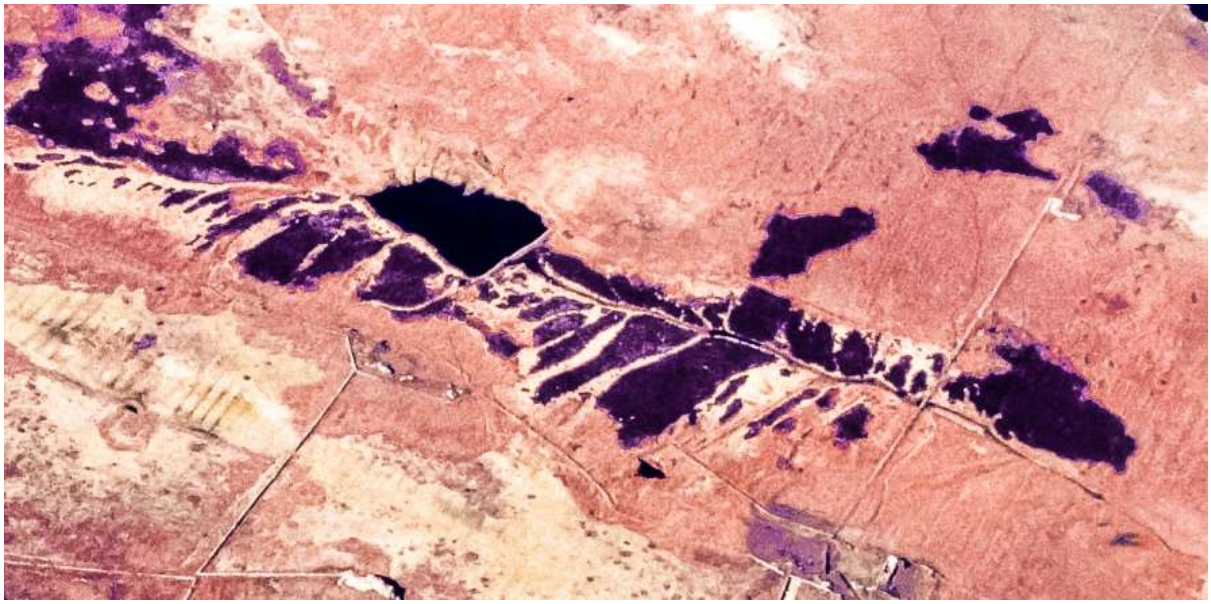
The 2017 heather map is by far the most accurate. It was digitised from a very high resolution aerial image. In general, it confirms a continuation of the overall decline, with further losses since 2008, but, surprisingly, there has been some recovery in the south of the island.

Note: Earlier maps indicate 'heath' but, given the inconsistent way in which heath has been defined in the past, the 2017 survey simply mapped heather. The areas which contained heather were mapped, regardless of the density of cover.

Heather 2008 North Valley following a severe outbreak of myxomatosis

Heather 2008 east of Bull Hole

An aerial photograph from 1983. Areas of heather are clearly defined - they are the darkest patches in the photograph. The only exception is the dark area at Skomer head: this was bare ground.



Oblique aerial photo of North Valley 1983 - the dark purple areas are heath. The darkest area is North Pond.

There has been an obvious and dramatic decline in the cover of heath on Skomer since 1969. At that time, heath covered 8% of the island. By 1983, the area had declined to 6%, with a further decline to less than 1% by 2017. Because the 1947 map (Buxton & Lockley 1950) clearly misrepresents the distribution of heath, it was an inaccurate copy of Sadd's map, it must be used with caution. Suggestions by some authors, based on Sadd's map, that heath actually increased between 1947 and 1969 were probably erroneous, but there was certainly a change in distribution. This is best

demonstrated in South Park, the large field to the south of the farm. By the 1960 this was one of the best areas of inland dry heath. The 2008 map reveals that it was one of the largest areas of heath on the island at that time. Sadd prepared a very detailed description and sketch map of this field. In his day it was grassland with bracken on the deeper soils around the edges of the fields. The only heather was on the dry, rocky areas on the edges of the field. It is completely absent in these areas today. In 1947, unlike most other grassy areas, this field was rarely grazed by the domestic animals, but it was heavily grazed by rabbits.

The descriptions prepared by Sadd and information available from subsequent surveys reveal a significant decline in the quality of the heath. For example, bell heather *Erica cinerea,* once frequent in the heath communities, has almost completely disappeared outside the exclosures.

' The Callunetum appears from the map to occur fairly evenly over the whole island . . . but it should be noted that what appears on the map as one association is in reality two different ones. Both have Calluna vulgaris as the dominant species and most areas have a certain amount of Erica tetralix.' (Sadd 1947)

Flowering cross-leaved heath (pale pink) and bell heather (darker purple) surrounded by heather, which is not in flower. This combination would have been quite common on Skomer when the island was farmed. Today, both cross-leaved heath and bell heather are almost extinct on Skomer.

It is just possible that we are not witnessing the extinction of heath on Skomer, and there is some reason for optimism. The best surviving original area of heath, near Bull Hole, is quite vigorous, despite the removal of the exclosures. Towards the south coast, near South Pond, an area of heath which appeared to be completely dead by 2013 suddenly began recovering in 2016.

South valley viewed from the west, showing an extensive area of heather which died before 2008. This photograph was taken in 2013, and, at that time, there had been no recovery and very limited replacement by other species.

A similar view of South Valley taken in July 2019. Most of the dead heather shown in the 2013 photograph has been replaced by a remarkable area of fresh, new growth.

GRASSLANDS OF THE CENTRAL FIELDS

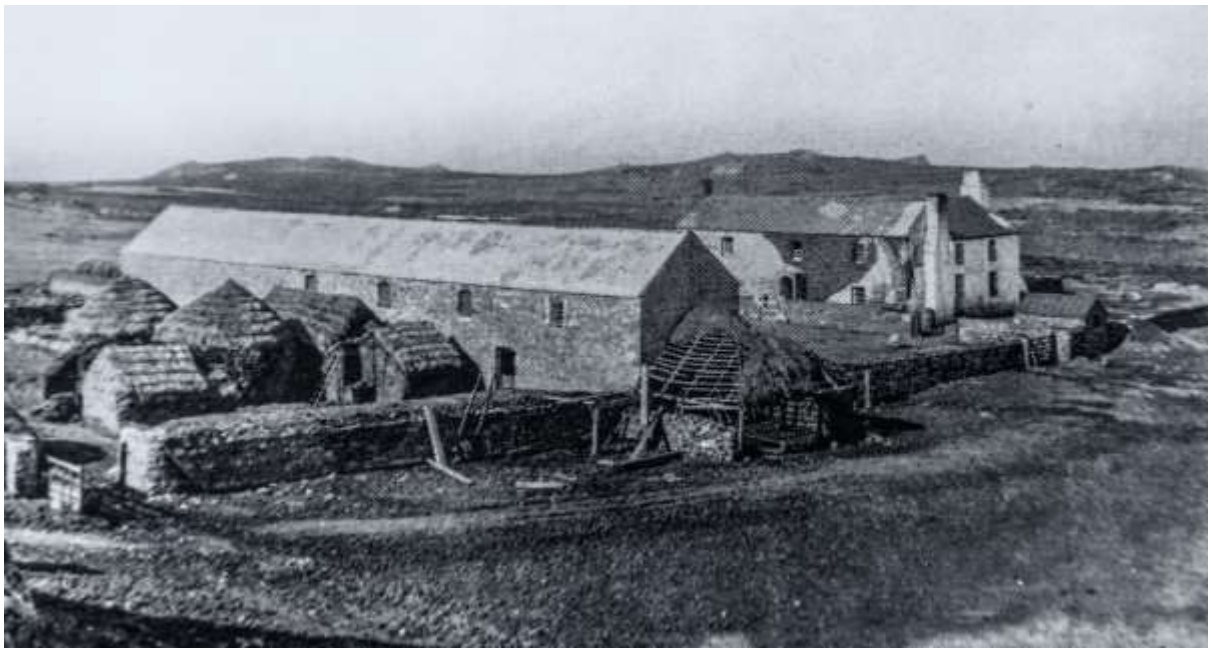
The grassland community in the central fields is the bent-fescue pasture, NVC U4 *Festuca-Agrostis-Galium* grassland. This was identified by Wilberforce in 3 quadrats, two in the central fields and one outside the field system near the west coast, inland from Pig Stone Bay. Rodwell (2004) also identified this community in the central fields. *'This community is the most extensive kind of pasture on better-drained, more base poor mineral soils throughout the cool and wet sub-montane zone of north west Britain'* (Rodwell 1992).

Bray (1981) identified two grassland communities, 'inland grasslands' and 'disturbed ground', he also includes a community which he describes as 'bracken dominated wetlands'. These are mainly the purple moor grass *Molinia caerulea* marsh grasslands. They will be treated as separate feature.

The central fields, with Shearing Hays on the left and Calves Park on the right.

The central fields

Before considering the descriptions of the fields from the 1940s, 80s and 90s, it is worth taking a very brief look at how this land was used at the end of the 19th century. There are no descriptions of the vegetation, but here are some very informative photographs:



The farm in 1889. Although this does not show the vegetation, the hay or straw ricks provide a very clear indication of how the central fields were utilised.

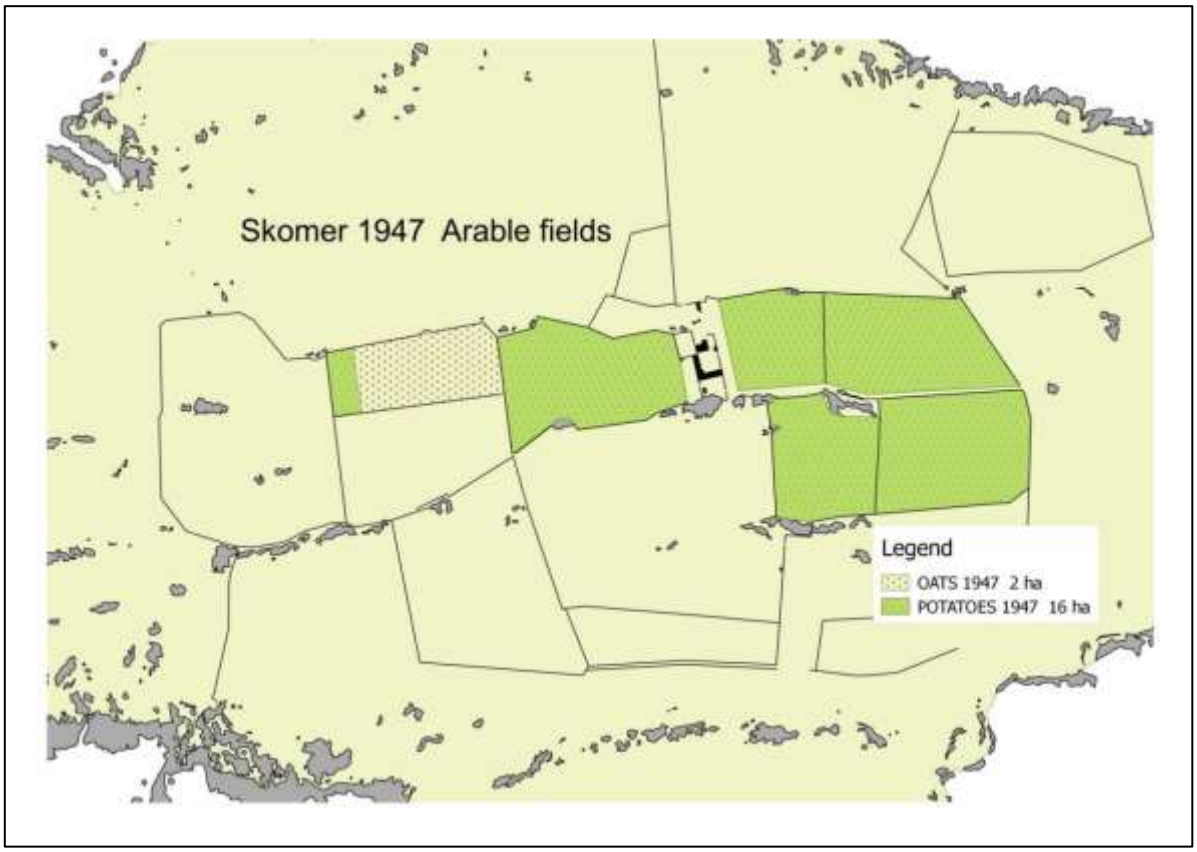
Liza Stephens at the well in Well Meadow in 1889. It may not be possible to identify any of the plants, but this is clearly a grazed meadow or pasture: a short, floristically rich, grassy sward.

Milking in the farmyard 1889

Washing sheep in Green Pond, on the northern edge of Calves Park. 1899

Lime kiln North Haven

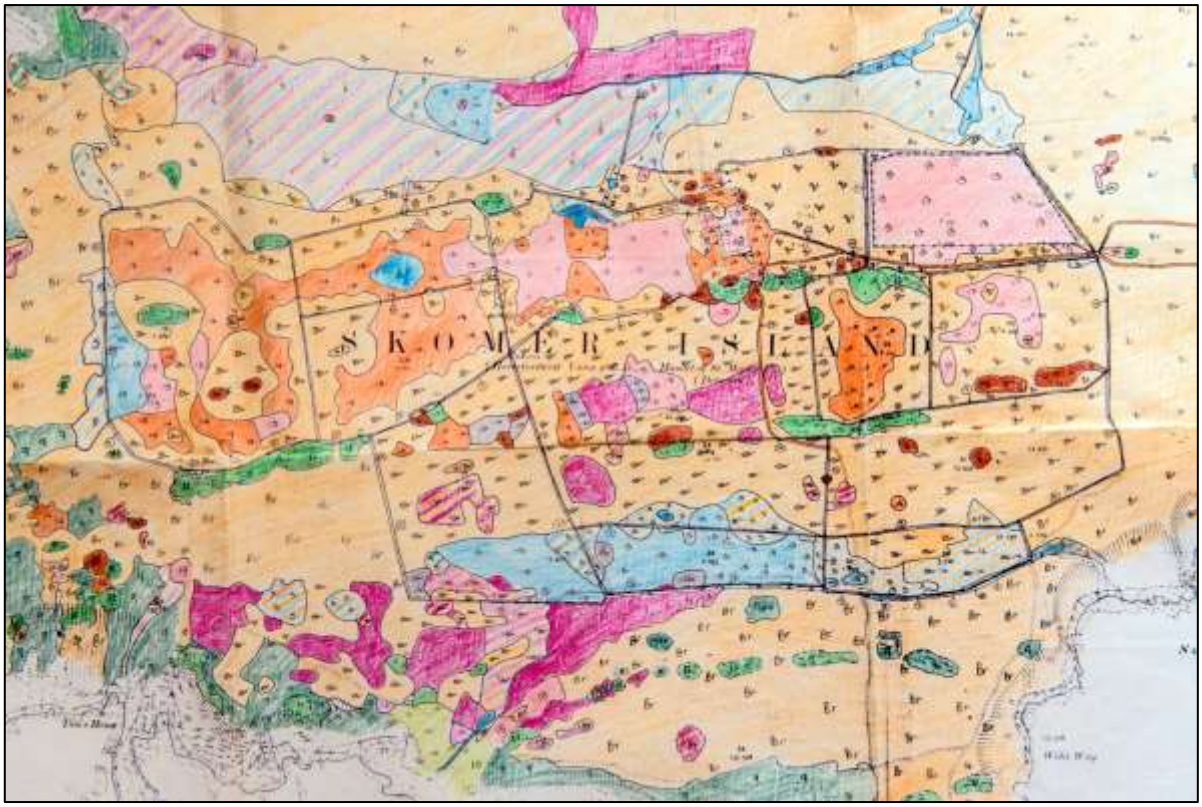
There are two lime kilns on Skomer the younger, best preserved, was built in the mid-1800s, the date of construction for the older derelict kiln is uncertain. The kilns provide the clearest evidence that the land at that time would have been limed and probably fertilised with farmyard manure to deliver arable crops and hay.



Inland grasslands

Bray (1981) used the heading 'inland grasslands' to define the rabbit-grazed grassy areas found in the old field system in the middle of the island. We benefit from four descriptions of these areas: Sladden in 1946, Sadd in 1947, Bray in 1980 and Rodwell in 2008. These are presented in chronological order.

In 1946, Sladden described the fields as, *'agriculturally very degenerate and overgrazed by rabbits'*. But, even so, the sward at that time was composed mainly of grasses: sheep's fescue *Festuca ovina*, red fescue *F. rubra*, annual meadow grass *Poa annula*, smooth meadow grass *P. pratensis* , rough meadow grass *P. trivialis* and common bent Agrostis capillaries, with colonies of ragwort *Senecio Jacobaea,* creeping thistle Circium arvense, spear thistle Cirsium vulgare, yarrow *Achillea millefolium,* sheep's sorrell *Rumex acetosella* and common dog violet *Viola riviniana* in the spring.



A section of Graham Bray's map showing the central fields. The pink (13) areas are 'inland grasslands', the orange (14) areas are 'disturbed ground' and the yellow (Br) is bracken.

When Sadd visited the island in 1947, six of the enclosed fields were arable: West Park, Well Meadow, West Meadow, Calves Park, New Park and Shearing Hays. With the exception of West Park, which was planted with oats, Reuben Codd had planted all the remaining arable land with potatoes. The 'weed' species found in the potato fields were, a dense mat of scarlet pimpernel *Anagallis arvensis* with an abundance of '*Brassica campestris'.* The latter was probably wild turnip *Brassica rapa*. Field pansy *Viola arvensis*, sand spurrey *Spergula rubra*, creeping thistle *Cirsum arvence* and ragwort *Senecio Jacobaea* were also recorded. These areas coincide exactly with the areas described as inland grassland by Bray.

Bray's description of the vegetation in 1980, just over 30 years later than Sladden, is quite different. Bray described the community at a time when rabbit grazing was very high. The sward was very short and dominated by grasses, mainly common bent *Agrostis capillaris* and red fescue *Festuca rubra*. He also mentioned that the sward contained a very rich scattering of dicots, with often more than 20 species present in a sample. These included heath bedstraw *Galium saxatile*, procumbent pearlwort *Sagina procumbens*, birdsfoot trefoil *Lotus corniculatus*, common mouse-ear Cerastium fontanum and common dog violet *Viola riviniana*.

John Rodwell visited Skomer in 2007, following a severe outbreak of myxomatosis. In his report he wrote: 'The vegetation in some of the farm fields was much more recognisably some kind of semi-improved U4b *Festuca-Agrostis-Galium* grassland (Rodwell 1991 et seq.) with a luxuriant rough turf of red fescue*, Festuca rubra,* common bent*, Agrostis capillaris,* rough meadow grass*, Poa trivilais,* Yorkshire fog*, Holcus lanatus,* heath bedstraw*, Galium saxatile,* tormentil, *Potentilla erecta,* field wood-rush*, Luzula campestris,* common mouse-ear, *Cerastium fontanum,* white clover*, Trifolium repens,* germander speedwell*, Veronica chamaedrys,* as well as patches of scarlet pimpernel*,*

Anagallis arvensis, ground ivy, *Glechoma hederacea* and sheep's sorrel*, Rumex acetosella, typical of the rabbit-infested landscape and* common ragwort*, Senecio Jacobaea,* spear thistle*, Cirsium vulgare,* wood sage*, Teucrium scorodonia* and stinging nettle, *Urtica dioica* around remaining active burrows.' (Rodwell 2008)

The biggest change since the 1940s has been bracken invasion and consequential loss of most of the grassland in the fields. Species diversity has also diminished. Even by 1979, when Bray surveyed Skomer, sheep's fescue *Festuca ovina* and rough meadow grass *Poa trivialis* were absent in the fields. Since 1980, with the exception of the years when the rabbit population was low following a major crash, there has been a very significant increase in the unpalatable species, including stinging nettle *Urtica dioica,* common ragwort *Senecio Jacobaea, and* ground ivy *Glechoma hederacea,* but the most notable change has been the increase of wood sage*, Teucrium scorodonia*. Today it completely dominates the non-bracken areas of sward. (Sladden did not even mention the presence of wood sage in the fields though he did give ground ivy some attention because it was poisonous to the horses which grazed in the fields.) There is very little grass apart from Yorkshire fog *Holcus Lanatus* and only rather sad remnants of the more palatable flowering species. A small area in the south east corner of Calves Park was used as a store for building materials from 2005 to 2007. During this period the vegetation was destroyed and for several years it remained as mainly bare ground. In 2013 it was covered in a spectacular display of spear thistle *Cirsium vulgare* and creeping thistle *Circium arvense* with a few nettles *Urtica dioica*. In 2013 almost the entire area of inland grassland was covered in common ragwort *Senecio Jacobaea.* A detailed account of ragwort will be included at the end of the section on communities.

Marsh Thistle Circium palustre west of the old farm 2019.

Disturbed ground

The community that Bray (1981) described and mapped as 'disturbed ground' was found mainly in the bracken-free areas in the western fields, Abbyssinia, West Park and South Field. There were also small areas in the middle of Well Meadow, along the northern edge of Young Ground and around the Farm.

Sladden's 1946 description of these same fields to the west and south of the farm is very different to that described by Bray and to the current situation:

'Here we find a springy turf of sheep's fescue Festuca ovina, with plants of wild white clover, Trifolium repens, and strong colonies of Bird's-foot trefoil, Lotus corniculatus. Associated with the well-drained pasture are scorpion-grasses, Myostis collina and M. versicolor, and as the summer advances, a host of other dwarf plants come into flower, we find eyebright, Euphrasia offinalis , two bedstraws, Galium saxatile and G. vernum, Tormentil, Potentilla erecta, Common centaury Centaurium umbellatum, milkworts, Polygala vulgaris and P. serpyllifolia,... etc.'
More or less the same areas were described by Sadd in 1947. His study was carried out during July and August, so the spring flowering species were under recorded. The main change between 1946 and 1947 was that West Park was arable, mainly planted with oats, but also with a narrow strip of potatoes along the western edge. Sadd noted that the 'fenced pasture' varied much from field to field. Red fescue *Festuca rubra* was the dominant grass with birdsfoot trefoil *Lotus corniculatus*, wood sage *Teucrium scorodonia*, sheep's sorrel *Rumex acetosella* and white clover *Trifolium repens*. He also describes large patches of yarrow *Achillea millefolium* in Abyssinia.

By 1981, the fields had a disturbed soil surface with bare earth, high moss cover and intensive rabbit grazing, along with rabbit scrapes, burrows and latrines. The frequent species were, common bent *Agrostis capillaris* and Yorkshire fog *Holcus lanatus*, with occasional silver hair grass *Aira caryophyllea*, ground ivy *Glechoma hederacea*, wood sage *Teucrium scorodonia,* procumbent pearlwort *Sagina procumbens*, common dog violet *Viola riviniana,* sheep's sorrel*, Rumex acetosella,* birdsfoot trefoil *Lotus corniculatus,* red clover *Trifolium pratense* and white clover *T. repens.*

The western fields were described by Bray as, 'showing signs of relatively recent agriculture with quite distinct ploughing ridges and furrows'. These are less obvious today but still visible. According to Sadd these western fields were <u>not</u> ploughed in 1947, and Sladden, in 1946, described these fields as grassland. They were probably last ploughed before 1890. These areas, within the central field system, which Bray described as 'disturbed ground' had the least recent agricultural disturbance. However, they were the most disturbed by rabbits. Bray speculated that these fields may have been more exposed to salt spray than the fields to the east of the farm and that this may help explain the differences. Since 1980, the areas of inland grassland in the eastern fields that have not been invaded by bracken are becoming rather similar to Bray's disturbed areas. The most notable similarity is the very substantial increase in wood sage. Today (2013) the area occupied by this community has declined as bracken has invaded, and very little remains. These fields are occupied by one the densest rabbit populations on the island.

Wood sage in the 'disturbed ground'

Sorrel / bracken mosaic west of North Pond 2019.

BRACKEN

Bckground information

Bracken is one of the oldest ferns, with fossil records dating back over 55 million years. It is a very common species with an extremely wide global distribution, occurring in both temperate and subtropical zones. It is widespread and prolific in Britain, but limited to altitudes of below 600 m and it does not prosper in wet areas, marshes, or fens. Bracken-dominated communities occupy a mid-successional position between early-successional, semi-natural communities, such as grassland, heaths and moors, and late-successional woodlands (Marris et al 2000). Bracken was once valued for use as animal bedding, in tanning, soap and glass making and as a fertiliser. It is now generally regarded as a pernicious, invasive, and opportunistic problem species.

It is extremely successful, and is the only terrestrial fern that dominates large tracts of land outside woodland in temperate climates. Originally a woodland plant, it has managed to maintain high productivity outside the woodland habitat, probably as a result of being able to restrict its water loss more effectively than other ferns (Pakeman and Marrs, 1992). There are many reasons why bracken is successful, these include:

- A very large rhizome system containing large carbohydrate and nutrient reserves, and many buds capable of producing new fronds.
- High productivity, which produces a frond canopy that casts deep shade.
- It produces large accumulations of litter which prevent other species from colonizing.
- Bracken is allelopathic (it produces compounds that inhibit the germination and growth of other plants).
- It contains a range of toxic chemicals within its tissues which can prevent it being eaten or decaying.
- The fronds are cyanogenic. They contain a substance known as prunasin that is converted into the poison hydrogen cyanide. The plants, particularly the rhizomes and young fronds, produce type I thiaminase, an enzyme that breaks down thiamine and thus causes vitamin B deficiency. The plants, including the spores, are also carcinogenic.

There is a belief that once bracken is established it will persist forever. However, there is good evidence that bracken exhibits a form of cyclic regeneration. This hypothesis was developed by Watt (Watt, 1945, 1976) and substantiated by Marrs and Hicks (1986). (NOTE: The divisions used by Bray, when describing the three different bracken communities, were based on this hypothesis.)
Mary Gillham (1954) suggested that bracken on Skokholm was possibly a relic of some early forest. The presence of woodland species, such as bluebells and red campion, supported this assumption. Bray took a different view, doubting that woodland which could support these species ever existed on Skomer. As an aside, the bluebells on Skomer usually flower two weeks later than those in Pembrokeshire's woodlands, and this is also true of the coastal and ffridd bluebells of the West Wales coast and Snowdonia. In most years, trees come into leaf two weeks before the bracken fronds develop.

Large clumps of male-fern, Dryopteris filix-mas on the north slope, there are completely lost from sight when the bracken achieves full frond. (June 2013)

Bracken covers approximately two thirds of the island. The divisions between the different plant communities which comprise this habitat are blurred or complicated by the ways in which the communities have been previously described.

Wilberforce identified two NVC bracken communities: A single quadrat near the west coast was recorded as U20c Pteridium aquilinum - Galium saxatile, bracken-bedstraw stands, this is a community where bracken is the sole dominant species. By far the most common community identified by Wilberforce is the W25 Pteridium aquilinum-Rubis fruticosus underscrub, bracken underscrub. This was confirmed by Rodwell (2004).

