Bird’s-eye Landscape Microcosms

With special reference to Skomer Island NNR

Part 2: ‘Keeping every cog and wheel’

A Work in Progress 2019

“The last word in ignorance is the man who says of an animal or plant, "What good is it?" If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering.”
Aldo Leopold, Round River: From the Journals of Aldo Leopold

1 The Island

WILDERNESS IS A PLACE WILDNESS IS A PROCESS

Surprisingly for such a small island, about two miles square, Skomer has a great diversity of habitats. In this part of Wales the mainland cliff edge slopes comprise maritime grassland exposed to southwesterly winds that is dominated by red fescue (Festuca rubra) This quickly grades landwards into a more diverse coastal maritime heath, grassland and scrub. However, it is impossible to generalise about this landward gradient of increasing biodiversity by studying the mainland because mainland fields are now farmed up to the cliff edge.

Most modern ecosystems result from complex interactions among ecological, physical, and anthropogenic processes. With respect to Skomer as a maritime extension of the mainland, the vegetation has been impacted by at least three thousand years of farming. The physical evidence of ridge and furrow cultivation indicates that most of the surface of the island has been ploughed. It is from this agricultural 'ground zero' that the present vegetation cover has developed. Probably this has happened repeatedly throughout history as farming has waxed and wained. The latest event leading to the current situation was the introduction 800 years ago of free ranging rabbits to provide a commercial crop of skins for export to England. During the medieval period it is possible that the island was farmed seasonally with sheep and cattle with an arable component, but there is no documented evidence for this. It is thought that the rectangular, dry stone walled central fields were laid out as part of an episode of intensive farming in the mid 19 century. There is firm evidence that three of these central fields were under the plough in 1947, so their plant cover has developed over the past 70 years from bare soil. The ecology of these three fields can now be compared with each other and with other fields to unravel the processes governing plant succession and the maintenance of topographical biodiversity.

The island became a national nature reserve in 1959. Since then culling rabbits has been forbidden. They can now reach a population density of around 40 per acre; the highest number recorded anywhere in the world. So, most of the island's vegetation is subject to intense rabbit grazing, and there is dynamic pattern of plant distribution dominated by their grazing, burrowing, trampling and territorial marking. To this can be added the impact of thousands of burrow-nesting shearwaters which cohabit with the rabbits in all parts of the island.

The core management plan currently overseen by Natural Resources Wales takes the view that the island's flora and fauna have been created and maintained by a combination of traditional farming methods such as grazing and mowing (and to a lesser extent, burning), and by natural processes such as exposure to wind, salt spray, waves, and drought conditions. The many thousands of seabirds which use the islands have also contributed to the vegetation types and species present, principally through disturbance, or through the deposition of guano, both of which has resulted in local nutrient enrichment. The majority of present day management is directed towards the control of visitors and visitor facilities such as footpaths. There is some vegetation management including bracken control but, for the most part, these habitats are maintained by natural processes. Habitat and species management tends to be restricted to scything, hand pulling, 'bruising' and brush cutting of bracken along all path edges, the establishment of rabbit exclosures and occasional use of the herbicide Asulam for chemical bracken control where mechanical control encroach on the wellbeing of other species. However, most of the island is left to its own devices and the the landscape is a scene of interlocking ecological microcosms.

The main habitats now responsible for Skomer's scenic qualities are bracken-woodsage grassland and smaller areas of purple moor grass wetland. Small wetland subcommunities are maintained by spring-fed flushes and streams. However, Skomer is a rare dynamic botanical jigsaw. At any time, the pattern of vegetation is a provisional snapshot of a long term, everchanging patchiness related to fluctuations in the size of the rabbit population and occasional inundations of toxic salt spray carried across the island by southwesterly gales. Because of its botanical uniqueness Skomer defies the application of quantitative standards of botanical classification developed for the vegetation of relatively static mainland habitats. A regular visitor to the island can appreciate this dynamism through an awareness that each year something is visually different. Botanical instability is expressed in year on year changes in a few common species to produce an ever changing visual experience, presenting the island as a small scale dynamic scenic model for linking ecology with landscape.This brings the study of Skomer's botanical dynamics into the scientific realm of landscape analysis, a concept first explored on Skomer by Cardiff University's departments of zoology and archaeology in the 1970-80s. This work is now being continued with digital photography using satellites and drones integrated with fixed point ground photography. This is a long term surveillance project underpinned with quantitative quadrat studies of selected microcosms to define Skomer's landscape both scientifically and artfully.

Artful landscape science releases fresh ideas for putting intelligence, enjoyment, and communicative power back into thinking with images. "Thinking in pictures," Sigmund Freud wrote, "stands nearer to unconscious processes than does thinking in words, and is unquestionably older than the latter, both ontogenetically and phylogenetically." There is, in other words, something primordial, something foundational, about thinking visually and Skomer provides the link between science and art to discover new truths. The truths that emerge from studying microcosms is that they are seen holistically as a picture, The philosophical task of looking for the essence of truth in a landscape is therefore unending, not because it is deep but because it is an example of the many ways in which we can all be captured mentally by a picture.

https://www.newstatesman.com/culture/art-and-design/2012/08/ludwig-wittgenstein%E2%80%99s-passion-looking-not-thinking

2 Landscape microcosms

Landscape microcosms are small ecosystems, distinguishable visually at a glance, with well-defined boundaries within a larger whole. They are small "worlds" useful for studying the way larger ecosystems work. Microcosms are important because they provide opportunities to study whole ecosystems in a miniature form. For example, they are outdoor laboratories for testing effects of habitat fragmentation or links between biodiversity and ecosystem processes, such as population dynamics and climate change. Microcosms also provide the topographical framework for studies in autecology of plant reproduction, where the spread, maintenance, local extinction and regeneration of a particular species are followed over a long period of time. To take the long term view is to follow a spiritual pathway and connect to the steadfast, though flucturating, life forces that are both beyond and in congruence with one's own.

It is sometimes difficult to define exactly what a microcosm is since they have so many different shapes, sizes, and compositions. Wimpenny (1988) states that there is a consensus among scientists that a microcosm possesses some, or al,l of the following properties:

1. Origin: Microcosms derive from natural ecosystems.

2. Isolation: The microcosm, whatever its origin, is enclosed within a boundary permeable to inputs and outputs that can be measured.

3. Size: Though variable in size, microcosms tend to be subsets of the natural systems from which they came.

4. Genotypic heterogeneity: Most research into microcosms makes use of natural, mixed genetic populations.

5. Spatial heterogeneity: Although spatial heterogeneity is not in any way implied by the term microcosm, virtually all retain this property to some degree.

To this scientific listing may be added:

6 Spiritual conections to wildness: The anthropological connection with ecology is through the concept of patches of protected wildness called sacred natural sites. These are microcosms which extend human needs for food and water to encompass relationships and meaning through a rare perspective upon ourselves. Taken together these protected patches can produce a more holistic vision of Earth as a system of interconnected ecological relationships. They are sacred because theyare ancient ancient. They may relate to ancient sites dedicated to deities, but are fundamentally a heritage component of people's sense of place with links to astronomy, agriculture and water supply. They are both

observatory and church and they act as guidebook places, where in ancient days and today people can learn about faith, values and life's deeper meanings.

MICROCOSMS FROM THE AIR

'Bird's-eye Landscape Microcosms Part 2' has been produced after recording the surface landscape of Skomer with a drone camera in 2017. The drone survey has revealed many distinct microcosms that characterise the island's botanical patchiness (Table 1). These habitat patches relate to the physical heterogeneity of the island and its future trajectory. Their botanical elements are pervasive, yet constantly shifting in space and time. There is a wildness to this ever-changing pattern. which is expressed visually as the species are entrained to homeostatic processes of plant succession, with feedback cycles operating on long timescales. For the most part the cycles are driven by changes in the population of rabbits and the random impact of catastrophic south westerly gales to which may now be added the influence of global climate change.

Mapping vegetation through remotely sensed images involves various considerations, processes and techniques, which expands the horizon of our choices of imagery sources. Various sources of imagery are known for their differences in spectral, spatial and temporal characteristics and thus are suitable for different purposes of vegetation mapping. In particular there are various techniques for rendering digital images to expose and accentuate variations in tone and contrast between plant communities and species. Generally, remote sensing aims to develop a map of vegetation classification using tonal analysis. Then these spectral classes of the imagery are translated into vegetation categories. Categorisation depends on ground truthing, which in the case of the 2017 aerial survey has only just begun.

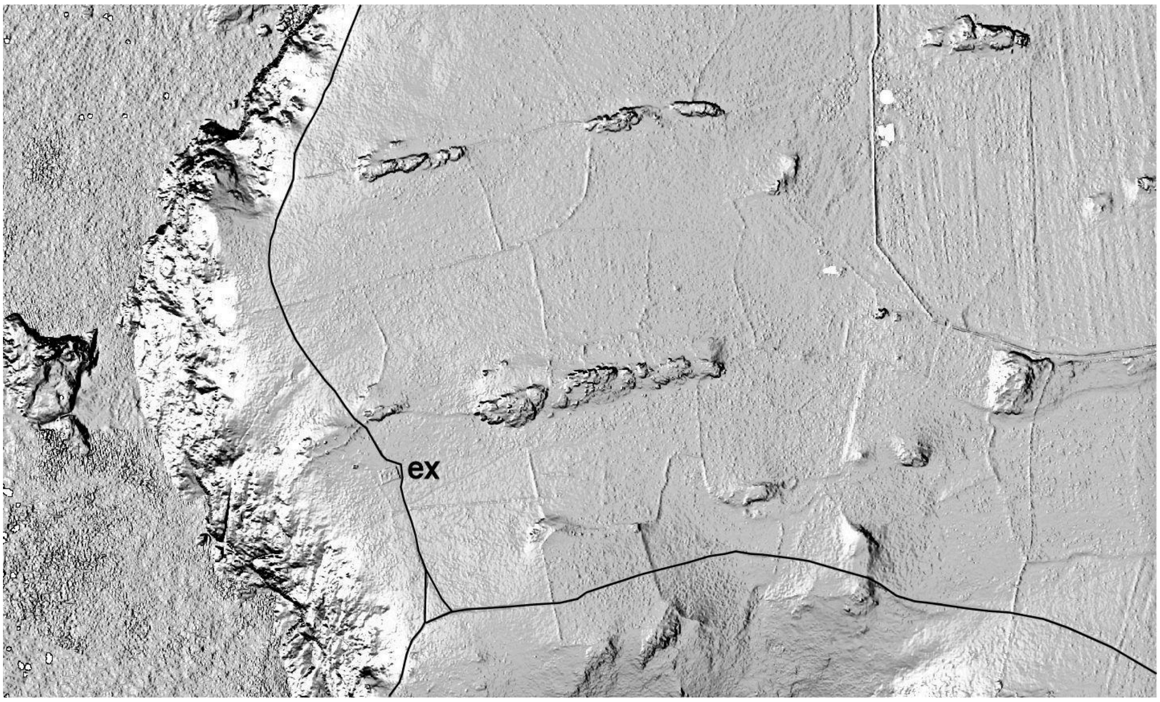
3 Provisional list of microcosms

These microcosms have been selected because they illustrate Skomer's topographic variety. They bring forward questions about the ecological dynamics, indetail and in principle, of vegetation and they are easy to access from the visitor footpaths.

3.1 Three Outcrops

Light Detection and Ranging (LIDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. Up to 500,000 measurements per second are made of the ground, allowing highly detailed terrain models to be generated at spatial resolutions of between 25cm and 2 metres. A LIDAR map of Skomer Island was produced in 2009 A portion of this map covering the western edge of the island is presented in Fig 1. It includes three rock outcrops running parallel to each other in a West to East direction that provided structural basis for the layout of fields by prehistoric farmers.

Fig 1 Portion of the western edge of the island



3.1.1 Rabbit proof exclosure

A rabbit proof enclosure, marked 'ex'.was set up in 1985. It's purpose was to demonstrate what this part of the island would look like in the absence of rabbits. Beginning as a heavily grazed area dominated by Holcus and bare earth the exclosure developed a dense 'mattress' of Festuca rubra which was in places about a half a metre thick. This was colonized by nesting shearwaters and the Festuca was gradually replaced by Holcus lanatus (Figs 2 a, b. c).

