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The New Forest heathland lichen survey 2011 to 2015

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THE NEW FOREST

HEATHLAND LICHEN SURVEY

2011 – 15

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A scan of a *Cladonia cryptochlorophaea* specimen from a tumulus at
Yew Tree Heath (SU3606) in H2c humid dry heath within the burning cycle

***Cover Picture*:** a vigorous and fertile thallus of Heathtooth *Pycnothelia papillaria* in open moderately browsed humid dry heath within a burn rotation (at Whitemoor, north east of Boltons Bench). This is a specialist species of well lit hard humus, which is tolerant of cool fires and moderate trampling. It is in serious decline in lowland Europe but it is still abundant in the New Forest, where it is showing no decline. It is a fire and grazing dependant species that thrives under traditional pastoral management of heathland but is rapidly declining under more sensitive conservation management of heathlands.

KEY POINTS & COMMENTS ON MANAGEMENT

Key points

- Between 2011 and 2015, field surveys covering 100 1km squares across the New Forest have been undertaken. Data from 25 systematically 1ha plots are also considered

- Remarkably high numbers of new species of conservation interest were found during the survey; many were quite unexpected species. Of significance on a UK basis, were one Critically Endangered RDB species, *Cladonia mediterranea*, which is also a Section 41 species, three Near Threatened and sixteen Notable species. Eleven other species are frequent in the uplands, but are increasingly rare to the south. Some of these are rapidly declining in England outside of the New Forest.

- The lichen diversity occurs mainly in discrete hot spots that are found widely through the heathland landscapes of the New Forest.

- No indication was found of a significant decline in heathland lichens within the New Forest heaths when compared to previous survey data.

- The survey supports the assessment by Fletcher et al (1984) that the New Forest is of international importance for its heathland lichen assemblage.

- The survival of the diverse lichen assemblages on the New Forest heathland is associated with the continued practice of traditional management.

- The RDB/Nb Scores are not nearly as high as those found for the New Forest woodlands, but are likely to be the highest recorded for English lowland heaths.

- The most significant group of species in European terms, are those of open damp hard humus surfaces. These include *Cladonia strepsilis* and Heathtooth *Pycnothelia papillaria*, which are highly burn- and grazing-dependent. These species have largely disappeared from the northern European plain from the Netherlands to Latvia. Similar in this respect are *Cladonia callosa* Nb (NS), *Cladonia zopfii* Nb (NS), *Cladonia subcervicornis*, *Dibaeis baeomyces* and *Icmadophila ericetorum*. These are all species of open damp black humus which are declining in lowland Europe.

Comments on management

- **Lichen-rich hard-grazed short heaths:** A unique feature of the New Forest which requires careful management to be maintained. Long-term retention of this habitat is likely to be linked to patterns of grazing, especially those associated with larger cattle herds. The latter are likely to need special support in the future.

Comments on management (cont.)

- **Burn rotation**: The current burning programme is very important to maintaining lichen diversity within the less heavily grazed heaths. This should be continued, with all types of heath included, including the driest heaths.

- **Heather mowing:** Mowing heathland does not produce a rich lichen habitat and is not a substitute for burning. Unburned old tall heath was not found to be of special lichen interest, but specific fire refuges in areas of taller heath should be managed for the benefit of other interest features.

- **Erosion and soil disturbance**: Erosion and soil disturbance have been an integral part of the heathland landscape for millennia. Rich assemblages can result from lichens slowly and naturally recolonising bare ground. It is important to allow some disturbance to create new lichen habitat, while balancing this against potential damage to other interests caused by erosion. Currently animal poaching and visitor pressure result in small-scale path creation and rutting followed by abandonment. This is the main source of bare ground which becomes lichen rich. Excessive path repairs, or management to increase vegetation cover, would greatly reduce the lichen diversity of the heaths.

- **The New Forest as baseline**: There seems to be little general recognition of declining lichen diversity in England's lowland heaths outside of the New Forest despite some evidence suggesting that is the case. An important aspect of the New Forest is that it has changed less than other heathlands in the lowlands in the last 150 years. As such, it can provide an important baseline for biodiversity conservation against which to measure changes that may have occurred on other heathlands before detailed recording began. Targeted lichen surveys of other English heaths are recommended.