Bray (1981) identified 3 divisions within the bracken habitat, although these might be simply regarded as three different phases in the development of bracken. They are immature bracken, mature bracken and semi-mature bracken. For convenience Bray's divisions will be used to describe the bracken areas.

Immature bracken community

This is a species-poor community, with usually less than 10 species present and most often no more than 5. The bracken canopy varies between dense and open, with a sub layer of Yorkshire fog *Holcus lanatus*, common bent*, Agrostis capillaris* and wood sage *Teucrium scorodonia*. This immature community represents the advancing bracken front, beginning with just a few fronds but rapidly developing into an extremely dense phase. In spring, all three bracken communities provide spectacular areas of bluebells and, a little later, drifts of red campion S*ilene dioica.*

Semi-mature bracken community

This follows the immature community. In addition to bracken, it is characterised by the presence of a very small number of species, sometimes no more than 3 or 4. These include bluebells, Yorkshire fog, common bent and sheep's sorrel. The ground layer is littered with dead bracken fronds, below which there are bare areas, devoid of vegetation, with a layer of decomposing fronds.

Mature bracken community

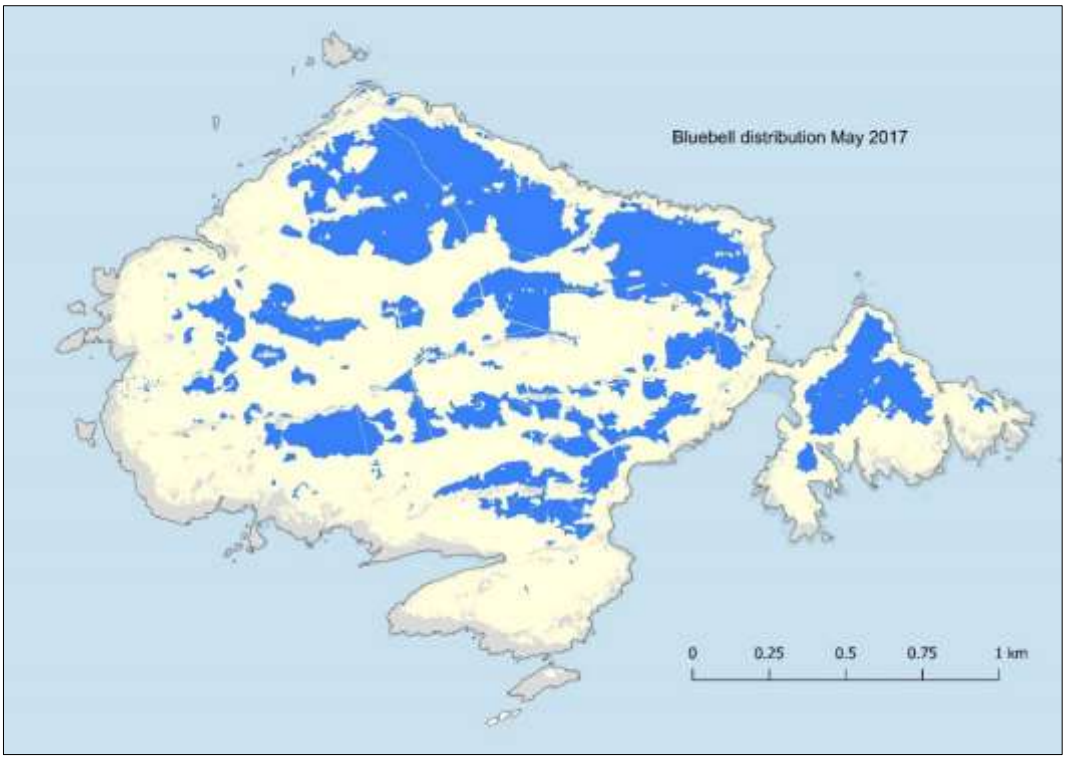
These areas contain the longest established bracken. They are usually fairly open, allowing plenty of light through to a dense ground flora. In places the bracken disappears, leaving a Yorkshire fog / common bent grassland. Generally, in addition to bracken there are few other species, usually no more than 5 to 8 in any sample, but overall many more species are associated with this community than the earlier bracken phases.

Bracken-bramble underscrub

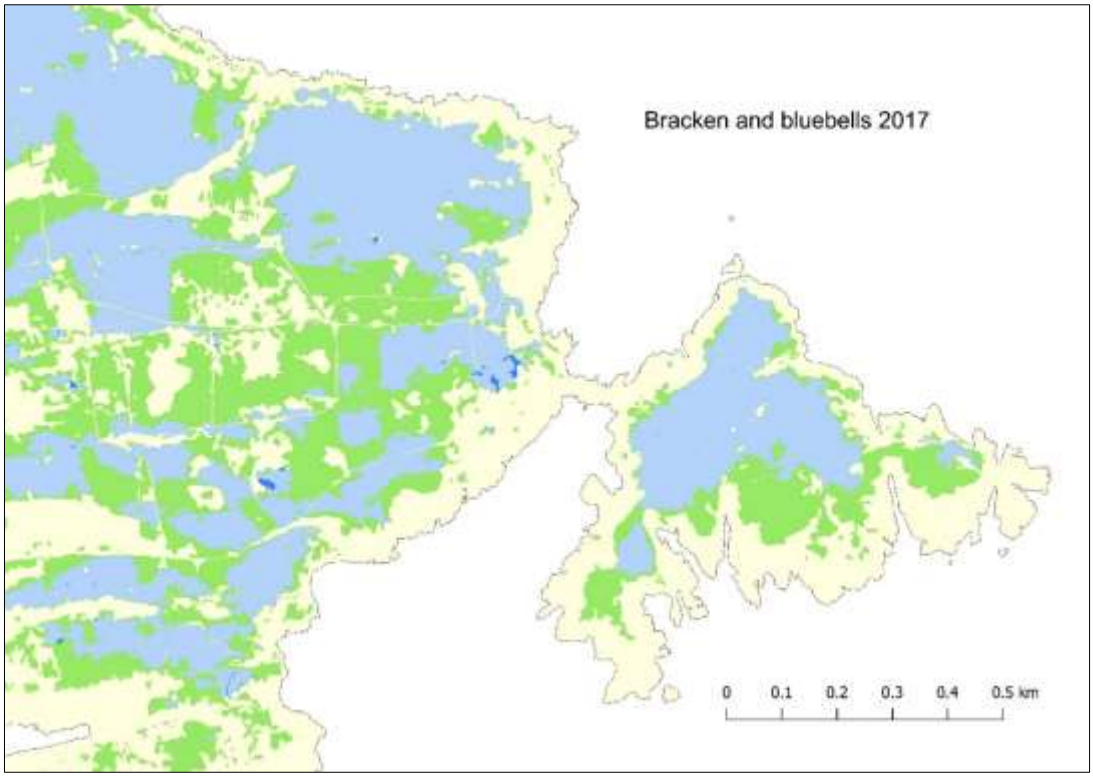
This community will be described in the following section, 'Scrub, shrubs and trees.

Bluebells

In spring 2017, a very high-resolution aerial flight of the island was arranged, and for the first time, we had a reliable and accurate distribution map of bluebells. Later that year, in August, we commissioned a second high-resolution flight, and this time the bracken could be mapped. It showed that, with the exception of a few extremely small areas, bluebells are restricted to within the bracken areas. The exceptions were all in areas where bracken had been recently replaced by Yorkshire fog.



May 2017: bluebells cover 84 hectares of Skomer, excluding the rocky areas. This represents slightly under a third of the soil surface. The distribution is limited by the wetter soils in both North and South Valleys. With only few exceptions, bluebells are also absent from the extremely exposed coastal land to the south and west.



The relationship between bluebells and bracken: The bracken is shown in green, bluebells which grow beneath the bracken are pale blue, and bluebells outside the bracken are shown in dark blue. With the exception of a few very small areas which have recently become covered by Yorkshire fog, the bluebells are confined entirely to the areas occupied by bracken.

The key to understanding bluebells on Skomer, and indeed on the Welsh ffridd, is to understand their relationship with bracken. This was first described by Sir Authur Tansley. For most of their range in Britain and Europe, bluebells are regarded as a spring-flowering woodland species. They exploit the available light before the woodland canopy begins to develop, and grow in woodland where the light intensity does not fall below 10% of normal daylight between April and mid-June (this is why they are excluded from dense conifer plantations). Bluebells primarily regenerate through seeds which are released in summer. They need moist, warm conditions followed by chilling in order to germinate. As a consequence, in areas of lower rainfall, they are restricted to shady woodlands where humidity is maintained by the tree canopy. When bracken becomes dominant in the upper field layer, it provides a canopy which does not close until late spring. This has more or less that same impact as the tree canopy in a bluebell wood. In addition, bluebells have contractile roots: as the bulbs develop over their first four to five seasons, they are pulled down through the soil to a depth of 25 cm or more. This allows them to co-exist with bracken, because they are able to exploit the subsoil below the bracken rhizomes. The Skomer bluebells are stimulated by seabird guano: they are extremely robust with generally much broader leaves than those on the Pembrokeshire mainland. Under normal circumstances, bluebells show severely depressed growth following the addition of nitrogen as a consequence of increased shading by grasses, but on Skomer, grasses and other potential competitors are controlled by rabbits. Although both sheep and cattle will graze bluebells, rabbits do not; their impact on competing vegetation is at its greatest during the spring when the bluebells are flowering.

Once established, bluebells can survive for a significant time in the absence of shade from trees or bracken, but can they colonise areas which are devoid of shade in the summer? Would they be able to compete with other light-demanding species? In 2017, bluebells covered slightly more than 84 hectares of Skomer, excluding the rock outcrops. This amounts to almost a third of the island. The larger, denser, and most spectacular areas are on the more sheltered, gently sloping, south-facing slopes, inland from the north coast. Bluebells could potentially occupy an even greater area; the critical limiting factors are waterlogged soils and extreme salt exposure. So, with the exception of the wet valleys and the most exposed south and west coasts, most of the remainder of the island is probably suitable. With few exceptions, the current distribution coincides with the land outside the later field systems. Bluebells are usually absent, or sparse, in the fields which were arable (potatoes and barley) in 1947. This pattern, consistent with that of the fridd elsewhere in Wales, confirms the fact that bluebells are generally intolerant of recently disturbed ground. Since 1947, there has been a slow but steady spread into the once arable fields. Bluebells are slow colonisers. The only published study concluded that, in an introduced population, the predicted spread is no more than 14 metres over a 45-year period.

The most obvious, and perhaps curious, exception to the general pattern is West Meadow, the field to the east of the farm buildings, which was ploughed and planted with a potato crop in 1947. For some reason, it was the first of the fields to be invaded by bracken, and this was possibly why the bluebells were able to colonise so rapidly. It is likely that there are more bluebells on Skomer today than at any time in the past. The early photographs show an island almost devoid of bracken. All the arable areas were obviously clear, but so, it would appear, were the extensive areas of coastal heath and grassland. The increase in bluebells coincides with agricultural abandonment. However, it is also apparent that bluebells are now absent from some areas which they previously occupied. The small area directly in front of the warden's house in North Haven was covered in bluebells in the 1980s; today there are none.

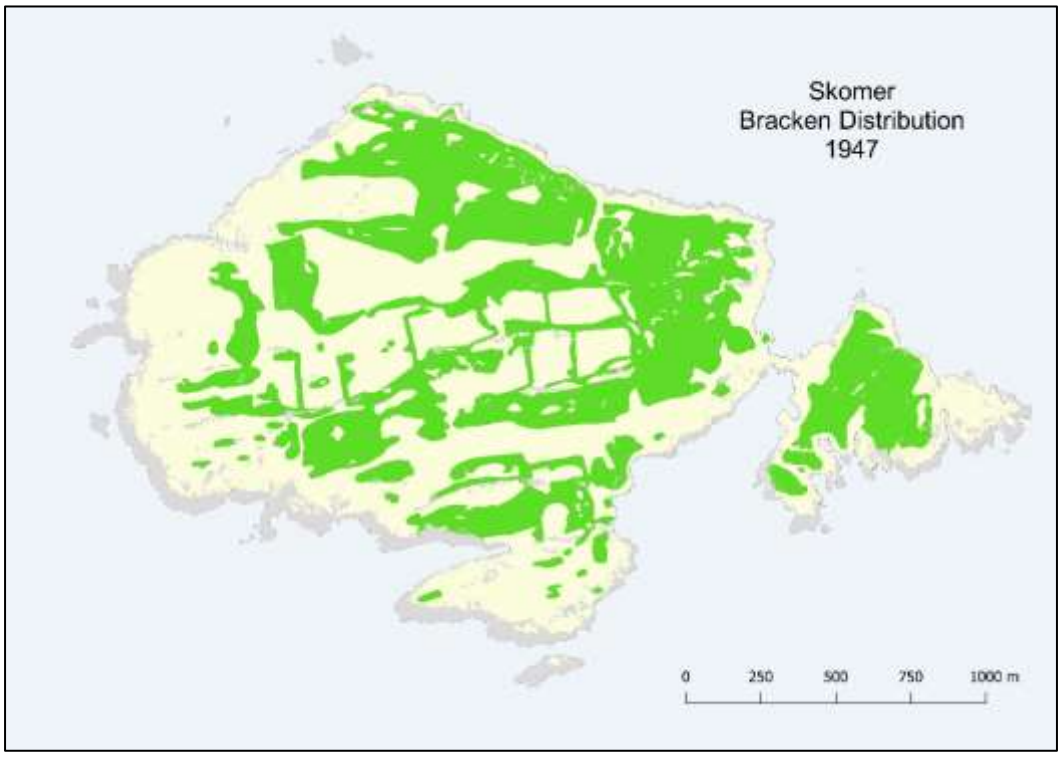
On Skomer, as the bluebells begin to fade, they are followed, in many areas, by red campion - yet another visual delight. Red campion was mentioned by Dr Sladden in 1945: *'In June . . . on the sheltered ledges of the north-east side where there is sufficient soil the luxuriant maritime variety of red campion triumphs over the fading flowers of primrose, bluebell and sea campion.'* (Buxton & Lockley 1950) Red campion was more or less absent in 1960, but by 1964 the south eastern gull colonies were a blaze of pink flowers (Gillham 1964). Red campion is a species which thrives in fertile soils; it is a nitrogen lover. It is not surprising, therefore, that the current distribution of the densest patches coincides with the areas that are, or were formerly, gull colonies. Red campion generally prefers a moist, cool climate. So, in addition to soil fertility, rainfall is also an important factor. Its absence in 1960 followed a severe drought in 1959, but 1960 was a very wet year, and this may have led to the recovery and spread of campion. By 1963, there were extensive areas of campion in the middle of the Neck, to the south of the Garland Stone and above the south east coast. These areas survived through the drier decades 1970 to 1990. Coinciding with the wetter period, which began in the late 1990s, there has been another spectacular increase in the areas occupied by red campion. The individual plants are extremely vigorous, probably a demonstration of high soil fertility. In some places the campion has almost displaced the bluebells. The most obvious example of this is in the lower part of South Valley, above and to the west of south stream cliff. This was one of the largest and most densely populated lesser black-backed gull colonies on the island during the 1970s. Campion is also present, but has not fared as well, on the more exposed western edges of the island. There is an interesting note in a paper by Mary Gillham (1964). She compares the national distribution of white campion *Silene alba* with that of red campion, and ends the discussion with an intriguing statement about white campion: *'There is a small colony in the garden of the old Skomer farmhouse. Here it hybridises freely with the red campion to give fertile, pale pink flowered offspring capable of back-crossing with the parents'*. There are no other references to white campion on Skomer.

Bluebells, red campion, and gulls

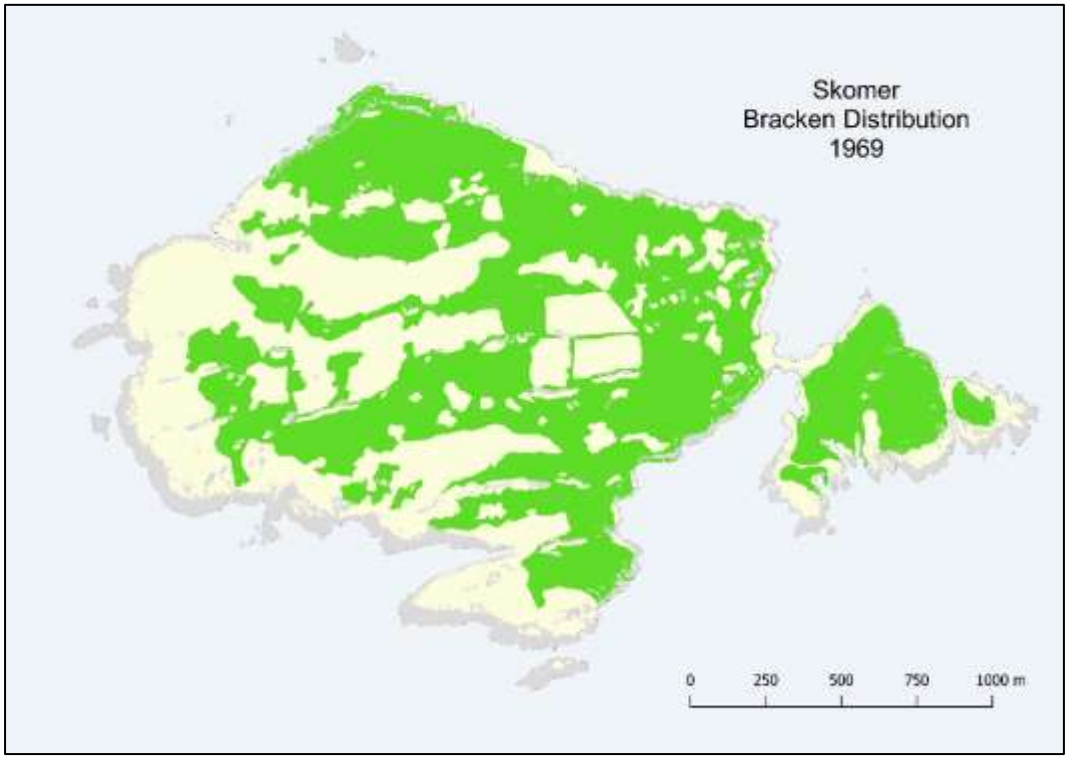
Red campion at dawn

Changes in bracken distribution since 1947

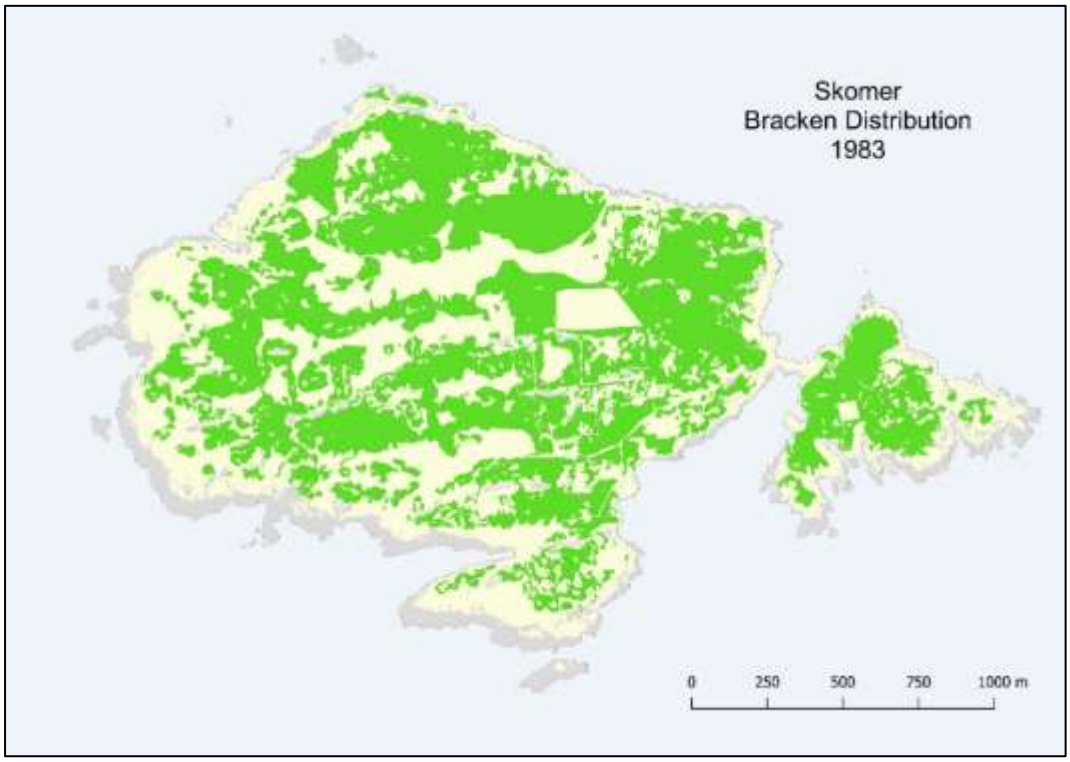
The increased distribution of bracken since 1947 is best illustrated with a sequence of maps:



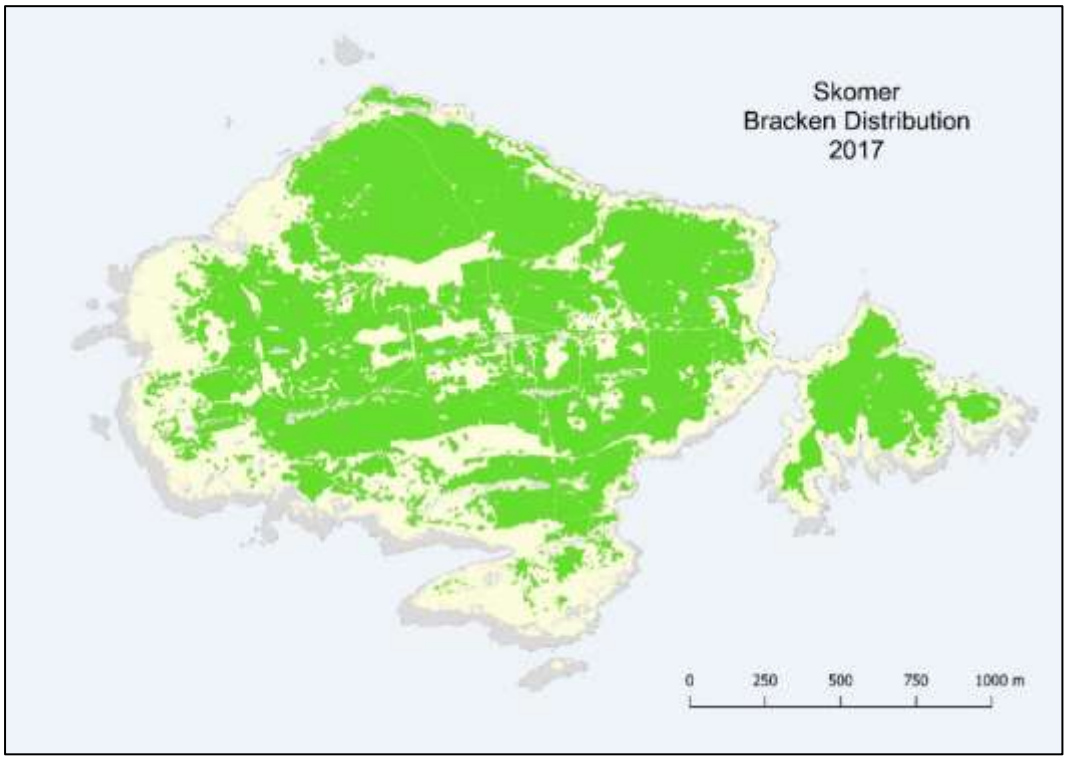
Bracken map 1947



Bracken map 1969



Bracken map 1983



Bracken map 2017

The 1947 map shows areas of bracken which were defined as, *'land where bracken affords at least 50% cover of the area'.* This suggests that bracken was underrepresented on this map. There is no information for the 1969 map, but it probably does not include the areas where bracken cover was light. The 1983 map was digitised from aerial photographs taken in late August; the bracken was very clearly defined but areas with light cover were probably missed. In August 2017, we produced a digitised map from a high-resolution aerial image.

The 1947 map, originally prepared by Sadd, was published in 'Island of Skomer' (Buxton & Lockley 1950). This was prepared during the final years of farming on Skomer. The highpoint of farming on the island was during the second half of the 19th century. It was already in decline by the end of the century and was more or less abandoned after the outbreak of the First World War in 1914. The land was largely neglected until 1946 when Reuben Codd made the last attempt to farm Skomer. The 1947 map represents a snapshot of an island where nature had been reasserting her presence for almost half a century. During these post war years Reuben must have had a very significant impact on the rabbit population, and, without doubt, this would, in part, help to explain the condition of the vegetation at that time. Reuben also made an unsuccessful attempt to grow a potato crop, planting the fields to the east of the farm and Well Meadow to the west of the farm. He cultivated another field due west of Well Meadow, where he planted oats and a small patch of potatoes. This accounts for the complete lack of bracken in these areas during 1947. However, Sadd mentioned that fronds of bracken were growing among the potatoes. Reuben burned large areas of heath, probably giving bracken an opportunity to hasten its invasion. The remainder of the island was rough grazed by cattle, sheep and two horses. Sadd specifically mentioned South Plateau, which, in 1947, was almost completely free of bracken. This was the area preferred by the dairy cattle, and Sadd suggested that it was their presence that suppressed the bracken by trampling. He compared this to the Neck, which was stocked with 20 to 30 sheep, and where bracken was apparently not 'influenced' by the sheep. The spread of bracken was most advanced along the more sheltered north east coast and inland areas. There was very little on the exposed west and south coast. The central valley wetlands were also clear. It may be reasonable to assume that when the farm was at its most productive bracken would have covered very much less of the land. By 1947 c118 Hectares, or 41% of the island, had already been invaded.

The next map (1969) demonstrates only a modest increase, from 41% to 53%. Along with the main fields and the exposed west coast, the two valleys had remained more or less clear. The increase was a product of consolidation and a general advance of the pioneering edges.

By 1983 at least 48% of the island had been invaded by bracken. With the exception of Calves Park and the central areas of some of the other fields, most of the areas that could support bracken had been occupied. With few other exceptions, only the extremely exposed coasts and the rocky outcrops were spared.

The 2017 map showed that there had been a slight increase, to 55% cover (1589 hectares). Both the dense areas of bracken and the areas with sparse cover were clearly visible, and, as a consequence, some of the increase in the total area of bracken can be explained by this much more accurate measurement. There were obvious localised changes of distribution - South Plateau is a good

example – but, given the inaccuracies in creating the earlier digitised bracken maps, the overall change cannot be regarded as significant.

This is certainly not the end of the bracken story. In long-term studies on unmanaged heathland, there is a cycle where bracken invades grass heath, increases in density and then degenerates to leave grass heath again, although the bracken does not die out completely and may increase again at a later date (Marr & Hicks 1986). Casual observations on Skomer over the past three decades suggest that the 'open' areas of grassland in the mature bracken community have increased quite substantially. There is a very large area extending over most of the north east corner of the island where grasses, mainly false oat-grass *Arrhenatherum elatus*, now overtop the bracken when in flower.

