

# Interpreting Aerial and historic photography to ascertain vegetation dynamics over time on Copeland Bird Observatory

## Interpretation approach

A number of photographs of the islands vegetation over the years were sourced, taken by CBO members Sandy McWilliams and Ian McKee.

Each can be interpreted and an assessment carried out to estimate the areas that were covered by the following vegetation categories:

Group 1. Dry grassland.

Group 2. Wet grassland.

Group 3. Tall-herb vegetation.

Group 4. Bracken dominated tall vegetation.

These are the categories described in the main text.

Aerial photography, including Bing maps, Google maps, and aerial photos taken by Sandy McWilliams can be used to identify areas of Group 4 and Group 3, and attempt to separate these from the Group 1 and 2 Grassland types. Group 3 and 4 can be separated, however group 1 and group 2 can only be separated combining the images with knowledge of the land forms, unless surface water can be seen. In addition, for aerial photographs taken in late Autumn, through Winter and Spring, areas of red campion and grasses that are under bracken in the Summer can be difficult to separate (groups 1 and 3).

It is obvious that the seasons or times in the year that the photographs were taken needs to be taken into account. Bracken fronds only emerge in May and have a partial height and density until mid-July. Likewise, Ragwort, thistles, hogweed, and Himalayan balsam only become noticeable after they have reached a certain size, normally in June/ early July.

Aerial photographs taken in July and August can therefore be used to estimate whether any particular area is covered in dense bracken, or tall herbs, using colour, texture (indicating uniformity, or patchiness). In addition, as with tree plantations but to a lesser extent, shadows alongside paths are an indication of height and density of bracken.

Ragwort flowers can show yellow, if they have been allowed to mature to flowering stage in July, and had not been mown up to that point in the season.

Bracken in Autumn tends to brown off quickly if strong winds combined with low soil moisture content is experienced. This is a gradual process through to late Autumn, when bracken litter is obviously lying on the ground as it is the only significant cover of vegetation that is obvious that turns brown. Lower density bracken is less pronounced, particularly if there is a grassy sward within or underneath. However, even then, bracken fronds can be seen occasionally.

As winter progresses, the bracken litter breaks down, such that by March and April, it cannot be seen unless it was very dense. These areas are conspicuous because they are obviously not covered in a dense grassy sward. However, if the grassy sward is in poor health and cover, for example after a death due to drought in previous years, then the contrast between bracken dominated ground (group 4), red campion and grassy sward (groups 3, 1 and 2) may not be apparent through the winter.

Red campion remains green and noticeable throughout the year, since even in winter it appears to grow slowly.

Land based photographs can be interpreted in much the same way as aerial photos. There is added value in comparing these with the aerial photographs, since foregrounds can add confidence to the conclusions. They can be important for separating red campion from grasses.

## Photographic analysis through the years

The aim of this document is to describe the vegetational changes that have occurred from the 1970s through to present day, paying particular attention to the cover of bracken. As outlined above, land-based photographs can help refine the conclusions drawn from aerial photographs.

Year, date if available, and photographer will be noted beside each photograph. A description of what areas are shown, with conclusions will be stated, with a rough estimate of the various proportions of each vegetation category that can be seen within the whole photograph, and a confidence measure stated against each.

Photographs will be in order of when they were taken, and not by site. For example, some of a particular site will appear scattered throughout.

Photograph 1



**Date/Season/year:** Estimated early Spring, 1977.

**Photographer:** Sandy McWilliams

**Areas shown:** appears to be along the main ditch/bank/old wall running from South Path to Well Path, with Sandy standing around the place where the later South Alley Path came up to meet it. The brow would have been where the Well Path crossed left to right, towards the house and top of the island.

**Conclusions:** There is a clear line of dense bracken remains from the previous years growth. It is striking to note that the foreground is made up of category 1 (dry grassland), cropped close by rabbits. This area was dominated with Bracken (category 4) by approximately 2005, with the flat area to the middle left of the photo many years before that.