Fig 2a Position of exclosure May 2017

Fig 2 b Three Outcrops Exclosure (May 2017)

Fig 2 c Three Outcrops Exclosure (July 2017): Flowering Holcus

Fig Effect of excluding rabbits on vegetation of Skokholm (Gillham, 1955)

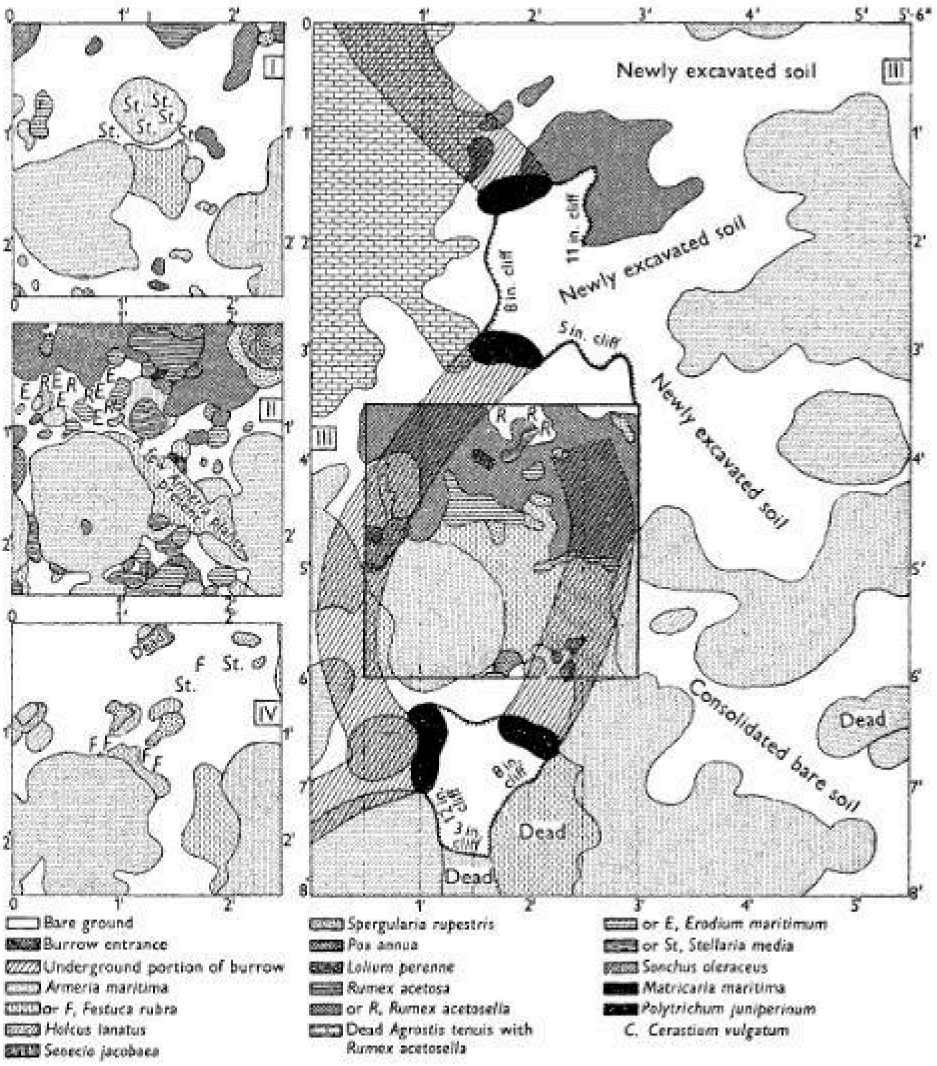


Fig. 3. Diagrams showing the effect of excluding the fauna from a small area for a period of 1 year and the subsequent degeneration resulting from the re-entry of rabbits. I, July 1948; vegetation at the time of enclosure. II, September 1948; III, July 1949: note the contrasting vegetation inside and outside the enclosure. IV, October 1949: after the re-entry of rabbits. Note the high survival capacity of *Armeria*.

3.2.1 White Campion/Bracken Interface

This microcosm is expressed visually as a cliff edge community of white campion that extends a few metres inland to the remains of an old wall which seems to be a barrier to its further spread (Fig 4a). Bracken to the east also seems to be inhibited from spreading west (Fig 4b). Comparison of the distribution of bracked from field surveys and aerial mapping from 1947 to 2017 shows that the bracken edge in particular has been very dynamic in the long term. Stands advance and then fragment to he replaced by new invasions.

Fig 4a May 2017

Fig 4b August 2017

3.2 Heath and Heather

In prime condition, heaths are the lowland equivalent of wild, open, windswept moorlands typical of much higher altitudes. Now an international rarity, lowland heathland is home to a distinctive and diverse range of plants and animals, and provides a unique cultural and recreational resource. Heathlands are dominated by any of the Ericaceae; shrubby dicotyledonous and often evergreen plants of either of two genera (Erica and Calluna) . Heathlands thrive on open barren usually acid and ill-drained soil; producing a surface rich in peat or peaty humus. Both bell heather and cross-leaved heath occur together and they can be prominent especially after burning,which is a traditional agricultural practice to improve heathland as a resource for free ranging livestock.

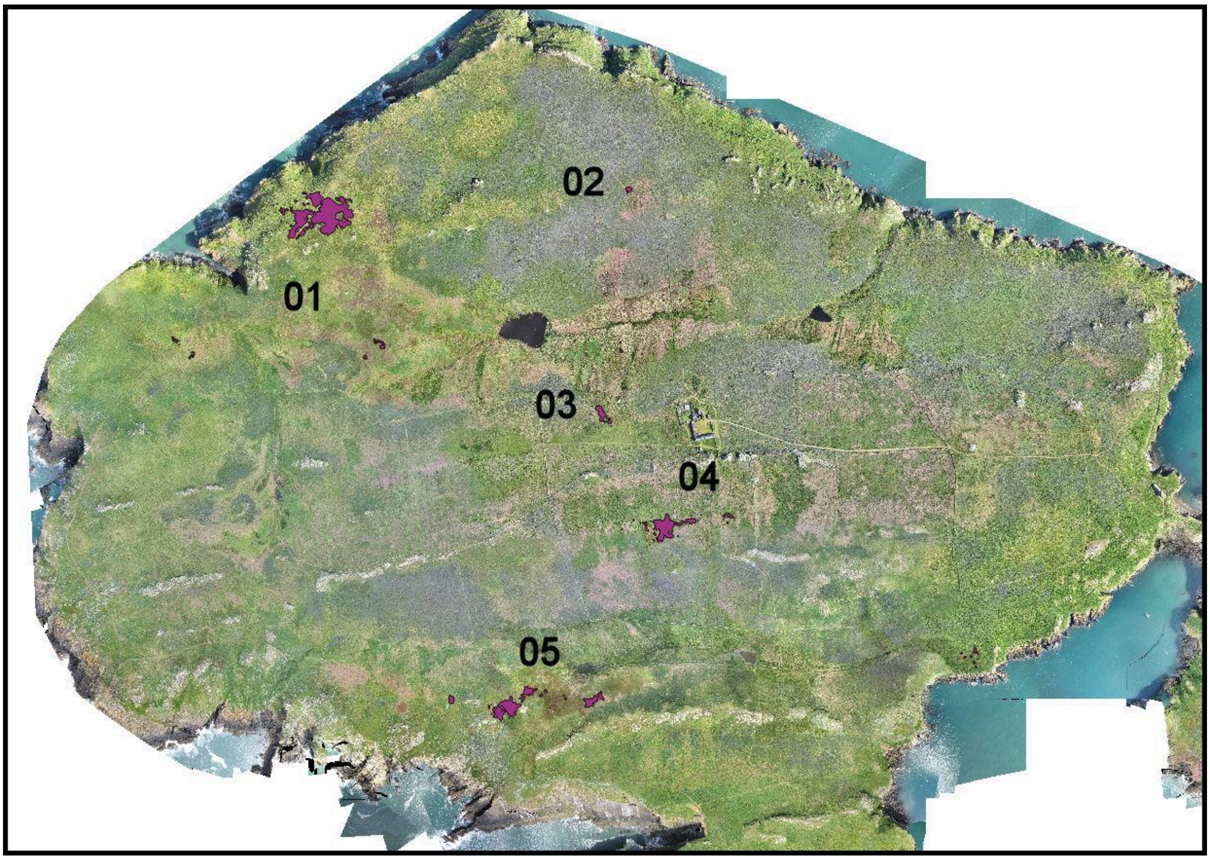
Heathland has probably never been dominant on Skomer. The first record of its presence is an area labelled burned heath depicted in the first botanical map of the island made by John Sadd in 1947 (Fig 1).

Fig 1 Burnt heath mapped on Skomer 1947.

The largest extent was recorded in 1969 and this distribution has been superimposed on the 2017 drone map of Skomer (Fig 2). Since then there has been a dramatic decline (Fig 3).

Fig 2 Distribution of heathland on Skomer in 1969.

Fig 3 Distribution of heather detected at six places from the 2017 drone survey



3.3 South Plateau

A visitor climbing over the steep outcrop onto South Plateau enters another world whose visual impact at any one time is governed by eleven botanical surface features (Table 1) The dynamic relationships between features 1 to 9 sets the mood of South Plateau as a special place. It is truly a wilderness valuable for its ecological, geological, or other features of scientific, educational, scenic, or historical value. Wilderness is often said to represent a "baseline": a landscape with a mosaic of ecosystems that function with as little influence from human beings as any on Earth.

Part of the landscape wildness of South Plateau is the fact that bracken and woodsage are not visually dominant as in all other parts of the island. Over the years, where bracken has been recorded it has been as relatively small mobile patches. There has been no general advance as elsewhere on the island (Fig 1). This makes the South Plateau a good place to study factors that control the population expansion of bracken and the lifespan of patches.

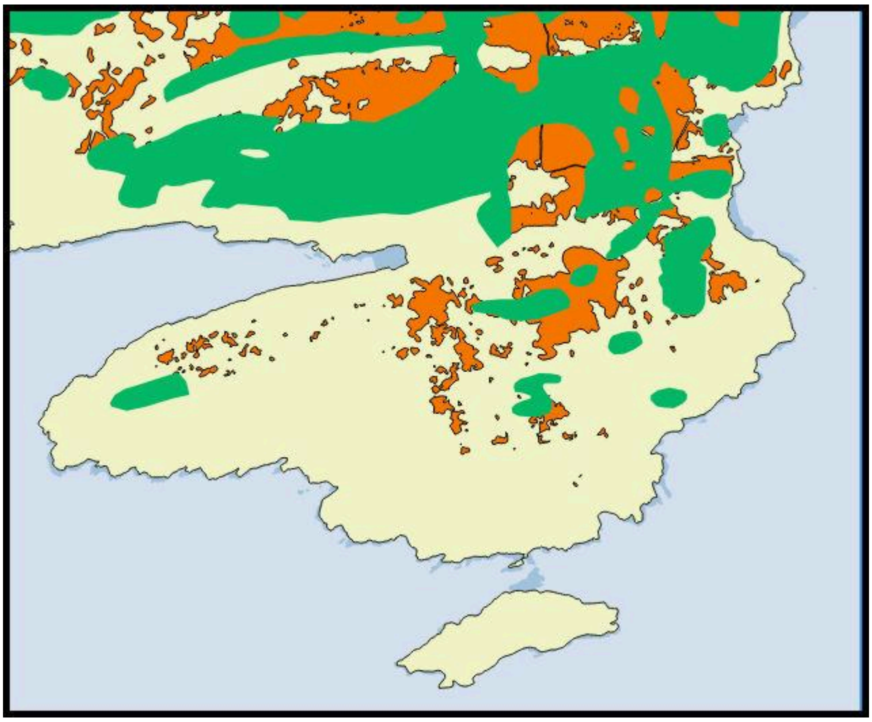
There are no obvious visual signs of past human use. But below the surface there is evidence that the flatter portion above the steep coastal slopes has been divided into several compartments by long rectangular walls (Fig 7). This is indicative of a farming system distinct from that in the rest of the island.

Table 1 Main surface scenic elements of South Plateau

1 Holcus lanatus	Yorkshire Fog
2 Rumex acetosella	Sheep's sorrel, red sorrel, sour weed and field sorrel. Propagation by seed and rhizomes
3 Dead grass	Usually Holcus lanatus
4 Bare earth	Often due to rabbit scraping
5 Dead Rumex acetosella	Indicative of a rabbit population cycle
6 Rumex acetosa	Common sorrel
7 Armeria maritima	Commonly called thrift or sea pink
8 Agrostis stolonifera	Creeping bent grass
9 Festuca rubra	Red fescue
10 Silene maritimum	Sea campion
11 Triplorospermum maritimum	Sea mayweed. Found on lower coasal slope facing the Mewstone.

The plateau terminates at its southernmost end in the magnificent Mew Stone. A prime icon of primeval wildness, which past occupants of Skomer must have viewed with awe.

Fig 1 Distrtibution of bracken in 1947 (green) and 2017 (red)



The feature that currently (2017) defines South Plateau's scenic character is Holcus lanatus. This grass flowers In midsummer when it can give the appearance of a uniform meadow (Figs 2-4)

Fig 2 South Plateau looking south (14.07.2017)

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Fig 3 South Plateau looking towards Skokholm (14.07.2017)

Fig 4 South Plateau looking North East (14.07.2017)

In Fig 5 a drone shot taken in August 2017 has been rendered by manipulating hue, saturation and lightness of the image to accentuate bracken (dark red; also compare with Fig

1) and two populations of Holcus; one to the East, which was photographed in Figs 2-4, and the other to the West, which was more open and patchy, interspersed with rabbit-grazed Holcus/ Rumex acetosella lawns.