July 2007, the pale green expanse of grass overtopping the bracken.

There has also been a spectacular change to the coastal slopes surrounding North Haven and along the more sheltered sections of the coast around South Haven. During the 1970s and 80s the North Haven slopes were, for the greater part of the year, the dull ochre of dead vegetation, interspersed with bare ground and scattered with dead bracken. Spring delivered some very spectacular bluebell areas, and these later became dense bracken, surrounded by the same dull ochre, but now decorated with occasional bracken fronds and small patches of green Yorkshire fog. Once the bracken had succumbed to autumn gales, October usually delivered a velvet green flush of Yorkshire fog with some common bent. By the middle of winter all was once again ochre.

During the past decade the cover of Yorkshire fog has increased. In May 2008 the slopes were uniform green with a dense, almost luxuriant, growth of Yorkshire fog and almost no bare ground. The canopy in the once dense areas of bracken has thinned and some of the smaller patches of bracken have disappeared. Areas of Yorkshire fog grassland have occupied some parts of North Haven for many years; they were described by Sadd in 1947. He wrote of Yorkshire fog dominating grassland on the cliff edges in the extreme northern corner of North Haven. He suggested that its presence was the consequence of overgrazing by rabbits and the loss of the more desirable grasses.

It is important that we appreciate how recently the Yorkshire fog grassland, and some of the other communities, have developed on Skomer. Sadd (1947) described a very different place: *'The banks around the Havens are likewise honeycombed by Puffin burrows and the vegetation here is virtually a pure consociation of Agrostis tenuis'*

Yorkshire fog North Haven May 2008

It is essential that our response is cautious. The bracken may appear to be becoming less vigorous, but this may simply be an illusion created by the increase in Yorkshire fog. There are a number of factors which could explain the increase in Yorkshire fog, but perhaps the most likely is the succession of years since the late 1990s with a much higher than average rainfall.

Temperature could also be an important factor. Milder winters certainly favour grass growth, and, with the exception of 2010, mean annual temperatures since 1990 have been higher than all previous decades since 1960.

Over the longer term, an increase in soil fertility may have given Yorkshire fog a competitive advantage. Yorkshire fog will survive on low to moderately fertile soils. However, nitrogen availability is a limiting factor in Yorkshire fog, and fertilization is known to improve its competitive ability (Remison and Snaydon 1980). The slopes of North Haven contain some of the densest shearwater and Puffin colonies, and their droppings will certainly have had a considerable impact on soil fertility. Nettles *Urtica dioica,* a clear indicator of enriched soils, have been spreading rapidly on the north west corner of the Isthmus. This may be, in part, a consequence of concentrated human activity, but the fact that the plants are thriving in one of the densest bird colonies could suggest that they are responding to guano.

Without wishing to appear too gloomy, it is also important to recognise that bracken 'exhibits a form of cyclic regeneration'. In other words, it may return again, and, possibly, each time it progresses through the pioneer to mature phases more species will be lost.

A review of Bracken control

General

Bracken control measures can have short term dramatic effects, but no treatments can completely eradicate bracken. The herbicide Asulam is one of the most effective controls, but there is relatively rapid recovery, even following repeat applications. A ban on the use of Asulam in EU member states came into effect on 31 December 2011. Since that time, this has been rescinded on an annual basis for restricted use. The use is restricted, and weedwipers and drift sprayers (e.g. the Micron ULVA) are not authorised for use. In addition, the only concentration that is approved for use with hand-held equipment is 1 part of Asulox to 100 parts of water. The use in conservation areas must be under the direction of the relevant conservation body. A complete ban in the UK is predicted.

The most successful treatment for bracken is cutting twice yearly for 6 years; frond biomass had reached only 40% of untreated levels 12 years after the last cut (Marrs et al., 1998*).*

Bracken control on Skomer

At one time or another most of the Skomer wardens have resorted to bracken bashing. The first record was in 1961 when a small area was 'rolled', but the location is not given. There is no record of a rationale or justification for bracken control until 1978 when Professor Denis Bellamy, University College Cardiff, produced a paper for the island management committee and the Nature Conservancy Council, 'A commentary on the decline in diversity of Skomer Island and some proposed experiments to arrest and reverse this trend'. His main focus was the loss of biodiversity in the central fields, but his proposal was primarily for a research project. More recently, in 2003 a rationale was prepared by the island warden to justify the reconstruction of the Calves Park exclosure:

'At present, intensive bracken management merely gives way to an overgrazed grassland dominated by Teucrium, with little conservation interest. The area is an ideal arena for habitat recreation, as the density of Rabbit burrows is low (and so the species is easier to exclude), and bracken is absent. In the absence of rabbit grazing, a herb-rich grassland would probably develop, with unpalatable species such as Tuecrium and bracken being naturally outcompeted by more vigorous herbs. The meadow habitat would benefit invertebrates and nesting and migrant birds, and where this exists close to the path would provide an opportunity for interpreting such conservation management to education groups and the general public. The field may require occasional subsequent management (by cutting) to maintain floral diversity. Management by altering conditions by excluding rabbits is more desirable than resource-intensive direct bracken control, which will never be effective if conditions conducive to the species' dominance remain.'

The grassland in Calves Park is believed to be NVC U4b *Festuca-Agrostis-Galium* grassland. In the late 1970s the field, at that time enclosed and free of rabbits, was mowed annually. The 2003 rational mentions the need for 'cutting, if the rabbits were removed'. In other words, the enclosed pasture would be treated as a meadow. *'The Festuca-Agrostis-Galium grassland is the most extensive kind of pasture . . . Grazing is of prime importance in preventing the regression of the community . . .'* (Rodwell 1992). In 1947 this field was arable and full of potatoes. Before that time it was probably pasture, and earlier it was arable or a hay meadow. If it had been managed as a meadow, in addition to cutting there would have been aftermath grazing along with the addition of lime and possibly farmyard manure. Grasslands can be managed by grazing alone, but if cutting is the only form of management species diversity in the sward will decline.

In 1968 a borrowed flail was used to cut bracken in the fields east of the farm. Cutting in the central fields continued during most years until 1973, when the flail became unserviceable. There was no

further bracken control in the central fields until 1979 when Calves Park was fenced to exclude rabbits and then mowed each year until 1985. The exclosure was effective for three years but, as with all exclosures on Skomer, the rabbits eventually found their way in. Over time, it has become apparent that rabbits are quite capable of biting through wire netting. Netting wire has a very short life expectancy on the island; it is corroded by salt spray and blown apart in the gales. The exclosure was used for a further period for research but was eventually abandoned and removed by 1997.

Asulam, a herbicide specifically designed to control bracken, was trialled on the island in the early 1980s, and in 1986 Shearing Hays was sprayed. The results were disappointing, with the bracken quickly recovering. At that time ultra-low volume applications were not available. There was an almost unavoidable risk of uncontrolled drift when an Asulam/water mix was applied with conventional spraying equipment. Asulam has an impact on a number of species, including ferns and lichens. Following the trial it was decided that Asulam was not suitable for use on Skomer.

In 2002 another substantial effort was made to control bracken in the central fields by pulling, scything and crushing stems. This continued in 2003 when, in addition to mechanical control, Calves Park, Shearing Hays and Well Field were also sprayed with Asulam. There are no records of spraying after that time but mechanical control, mainly crushing stems with canes, continued in the central fields during most years up to the present time. On several occasions there were suggestions that a new exclosure, primarily to provide opportunities for research, should be erected at Calves Park.

In addition to the central fields, Asulam was also used during 1998 and 1999 to control the bracken invading the areas of heath, mainly around the exclosures in North Valley. There is nothing on record concerning the reversal of the decision not to use Asulam, but ultra-low volume spraying equipment was used, and we can assume that this was why Asulam was considered suitable for use on Skomer.

Bracken has also been controlled by cutting and pulling around the Puffin burrows in North Haven. Bracken growing in these marginal habitats is much more vulnerable and easier to control than the established bracken in the sheltered areas.

Bracken around the Puffin colony above South Haven

With the exception of Calves Park and the central part of Shearing Hays, which have remained more or less clear of bracken, there is very little to show for so many years of intervention. Clearly, the advance of bracken has been slowed in the central fields but, in common with experience of bracken control elsewhere, the results are very disappointing. Bracken management in the absence of grazing control delivers poor quality, overgrazed grassland, dominated by species that are unpalatable to rabbits. The exception is control around the Puffin burrows which has been very effective.

SCRUB, SHRUBS AND TREES

Prosser and Wallace (1996) identified two NVC scrub communities, NVC W25 *Pteridium aquilinum - Rubis fruticosus* underscrub, bracken - bramble underscrub, and W23 *Ulex europaeus - Rubis fruticosus scrub*, gorse - bramble scrub. Wilberforce (1999) also recorded W23.

Note, The W25 underscrub community is introduced and discussed under the 'bracken' feature.

Gorse *Ulex europus,* barely survives. Sladden, writing in 1947, mentions *'a few ancient furze bushes'*. Gorse is such a palatable plant it is surprising that even a few scattered remnants are able survive. There have been many attempts to propagate gorse cuttings, particularly at Gorse Hill. The justification is shelter for migrants and habitat for nesting linnets, Whitethroats and Stonechats. Rodwell (2004) pointed out that gorse is something of a cultural relict and that its maintenance would provide a reference to earlier times.

Gorse south of the farm

Prior to the 1960s, and the beginning of conservation management on Skomer, the only scrub or trees present were a few gorse bushes *Ulex europus*, a small patch of blackthorn *Prunus spinosa* in the narrow gorge in North Valley (with a vague mention of its presence in South Valley), a very small

number of scattered elders *Sambucus nigra* and the single black poplar *Populus nigra* which had been planted in the corner of the farmyard. There were a few garden shrubs, but only the fuchsias have survived. There were also patches of bramble *Rubus fruiticosus* in the inland sheltered valleys and around the farm.

Scrub, elder and blackthorn in North Valley

Following the declaration of Skomer as an NNR there have been many deliberate introductions. Since 1961, willows have been planted in North Stream Valley, South Stream Valley, North Pond, Well Pond and below Green Pond. In 1961 they were even planted around the water tank above the warden's house in North Haven. We can be almost certain that willow was not present on Skomer in 1956 or 1947 (Sadd 1947) (Buxton and Lockley 1950). Monterey pines, blackthorn and privet were planted around the farm in the early 1970s, but these all failed. Elders were collected from North valley and planted around the farm in the 1960s and it is also obvious, although it was not recorded, that some additional blackthorn has been planted. Almost all the planting was an attempt to improve cover for migratory birds or to provide shelter around the ponds.

The planted willows have done well, but there are no signs of natural regeneration. It is now possible to walk beneath a wooded canopy in North Valley, just below Green Pond (although, perhaps wooded canopy is an exaggeration - a scrubby canopy may be a more appropriate description). The elders have increased, with sparsely scattered bushes mainly in North Valley and around the farm, but, with the exception of a few very sheltered plants, most appear to be quite unhealthy.

'Scrub' canopy in North Valley, (2019) most of these were planted in 1978.

Bracken-bramble underscrub

NOTE – Bramble is treated as a potential negative factor in the seabird sections of this plan.

It is important that, in addition to Bray's divisions of the bracken areas, to include the bracken-bramble community W25 Pteridium aquilinum-Rubis fruticosus underscrub. This was not given much attention by Bray, and I suspect that it is included in his description of 'mature bracken'. This is a community of the deeper, drier soils on Skomer. Except for the wettest areas, most of the bramble on Skomer is associated with bracken. The bracken-bramble under-scrub community is usually dominated by bracken, with varying bramble cover, but there are occasional small patches of vegetation where the bramble is dominant. This community is given priority attention in this plan following recent (2018-19) concern about bramble on Skomer. There have been suggestions that Manx Shearwaters can become trapped in the bramble, and occasionally dead bird are found entangled in bramble, however the scale of the impact has not been assessed. There is also a possibility that Shearwaters will not be able to burrow in areas of dense bracken, this requires further investigation.

Most of this community is found on the deeper, damper soils on the island. The only obvious exception is the North Valley slope, but, even here, the distribution of bramble coincides with deeper, if not damper, soils. The other key limiting factors are exposure and rabbit browsing.

The range of the bramble community includes much of the western and northern slopes of North Valley, extending from Bull Hole in the west to Green Plain in the east. In South Valley it extends

along the north flank of the valley. It is very noticeable around the farm, with occasional infrequent patches to the west. It is mainly confined to the least exposed areas of the island, but there a few small patches on the coast between Bull Hole and the Garland Stone. There has been a suggestion that bramble is replacing the heath communities. The 2019 bramble map was overlaid on the heath layers from 1969, 1983 and 2017. It is clear that bramble has replaced heath in the damper areas of North Valley, but bramble has also invaded many areas which were not previously mapped as heath.

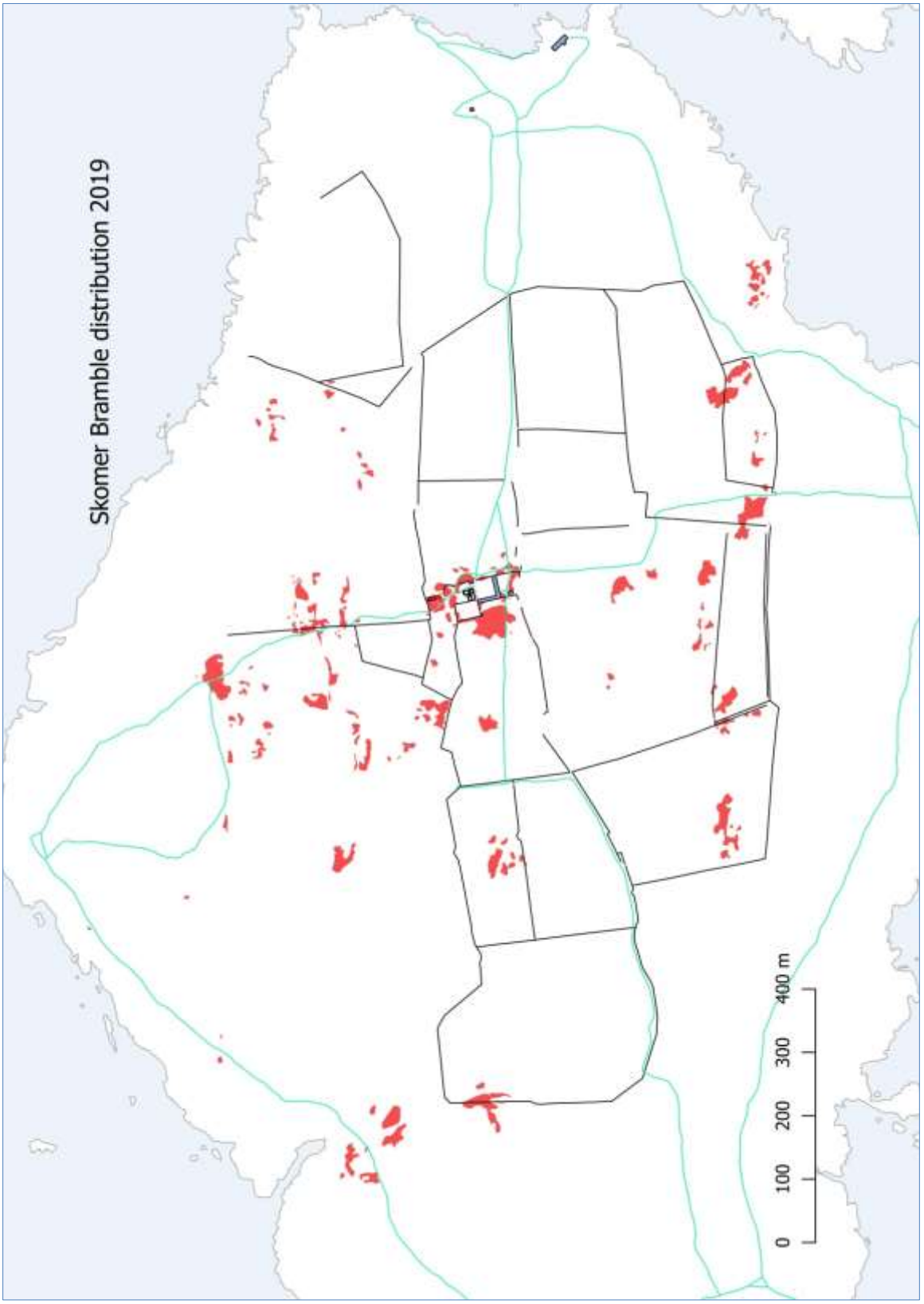
This community appears to be increasing its range, but, unfortunately, it had not been mapped prior to 2019 and the distribution has not been previously described. Photographic evidence is sparse but points to a similar distribution over the past 60 years. However, frequency has increased and, in some areas, patches have grown larger. Given the current distribution, there is obvious potential for further expansion. The rate of expansion over the past decades has been quite slow but, obviously, this could change. Bramble is heavily browsed by rabbits. This is very obvious in the spring, when most bushes accessible to rabbits are completely bare of foliage. Brambles are a deciduous shrub, but in the absence of grazing they often retain their leaves throughout the winter. The exclosures in the North Valley heath also provide very compelling evidence that rabbits are seriously suppressing the spread of bramble on Skomer.

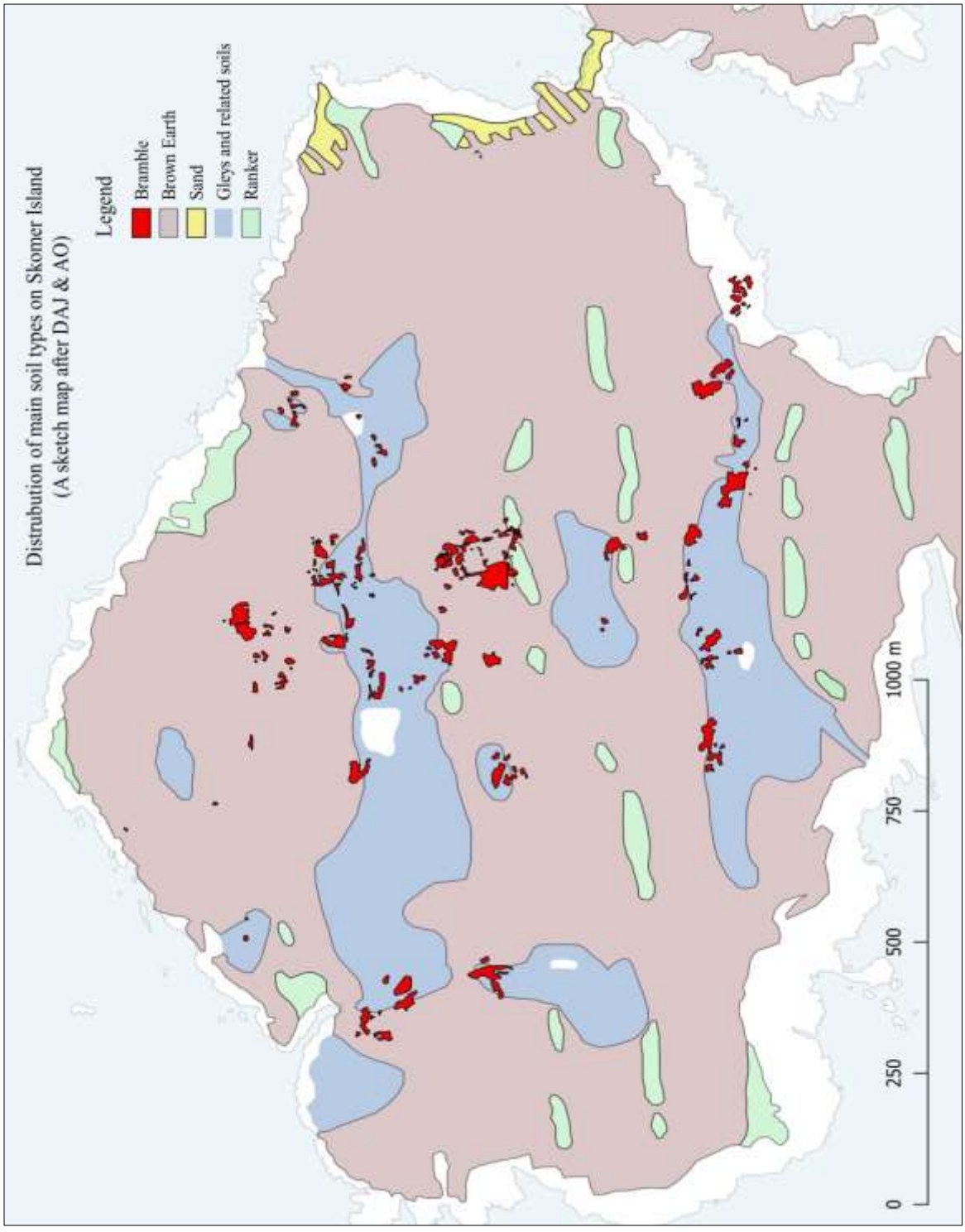
It is important that we recognise that bramble make a very positive contribution to biodiversity on Skomer. The most obvious benefits arise from increased structural diversity in the vegetation, which provides opportunities for invertebrates and birds.

2019 - Bramble has replace heath in part of the enclosure in North Valley; note the complete absence of bramble in the rabbit-grazed exterior.

Two photographs of North Valley. Top c 1960: note the lack of salix. The bracken is not significantly different to the situation today. Second photo 2018: bramble is still there, but obscured by purple loosestrife.

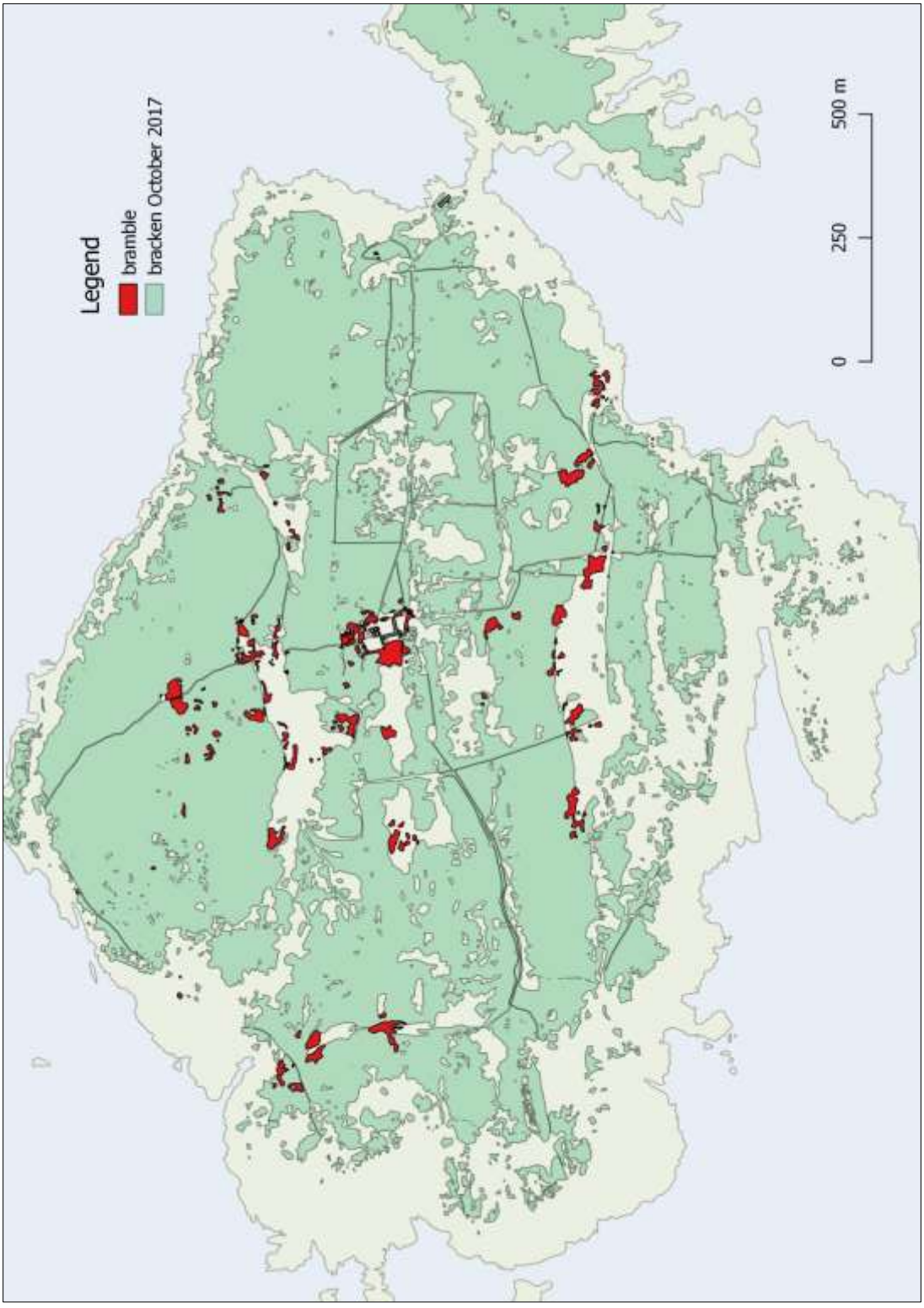
The small patch of surviving wet heath in North Valley 2018, note the bramble encroachment


Skomer Bramble distribution 2019
0
100
200
300
400 m

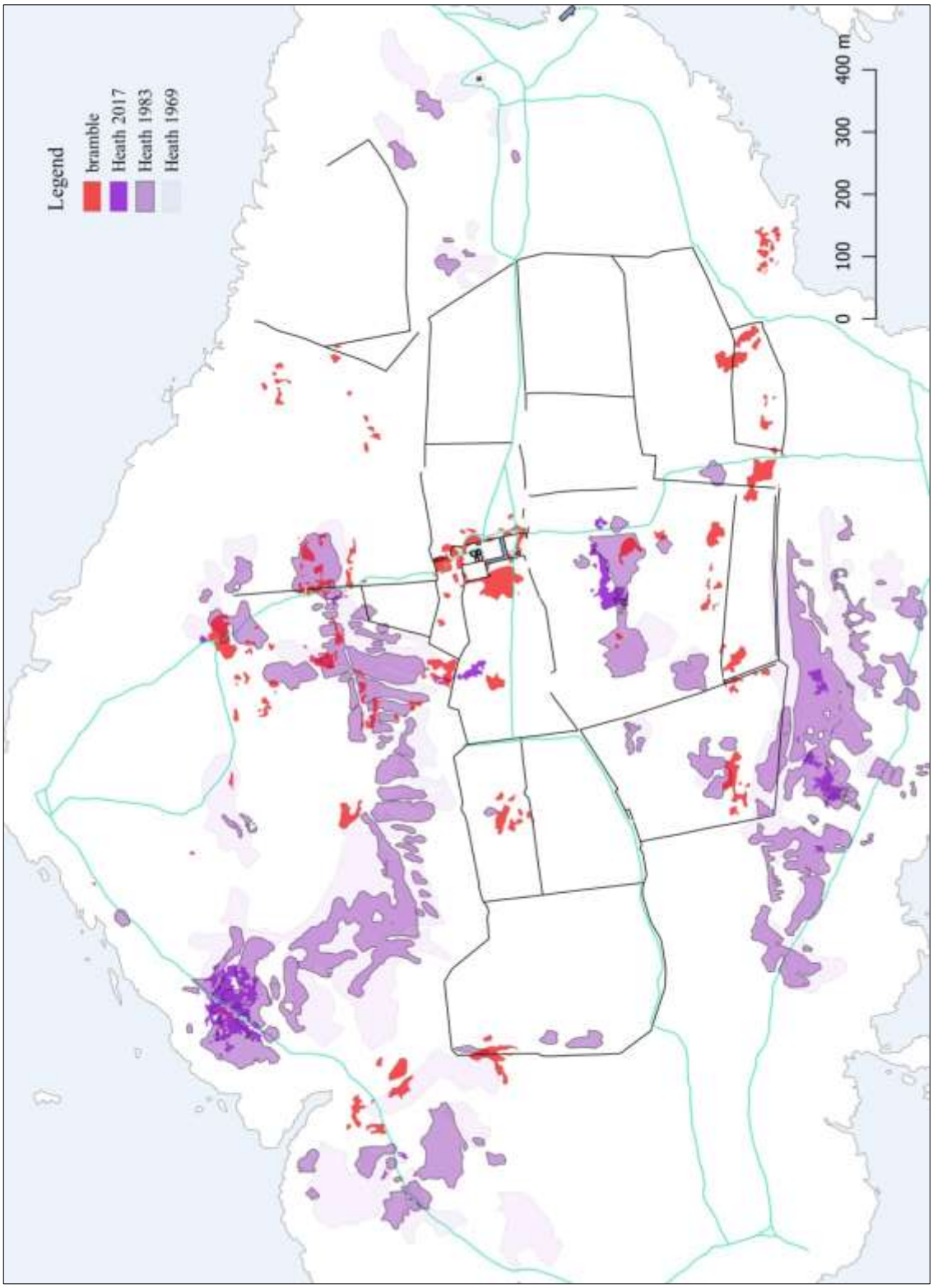


The relationship between bramble and soil distribution

Bramble is mainly associated with the gleys and related soils. These occur in the wet, poorly drained areas. The obvious exceptions are around the farm and the slopes to the north of the farm, where the community occurs on the brown soils. Bramble does not invade the shallow rankers around the inland rock outcrops. (Please note that this is a digitised copy of an original inaccurate sketch map. It provides little more than an indication of soil distribution. The break in the pattern of gleys above Bull Hole is probably an error, and the areas of coastal rock are completely inaccurate.)