**Proportion of group 1 category:** Foreground 75% (certain)

**Proportion of group 3 category:** An area of longer grass to the left in front of the bracken may have some red campion within it, 5% (uncertain)

**Proportion of group 4 category:** the distance has a dense cover of bracken, making up 20% of the area in this photo (certain)

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Photograph 2



**Date/Season/year:** April, 1977.

**Photographer:** Sandy McWilliams

**Areas shown:** The top of the cliff, with Cliff path leading towards the centre.

**Conclusions:** Bracken free, close rabbit cropped grasses, possibly some sea campion in the middle foreground (the hummocks), but these seem remarkably low lying.

**Proportion of group 1 category:** 100% (fairly certain)

**Proportion of group 3 category:** It is possible that some low density and small bracken fronds were present the year before (uncertain)

It is useful now to study some aerial photo graphs and compare them with the above land-based ones. The photo below was taken by Sandy, the date is uncertain, but thought to be in 1980, 3 years after the above photographs were taken.

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Photograph 3



**Year:** thought to be 1980

**Season:** Winter

**Photographer:** Sandy McWilliams

**Areas shown:** Gully, part of Gully Bridge, House, North Garden, Cricket pitch, Well Path, Alley, East Alley path, across to South Path and pond.

**Conclusions:**

The bracken area to the South of Well Path (right hand side in this photo) is limited and not within 20 metres of the ditch/mound/wall correlating with the area shown in the photo 1 above. The darker brown, almost black areas both sides of the Well Path are of seeding ragwort. Note the extensive lazy beds, across the whole of the North West quarter of the island. Note the very thin band of bracken across the Cricket pitch, correlating with the description by Neville McKee in his article in the 1982 annual report *"Some strips of bracken have been identified over the years as being on the move. Long strips of dense bracken trail across the top of the island and on the dry western grassland west of the garden. The most obvious one is from the pond to the well path. The band is moving slowly North East. The leading edge is sharply defined but areas behind are left with a light scatter of fronds. A total area (on the whole island) of around 8 acres are dominated by bracken."*

Neville also told the following (pers. Comm, 2019): *"In the early years, up to about 1960, the paths north of the well, gully trap, and northern third of North garden, everywhere north of North garden wall, and the slope down to the shag roost were all inaccessible from June to at least end of September. Efforts were made with scythes to create tracks for access. By 1960 one man, called Ormond Hall, helped by me, regularly scythed the paths and connections towards the top of the island right round the north. I remember doing the path along the north wall for years by scythe. The bracken was well over my height, and I was*

*over 6'3". It was very hard going. We took a week specially to do that at the start of July. The bracken was up to 8 feet tall in the dips.*

We can conclude that the brackens vigour varied over the years, fitting in with studies concluding it can increase and decrease in vigour, related to the health of rhizomes, and being replaced by new fresh rhizomes. The driver for the variation in vigour may be soil wetness, as water is lying in the furrows in the above photograph.

8 acres represents 20% of the islands land area. It is worth bearing this in mind when viewing more recent photos.

**Proportion of group 1 category** 20% shown by the long rougher grassy areas (fairly certain)

**Proportion of group 2 category** 5% (certain) The bases of the ditches and hollows have standing water in them. The middle bottom of the photo shows the upper half of the Gully Bridge area.

**Proportion of group 3 category** 25% (fairly certain) The areas of ragwort are prominent, and would probably have extended further than shown on this aerial, due to the variable density of stems and because smaller less dense stems would not show up on this aerial.

**Proportion of group 4 category** 30% (fairly certain)

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Photograph 4



**Year:** unknown, but thought to be 1980 since the fence in the North garden has been erected, but there are no noticeable trees growing yet, although they are undoubtedly present, just too small to see from this distance. This photo was probably taken on the same flight as photo 3, however the exposures are very different, probably as a result of the angle of the sunlight.