Fig 5 Rendered drone image May 2017 (light green white campion, dark green thrift)

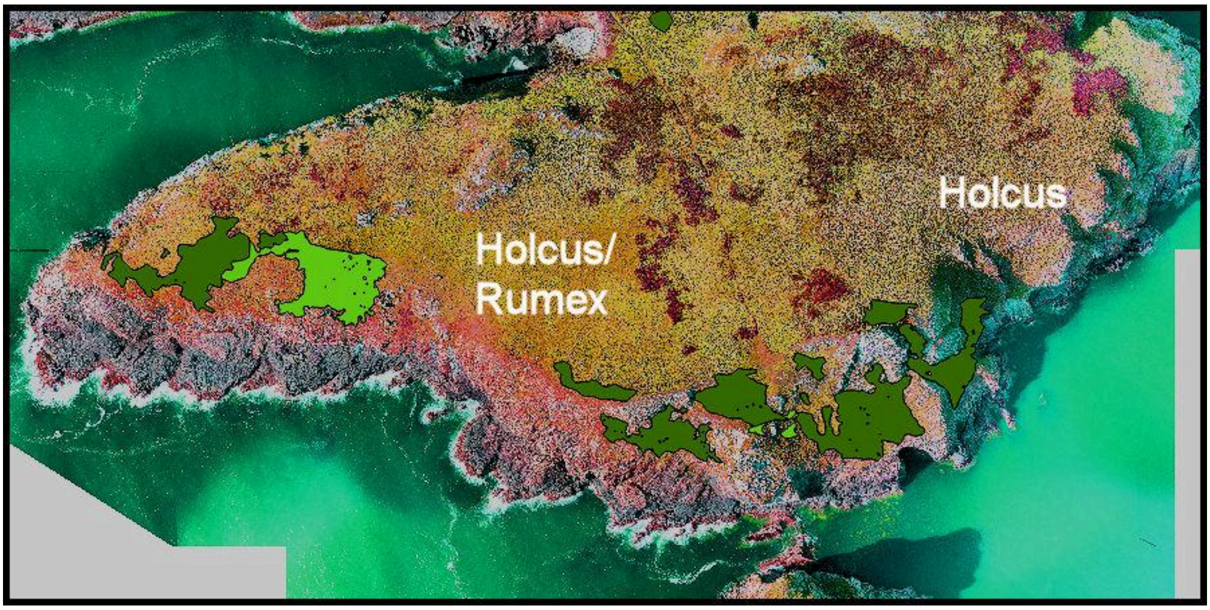


Fig 6 South Plateau West; example of a Holcus/Rumex rabbit grazed sward (14.07.2017).

A Holcus/Rumex acetosella sward is formed on Skomer when there is a high local population of rabbits. Rabbits closely crop two grasses, Festuca and Agrostis, creating a dynamic relationship between features 1-9 listed in Table 1. Rumex acetosella is avoided by rabbits and flourishes as a companion species.(Fig 6). The closer the grasses are are cropped the more the acetosella is able to compete with grasses for ground space. This is expressed graphically in Fig 7, which indicates this reciprocal relationship between these two species is expressed as a long term ecological cycle.

Fig 7 Frequency of two botanical fearures of walking transect 1978-86

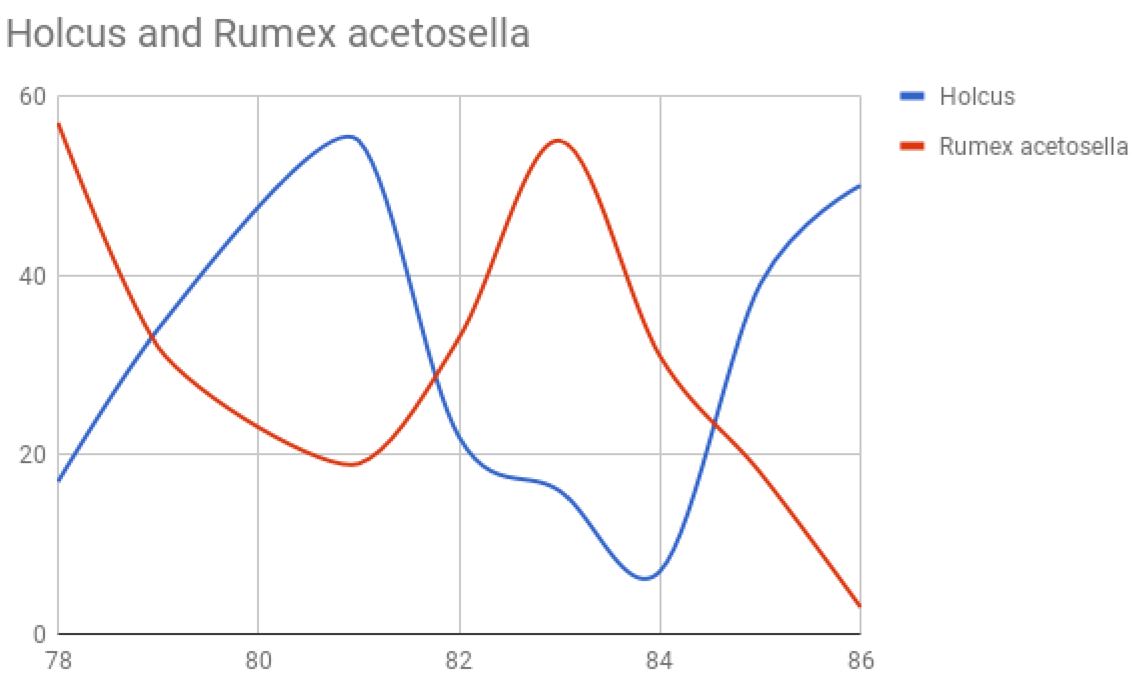
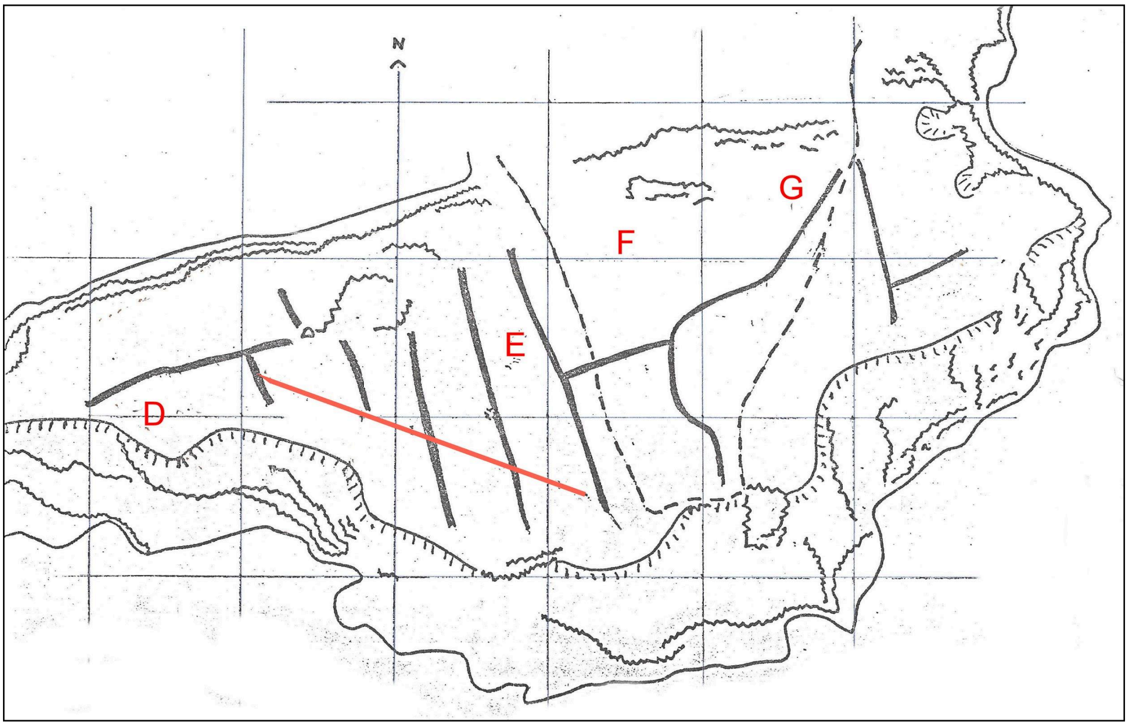


Fig 7 Sketchmap of South Plateau showing northern outcrop and coastal slopes



Dashed line = visitor footpath; solid black llines = old walls; solid red line = walking transect; Letters D to G = positions of quadrats and exclosures

