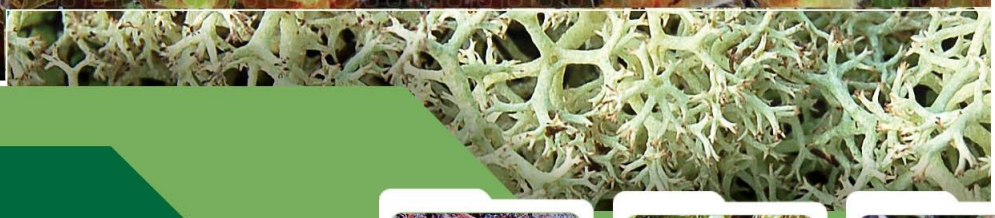

Bryophyte and Lichen Site Dossier of Greenham Common, Berkshire

By Thomas Haynes

March 2009

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Preface:

This project was developed by NatureBureau in conjunction with West Berkshire Council and Natural England. The project aimed to ascertain the current conservation status of Bryophyte and Lichen communities on Greenham Common Site of Special Scientific Interest and also to provide management recommendations with regard to these communities.

This report uses the recommended format for bryophyte and lichen site condition assessment outlined by the JNCC.

The field work, data analysis and site dossier were funded by DEFRA's Aggregate Levy Sustainability Fund, West Berkshire Council and Greenham Common Trust.

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Bryophyte and Lichen Site Dossier of Greenham Common, Berkshire

Site Name: Greenham Common (part of Greenham & Crookham SSSI)

Administration: West Berkshire Council

Site Description: Grid Ref: SU 501 646; Full Grid: 450155, 164671; Long Lat: 51.38, -1.28

Greenham Common is a large site (512ha including Crookham Common) located 1.3 miles SE of the centre of Newbury, Berkshire. Greenham Common is located on a raised plateau strip that is aligned approximately west-east. The site was commandeered for military usage at various times beginning in 1941 and during this period the heath complex was converted to a military airbase which lead to the plateau being artificially widened (Parkin, 1997). In 1995 the sites runways and military installations began to be removed and in 1997 the site was sold by the MOD to The Greenham Common Trust and Newbury District Council (Parkin, 1997). A restoration project began around 1997 with heather seed spreading of former heathland areas and bioremediation of soils polluted by engine fuel.

The site was opened to the public in 2000 and grazing was also introduced to the common (by cattle and ponies) to restore pre-military management of the commons and also to substitute for the regular mowing regime undertaken by the military (Allen, 2000).

The plateau is occupied by the largest extent of open heathland and acid grassland in Berkshire (Porley, 1993) along with areas of secondary woodland, scrubland and a mixture of gravel and stony soil based communities. The sloped edges to the plateau are occupied by steep wet-woodland gullies to the north and south. Imported cement from the construction of the airbase has lead to infiltration of traditionally acid based communities by more calcareous species (Porley, 1993). The introduced substrates and drainage works have also lead to a series of stony scrapes and pools with varying levels of porosity.

Previous Surveys:

In 1988 and 1993 J.W. Bates undertook a number of bryophyte surveys on Greenham looking at various habitats. The surveys highlighted species of local and national importance.

The first report to detail the species of bryophytes and lichens of Greenham Common was a heathland survey undertaken by R.D. Porley in 1993. In this report locally and nationally rare species are highlighted and the conservation value of the site is described. The early successional bryophyte heath community and mixture of calcicole and calcifuge species are indicated as important features of the site. The report concludes that Greenham Common is of considerable importance for lower plants.

In 1994 R.D. Porley and B. Hyder established a site monitoring survey that was repeated in 1996, 1998 and 2000. This study is dealt with in more detail in the Condition Assessment section.

In 1995 F.Rose and R.D. Porley undertook a lichen survey across Greenham Common's heathland. Typical lichens of heathland communities were recorded along with species on flint pebbles and bare, stony soil. The survey concluded that the lichen community was moderately rich.

In 1999, T.A. Hedderson undertook a bryophyte survey expanding Porley's survey into other habitats on Greenham Common. Five additional species were recorded within this survey and 18 species were highlighted that are scarce nationally and/or locally. The report concludes that Greenham Common is of high conservation value for bryophytes.

In 2000 a field excursion was undertaken by members of the British Bryophyte Society to Greenham Common and many of the species highlighted in previous surveys were recorded. 15 extra species were recorded as part of this excursion (Porley, 2000).

In 2008 J. Welsh and R. Longton undertook a Wet Woodland Survey of Thornford Gulley, Ballshill Gully and Handpost Gully. The survey highlights that the bryophyte flora of the Alder (*Alnus glutinosa*) gullies is species rich, including two species of *Sphagnum* that occur rarely within Berkshire.

The following datasets are also of importance with regard to the bryophytes and lichens of Greenham Common which are available for viewing from the NBN Gateway. These data sets include:

- Bryophyte data for Great Britain from the British Bryological Society held by BRC
- Threatened Bryophyte Database
- Field Notebook Records of Dr Francis Rose 1950's to 1990's
- Fungal Records Database of Britain and Ireland

A full species list is included in Appendix 01.

Habitat Survey Methodology:

The following habitats were surveyed as part of the survey:

Heathland
Acid Grassland
Alder Gullies
Gravel Areas (Including restored areas)

Surveys were undertaken January-February 2009 with species recorded and community observations noted. Distinctive and example communities were marked with a GPS and coordinates are included within the text (also see Appendix 02 for the full list of coordinates).

Samples were collected for difficult species groups and identified with the use of chemical tests and/or a microscope (Bresser, Biolux AL). If further confirmation was required then the appropriate authorities were contacted to confirm identification.

Areas where scarce/distinctive species were recorded in previous surveys were also re-surveyed to assess each species present extent.

An indication of each habitat and each scarce/distinctive species' present condition is included within the following text. Condition is based on available records of species abundance/occurrence and also infiltration of the moss/lichen community by non-characteristic species, nutrient enrichment, over/under grazing etc. and each surveyor's personal experience.

Condition Tables for each habitat (with regard to bryophytes and lichens) and key species have also been created to aid future monitoring of the site. 'Limits of acceptable change' have been created to act as a baseline for future monitoring and 'methods of assessment' are also included within the tables to act as a guide to creating a monitoring programme for these attributes (see tables 01-09). 'Limits of acceptable change' and 'method of assessment' criteria are based on areas of Greenham Common where high and low diversity of bryophytes and lichens trends were observed (e.g. high gorse percentage cover = low bryophyte diversity). The data collected as part of the Condition Assessment and management literature (e.g. Hodgetts, 1996) were also used to create the Condition Tables.

A full detailed assessment of the sites present condition is included in the Condition Assessment section. Threats facing the surveyed areas are discussed in the Management Recommendations section.

Bryophyte and Lichen communities:

Figure 01 illustrates the areas of Greenham Common that are important for their lichen and bryophyte communities. The red areas illustrate sections of heathland. It should be noted that the distribution of heathland on the site is strongly influenced by the tracks of the former runway and taxiways which split the heathland mosaic into four distinct sections. These heathland sections are referred to in the following text as heath 'lozenges' with reference to their compass orientation.

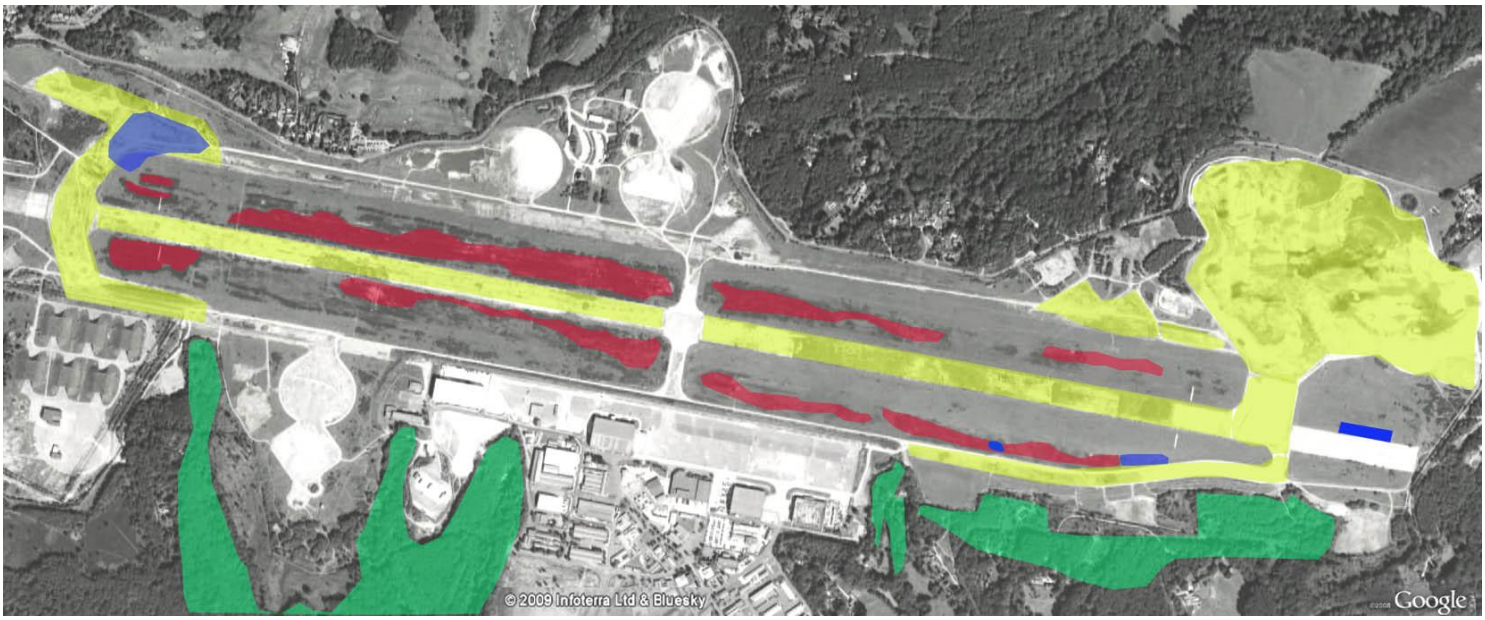

Figure 01. Aerial photograph of Greenham Common showing habitats of key importance for bryophytes and lichens. Yellow indicates areas of gravel-based communities. Red areas are heathland. Blue areas are sections of base rich soil. Green areas are Alder gullies and adjacent deciduous woodland. Light grey areas are occupied by grassland communities.

Alder Gully Communities

The outer edges of the Alder gullies tend to have a typical tree base community of bryophytes including *Brachythecium rutabulum*, *B. velutinum*, *Amblystegium serpens* and *Isothecium myosuroides*. *Thuidium tamariscinum* and *Fissidens bryoides* can also be found around the stumps of trees near the edges of the gullies. The liverwort *Lophocolea bidentata* occurs amongst the mosses in these areas.

Hypnum cypressiforme and *H. andoi* often dominate their own sections of the tree trunk with more open areas occupied by species such as *Orthotrichum affine* and *Synthrichia laevipila*. On a few damper tree trunks the liverworts *Metzgeria furcata* and *Frullania dilatata* can become abundant, dominating large sections of the tree trunk.