The relationship between bramble and bracken



The relationship between heath and bramble

STREAMS AND ASSOCIATED WETLANDS, INCLUDING PONDS, MARSHY GRASSLAND AND STREAM EDGES

This section follows Bray's (1981) lead: he brings together all the wet areas under the heading 'streams and associated wetlands', but in an attempt to simplify my description, a number of subheadings have been included.

Ponds

There are small ponds at the head of both main valleys, but these are not natural; low dams were constructed at some time in the distant past. The South Pond dam has not been maintained in recent years and the open water has more or less disappeared. It is probably now best described as a wet depression. The North Pond dam was completely reconstructed in the mid-1960s, and the bottom of the pond was also scraped at that time. Subsequently, the dam has been improved and maintained, and, in all but the driest years, it holds a reasonable area of open water. Streams flow from both ponds in a more or less easterly direction, initially through very gently sloping waterlogged areas, which then terminate in shallow gorges as they approach the sea cliffs. The flow of south stream is interrupted by a dam and small pond at a point mid-way between South Pond and the sea. This was an ancient dam which was reconstructed in the late 1980s. Green Pond, in the lower section of North Valley, was created 1978 when the stream was dammed just below the point where the valley deepens into a shallow gorge. This is the deepest pond on the island but the surface area is very small.

North Pond 2019

The larger ponds on Skomer provide extremely attractive bathing and preening areas for the gulls, resulting in turbid and highly enriched water which offers limited opportunities for aquatic plants. The margins are dominated by rushes, mainly soft rush *Juncus effusus* and jointed rush *J. Articulates*, *J. bufonius* and *J. bulbosus*. Some of the more frequent species in the open areas between the rushes are marsh pennywort *Hydrocotyle vulgaris*, bog pimpernel *Anagalis tenella*, water mint *Mentha aquatica* and creeping forget-me-not *Myosotis secunda*. The drying water margin is usually covered with a mix of species, including, water pepper *Polygonum hydropiper,* and amphibious bistort *Persicaria amphibia.* Red goosefoot *Chemopodium rubrum* can dominate the margins of North Pond. Shoreweed *Littorella uniflora,* a scarce plant in Pembrokeshire, has been found on the edge of the mud in the centre of South Pond and at North Pond when it was described as abundant in July 1980.

West Pond on the far western edge of the field system is in fact two, almost certainly, artificial scrapes of unknown antiquity. They could simply have been a means of providing fresh water for stock kept in this field. They are very shallow and tend to dry up during most summers. However, they lay claim to one of the few rare plants found on Skomer, lesser marshwort *Apium inundatum*, which grows in the centre of the dried-up ponds. (Lesser marshwort has also been found at South Pond) It is surrounded by a common spike rush *Eleocharis palustris* sward, with marsh cudweed *Gnaphalium uliginosum* and redshank *Persicaria maculosa.* Red goosefoot *Chemopodium rubrum,* another Pembrokeshire rarity, is found around the margin of this pond.

Green Pond 2019

Marshy grassland

The NVC communities are M23 *Juncus effusus-Gallium palustre* rush pasture, identified by Wilberforce (1999) and M25 *Molinia-Potentilla* mire identified during the 1996 heathland survey.

The M25 Molinia mire is mainly found in the centre of North Valley on either side of the footpath which leads from the farm to the Garland Stone, and there is also a very small area to the south of South Pond in South Valley. The distribution of the remaining purple moor grass *Molinia caerulea* dominated grassland is mainly restricted to the lower lying wet areas in the western level sections of both North and South valleys.

Purple moor grass in North Valley 2014

The central section of North Valley, below North Pond, is the wettest area on Skomer, there are very obvious signs of early agricultural drainage with old, and now completely redundant, ditches which run towards North Stream in the centre of the valley. There are also occasional deep holes, probably as a result of earlier peat cutting. These are now waterlogged and, along with the ditches, provide a rare opportunity for sphagnum on Skomer. Bulrush *Typha latifolia* occurs infrequently in some of the wettest hollows. The areas currently dominated by purple moor grass were, even as recently as the 1990s, mainly wet heath interspersed with narrow strips of purple moor grass. The heath was described in the 1996 heathland survey as NVC H8 *Calluna vulgaris - Ulex gallii* heath. Western gorse Ulex gallii was only recorded as being present in one of nine quadrats; the community comprised mainly heather, bracken and purple moor grass, with a small amount of bell heather *Erica cinerea* in one sample. Most of the samples held less than six species. Some of the strips of purple moor grass followed the line of the ancient blocked ditches, suggesting that there may be some ground-water movement (purple moor grass is most abundant and grows vigorously where there is a flow of ground-water). Bray mapped this entire area as 'inland heath', and the heath shows very clearly on an aerial photograph taken at that time.

Aerial photo of wet heath in North Valley, 1983. The darker areas of heath are interspersed with pale, purple moor grass.

Drumstick heather North Valley

Since 1983 there has been a very rapid decline in heather cover, and much of what survives is heavily grazed by rabbits and in very poor condition. What little heather persists can be described as ‘drumstick’ or ‘mop’ heather. This is usually indicative of prolonged heavy grazing, reducing the heather canopy to small, compact masses of intertwined and contorted shoots on the ends of scattered, long, bare stems. This can happen on wet heaths even when browsing is not heavy, but obvious signs of continuous rabbit nibbling confirm that it is the consequence of grazing (JNCC Common Standards). The heather and purple moor grass in these areas is very obviously grazed. Brambles have invaded the drier marginal areas and bracken fronds are scattered throughout. Sadd (1947) describes *'a low growth of Calluna in this area almost certainly a stage in regeneration after a previous severe burn. Many charred stumps of much larger Calluna plants were to be seen.'*

South Valley was also significantly modified by earlier inhabitants; a deep, very straight, ditch runs through South Valley from the outlet at South Pond to just above the main coast footpath in lower South Valley. The section between South Pond and Moorey Mere is flanked on both sides by quite substantial walls or raised banks. There is a confused area below Moorey Mere where the ground is waterlogged, but a metre or so to the east of the footpath the ditch reappears, and this lower section is flanked on the south side by a bank or wall. The age of this structure is unknown. It is possibly contemporary with the later central field boundaries, but this should be confirmed. The land to the south of the ditch is quite well drained, deep, peaty soil.

South Valley has some fairly large, and very distinct, areas dominated almost entirely by purple moor grass. There are some smaller patches of soft rush *Juncus effusus* and, on the slightly drier ground, areas of tall vegetation with dense patches of hogweed *Heracleum spondylium* and wild angelica *Angelica sylvestris*. The vegetation in this area has changed very little over the past decades. The only exception is to the west of South Pond, which was once (1960 - 1985) one of the largest extents of heath on the island. The gradation of heath into purple moor grass was at that time a characteristic of this area.

The deeper lower valleys

The lowest reach of South Valley is a delightful, small, shallow, but quite steep sided, gorge. It is one of the more sheltered parts of the island and always the first place that bluebells come into flower. The bluebells are followed by dense swathes of red campion. Later, as spring drifts into summer, swathes of purple loosestrife *Lythrum salicaria*, hemlock water dropwort *Oenanthe crocata* and ferns dominate the taller vegetation in the damper centre of the valley. There is no scrub apart from a solitary blackthorn at the head of the gorge and a little bramble lower down. The stream finally tumbles off the cliff into the sea in South Haven. The scrub or 'wooded' area in North Valley was described in the previous subsection. Below the blackthorn the secluded, damp, shaded and sheltered stream edges are places where ferns can dominate. The summer vegetation is almost identical to South Valley.

Lower North Valley

Early summer 2019 in South Valley with hemlock water dropwort Oenanthe crocata

MISCELLANEOUS

This heading is included as a convenient way to introduce the vegetation that requires further investigation before we can reach any conclusions, and to introduce aspects of the vegetation which do not fit comfortably under any one of the preceding headings.

Farm walls and limekiln

Under the former category Rodwell (2004) pointed out that Bray's description of the vegetation missed out some areas, and he specifically mentioned the vegetation on the mortar of the farm buildings. He suggested that this was probably the NVC community OV39 *Asplenium trichomanes - A. ruta-muria,* spleenwort crevice vegetation.

Farm wall with limestone mortar and lancolate spleenwort Asplenium obovatum (top right) and maidenhair spleenwort, Asplenium trichomanes (lower left)

Wild Thyme Thymus polytrichus

Polypody ferns (Probably Polypodium vulgare) on the apex of the old building north of the farm.

Ribwort plantain, Plantago lanceolata, growing on a farm wall. Once common and widespread in the Skomer pastures, now a refugee confined to the few places which are inaccessible to rabbits.

The vegetation of the inland rocky outcrops with their thin pockets of soil have not been described in this plan. They were included by Bray in his vegetation type 'rocky slopes and inland outcrops', but the most sheltered inland outcrops would benefit from further attention. Apart from the lichens, which will be described in a different section, the sheltered outcrops provide opportunities, in addition to some of the maritime cliff species, for plants including English stonecrop *Sedum anglicum*, biting stonecrop *S. acre*, navelwort *Umbilicus rupestris* and sheep's bit *Jasione montana*.

Rock outcrop south of the Farm

Navelwort, Umbilicus rupestris on an inland rock outcrop.

Spear thistle, Circium arvense, growing in profusion in the disturbed ground behind the old farm.

Lords-and-Ladies, Arum maculatum, always appear in spring around the lime kiln.

Aquatic vegetation.

The only description of the aquatic pond and stream vegetation is over 60 years old and many of the species recorded at that time have not been relocated in recent times. These habitats were not regarded as being particularly important in 1947 and, it is unlikely that their status has improved, there is scant justification for a survey.

Ephemeral invaders.

There are two species of ephemeral invaders, ragwort *Senecio jacobaea* and foxglove *Digitalis purpurea,* which occasionally, and usually for brief periods, appear to dominate the island vegetation. Both are biennials, though ragwort can sometimes, for example, when grazing pressure is high, behave as a perennial.

Ragwort is quite a controversial species. In Wales it is subject to the Ragwort Control Act 2003. This act creates a code for the management of ragwort. There are no implications for Skomer as, contrary to popular belief, the act does not place any legal obligation on anyone to control ragwort. Ragwort can germinate anywhere where the soil surface is exposed, and rabbit disturbance on Skomer provides ideal opportunities. For many years there was a sequence of colonisation: often after a very dry year a few ragwort plants would appear, then the following year colonies of the rosette stage dominated significant areas of both inland and coastal habitat, and a year later and the island was adorned with swathes of golden yellow flowers.

Usually, cinnabar moths *Tyria jacobaeae* appeared in small number at this time. (These are beautiful day-flying moths, with unmistakable bright red, or cinnabar, spots and stripes on their forewings and equally bright red hind wings edged in dusty black.) As the ragwort came into flower for the second or third years there was a cinnabar 'population explosion', and the ragwort was rapidly stripped bare by hordes of distinctive black and yellow hooped caterpillars. In some years, the impact was so extreme that it took ragwort several seasons before it once again appeared in any quantity. Since 2007, there have been seven consecutive years when the extent of the ragwort has increased each year. The cinnabar moths were not seen between 2009 and 2012, although a small number reappeared in 2013. Cinnabars have their own limiting factors, being susceptible to nosema, a fungal related parasite, and this may explain their absence. In 2013 there was a greater cover of ragwort on Skomer than anything previously recorded: almost all the central fields were covered. Calves Park was the most spectacular, but further west there was huge expanse extending, almost unbroken, from behind the farm to Skomer Head. The core area was South Field and Abyssinia (the field containing West Pond). The area between Abyssinia and Bull Hole, including most of the Table was also inundated, with smaller patches around the Wick and a little on South Plateau.

Ragwort, Senecio jacobaea - North Valley

Cinnabar moth caterpillars, Tyria jacobaeae feeding on Ragwort.

Foxgloves are a species of disturbed ground. One of the most spectacular foxglove displays on Skomer followed two years after the extreme drought year 1976. The vegetation was burned out by the long, hot, dry summer and any surviving edible vegetation was eaten by rabbits. There was bare ground everywhere, and this was where the foxgloves took advantage of the opportunity. They are always present in small numbers on the island, waiting for, and rapidly responding to, their favoured conditions.

Foxgloves Digitalis purpurea

RARE HIGHER PLANTS AND FERNS

Background

This section of the plan was written by Stephen Evans. (December 2019)

The first attempt to systematically survey the rare and scarce higher plants growing on Skomer was undertaken in August 1974. Tommie Warren Davis provided information from the Botanical Society of the British Isles Pembs. Card Index to select those species deemed to be notable.

Stephen Evans (SBE, of NCC) and Tommie Warren Davis (BSBI Pembs. recorder and WWWT Islands Committee Member) stayed the night on Skomer and with warden John Davis examined the most notable plants over two days. Over the previous summer SBE, along with Alan Parker, Colin Helliwell and Ray Woods had carried out a similar survey of rare plants along the mainland Pembrokeshire

Coast from Fishguard to Tenby. This survey had included Skomer, Skokholm and Ramsey but only 3 of the notable plants were re-found on Skomer in this 1973 survey. The methods adopted for both surveys used a standard proforma for recording rare plants initially developed by Dr. Frank Perring of the Biological Records Centre at Monk's Wood Experimental Station in preparation for the first ever GB Red Data Book (Red Data Book for vascular plants in Great Britain, Perring and Farrell, 1977).

This standard proforma provided locational information, habitat details, a list of plants associated with the notable species, a sketch map of the population and information on population size. A report of the 1974 survey 'Rare and Local Plants of Skomer Island. 1974 by S.B.Evans & T.A.W.Davis.' was produced and circulated to those involved with the island. It was a simple document composed of 10 population forms for species found and 4 forms for those species not found along with very basic monitoring recommendations.

SBE has continued to use this method of detailing rare Pembrokeshire plants but over the intervening 40+ years the classification of what constitutes a 'rare' plant has been greatly refined. There have been 3 more G.B.Red Data Books. The 4th version and current version is 'The Vascular Plant Red Data List for Great 'produced by the JNCC in 2005 following on from the publication in 2002 of 'The New Atlas of the British and Irish Flora'.

In 2008 'A Vascular Plant Red Data List for Wales' was produced by Plantlife following the same I.U.C.N. criteria as had been used in the 2005 JNCC Red List. Both this and the JNCC one are based on threat rather than just rarity. The threat level has been determined by calculating the changes in distribution when comparing the hectad distributions in the 2002 Atlas with the 1976 Atlas.

In 2017 a second draft of the Pembrokeshire Rare Plant Register was produced. This combined the latest G.B. and Wales Red List criteria with Pembrokeshire rare higher plant categories. Pembrokeshire 'rarities' were defined as rare if they were limited to 1-5 sites and scarce if they were in 6-15 sites in the county where sites were described as movable 1km squares.

Skomer Island and Middleholm SSSI was renotified in December 2001 before the current GB and Wales Red Lists were available. As a result the SSSI citation and management statement are somewhat out of date in relation to rare higher plants and ferns.

SSSI assemblage of vascular plants

The SSSI qualifying features include an Assemblage of four nationally rare and scarce vascular plants. Rock Sea-lavender, *Limonium bineryosum,* Three-lobed crowfoot *Ranunculus tripartitus,* lanceolate spleenwort, *Asplenium obovatum*, and Portland spurge *Euphorbia portlandica.*

The following is a list, provided by Stephen Evans of the rare higher plans and ferns of Skomer recorded between 1974 and 2019, they are arranged in order of rarity.

GB Red List

1-*Ranunculus tripartitus* Three-lobed Water-crowfoot/Crafanc Trillob is known from the one site where it was first found new to the island in a coastal flush east of Wick Stream at SM7231 0889 in May 1985 and is still present (2019). There are larger populations on Skokholm and Ramsey. It is **endangered** in GB but because of its abundance in Pembrokeshire it is not a Welsh or Pembs. rarity

yet is a species of Principal importance for Conservation of Biodiversity in Wales. It is named in the SSSI citation and features in the management statement under 'Assemblage of vascular plants'.

2-*Lysimachia minima* Chaffweed/Gwlydden-Mair Bach is known from several sites such as Wick Spring area (last record 2016 from SM72328 08889 to 72324 08893), the steep tractor track by the bungalow water tank (2004 at SM7344 0939) along with earlier records from east of West Pond and Comparment 5, south of the farm (1960-1980). It is **near threatened** in GB and **vulnerable** in Wales but is not a Pembs. rarity. It is named in the SSSI citation but does not feature in the 'Assemblage of vascular plants'.

3- *Asplenium obovatum* Lanceolate Spleenwort/Duegredynen Hirgul has been known from rock outcrops adjacent to the tractor track/greeting and information area at North Haven since 1958 and is still present (2019 at SM7349 0958). It is **near threatened** in GB and although it is not a Welsh rarity it is a scarce plant in Pembs. It is named in the SSSI citation and features in the management statement.

4- *Radiola linoides* Allseed/Gorhilig has been known from numerous locations around the island between 1945 and 2016 including the Wick spring area, the footpath above Tom's House and elsewhere between the Garland Stone and Skomer Head. More inland locations are east of West Pond, North Stream area and the field west of the farm. It is **near threatened** in GB but is not a Welsh or Pembs. rarity. It is not named in the SSSI citation nor in the management statement.

5- *Glebionis segetum* Corn Marigold/Melyn yr Yd was recorded on Skomer in 1991. It is **vulnerable** in GB but is not a Welsh or Pembs. rarity. And is an archaeophyte that arrived in Pembs. with early farmers before 1500 rather than a native plant. It is not named in the SSSI citation nor in the management statement.

Wales Red List but not on the GB Red List

6-*Jasione montana* Sheep's Bit/Clefryn has been found at numerous locations in rocky areas from 1945 to 1999 and is almost certainly still present. It is **near threatened** in Wales but is not a GB or Pembs. rarity. It is not named in the SSSI citation nor in the management statement.

(7- *Ophioglossum azoricum* small adder's-tongue/Tafod-y-neidr Bach was possibly once present in a depression inland from Skomer Head at about SM719 091 in 1966 -68 but was believed to have been lost to gull colony expansion by 1974. A population form is in the 1974 report but based on the 1966-68 potential record. **The find was never confirmed.** The confirmation of this species on Skokholm in 2018 would suggest that all *Ophioglossum* plants on Skomer need in future to be carefully examined. *O. azoricum* is classified as **vulnerable** in Wales and is **rare** in Pembs. where Skokholm has the only confirmed record**.**

Pembrokeshire rare Species either rare or scarce

(8 -*Sisyrinchium californicum* Yellow-eyed-grass/Glaswellt Melynlygad was present at Pigstone Spring between 1973 and 1976. A population form is in 1974 report – see attached. **It is now certainly extinct**. This casual is a neophyte = post 1500 arrival in GB. It is **rare** in Pembrokeshire and there has so far only been one other record which was an obvious garden escape.**)**

3. FACTORS

A factor is anything that has the potential to influence or change a feature, (habitat, plant community, or species), or to affect the way in which a feature is managed. These influences may exist, or have existed, at any time in the past, present or future. Factors can be natural or anthropogenic in origin, and they can be internal (on-site) or external (off-site).

There is no obvious or comfortable home for factors in a management plan, they are used for several different purposes and so logically they are best identified at an early stage in the planning process. The convention is to initially identify all potential factors and provide little more than a list of all the factors which will become relevant later in the plan. Because factors can be feature specific it is generally wiser to identify the factors after the features have been identified. For example, on Skomer the factors which could have a significant impact on the seabird populations; human disturbance, predation etc. will be completely irrelevant to the vegetation. The factors which impact on the Skomer vegetation will have a significant influence on the identification of the features and the choice of management options. For these reasons, in this plan the factors will be identified and discussed before the features are considered.

ENVIRONMENTAL FACTORS

SEABIRDS

Any decision about the future of the vegetation on Skomer must be conditioned by our overwhelming responsibility to protect the populations of seabirds. Their security must always be our prime concern. We need to continually ask a rather obvious question does the vegetation threaten the bird populations in any way. Strictly the seabirds, in this context, are a secondary and not a primary factor, they will not have a direct impact on the vegetation. (The impact of bird droppings on the soils will be discussed later). The primary factors, which currently give reason for concern, are bracken or other tall vegetation encroaching on the Puffin colonies. And the development of scrub including bramble with the recent appearance of Rosebay willowherb, *Chamerion angustifolium,* these are all species which could have implications for the Manx shearwaters. These will be given attention in the management rationale.

SALT SPRAY

There can be no doubt that salt spray is one of the primary factors influencing the type and distribution of vegetation in a coastal environment (Malloch 1972, Bray 1981). Obviously, it is the western and southern cliffs that are the most exposed on the island. The degree of exposure is best understood by turning to the Ballantine scale, a biologically defined scale for measuring the degree of exposure to wave action on a rocky shore. The scale runs from 1, the most extremely exposed shores, to 8, the extremely sheltered shores. Skomer Head and much of the west coast is described as 1 on the Ballantine scale. In other words, these shores represent the highest limits of exposure. Salt spray is frequently deposited on the western coastal grasslands, and it is not uncommon during a westerly storm to see the cliff tops deluged in seawater, so that puddles fill the hollows. Often in September, following the autumn equinox gales, the bracken fronds over the entire island are burned black by salt spray. There is no shelter: to varying degrees everywhere on the island is at some time exposed to salt water.

Graham Bray (1981) used simple salt traps at twelve locations to measure the varying rates of salt deposition around the island. His data revealed no surprises: deposition is heaviest along the south and particularly the west coasts. Further inland, there is a gradual decline in deposition from west to east. There is little purpose in dealing with anything other than generalities. The detail will be of

academic interest, but the important point is that variations in salt deposition are reflected by variations in the vegetation.

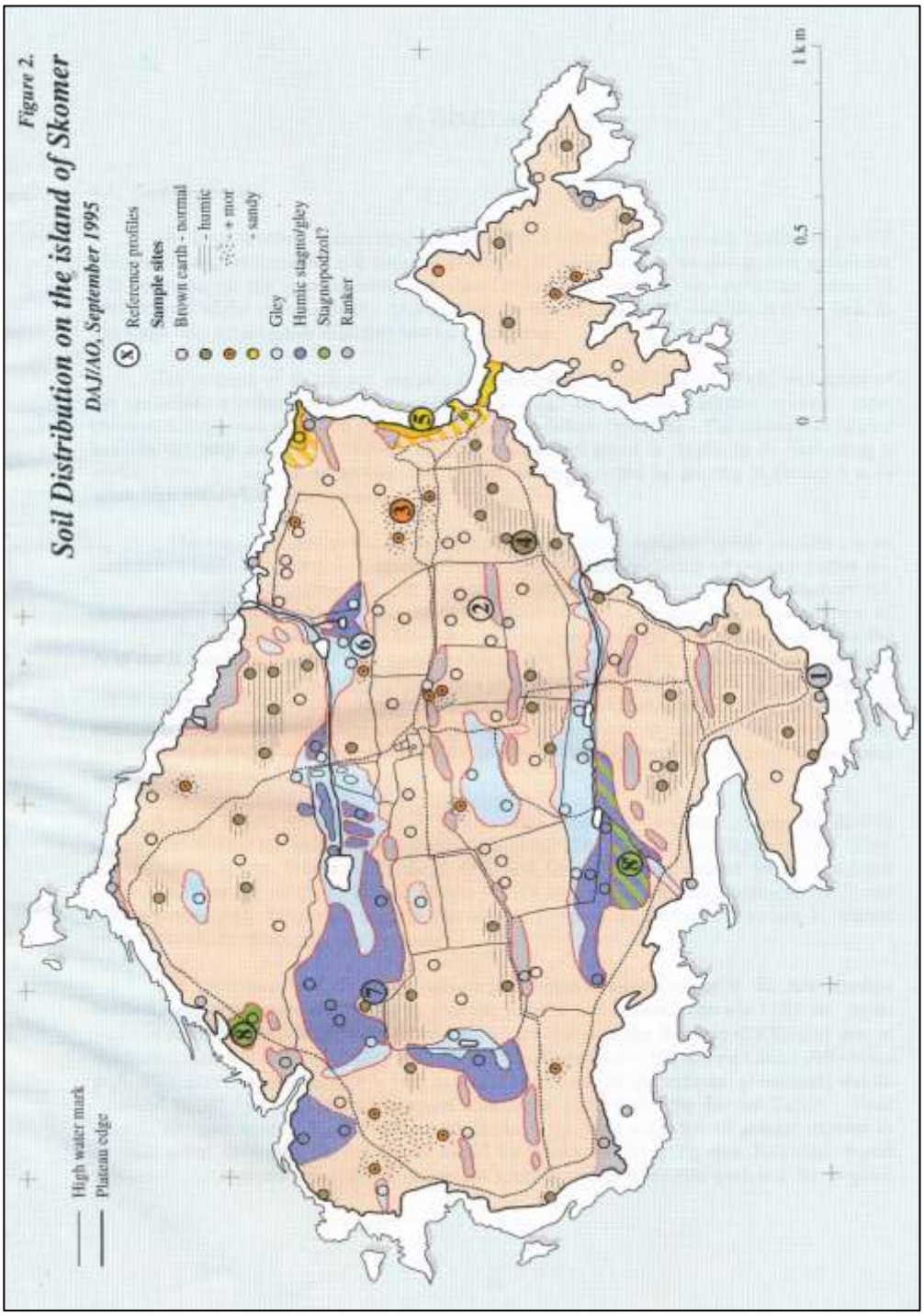
The yellow cliffs Skomer head.