Fig 9 Frequency of four elements of walking transect 1978-86

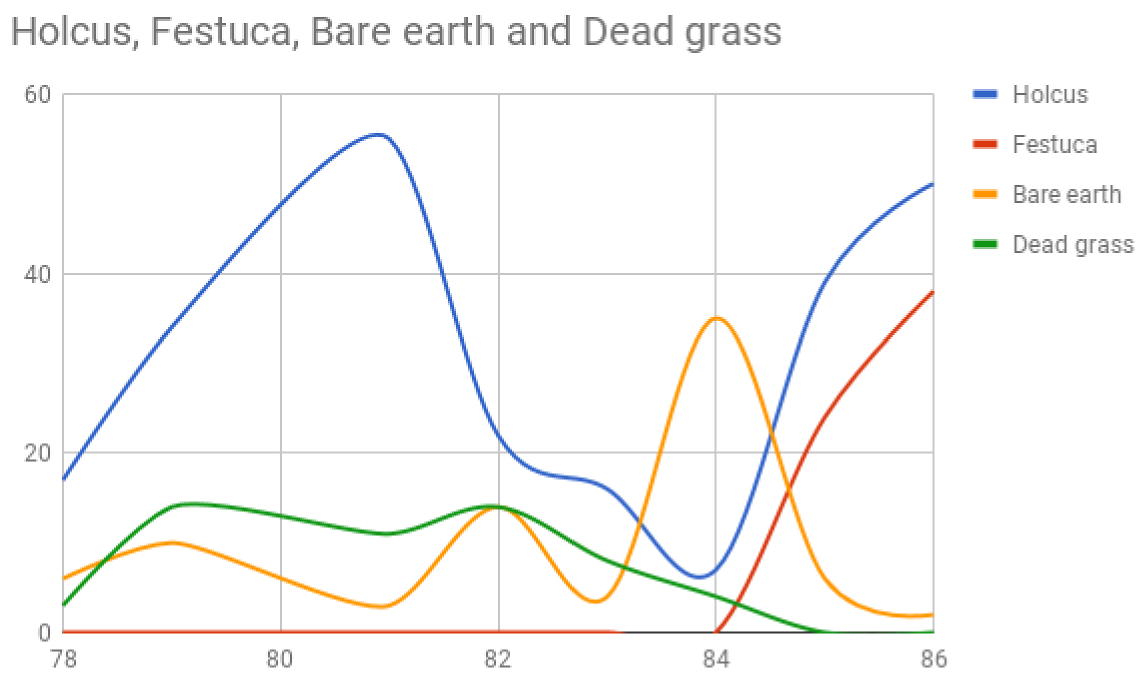


Fig 10 Plot A

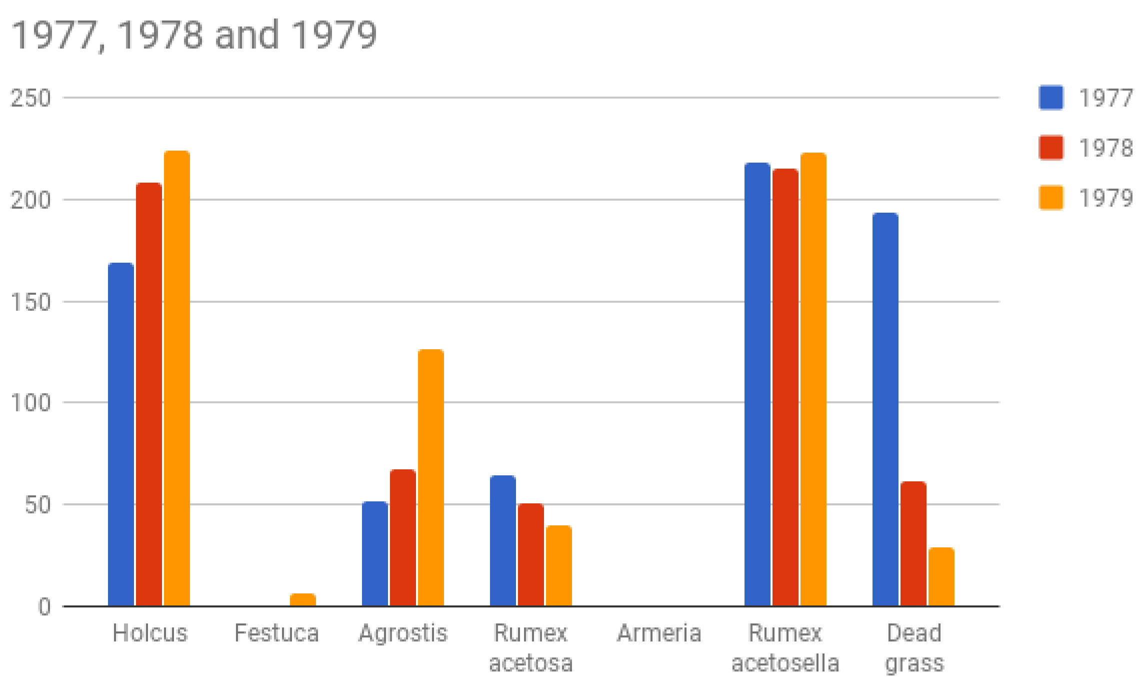


Fig 11 Plot B

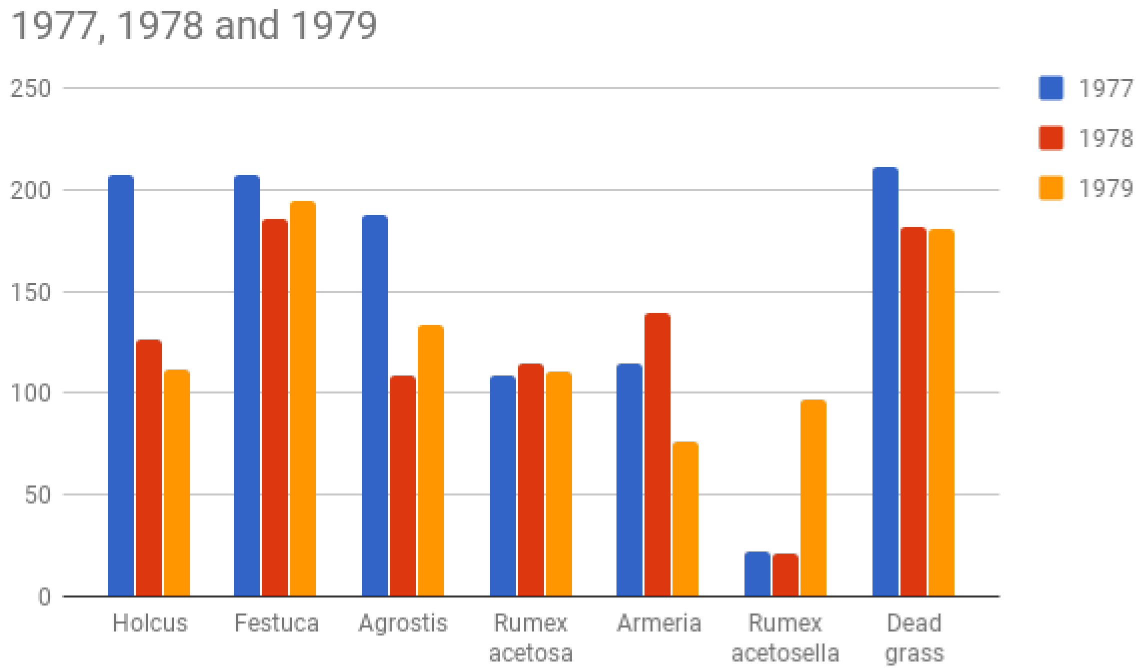
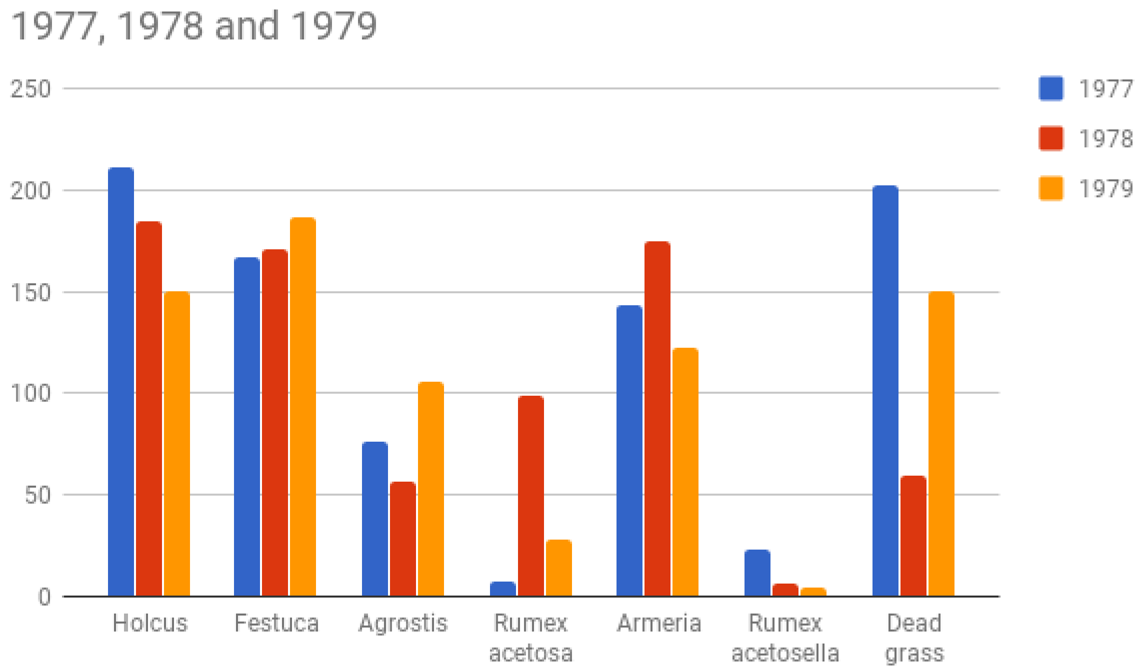


Fig 12 Plot C



3.3.1 Rock Lichen: Crab Rocks

https://www.thoughtco.com/outcrops-versus-exposures-an-essay-1440827

Andrew Alden, in an essay on the meaning of the terms ‘exposure’ and ‘outcrop’ in geology, argued that there are subtle shades of meaning in these two words applied to describe rocks. The words reflect their deepest roots in the history of human language. In particular, he took the view that the verb ‘to crop’ was adopted by early miners to mean the hewing of rocks. An outcrop was a rock that was visible and therefore workable above ground.

In ancient usage, ‘crop’ meant growing or swelling. According to Alden, farmers changed it first into a verb to describe the growth of fruit and grain, then into a noun to denote the fruit or grain itself, then into a verb again for the act of harvesting the crop. When miners began to use the word crop to define rock as a harvestable resource it is a clear sign that they saw rocks emerging from below ground as an active process. Alden says: *“Miners have always been superstitious people with magical beliefs, and the notion of rocks growing was a clear sign that they saw the underground as an active, living place. “*

We must guard against confusing the scientific reality of what we can know for sure about the ancient past and modern day interpretations. Nevertheless we can only look at Skomer’s unique semi regular landscape of parallel outcropping rocks, and think of other places where a thin soil cover is interrupted by bare lichen covered rocky outcrops, most often of volcanic types. One such place is the the Canadian Shield, a vast geological territory covering a significant part of North America.. For thousands of years, this land has been mainly inhabited by Algonquin peoples who, until the 20th century. lived as small bands of hunter- fisher- gatherers pursuing a nomadic way of life. In such places the natural environment becomes an intrinsic part of daily life, and it is not surprising that rock outcrops have been incorporated into their cosmological belief system, culture not being understandable without constant reference to local nature. One expression of Algonquin spiritual beliefs is manifested in the hundreds of rock art sites found especially on outcrops projecting from lakeshores and riverbanks. Closely combining the tangible with the intangible, these places are, as they were centuries ago, an integral part of the sacred landscape of the people that lived there.

For visitors to Skomer wishing to merge spiritually with outcrops the island is topped and tailed, north and south, by two magnificent outliers of volcanic rhyolite, they were named by the first map makers as the Garland Stone (Fig) and the Mew Stone. Contemplating either of these natural wonders from the cliff edge is to see what the first islanders saw. We can be certain that they gave them names but pre-history does not record them.

Fig The Garland Stone

If the Mew Stone could speak she would tell humanity, without romanticising first nation peoples, to adapt algonquinism as an effort to conserve and promote oneness with nature by only cropping resources from self sustaining ecological cycles.   As a practical Buddhist her message from rock-kind to human-kind would be,

“ *You humans now drive and are entangled in all environmental change, You all need to move beyond talking about the environment, as this leads you to experience yourselves and Earth as two separate entities, to see the planet in terms only of what it can do for you. You have constructed a cultural system you can't control. It imposes itself on you, and you become its slaves and victims. Change is possible only if you recognise that people and planet are ultimately one and the same.* Only with *that insight of inter-being, it is possible to have real communication with Earth”.. Just look down at what your booted presence is doing to the soil !*

Fig The Mew Stone

While we need to live and operate in a dualistic world, it is also vital to understand that our peace and happiness lie in the recognition that the ultimate historical dimension of our origins can only be expressed in holistic education. If we are able to touch deeply the vast historical dimension of our origins – through a leaf, a flower, a pebble, a beam of light, a mountain, a river, a bird, or our own body – we touch at the same time the ultimate dimension. The ultimate dimension cannot be described as personal or impersonal, material or spiritual, object or subject of cognition – we say only that it is always shining, and shining on itself. Touching the ultimate dimension, we feel happy and comfortable, like the birds enjoying the blue sky, or the deer enjoying the green forests. We know that we do not have to look for the ultimate outside of ourselves – it is available within us, in this very moment.

Fig Meditation on North Face of the Mew Stone

Fig Mew Stone: North Face

3.4 Captain Kite’s

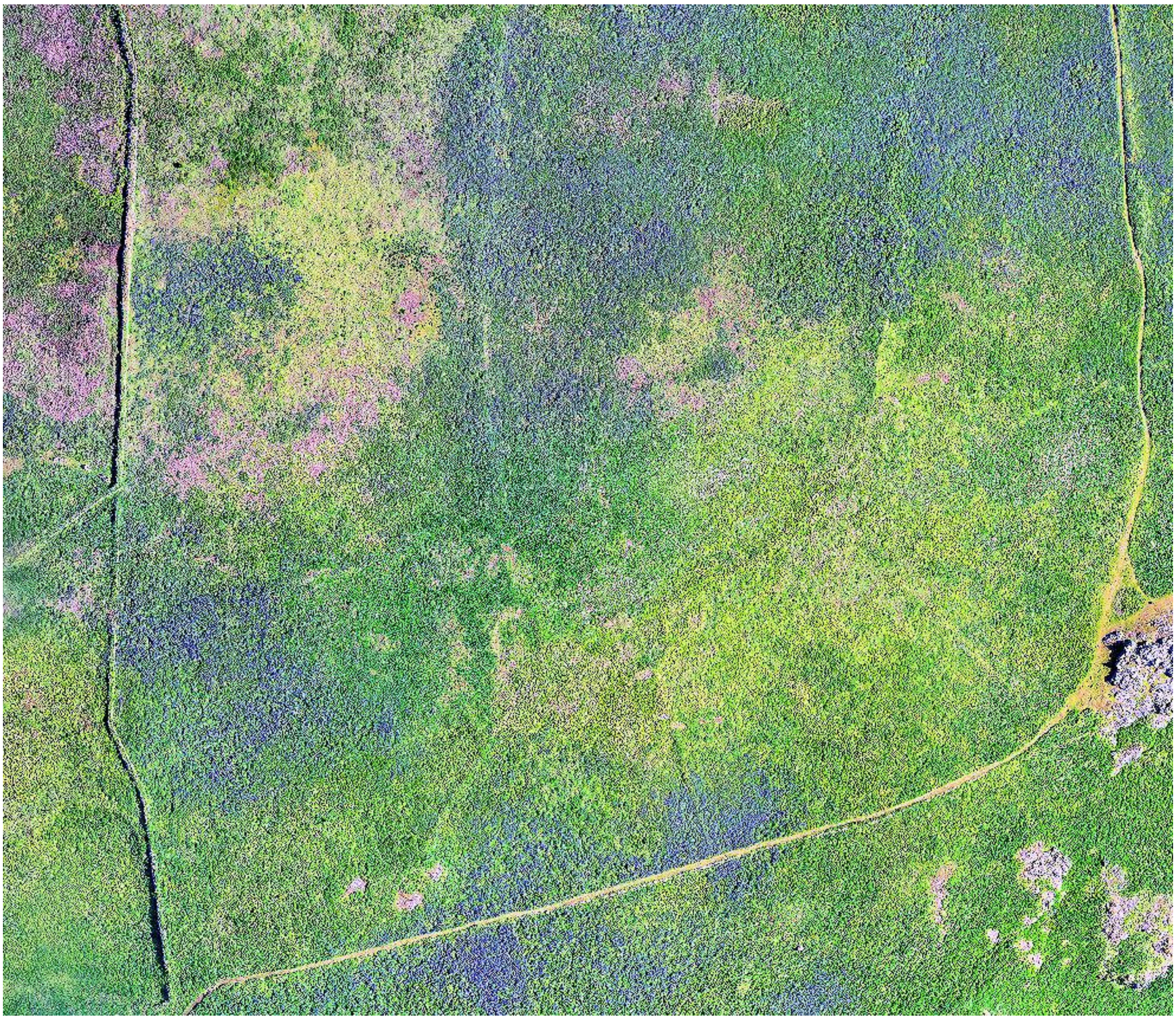
https://academic.oup.com/jpe/article/1/1/9/1132900

Captain Kite’s is the name of a large rock overlooking South Haven and The Neck. It is the first outcrop to be encountered at close quarters by visitors taking a clockwise walk around the island. To the Northwest there is a cluster of ancient rectangular fields aligned down the coastal slope with their longest dimensions parallel to North Haven (Fig). A visual contact with Captain Kite’s must have been a daily experience of the farmers who tilled these ancient fields.

Fig LIDAR scan of ancient field system, Captain Kite’s is in the bottom right hand corner

With regards to its botanical patchiness, the land immediately to the West of a line between Captain Kite’s north to the Harold Stone is without doubt one of the most visually diverse areas of the island. This diversity resides in its tonal variety rather than its species diversity. The latter is limited to Bracken, Woodsage and two grasses, Yorkshire Fog and False Oat, with massed Bluebells in the Spring. The tonal mapping of the digital images taken by a drone-mounted camera indicates that the appearance of this microcosm is due to variations in the colour of fronds and leaves, within and between these five dominant species. What the coloured parches mean in terms of the distribution of individual plants has to be determined by comparing tonal maps with ground surveys.

Fig Captain Kite's microcosm May 2017 (tonal mapping)

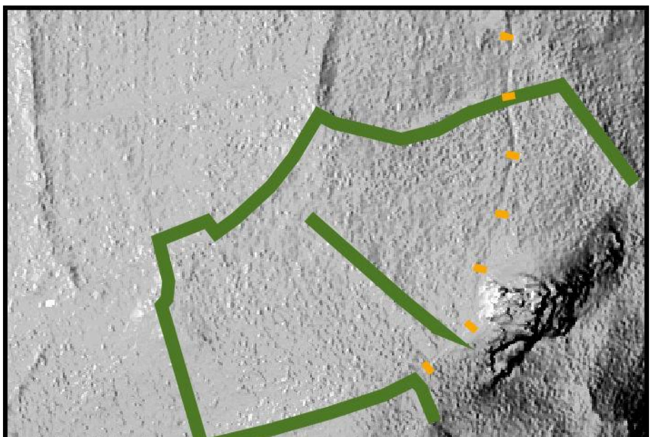


Blue areas are flowering bluebells and the other patches of colour represent dead bracken, grasses and woodsage.