The trees of the Alder gullies tend to be dominated more by bryophytes than lichens, but *Parmelia sulcata*, *P. Saxatilis, Parmotrema perlatum* and *Xanthoria parientina* are frequently present on twigs and branches with exposed bark. Some trees also support *Melanelia subaurifera* and *Hypogymnia physodes*. Bryophyte-dominated trunks are often accompanied by a mixture of *Cladonia fimbriata* and *C. coniocraea*. Lichen-dominated trees are rare deeper into the Alder gullies, but some do persist at the outer edges of the woodland.

Exposed patches of soil between trees and near tree bases are often occupied by *Atrichum undulatum* and *Polytrichum formosum*. A few areas of the Alder gullies have become dominated by Bracken (*Pteridium aquilinum*). These areas hold little interest in terms of lichens and bryophytes.

Near the water's edge at the centre of the Alder gullies a different group of species was prominent, with *Mnium hornum* found growing on banks and across rock faces and abundant stands of *Dicranella heteromalla* are also found in similar conditions. A distinctive liverwort of this section of the gullies was *Pellia epiphylla* which occurred in areas of wet, bare rock just above water level. This species maintains a presence close to the water and often occurs on peaty ground and areas of decaying wood.

On areas of waterlogged soil, *Sphagnum* species can start to dominate the ground vegetation. There are two main areas where these species occur, near the centre of Aldernbridge Gully (Grid Ref: SU 48987, 64289) and an area at the intersection between Ballshill and Handpost gullies.

Present Condition: The Alder Gullies are considered to be in favourable condition with Aldernbridge Gully and the lower section of Handpost Gully being of the best quality. Records from Aldernbridge Gully are directly comparable with this present study, with little change in species presence or frequency observed.

The gullies below the New Greenham Park (Ballshill, upper section of Handpost and sections of Heads Hill) seem to have declined in quality while the site was under MOD ownership. Therefore they are of a lesser quality than the above mentioned sections, but still hold a moderately rich bryophyte and lichen flora.

ALDER GULLIES			
Attribute	**Acceptable limits**	**Method of Assessment**	**Comments**
Quantity			
Extent	At least one tree dominated with bryophytes at the tree-base level and at least 1 tree dominated with bryophytes at the tree-trunk level present in every 30m² of each Alder gully.	Sampling areas (e.g. transects or plots) should be established for each Alder gully. Trees recorded within these areas for presence and absence of the described communities. *Timescale*: Every 5 years.	Timescales may require adjustment dependent on external impacts such as pollution and prolonged abnormal weather conditions. These communities do not have to occur on the same tree.
Species composition			
Key species	*Cladonia fimbriata, Metzgeria furcata* and *Frullania dilatata* recorded at least once in each Alder gully.	Species inventory style survey undertaken for each Alder gully. *Timescale:* Every 5 years.	Timescales may require adjustment dependent on external impacts such as pollution and prolonged abnormal weather conditions.
Characteristic species	*Pellia epiphylla* recorded in every 50m section of the water course. *Xanthoria parientina, Parmotrema/Palmelia spp, Mnium hornum, Atrichum undulatum*, *Polytrichum formosum* & *Barbula/Syntrichia spp* recorded every 30m² of each Alder gully.	Water course corridor (approx 5m x 50m sections of the watercourse) should be surveyed for each gully. *Timescale:* Every 5 years Either further transect survey work in each Alder gully or sampling of the gullies to obtain data on these species. *Timescale:* Every 5 years	Timescales may require adjustment dependent on external impacts such as pollution and prolonged abnormal weather conditions.
Undesirable (non-native) species	*Orthodontium lineare* recorded from two Alder gullies at most.	Species inventory style survey undertaken for each Alder gully. *Timescale: Every 5 years.*	Timescales may require adjustment dependent on external impacts such as pollution and prolonged abnormal weather conditions.

Table 01: The above condition table sets out the features and the acceptable limits of their attributes that determines whether the habitat/species is in favourable condition for bryophytes and lichens/bryophyte and lichen biodiversity. It also specifies the methodology for assessing the feature's attributes as part of a monitoring scheme. Where the acceptable limits are not met, then the feature is not considered to be in favourable condition and appropriate management measures should be taken (or reviewed). It should be noted that these tables should be revised only after careful consideration and review by the management authorities.

Heathland

There are four main areas of heath, and each occurs within a section of ground located between the former runway and taxiways (see Fig 01.). These heathland lozenges will be dealt with individually.

NW Heath Lozenge

This first section of heath is surrounded by tall Common Gorse (*Ulex europaeus)* shrubs. The common species *Pseudoscleropodium purum* and *Calliergonella cuspidata* tend to be the only species found within the grass-dominated areas around Gorse bushes. The lichen *Xanthoria parientina* and common bryophyte *Brachythecium rutabulum* can occasionally be found on the woody stems of Gorse.

The heathland that occurs within this area of Gorse is short and quite often occupies damp soil. One of the most abundant bryophytes within this area is *Fissidens adianthoides* that can be found in large clumps. In more waterlogged areas the red-stemmed *Bryum pseudotriquetrum* occurs. Other typical bryophytes include *Campylopus introflexus* (an alien species), *Ceratodon purpureus* and *Campylopus flexuosus*. A typical example of this wetland community is located at Grid Reference: SU 48892, 64994. The low-lying species *Archidium alternifolium* and *Pleuridium acuminatum* are also found within these areas when close observation of the soil is undertaken.

Polytrichum piliferum is common in damp, open areas with *Polytrichum commune* and *Polytrichum juniperinum* found only occasionally (e.g. Grid Reference: SU 49134, 64942).

Patches of open ground amongst heather are frequent and support a ground cover of *Cladonia strepsilis* and *Peltigera membranacea*. *Cladonia crispata* can be found in high abundance within these areas along with both *C. rangiformis* and *C.portentosa* being relatively common. *Cladonia diversa,* with its striking red fruiting bodies in autumn, is also found occasionally within these areas (e.g. Grid Reference: SU 49750, 64851). The alien liverwort *Lophocolea semiteres* was also found occasionally on open ground.

Near the Eastern edge of this heathland lozenge is a grassy waterlogged area where a population of *Climacium dendroides* is locally abundant (Grid Ref: SU 49712, 64855). A species previously recorded close by to this population was *Campyliadelphus chrysophyllus.* It was last recorded in 1999 (Hedderson, 1999), but it was not encountered in this area as part of this survey.

NE Heath Lozenge

A shorter turf of heather was recorded within this area with a more constant community of *Cladonia* species with *Cladonia crispata* being abundant (Grid Reference: SU 50454, 64718) within this community and *C. furcata* and *C. cervicornis* ssp. *cervicornis* frequent within this area. *C. portentosa* was also common within this section. Common bryophytes of this section include *Polytrichum piliferum* and *Campylopus introflexus*.

At the east end of this heath system is an area with strongly compacted, stony soil with mats of *Cladonia portentosa* and *C. rangiformis*. This area holds suitable habitat for the Nationally Scarce *Cladonia cariosa*

which is an ephemeral species. *Cladonia cariosa* was previously recorded from this area in 1995 (Rose, 1995), but was not located as part of the current survey. Bryophyte species from this area include *Dicranum scoparium*, *Pseudoscleropodium purum* and *Calliergonella cuspidata*.

SE Lozenge

This area of heathland is the most distinctive of the heathland lozenges. The heather within this area is often close to the ground and very turf like. This area hosts a set of calcicole species including abundant *Hypnum lacunosum* interspersed with more calcifuge species such as *Archidium alternifolium*.

Other species recorded included the calcicole species *Encalypta streptocarpa* (located just outside the heath) and *Aloina aloides*. A small patch of *Riccia subbifurca* was also recorded here along with large expanses of *Archidium alternifolium* across bare ground. The alien liverwort *Lophocolea semiteres* was also found in abundance in this area along with occasional *Lophocolea bidentata*.

Cladonia crispata and *C.furcata* were mostly absent from this area with *C. portentosa* and *C. rangiformis* much more prominent within the heath. *C.arbuscula* was also recorded from this area which is a species of drier heathland indicating the drier conditions observed within this heath system compared to the other three heath lozenges.

SW Lozenge

This area of heathland is quite damp with abundant *Fissidens adianthoides* recorded. However, much of the heathland is infiltrated by grassland so only a few species of bryophytes occurred. The alien liverwort *Lophocolea semiteres* was again abundant within this heath lozenge.

Lichens include *Cladonia portentosa* which remains prominent and *C. chlorophaea*, *Cladonia floerkiana* and *C. uncialis* ssp*. biuncialis* are also found very occasionally within the heath system. *Polytrichum piliferum* and the alien *Campylopus introflexus* remain the most abundant bryophytes of this area with similar associated species to those found in the NW lozenge. An open sandy area is also present within this heathland with *Polytrichum piliferum* beginning to establish in this area.

Heathland Condition: The NW lozenge of heathland is surrounded by tall Gorse bushes and is occasionally infiltrated by grassland vegetation. There are large expanses of short turf heather within this section with a diverse array of heathland bryophyte and lichen species present. At the present time this section of the site is considered in favourable condition, however a decline in condition is possible in the future due to encroachment by the surrounding Gorse.

The NE lozenge is considered to be in favourable condition due to the large and diverse patches of *Cladonia* recorded within this area and a short turf of heather across much of this section. Evidence of grazing within this section was clear which is possibly helping maintain the present condition of this heathland. The more compacted and open area to the NE is also a favourable feature as habitat for the species *Cladonia cariosa*.

The SE lozenge was previously reported to be one of the areas of most interest (Porley, 1993 & 1994). Although this heathland still maintains a presence of characteristically calcicole species, many are now missing from this area and therefore this section of heath is considered to be in an unfavourable/declining condition based on the decline of the base rich element of the heath. Factors impacting this area of the site to cause this decline include the removal of the runway and taxiways which has likely diminished the characteristic calcareous condition of this area. Infiltration by *Lophocolea semiteres*, areas dominated by Gorse cover (*Ulex minor* & *U. europaeus*), an influx of grassland species and nutrient enrichment by rabbits all seem to be influencing the decline in the condition of this area.

The SW lozenge is considered in declining condition with infiltration of *Lophocolea semiteres* evident and the heath mosaic broken up by grassy areas and taller Gorse bushes. Of the four heath areas surveyed this section is of the lowest quality. This section is still important for lichen species with three species recorded only from this section.

HEATHLAND			
Attribute	**Acceptable limits**	**Method of Assessment**	**Comments**
Species composition			
Key species	*Fissidens adianthoides, Polytrichum juniperinum, Polytrichum formosum, Cladonia portentosa*, *Cladonia diversa/floerkiana* and *Cladonia rangiformis* recorded in each heath lozenge.	Species inventory style survey undertaken for each heath lozenge. *Timescale: Every 3 years.*	The collection of a survey herbarium or picture guide would aid consistency.
Characteristic species	*Cladonia crispata* recorded at least once every 2m² in NE and NW heath lozenges. *Cladonia arbuscula's* presence recorded from the SE lozenge. *Archidium alternifolium* recorded from at least ten samples of transect 1.	Either further transect survey work in each heath lozenge or sampling of the heathland habitat to obtain data on *Cladonia crispata. Timescale:* Every 3 years Species inventory style survey or single species survey undertaken on SE heath lozenge for *Cladonia arbuscula*. *Timescale:* Every 3 years Continued surveying of the monitoring transects in the SE lozenge. *Timescale:* Every 3 years	*Cladonia arbuscula* looks very similar to *C. portentosa* but all of the branches of the plant are curved in the same direction, where as *C. portentosa* branches in all directions.
Undesirable (non-native) species	*Campylopus introflexus* and *Lophocolea semiteres* recorded from less than eight samples of Transect 1 and less than six samples of Transect 2	Continued surveying of the monitoring transects in the SE lozenge. *Timescale:* Every 3 years	
Vegetation structure			

Gorse Cover	Gorse cover less than 80% in all samples of Transect 1 and 2	Continued surveying of the monitoring transects in the SE lozenge. *Timescale:* Every 3 years	
Physical characteristics			
Bare ground	30% of samples in each transect with >10% bare ground	Continued surveying of the monitoring transects in the SE lozenge. *Timescale:* Every 3 years	

Table 02: The above condition table sets out the features and the acceptable limits of their attributes that determines whether the habitat/species is in favourable condition for bryophytes and lichens/bryophyte and lichen biodiversity. It also specifies the methodology for assessing the feature's attributes as part of a monitoring scheme. Where the acceptable limits are not met, then the feature is not considered to be in favourable condition and appropriate management measures should be taken (or reviewed). It should be noted that these tables should be revised only after careful consideration and review by the management authorities.