- **A need to revise Common Standards Monitoring**: The standard methods for carrying out condition assessments in lowland heaths are concerned only with cover of lichens, not species diversity. This is problematic, as diversity declines well before the cover of common robust species.

THE NEW FOREST HEATHLAND LICHEN SURVEY 2011 – 15

SUMMARY

INTRODUCTION

The New Forest is well known for its internationally important lichen assemblages in old growth pasture woodland but there is evidence to suggest that the heathlands also have an internationally important diverse lichen community but little published survey evidence exists.

Between 2011 and 2015, field surveys covering 100 1km squares across the New Forest have been undertaken in large part by ecologist, Neil Sanderson including work undertaken as part of the Natural History Museum New Forest Quantitative Inventory.

Natural England, the Forestry Commission and the National Trust commissioned Neil Sanderson Botanical Assessment & Survey to produce a report providing evidence and information about the richness, diversity and relative importance of the heathlands of the New Forest for lichens.

METHODS

Old Data

Data from previous surveys of 13 selected sites in the 1980s & 1990s New Forest heathlands carried out by Dr Francis Rose were compared to the recent results. Some old literature records were located.

New Forest Quantitative Inventory

The New Forest Quantitative Inventory (NFQI) was a Natural History Museum project to explore biodiversity patterns in a quantitative way across the whole landscape of the New Forest.

The NFQI included five or 10 randomly placed hectare plots in habitats across the New Forest, sampled by 12 regularly placed quadrats. The lichens within sampled heathland habitats were recorded by Neil Sanderson and Pat Wolseley in October 2011. Data from 25 heath and grassland plots were used as part of this report.

Full data analysis of the New Forest Quantitative Inventory has not yet been undertaken, however, some initial analysis was carried out. The plot data was combined to make constancy tables for each habitat. A separate statistical analysis was made of the individual quadrat data, with the species diversity between heathland habitats compared and species diversity within the heath quadrats compared with environmental variables, including the date of last burning from the Forest Enterprise GIS system.

New Forest Heathland Lichen Survey

The Survey

New Forest Heathland Lichen Survey (NFHLS) was then carried out to give a wider sample of the New Forest heathlands than that of the NFQI. A representative sample of the New Forest by grid 1km squares was aimed for. The data from the NFQI was incorporated into the NFHLS data. Beyond this, the survey was undertaken as a spare time voluntary activity.

Ecological Scope
The survey encompassed a traditional broad definition of heathland, taken to be all the open rough grazing areas within the open Forest.

Areas Covered
The 1km squares chosen for survey were partly governed by the existence of past localised data, allowing comparisons between data sets. The target coverage was 30%, with finally 100 1km squares fully recorded. Furthermore, by February 2015, species of interest were recorded in passing from 28 additional squares.

Heathland Meta-sites
For descriptive purposes the Forest heathland was divided into six meta-sites: the Eastern Heaths, Beaulieu Heath West, the Northern Commons, the South Western Heath, the Central Heaths and the North Western Heaths.

The CCP Index
The CCP Index, is the total numbers of terrestrial *Cetrelia*, *Cladonia* & *Pycnothelia* taxa recorded within a site. It is used as a way of measuring lichen species diversity within heathland in a consistent way. In a New Forest context, a discrete patch of lichen-rich heath would be expected to score at least 10 to be of high interest, whereas a 1km square, would be expected to score over 15. The scores in lichen-rich heaths are similar in the lowlands outside of the New Forest, but such sites of interest are much less frequent.

SURVEY RESULTS

New Forest Quantitative Inventory

Lichen Assemblages and Habitat Diversity
The dry heaths were found to be significantly richer ($p < 0.01$) than all other main vegetation types sampled (Wet Heath, Acid Grassland and Wet lawn). The other main vegetation types were not significantly different from each other in terms of lichen diversity.

Lichen Diversity and Environmental Variables
Data from all the quadrats recorded as dry heath were analysed further against the environmental variables recorded for each quadrat.

Dry Heath Vegetation Type: heaths with high Bristle Bent *Agrostis curtisii* cover were less lichen rich than dry heaths with low grass cover but this was only weakly significant ($p < 0.1$).