**Season:** Winter

**Photographer:** Sandy McWilliams

**Areas shown:** House, North Garden, Small triangle in front of house, Heli-bushes paths, Radar.

**Conclusions:**

Cricket pitch – the band of bracken heading north into the south garden wall tallies with the previous photograph 3 in 1980.

South Garden – the very dark areas are thought to be Comfrey and Himalayan Balsam plants from the previous year, same in North garden and Heli-bushes.

North Garden – The bracken area is expansive, with a significant part of the main area that was restored, already covered in bracken. Soils are deep here, but perhaps the ditch was more effective than latterly. The current 2018 condition is a good example of Group 2 category, due to the drain not being effective, and more like a semi-natural type.

Radar – looks like tall grassy sward with dense bracken, very unlike the 2018 condition, which is close cropped with a high proportion of pearlwort, after 19 years of mowing treatments.

**Proportion of group 1 category:** 20% (fairly certain)

**Proportion of group 2 category:** 10% (fairly certain)

**Proportion of group 3 category:** 20% (fairly certain)

**Proportion of group 4 category:** 40% (fairly certain)

**Proportion of trees/woodland:** 10% (certain)

Photograph 5



**Year:** 1980

**Season:** Summer (July)

**Photographer:** Sandy McWilliams

**Areas shown:** Front of house small, Cricket pitch

**Conclusions:**

Front of house small –Ragwort, perhaps some slender thistles (group 3), with good edge of grasses.

Cricket pitch – the band of bracken is clearly shown, with dense broad band of ragwort flowering in front.

**Proportion of group 1 category:** 10% (certain)

**Proportion of group 2 category:** 10% (certain)

**Proportion of group 3 category:** 60% (certain)

**Proportion of group 4 category:** 20% (certain)

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Photograph 6



**Year:** 1981

**Season:** early Spring

**Photographer:** Sandy McWilliams

**Areas shown:** Front of house small, Cricket pitch, Cliff path

**Conclusions:**

Front of house small – bracken and ragwort, perhaps some marsh thistles, with good edge of grasses around the right side (between South and Cliff paths). Left side dominated with bracken.

Cricket pitch – the band of bracken is clearly shown, with some tall grasses behind. The darker brown front band is probably ragwort (see previous photograph 5)

Cliff and South paths – narrow and bracken growing along edges.

**Proportion of group 1 category:** 20% (certain)

**Proportion of group 2 category:** 10% (certain)

**Proportion of group 3 category:** 35% (certain)

**Proportion of group 4 category:** 35% (certain)

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## Photograph 7



**Year:** February 1985

**Season:** Winter

**Photographer:** Sandy McWilliams

**Areas shown:** all

### **Conclusions:**

Front of house small – bracken dominated, with paths cut through it.

Cricket pitch – the remnants of the band of bracken is shown, but most appears to be grassland, and the bracken had probably been cut with the Agria Sickle mower in the previous season.

Cliff and South paths – narrow and bracken growing along edges, though appear less dense than previously?

North Garden – of the recently restored part, there is a large long triangle of bracken.

Alley – the bracken has not yet reached the ditch/mound/wall part shown in the first land based photo from 1977. Most of Alley is grassy or no more than category group 3.

North West sector – 40% is no more than low density of bracken.

**Proportion of group 1 category:** 15% (fairly certain)

**Proportion of group 2 category:** 5% (uncertain)

**Proportion of group 3 category:** 30% (uncertain)

**Proportion of group 4 category:** 40% (certain)

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Photograph 8



**Year:** February 1985

**Season:** Winter

**Photographer:** Sandy McWilliams

**Areas shown:** all, from opposite direction than previous photo 6.

**Conclusions:**

As in previous photograph 7, plus:

Cliff – The rounded rock known as the ‘Mole’ is seen, bracken is south of it, but most of the flat area towards the cliff is not covered in dense bracken. There is a band of bracken free grasses of perhaps category group 3 vegetation to the west of the Cliff path. This was probably cut with the Agria Sickle mower.

East Alley – Largely bracken free, apart from some limited patches near the South path.