Gravel communities

The gravel communities across the site are similar in composition with common tendril-like mosses including *Brachythecium glareosum*, *B. albicans*, *Pseudoscleropodium purum* and *Calliergonella cuspidata*. *Hypnum lacunosum* is also prominent in base rich areas. *Bryum capillare* and *Syntrichia ruralis* can also be found among these other bryophytes in abundance. The pale, matt green blanket of *Barbula convoluta* is also present in localised areas

The lichens *Peltigera membranacea* and *Peltigera polydactyla* can be abundant in localised areas on the gravels often dominating the areas in which they occur. Other common lichens include *Cladonia portentosa* , *C. rangiformis*, *Xanthoria parientina* and *Rhizocarpon reductum*. A large localised patch of *Cladonia pyxidata* was located in the NW of the site.

As the gravels begin to grade into woodland and heath, *Rhytidiadelphus squarrosus* often occurs in abundance, and in damper areas *Calliergonella cuspidata* becomes dominant along with *Bryum pseudotriquetrum.* Localised areas of *Fissidens adianthoides* also occur.

Another interesting gravel community is located on the network of gravel ridges and gravel heaps located around the site (see Appendix 03). On the tops of these gravel areas *Bryum dichotomum* is abundant along with *Ceratodon purpureus, Bryum capillare*, *Bryum argenteum*, *Didymodon fallax* and *Amblystegium serpens*.

To the NE of the site is an interesting community forming across an excavated area that has been converted to gravel pools. This area hosts large patches of *Polytrichum juniperinum*, along with patches of *Cladonia fimbriata* and *Campylopus introflexus*. Gorse is also starting to colonise this area of the site and is an area where heathland will likely begin to form in the future. Other species present within this area include *Didymodon fallax* and *Ceratodon purpureus*. *Xanthoria parientina* and *Parmotrema perlatum* are also present on shrubby vegetation. Patches of the alien liverwort *Lophocolea semiteres* also cover bare ground (e.g. Grid Ref: SU 49916, 64641).

Gravel Communities Condition: These areas are considered to be in favourable condition with a range of typical gravel based species recorded and also areas in the early stages of heathland colonisation and a base rich zone to the NW. The main aspect of concern to this habitat is the presence and abundance of two alien bryophytes and the continued colonisation of Gorse.

GRAVEL COMMUNITIES			
Attribute	**Acceptable limits**	**Method of Assessment**	**Comments**
Quantity			
Extent	At least 15ha of Greenham Common maintained as gravel-based habitat with less than 40% Gorse cover	Aerial photographic analysis or Habitat mapping. *Timescale:* Every 10 years	
Species composition			
Characteristic species	*Barbula convoluta, Didymodon fallax, Syntrichia ruralis, Bryum dichotomum* and *Brachythecium albicans* recorded every 15m² of gravel based habitat.	Either further transect survey work in each heath lozenge or sampling of the gravel based. *Timescale:* Every 3 years	

Table 03: The above condition table sets out the features and the acceptable limits of their attributes that determines whether the habitat/species is in favourable condition for bryophytes and lichens/bryophyte and lichen biodiversity. It also specifies the methodology for assessing the feature's attributes as part of a monitoring scheme. Where the acceptable limits are not met, then the feature is not considered to be in favourable condition and appropriate management measures should be taken (or reviewed). It should be noted that these tables should be revised only after careful consideration and review by the management authorities.

Grassland

Grassland communities tend to surround the heathland habitats and also occur at the edges of woodland on Greenham Common. The grassland bryophyte communities are typically made up of *Brachythecium glareosum*, *Pseudoscleropodium purum*, *Dicranum scoparium* and *Ceratodon purpureus*. *Fissidens adianthoides* is also present in some areas.

Areas around the taxiways have become waterlogged and tend to be dominated by *Calliergonella cuspidata* which gives an olive green hue to the ground cover. In more shady areas near the woodland edges *Rhytidiadelphus squarrosus* can become locally dominant.

Shorter grass swards can include *Bryum capillare* and *Syntrichia ruralis* along with *Hypnum jutlandicum*. Grassland to the NW of the site also has *Ctenidium molluscum* present within the sward. In general these grassland areas have very few lichen species.

Grassland Condition: The grassland zones contain a typical mix of grassland based bryophytes and are considered in favourable condition with a strong abundance of these species across this habitat type on Greenham.

GRASSLAND			
Attribute	**Acceptable limits**	**Method of Assessment**	**Comments**
Species composition			
Dominant species	*Calliergonella cuspidata* and/or *Rhytidiadelphus squarrosus* dominant in 70% of grassland cover	Either further transect survey work in each heath lozenge or sampling of the gravel based. *Timescale:* Every 3 years	
Characteristic species	*Brachythecium glareosum, Ceratodon purpureus* and *Fissidens spp* all recorded from the grassland habitat.	Species inventory style survey undertaken for grassland areas. *Timescale: Every 3 years.*	
Physical characteristics			
Skeletal soils	20% of grassland cover with a compact, stony soil base	Habitat mapping. *Timescale:* Every 10 years	

Table 04: The above condition table sets out the features and the acceptable limits of their attributes that determines whether the habitat/species is in favourable condition for bryophytes and lichens/bryophyte and lichen biodiversity. It also specifies the methodology for assessing the feature's attributes as part of a monitoring scheme. Where the acceptable limits are not met, then the feature is not considered to be in favourable condition and appropriate management measures should be taken (or reviewed). It should be noted that these tables should be revised only after careful consideration and review by the management authorities.

Localised Areas and Species of Interest

The following section describes important areas and key species in more detail (see Figure 02).

Figure 02. Areas of importance for key species on Greenham Common

Base Rich Zone

Within the SE of the site is an area of base rich soil that has infiltrated the heath system due to the nutrient intake from the former taxiway. The area has historically hosted a group of calcicole species interspersed within the heathland community. The introduced substrate that provided this base rich character to the soil was removed from the site in the late 90's but the base rich vegetation was still present in 2000 (Porley, 2000).

The vegetation composition in this area now seems to be changing, with many of the formerly recorded calcicole species absent in 2009. Based on the Condition Assessment survey this group of species is no longer prominent, and the area is mainly dominated by grasses, except for the short turf heath system which was analysed as part of the condition monitoring. The calcicole species *Hypnum lacunosum* is however still prominent within this zone.

A large strip of ground at the East end of the runway is abundant with the calcicole species previously recorded from the heathland system. *Encalypta streptocarpa, Campyliadelphus chrysophyllus, Trichostomum crispulum* and *Ctenidium molluscum* were all abundant within this area with the extensive clumps of *Encalypta streptocarpa* very prominent within this grassland strip. Unlike the base rich areas described above there was no crossover between calcifuge and calcicole species, with the area also abundant in calcareous grassland species. This area was recorded near the end of the project (March 2009) and an extensive survey was not carried out, but it was clear that this section was the largest and most important area of this community currently recorded on Greenham Common. The extent of this base rich zone was more than four times the area of the zone previously recorded in the SE heath lozenge

Another area excavated around the late 90's in the NW of the site has exposed a large gravel based area that seems to be showing signs of developing a similar community to that formerly recorded in the SE of the site. This area is abundant in *Ctenidium molluscum* and *Hypnum lacunosum* and these species have even graded into the nearby acid grassland system. Other species recorded include *Cladonia rangiformis*, *Polytrichum juniperinum* and the only present record of *Cladonia pyxidata* in a large localised area. This zone covers a wide area but is not as diverse as the area recorded from east of the site

Base Rich Zone Condition: As discussed in the SE heathland section the previously reported base rich area is observed to be in unfavourable/declining condition (See SE Heath Lozenge). The area in the East of the site is considered in favourable condition and the NW area of the site has the potential to emulate the communities formerly observed in the SE section and would be considered to be in favourable condition.

BASE RICH ZONE			
Attribute	**Acceptable limits**	**Method of Assessment**	**Comments**
Quantity			
Extent	At least 0.3 ha of total base rich zone habitat maintained within Greenham Common	Aerial photographic analysis or Habitat mapping. *Timescale:* Every 5 years	
Species composition			
Key species	At least three of *Ctenidium molluscum, Hypnum lacunosum, Hypnum jutlandicum*, or *Encalypta streptocarpa* recorded in the SE Lozenge and NW areas.	Species inventory style survey undertaken for base rich areas. *Timescale: Every 2 years.*	*Encalypta streptocarpa* has not currently been recorded from the NW zone.
Characteristic species	*Hypnum jutlandicum, Encalypta streptocarpa, Campyliadelphus chrysophyllus* and *Trichostomum crispulum* all recorded from the eastern base rich zone	Species inventory style survey undertaken for base rich areas. *Timescale: Every 2 years.*	
Undesirable (non-native) species	*Campylopus introflexus* and *Lophocolea semiteres* recorded from less than 10% of base rich zone area	Either transect survey work in each base rich zone or sampling of each area. *Timescale:* Every 3 years	Apart from within the SE heath lozenge there is currently no infiltration of either species (2009).
Vegetation structure			
Gorse cover	Less than 30% Gorse cover for NW and SE Lozenge areas; less than 10% Gorse cover for eastern area	Vegetation mapping. *Timescale:* Every 3 years	

Table 05: The above condition table sets out the features and the acceptable limits of their attributes that determines whether the habitat/species is in favourable condition for bryophytes and lichens/bryophyte and lichen biodiversity. It also specifies the methodology for assessing the feature's attributes as part of a monitoring scheme. Where the acceptable limits are not met, then the feature is not considered to be in favourable condition and appropriate management measures should be taken (or reviewed). It should be noted that these tables should be revised only after careful consideration and review by the management authorities.

Polytrichum piliferum & Polytrichum juniperinum

Both of the above *Polytrichum* species are found in early successional stages of heathland systems (Porley & Hodgetts, 2005) and in previous reports have been given equal weight in their presence across the sites heathland system. This present survey has found that *Polytrichum piliferum* seemed to be prominent in the heath systems in all areas and was often recorded in wetter, more exposed areas.

Polytrichum juniperinum was much more localised in its distribution. Large islands of *Polytrichum juniperinum* are located in the NE corner of the site (see Fig 02.) on gravel beds that seem to be in the very early stages of heath transformation; however no records of *Polytrichum piliferum* were gathered from this area. The separation of the two species is an interesting trend found within the records and would make an interesting study into the ecology of the two species.