Controlled Burning: the dry heaths surveyed included areas grazed so short as to be unburnable (NB), areas of taller heath capable of being burned but not burned for more than 20 years (>20) and areas subjected to controlled burning within the last 20 years (1 – 19). The latter were also divided into one to nine years old burns (1 – 9) and 10 to 19 year old burns (10 – 19). Within the controlled burns, the older (10 – 19) heaths did show lower diversity scores than the younger burns (1 – 9) but this decline was not significant. Within the wider categories very wide differences in diversity were clearly evident in the field and this is confirmed by the highly significant ($p < 0.01$) differences found between the diversity scores of the different ages of heaths. The unburnable short grazed heaths were the richest at a quadrat

level. Control-burned quadrats younger than 20 years were less rich at a quadrat level than the unburnable short grazed heaths, but were much richer than the burnable heath over 20 years old. The latter were extremely species poor and impoverished, indicating a rapid drop off in lichen diversity 20 years after a burn.

Sward Height: the sward height in the quadrats was recorded in three height classes. Between all classes, the means of all diversity scores were significantly different ($p < 0.01$ or $p < 0.05$). The short swards were richest, with the medium height sward about half as rich but with the tallest swards very species poor. The short swards occur on the unburnable short grazed heaths and recently burned pioneer stands, while the medium height swards occur on mainly older control-burned stands. The tall stands are either long unburned stands over 20 years old or older burn sites over 10 years old in lightly browsed areas. Increasing sward height clearly causes both decreasing light levels on the ground and an increasing build up of loose litter covering hard humus, both of which reduce lichen diversity.

Browsing: the browsing intensity was defined in three classes. The heavily browsed heather stands were the richest and significantly richer ($p < 0.01$) than either medium or low browsed stands. The low browsed areas were on average poorer using the diversity scores than medium browsed areas, but this was not a significant difference. The low browsed areas were not nearly as species poor as either long unburned stands or very tall stands. This demonstrates that even in low browse areas, burning can open up the heather stands to allow colonisation by lichens. Heavy browsing produces very open short swards and this does significantly increase the diversity of the lichen assemblage over the more lightly browsed areas.

New Forest Heathland Lichen Survey

Total Assemblage 2011 – 2015
A total of 161 taxa were recorded from the New Forest heathlands between 2011 and 2015. Before the 2011 – 2015 systematic survey, only 82 lichen taxa were recorded from the heathlands. Of the 161 taxa, 30 were totally or largely confined to lumps of concrete, limestone and brick, or moss growing upon these substrates. Natural pebbles supported 16 taxa and 99 were recorded on the ground.

Remarkably high numbers of new species of conservation interest were found during the survey; many were quite unexpected species. A total CCP heathland index score of 51 was recorded, an exceptionally high total. The score was about 31 before the survey began. The numbers of rare species on a UK basis include one Critically Endangered RDB species, *Cladonia mediterranea*, which is also a Section 41 species, three Near Threatened and sixteen Notable species. Eleven other species are frequent in the uplands, but are increasingly rare to the south[1]. Some of these are rapidly declining in England outside of the New Forest.

Species Accounts
Descriptions of the ecology and distribution of all the terricolous species are given along with those found on natural rocks. Briefer lists of other species are given.

[1] Notable species = Nationally Rare or Scarce species which are not RDB species

Description of Heathland Meta-sites
Descriptions of the individual heathland meta-sites are given, describing the landscape context for the lichen diversity and listing the most important known hot spots. Any conservation management issues are also mentioned.

DISCUSSION

Results of New Forest Heathland Lichen Survey

Comparison with Old Records
The majority of species recorded in past site surveys were refound during the present survey. There is no evidence of any significant loss of heathland lichen diversity from the New Forest.