South Path – the grey vegetation is probably hogweed remains from previous years growth, also present on East Promontory, in between the Elder bushes.

Proportion of group 1 category: 15% (fairly certain)

Proportion of group 2 category: 5% (uncertain)

Proportion of group 3 category: 30% (uncertain)

Proportion of group 4 category: 40% (fairly certain)

Please see over/

Photograph 9



**Year:** 1986

**Season:** Summer

**Photographer:** Sandy McWilliams

**Areas shown:** all, especially Cliff,

**Conclusions:**

Interesting to see the red campion showing pink, including across that area around the East Alley, west of the South path. This indicates this area was already category group 3, and not grassy as suggested in previous photographs. Himalayan Balsam does not appear to be visible, but is there, e.g. in Heli-bushes. The pink area at the north end of the North Garden is suspiciously pink, this was a mixture of Himalayan Balsam and bracken, with only some red campion.

The bracken is showing light green. The Well Path is clearly shown as a thin darker line, and the edge facing us at the back of the Alley is a good example of this contrast.

Photo by Sandy McWilliams from summer 1990 of North garden showing the Himalayan Balsam:



As in previous photograph 8, plus:

Cliff – The rounded rock known as the ‘Mole’ is seen, bracken is south of it, but most of the flat area towards the cliff is not covered in dense bracken. There is a rectangular band parallel to the west of the path of bracken free grasses of perhaps category group 3 vegetation. This was probably cut with the Agria Sickle mower.

East Alley – Largely bracken free, apart from some limited patches near the South path.

South Path – the grey vegetation is probably hogweed remains from previous years growth, also present on East Promontory, in between the Elder bushes.

**Proportion of group 1 category:** 10% (fairly certain)

**Proportion of group 2 category:** 5% (uncertain)

**Proportion of group 3 category:** 40% (uncertain)

**Proportion of group 4 category:** 35% (certain)

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Photograph 10



**Year:** 1990

**Date:** August/ early September

**Season:** Late Summer

**Photographer:** Sandy McWilliams

**Areas shown:** Cricket pitch, top of Well path.

**Conclusions:**

Cricket pitch – The band of bracken has widened and become more dense than in 1981 (see photograph 3, and subsequent photographs 5 and 6 for example). The paler vegetation is probably a mixture of Yorkshire fog grasses and thistles.

Well Path – note the path is wide with grasses, and bracken is not tall or dense along the edges.

**Proportion of group 1 category:** 35% (fairly certain)

**Proportion of group 2 category:** 5% (fairly certain)

**Proportion of group 3 category:** 30% (fairly certain)

**Proportion of group 4 category:** 30% (certain)

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Photograph 11



**Year:** 1992

**Date:** July/August

**Season:** Summer

**Photographer:** Sandy McWilliams

**Areas shown:** Cliff path. Flagpole, part of Cricket Pitch

**Conclusions:**

The band of Bracken towards the cliff looks to be surprisingly far towards the Cliff, with the area around the Flagpole and East Side showing to be dense Himalayan Balsam. It could be that this area had been cut in the years before with the Sickle mower, weakening the bracken and encouraging the Balsam to spread and thrive here at higher densities than if it was to compete with the bracken. In some areas, Balsam could survive within bracken stands if it was not too dense or tall. However, this illustrates how a native plant can constrain invasion by a non-native plant, and how if the native plant is weakened, it allows non native plants to invade an area unconstrained.

**Proportion of group 1 category:** 5% (certain)

**Proportion of group 2 category:** less than 5% (certain)

**Proportion of group 3 category:** 55% (fairly certain) – mostly Himalayan Balsam

**Proportion of group 4 category:** 40% (fairly certain)

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Photograph 12



**Year:** 1994

**Date:** September/October

**Season:** Autumn

**Photographer:** Sandy McWilliams

**Areas shown:** Cricket pitch

**Conclusions:**

There white clusters and spots are seeding Ragwort plants, showing with a rough texture. This indicates that this area was not managed. The even rusty brown is Bracken.