The more exposed cliff edges display very obvious zonation, beginning above high water with the splash zone where lichens are the dominant organisms. The bottom of the cliff is populated by a wide zone of the black tar lichen *Verrucaria*, followed by the distinctive bright yellow-orange zone dominated by *Xanthoria*. Further up the cliff, and in occasional sheltered crevices, the first flowering plants appear: thrift *Armeria maritima*, sea campion *Silene uniflora* and buck's-horn plantain *Plantago coronopus* are the most obvious on Skomer. Once soils are able to develop, and salt deposition declines, the maritime grasslands appear. At first, in the absence of heavy grazing, a community mainly comprising red fescue *Festuca rubra* and thrift *Armeria maritima* dominates. A little further inland, or in more sheltered areas, this grassland grades into Yorkshire fog cliff grassland. During earlier times, when rabbits were either absent or heavily controlled, these grasslands would probably have been interspersed with maritime heath dominated by heather *Calluna vulgaris*.

Soils

It would make little sense to make any attempt at understanding the vegetation on Skomer without considering the soils. The soil type will always influence the plant community which can occupy any specific area. The situation is a little more complicated because it is the vegetation, particularly dead and decaying vegetation, that makes a major contribution to the development of soils and the soil type. A further complication is that soils are not static; they will respond over time to both natural and anthropogenic influences, and as these influences change so, eventually, will the soil. The soils on Skomer are continually evolving: soils are forming and soils are lost. As the soils evolve and change so will the vegetation.

We are extremely fortunate to have a report, ‘Soils of the Island of Skomer’, prepared in 1995 by D.A. Jenkins and A. Owen from the School of Agriculture and Forest Sciences, University of Wales, Bangor (Jenkins D.A. & Owen A. 1995). The report was commissioned by the Countryside Council for Wales, and most of the following text is a précis of this work.



Map of soil distribution on Skomer.

Soil types:

Group 1 Rankers

Rankers are defined by their shallow depth, 10 to 20 cm over rock outcrops. These are dark soils with a high organic content, and they are acidic (pH 4.1 – 5.5). These soils support the vegetation of the inland rocky outcrops and the extreme maritime vegetation zone on the exposed cliff edges, which grades into the red fescue *Festuca rubra* maritime grassland zone. This was also the original stronghold of the maritime heath.

Inland rocky outcrop

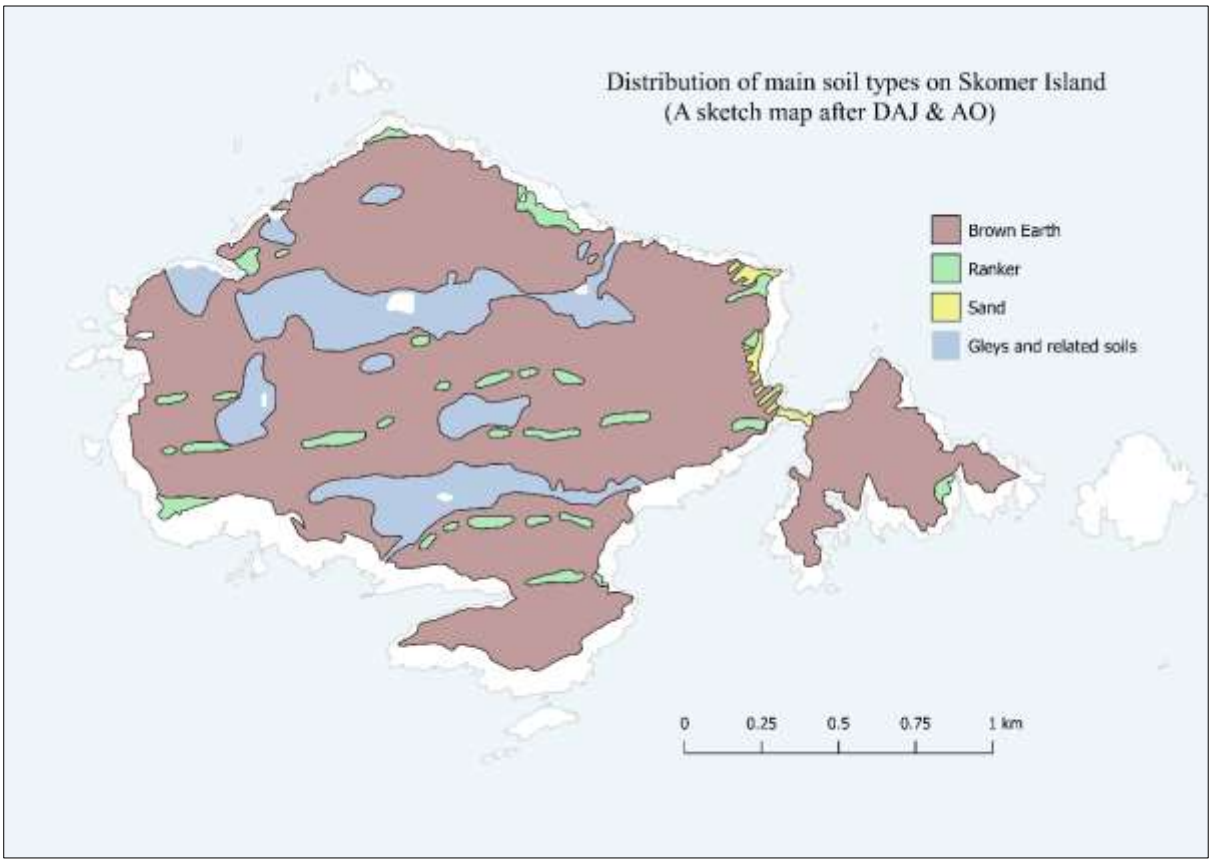
Groups 2 – 5 Brown Soils

These are the dominant soils of the inland, well-drained areas. Group 2 was described as the 'normal' variant, a dark brown soil with a slightly stony surface. They show a distinctive humic, silty / sandy silt loam. The pH values are moderate, averaging 4.4. Groups 3 and 4 were described as intermediate and developing a mor humus. (Soils with a mor profile have a dark-coloured band of organic matter, including litter, in the upper horizon.) Group 5 are described as *Brown Sands,* and these are sandy loams rather than the more usual sandy silt loams. The pH is over 6 at the surface but declines at depth. These are the lighter soils favoured by rabbits and burrowing birds and, consequently, are very disturbed in places. This vegetation of this group of soils includes the less exposed coastal grasslands, the acid grasslands, the areas of bracken, bluebells and the surviving patches of dry heath.

Groups 6 – 8 Gleys and related soils

The following text is taken directly from Jenkins and Owen, recently there has been some concern about their classification of the gleys and related soils. It is probably wise to simply group these soils under a single heading.

The pattern of soil distribution on Skomer is mainly a consequence of drainage or lack of drainage. The gleys and related soils are distributed within the wet, poorly-drained areas, with groundwater gleys, adjacent to standing and running water, grading into humic stagnogleys at the head of both North and South Valleys. In association with the latter, on shallow slopes, there are small patches of stagnopodzol. Group 6, the groundwater gleys, are the saturated areas where surface water is usually present. They are characterised by a dark greyish brown A horizon, while the underlying B horizon is a paler grey with orange-brown mottling. The pH is an average of 5 at the surface. Group 7, the humic stagnogleys, are distinguished by a dark peaty surface layer which overlies a stone-free, very dark greyish brown horizon. The surface pH value averages 3.8, rising at depth to 4.6. Group 8, the humic stagnopodsols, was only sampled in two locations, so no generalisations were made. There is an obvious and direct relationship between these soils and the wet valley vegetation. The groundwater gley is easily defined by the presence of purple moor grass Molinia caerulea, while the pattern of parallel stripes of wet heath in North Valley is explained by the underlying corresponding bands of dryer humic stagnogleys.



A simplified soil map which groups the gleys and associated soils.

Purple moor grass and wet heath in North Valley

Parentage of the soils

The drier soils on Skomer suggest that there is a general cover of loess, with some localised areas of coarser cover sand. These are presumed to be a consequence of periglacial and later postglacial processes, and derived from the wind erosion of glacial deposits. (Periglacial refers to places at the edges of glacial areas which were not buried by glacial ice but were subject to intense freezing cycles.) Most of the soils are stone-free to a depth of c 30cm (Bray 1981). The deeper sections, exposed at the Wick and the Isthmus, are roughly banded with alternating finer materials. These are probably deposits of local material at the edge of the once glaciated area. There is also evidence on the Island of glacial deposits of reddish Devonian rocks from the mainland and occasional erratic boulders, for example, the large rounded boulder of pale grey granite just south of Bull Hole. There are also deposits of gravelly materials which suggest a raised beach or fluvial deposits, but overall these are rare, and the conclusion reached by Jenkins and Owen was that the soil parentage is dominantly periglacial in origin.

Impact of birds on the soils

Jenkins and Owen noted that the soils of Skomer are markedly influenced by both rabbits and seabirds. Burrowing activities disturb and mix the soil horizons, returning less leached materials to the surface. Seabirds, in addition to burrowing, have deposited very significant quantities of nutrients: faeces, dead birds, regurgitated fish bones and other similar material. Jenkins and Owen suggested that the annual deposit of phosphorus could amount to 10kg per hectare (this did not include the input from carcases). However, their calculations were based on an overestimate of the total island bird population and did not account for the fact that some of the species, guillemots, razorbills and the cliff-nesting gulls, would have no impact on the inland vegetation. The most important point is their claim that levels of phosphorous are significantly high and this reflects the input from birds.

Mary Gillham, working on Skokholm in the 1950s, identified burrowing and manuring as the two most significant ways in which the seabirds influenced the vegetation on Skokholm. The soils on Skomer are also clearly influenced by burrowing seabirds. The birds disturb and mix the soil horizons, returning less leached materials to the surface. In addition the burrows help drain and reduce the moisture content of the soil. Manuring, or fertilising, by sea birds is different to the impact of herbivorous mammals: mammals recycle nutrients, mainly returning to the vegetation what they have taken from it. Sea birds primarily feed elsewhere, offshore or on the mainland, returning to the island and depositing their droppings.

During 2018 an undergraduate student, Harriet Sleight from Lancaster University, investigated the impact of enrichment from seabird guano on the Skomer soils and vegetation. She confirmed that concentrations of phosphorous were up to 10.8 times greater than mainland soils at the Deer park, and that nitrogen concentrations were up to 4.4 times greater. She also established that the isotope signatures of nitrogen in the Skomer soils demonstrate that it is derived from marine sources, that is, seabird droppings, feathers and other bird remains.

Manuring has the greatest impact when it is concentrated, for example, around nest sites or colonies and in the gull roost areas. In the 1950s, there was a very large gull roost, occupying approximately a third of the east side of Midland Island, presumably because, at that time, in contrast to the neighbouring islands, it lacked human occupation. The area was covered with an open community: it contained significant areas of bare ground, completely dominated by chickweed, a plant which favours soils rich in nitrogen. The plant communities include two which thrive specifically as a response to seabird droppings: the 'orache bird-cliff community' and the 'chickweed bird-cliff community'. The gull roosts around the cliffs on Skomer are often defined by spear-leaved orache, another nitrophilous species. There are also many species, for example, common sorrel and sea campion, with a widespread distribution which also reflects the impact of guano. The large areas of Yorkshire fog, now covering much of south plateau and the slopes above North Haven, may have also gained a competitive advantage as a consequence of enrichment.

In most mainland situations, bluebells suffer from the addition of nitrogen - they become shaded by grasses - but on Skomer, because rabbit grazing suppresses the grasses, bluebells are greatly stimulated by guano. Thrift, for example, which is tolerant of grazing pressure and salt exposure, appears to be less resistant to guano and, in enriched areas, is out-competed by other species, mainly fescue and sea campion. In addition to the obvious areas where the impact of sea birds is concentrated, the entire surface of the island has been enriched to some extent.

GRAZING BY DOMESTIC ANIMALS

Before discussing rabbits, it is necessary to consider grazing by domestic animals. If it were ever possible to remove the rabbits, in order to avoid some of the negative consequences of this, we would have to consider alternative grazing, by animals that we could control, thereby allowing us to manipulate the vegetation. The issue of reintroducing domestic grazing stock has been discussed at intervals over the years, with varying levels of support for the idea.

No decision was ever taken not to graze Skomer. Up until 1958 Reuben Codd kept sheep, cattle and a horse or two on the island, and this followed centuries of human occupation and utilisation. Once the island became a National Nature Reserve, Ronald Lockley, at that time the Honorary Chief Warden for the Field Society and the 'elected' Skomer Warden, put a flock of his own sheep on the island to ensure continuity of grazing. This and other issues created serious divisions within the Society and, eventually, regardless of any rights or wrongs, with the exception of a small number of Soay sheep, the animals were removed. There was always an intention that the island would be grazed: The Nature Conservancy (the government agency that owned Skomer at that time) had no doubt about the importance of keeping enough sheep or other grazing animals on the island to control the vegetation. The first job description for the Skomer warden suggested that he should

keep sheep to supplement his income, but this never happened. Over the years there was much discussion, many file notes, but never a decision. The belief that there should be grazing was never questioned; the only concerns were about the breed and numbers of animals. The final word in the debate was a Nature Conservancy file note written in 1974, stating that the decision would be deferred until the island management plan was completed. The removal of grazing by domestic animals was entirely the consequence of indecision and not the result of a rational or reasoned decision-making process.

Could sheep, or any other herbivores, be reintroduced to Skomer? *'The introduction of sheep onto a densely burrowed Puffin colony causes widespread collapse of burrows but colonies which have been grazed for many years are remarkably stable. Burrows in grazed areas are deeper and longer and the nest chamber has a solid roof, in non-grazed areas the burrows are short shallow and easily collapse.'* (Harris 1984) The simple answer is no, we cannot at this stage introduce heavy animals, and sheep, with their sharp, penetrating hooves, must be regarded as heavy animals. The shearwater and Puffin burrows are so very fragile and vulnerable that, in reality, it is far too late for this debate. Indecision in the early years removed any choice that we might have had today, but is this a disaster? On islands that are grazed by domestic stock and occupied by shearwaters, for example, Ynys Enlli (Bardsey) in North Wales, the shearwaters are restricted to the walls or mountain areas which are not over utilised by grazing animals. This pattern was also probably true of an earlier Skomer, and there are still very low numbers of shearwater burrows in the middle of the central fields. We have to be cautious, but is it possible that the incredible success of the shearwater population is, in some minor part, because they have so much room to burrow? What would have happened if grazing animals had been retained?

Sheep grazing, North Haven, 1958

RABBITS

There is an extremely large, though unstable and fluctuating, rabbit population on Skomer. Rabbits are native to the western Mediterranean region, and were introduced to Britain sometime in the 12th century, during the reign of Henry II. The first record for the Pembrokeshire Islands, and in particular Skokholm, can be found in a document concerning the valuation of Aymer de Valence, the Earl of Pembroke's estate after his death in 1324. There were rabbits on Ramsey by 1293. It is not known precisely when rabbits were first introduced to Skomer, but David Stanbury (1997) suggests that the date for introduction to Skokholm was probably around 1180, and there is every probability that this was also the time when rabbits arrived on Skomer. By 1387 the islands were under royal control and detailed accounts were kept of the number of both rabbit carcases and skins which had been sold. The records also mention, food for ferrets, salt for salting rabbits, and 'repairs of a house on the island of Skalmey'. The first record of rabbit 'farming' on Skomer was in a record for 1387-8. From that time, the 14th century, onwards, until 1954, rabbits were an important source of income for landowners and provided a livelihood for ferreters and trappers. The island was an ideal warren, with no ground predators and few significant bird predators.

Rabbits also made an important contribution to farming in the 1800s; they were an essential, and probably primary, source of income. Edward Robinson farmed Skomer from 1846 until 1861. His first task on Skomer was to make the outer field walls rabbit-proof, using heather pointing outwards on the tops of the walls. He employed a rabbit catcher, and one of his urgent tasks was to remove the large number of feral cats which were killing the young rabbits. It is also apparent that Vaughan Davies was obliged to rely rather more on rabbits than traditional farming for his income. In April 1878, he wrote a number of letters to the editor of the Times, complaining about the impact of the Sea Birds Preservation act of 1869 on his income from rabbits on Skomer. His letter contains a record of rabbit catches from 1861 to 1877, assuming that the value of rabbits did not change through much of that period, his income, at 2s a couple, would have been on average £535 for the

first nine years and £200 for the following eight years. This must have represented a very significant part of his annual income, but it is not easy to gain an appreciation of what this might have meant to the economy of the whole farm; there are no records of his entire annual income. His rent for this period was £145 per annum, at a time when less than 2% of the British population had an income of over £150 a year. If nothing else, these statistics confirm that rabbits were a very important source of income.

The last man to make some income from rabbits was Reuben Codd: he caught the rabbits with dogs and ferrets, and his lurcher, Bella, was almost as well-known as her owner. His preferred method was 'lamping': a powerful, hand-held lamp was used to find the rabbits and the dog did the rest. On one night, between them, they caught 190 rabbits. This was during the early 1950s, and by this time Reuben was living at Martin's Haven, but he continued to keep grazing animals on Skomer.

Rabbiting came to a very abrupt end in 1954, when the rabbit disease myxomatosis reached Pembrokeshire and Skomer. By the end of the following year, Gillham (1965) estimated that only 20 animals had survived. This is probably not a credible estimate, and it is sufficient just to say that there were very few survivors. However, by 1959 numbers had increased again, to perhaps two thirds of the previous maximum of 15,000. Large numbers of rabbits died in the very harsh winter of 1962/3 when 2500-3000 carcases were seen and perhaps 20-25% of the population was lost, but numbers had quickly built up again by late summer 1963 (Saunders 1965). There was a further outbreak of myxomatosis in 1965, and in the following year there were striking vegetation changes, chiefly the lush growth of grasses in the central fields and displays of flowering plants which were usually absent or very local (Saunders 1967). Between 1967 and 2006 there were a few notable outbreaks and occasional years when myxomatosis was not recorded. Over the winter 2006/7 an extremely virulent outbreak killed most of the rabbits. An extract from the annual report for 2007: '*It was estimated that only about 5% of the population remained, with a mean of 1.66 per hectare being counted across the plots (compared to 40.8 per hectare in 2006). The centre of the island was almost completely devoid of Rabbits, though a number of animals were still evident on the west coast and Neck. Later in the season, small numbers began to appear at North Haven and around the Farm, but counts at study plots remained consistently low throughout. The disease remained persistent throughout the season.*'(Skomer annual report 2007) Myxomatosis has been recorded at low levels during most years since 2007.

Rabbit viral haemorrhagic disease (RVHD) first appeared on Skomer in 1995, followed by outbreaks in 1996 and 1997. It affected mainly the young rabbits, and blood analysis revealed that c. 70% of the rabbits had immunity.

Monthly rabbit density has been recorded in study plots at South Plateau, Wick Grassland and Calves Park / Shearing Hays since 1995. This provides an excellent account of changes in the population over this period. The dip in rabbit numbers between 1995 and 1997 was due to outbreaks of rabbit viral haemorrhagic disease, while the huge crash in 2007 was the consequence of a particularly virulent outbreak of myxomatosis.

Prior to 1954, rabbits were exploited for meat and skins, and they were also controlled in the main central fields during the peak agricultural episodes on the island. There is little useful evidence, apart from records of the numbers of animals taken, to help us understand the status of the population during these earlier periods. Since the first outbreak of myxomatosis in 1954, the population has followed a typical boom and bust cycle. Experience on Skomer has shown us that once the population reaches extremely high levels it becomes vulnerable to disease and even, occasionally, to severe winter weather. The most pressing question must be, will this pattern continue?

There is a significant volume of literature on the impact of rabbits on vegetation. Some of the most useful and relevant stems from the 6 years that Mary Gillham spent on Skokholm during the early 1950s. Taken together, the literature confirms the obvious: rabbits are preferential grazers, and their impact varies from plant species to species.

- There are some species, for example heather *Calluna vulgaris*, that, because they are so palatable, are the least resistant and least likely to survive grazing by rabbits. These species are either absent, restricted to occasional isolated areas where rabbits cannot graze, or in serious decline.

- Other species, for example the grasses red fescue *Festuca rubra* and common bent *Agrostis capilliaris,* are palatable and favoured by rabbits. As a consequence they are severely suppressed but not completely eliminated. Under extreme grazing pressure these plants develop into a prostate or creeping form, which is an excellent strategy for avoiding large herbivores, but less effective when challenged by rabbits. Nevertheless, these species do somehow survive and can deliver vigorous displays following crashes in the rabbit population. Yorkshire fog is also included in this category: it is perhaps not severely suppressed, but it is kept in check and sometimes prevented from flowering. Yorkshire fog, according to the literature, is unpalatable to rabbits because of the dense felt of hairs on the leaves and acrid sap, but whatever happens elsewhere, the rabbits on Skomer eat Yorkshire fog. This occurs mainly in areas, and at times, when there is nothing much else for them to eat.

- Most of the species that are now abundant and dominant - the species that define the Skomer landscape - fall into a third category: species that are almost completely unpalatable and ignored by rabbits, for example, wood sage *Teucrium scorodonia,* bracken *Pteridium aquilinum*, bluebells *Hyacinthoides non-scripta* (only the flowers are occasionally eaten) and red campion *Silene dioica*.

RABBIT CONTROL

Rabbits (*Oryctolagus cuniculus*) *have been nominated as among '100 of the world's worst' invaders in recognition of their extensive damage to biodiversity and difficulty to eradicate.* (Global Invasive Species Database 2009)

Almost every new generation of reserve manager, sooner or later, concludes that rabbits should be eliminated, or at least controlled, because of their impact on the vegetation. It is likely that sometimes these attitudes are formed and fuelled by the idea that the vegetation on Skomer is somehow inferior to that on the mainland. Also, many of us engaged in nature conservation are by disposition preservationists and intuitively feel that we must not allow anything to change or to be lost. Efforts made over the years to maintain open grassland in the central fields and to prevent the decline of heath are testament to our attitudes. There is a long history of speculation concerning the potential impact that eliminating rabbits would have on the vegetation and, of course, on the bird populations. There is a sound body of evidence generated by the rabbit exclosures which, at one time or another, have occupied examples of most of the main vegetation communities on Skomer. The fine detail of change within the exclosures has been recorded, but it is the more obvious gross changes that are most relevant to this discussion.

The rabbit control/eradication debate has been visited by people representing a wide range of human values and ethical positions. Roscoe Howells in his book about Skomer, 'Cliffs of Freedom,' includes an interesting argument in favour of rabbit control. He clearly regards himself as farmer, or

at least an advocate of farming interests, but he was also a religious man and something of a 'dominionist', a doctrine that he often refers to in his books:

'Much of the talk, of course, was on the lines of upsetting the balance of nature. Which was just plain humbug. For God gave man 'dominion over all'. And it is clearly evident that rabbits are not indispensable because this country managed well enough without them before they were introduced. They were not indigenous to these islands, so the balance of nature does not enter into it. And the only point in wanting to maintain a rabbit population after their introduction would be if they proved of any use. Which they haven't.'

This is not an uncommon opinion, though few resort to dominionism to support their cause. Most often, people claim that rabbits are not a native British species and therefore cannot be regarded as a natural component of any British ecosystem, so they should be eliminated. The counter argument is that rabbits have been on Skomer since the 12th century, so they have naturalised and become a legitimate component of the island ecosystem. This simple argument cannot be resolved: both sides are adopting something close to ethical positions which have rather more to do with belief than science or logic. This is, perhaps, one of the reasons why the debate remains unresolved and why rabbit control on Skomer has most often been experimental.

Before pursuing this argument any further there is a need to consider the most pressing practical question: could we, if we wanted to, actually exterminate the rabbits? Ronald Lockley used Cyanogas (calcium cyanide), a powder which produces hydrocyanic acid when exposed to moisture, in an attempt to exterminate the rabbits on Skokholm. Between 1938 and 1940 he managed to reduce the population to c. 400, with the surviving animals mainly in cliff and scree areas, but when control ceased the rabbit population recovered very quickly (Lockley 1947). Today there are a variety of different poisons available, for example, magnesium phosphide, sodium fluoroacetate, sodium cyanide, aluminium phosphide and more. Evidence suggests that it may be technically possible to eradicate the rabbits. There are many examples, mainly from New Zealand and Australia, of successful eradication programmes:

'Rabbit control methods are becoming increasingly efficient, and rabbits have been eradicated, by one method or another, from at least 87 islands'. (Flux 1993)

'Worldwide, rabbits have been introduced to over 800 islands with devastating impacts. There have been at least 48 attempts to eradicate them, with about a five percent failure rate, but even on small islands eradicating them is very difficult and often requires a combination of techniques' (Flux and Fullager 1992).

Although technically possible, the use of poisoned bait to control rabbits is currently illegal in the UK. Even if poisoned bait could be used legally on Skomer, there would be a risk, albeit a small risk, that the small mammal populations, certainly the mice and voles, would also be exterminated. There is no information on the effect of poisoned bait on shrews. It might, in theory, be possible to establish secure captive populations before using poison, but success could not be guaranteed, so could the risk, regardless of how small it might be, ever be justified?
Control using various gasses in closed burrows is legal. However, the method is not suitable for use on Skomer. It requires that all the burrows in an area are located, a tablet or powder is placed in each burrow entrance, the burrows are then blocked with earth. The gas released when these substances come in contact with moist soil permeates through the burrows and kills everything, even the invertebrates, inside. Taking into consideration the hundreds of thousands of sea bird burrows often used by rabbits in the winter, the impossible task of finding and treating all the burrows, the damage to burrows both directly from stopping and indirectly by trampling, the

prospect becomes unthinkable. Even if it were possible to deal with the rabbits in burrows, we would encounter the same problem that led to the failure of this method on Skokholm. Large numbers of rabbits occupy the boulder strewn slopes, particularly along the south and west coasts of Skomer: these areas cannot be gassed.

The more traditional means of control - shooting, netting, ferreting, lamping and trapping - are all very labour intensive and, consequently, extremely expensive. Control of any kind is controversial, and Skomer is a very public place. If a decision is made to 'manage' the rabbits, the work will have to be carried out during the winter closed period. If the decision is to completely eliminate the rabbits, the only time when this might be possible would be immediately following another huge crash in the population. Nothing is impossible. Given the will and almost unlimited resources rabbit eradication could probably be achieved, but what would we gain?