Condition: The population of *Polytrichum piliferum* is considered to be in favourable condition with an abundance of this species noted across the majority of the heathland sections of the site. The population of *Polytrichum juniperinum* is however considered to be in declining condition with a reduction in abundance recorded for the present study. This species is however abundant in the NE gravel area and is still found in localised patches across the heath system (but not as widely or in as much abundance as *Polytrichum piliferum*).

POLYTRICHUM PILIFERUM & POLYTRICHUM JUNIPERINUM			
Attribute	**Acceptable limits**	**Method of Assessment**	**Comments**
Quantity			
Polytrichum juniperinum	Recorded at least once in every 30m² of each heathland lozenge. At least 25 patches recorded measuring 30cm² or more in the NE gravel area (see Figure 2).	Either further transect survey work in each heath lozenge or sampling of the heathland habitat to obtain data on *Polytrichum juniperinum. Timescale:* Every 3 years Patches of *Polytrichum juniperinum* surveyed in the NE of the site with patch counts and area measurements taken. *Timescale:* Every 3 years	
Polytrichum piliferum	Recorded at least once every 2m² in each heath lozenge. Recorded in at least five samples of transect 1 and at least three samples of transect 2.	Either further transect survey work in each heath lozenge or sampling of the heathland habitat to obtain data on *Polytrichum piliferum. Timescale:* Every 3 years Continued surveying of the monitoring transects in the SE lozenge. *Timescale:* Every 3 years	

Table 06: The above condition table sets out the features and the acceptable limits of their attributes that determines whether the habitat/species is in favourable condition for bryophytes and lichens/bryophyte and lichen biodiversity. It also specifies the methodology for assessing the feature's attributes as part of a monitoring scheme. Where the acceptable limits are not met, then the feature is not considered to be in favourable condition and appropriate management measures should be taken (or reviewed). It should be noted that these tables should be revised only after careful consideration and review by the management authorities.

Lophocolea semiteres

Lophocolea semiteres is native to South America, South Africa and Australasia. It is a mat-forming liverwort that can occupy a number of habitats. The first British record was from the Isles of Scilly in 1955 and the first mainland record from Scotland in 1972 (Hill, Preston & Smith, 1991). Current distribution maps do not seem to reflect the distribution of Lophocolea accurately, suggesting a rapid range increase in recent years. It was first recorded from Greenham Common in 2000, growing on a gravel bank in birch woodland (Porley, 2000). In the present survey this species was found across the whole site (except the Alder gullies). Species identification was checked by microscope and samples were sent to Chris Preston at the Centre for Ecology and Hydrology to confirm identification. This particular species forms blankets on bare soil which puts it in direct competition with closely related liverwort species (*Lophocolea bidentata* and *Lophocolea heterophylla*) and also low-growing bryophytes

such as *Archidium alternifolium* and *Pleuridium acuminatum*. Further study of the extent and impact of this liverwort invasion is required.

Condition: The profuse presence of this species across a number of habitats on Greenham Common has led to a general site wide decline in bare ground quality. Figure 03 provides a map of the areas where *Lophocolea semiteres* was recorded.

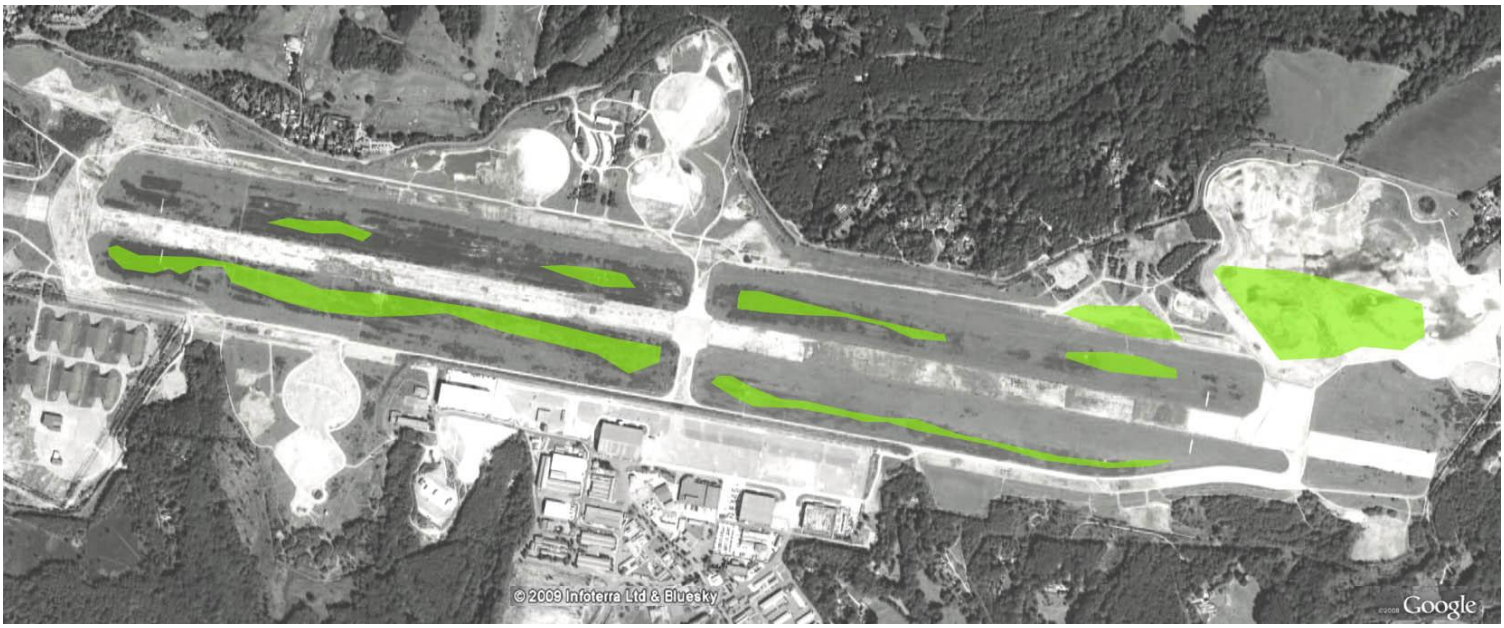

Figure 03. Approximate distribution of *Lophocolea semiteres* (green areas) on Greenham Common.

Campylopus introflexus

Campylopus introflexus was also found in many of the same areas as *Lophocolea semiteres*. *Campylopus introflexus* was first found on the mainland in 1941 and spread rapidly from this point onwards (Smith, 2004). *Campylopus introflexus* was found in the same habitats as it has been in all previous surveys.

Condition: As little data is available on the abundance of *Campylopus introflexus* on Greenham Common it is difficult to assess whether this species has increased in abundance, but its distribution is similar to previous records.

Aloina aloides

This species has a localised distribution in the SE corner of the site, just outside the heathland area (Grid Ref: SU 51278, 64378) and is a calcicole species that has been thriving on the influx of base rich soil in this area. This species is one of a select few that have been mapped in the past. Although no specific data with regard to abundance has been generated for the species in the past, the population has been reported to be in favourable condition with a large patch of *Aloina aloides* occupying this area.

In the present study the species was very difficult to locate and was eventually found within its original local zone, but with only a small number of plants present on a small raised section of earth. *Aloina*

aloides is a species of exposed soils and this particular habitat is now very sparse at this location with an influx of grasses moving in from higher up the bank. The local areas nutrient intake has likely been adjusted due to this location being used as a rabbit latrine. It can be concluded that this species presence at this site will likely diminish in the coming years.

Condition: The present condition of the species in considered unfavourable with only a few plants still present within its former area.

ALOINA ALOIDES			
Attribute	**Acceptable limits**	**Method of Assessment**	**Comments**
Quantity			
Individual plants	At least 200 plants recorded (last recorded < 100 in 2009)	Individual plant count established in the defined area of *Aloina aloides* (see figure 02 and appendices 02).	Individual plants are easily defined due to the nature of the plant in question. The bryophyte herbarium may require consultation if surveyors have not undertaken work on this species before. An ecological impact assessment should be adhered to when surveys are undertaken for this species.
Habitat extent			
Extent	At least 50cm² of bare ground occupied by *Aloina aloides* (see figure 2).	Bare ground with presence of *Aloina aloides* measured.	The bryophyte herbarium may require consultation if surveyors have not undertaken work on this species before. An ecological impact assessment should be adhered to when surveys are undertaken for this species.

Table 07: The above condition table sets out the features and the acceptable limits of their attributes that determines whether the habitat/species is in favourable condition for bryophytes and lichens/bryophyte and lichen biodiversity. It also specifies the methodology for assessing the feature's attributes as part of a monitoring scheme. Where the acceptable limits are not met, then the feature is not considered to be in favourable condition and appropriate management measures should be taken (or reviewed). It should be noted that these tables should be revised only after careful consideration and review by the management authorities.

Cladonia crispata

Cladonia crispata is prominent within the two northern heath lozenges. This species is particularly prominent in the NE section of the heathland that is occupied by a short turf of heath. The NE population seems to be maintained by grazing as many of the *Cladonia* stands show signs of grazing. This species is easily identifiable due its habit of forming cups with holes that lead into the main section of the plant. The occurrence of this species in the northern sections of the heath is indicative of its preference for wetter heathlands (Lambely, 2001a).

Condition: The population of this species is considered to be in favourable condition with *Cladonia crispata* abundant in the Northern heathland sections.

CLADONIA CRISPATA			
Attribute	**Acceptable limits**	**Method of Assessment**	**Comments**
Quantity			
Extent	*Cladonia crispata* present in both NW and NE heath lozenges	Species inventory style survey undertaken for NW and NE heathland areas. *Timescale: Every 3 years.*	
Cover	*Cladonia crispata* with at least 70% coverage of at least a 50cm² of ground in the defined Cladonia crispata area in the NE lozenge (see figure 2)	Either further transect survey work in each heath lozenge or sampling of the NE heathland lozenge. *Timescale:* Every 3 years	

Table 08: The above condition table sets out the features and the acceptable limits of their attributes that determines whether the habitat/species is in favourable condition for bryophytes and lichens/bryophyte and lichen biodiversity. It also specifies the methodology for assessing the feature's attributes as part of a monitoring scheme. Where the acceptable limits are not met, then the feature is not considered to be in favourable condition and appropriate management measures should be taken (or reviewed). It should be noted that these tables should be revised only after careful consideration and review by the management authorities.

Sphagnum species

Sphagnum palustre is the most common species that occurs within these areas with *Sphagnum flexuosum* found towards the centre of the *Sphagnum* blanket. A number of different *Sphagnum* species have also been recorded from the intersection of Ballshill and Handpost gullies (Welsh & Longton, 2008).

Condition: As described in the Alder Gullies section this group of species is in favourable condition at the present time with good diversity of species and an ample coverage of *Sphagnum* present. Monitoring of these populations is recommended.

SPHAGNUM SPECIES			
Attribute	**Acceptable limits**	**Method of Assessment**	**Comments**
Quantity			
Species richness	At least two species of *Sphagnum* recorded in each defined *Sphagnum* area (see Figure 2)	Species inventory style survey or single species survey undertaken on for *Sphagnum spp*. *Timescale:* Every 2 years	
Extent	Each defined area of *Sphagnum* (see Figure 2) at least 10m²	Area of *Sphagnum spp* in each defined area measured. *Timescale:* Every 2 years	

Table 09: The above condition table sets out the features and the acceptable limits of their attributes that determines whether the habitat/species is in favourable condition for bryophytes and lichens/bryophyte and lichen biodiversity. It also specifies the methodology for assessing the feature's attributes as part of a monitoring scheme. Where the acceptable limits are not met, then the feature is not considered to be in favourable condition and appropriate management measures should be taken (or reviewed). It should be noted that these tables should be revised only after careful consideration and review by the management authorities.