Fig Captain Kite's microcosm August 2017 (tonal mapping)

Dark brown areas are isolated areas of bracken

Fig Captain Kite's LIDAR scan.



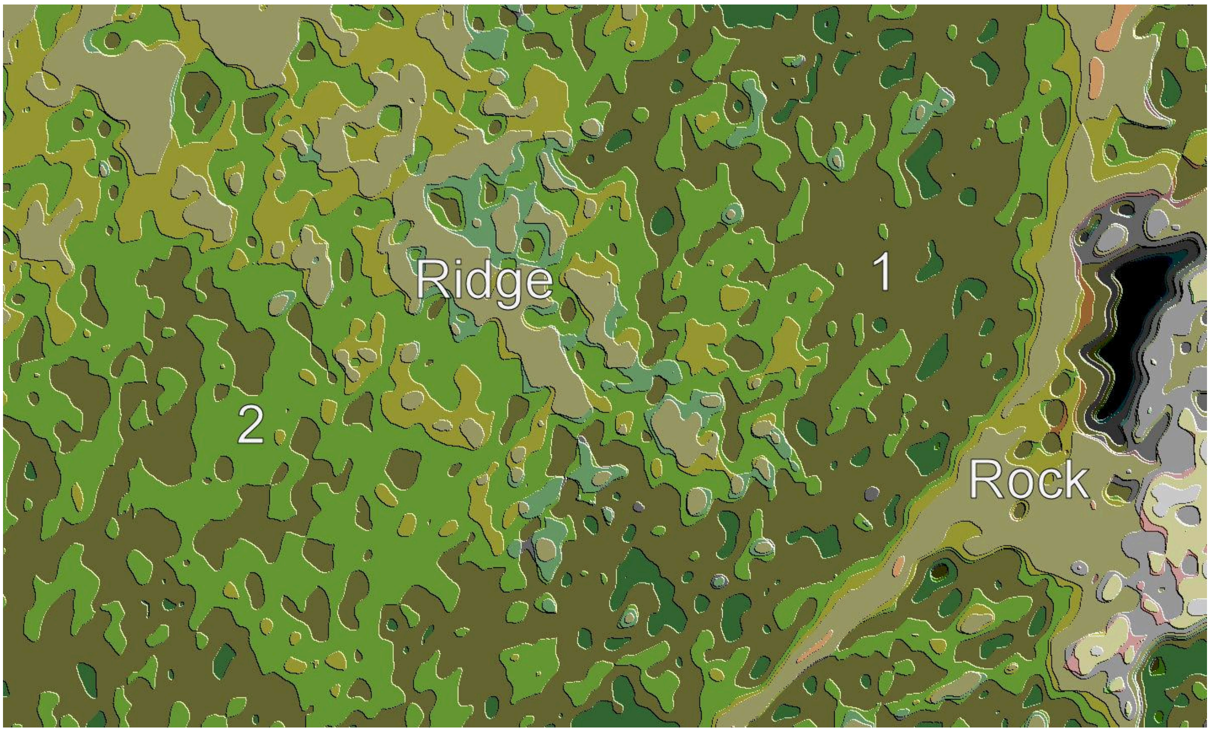
Old field boundaries green and footpath dashed orange

Fig Captain Kite's; Drone survey, May 2017 (tonal mapping)

Fig Captain Kite's; Drone survey, May 2017 enlargement of part of Fig

Fig Captain Kite's; Drone survey, August, 2017

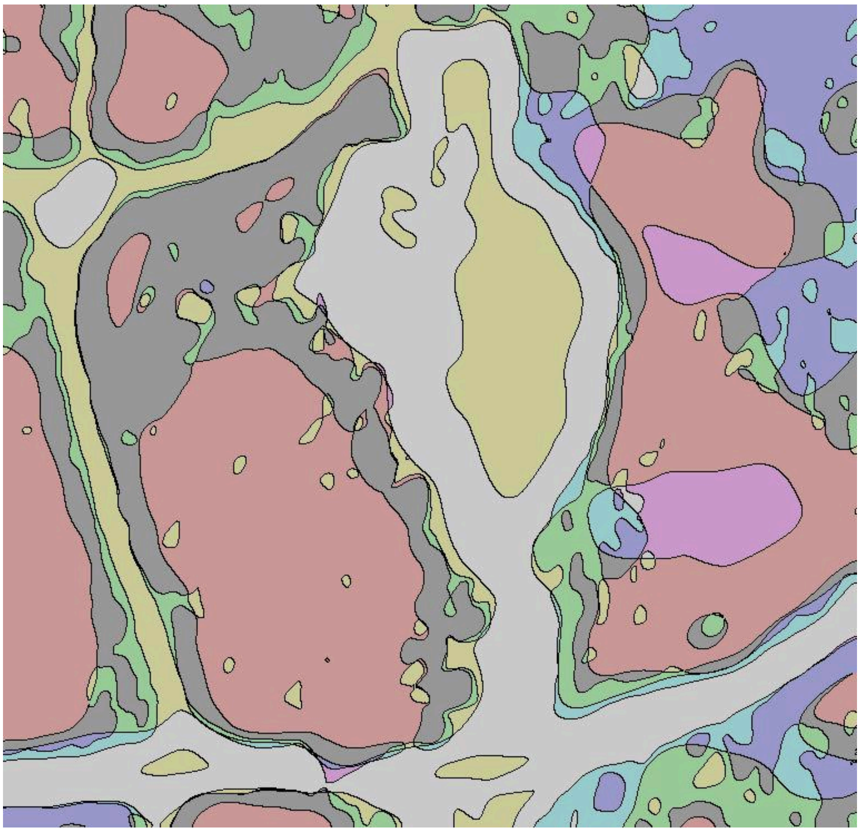
Fig Rendered with PaintShop Pro contour filter



The ridge or old field boundary separates two distinct vegetation types (marked 1 and 2}

3.5 Harold Stone Warren

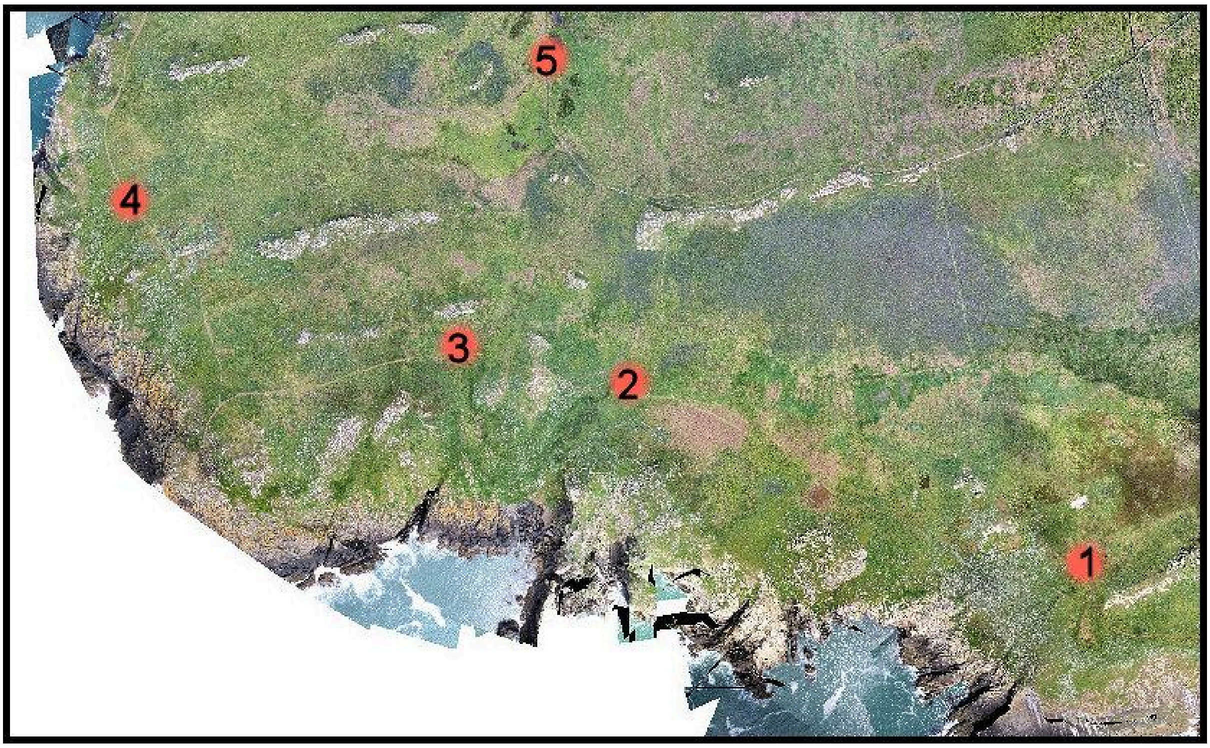
May 2017



3.6 Western Wet Flushes

The red dots in Fig 3 mark the positions of four of Skomer's wet flushes in the south west of the island.

Fig 3 Positions of four wet flushes on the edge of Skomer's south west coastal slopes and one inland site at West Pond (May 2017).



All have evidence of water management.

The two flushes (2 and 3) that cross the path in the centre of Fig 2 are particularly interesting because they appear to have been managed to feed small rectangular enclosures (Fig 4). They are notable in that the vegetation cover of both features consists mainly of dwarf silverweed (Potentilla anserina). They have been the under surveillance since the 1970s and during this time they have not changed with respect to the density of silverweed or its extent.

Fig 4 Northern flush (Drone flight, 2017)

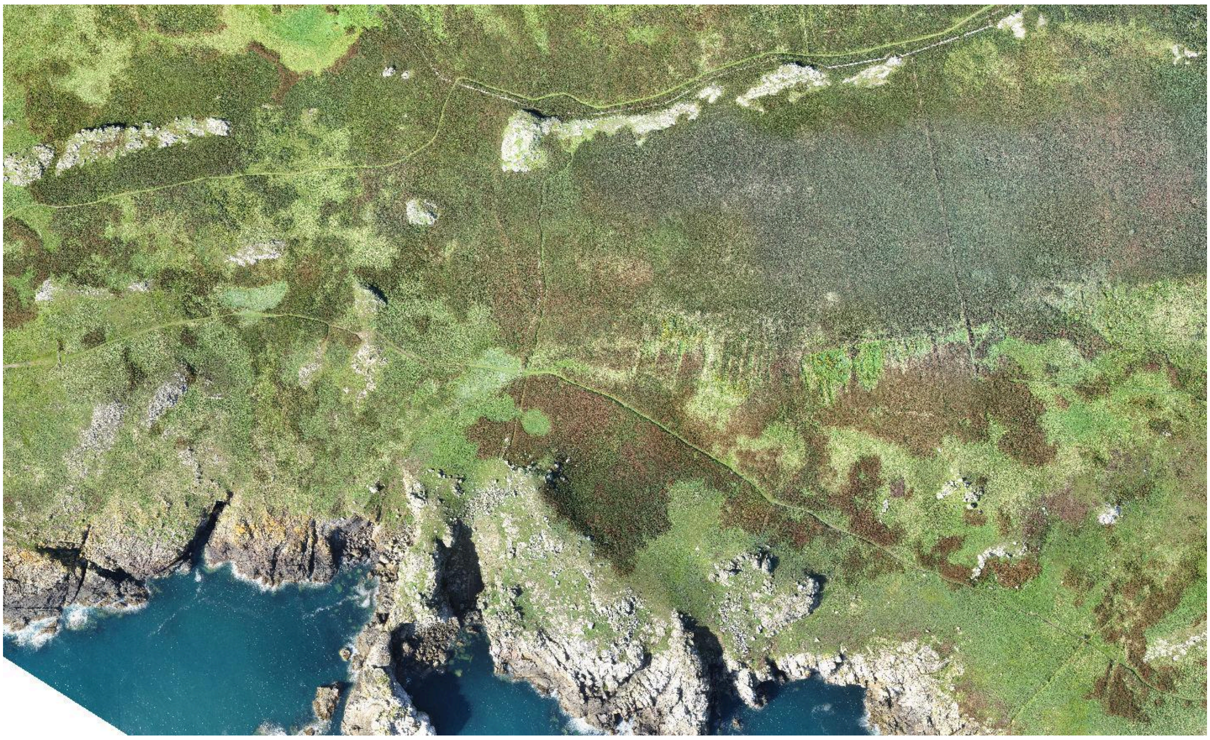
Fig 5 Eastern flush (drone flight 2017)