THE IMPACT OF RABBITS ON SKOMER.

Negative impact of rabbits:

The specific impact of rabbits on the vegetation is discussed elsewhere. Rabbits have eaten most of what they can eat, and this has been going on at various intensities for at least 800 years. In all probability, some plant species have become extinct and more may become extinct in the future.

- All the plant communities on Skomer have been suppressed, or highly modified, by the rabbits.

- Species that are not palatable to rabbits have come to dominate many of the communities, for example, wood sage is now rampant in what used to be grassland.

- There are records of soil erosion and damage to seabird burrows in some of the more exposed, free-draining areas as a consequence of rabbit grazing. Between 1979 and 1988, four exclosures were established on South Plateau to examine the pattern of vegetation that would emerge if rabbits were eliminated from this area. There was a very significant increase in peat or soil humus in all the exclosures: peat in the most exposed western exclosures and humus in the relatively sheltered east. Outside the exclosures, 50 cm marker pegs were driven into the soil. A few years later the pegs were found on the surface, and close examination revealed that the level of the soil had decreased relative to the underlying rock (Bellamy 1992). Bellamy also looked at other areas along the exposed west coast and observed near Skomer Head, *'a very large set of burrows, which in the early 1970s housed a colony of around 50 pairs of shearwaters, had completely disappeared.'* (Bellamy 1992)

- Then there is the nightmare scenario. Many people have suggested that each time the rabbit population 'booms' the damage that occurs to the vegetation has a long term and cumulative impact. It would be unwise to ignore the theory of 'island biogeography'. The theory builds on the first principles of population ecology and genetics to explain how distance and area combine to regulate the balance between immigration and extinction in island populations (MacArthur & Wilson 2001). Expressed in simpler language, the smaller and more isolated an island, the more likely it is for species to become extinct. On the mainland, localised extinctions of species are not necessarily a disaster if there are physical links with areas of habitat where the same species has survived. These species can re-colonise the area, if the local factors which led to the original extinction are brought under control. This is not true of isolated small islands. When a species becomes extinct, re-colonisation may never occur without artificial re-introduction. The cumulative impact of the rabbit 'booms' could potentially, over time, dramatically reduce species diversity on Skomer.

This would not only be restricted to plants but could include other species - invertebrates in particular - which depend on the quality of the vegetation.

Positive impact of rabbits

- We know that the most important of all features on Skomer, the seabird populations and particularly the Manx shearwaters, have thrived in the presence of rabbits and their impact on the vegetation. *'Rabbits and Puffins occur together in many places, and rabbits start burrows in places where Puffins have difficulty in getting through the turf. These short burrows are then taken over by Puffins.'* (Harris 1984) Could this also be true for Manx shearwaters, and even if it is true is it in any way a significant factor?

- The maintenance of a short, open sward, interspersed with patches of bare ground, is good for some invertebrates and their predators, including Chough and Wheatears.

- Rabbits prevent rank or tall vegetation developing around the Puffin colonies. On the island of Craigleith in the Firth of Forth, Puffin numbers declined from 28,000 burrows in 1999 to only 14,000 in 2003. This happened because of a dramatic increase of tree mallow, forming dense stands in the area once occupied by Puffins. Puffins in nearby colonies, in the absence of tree mallow, have continued to expand (CEH 2005, Harris et. al. 2003). Tree mallow, particularly the young plants, cannot tolerate rabbit grazing. The more significant populations of tree mallow on Skomer are on the rabbit-free, off-lying rocks (the Mew and Garland Stones) with occasional plants on the south side of the Neck. Around 20 plants appeared on the Puffin slopes around Amy's Reach following the 2005/6 outbreak of myxomatosis. The bird-fertilised soils around the coast on Skomer provide ideal habitat for mallow, and no doubt in the absence of rabbits it would thrive. Tree mallow is just one tall species, and there are many others that could occupy the Puffin colonies. During the early 1980s reserve managers were concerned about the impact of bracken on Puffins. Observations at the Puffin colony on the south east corner of the isthmus led to the conclusion that Puffins continued to nest in burrows that had been established before the spread of bracken but that young birds were less likely to prospect for burrows in dense bracken. Our assumption was that the youngsters were too nervous to remain in areas where they were out of sight of other Puffins. Once the bracken was cleared, prospecting Puffins were no longer deterred. These assumptions arose from casual observations, and care must be taken to avoid coming to the wrong conclusion. However, there is a need for caution as there is enough evidence to suggest that Puffins and tall vegetation do not mix. This should be a topic for further research.

- Rabbits can provide an important source of food for the predatory birds on Skomer, thereby diverting their attention from the seabirds.

- On Skomer the plant communities, and all the associated fauna, have been suppressed or highly modified by the rabbits. Yes, this same statement is given in the 'negative impact' section, but it is also included here because the way in which people perceive and value the vegetation on Skomer is unavoidably subjective. Perhaps managers need to think about those aspects of Skomer that both define the island and give enormous pleasure to human observers: the extensive, colourful, and spectacular drifts of sea campion, mayweed, thrift and bluebells. These are the positive outcomes delivered by rabbits selectively grazing the vegetation. We cannot be certain about the alternative - an island without rabbits or any other grazing pressure - but it is a reasonable assumption, based on experience from so many exclosures. The exposed coastal areas will rapidly develop into a dense fescue

mattress with very few other species. Most of the central areas, where soils are deeper, fertile, and reasonably free draining, could become completely covered in brambles within a couple of decades. After that, scrub might increase, and this may, over an extremely long period of time, become scrubby woodland. The predicted bramble infestation is based on direct experience from exclosures in North Valley, while the woodland is conjecture. Whatever this future vegetation might become, there is no guarantee that it will be good for shearwaters or other seabirds.

Bramble inside the rabbit exclosure in North Valley, April 2013

Impact of rabbits a discussion

It is important that we recognise the impact that rabbits have had on Skomer. They have 'naturalised' and have been part of the island ecosystem for a very long time. Following their initial escape into the wild, rabbits adapted their behaviour in order to survive in those new and alien habitats, but, equally, the habitats also changed to accommodate the rabbits. The entire ecosystem and its dependent species changed: some species were lost or suppressed, but others were given very significant advantages. Skomer is not unique in this respect. Elsewhere the positive impact of rabbits on other species became a very serious issue following myxomatosis. The best-known example in British conservation was the extinction of the large blue butterfly in 1979. The recovery of the rabbit population resulted in the restoration of optimum habitat for the butterflies and this made reintroductions possible (Lever 2009). We do not have, and will probably never have, a complete understanding of the complexities, the interdependencies, or even the simplest relationships, between the different species that now occupy Skomer, so there is no point in excessive speculation about the detail of what would be lost and what could be gained. If the rabbits were removed, the island would probably be transformed into a species-poor shadow of the mainland coast, and much of what people have come to value so highly about Skomer could be lost.

There is another significant issue that must be considered - the lack of predation. There are no ground predators, and it is unlikely that bird predators will ever have any significant impact on the rabbits. People used to be the key predator, certainly from the time of introduction to the cessation of rabbit harvesting, and, in place of predators, rabbits have been controlled by disease and extreme weather. Both have been discussed previously, but we need to recognise that they are not factors that we can, or would want to, rely on. Both are unpredictable and unreliable. Does climate change point to warmer winters, and will the rabbits become less vulnerable to myxamatosis? There is a danger that this discussion will become more and more speculative, but the important point is that we recognise the need to keep the rabbit population under surveillance and perhaps, in the future, accept a need for management.

The next question is perhaps the most difficult to answer. Do we regard rabbits as alien invaders or treat them a naturalised or 'new natural' species? The answer depends entirely on our personal perspective. Some people will always argue that rabbits are not native to Britain: they were introduced by the Normans and, therefore, can never be regarded as a natural factor. Others will claim that rabbits have been here for a very long time - such a long time that we generally speak of 'wild' rabbits. They have become naturalised and very much an integral part of today's island ecosystem.

If we chose to regard rabbits as the 'new natural' and accept their position as an integral component of the island ecosystem then all the significant factors that currently impact on the vegetation could be regarded as natural.

INTRODUCTIONS AND BIO-SECURITY

In addition to rabbits, there is one other factor with the potential to affect most of the vegetation on Skomer. People have introduced species to the island for as long as there have been people on the island. It will probably never be possible to differentiate between the species that are naturally native and those that were introduced at some time by people. The early inhabitants (post Ice Age) would have had animals and probably grown crops. Rabbits were deliberately introduced sometime in the 12th century, but when did the Skomer vole and other small mammals arrive? During the farming heyday there must have been considerable opportunity for the accidental introduction of species, and some species have been deliberately introduced. Just a few minutes walking around the

farm will confirm this: fuchsias, narcissi and blackcurrants are all survivors of garden introductions. Sadd (1947) describes the consequences of a lawn which was laid in the farmyard some twelve months before his visit. He discovered perennial rye grass *Lolium perenne*, crested dog's-tail *Cynosurus cristatus* and corn spurrey *Spergula arvensis,* and noted that none of these species had been recorded before the new lawn was seeded. Even since the island became an NNR there have been many deliberate introductions, including willow, Monterey pine, blackthorn and privet. In 1967 and 1968 burr reed *Sparganium* and bulrush *Typha latifolia* were planted at North Pond, *'because the pond was deficient in plant life'.*

The bio-security section in this plan identifies the potential for future introductions and the management response to invasive or threatening species. Threatening species, are not necessarily exotic alien species, species which are native and common place on the mainland could become a problem on Skomer.

The legal situation for Natura 2000 sites is clearly set out in an official European Commission document, *Managing Natura 2000 sites: The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC* (EC 2000). Although the legal implications of Article 6 are only relevant to Natura sites, the concept that gave rise to the article is relevant to all sites. The article states:

Member States shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbances of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this directive.

In addition to the article, the document contains two particularly appropriate passages:

This article should be interpreted as requiring Member States to take all the appropriate actions which it may reasonably be expected to take, to ensure that no significant deterioration or disturbance occurs.

In addition, it is not necessary to prove that there will be a real significant effect, but the likelihood alone ('could be') is enough to justify corrective measures. This can be considered consistent with the prevention and precautionary principles.

As Britain heads toward Brexit (2020) there is some uncertainty about the future status of the law relating to Natura sites, this section will require review if the law changes. However the precautionary principle is a sound and essential concept regardless of any legislation.

ROSEBAY WILLOWHERB, CHAMERION ANGUSTIFOLIUM

Map showing three known locations for rosebay willowherb Chamerion angustifolium, (shown in red) on Skomer, September 2017.

Rosebay willowherb *Chamerion angustifolium,* has recently appeared on Skomer. Mike Alexander first noticed a patch north of South Pond in Spring 2017. There are no earlier records, but given the size of the patches it is more than likely that it had been missed for a year or two.

This is an extremely invasive species, capable of filling any open spaces in the vegetation. If it was producing seeds in a year following a serious drought, when the existing plant communities are open and full of bare ground, there is potential for large scale and quite rapid colonisation. Willowherb has extremely robust tall stalks which grow in dense thickets. It is possible that Manx shearwaters would experience serious difficulty in trying to fight their way through these thickets.

At the moment the patches, one in South Valley and two in North Valley are small enough to be easily eradicated. If it increased as suggested, control would become difficult and very expensive. In short if by the time the prediction is tested, if the assessment is correct it will be too late to easily tackle the issue. The precautionary principle is so important in this context. If there are good reasons to believe that there could be a threat to a European protected species, action should be taken even in the absence of conclusive scientific proof.

A decision was made in 2017 to eradicate willowherb. Control will have to be done mechanically. It is extremely resistant to all the easily available and approved herbicides. (Herbicides should only be used as a last resort on an NNR/SSSi/SAC.)

The factors which have influenced heath on Skomer.

For the past 6 decades management interventions have sought to maintain or reintroduce areas of heath to Skomer. The scale of the effort and the significant commitment to these communities justifies a disproportionately, in-depth consideration of the factors which have and will continue to influence this community.

Early human intervention

We believe that most of the dry and wet heath on Skomer was an incidental by-product of farming, particularly rabbit control, grazing by domestic stock and burning. Heath, in most situations, is regarded as a plagio-climatic community: a transitional stage which will be succeeded by scrub and, eventually woodland.

The maritime heath (H7 *Calluna vulgaris* - *Scilla verna* heath) may be different, and there is a suggestion that exposure or impoverishment may be sufficient to prevent succession to scrub even in the absence of grazing. It is generally held that maritime heath was a natural community of the infertile cliff edges. The single most distinctive difference between the habitat of the maritime heath and the habitats of other heath communities is the impact of salt spray (Rodwell 1991). This is a community which occupies a narrow zone, restricted on the seaward side by the cliff edge fescue grasslands which are more tolerant of salt, and outcompeted on the landward side by inland heath or other communities which are less salt tolerant. Earlier authors suggest that heath on exposed sea cliffs probably represents the climatic climax community although grazing pressure will influence it. Salt and/or grazing pressure will prevent further successional development. More recently, there is a suggestion that past human intervention or exploitation reduced the natural soil fertility, thereby providing coastal heath, particularly heather, with the necessary competitive advantage.

Soil fertility

On Skomer, the limited zone which could be occupied by maritime heath represents some of the most guano enriched parts of the island, but maritime heath cannot survive in these fertile soils.

In addition to impact of increased soil fertility on the maritime heath, the dry inland heath communities will also be affected. Heather *Calluna vulgaris* can only out-compete other species to form heath communities on poor, infertile, acid soils. The seabird populations, particularly gulls, have substantially increased since the cessation of farming on Skomer in c1900. More significantly, the cumulative effect of their droppings has significantly increased soil fertility. Gillham (1955) working on Skokholm noted that in the areas of *Callunetum* (heath) used by gulls as a roosting ground the *Callunetum* degenerated into an Agrostidetum (Yorkshire fog grassland). This factor requires further research.

Rabbits and heath

Rabbits have been discussed, in detail, earlier in this section. Rabbit-proof exclosures have been used on Skomer to evaluate the impact of rabbit grazing since the 1960s, and, more recently, they have also been used in an attempt to manage the heath. The lessons learned from the exclosures are particularly informative. Above all, we now know that the main factor which led to the demise of the heath, and prevents its re-colonisation, is over-grazing by rabbits.

Traditional heath management

Traditionally the favoured management for heath was burning with controlled grazing. More recently, cutting has been adopted where burning and grazing are difficult. In the past, burning management was mainly used to maintain structural diversity in heathland. We know that, as late as 1958 Reuben Codd, was burning heath on the Island. The large area of heath that once extended from South Pond around to the Wick and on towards Tom's House was, in 1960, recovering from a 'recent' fire. The vegetation map prepared by J. Sadd in 1946 shows extensive areas of burned heath to the north west of North Pond. It is reasonable to assume that Reuben Codd burned the heath to encourage fresh, new growth for his sheep. However, burning heath can provide bracken with a very significant opportunity to invade. This is well documented from elsewhere, and there is every reason to suspect that inappropriate burning could have hastened the demise of heath on Skomer. Heath has not been burned on Skomer since 1960.

Invasive scrub, apart from bramble, has not been an issue on Skomer for a very long time, and it is certainly not a current concern. However, following the myxomatosis outbreak 2005/6 there was a significant crop of young blackthorns in North Valley. This would suggest that, providing rabbits remain on the island, that traditional management to prevent scrub encroachment is not necessary. It is a common misconception that heather will not survive unless it is burned: in common with many other plants, heather can regenerate by the layering of stems as well as from seed.

Heath cannot tolerate heavy or prolonged grazing, but grazing by domestic animals, at an appropriate level and in combination with burning, is one of the most effective management tools. There have been no domestic animals on Skomer since the early 1960s. There is no longer any possibility that stock will be reintroduced.

The exclosure above Wick Basin.

Outside and inside a North Valley exclosure. The heath inside is becoming lost to bracken/bramble scrub.

Heath management on Skomer

Exclosures were originally erected on Skomer to investigate the impact of rabbit grazing. When exclosures were placed in areas containing heather there was an initial rapid recovery, but this was not always sustained. In some areas, the sub-shrubs were outcompeted by other species, particularly grasses and brambles. Continuous and considerable effort has been required to clear brambles from the inland exclosures on the deeper soils in North Valley. The exclosure above Wick Basin, was originally chosen to be representative of the seaward edge of maritime heath, was very informative. In the absence of rabbits, the heath/maritime grassland boundary within the exclosure inched to seawards, while the grazed heath outside retreated landwards in the few years after the exclosure was established. Unfortunately, this exclosure is now a completely isolated island of degenerate heath.

In 2000, exclosures were used in an attempt to arrest the decline of heath. A temporary rabbit exclosure was constructed in North Valley alongside the area of heath that had been sprayed with Asulam to control bracken in 1999. The area was chosen because of the presence of many fresh heather shoots. The exclosure was only 50 cm high and intended as a short-term measure (two to three years) to give heather sufficient time to pass through its most vulnerable stage. Initially, the exclosures were very effective and there was good colonisation by heath, but, after a few years, the rabbits got in and the heath began to fail. Some blocks of heath have survived in the exclosures, but these contribute little to the surrounding vegetation (or, indeed, to the future of heath on Skomer).

It has also become evident that maintaining the exclosures in a rabbit-proof condition is extremely difficult in the longer term. Sooner or later all the exclosures have failed. The legacy is a collection of unsightly, dysfunctional structures which, in places, diminishes the quality of the island's landscape.

Exclosure above Bull Hole in 2013. Rabbits have invaded the exclosure.

Lesser black-backed gull colonies can completely destroy heath. The area of heath on the Table, west of Bull Hole, was the first to suffer and eventually disappear. Over the last 15 years the gull colonies have, despite reducing in overall size and density, continued to spread into the heath community in both North and South Valleys. Heather provides desirable cover for the nesting gulls, but a combination of gull droppings, vegetation pulling and trampling kills the heather. The management response was to destroy the gulls' nests and, in some years, up to 90 nests were removed.

During the 1970s and 80s the lesser black-backed gulls were perceived as a serious problem and, consequently, were culled. However, by the 1990s the gull population was in serious decline and were regarded as a threatened species. The lesser black-backed gulls became designated as a SPA feature, and in 2001 the revised features list for Skomer include the gulls as a formal SSSI feature. The heath is not a designated feature on Skomer. It is not obvious why management was implemented to control a designated wildlife feature, in this case a bird population which is clearly in decline, in order to protect heath which does not qualify as a feature. This is even more difficult when the heath is failing as a consequence of other insurmountable factors and is, in any case, a very poor example of this community. Nature conservation is not about protecting everything everywhere, and it is not only about protecting species (plant or animal) that we happen to find attractive.

4. FEATURES - EVALUATION

A feature is any aspect of the site which can be described as a distinct entity. Nature conservation features can be a habitat, a community or a population. Other features of interest can include geological, geomorphological, archaeological and historical features. An **entire site**, regardless of size, can be treated as a single feature.

In this section of the plan the **features** which will provide the focus for the remainder of plan are identified. In most plans the discussion in this section would consider all the potential features on a site, however this plan has an unconventional structure, it was divided at an early stage into a number of different sections including this stand-alone section on the Island's vegetation.

Evaluation – potential features

The section on vegetation in the earlier Skomer management plans focussed on three distinct features, the maritime cliff and crevice community, the sea cliff grasslands and the maritime and wet heath communities. The remaining vegetation was more or less ignored. The validity of these divisions must be questioned.

Maritime cliff and crevice community; The cliff and crevice communities exist in the absence of any human intervention, so there is nothing that we need to do and nothing that we can do. Its composition, structure and distribution are the consequences of natural processes and the influence of natural factors.

Sea cliff (Coastal) grasslands; For the past 20 years, as a consequence of their legal status the sea cliff grasslands were recognised collectively as an independent feature. The objective and associated performance indicators were influenced by JNCC generic guidance.

Each year the feature was monitored and the results included in the annual report. In addition to the extent of the grassland, which was identified as an attribute, but never recorded, four attributes were used as the basis for monitoring:

- *The percentage of the sward below 'ankle height'*
- *The presence of thrift, red fescue, sea campion and squill*
- *An upper limit of 33% for Yorkshire fog*
- *An upper limit of 25% for bracken and scrub*

The JNCC Common Standards guidance for the selection of performance indicators for this community states: *'For grazed grassland the sward height should ideally be kept to less than 10cm, especially at sites important for chough'* (JNCC 2004). The Skomer interpretation - 'ankle height'- is a good approximation of this. However, the application of generic guidance which does not take account of local conditions has little value or meaning. On the mainland it is sometimes possible to manipulate the grazing levels to deliver the required sward height, and this is one of the reasons why setting a limit is recommended. On Skomer the height of the sward cannot be managed; it will vary according to the size of the rabbit population and, to a lesser extent, rainfall. When the rabbit population crashes the sward height can increase very dramatically and certainly exceed ankle height. If this happens, should we assume that the feature is unfavourable? Or should we regard these very occasional interludes as extremely favourable periods when the vegetation can, even if

only to a limited extent, recover or rejuvenate? The species composition of these dynamic communities on Skomer is unpredictable, extremely variable, and completely unmanageable. Therefore, specifying a number of desirable species that should be present, or applying an upper limit for cover by less desirable species, makes little if any sense. Squill, *Scilla verna*, in particular should not have been included. On the mainland, squill is an important component of this community, but on Skomer it has a very restricted distribution. It is vital that we recognise that the communities on mainland cliffs, which influenced the development of the JNCC standards, do not exist in the same form on Skomer.

Some of the sea cliff communities were not included as features in the earlier management plans. JNCC Common Standards contain a pertinent statement: *'There is no reference to sea bird cliff communities (MC6 & MC7), since apart from occasional stands of Lavatera arborea, they are of limited botanical interest. They are also very unstable and ephemeral, often with a cyclical nature depending on the degree seabird activity.'* MC6 is the highly fertilised version of MC1 and possibly MC8. It is dismissed by JNCC because of *'limited botanical interest'*. This is very difficult to understand. How can a community that is the consequence of the impact of an entirely natural factor be less interesting than the same community in the absence of that factor? In the past, Skomer was described by a notable maritime vegetation expert as a 'bird slum', simply because it did not match his expectation - his bench-mark - which was derived from mainland experience. Rodwell (2008) took a different view in this extract from his report on the island vegetation:
'The poor fit to the NVC of some of the vegetation types described from the islands may be partly related to differences in survey methodology but it is also a reflection of their isolation and the particular factors at play there. Compared with neighbouring stretches of mainland coast, to be seen, for example, on St David's Head, certain vegetation types look more species-poor, sometimes lacking plants that are constant in or characteristic of the published definitions. Such particularities ought to be a cause for celebrating local distinctiveness, rather than a source of disappointment, either with the plant communities of the island themselves (that they are not 'good examples') or with the adequacy of the NVC (that it 'doesn't work' on the islands).'

Even if we decided to treat the sea cliff communities as independent features, we would not have the ability to manage them in order to obtain the condition as defined by JNCC common standards.

Maritime and Wet Heath; In 1969, 8% (23.6 ha) of Skomer was covered in heath, but by 2008 this had fallen to 1% (3.1 ha). Heath will inevitably continue to decline unless the negative factors can be brought under control. For over 15 years, the heath inside and outside the exclosures has been monitored using a methodology developed for the extensive areas of upland and lowland heath in Britain. This method focused on a perceived need to need to record the different growth phases of heather. As heather grows larger and becomes woodier and its growth rate and form changes. The changes are described according to four developmental phases: pioneer, building, mature and degenerate. The younger growth phases are much more palatable to domestic animals and grouse than the leggy, tough, degenerate growth.

'There was an encouraging increase in pioneer heather in 2009 which has not been repeated in 2010. Bracken was removed from this exclosure several times this season. The Bull Hole East exclosure clearly shows a massive increase in mature heather and a decrease in building. This might be a sampling error – either the randomness of quadrats or more likely due to the subjective nature of classifying between building and mature heather types which gets harder towards the end of the building phase.' (Skomer annual report 2009)

This is an extremely laborious and tedious procedure which, on Skomer, delivered ambiguous results. We must question the validity of taking a methodology that was designed to monitor vast grouse moors and applying it on Skomer. All that we really needed to know was that the heather cover was stable, increasing or decreasing. A simple sketch map or photograph would have been adequate.

Although heath can easily be described as a distinct feature there is not sufficient justification to include it as an individual feature for management purposes.

All the other potential vegetation features were included in the preceding description, none are important enough to be recognised as individual features.

CONCLUSION

Perhaps at this point it is worth recapping on why the vegetation is changing. For hundreds, probably thousands, of years people have been the major factor in the development of the vegetation on Skomer. The cessation of quite intensive agriculture at the end of the First World War was possibly one of the more abrupt changes in land use. Although there were some agricultural activities after that time, its impact did little more than delay the inevitable process of change. When descriptions of Skomer from earlier times are compared with contemporary descriptions of similar habitat on the mainland it is obvious that, although there are differences, the overall impression would have been similar. Since the 1940s change has been rapid, and today the island is very different even to the Deer Park above Martin's Haven, on the closest mainland cliffs.

Change is an inevitable consequence of agricultural abandonment. In some places the direction of change is reasonably predictable, but on Skomer there are factors that obscure our ability to see the potential futures. The impact of the rabbit population is considerable, and, for a variety of reasons, the population is unstable and given to extreme fluctuations. The consequence is that, in addition to the gradual progression away from vegetation, which was mainly the incidental product of anthropogenic factors, there are also intermediate variations. It would be inaccurate to describe these as cycles, though they can give that impression. These very short-term changes are most easily recognised in the vegetation of the exposed south western coasts: the zone between the extremely exposed rocky sea-cliff vegetation and the more sheltered inland area.

If the factors which influence a feature cannot be controlled, and this is not uncommon, then we cannot manage the feature. This implies that there is little or no point, in specifying a desired stable state for the feature. On Skomer, the vegetation varies or develops as a consequence of a number of different and uncontrollable factors. Most, we can argue, are entirely natural, for example, enrichment from bird droppings, storms and other extreme weather conditions. Rabbit grazing is by far the most important factor. Earlier the case that rabbits on Skomer are best regarded as 'naturalised' was presented. If we accept rabbits as the 'new natural', then their impact on the vegetation must also be regarded as acceptable. This means that whatever the condition of the community, providing there are no additional anthropogenic factors, it should be considered as being favourable.

Our conclusion, in broad terms, is that we should allow all the vegetation on Skomer to develop as mosaic of communities unhindered by any further human intervention. This means we can have a single objective for all the vegetation on Skomer. We also recognise that management intervention will be minimal and only justified when other important features are threatened.

5. MANAGEMENT OPTION

There is little or no choice when preparing objectives for the important seabird populations: they are features of the SPA or SSSI, and there is a legal obligation to protect them. This means that there is an obligation to define what is required of these populations, and our objectives are expressed in terms of minimum population size, survival rates, productivity, etc. This approach is usually referred to as 'management by defining outcomes'. There is no need to adopt this approach when considering the vegetation on Skomer. There are only two SSSI features: the cliff and crevice vegetation and the coastal grasslands. The status of both communities as features is rather dubious, and at some time it should be reviewed. WTSWW is **not obliged** to monitor these features. The remaining plant communities do not have legal recognition, and this provides some freedom when making decisions.