Rare and Protected Species

Table 10 provides information on species of bryophytes and lichens that are nationally rare and/or under statutory protection. Notes on location and extant are included where the information is available.

Species Name	Last recorded by	Year	Location/Habitat	Species Status	Status Source
Leucobryum glaucum	T. Haynes & P. Creed	2009	Woodland	Annex 5, Wildlife and Countryside Act	Habitats Directive
Brachythecium salebrosum	T.A. Hedderson	1999		Rare and scarce species (not based on IUCN criteria)	Bryophyte Red List (British Bryological Society, 2005) + Preston, C.D. (2006). A revised list of nationally scarce bryophytes. Field Bryology 90: 22-30.
Bryum pallescens	R.D. Porley	1993	Edge of heathland NW	Rare and scarce species (not based on IUCN criteria)	Bryophyte Red List (British Bryological Society, 2005) + Preston, C.D. (2006). A revised list of nationally scarce bryophytes. Field Bryology 90: 22-30.
Sphagnum flexuosum	T. Haynes & P. Creed	2009	Woodland	Rare and scarce species (not based on IUCN criteria)	Bryophyte Red List (British Bryological Society, 2005) + Preston, C.D. (2006). A revised list of nationally scarce bryophytes. Field Bryology 90: 22-30.
Thuidium abietinum ssp. hystricosum	BBS Field Visit	2000		Rare and scarce species (not based on IUCN criteria)	Bryophyte Red List (British Bryological Society, 2005) + Preston, C.D. (2006). A revised list of nationally scarce bryophytes. Field Bryology 90: 22-30.
Cladonia portentosa	T. Haynes & P. Creed	2009	Heath/Gravels	Annex 5, Wildlife and Countryside Act	Habitats Directive
Catapyrenium michelii	F. Rose	1995		Nationally rare	A conservation evaluation of British lichens, R.G. Woods & B.J. Coppins. British Lichen Society, London, 2003
Cladonia chlorophaea	T. Haynes & P. Creed	2009	Heath	Nationally rare	A conservation evaluation of British lichens, R.G. Woods & B.J. Coppins. British Lichen Society, London, 2003
Cladonia crispata	T. Haynes & P. Creed	2009	Heath	Nationally rare	A conservation evaluation of British lichens, R.G. Woods & B.J. Coppins. British Lichen Society, London, 2003
Cladonia cariosa	F. Rose	1995	Gravelly soil NE	Nationally scarce	A conservation evaluation of British lichens, R.G. Woods & B.J. Coppins. British Lichen Society, London, 2003

Table 10 displaying species that are nationally rare or under statutory protection

Condition Assessment

In 1994 Ron Porley established a site quality monitoring programme. Part of this work included establishing a set of permanent transects in the SE heathland lozenge. The objective of this aspect of the monitoring programme was to detect floristic changes in the bryophyte and lichen rich open heath so that management could be modified accordingly (Porley, 1994). Data has been collected for 1994, 1996, 1998 and 2000 for the site quality monitoring programme and as part of this *site dossier* these transects were revisited with a new set of data collected for 2009.

All years of the condition monitoring protocol are analysed and tested for similarity to assess whether the vegetation composition of the heathland has changed overtime.

Methodology:

Survey

The methodology follows that outlined in *Site Quality Monitoring, Greenham and Crookham Commons SSSI, Berkshire* (Porley, 1994); please consult this document for the full methodology.

Transect 1 is a 50m transect orientated N-S and is marked with 5cm transponders at either end (start Grid Ref: SU 51137, 64376; end Grid Ref: SU 51088, 64381). Transect 2 is a 26m transect orientated E-W and is marked with wooden posts at each end.

A nested quadrate sampling strategy was adopted with species presence/absence recorded at 10cm², 20cm² and 50cm² scales in each sample. Vegetation height was recorded for each sample, along with the percentage cover of Gorse, Heather, bare ground and *Archidium alternifolium*. Each quadrat sampled was also pictured with a Nikon digital SLR camera (see appendix 04).

Analysis

The species presence/absence data was analysed using the Sørensen coefficient of similarity. Sørenson's coefficient is generally used for qualitative data and is preferred over the Jaccard coefficient because it gives weight to those species that occur within the same samples (Kent & Coker, 1995). The resulting similarity measures were then used to plot an ordination of all samples across all years using the Bray and Curtis ordination. Although Principle Component Analysis (PCA) and various forms of correspondence analysis are now more commonly used, the Bray and Curtis method holds value for explorative analysis (Beal, 1984). Ordination plots were created using Sbraco software (Spinazzi, 2009). The raw data set and analysis files are provided in appendix 05.

A set of radial charts were produced from the results of the similarity analysis to assess whether the vegetation composition (presence/absence of species) of each sample has changed over time. A factor in need of consideration when interpreting these results is the change in the time of study for 2009 (as some species will be easier to identify while others are not). This has been taken into consideration where possible including the grouping of all grass species within the analysis.

Results:

The following graphs are taken from the results of the similarity analysis. Three charts are represented for each transect. The first chart explores the similarity of the vegetation composition across the whole transect for each year data has been recorded. The remaining two charts explore the vegetation composition of each individual sample in time.

Transect 1

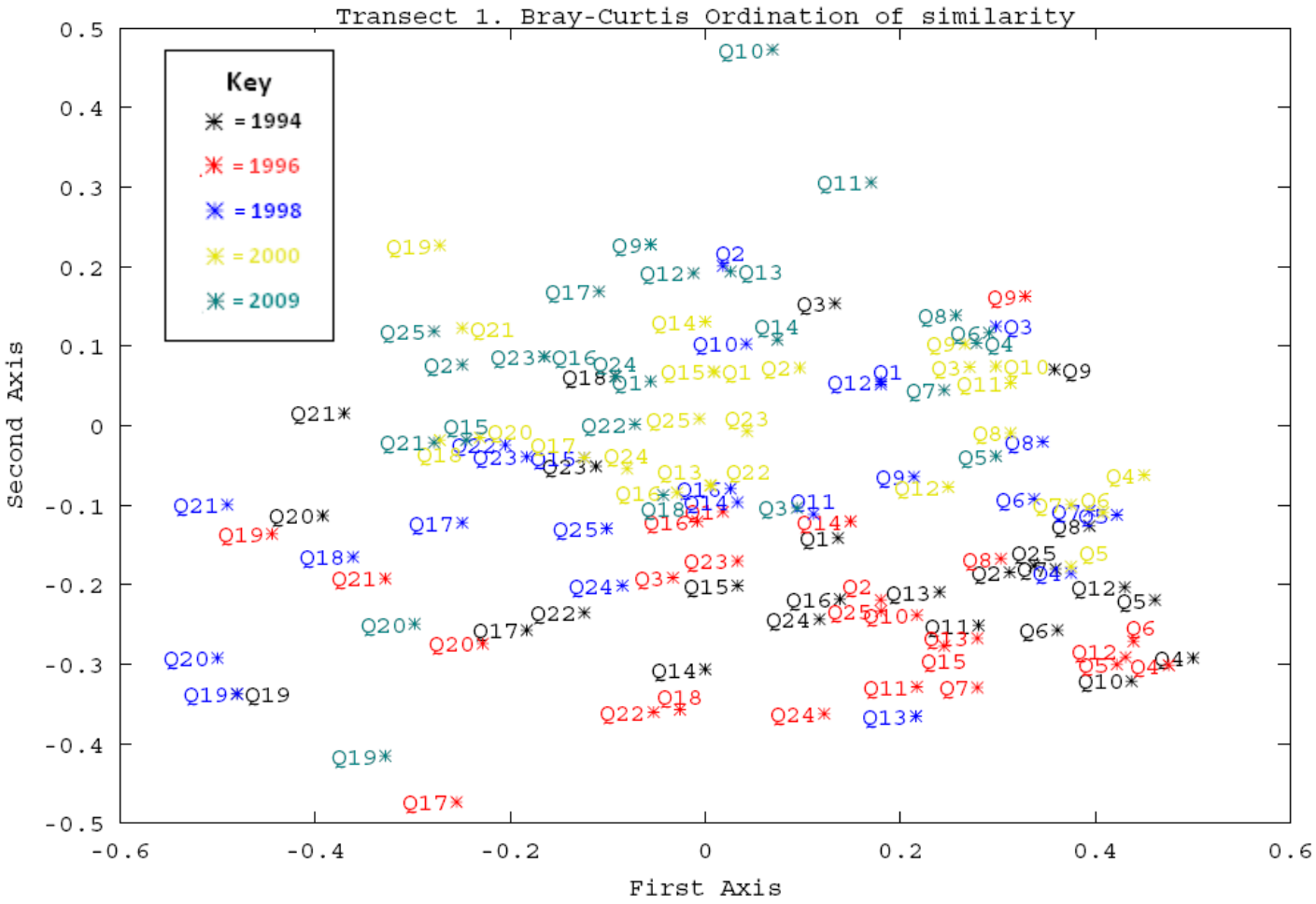

Figure 04. Ordination plot showing the similarity between each plot in transect 1 across all years. Both axes are a measure of similarity allowing the graph to show how similar each plot is in 2-dimensional space. Points that occupy the same space (such as Q19 blue and black) are identical in vegetation composition based on the presence/absence data whereas points that are far away from each other are dissimilar. Each colour indicates a single year of samples and each number (Q00) indicates the sample identifier.

The chart above shows that the data recorded from 1994 and 1996 are plotted in close proximity to each other which indicates a similar species composition across the transect in these years. The chart also shows the between-sample similarity for each year (e.g. all red points). The general shape of this trend can be seen clearly through 1994 and 1996.

In 1998 the samples are more spread out than in the preceding years but still follow the general between-sample similarity observed in 1994 and 1996. The entire year has shifted away from the plots of 1994 and 1996 indicating a less similar species composition across the majority of samples.

In 2000 the majority of the samples have become less similar to the original vegetation composition and the between sample similarity has increased as many of the samples start to clump into two vegetation compositions.

In 2009 the vegetation composition is at its most distinct being most similar to plots from 2000, a few from 1998 and isolated vegetation communities that appeared in 1994.