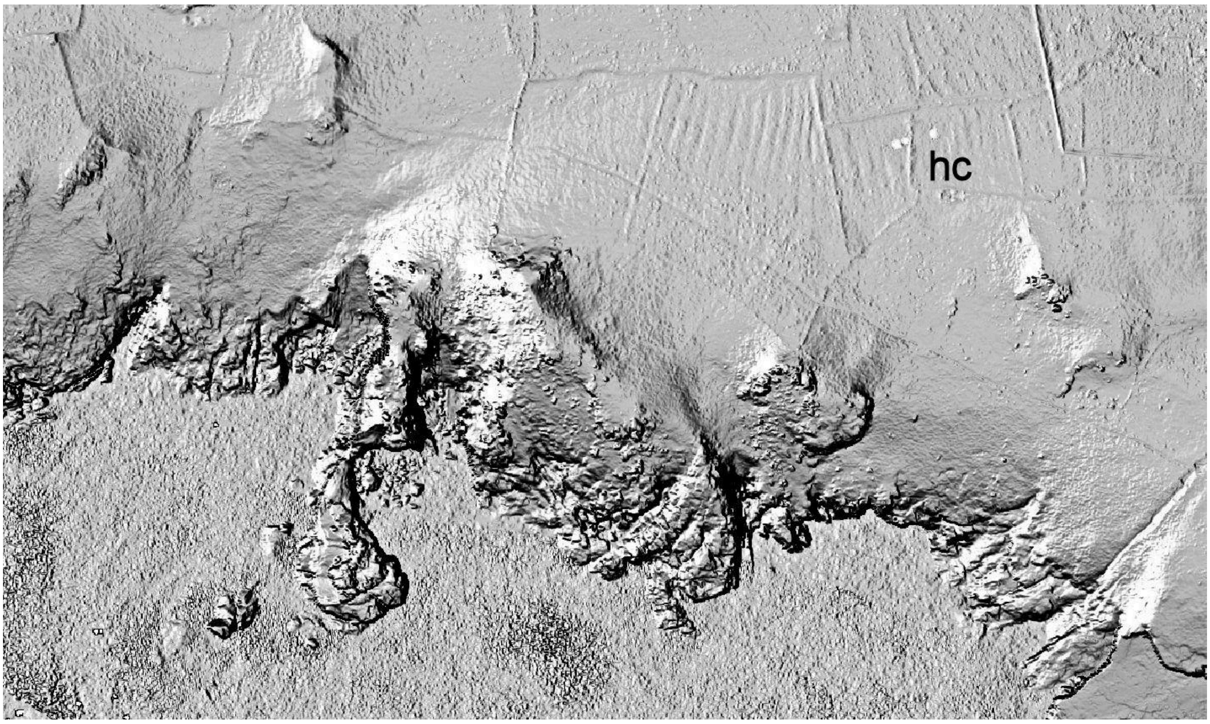
Fig 4 Silverweed compartments alongside the path above Thom's House

3.7 Southwest ridge and furrow

May 2017

August 2017





May 2017

3.8 Central Fields

Fig Sketch map of Central Fields, taken from J Sadd's survey 1947

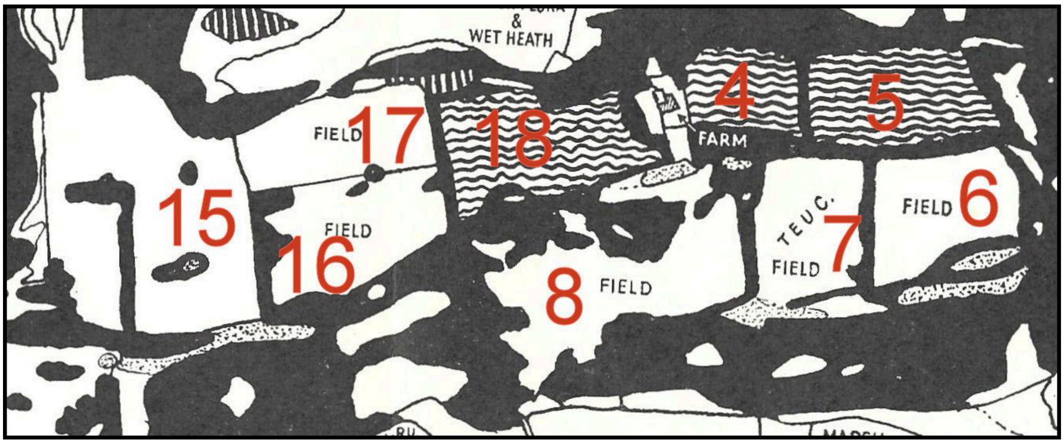


Fig Putting finishing touches to rabbit enclosure; Field 5 (CalvesPark), May 1981

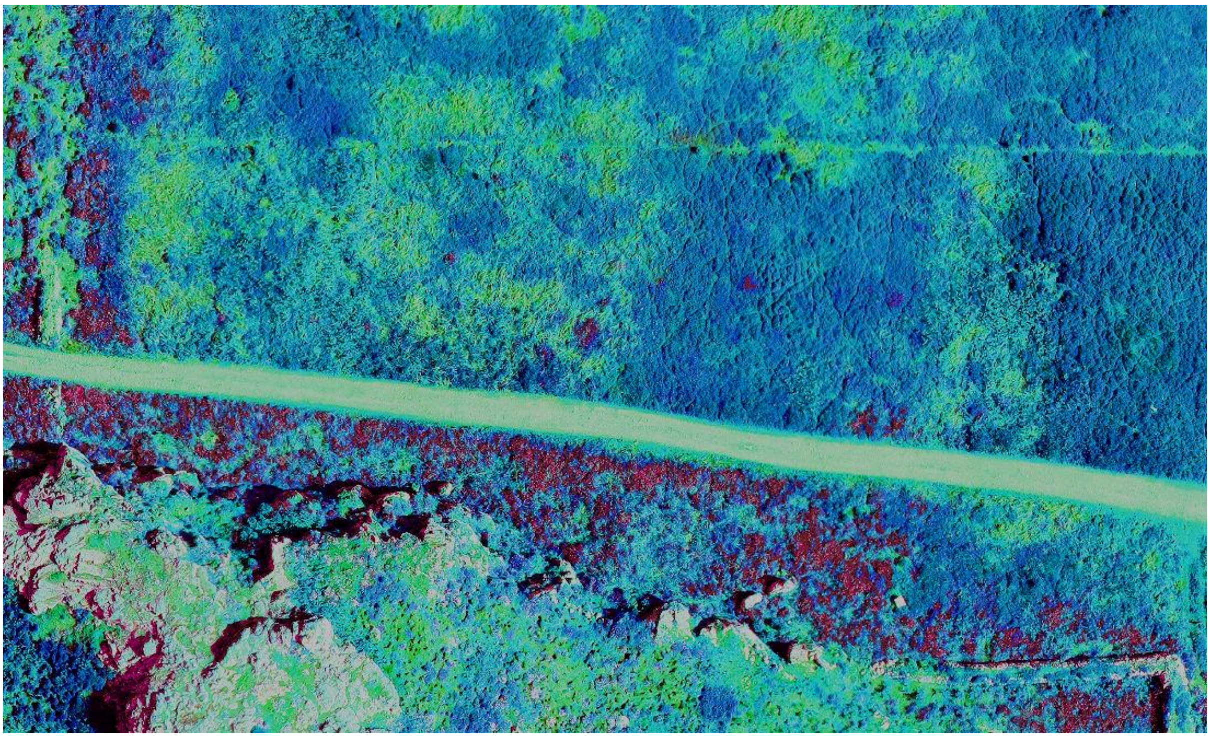
Fig The 'rabbit team', May, 1982

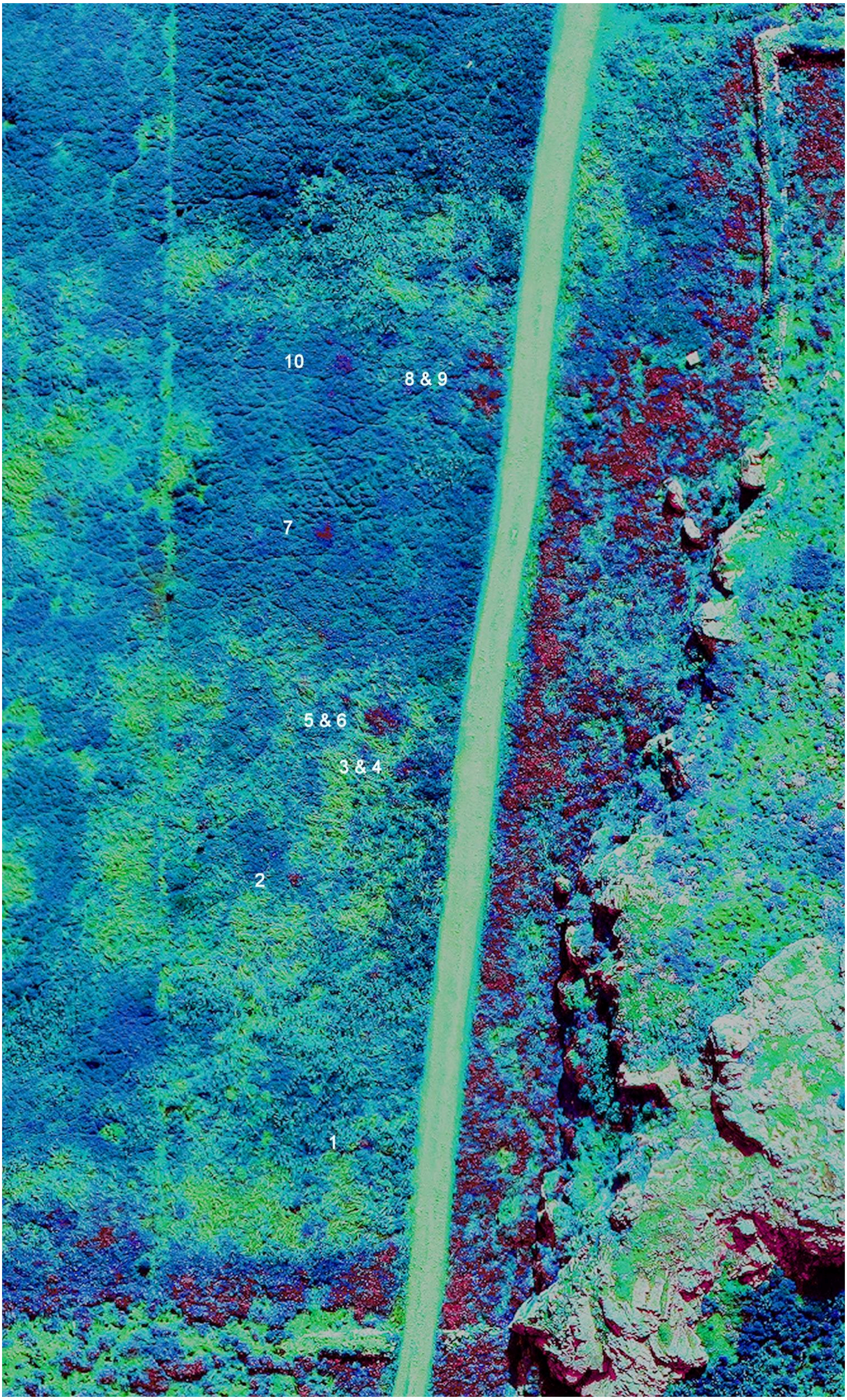
Fig Vegetation survey; Field 5 (CalvesPark), May 1983