Alley – grassy, with scattered Ragwort.

Cricket Pitch – compare with Photograph 10 for direct comparison. The bracken band has widened significantly, and the areas shown in 1990 appear to have got taller.

Well Path – bracken along the edges of the path is taller and denser.

**Proportion of group 1 category:** 20% (fairly certain)

**Proportion of group 2 category:** <5% (uncertain) only along South Path.

**Proportion of group 3 category:** 35% (fairly certain)

**Proportion of group 4 category:** 40% (fairly certain)

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## Photograph 13 and 14



**Year:** 2009

**Date:** 24/09/2009

**Season:** Autumn

**Photographer:** Ian McKee

**Areas shown:** This is the area of the Cliff, just to the North East of the Cliff path, leading from the Cliff steps to the house. This area of bracken was continuous with the area to the “mole” until 2008, when the area between was mown and ever since. The isolated piece was mown from 5<sup>th</sup> October 2010 onwards.

**Conclusions:** Reference previous photograph 2 (in 1977)

(Proportions are for the area viewed in photograph 13)

**Proportion of group 1 category:** 15% (fairly certain)

**Proportion of group 2 category:** 0% (certain)

**Proportion of group 3 category:** 35% (fairly certain) – this includes most of the mown treatment area which had prolific red campion cover, see photo below

**Proportion of group 4 category:** 50% (certain)





Photograph 15



**Year:** Probably 2010

**Date:** unknown

**Season:** Summer

**Photographer:** Bing maps

**Areas shown:** All. I would estimate the time at 10:00hrs to 11:00hrs judging by the lie and direction of the shadows (towards NW)

**Conclusions:**

Bracken dominated areas are dark green. The lighter coloured areas are areas of grassland and red campion (groups 1 and 2, and 3). The straw-coloured areas are where the grasses/pearlwort/mosses have died off temporarily due to the drier conditions.



The Alley area, slightly left (west) of centre is the only area of grasses that is not part of the annual mowing programme. Note the large area on the Cliff has not been started yet, as has the bracken areas in the centre of the Gully.

**Proportion of group 1 category:** <5% (uncertain) – would include most of the Cricket pitch

**Proportion of group 2 category:** <5% (uncertain) – would include most of the Gully Bridge and North garden main area

**Proportion of group 3 category:** 10% (uncertain) – includes most of the mowing treatment areas

**Proportion of group 4 category:** 75% (certain)

**Proportion of tree cover** (for completeness): 5% (certain)

The estimates above that are uncertain are because the only way of differentiating groups 1 from 2 from 3 is to map them accurately on the ground. The total proportion of group 1, 2, and 3 is more certain.

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Photograph 16



**Year:** 2016

**Season:** Summer (probably late June/ early July because the Ragwort is flowering (yellow spots and patches))

**Photographer:** Google Maps

**Areas shown:** All. I would estimate the time as between 13:00hrs and 15:00 hrs judging by the lie and length of the shadows.

**Conclusions:**

Similar to Photograph 15, except:

There has been a gradual narrowing of all of the paths e.g. Well Path, South Path, and regression and encroachment of bracken into some of the areas, such as North Garden main. Also, the presence of flowering ragwort means that the areas were not mown prior during this season.