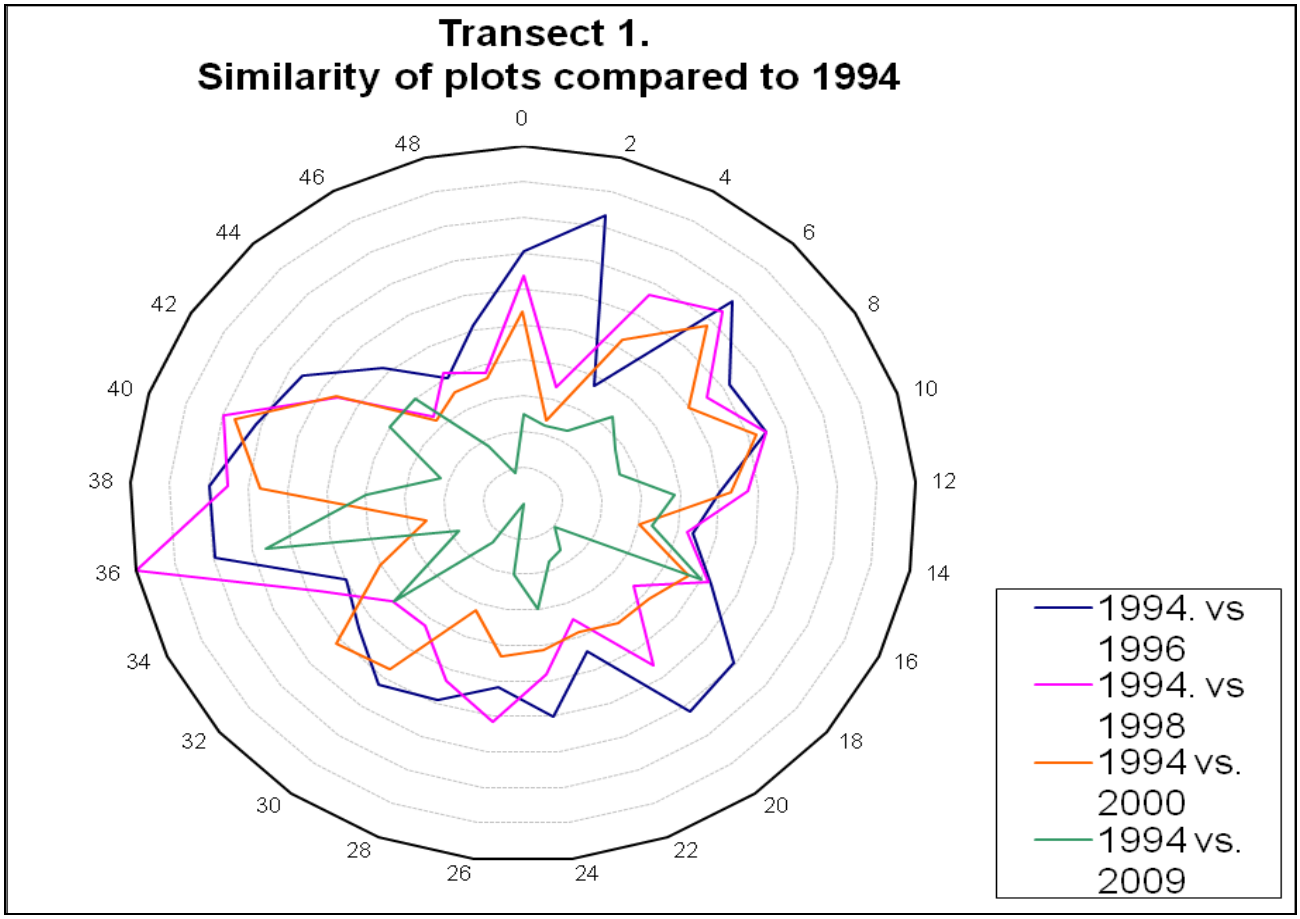

Figure 05. Radial graph showing the similarity of the vegetation composition of each plot compared to a control year. The outer ring is the year being compared and deviations towards the centre of the graph indicate the level of dissimilarity. Perfect similarity would be indicated between two years if both years formed on the outer black circle. The numbers around the edge of the outer ring represent in metres where samples were taken across the transect.

Figure 05 shows how similar the vegetation composition in each quadrate is compared to the original data collected in 1994. It can be seen that the level of similarity of each sample reduces in succeeding years. The sample collected at 36 m seems to have changed the least over the years even managing to be exactly the same in 1998. 2009 shows a high level of dissimilarity compared to the other years.

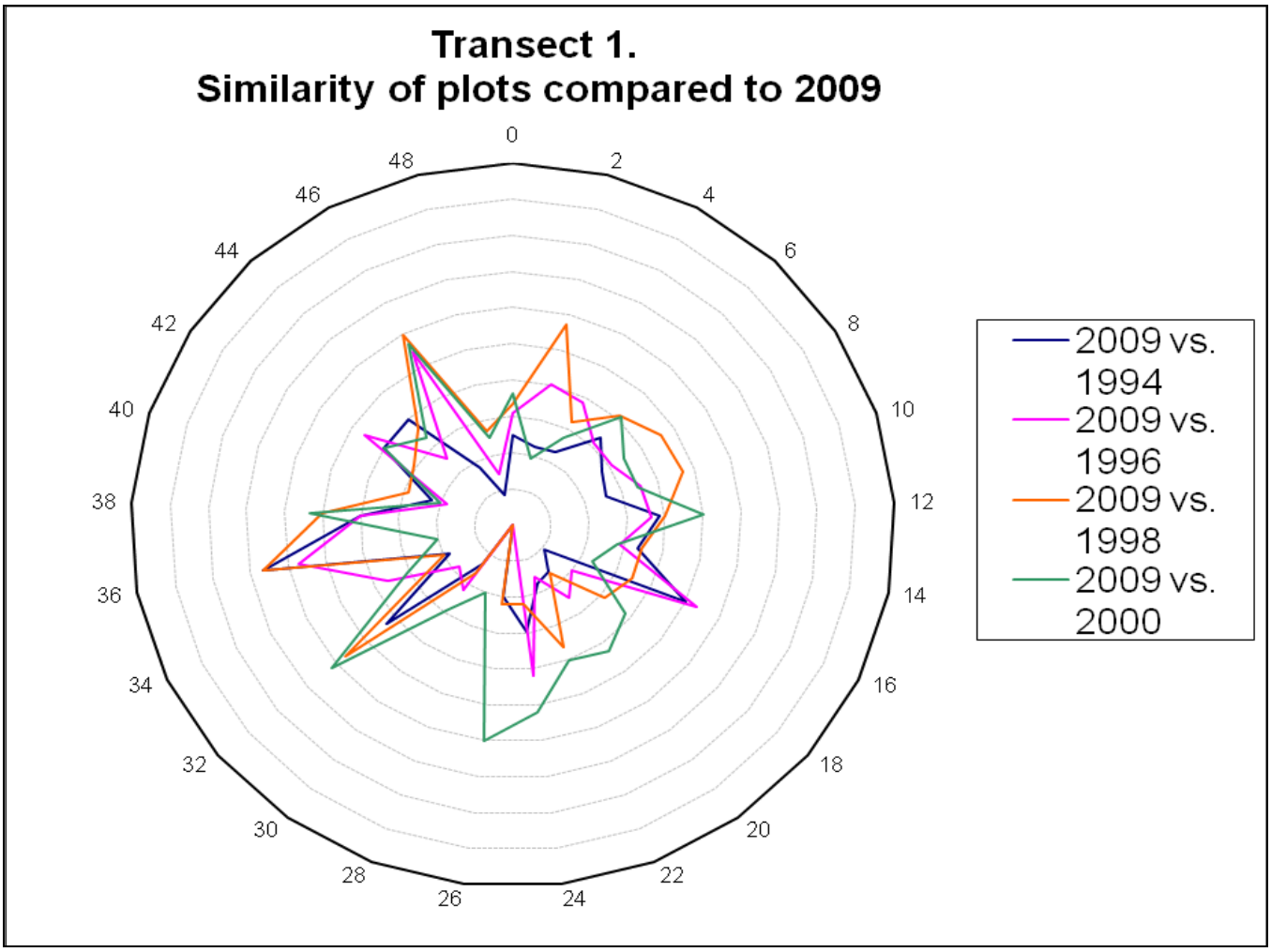

Figure 06. Radial graph showing the similarity of the vegetation composition of each plot compared to a control year. The outer ring is the year being compared and deviations towards the centre of the graph indicate the level of dissimilarity. Perfect similarity would be indicated between two years if both years formed on the outer black circle. The numbers around the edge of the outer ring represent in metres where samples were taken across the transect.

Figure 06 shows how similar the vegetation composition in each quadrate is compared to the data collected in 2009 and is effectively the inverse of Figure 05. The samples collected in 2009 are seen to be highly dissimilar compared to the relationships seen in Figure 05 and also indicates that samples are equally dissimilar when compared with 2000, 1998 and 1996. The data collected from 1994 is seen to be the most dissimilar.

Transect 2

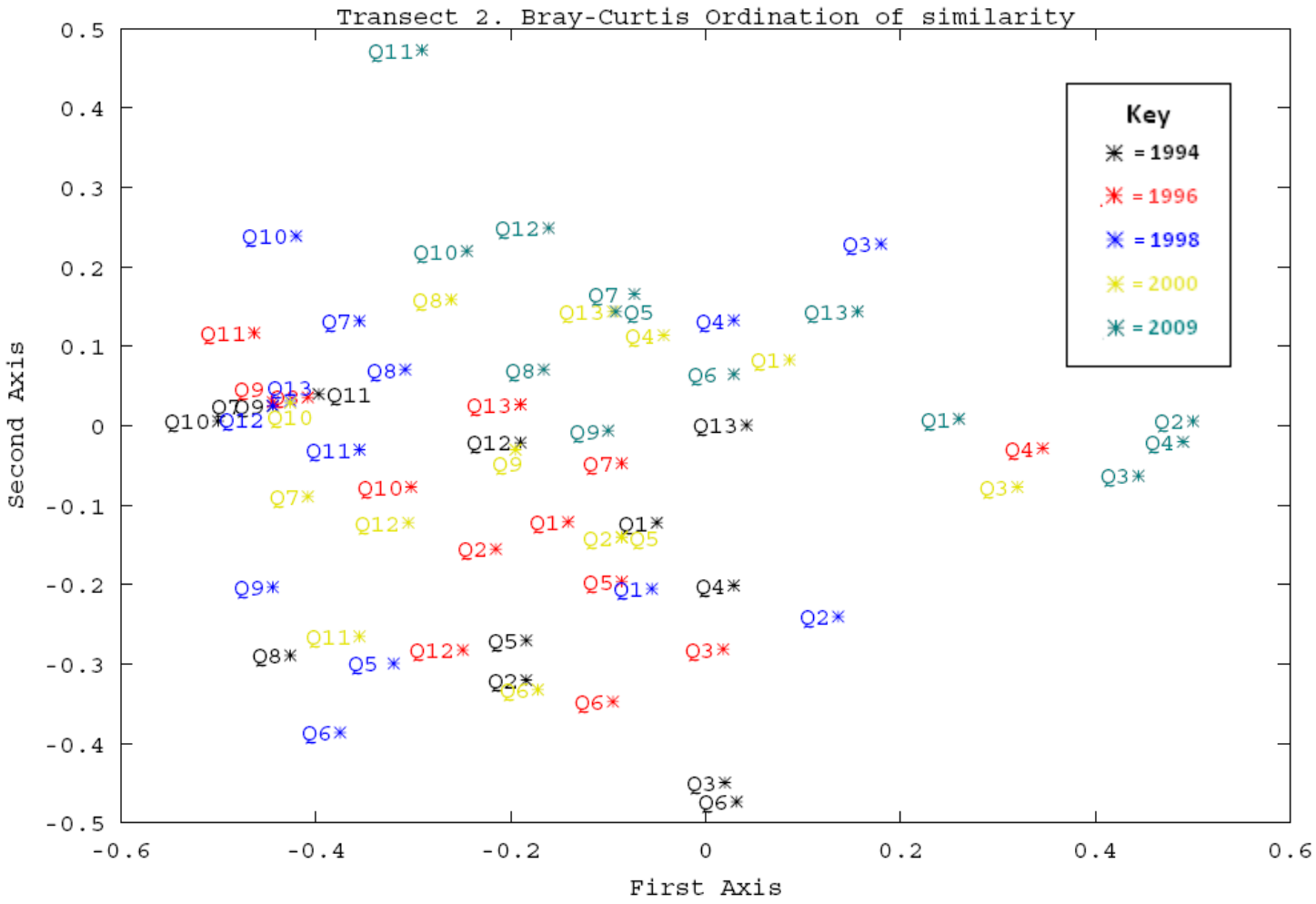

Figure 07. Ordination plot showing the similarity between each plot in transect 2 across all years. Both axes are a measure of similarity allowing the graph to show how similar each plot is in 2-dimensional space. Points that occupy the same space (such as Q13 yellow and Q5 green) are identical in vegetation composition based on the presence/absence data whereas points that are far away from each other are dissimilar. Each colour indicates a single year of samples and each number (Q00) indicates the sample identifier.