For more than 50 years the vegetation has been described, 'monitored' or recorded, but at no time have any significant decisions been made about its future. Management interventions have been sporadic but not sustained, and, with few rare exceptions, there has been an absence of any detailed rationale to support any management operations. Managers adopted, quite understandably, a very cautious approach, reluctant to make decisions in the absence of sound evidence. This indecision has had some very serious implications for the vegetation and for our ability to make future decisions. The worst, or perhaps best, example of indecision concerned the removal of grazing by domestic stock.

Past conservation management on Skomer has sought, in places, to maintain something which is representative of a time when agriculture was in decline. By this we mean the poor grassland which developed originally as the consequence of abandoning once arable land and the relict heath, another product of less intensive agriculture. This, of course, raises the obvious question: why did past managers believe that an approximation of something that happened between 1890 and 1960 was so important?

The past is relevant, and it is often claimed that one of the keys to understanding the present, and potential future, vegetation lies in the past, but what does this really mean? Certainly, understanding the history of habitat development - their past composition and structure, their spatial and temporal variability, and the principal factors, or processes, that influenced them - might help us to identify potential futures. The big questions, if we want to replicate the past, are, how far back can, or should, we go, and was there a specific time in the past that we want for tomorrow? George Peterken helps with his definition of ‘original naturalness’: this was the state that existed before man became a significant ecological factor. The important word is ‘significant’, although, unfortunately, George Peterken does not provide a definition for this. Was there a time on Skomer, perhaps in the early Holocene, which could be regarded as ‘original natural’?

George Peterken also suggests a different naturalness: ‘present naturalness’ - the state that would prevail now if man had not become a significant ecological factor. Even if people had been absent from Britain over the past 7,000 years the habitats would have changed; they would have evolved; they would have responded to fluctuating natural influences. We can never know for certain, or in sufficient detail, what ‘present natural’ might be. Consequently, the concept does not provide a useful target for future conservation management, but it certainly undermines the validity of a reference point, taken from some arbitrary period in the past, as a useful definition of something that we might want for the future.

CONCLUSION:

- Nature conservation on Skomer will be concerned with what we require of the future, and not about recreating or fossilising the past.

- We will set aside the approach to nature conservation that is almost entirely based on achieving defined or specified outcomes.

- On Skomer we will rely, as far as possible on natural processes to dictate the future vegetation. The only conditions are that we will ensure that opportunities for all wildlife on the island are optimal, and that we can ensure that the status of the seabird populations is not compromised.

- We will recognise that the outcomes will not always be predictable, at least in terms of the detail, and we will have to be content with whatever nature delivers.

- We will not be disappointed when the vegetation does not match something that happens somewhere else on mainland cliffs, or that happened at some earlier time on Skomer. We will recognise that the vegetation on Skomer, particularly on the very exposed coasts, offers something unique and very special.

The management option adopted for the Skomer vegetation is **minimal intervention**, we will only intervene when necessary, and then only applying the lightest of hands.

6. Objective for vegetation on Skomer

An objective is, quite simply, an expression of something that we want to achieve: our aspiration. It is, and can only be, a reflection of our values, knowledge, and expertise at the time of writing.

Objectives contain two basic components: a **vision** which describes in plain language the outcome or condition that we require for a feature, and **performance indicators** which are monitored to provide the evidence that will be used to determine whether the condition that we require is being met.

Vision:

Our vision for the vegetation on Skomer is:

To enable the natural development of all the plant communities on Skomer, in so far as any change is compatible with maintaining the breeding seabird populations and other legally protected features, wildlife or archaeological, on the island.

Performance indicators

For a habitat feature to be considered to be at **Favourable Conservation Status**, ALL of the following must be true:

- The area of the habitat must be stable in the long term, or increasing.
- Its quality (including ecological structure and function) must be maintained.
- Any typical species must also be at FCS, as defined below.
- The factors that affect the habitat, including its typical species, must be under control.

The conventional approach is to identify performance indicators for each of the conditions given in the definition of Favourable Conservation Status. For example the size and distribution of the various plant communities would be defined. On Skomer, given our decision to enable natural processes, the size, distribution, and quality of the communities will be determined by these processes, and we will accept whatever nature delivers. The only exceptions may arise from our obligation to protect the seabird populations and so there may be a need to place limits and identify monitoring projects for vegetation changes which could threaten the seabirds.

The approach applied to objectives which define a required outcome is clearly inappropriate and consequently, in the absence of defined outcomes, there is **no need** to identify individual attributes with associated monitoring projects. We cannot, and should not, set meaningless targets for any particular species or any manifestation of the community.

Surveillance.

It is essential that anyone reading this plan has a clear understand of the definition of monitoring and surveillance used in the document:

> Monitoring, surveillance undertaken to ensure that formulated standards (objectives) are being maintained. The 'formulated standards' are the 'objectives with performance indicators', and these are a product of the planning process.
>
> Surveillance, making repeated standardised surveys in order that change can be detected. This is quite different to, but often confused with, monitoring. Surveillance lacks the 'formulated standards' that are so important in monitoring. Surveillance is used to detect change but does not differentiate between acceptable and unacceptable change. Surveillance is often used when monitoring is not possible because the 'formulated standard' or specified limits for the attributes and factors are unknown.

In the absence of monitoring, surveillance is essential. As the vegetation changes, it must be observed and recorded. Hopefully, this will help future managers to gain an understanding of its development and its ecology. There can be no certainty about what the future may hold, particularly at a time when our ability to predict future change is obscured by the clouds of climate change.

High resolution aerial photography

Commission low-level, high-resolution aerial photography. This project became active in 2017. The two flights provide a baseline photo description of the vegetation. In the future this project should be repeated at c 10-year intervals. The interval between sampling must be reviewed if there are concerns about the speed or direction of change.

There should be two flights: the first, in June, can be used to map some of the obvious spring flowering communities, and a second, in October, to map bracken and its various developmental phases. This will also reveal the areas of purple moor grass. The aerial photographs will be used to produce the following digitised maps showing the distribution of: bracken, bluebells, red campion, thrift and sea campion.

Fixed point photography surveillance.

Develop fixed point photography, having regard for all past photo recording projects.

Permanent vegetation quadrats.

90 fixed and permanently marked quadrats were established by Bray in 1979, and 65 of these were relocated by Wilberforce in 1997. They provide an excellent basis for developing a detailed vegetation surveillance project. The original locations were based on randomly selected locations within defined areas of vegetation. This method was entirely appropriate for the initial and repeat survey, but it requires modification for future use. The purpose of a revised surveillance programme will be to record the development of the vegetation. Therefore, it would make sense to locate quadrats in the more stable blocks of the main vegetation communities and to supplement these

with quadrats placed in areas that are most likely to change, or where there is potential for conflict with other features. It is also important that, in addition to establishing the distribution of the quadrats, the total number of quadrats is restricted to the minimum that will deliver a statistically robust sample. Thought must also be given to the detail recorded in each quadrat. Simple presence or absence of a species is probably far too crude, the measurement of cover/abundance using the Domin scale would probably be the most appropriate approach. There is also a need to decide which species and factors need to be recorded. If a sub-set of the most significant species is considered sufficient, this would both speed up the recording process and enable the work to be carried out by less expert personnel. Finally, the interval of recording must be established, although this need not be more frequently than every 10 years.

Record significant damage to vegetation.

There have been a number of quite significant incidents when areas of coastal vegetation have been damaged. The worst on record was at Skomer Head in 1975 when the vegetation was killed over an area extending from the headland to the ridge of rock north of the enclosure and from the cliff edge inland well beyond the current footpath. The vegetation took almost a decade to recover. The damage at Skomer head was attributed to an extreme gale during 1974 when the area was saturated with salt spray. However, this was by no means an unusual occurrence; Skomer Head is frequently drenched with sea water during the winter gales with no consequential dieback of vegetation. The damage, when it occurs, could be the concurrence of several different factors, these might include; dry conditions prior to the gale which allows the soil to become saturated with salt water, low rainfall after a gale with the consequence that the salt is not flushed away, and, the vegetation in a vulnerable state following prolonged dry or drought conditions. The entire area at Skomer Head was riddled with Shearwater burrows; this could have increased the impact of all of the other factors.

In 2016 there was a major die off of vegetation at North Haven and the Neck. The 2016 incident was quite different to the Skomer head experience when all the vegetation was killed, in 2016 an excellent sequence of photographs, taken by the Warden, reveals that the die back was almost entirely restricted to Holcus lanatus, the maritime species, Silene and Armeria survived as did the deep rooted species, including Urtica dioica and Sonchus spp. Bracken was also unaffected. Following the winter 2016/17 the Holcus appears to have recovered. The slopes in North Haven were often bare during the latter half of the 1970s following the extreme drought years of 1975 and 76. Rainfall on Skomer was more or less average during 2016 with no obvious unusual or exceptional events. It is unlikely that the dieback could be attributed to drought. Rabbits are always a variable influence, in general they apparently avoid Holcus, it is not particularly palatable, however, on Skomer when there is nothing else available, they will graze it. The species that survived are all unpalatable and avoided by rabbits. There is no obvious single factor that can be associated with the dieback. There is concern that the loss of vegetation can lead to the collapse of burrows and wind erosion of the soil, this is a particular problem when research sites are affected and the area becomes extremely fragile.

It is possible that in the future a serious coincidence of factors could have a much more significant impact on the vegetation and in particular this could threaten the burrowing birds. It is important that all incidents are recorded. The standard for recording was established by the wardens in 2016 and this should be repeated whenever there is future cause for concern. There is no obvious management action, but the reserve wardens should closely supervise any research activities in damaged areas to ensure that there is no unnecessary risk of damage to the burrows. In the event

of a serious incident in the future, if recovery is slow, the managers should consider temporary rabbit exclusion.

The key factors that influence the vegetation must also be recorded. The obvious factors are rabbits, soil fertility and weather. The less obvious focus for recording stems from the decision to apply a condition to the vegetation objective: changes to the vegetation will only be tolerated if they are conducive to maintaining the qualifying seabird populations and other important features. This imposes a requirement to monitor the impact of vegetation change on the seabirds and the other features that could be affected. Obviously, most of this information will be generated incidentally by monitoring the other features. But there is one instance where the need for some additional monitoring is obvious: this is the potential encroachment of bracken, or other tall vegetation, into the Puffin colonies. Consideration should also be given to the potential impact of vegetation change on the shearwater population. This would need to be a long-term study and would probably require the development of a project to map, or otherwise sample, changes in the distribution and density of the shearwater burrows. The impact on the island's archaeological heritage will also need careful consideration.

New potentially invasive or threatening species.

Island managers must always maintain a high level of vigilance sufficient to recognise and respond to the appearance of any new species to the island. If a new species is discovered, its origin should be considered, it might, for example, be a previously overlooked species. If there is any concern that a newly discovered species could pose a threat, irrespective of how minor a threat, the discovery must be reported to the Trust and the Islands advisory committee.

Rabbit surveillance.

Continue with the existing project.

Soil fertility surveillance.

Develop a simple, cost-effective methodology.

Weather recording.

A fully automated weather station is situated on Wooltack Point, there is little purpose in making additional recordings on the island.

Monitor bracken encroachment into Puffin colonies.

Bracken should be mapped along the edges of the colonies that are likely to be invaded. Acceptable boundaries should be defined and subsequently monitored. If the Puffin population continues to increase, these boundaries must be reviewed.

Bramble

Manx Shearwaters can become trapped in the bramble, and occasionally dead birds are found entangled in bramble, however the scale of the impact has not been assessed. There is also a possibility that Shearwaters will not be able to burrow in areas of dense bracken, this requires further investigation. There is insufficient evidence to support bramble control at this time, a surveillance project will be established to record any changes in the extent and distribution of bramble.

Ragwort

Map the distribution of Ragwort during 'ragwort years' and maintain annual records of status.

Rare plant surveillance.

The known locations of the recognised rare species should be visited and the status at each location recorded. Records will include the number and distribution of individual plans and a note on any known change, i.e. increasing decreasing or stable.

7. MANAGEMENT RATIONALE

Management to achieve an objective is always about taking control, and specifically taking control of the factors. A factor, in this context, is anything that has the potential to influence or change a feature, or to influence the way in which a feature is managed. Factors can have both a negative and positive impact. Control means the removal, maintenance, adjustment, or application of factors, either directly or indirectly.

The management option adopted for the vegetation on Skomer is minimal intervention. This implies that the only justification for management interventions would be an actual or perceived threat to the important populations of breeding seabirds or other legally protected features, wildlife or archaeological, on the island. The precautionary principle should be applied. In simple terms this means that actions could be taken to control the vegetation even when there is no evidence to demonstrate, beyond any doubt, that the threat is real.

It is essential that we recognise the potentially disastrous consequences of inappropriate introductions. There must be no further introductions, unless an extremely robust case can be prepared and approved. The bio-security section of this management plan will provide further details and an account of the control measures. The propagation of species currently growing on the Island, even when these are known to be recent introductions, for example scrub species, remains open for consideration. At very least, careful thought must be given to any activities of this kind, and approval must be granted by The Wildlife Trust of South & West Wales and Natural Resources Wales before any work commences.

THE KEY FACTORS

The most logical approach to identifying the management requirement is to consider the key factors that have, are or may have potential to impact on the vegetation. Nature conservation management is invariably about controlling these factors.

Rabbit management

Apart from the obvious natural factors - edaphic, climatic, etc. - the single most important factor which influences the vegetation on Skomer is grazing by rabbits. There are currently no plans for rabbit control, but the populations trends must be recorded and reassessed each time the management plan is reviewed, or at any time if there are significant changes in the rabbit population, and in particular loss of vegetation and soil erosion. There may be a time in the future when rabbit control is necessary.

Bracken management.

Any decision about the future of bracken on Skomer must begin by considering our ability to effectively manage this species. Experience elsewhere points to Asulam as probably the most efficient means of control, but, for now, Asulam cannot be used on Skomer. ULVA spraying is not permitted and alternative methods of application pose a high and unacceptable risk to other species, particularly the lichens, which are a protected feature on Skomer. The most effective means of control is repeated annual mechanical cutting. With the exception of some areas in the central fields, mechanical cutting can never be an option because of the burrowing shearwaters and Puffins. Hand cutting with scythes or brush-cutters is acceptable and extremely effective in and around the Puffin colonies, and there is no doubt that this should be continued.

The obvious question must be, what has 30 to 40 years of bracken control on Skomer delivered, and what can we expect in the future? There has been limited success in the central fields, but only in the sense that the advance of bracken has been slowed down. The resulting sward is extremely poor, dominated by wood sage and other unpalatable species. There are very occasional periods, following a crash in the rabbit population, when other species have a very brief respite, but there has been an inevitable decline in species diversity. The traditional management that would be required to restore species-rich acid grassland is almost certainly impossible on Skomer, and the wildlife benefits would be insignificant and short-lived. It could be argued that the open fields are an important landscape feature, a reference to Skomer's past. They speak of the cultural heritage, but the messages are quite obscure. This was originally arable land, but there is virtually nothing, apart from the walls, remaining as testament to that era. In any case, the field systems, particularly the walls, will be exposed and visible from the end of September through to June each year, even if they are completely invaded by dense bracken. West Meadow, the field immediately east of the farm buildings, is now one of the best bluebell areas on the island. This was a potato field in 1947, and was in exactly the same condition as both Calves Park and Shearing Hays at that time. Since 1990, bluebells have begun to follow the invading bracken in Calves Park, providing further evidence to suggest that, if bracken were allowed to invade, there is a very good chance this could become another bluebell field.

With the exception of clearing bracken from Puffin colonies, if further research can substantiate the need, there is little, if any, justification for bracken control for nature conservation elsewhere on Skomer. There are four minor exceptions:

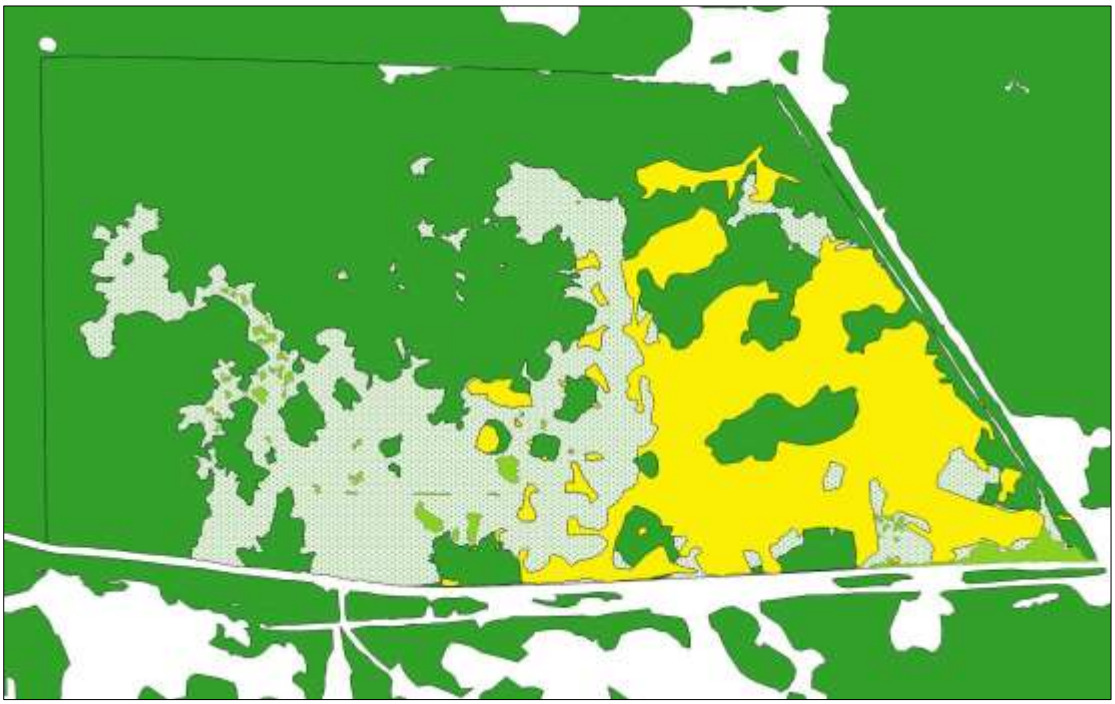
- Bracken management around the Puffin colonies. This will be in response to the monitoring project.

- Bracken control to protect the vegetation on the lime mortar walls around the farm and the limekiln.

- Bracken control to protect or reveal heritage features, a qualified archaeologist should be consulted before a project commences. Routine maintenance, for example keeping footpaths open, is exempted.

- Bracken control to maintain footpaths.

Mike Alexander Mowing Calves Park in 1980 – a uniform species poor sward with very little bracken.



Calves Park - The vegetation was mapped in 2017, and shows that, 37 years after it was last mowed, barely any grassland survives (pale green on the map). Bracken has invaded most of the field (shown in dark green), and most of the remainder is a dense cover of wood sage (spotted green). The yellow is an ephemeral ragwort invasion, which occupies areas which would otherwise be covered mainly in wood sage or bracken. The uncoloured areas are tracks, walls and bare ground. The overwhelming dominance of unpalatable species - bracken, wood sage and ragwort - is almost entirely the consequence of rabbit grazing.

Heath management.

Heath will be regarded as something that once had a place on Skomer. We will recognise that the factors that influence the community can no longer be controlled and understand that there is a high probability that, regardless of any intervention, heath will eventually be lost. There is no justification for new management exclosures. Two of the existing heath exclosures, the small exclosure alongside the footpath between the farm and the Garland Stone, and the large inland exclosure south of the farm, will be maintained. They make little contribution to heath management but can fulfil a research and educational role. All the other exclosures should be dismantled once they cease to be rabbit-proof. There is also some evidence that heath may recover, unenclosed, in a few areas.

Bramble management.

There is insufficient evidence to support bramble control at this time, if the surveillance project identifies any significant changes in the extent and distribution of bramble management intervention will be considered. Bramble which is threatening or obscuring the farm buildings or the lime kilns will be removed.

The control of invasive or threatening species.

The only known invasive and threatening species on Skomer is Rosebay willowherb. This has recently appeared on Skomer (2016). There are no early records, but given the size of the patches it is more than likely that it has been missed for a year or two. Control measures were introduced in 2018 and these must be given the highest priority until the species is eradicated.

Tree mallow *Lavateria arborea* has been identified by Mike Harris as one of the main factors which lead to the decrease in the Puffin population on Craigleith. At the moment tree mallow has a very restricted distribution on Skomer, it is mainly confined to the largest offshore rocks. However, it has the potential to invade and become a threat to the puffins, consequently any appearance of tree mallow on the main part of the island must be recorded and kept under close observation. Control may be considered necessary.

8. PROJECT DESCRIPTIONS

RF00/01 Commission low-level, high-resolution aerial photography.

1. FEATURE: *Vegetation*

2. ATTRIBUTE or FACTOR: Vegetation

3. DATE: 2021/2026 this project is not active during this planning period.

4. PROJECT PRIORITY: 1

5. PROJECT SUPERVISOR: WTSWW Head of Islands and Marine, and Island Warden

6. INDIVIDUAL/S RESPONSIBLE FOR CARRYING OUT THE PROJECT: Contractor

7. GENERAL BACKGROUND/BIBLIOGRAPHY: There have been many high level commercial aerial photographs of the island, these have been taken by many different organisations for a variety of purposes. Most provide a useful record of the main patterns in the vegetation, but none reveal any detail. The 2014 management plan identified the need for establishing a new approach to vegetation surveillance including low level, high resolution photography.

Two flights were completed in 2017.

References

Alexander M. Bellamy D. (2017) Aerial photography on Skomer - high resolution low level aerial photography May and September 2017. Unpublished report to WTSWW.

8. METHODOLOGY

8.1 Location of the sample: The entire island and offshore rocks.

8.2 Sampling technique and equipment:

Use a low-level drone equipped with a high-resolution camera.

- fly an area of up to 4 square km (including buffer areas necessary to account for irregular habitat areas totalling 3 square km).

- provide an Image resolution to be better than 4.5 cm per pixel.

- orthorectify and 'stitched' together (orthomosaiced) the individual images to provide wide area, high quality, and high-resolution images.

8.3 Unit of measurement: N/A

8.4 Sampling period and frequency of sampling: Organise two flights one to coincide with the spring flowering period (9 & 10 May 2017) the second to coincide with peak bracken growth. (1 & 2 September)

8.5 Repeat interval: Once every 10 years

8.6 Special considerations: Flight must be supervised by a member of WTSWW staff

9. DATA MANAGEMENT (Format, location, security and any analytical technique): The final image files will be stored by the Wildlife Trust South and West Wales. The donor agreed that there will be no copyright limitations on the data which can be made available for any legitimate use in connection with the work of the WTSWW**. Copyright will be held by WTSWW.**

The copyright of all processed data captured from the original images, for example, the digitised maps, will also be held by WTSWW.

Data - analytical technique:
Compare with previous photographs. Record any significant changes, in particular species losses or gains.

The digital image will be used to provide various vegetation maps:

RF20/01 Map the distribution of Bracken/ Bluebells / Ragwort / Thrift / Sea campion / Heath.

10. REPORTING/CIRCULATION OF REPORTS:

Appendix: Mapping using drones

Note: The following is the description of the 2017 drone survey, this is a rapidly developing field and there can be no doubt that by the time of the next survey methods will have evolved.

Drones are now widely used to provide cost-effective capture of aerial photography and video. The majority of drones are multi-rotor which are good for video, oblique and small area surveys. There are also fixed wing drones that are designed for larger area mapping, generally using vertical photography. The photography from these units can be used to create seamless 'map-accurate' ortho-rectified aerial photo mosaics and surface terrain models, registered to the Ordnance Survey National Grid.

The creation of these map products requires the use of specialist photogrammetric software that calculates the terrain height based on the position of ground features in overlapping photos. The terrain height is then used to convert the photography from hundreds or thousands of individual photographs into a single seamless photo-mosaic in which all photo distortions have been removed,

resulting in a standard scale image that is 'map accurate' and registered to the Ordnance Survey National Grid coordinate system.

The Skomer survey was carried out using a fixed wing Sensefly Swinglet CAM drone carrying a Canon ELPH 110 HS 16MP camera.

Pre-site visit flight planning: Prior to the site visit the survey is planned using Sensefly eMotion flight planning software. The flight plan must be setup to ensure that the flight is flown within the current Civil Aviation Authority (CAA) guidelines, i.e. below 400ft above the terrain and within 500m of the operator. The flight time is also limited by the maximum flight time of the drone.

Site visit flight planning: A sunny day with low winds was chosen for the survey. Good light levels allow a fast camera shutter speed, thus reducing any movement blur and low wind speeds ensure that the camera platform is as stable as possible, again minimising image blur.

Onsite survey: On visiting the site the wind speed and direction was checked and a risk assessment carried out. The flight plan was then adjusted as necessary. The flights were flown to take advantage of the location of the sun during the day so that slopes and cliff faces were not in shade. As a result Skomer was flown in 10 flights working clockwise around the island with the drone being visually monitored during the process.

As the drone flies the planned grid, vertical photographs are automatically taken at predefined locations. At the moment that each photograph is taken the drone also records the GPS position, photo name and time. This is used to tag the photos ready for processing.

For higher spatial accuracy ground control is often established prior to the flight. Ground control can be in the form of readily identifiable natural features on the ground or targets placed just for the survey. All these control points are surveyed using centimetre accuracy GPS to provide the coordinates of points visible in the photography. For the Skomer survey, the absolute accuracy of the orthomosaic and DSM were not so important, so no additional control was used.

On completion of the survey the data was visually checked on a laptop whilst still on site to ensure that there was complete coverage.

Processing: Back in the office the Sensefly eMotion software was used to process the location data to refine the accuracy of the GPS positions, then this data was added to the existing camera parameter meta-data that is stored within each photo file. The photos were then loaded into Pix4D professional photogrammetry software where the meta-data is read, enabling the locations of the images to be plotted on a map of the area and used in the next, aerial triangulation, stage of the processing.

The Pix4D photogrammetric software then computes more accurate positions and orientations for the camera at the moment that each of the photos was taken using aerial triangulation and then uses pattern matching between overlapping photos and calculation of parallax to determine the ground surface height across the survey area. This data is saved as a digital surface model (DSM) which is then used to ortho-rectify and combine the images into a single orthomosaic. Each of the resulting image is registered to the local coordinate system, in this case the Ordnance Survey National Grid.

The orthomosaic and DSM are saved in a geo tiff format which can be opened by most GIS and 3D modelling and analysis packages. Once a registered orthomosaic is loaded into a Geographic Information System (GIS), it can then be used for mapping any features visible in the photography.

RF00/02 Record Permanent vegetation quadrats.

1. FEATURE: Vegetation

2. ATTRIBUTE or FACTOR: Vegetation

3. DATE: 2021/2026

4. PROJECT PRIORITY: 2

5. PROJECT SUPERVISOR: WTSWW Head of Islands and Marine

6. INDIVIDUAL/S RESPONSIBLE FOR CARRYING OUT THE PROJECT: Warden

7. GENERAL BACKGROUND/BIBLIOGRAPHY: Monitoring is entirely dependent on the accurate repetition of survey or census. A project description must include sufficient information and guidance to enable anyone to carry out the work without further instruction. When projects follow a generic methodology, give a reference to the guide and a location where it is available. Make sure that any variations or adaptations are noted.