**Proportion of group 1 category:** <5% (uncertain) – would include most of the Cricket pitch

**Proportion of group 2 category:** <5% (uncertain) – would include most of the Gully Bridge and North garden main area

**Proportion of group 3 category:** 10% (uncertain) – includes most of the mowing treatment areas

**Proportion of group 4 category:** 80% (certain)

**Proportion of tree cover (for completeness):** 5% (certain)

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Photograph 17



**Year:** 02/09/2018

**Season:** Late Summer

**Photographer:** Ian McKee

**Areas shown:** South Path

**Conclusions:** The path is narrower than that taken on 11/10/2012 below



**Proportion of group 1 category:** 5% (certain - – centre band of paths and foreground)

**Proportion of group 2 category:** <5% (certain - shallow soil area on path at right hand side)

**Proportion of group 3 category:** <5% (certain - edges of South path)

**Proportion of group 4 category:** 40% (certain)

**Trees/ woodland cover:** 50% (certain)

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Photograph 18



**Year:** 1/8/2010

**Season:** Summer

**Photographer:** Ian McKee

**Areas shown:** Cricket pitch, Well Path, South Path

**Conclusions:** compare with photographs 10, 12, and 19. Well path and South path are wide, bracken looks weak between the two patches beyond the Cricket pitch. There has been a restoration of groups 3 and 4 vegetation to group 1.

Proportion of group 1 category: 35% (certain – Cricket pitch front of house small, Well path and South path)

Proportion of group 2 category: 5% (certain – top of South path, part of South Garden)

Proportion of group 3 category: 15% (certain – between Well path and South Garden wall, within the south garden, and a mosaic of groups 3 and 1 in Alley.

Proportion of group 4 category: 35% (certain)

Trees/woodland cover: 10%

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Photograph 19



**Year:** 02/09/2018

**Season:** late summer

**Photographer:** Ian McKee

**Areas shown:** Cricket pitch, Well Path, South Path

**Conclusions:** compare with photograph 18. Well path is considerably narrower, as is South Path. The two patches of bracken seen in 2010 have filled in and joined up, and the edge appears to have moved towards the house, using the rocky outcrop near the Well path as a marker. Bracken has moved across towards the post in Alley.

Proportion of group 1 category: 20% (certain)

Proportion of group 2 category: <5% (certain – bracken has invaded from far side of Well path at the top, and group 3 invaded part of the South Garden)

Proportion of group 3 category: 25% (certain - increase in Alley, and on Cricket pitch with Ragwort)

Proportion of group 4 category: 45%

Trees/woodland cover: 10% (certain)

Please see over/

Photograph 20



**Year:** 11/10/2012

**Season:** Autumn

**Photographer:** Ian McKee

**Areas shown:** North Garden Main, Eden in distance

**Conclusions:** compare with Photograph 21 below

**Proportion of group 1 category:** 5% (certain – sloping areas in foreground at top of mown area, and at Gully)

**Proportion of group 2 category:** 15% (certain – lower lying flat areas in North Garden)

**Proportion of group 3 category:** 10% (certain – edges of mown area, and recent path looping around the Elder bushes at Pigsty netsite)

**Proportion of group 4 category:** 55% (certain)

**Trees/woodland cover:** 15% (certain)

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Photograph 21



**Year:** 02/09/2018

**Season:** Late Summer

**Photographer:** Ian McKee

**Areas shown:** North Garden Main, Eden in distance

**Conclusions:** compare with Photograph 20 above. Invasion of bracken on North, East and South sides of main area due to absence of mowing this season.

**Proportion of group 1 category:** <5% (certain)

**Proportion of group 2 category:** 5% (certain)

**Proportion of group 3 category:** 20% (certain)

**Proportion of group 4 category:** 60% (certain)

**Trees/ woodland cover:** 15% (certain)

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### Main conclusions:

1. Bracken increase in extent, decrease through appropriate management, then increase again due to reduction in management extent and frequency.
2. Natural Succession from grassland (groups 1 and 2) through group 3, into bracken dominated (group 4) - driven by nutrient enrichment over the years because of an absence of cropping management.
3. Significant increase in bracken cover from an estimated 20 to 30% (ground and aerial estimate respectively) in the early 1980s, to 80% in 2016 (aerial estimate).
4. The increase in bracken cover from the 1980s through to 1990s was in spite of, or perhaps because of the bracken control attempts, using sickle mowers and scythes, leaving the cuttings in situ. This can be elaborated upon, bracken rhizomes response to cutting – rejuvenation of old senescent rhizomes, increase in frond density as a response to damage. Also piles of cuttings suppressing grassy sward, leaving an area more readily invaded by bracken without the exiting competition.