Figure. 07 shows the similarity of plots across all years for the smaller transect 2. Samples collected for 1994 – 2000 show similarities in vegetation composition across years and also between samples, with samples collected from 1998 being less similar to each other. 2009 shows little similarity with 1994 and is most similar to the divergent samples recorded in 2000.

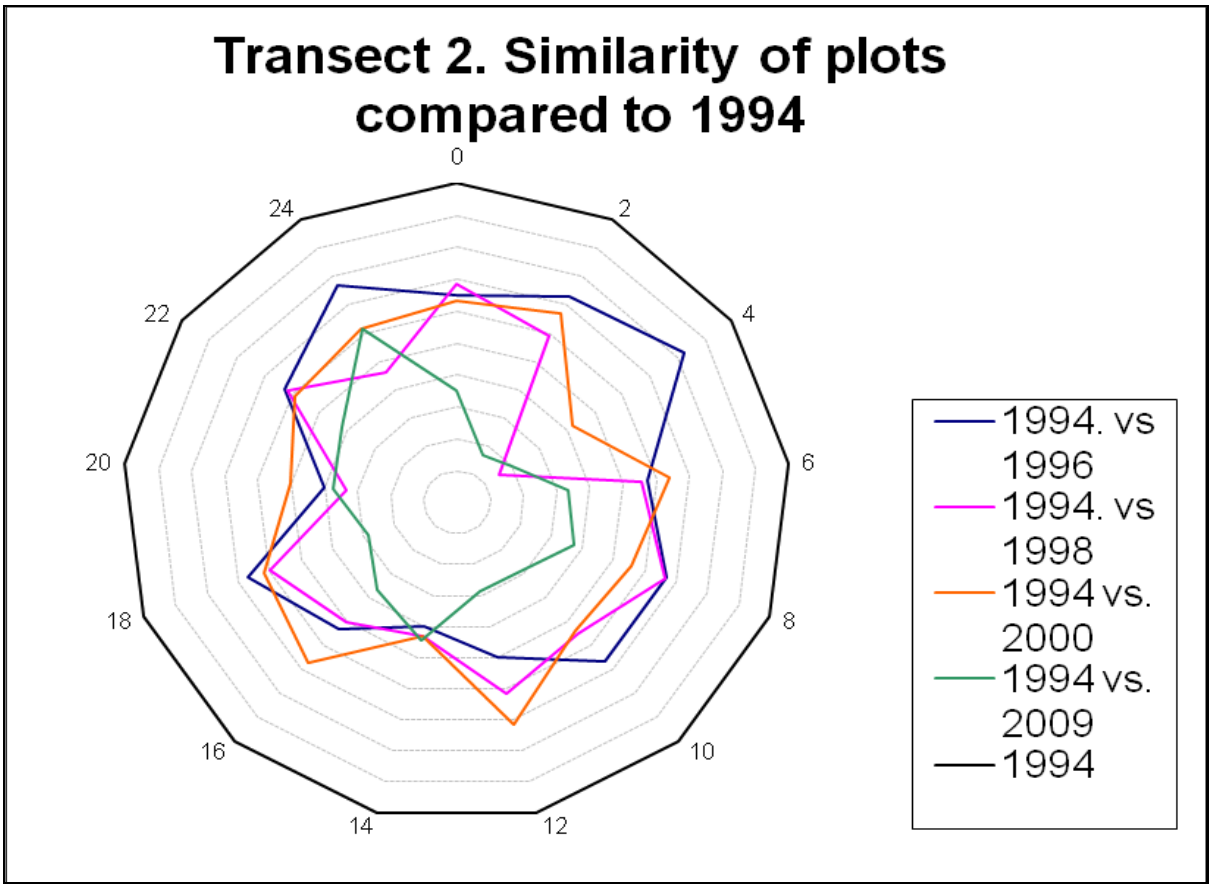

Figure 08. Radial graph showing the similarity of the vegetation composition of each plot compared to a control year. The outer ring is the year being compared and deviations towards the centre of the graph indicate the level of dissimilarity. Perfect similarity would be indicated between two years if both years formed on the outer black circle. The numbers around the edge of the outer ring represent in metres where samples were taken across the transect.

Figure 08 shows the same trend as Transect 1 with each consecutive year the vegetation community becoming less similar to the original data recorded in 1994.

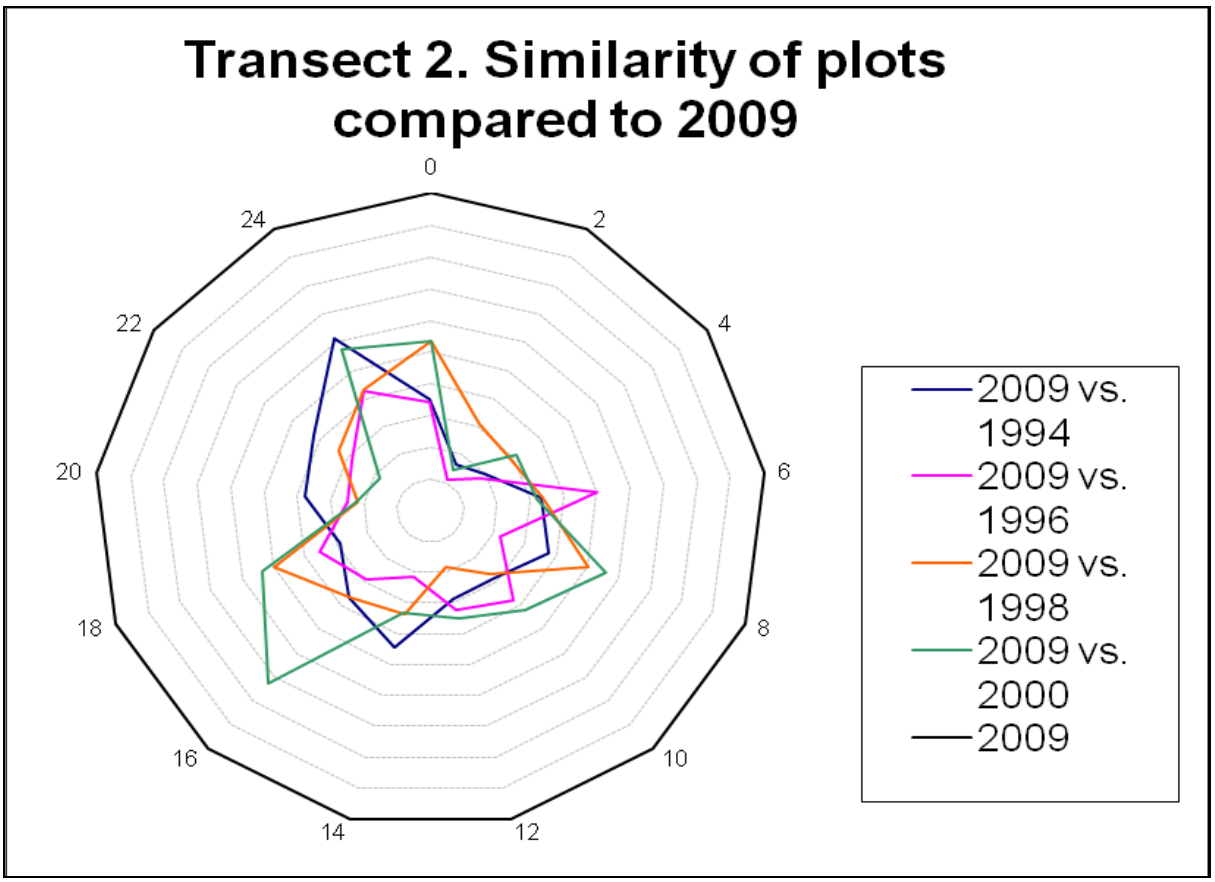

Figure 09. Radial graph showing the similarity of the vegetation composition of each plot compared to a control year. The outer ring is the year being compared and deviations towards the centre of the graph indicate the level of dissimilarity. Perfect similarity would be indicated between two years if both years formed on the outer black circle. The numbers around the edge of the outer ring represent in metres where samples were taken across the transect.

Figure 09 shows the similarity of each plot across all years in comparison with 2009. Samples from 2000 and 1994 seem to be the most similar with 1996 observed to have a markedly dissimilar vegetation composition. It should be noted that the level of similarity compared to Figure 08 is much lower.

Discussion

Both transects were established in an area of heath that is markedly different in structure to the remaining three areas as it is dominated by a dry short turf of Heather and Gorse. Also interesting about this section of Greenham Common is the influx of calcicole species into the acid system (particularly in transect 2).

Transect 1

Based on the data presented in Figure 04 the vegetation composition of the whole transect is very similar across earlier years with the relationship starting to break up in 1998 with the overall transect becoming quite different to that observed in 1994 and 1996. 2000 then shows a very different vegetation composition compared to the preceeding years with clumping occurring into what seems to be two main vegetation compositions (see Figure 04). The larger of the two groups seems to have

persisted in 2009 with only a few samples occurring outside of this range, but with little association with the original data from 1994. With reference to the raw data (see Appendix 04) the area of clumping to right of the graph seems to link with the exposed soil communities dominated by *Archidium alternifolium* and the larger area of clumping at the centre of the graph is indicative of Gorse dominated areas.

The bare ground community is only represented by a few samples in 2009. The Gorse-dominated communities of 1994 (Q18-22) were shown to be distinct between samples and over time have become more homogenous and have also included more samples indicating a gradual increase in Gorse cover.

Figures 05 and 06 show that each sample fluctuates in species composition between years with a gradual change from the species composition observed in 1994 (Figure 05) and also a markedly different vegetation composition in each sample in 2009 compared to previous years (Figure 06). The radial charts show that vegetation composition fluctuations at the sample scale are quite high in comparison to observations of the vegetation composition of the whole transect (Figure 04).

Transect 2

The strongest area of clumping observed on transect 2 is no longer present in 2009 (Figure 07) and only had one sample present in 2000. This area represents an area dominated by *Cladonia* species and *Polytrichum piliferum*. A crash in the *Cladonia furcata* population has been discussed in previous surveys of the monitoring programme and this species was only recorded from two samples in 2009. *Polytrichum piliferum* was recorded at much decreased incidence compared to previous years in 2009 which may explain the dissimilarity in 2009 from these samples. The lack of *Polytrichum piliferum* also suggests a change in the successional stage of the heath. The samples located to the far right of the graph in 2009 (Figure 07) represent samples dominated by Gorse cover at the beginning of the transect. In 2009 this section was very sparse in species and shows a change in the species composition at the beginning of the transect.