3.8.1 Field 5: Calves Park (2017)

Teucrium

Bluebells




10
8 & 9
7
5 & 6
3 & 4
2
1

Scarlet Pimpernel

3.8.2 Field 18

May 2017

August 2017

3.8.3 Field 15

May 2017

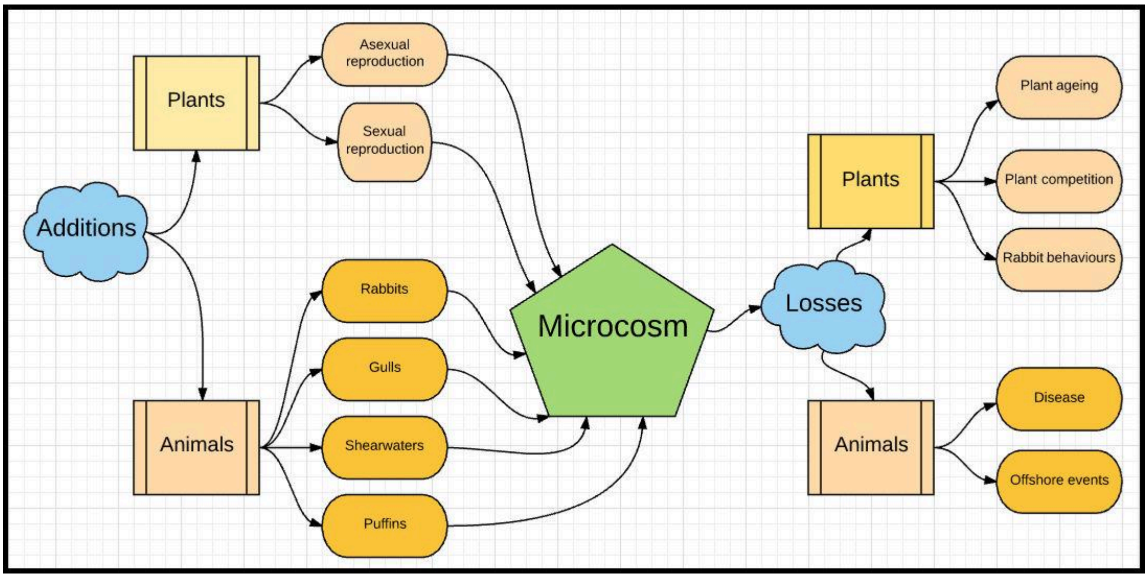
August 2017

3.9 North Valley Crossing

4 Microcosm dynamics

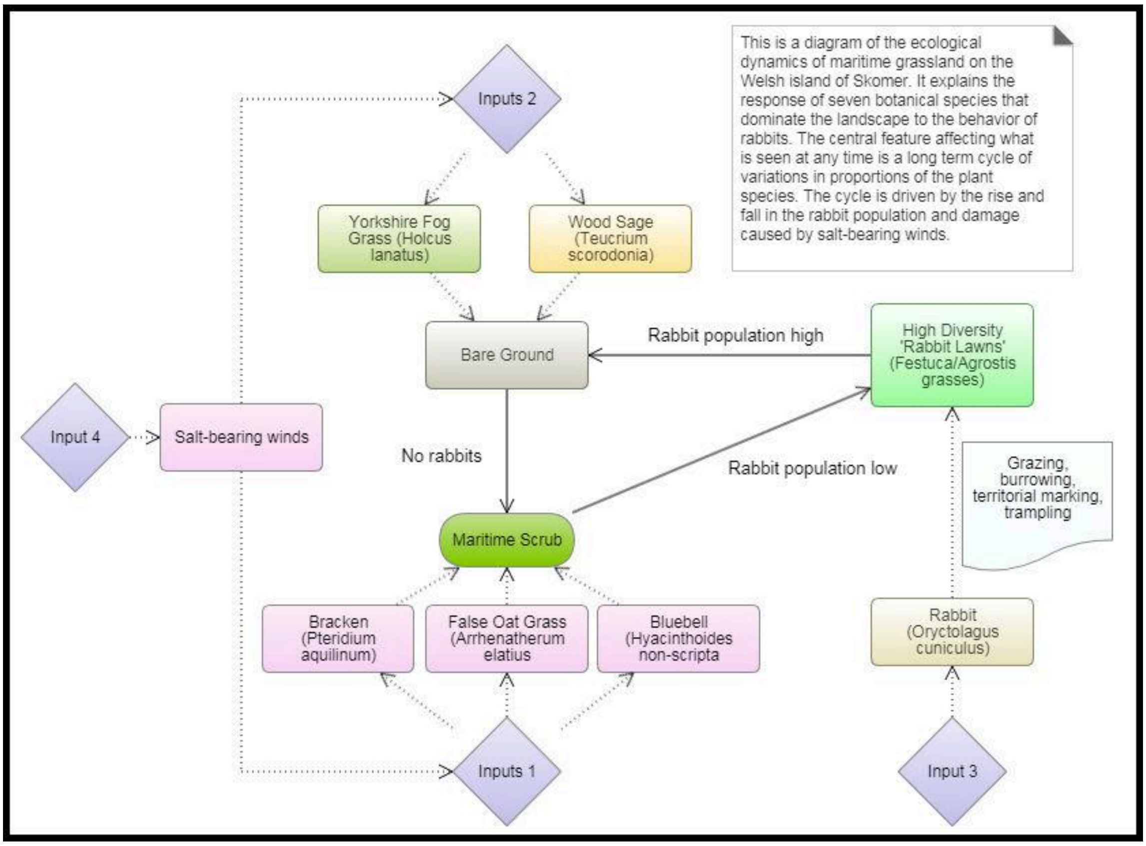
Every microcosm has distinct inputs of external factors like light, water, mineral nutrients which interact with variable environmental factors such as temperature and weather. Resources are distributed heterogeneously at various scales, including at scales relevant to individual plants. This heterogeneity is the basis for the existence of visually distinct botanical constellations on Skomer, which at any one time are maintained in a dynamic state through changes in the additions and losses of plants and animals. (Figs 1 & 2)

Fig 4.1 Flow diagram of a microcosm



The island is a good place for studying the growth, reproduction and ageing of common place plants in microcosms and the evolution of clumping and cloning.

Fig 4.2 Fig Ecological dynamics of Skomer grassland



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Appendix 1 Tonal Mapping of Vegetation

Saturation is the purity or vividness of a colour, expressed as the absence of white. A color with 100% saturation contains no white. A color with 0% saturation corresponds to a shade of gray. A hue is the property that defines a particular color. For example, blue, green, and red are all hues.
Hue refers to the actual color (such as red or yellow). Saturation is the vividness of the color. Imagine bright orange, which is a highly saturated color. As the saturation is reduced (keeping the hue and lightness unchanged), the orange color becomes brownish, then taupe, and finally a middle neutral gray (after the saturation has been reduced to zero). Reducing the saturation drains the color away, leaving just the grayscale component. Taupe and mauve are low-saturation colors because they are quite neutral, with just a touch of color. Apple red and banana yellow are high-saturation colors. Saturation is a measure of how different a color is from a neutral gray of the same brightness.
In digital images, increasing the saturation can give the image brilliant color and “punch,” and at very high values can introduce false colour, You can use the Vibrancy control to target only those areas that are low on saturation without affecting the rest of the image.

Corel PaintShop Pro gives four ways to alter the hue and saturation of a selection or of an entire image:

•You can replace all colors with a single color and saturation while leaving the lightness values unchanged.
•You can shift all colors and change their strength and lightness. Changing the hue shifts all pixels in an image to a different point on the colour wheel. For example, if you change the red pixels to green, the green pixels turn to blue, and the yellow pixels turn to cyan. Adjusting the saturation changes the amount of gray in a color. (The level of gray increases as the saturation decreases.) Adjusting the lightness changes color brightness.
•You can replace one or more colors. For example, you can shift all greens to blues. You can also change the saturation or the lightness. When you adjust these values, all colors (both original and shifted colors) are adjusted.
•You can adjust only the least saturated colors in the image using the Vibrancy control and thus leave unaltered those pixels that are already relatively saturated. The result is that you will get a general improvement in the saturation in the colors of an image.

Appendix 2 Pease Bay Microcosms

file:///home/chronos/u-86da6e328062dbffbe27accbc67d76d51cfd9c4d/MyFiles/Downloads/Site_Management_Statement_1276%20(1).pdf

Narrow band of maritime MC8 or MC9 grassland between stream and beach with *Tripleurospermum maritimum*, *Cochlearia officinalis*, *Plantago lanceolata* and *Prunus spinosa* scrub.
Headland comprises a mix of *Pteridium aqulinum*, *Arrhenatherum elatius* and *Hedera helix*.
Patch of maritime grassland dominated by *Festuca rubra*.
Marshy area, spring fed, dominated by *Valeriana officinalis*.
Dense *Hippophae rhamnoides* scrub on the steep sides of Rams Heugh.
This area comprises mostly *Pteridium aquilinum* and *Rubus fruticosus* scrub.
Narrow band of maritime grassland with *Armeria maritima*, *Plantago maritima* and *Cochlearia officinalis*.
Small area of SM16 saltmarsh backed by *Honckenya peploides* strandline and *Festuca rubra* maritime grassland with some yellow horned poppy (*Glaucium flavum*) and *Carex distans*.
A mixture of *Arrhenatherum* grassland, *Pteridium* and *Ulex* with spring fed marsh dominated by *Filipendula ulmaria*.
Steepest sections here support *Festuca rubra*, *Armeria maritima*, *Thymus polytrichus*, *Pimpinella saxifraga*.
Small patch of *Phalaris arundinacea*.
Dense area of *Hippophae rhamnoides* scrub with hawthorn, elder and willow scrub.
Frequent teasel here.
Narrow band of *Leymus arenarius* at shore front.
A mosaic of *Arrhenatherum* grassland, *Ulex* and *Hedera* scrub.
Very steep cliffs supporting dense scrub communities with *Pteridium*, *Luzula sylvatica*, *Hedera helix*, *Crataegus monogyna*, *Prunus spinosa*, *Ulex europaeus* and some *Calluna*.
Hedera helix, *Luzula sylvatica*, *Prunus spinosa* and *Calluna* on rocks.
This area supports species poor *Arrhenatherum* grassland at the top of the slope with more diverse MG1 further down *Luzula sylvatica* and *Hedera helix* on rocks plus some *Calluna*.
Flushed area with *Juncus inflexus*.
Spring fed marshy area with *Filipendula ulmaria* and *Juncus inflexus*.
Outcrop with much *Calluna*. Possible remnants of H7 maritime heath.
More diverse *Arrhenatherum* grassland along path. Very steep cliffs with maritime grassland dominated by *Festuca rubra* with plentiful *Armeria maritima* and some *Calluna vulgaris*.
Dune grassland with *Ammophila arenaria* and *Arrhenatherum elatius*.
Steep slopes with species poor MG1 *Arrhenatherum* grassland at the top and more diverse *Arrhenatherum* further down. Flushed sections support *Filipendula ulmaria*.

Appendix 3 South Plateau: a Place for Poetry

This tiny patch of land,
A mere scratch,
Is a place of artful intersections,
With a wild will of its own
Where invaringly we stumble into
Earth's blind operating system;

A place of growth without cultivation
Spinning threads of wildness
Beyond the so called bounds of nature,
Embattling people with the natural,
Our educational impediment
To binding the wild around and within us.

A mere speck;

But if we have the luck to become
Free of our self willed stickiness
To being wilfully human
We see the ever recomposing wild
We live with becoming more;

A jigsaw of collective memory,
Assembled by selective death,
There is peace in everything,
Promulgated in the soft language
Of rocks connecting the dots
Revealing teeming lives
Making their dependent ways
Through a cyclic amalgam
Of soil grass and water,
The familial entanglement of co creation,
Where wild is the human condition
And we are astride the seesaw.

An example of cultural ecology

Ecological constellations

Clonality

A clonal colony or genet is a group of genetically identical individuals, such as plants, fungi, or bacteria, that have grown in a given location, all originating vegetatively, not sexually, from a single ancestor. In plants, an individual in such a population is referred to as a ramet. In general, stolons grow above ground and rhizomes are below ground. Rhizomes tend to be light colored (often white) and appear very smooth and fleshy. Like roots, they initiate below a plant's crown. Stolons generally look similar to regular stems. They can be just about any color including white and can sometimes have leaves. A stolon is one of many possible stems radiating from a plant's crown. They initiate from the crown like any other stem. Strawberries send out runners. Some Botanist don't consider runners to be stolons. By itself, a runner is not a self-sustaining structure, merely a connector between ramet and mother plant. Runners have a rosette of leaves at their terminal point, stolons do not. Technically, both stolons & rhizomes are modified, horizontal stems, not roots, though roots can form at their nodes.

sms rendered as contoured pictures

Skomer drone flights

https://www.fs.fed.us/database/feis/plants/graminoid/hollan/all.html#INTRODUCTORY

Maritime cliff and coastal habitats
http://jncc.defra.gov.uk/pdf/CSM_coastal_cliff_slope.pdf

http://www.culturalecology.info/pastoralism/thoughtData/15.html

Oenanthe crocata subcommunity (S26c)
Molinia wetland S24-6

Potentilla growth
http://www.pakbs.org/pjbot/PDFs/47(3)/21.pdf

Prunella
https://link.springer.com/article/10.1023/A%3A1024460525317?no-access=true

Strawberry
http://www.hort.cornell.edu/expo/proceedings/2012/Berries/Berry%20Plant%20Structure%20Poling.pdf
https://link.springer.com/article/10.1007/BF00377637

See onlinw flow diagram

Ridge and furrow

Ridge and furrow in wales

Wales 2

Management plan

Artful science

A wide variety of leaf sizes, shapes, and displays has evolved in plants, presumably so that energy gain can in some sense be optimized in different environments. Some species have specialized in rapid growth of the stem so their leaves will be in high light, above their neighbors. At the other extreme, small understory species exhibit little growth in height and instead must survive in conditions other species cannot tolerate. Wild strawberries are an example of this second group; strawberries are herbaceous perennials with leaf blades rarely higher than 25 cm above ground. A single genotype of strawberry, via clonal reproduction, also may experience a wide range of environments over successional time.

Leaves of such species will be required to perform in quite different environments during any one growing season and over the life of the genotype. How do strawberries and similar species meet the requirement of one genotype producing sets of leaves that perform satisfactorily in different conditions? From the opposite perspective, we may ask what the effects of different environments are on leaf carbon gain, assuming carbon gain is a major factor limiting growth in shaded environments (see Jurik 1983). Are there particular strategies (sensu Harper 1967) or adaptations which may be useful in given types of environments ? Despite the importance of leaves, only recently have a few studies of leaf dynamics appeared (e.g., Bazzaz and Harper 1977, Jow et al. 1980, Lovett Doust 1981, Robertson and Woolhouse 1984). Although carbon balance models have been used widely in the last few decades for examining plant growth, the use of such models for evaluation and interpretation of leaf structure and function (e.g., Mooney and Gulmon 1982) is relatively unexplored. This study analyzes the effects of environment on leaf size, longevity, turnover, and carbon gain. We investigated patterns of leaf characteristics for five field populations of wild strawberries. Simulations of carbon gain in different environments were then used to explore the effects of various leaf characters in each environment and to suggest possible adaptive significance.

Pease Bay

he maritime heath is dominated by heather (*Calluna vulgaris*), bell heather (*Erica cinerea*) and western gorse (*Ulex gallii*).

.

with spring squill (*Scilla verna*), wild carrot (*Daucus carota*), kidney vetch (*Anthyllis vulneraria*) and sea plantain (*Plantago maritima*). The Red Data Book western clover (*Trifolium occidentale*) and the nationally rare hare's foot clover (*Trifolium arvense*) grow here as well as hairy bird's-foot trefoil (*Lotus subbiflorus*) and bird's-foot fenugreek (*Trifolium ornithopodioides*). Large areas are covered by scrub, dominated by gorse (*Ulex europaeus*) and blackthorn (*Prunus spinosa*) and provide habitat for invertebrates and birds. Common dodder (*Cuscuta epithymum*) parasitises the gorse. A number of wet flushes occur along the coast dominated by common reed (*Phragmites australis*). A small area of woodland dominated by elm (*Ulmus glabra*) and sycamore has developed on abandoned horticultural plots.[5]

Pease Bay SSI Headland comprises a mix of Pteridium aqulinum, 01-Aug-04 FM Arrhenatherum elatius and Hedera helix.