90 fixed or permanently marked quadrats were established by Bray in 1979, and 65 of these were relocated by Wilberforce in 1997. They provide an excellent basis for developing a detailed vegetation surveillance project. The original locations were based on randomly selected locations within defined areas of vegetation. This method was entirely appropriate for the initial and repeat survey, but it requires modification for future use. The purpose of a revised surveillance programme will be to record the development of the vegetation. During the period 2017 to 2019 additional quadrats were established in the more stable blocks of the main vegetation communities. It is also important that the total number of quadrats is restricted to the minimum that will deliver a statistically robust sample.

This project is only part complete it has been sadly neglected. It is essential that the initial set of quadrat data are collected as soon as possible.

References

Alexander M. 2014 Skomer Island vegetation

Hodgeson, J. M. 1976, Soil survey field handbook, Soil Survey of England and Wales, Harpenden.

Avery, B.W. 1980 Soil classification for England and Wales Harpenden.

8. METHODOLOGY

8.1 Location of the sample: See location map. Fixed point markers will be maintained at each location. The markers must be checked annually at the beginning of the season when the vegetation cover is low. All markers must be maintained in good condition.

8.2 Sampling technique and equipment: Record the quadrats using a standard approach recording the domin/frequency of each species, or a sub-set of the more significant species. (Refer to JNCC NVC guide) This should remain as an active project.

There would be some advantage in recording soil profiles for each of the sample location. The standard JNCC / NVC methodology recommends that: A small soil pit should be dug and the profile described using the horizon notation of the Soil Survey (Hodgson 1976). The profile should also be allocated to one of the Avery (1980) soil groups.

8.3 Unit of measurement: 1m x 1m

8.4 Sampling period and frequency of sampling: The sampling period is July to mid-August. This is to avoid disturbance to breeding birds. A single sample is taken at each quadrat.

8.5 Repeat interval: every 5 years

8.6 Special considerations: It is essential that care is taken to avoid any damage to seabird burrows.

9. DATA MANAGEMENT (Format, location, security and any analytical technique)

10. REPORTING/CIRCULATION OF REPORTS:

RF00/03 - PHOTOGRAPHIC VEGETATION SURVEILLANCE

This project needs further attention and discussion with the Wardens.

1. FEATURE: Vegetation

2. ATTRIBUTE or FACTOR: Vegetation

3. DATE: 2021/2026

4. PROJECT PRIORITY: 2

5. PROJECT SUPERVISOR: WTSWW Head of Islands and Marine

6. INDIVIDUAL/S RESPONSIBLE FOR CARRYING OUT THE PROJECT: Warden

7. GENERAL BACKGROUND/BIBLIOGRAPHY:
90 fixed or permanently marked quadrats were established by Bray in 1979, and 65 of these were relocated by Wilberforce in 1997. They provide an excellent basis for developing a detailed vegetation surveillance project. The original locations were based on randomly selected locations within defined areas of vegetation. This method was entirely appropriate for the initial and repeat survey, but it requires modification for future use. The purpose of a revised surveillance programme will be to record the development of the vegetation. Additional quadrats were established 2017 to 2019. This need to be checked
Project RF00/02 describes recording the quadrats using a standard NVC approach. The timing of the quadrat species recording will not coincide with the photographic survey. The photographic recording will be used to supplement the detailed quadrat recording.

References
Alexander M. 2014 Skomer Island vegetation

8. METHODOLOGY

8.1 Location of the sample:
See project RF00/02. Existing quadrat locations with additions, position to be confirmed. A number of the original quadrats have been located, probably insufficient. This need a full review before the project commences.

8.2 Sampling technique and equipment:
locate plot using the GPS.
Chose a bright but not necessarily sunny day. The white plastic quadrat marker, provided specifically for this project should be placed on the sample area.
Photograph the marked quadrat from a fixed height, with 35mm lens.
Set the camera to at least f9, and adjust the ISO to ensure that the shutter speed is at least 250.
Take a duplicate set of photographs at each location and check that the photos are good, i.e. covers entire quadrat, is in focus and properly exposed before leaving the location. Check all the photographs on a computer screen at the end of each day and repeat if any are unsatisfactory.
A Sony high resolution camera with a 35mm lens, along with a long pole fitted with an adapted camera attachment were provided for this project in 2018.

Sony Camera
There is a user manual on line
https://www.camerauserguide.net/sony-alpha-a7r-%CE%B17r-ilce-7r-camera-user-manual-instruction-manual-user-guide-pdf/22078
Use on 'auto' mode at all times
Set lens at **35mm** – this is important.
TH BATTERY HAS A SHORT LIFE. Always take a spare and SWITCH OFF THE CAMERA once you have taken the photos.
The camera will save both a 'raw' and jpeg image, please save both.
You can connect the camera to your laptop to download but best to use the card reader.
When on the pole use the Sony remote control. Press the 'shutter button' to take an image (DON'T use the red button)

Taking Photos

Chose a bright day, not heavily overcast and not 'middle of the day' bright sunshine. Light high cloud is best.
Write down the number of the quadrat on a notebook and photograph the page – this should be the first photo in the set for a quadrat.
Use the pole to hold the camera above the quadrat, extend the pole if using 2m x 2m quadrat. Try to avoid a shadow from the pole. Take 2 photos of each quadrat.
Check using the preview screen (arrow button bottom right on back of camera) that the photos are ok and that they cover the entire quadrat. It is important the quadrat fills as much of the photo as possible.
Take several general photos of the area surrounding the quadrat.
The camera will record the date, but keep a note just in case.
Copy the photos as soon as possible to your laptop.
PLEASE TAKE CARE OF THE CAMERA and LENS – replacement cost is £1500 – it is not insured.

8.3 Unit of measurement: Quadrat area 1m sq.

8.4 Sampling period and frequency of sampling: Once from July to mid-August. Please note that project RF00/02 will be carried out during the same time period. It is probably not a good idea to combine both projects, the photo projects are very weather/light dependant, this is not the case when recording quadrats.

8.5 Repeat interval: Once every 5 years. Develop a rolling programme, for example take the photographs over a two years. However, if there is an extreme weather event, for example severe drought, the quadrats should be recorded following the impact of the event.

8.6 Special considerations: Take great care to avoid damage to Shearwater and other burrows. The individuals involved with this project must be given full instructions.

9. DATA MANAGEMENT (Format, location, security and any analytical technique): Once checked for quality the duplicate images must be stored in at least two locations and on the WTSWW data store.

10. REPORTING/CIRCULATION OF REPORTS:

RF00/04 RECORD SIGNIFICANT DAMAGE TO THE VEGETATION

1. FEATURE: Vegetation

2. ATTRIBUTE or FACTOR: Vegetation

3. DATE: 2021/2026

4. PROJECT PRIORITY: 1

5. PROJECT SUPERVISOR: WTSWW Head of Islands and Marine

6. INDIVIDUAL/S RESPONSIBLE FOR CARRYING OUT THE PROJECT: Warden

7. GENERAL BACKGROUND/BIBLIOGRAPHY: There have been a number of quite significant incidents when areas of coastal vegetation have been damaged. The damage, when it occurs, could be the concurrence of several different factors, these might include; dry conditions prior to the gale which allows the soil to become saturated with salt water, low rainfall after a gale with the consequence that the salt is not flushed away, and, the vegetation in a vulnerable state following prolonged dry or drought conditions. The entire area at Skomer Head was riddled with Shearwater burrows; this could have increased the impact of all of the other factors.

8. METHODOLOGY

8.1 Location of the sample: Entire Island

8.2 Sampling technique and equipment:
Camera (high resolution). Give GPS location/s.

Photograph all the affected areas, once the damage becomes apparent, and at intervals of c 6 months following the initial damage. Continue with photography until the vegetation has recovered to a point where it is indistinguishable from neighbouring unaffected vegetation.

Map the affected areas as accurately as possible.

Consider the weather, in particular storms, periods of drought or other exceptional events, during the previous year or so and look for possible cause.

Establish additional permanent quadrats; see above, in any affected area.

Record any damage to seabird burrows.

8.3 Unit of measurement:

8.4 Sampling period and frequency of sampling:

Following any exceptional and significant weather event which has damaged the vegetation.

8.5 Repeat interval:

8.6 Special considerations:

9. DATA MANAGEMENT (Format, location, security and any analytical technique) Photographs, written records, sketch maps and GPS location

10. REPORTING/CIRCULATION OF REPORTS:

RF20/01 MAP THE DISTRIBUTION OF SPECIES

1. FEATURE: Vegetation

2. ATTRIBUTE or FACTOR: Bracken/ Bluebells / Ragwort / Thrift / Sea campion / Heath.

3. DATE: 2021/2026 this project is not active during this planning period.

4. PROJECT PRIORITY: 3

5. PROJECT SUPERVISOR: WTSWW Head of Islands and Marine

6. INDIVIDUAL/S RESPONSIBLE FOR CARRYING OUT THE PROJECT: Volunteer

7. GENERAL BACKGROUND/BIBLIOGRAPHY:

See project RF00/01. This project is linked to the aerial photography project. The various plant species can be easily recognised on the aerial photograph. This is not an essential project because the photograph can be digitised at any time. However, the digitised images are much easier to interpret than the original photograph. There are also significant advantages if the photo is digitised shortly after the flight by someone who has knowledge of the vegetation at that time.

8. METHODOLOGY: Digitise using computer with a large screen.

8.1 Location of the sample:

8.2 Sampling technique and equipment: Computer and GIS app.

8.3 Unit of measurement:

8.4 Sampling period and frequency of sampling: Following aerial survey.

8.5 Repeat interval:

8.6 Special considerations:

9. DATA MANAGEMENT (Format, location, security and any analytical technique)

10. REPORTING/CIRCULATION OF REPORTS:

RF 20/02 NEW POTENTIAL INVASIVE SPECIES

1. FEATURE: Vegetation

2. ATTRIBUTE or FACTOR: Potential invasive species inc. tree mallow. (factor)

3. DATE: 2021/2026

4. PROJECT PRIORITY: 1

5. PROJECT SUPERVISOR: WTSWW Head of Islands and Marine

6. INDIVIDUAL/S RESPONSIBLE FOR CARRYING OUT THE PROJECT: Warden

7. GENERAL BACKGROUND/BIBLIOGRAPHY:

There is always potential for the arrival of Invasive species. 'Non-native invasive' in the Skomer context, means any species which had not been previously recorded on the island and where there is potential for invasion. This is different to the general approach used to identify invasive non-natural species on the mainland. The recent arrival of rosebay willowherb in 2016 is a good example of what can happen. See project MS01/01 for details.

Tree mallow is a potential threat to the Puffin colonies. At the moment it is confined to the larger offshore rocks. If it appears on the main island in any of the bird colonies it must be recorded and reported to ICAC. A decision will then be made about control.

8. METHODOLOGY:

Maintain a sufficiently high level of awareness to detect any new species. Whenever a species which has not been previously recorded is identified, consider the possibility that it had been missed in the past, but always seek professional specialist advice. If a species is known to be a recent arrival, consider its potential for invasion and the need for control, again seek professional specialist advice.

8.1 Location of the sample: entire island

8.2 Sampling technique and equipment:

8.3 Unit of measurement:

8.4 Sampling period and frequency of sampling: Always maintain an awareness.

8.5 Repeat interval: On going

8.6 Special considerations:

9. DATA MANAGEMENT (Format, location, security and any analytical technique)

10. REPORTING/CIRCULATION OF REPORTS:

Report any events to the WTSWW Head of Islands and Marine

RF 20/03 SURVEILLANCE – RARE HIGHER PLANTS AND FERNS (SSSI)

1. FEATURE: Rare higher plans and ferns – the SSSI assemblage, Rock Sea-lavender, *Limonium bineryosum,* Three-lobed crowfoot *Ranunculus tripartitus,* lanceolate spleenwort, *Asplenium obovatum*, and Portland spurge *Euphorbia portlandica.*

2. ATTRIBUTE or FACTOR: Presence of the species

3. DATE: 2021/2026

4. PROJECT PRIORITY: 1

5. PROJECT SUPERVISOR: WTSWW Head of Islands and Marine

6. INDIVIDUAL/S RESPONSIBLE FOR CARRYING OUT THE PROJECT: Warden / Volunteer

7. GENERAL BACKGROUND/BIBLIOGRAPHY:

Please note that this and project RF 20/04 are provisional and included for discussion and confirmation.

***Ranunculus tripartitus*.** This species is usually a winter annual, flowering in the spring, but on the Pembs. islands it often has more than one generation. A repeat of the baseline population forms of 1985 and 1998 - see attached copies- every decade or so would be ideal supplemented by an annual check in spring or early summer when it is in flower to record its continued presence backed up by digital images of the plant and its habitats.

As a small, isolated population dependent on a high-water table and open muddy areas created by disturbance this plant is potentially vulnerable to chance untoward events such as the arrival of the highly invasive *Crassula helmsii.* Despite its need for an elevated water table it may be able to survive prolonged summer droughts resulting from climate change as it is a winter annual and provided the spring water continues to flow in the winter period. Fortunately its seeds seem to last several years so it can reappear after appropriate disturbance. It has been studied in much detail in Pembrokeshire and its life cycle and management requirements are well understood.

Asplenium obovatum is very easy to re-survey. The main population of this perennial fern by the dumper/tractor track just above the gathering place at North Haven has been examined and photographed on a huge number of occasions and is remarkably stable. All that is needed is to measure the extent of the population which is more or less continuous on the low vegetated rocky cut into the bank on the upslope side of the track. It extended along about 14 yards in 1974, 14.7m in 2000 and in 2018 it was the same being spread along 14 of SBE's paces at SM7349 0958. It reached 19.3m in 2003 and in some dry years such as 2006 it was about 10m in length with 80% dieback. There are also a few clumps of this fern nearby on rock outcrops. 3 clumps grow above the landing path below the gathering corner at SM73523 09618. In addition in 1997 there were 23 plants in major crevices at the back of a ledge. They were under a south-east facing overhang of the large rock outcrop above the gathering place at about SM7346 0958. These two outliers should also be

counted, perhaps every 5 years or so, as they may well be vulnerable to the impact of increased drought from climate change.

Euphorbia portlandica Portland Spurge/llaethlys Portland. This biennial or short lived perennial species is not in any Red List nor is it rare or scarce in Pembrokeshire. It was present in North Haven(2010 at SM7347 0945) and on the Neck at South Castle (1998 at SM7352 0889) and west of Roberts Wick (2005 at SM739089). It was first recorded on Skomer in 1925. All that is required would be confirmation that it is still present at these locations every 2 years with supporting images of the plants and their habitats against GPS readings. Hotter drier summers should suit the plant.

Limonium procerum* ssp *procerum Rock Sea-lavender/Lafant-y-mor Penfro *Limonium binervosum* agg was first reported from Skomer in 1946 from South Castle on The Neck where a small colony is still present at SM735 089. It is extremely abundant in places on the cliffs of south Pembrokeshire and with a few scattered colonies on cliffs in the north. There is a major colony at Renney Slip, by the Deer Park, Marloes so it is possible this was the seed source of the Skomer colony. The taxonomy of the Rock Sea-lavenders has proved problematic and Pembrokeshire has more of the different 'species' than almost anywhere else in GB as a result of the hugely varied rocky coastline and extreme exposure. Although Skomer's colony is undoubtedly of interest: it is not on Skokholm or Ramsey but is abundant on Caldey: it appears to be stable. This perennial plant is very well adapted to a hotter unstable climate with extreme storms as shown by the huge populations on the limestone clitter of Linney head at Castlemartin. Accordingly 5-year visits to count the number of flowering clumps and record the extent of the sub-colonies is all that is required along with digital images of the plants and their habitat with GPS readings. The only population form dates back to 1974 but there were counts in 1998 that suggest the colony has prospered.

8. METHODOLOGY:

This needs to be developed, the approach will be minimal. Known locations for these species will be visited at intervals. The number of individual plans and their location will be recorded and if possible, they will be photographed. Earlier detailed location maps are available, these will be retained to provide a record of the species. New maps will be produced following each visit or 'no change' recorded. There is also an obvious need, whenever the opportunity arises to look for new locations.

8.1 Location of the sample: See maps (There is no point in creating a new map until the next survey has been completed. Maps provide by SBE are available for the next survey.)

8.2 Sampling technique and equipment:

Photography, map, and written report.

8.3 Unit of measurement:

8.4 Sampling period and frequency of sampling: Ideally to coincide with flowering period. *Asplenium obovatum* late spring.

8.5 Repeat interval: To be established.

8.6 Special considerations: The recorder must be aware of potential damage to seabird burrows. If the recorder is a volunteer they will be required to read and comply with the appropriate island risk assessments.

9. DATA MANAGEMENT (Format, location, security and any analytical technique)

10. REPORTING/CIRCULATION OF REPORTS:

Report any events to the WTSWW Head of Islands and Marine

RF 20/04 SURVEILLANCE – RARE HIGHER PLANTS AND FERNS NOT-SSSI FEATURES

1. FEATURE: Rare higher plans and ferns

2. ATTRIBUTE or FACTOR: Presence

3. DATE: 2021/2026

4. PROJECT PRIORITY: 2

5. PROJECT SUPERVISOR: WTSWW Head of Islands and Marine

6. INDIVIDUAL/S RESPONSIBLE FOR CARRYING OUT THE PROJECT: Warden / Volunteer

7. GENERAL BACKGROUND/BIBLIOGRAPHY:

Lysimachia minima. As the name suggests this is a very small summer annual of early successional or ephemeral nutrient poor, damp habitats. It would benefit from more observations and counts especially in the old tractor/cart ruts east of west pond and in compartment 5 to the east. Because it is so small counting would inevitably be difficult. An approximate idea of numbers and extent would probably suffice but may well need to be undertaken over two or more consecutive years to obtain a useful baseline as numbers and extent are likely to fluctuate from season to season. *Radiola linoides* would be expected to be an associate so counts and extent of the population of this second summer annual could be undertaken at the same time. Occasional GPS'd close-up and habitat images would be useful after a baseline has been established.

Seeds can persist in the soil if conditions in above ground vegetation become unsuitable but the length of viability of the seed in the ground is unknown. The main threats to the islands extant populations would be loss of grazing by rabbits and reduced trampling and burrowing by rabbits (and by birds) that lead to closed swards and less small-scale disturbance. Human trampling on the margins of island paths along with rutting by the dumper truck can also be beneficial and hotter drier summers as a result of climate change could be beneficial.

Radiola linoides As for *Lysimachia minima* above.

Glebionis segetum This annual species is very much a casual on the offshore islands. It could turn up again from buried seed alongside burrows or be brought over by birds from the mainland where there are huge populations on the Marloes peninsula. No surveillance other than reporting any such occurrences is needed.

Jasione montana This widespread rocky coast and scattered inland biennial species in Pembs. requires no specific survey work other than to slowly compile a map by taking GPS readings of its locations on the island. Hotter drier summers should suit the plant.

8. METHODOLOGY:

This needs to be developed, the approach will be minimal. Known locations for these species will be visited at intervals. The number of individual plans and their location will be recorded and if

possible, they will be photographed. Earlier detailed location maps are available, these will be retained to provide a record of the species. New maps will be produced following each visit or 'no change' recorded. There is also an obvious need, whenever the opportunity arises to look for new locations.

8.1 Location of the sample:

See maps (There is no point in creating a new map until the next survey has been completed. Maps provide by SBE are available for the next survey.)

8.2 Sampling technique and equipment:

Photography, map, and written report.

8.3 Unit of measurement:

8.4 Sampling period and frequency of sampling:

Ideally to coincide with flowering period.

8.5 Repeat interval:

To be established

8.6 Special considerations:

The recorder must be aware of potential damage to seabird burrows. If the recorder is a volunteer they will be required to read and comply with the appropriate island risk assessments.

9. DATA MANAGEMENT (Format, location, security and any analytical technique)

10. REPORTING/CIRCULATION OF REPORTS:

Report any events to the WTSWW Head of Islands and Marine

RF20/05 Bracken invading Puffin colonies

1. FEATURE: Puffins

2. ATTRIBUTE or FACTOR: Bracken

3. DATE: 2021/2026

4. PROJECT PRIORITY: 1 (Note: this is priority 1 because it could have implications for a SPA feature)

5. PROJECT SUPERVISOR: WTSWW Head of Islands and Marine

6. INDIVIDUAL/S RESPONSIBLE FOR CARRYING OUT THE PROJECT: Warden

7. GENERAL BACKGROUND/BIBLIOGRAPHY:

During the 1970s /80s bracken began invading the Puffin colony on the Neck side of the Isthmus. Simple observations revealed that once Puffins are established in a burrow, they will continue to use the burrow even when bracken invades. However, it was also noted that young prospecting Puffins will not enter dense tall vegetation. This has subsequently been observed elsewhere. As the Puffin population grows this may become a factor which restricts their potential for expansion.

8. METHODOLOGY

Check all known Puffin colonies, paying particular attention to areas where the Puffins are expanding, and note the presence of bracken and any other tall vegetation in these areas. If there are any areas for concern, that is bracken is beginning to encroach, mark the bracken edge with permanent stakes and map and/or photograph the area. Re-visit the areas each year and note any changes. If bracken is already in a Puffin colony, consider the justification for control.

8.1 Location of the sample: All Puffin colonies

8.2 Sampling technique and equipment:

8.3 Unit of measurement:

8.4 Sampling period and frequency of sampling: Continuous from once the bracken becomes obvious in Spring. Visit vulnerable areas in July to coincide with the peak attendance of prospecting non-breeders.

8.5 Repeat interval: as required

8.6 Special considerations:

9. DATA MANAGEMENT (Format, location, security and any analytical technique)

10. REPORTING/CIRCULATION OF REPORTS:

RF20/06 MAP RAGWORT

1. FEATURE: Vegetation

2. ATTRIBUTE or FACTOR: Ragwort

3. DATE: 2021/2026

4. PROJECT PRIORITY: 3

5. PROJECT SUPERVISOR: WTSWW Head of Islands and Marine

6. INDIVIDUAL/S RESPONSIBLE FOR CARRYING OUT THE PROJECT: Warden / Voluntary Warden

7. GENERAL BACKGROUND/BIBLIOGRAPHY:

Ragwort is an ephemeral invader; it has never given any reason for concern and so there is little justification for this project. If resources are available, i.e. a willing and able volunteer, produce a sketch map of distribution.

8. METHODOLOGY: produce a simple sketch map.

8.1 Location of the sample: Entire Island.

8.2 Sampling technique and equipment:

8.3 Unit of measurement:

8.4 Sampling period and frequency of sampling: One a year in July- when the ragwort is in full bloom.

8.5 Repeat interval: annual

8.6 Special considerations:

9. DATA MANAGEMENT (Format, location, security and any analytical technique)

10. REPORTING/CIRCULATION OF REPORTS:

RF20/07 BRAMBLE

1. FEATURE: Manx shearwaters

2. ATTRIBUTE or FACTOR: Bramble (factor)

3. DATE: 2021/2026

4. PROJECT PRIORITY: 2

5. PROJECT SUPERVISOR: WTSWW Head of Islands and Marine

6. INDIVIDUAL/S RESPONSIBLE FOR CARRYING OUT THE PROJECT: Warden or Volunteer

7. GENERAL BACKGROUND/BIBLIOGRAPHY: In 2018 following the aerial survey in 2017 a detailed map showing the distribution of bramble was prepared. This was in response to concerns that Shearwaters were becoming trapped in the bramble and the possibility that bramble would obstruct burrowing shearwaters. There is no sound evidence, anecdotal or otherwise to substantiate these claims. However, there is a possibility that bramble could pose a problem. There is no doubt that bramble has increased over the decades and evidence from the exclosures clearly demonstrates that rabbits keep bramble under control. The 2018 survey provides a baseline for surveillance.

8. METHODOLOGY

8.1 Location of the sample: entire island

8.2 Sampling technique and equipment: Use the aerial photograph to help locate and map al the bramble patches. Unfortunately bramble is not sufficiently distinct on the photograph to enable accurate digitising. The bramble patches are extremely variable both in colour and texture.

The method used during the 2018 survey relied on both the aerial photograph and a detailed site survey. Enlarged sections of the photograph were used as a base map and each patch of bramble, once located on the ground, could be accurately mapped using the photograph as a guide.

8.3 Unit of measurement:

8.4 Sampling period and frequency of sampling:

8.5 Repeat interval: 10 years to coincide with the a

8.6 Special considerations:

9. DATA MANAGEMENT (Format, location, security and any analytical technique)

10. REPORTING/CIRCULATION OF REPORTS:

MS01/01 CONTROL ROSEBAY WILLOWHERB *CHAMERION ANGUSTIFOLIUM*

1. FEATURE: Vegetation

2. DATE: 2020/2026

3. PROJECT PRIORITY: 1

5. PROJECT SUPERVISOR: WTSWW Head of Islands and Marine

6. INDIVIDUAL/S RESPONSIBLE FOR CARRYING OUT THE PROJECT: Warden with volunteer

7. GENERAL BACKGROUND/BIBLIOGRAPHY:
Rosebay willowherb has recently appeared on Skomer (2016). There are no early records, but given the size of the patches it is more than likely that it has been missed for a year or two.

8. Justification for the project (i.e. the purpose and intended outcome):
Local 'native' vegetation will be displaced. It is possible that Manx shearwaters would experience serious difficulty in trying to fight their way through these thickets.

This is an extremely invasive species, capable of filling any open spaces in the vegetation. If it was producing seeds in a year following a serious drought, when the existing plant communities are open and full of bare ground, there is potential for large scale and quite rapid colonisation. Rosebay willowherb has extremely robust tall stalks which grow in dense thickets. At the moment the patches, one in South Valley and two in North Valley are small enough to be easily eradicated. If it increased in the way, control would become difficult and very expensive. The precautionary principle is so important in this context. If we have good reason to believe that there could be a threat to a European protected species, we should take an action even in the absence of conclusive scientific proof.
ICAC recommended this project for approval autumn 2017

The desired outcome is the complete eradication of this species.

9. METHODOLOGY:

During late spring check all known locations and widen the search to ensure that there are no new locations. Prepare map showing all locations. Once the plants have reached full height but have not begun to flower, they should be cut back close to the ground. The cut material should be heaped and left to rot or if possible solarised. (solarisation is using the heat of the sun to destroy the plants, the heaps are covered in black plastic and left for a year or two - Possibly not a good idea on a windy island). Cutting must be repeated year after year until the plant has been eliminated.

8. Location of the work: entire island but use the attached map for known locations.

8.2 Work programme: Late spring and completed before plants flower and set seed.

8.3 Equipment: Strimmer or hand scythe.

8.4 Special considerations:

8.5 Risk assessment: Must be prepared and appended to this project before work commences.

9. REPORTING/CIRCULATION OF REPORTS:

Record progress in the annual report

Rosebay willowherb shown in red 2017

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