Figures 08 and 09 show a similar pattern to that seen in transect 1 with a gradual change in the species composition of each sample. 1998 seems to show a fluctuation from this seeming less similar in most samples to the following year. It was noted during the analysis of the data that 1998 seemed to fluctuate in some data records compared to other years. 2009 is still shown to be the most dissimilar of the years.

Much has changed on the common to promote vegetation change across the years: changes of ownership, management and use have occurred since the monitoring transects were erected. Transect 1 was becoming blanketed with gorse in 2009 with only a few plots retaining bare open ground where lichen and bryophyte species were abundant. This is likely due to the change from regular mowing with removal of arisings to a grazing regime. The selective grazing of cattle has not benefitted this transect and the former expanse of *Archidium alternifolium* in this area is being lost to Gorse.

This pattern is also occurring in Transect 2 but near the start of the transect. This transect retained its open form observed in previous field visits, however the base rich species were in decline (see Base Rich

Zone) with no records of *Ctenidium molluscum* and other calcicole species recorded in the proximity of the transect. This area (and sections of transect 1) have also been invaded by *Lophocolea semiteres* which was not present in the study area before 2009. This species occupied many areas of transect 2 and has also been recorded site wide, which may also further explain the distinct vegetation composition observed in 2009.

Conclusion

Based on the condition assessment the overall vegetation of both transect 1 and transect 2 has changed since the monitoring programme began in 1994. The heathland within this area is becoming more dominated by Gorse, and the base rich zone is occupied by a less diverse set of calcicole species than previously recorded. The original interest of transect 2 (the calcicole element) may have been lost due to the removal of the runway and taxiways, however this is not the loss of this community on Greenham as similar calcicole communities have been detected from the East and NE of the site (see Base Rich Zone).

Transect 1 has pockets of the original interest that still persist, but in a reduced abundance due to the lack of open ground. An increase in the grazing of this area (and transect 2) to promote bare open soil would benefit the species of this transect.

Further study

The analysis performed for this study is essentially the first steps in forming hypotheses for this data set. The qualitative nature of the data restricts the type of statistical analysis that can be performed. Based on the ordination produced, this condition protocol would benefit from an inverse ordination (species instead of samples). The Bray and Curtis ordination is not capable of providing accurate inverse analysis which is why this ordination was not performed for the present study. This would allow the actual consistency of the vegetation communities to be assessed to compare with the quadrat ordination. The data obtained for percentage cover and vegetation height would also benefit from being tested for an association with the ordination provided which should be performed using correspondence analysis.

A third transect erected in either the eastern end or the NE corner of the site is advised as these areas now occupied by many of the species formerly present in Transect 2.

Management recommendations

The following recommendations are based on evidence and observations from both the Condition Assessment and the habitat surveys. Consideration of the objectives set out within the current version of the Greenham and Crookham Management Plan is also included.

Heathland

With regard to bryophyte and lichen communities the eastern sections of heathland should be prioritised for management. The results of the Condition Assessment indicate that the SE lozenge is in particular need of management to prevent the decline of the bare ground habitat required by species such as *Archidium alternifolium* and *Pleuridium acuminatum*. The Condition Assessment has shown that

much of the decline in the bare ground community is due to the dominance of Gorse cover. The present condition of the NE heath lozenge suggests that an increase in the grazing pressure of the SE heath lozenge would be beneficial to allow areas of bare ground to be opened and Gorse cover to be reduced. An increase in stocking density is advised and/or fencing of priority areas for grazing would help maximise the grazing pressure needed in the SE section.

Although the western areas of the site would also benefit from an increase in grazing pressure, the eastern areas have been prioritised, as the taller areas of gorse within the western area are important for other taxa, while a diverse array of bryophyte and lichen species still persist within the eastern heath areas. It should be noted however that several *Cladonia* species were recorded from the SW lozenge that were not recorded from other areas of the heath. Consideration of these species of the short turf heathland should be considered with other plans for this area.

The NE and NW sections of heath are host to lichen species indicative of wetter heath systems and that as a group are declining nationally (Lambely, 2001a). Sanderson (1996) observed that the most species rich lichen heaths within the New Forest were recorded from areas where heather had been heavily grazed into a turf for many years. This system has been maintained on Greenham Common in the past by intensive mowing and the key factor being the removal of cuttings from the site. Ponies and cattle are observed to be the best grazing species in regard to lichens as they tend to focus on grass removal creating open patches for lichens to colonise.

The aim of a grazing regime to benefit lichens and bryophytes is to establish a stand of heath that is maintained in an open state (e.g. not beginning to dome). This is currently the case with the majority of the heather areas; however the same management requires application to gorse cover where this is also in close proximity to the heathland turf.

Under MOD management the heathland was close mown until 1992 (Porley, 1993). A key factor of this management was the removal of cuttings from the site which helped promote low nutrient conditions while retaining the short turf nature of the heathland. This management will also have kept Gorse cover under control. Re-establishing the MOD mowing scheme is a viable method of heath management. This type of management would especially benefit the SE lozenge and trials are recommended. It should be noted that this type of management can allow Gorse to increase stand density over time if mowing is subsequently halted.

Controlled burning is a possible management measure if Gorse cover cannot be adequately controlled by grazing. Studies have shown that areas where small controlled burns have taken place are re-colonised by lichens in around 5 years (Lambely, 2001a).

The above management suggestions will allow the diversity of the bare ground and short turf heathland communities to be enhanced. Conservation of the calcareous areas of the SE heath lozenge are discussed in the base rich zone section.

Alder Gullies

The species richness of the bryophyte communities within the Alder gullies is due to the perpetually shaded and humid nature of these wet woodlands and the presence of exposed stone. Any work to adjust the light levels or age structure of the species present is not recommended. Removal of non-native tree species also needs to be approached with caution as some non-native tree species (such as Sycamore (*Acer pseudoplatanus*) are beneficial for lichen species (Hodgetts, 1996).

The lower section of Aldernbridge gully has been managed under a coppice management scheme at some point in the past. This area was noted as having less of a bryophyte interest to areas further up the gully where epiphytic species and *Sphagnum* species were abundant. It is advised that non-intervention be maintained within all the gullies allowing their shaded nature to perpetuate. Bryophytes that specialise on tree trunks tend to be strongly associated with trees with sloping trunks (Hodgetts, 1996) and management that would alter this element of these habitats (as will occur under certain woodland management methods) should be avoided.

A stand of pine near the top of Aldernbridge Gully's western bank, if removed, would adjust the climate in a particularly interesting area near the centre of the gully, where a rock face of the liverwort *Pellia epiphylla* is abundant. It is advised that this plantation be kept *in-situ* or phased out gradually as a shelter crop for deciduous trees if future management is planned.

Bracken is abundant on some of the banks leading down towards the stream. Much of the bryophyte and lichen interest remains unaffected by this at the present time, but further encroachment of Bracken in the Alder gully habitat should be prevented. Monitoring of the stands of Bracken is advised.

Gravel Communities

The gravel communities of the commons cover a large expanse of the site and some of these areas are planned for heathland restoration in the future. A mosaic of different successional stages tends to be the practice recommended by most heathland management texts. This form of management can be applied to these gravel systems during the restoration process, but this current stage of heathland development needs to be considered with a percentage of this early gravel community conserved. A lack of consideration towards this early stage of the community could potentially lead to a loss of nationally scarce species such as *Cladonia cariosa* and the declining *Polytrichum juniperinum*. Gravel heaps and ridges are also a distinctive bryophyte community and should be conserved where possible.

Shading of gravel areas should also be considered when planning management as shading (especially by species such as Gorse) can have negative affects on the microclimates of important groups of lichens (Fletcher, 2001). Manual Gorse removal of taller shrubs is possible within these areas. Gorse stumps should be treated to prevent re-growth.

Scarification or rotovating of the top soil is a possible management method to allow restoration of gravel communities that are beginning to decline. This type of management essentially resets the habitat to a colonising successional stage.

Grassland

The grassland community of fine grasses and abundant bryophytes has persisted on Greenham Common through the change from mowing to grazing. Bryophytes tend to benefit from closely grazed grassland and grassland types that are based on skeletal soils like those on Greenham Common. The current management of grazing by cattle and ponies should be continued. Sheep grazing is recommended by some for bryophyte rich grassland (Lambley, 2001b), however the grassland community is not the main feature of interest on the site and sheep grazing is not recommended.

The aims of maintaining areas of skeletal soils and scrapes for colonising lichens and bryophytes should complement other management needs. The act of disturbance by visitors to the common will also create these exposed areas.

Base Rich Zone & Aloina aloides

As discussed in previous sections, the base rich zone in the SE is the area in need of priority management. Adjustment of the soil to better suit the species in decline within this area is not advised, however transplantation of species material to a receptor site in the East of the common should certainly be considered. This should be undertaken as a matter of urgency for the species *Aloina aloides*. A translocation plan should be designed based on evidence gathered on the ecological requirements of the species. A very simple solution to the current threat facing this species would be removing by hand some of the vegetation surrounding the remaining plants to expose soil. Monitoring of this species is advised with individual plant counts simple to obtain due to the nature and current number of plants. The newly recorded area to the east of the site should also be surveyed for the presence of *Aloina aloides.*

As discussed within the heathland section, an intensification of grazing in this area would benefit the species in question.

Heathland restoration of the newly recorded base rich zone in the east and NW should be avoided and colonisation should be allowed to occur naturally (other than via transplant of bryophytes from the SE).

It is also recommended that transects be established within the east and NW zones to be included within the monitoring programme if time and finances permit.

Invasives

Information on the management of invasive bryophytes is sparse. Manual removal would be time consuming and costly in the amounts recorded. Further information on the extent of the problem on Greenham Common is required so appropriate management measures can be designed. Collaboration with specialist institutions is required to assess current management practices and to further understand the ecology of these species.

Sphagnum

A simple monitoring regime of the *Sphagnum* species within the Alder gullies is possible with species relatively simple to identify and area of coverage simple to assess across years. This work may help monitor changes in water quality across the wider area of the Alder gullies.

Conclusion

Greenham Common is regarded as one of the most important sites for bryophytes and lichens in Berkshire. Based on the findings of this Site Dossier key species have been seen to be in decline since the last data was recorded in 2000. *Aloina aloides* and *Polytrichum juniperinum* show an observed decline and the base rich community in the SE heathland has been shown to be degrading. Species that were formerly recorded frequently in the past (such as *Riccia sorocarpa*) have been unrecorded in the present study.

The Condition Assessment has shown that the vegetation composition of the heathland has changed more each year and Gorse has become more of a prominent feature which is limiting the required conditions of many of the remaining characteristic bryophyte and lichen species.

New areas have also been located of conservation interest and non-native invasion also has been recorded as a major issue facing the bryophyte and lichen flora of Greenham.

Consideration of this important aspect of the sites ecology now needs to be given due regard within management objectives for the site. By the prioritisation of management requirements and features of special interest within this site dossier, it is hoped that these species can be incorporated into the traditional management process. This dossier should be kept as current as possible and should be amended when management has progressed or changed. For further information please consult the appendices.

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Appendices Contents

Appendix 01 – Species list (excel file)

Appendix 02 – Coordinates list (excel file)

Appendix 03 – A3 Map of site including habitats and features (BMP file)

Appendix 04 – Transect photos (jpegs in folders)

Appendix 05 – Condition Assessment data including analysis and raw data (folders and excel files)