A mixture of Arrhenatherum grassland, Pteridium and Ulex with spring fed marsh dominated by Filipendula ulmaria.

A mosaic of Arrhenatherum grassland, Ulex and Hedera scrub.

This area supports species poor Arrhenatherum grassland at the top of the slope with more diverse MG1 further down Luzula sylvatica and Hedera helix on rocks plus some Calluna.

More diverse Arrhenatherum grassland along path. Very steep cliffs with maritime grassland dominated by Festuca rubra with plentiful Armeria maritima and some Calluna vulgaris.

Steep slopes with species poor MG1 Arrhenatherum grassland at 01-Aug-04 FM the top and more diverse Arrhenatherum further down. Flushed sections support Filipendula ulmaria.

Mesotrophic grassland The majority of the cliff vegetation at Pease Bay is composed of mesotrophic grassland dominated by Arrhenatherum elatius. Along the top path and upper slopes of the cliffs where soils are deeper, this is quite impoverished and contains large amounts of ruderal species such as Cirsium sp. and Heracleum sphondylium. Festuca rubra and Elymus repens are also very common indicating the Festuca rubra sub-community (MG1a) and possibly the MG1b Urtica dioica sub-community. Further down the slopes, where soils are slightly thinner, the sward becomes more diverse with the appearance of forbs such as Centaurea nigra, Agrimonia eupatoria and Knautia arvensis. Although not entirely convincing this indicates a transition to the MG1e Centaurea nigra sub-community.

The site comprises a stretch of the Scottish Borders coastline famed for its coastal geology. Sand, rock and water make up the majority of the site, however, the steep cliffs support mesotrophic grassland communities dominated by Arrhenatherum elatius (MG1) that are generally quite species poor but can be more diverse on the steeper sections.

P anserina
http://archive.bsbi.org.uk/Wats8p135.pdf
Clonality in plants is widespread and includes species that span temporally and spatially heterogeneous environments. Yet, theory predicts that clonally reproducing plants (clonals) evolve at slower rates than plants that reproduce sexually (sexuals). Clonals risk accumulating more mutations than sexuals, and potentially lack the benefits of DNA repair mechanisms afforded by meiosis. Does the apparent success of clonal plants contradict the severe costs of clonal reproduction suggested by theory? However, the question remains as to how epigenetics may confer ecological advantages to clonals that could outweigh these evolutionary costs.

A reliance on vegetative reproduction provides an opportunity for utilising the capacity to conserve or reverse gene regulation through cell divisions. This has clear potential for optimizing plasticity and acclimation in response to environmental variations. The evolution of clonality may be one of the best examples of organisms taking advantage of epigenetic acclimation as an alternative to the slower mechanisms of adaptation through sexual selection. If epigenetic processes are important in matching organisms responses to the environment, this may prove to be a mechanism that will buffer plants against the challenges of current and future rapid environmental changes.

Clonality
https://www.frontiersin.org/articles/10.3389/fpls.2016.00770/full

1 In natural habitats, essential resources for plant growth are heterogeneously distributed in space, resulting in environmental patchiness with favourable and less favourable microhabitats. Clonal plants may benefit from their ability to share resources between connected ramets experiencing contrasting levels of resource supply. This hypothesis was tested with clones of Potentilla reptans and P. anserina, consisting of a mother rosette and a number of daughters on an attached stolon, grown under homogeneously high and low light conditions, as well as in spatially heterogeneous light environments in which either mother or daughters were shaded. Biomass data were used to carry out an analysis of the costs and benefits of clonal integration.

2 Both species showed high benefits of integration. In P. reptans, connections to unshaded clone-parts enhanced biomass production of the shaded part.

It may be predicted that clonal integration would result in costs to unshaded clone-parts connected to shaded parts. However, unshaded ramets of both species developed higher instead of lower dry weights when connected to a shaded part. Thus, unshaded ramets actually benefitted from integration.

3 It is hypothesized that these unexpected benefits of integration were due to mutual support of connected clone-parts growing in shaded and unshaded patches. The high evaporative demands of the unshaded clone-parts probably resulted in water being translocated from shaded to unshaded ramets while, at the same time, carbohydrates were translocated from unshaded to shaded ramets.

4 We discuss implications of this suggested bidirectional transport of two different resources for the ecological significance of physiological integration in clonal plants and for the notion of habitat heterogeneity.

Biomorphism

The term biomorphism was coined in 105 by the British writer Geoffrey Grigson and subsequently used by Alfred H. Barr in the context of his 1936 exhibition Cubism and Abstract Art. Grigson was born at the vicarage in Pelynt, a village near Looe in Cornwall. His childhood in rural Cornwall had a significant influence on his poetry and writing in later life. As a boy, his love of things of nature (plants, bones and stones) was sparked at the house of family friends at Polperro who were painters and amateur naturalists. Barr as the first director of the Museum of Modern Art in New York was one of the most influential forces in the development of popular attitudes toward modern art. Biomorphist art focuses on the visual power of a nonrepresentational form or pattern that resembles a lliving organism, in whole or part. The creation of biomorphs has connections with Surrealism and Art Nouveau. Henri Matisse's seminal painting Le bonheur de vivre (The joy of Life), from 1905 can be cited as an important landmark. The paintings of Joan Miró are often notable for their playful, bright-colored biomorphs.

A constellation in cosmology is a group of stars that are considered to form meaningful patterns in the celestial sphere, typically representing animals, mythological people, gods or mythological creatures. In astronomy and navigation, the celestial sphere is an abstract sphere, with an arbitrarily large radius, that is concentric to Earth. All objects in the observer's sky can be conceived as projected upon the inner surface of the celestial sphere, as if it were the underside of a dome or a hemispherical screen. Similarly, a constellation in bioogy is a group of organisms that are considered to form meaningful patterns in the biosphere. The biosphere is the layer of planet Earth where life exists. This layer ranges from heights of up to ten kilometres above sea level, used by some birds in flight, to depths of the ocean such as the Puerto Rico trench, at more than 8 kilometres deep. These are the extremes. In general the layer of the Earth containing life is thin: the upper atmosphere has little oxygen and very low temperatures, while ocean depths greater than 1000 m are dark and cold. In fact, it has been said that the biosphere is like the peel in relation to the size of an apple.

The celestial sphere is a practical tool for spherical astronomy, allowing astronomers to plot positions of stars. The biosphere is also a practical tool that allows biogeographers to plot the positions of plants and their associated animals. For the purposes of research the biosphere is broken down into smaller units. For example, a biome is a geographical area related to a climatic zone that is very large in size. Each biome has certain groups of animals and plants that are present within it. They are able to thrive there due to their ability to adapt in that particular type of environment. The smallest functional units of the biosphere have been defined as microcosms. little worlds or worlds in miniature as opposed to biomes which are macrosoms representative of greater worlds.

But more than this it is through the concept of constellations that we observe we are part of something greater. Imagine a constellation in the sky – a grouping of stars where each star has an invisible string of energy connecting one to another and to Earth's biosphere. In our aliveness on Earth, we, and all living earthly beings, have our origins in a common system of cosmic evolution and are tethered to past starbursts in which stars and all life forms are as one. We can see that the systems creating stars and producing the structure of bacteria are governed by the same fundamental processes. We can detect the link between the hottest fusion reactions in gamma bursters and the essential metabolic reactions which give rise to, and sustain, life.

In a biological sense, depicting systemic constellations is a method of ecosystems analysis for revealing and re-aligning hidden links within groups of tightly bonded species. Like the study of stellar constellations, detecting ecological constellations it is a visual process for revealing the hidden dynamics between life forms. Since the origins of humankind, the physical environment has been profoundly shaped by the countless ways people make, modify, and interpret the places they inhabit or use. Conversely the environment has always shaped the material possibilities through which people can order their existence.This reductionist approach can be taken to the level of human families. For example, 'Systemic Family Constellations' describes a form of group psychotherapy that addresses current day to day problems of individuals at their source, in their family's past; 'Systemic Botanical Constellations' is a form of grouping plants according to the visual patterns they make in order to understand their place in the biosphere and their relationships with humankind.

http://fire.biol.wwu.edu/trent/alles/Cosmic_Evolution.pdf

https://www.permaculture.org.uk/education/course/ecological-constellations-mapping-systems-and-voicing-wild-2013-11-18

https://panoramas.guggenheim-bilbao.eus/en/surrealism-and-abstraction#there-motion-has-not-yet-ceased

In the early 1930s, Jean Arp developed the principle of the “constellation,” employing it in both his writings and artworks. As applied to poetry, the principle involved using a fixed group of words and focusing on the various ways of combining them, a technique that he compared to “the inconceivable multiplicity with which nature arranges a flower species in a field.” In making his Constellation reliefs, Arp would first identify a theme or set—for example, five white biomorphic shapes and two smaller black ones on a white ground—and then recombine these elements into different configurations. The Guggenheim Museum’s work is the last of three versions that Arp composed on this theme. His work, like Joan Miró's, engaged Surrealism at the level of process, for he used automatist strategies to get beyond the constrictions of rational thought. Jean Arp sought to devise an abstract art that would represent a truer indication of reality than representational art, because the way in which it would be created would echo the ways in which nature itself creates. He was using the artistic concept of constellation to investigate the environment as both a material and imaginary field through which social and cultural relations are represented and constituted.

Constellation According to the Laws of Chance c.1930 is a small rectangular painted wooden relief by French artist Jean (Hans) Arp. Eight monochrome biomorphic forms have been painted or placed onto the surface of a white painted board. These include three white wooden ovoid forms that sit in low relief casting shadows when under light. They are arranged among five black forms which have been painted directly onto the white background. Three of the black shapes are clustered in the centre but extend towards, and in some cases touch, the white forms, while two others seem to be either entering or leaving the composition, pushed into the lower left corner and top of the frame respectively. The white wooden frame both enhances and extends the composition, mirroring the white relief shapes within it.
It is likely that this relief was produced in Meudon, near Paris, in the studio to which Arp had moved in 1928. The white wooden forms were ordered from a craftsman and subsequently placed by the artist alongside the black shapes he had painted. It is unclear in which order the forms were added but it is evident that Arp determined the composition. In 1983 the collector Pierre Bruguière recalled how Arp, from 1930 onwards, often moved wooden shapes around in his reliefs before deciding on their definitive form (Robertson 2006, p.156). This relief shows Arp’s preoccupation with abstracted biomorphic forms inspired by constellations of natural forms such as stars and clouds, and his attempts to develop what he referred to in 1957 as an ‘object language’ based on a small number of similar shapes (quoted in von Asten 2012, p.86). He referred to such forms as ‘cosmic shapes’ and is quoted in a posthumous publication of 1972 stating that ‘the forms that I created between 1927 and 1948 and that I / called cosmic forms / were vast forms / meant to englobe a multitude of forms such as: / the egg / the planetary orbit / … the bud / the human head / the breast / the sea shell / … I constellated these forms “according to the laws of chance”’ (quoted in von Asten 2012, p.57). The black and white cell-like shapes of Constellation According to the Laws of Chance express Arp’s deep-seated interest not in replicating the precise forms of nature, but in creating art based on the generative power of nature, like ‘fruit that grows in man, like a fruit on a plant or a child in its mother’s womb’, as Arp stated in 1931 (quoted in Anna Moszynska, Abstract Art, London 1990, p.113). The organic forms in this image coupled with Arp’s tendency to reposition objects indicate this desire to develop abstract art organically through the process of making.

Art historian Eric Robertson has suggested that Arp's measured approach to the construction of his reliefs, combined with their 'high degree of finish', may seem 'incongruous' with the word 'chance' in many of their titles (Robertson 2006, p.156). However, the element of chance was manifest both in Arp's rearrangements of the reliefs, which indicate that he did not have a premeditated plan, and also in the making of the white forms themselves: Arp reportedly gave only ambiguous instructions to the craftsman so as to encourage free interpretation.

In 1955 Arp described how black and white shapes could 'equal writing' (quoted in Robertson 2006, p.150). Robertson has emphasised the dominance of these colours in Arp's work of the 1930s and 1940s but has pointed out that the 'spatial distribution' of forms within Constellation According to the Laws of Chance is 'more complex' than in most reliefs:

The forms continue to designate separate spatial realms, but the similarity of their shapes suggests not so much a tension as a relationship of complementarity in the balancing of opposites … The physical proximity of some of the white relief shapes and the black forms, whose edges occasionally touch, suggests objects of indeterminate scale moving and intersecting through three-dimensional space, an interpretation that Arp's choice of title, 'constellation', consciously invites.

(Robertson 2006, p. 150.)

Constellation According to the Laws of Chance belongs to a body of work titled Constellations that Arp had likely begun to produce in 1928. Early examples, such as Constellation 1928 (Arp Museum Bahnhof Rolandseck, Remagen), often show Arp experimenting with white wooden shapes on a white background. He continued to develop the dominant themes of this piece throughout the 1930s in his wooden reliefs such as Constellation with Five White Forms and Two Black, Variation III 1932 (Solomon R. Guggenheim Museum, New York) and papiers déchirés including According to the Laws of Chance 1933 (Tate T05005). At the time of the production of Constellation According to the Laws of Chance Arp was closely associated with dada and surrealism, both of which fostered an interest in the disruptive possibilities of chance operations as well as the flux and movement of biomorphic forms. Arp's wooden reliefs also influenced artists such as Henry Moore and Joan Miró.