Habitat Assemblages – Dry Heaths within the Burn Rotation
Most of the heather stands in the New Forest require controlled burning if a balanced structure is to be maintained. An average rotation length of 25 years is aimed for. It is important to separate the effects of controlled burning from those of wild fire. The latter typically occurs in summer and sterilises the soil. In wild fires, lichen regeneration appears to occur by colonisation from beyond the burnt area, which takes more than a decade. With controlled burning, the lower layers of compacted humus are unburned and intact propagule bank survives. Here the pattern of lichen regeneration is much more rapid than with wild fires, with regeneration evident soon after the burn. It takes about five seasons for lichen cover and diversity to fully develop. During this phase, the maintenance and creation of gaps in the heather sward is important and such gaps become the locus of latter lichen diversity in maturing heaths.

After the first five years, only the shade of adjacent growing heather bushes can destroy the lichen dominated patches. Canopy closure can be slowed by browsing, but all such lichen rich patches will eventually be shaded out. The occurrence of lichen rich heaths in light or moderately grazed heaths, therefore, is a relatively temporary phenomenon. Lichen rich patches develop where the effects of burning, grazing and climate combine to allow the survival of canopy gaps in the heather for a decade or more but most patches are probably lost after about twenty or so years. Overall, on large managed heathlands, lichen rich patches are normally developing in one area, as they are lost in another. Revisits to sites recorded in the early 1990s, however, suggest that favourable locations for lichen diversity are actually quite fixed in the landscape but reappear at suitable stages in the burning cycle.

The richest burned sites show a strong association with certain positions within the landscape; mainly those areas with low productivity soils that are not prone to very long periods of surface water ponding. The richest areas are found on terrace edges, the upper part of terrace edge slopes, and low undulating terrain in the south of the Forest and the Northern Commons, where there are no significant superficial deposits covering the Tertiary sands.

The New Forest Quantitative Inventory, however, did not find the effect of estimated browsing levels as marked as the impact of either burning or sward height within the New Forest grazings. The absence of grazing nevertheless does have a large impact. This can be seen on some heathlands outside of the Forest grazings looked at by the NFHLS. These heaths have dense swards suppressing most lichen diversity.

Mowing heather does not simulate the effect of controlled burning, as it fails to remove the common late succession mosses, loose litter and fibrous brown humus. Only controlled burning leaves the deeper hard black humus surface favoured by most lichens exposed.

The open areas in heaths within the burn cycle have a distinctive assemblage of lichens. Other species typical of banks can occur, wherever there has been some disturbance. Some moderately burn-sensitive species occur but usually in small fire refuges, such as along paths or areas with thin heather growth. Other highly fire-sensitive species, especially *Cladonia arbuscula* ssp. *squarrosa*, are totally absent from control-burned areas of dry heath.

Habitat Assemblages – Wet Heath Transition and Mires
Wet heaths are generally poor in lichens. At a local level, however, a very specialised version of the control-burned heath lichen assemblage is found in the transition from wet humid dry heath into wet heath. This occurs where the Bog Mosses are infrequent in the higher parts of wet heaths. Some burn-sensitive species become more widespread; these species presumably experience cooler burn temperatures due to the wetter soils of the wet heaths.

Habitat Assemblages – Short Grazed Dry Heaths
Short grazed dry heaths are a distinctive habitat, which appears to be very rare or extinct outside of the New Forest in southern English heaths. The 1986-1988 New Forest vegetation survey, however, found 16% of heather stands to be so heavily grazed that the heather was reduced to a prostrate creeping growth form. Many such areas are exceptionally lichen rich. The largest areas of prostrate heather in the Forest have been in this condition for decades. The short grazed heath areas probably have stable cores, which remain heavily grazed but, shifting boundaries with less browsed heath over time. These heavily grazed heaths are on a knife edge; a small increase in grazing pressure can begin to destroy the lichen interest. This has happened in parts of the Northern Commons since the 1980s, but much of these are now recovering.

Within the heathland landscape these short heaths have a very distinct position. They are invariably found where low productivity podzols occur in close proximity with much more fertile soils. Cattle are probably important in creating and maintaining short heaths; they browse more on heathers than ponies.

The lichen assemblage of short grazed heath is characterised by an abundance of Reindeer Mosses, with *Cladonia arbuscula* ssp. *squarrosa*, particularly characteristic, while the very rare *Cladonia mediterranea* CR (NR/S41) occurs in Ogden's Purlieu. Smaller species are less prominent, except where bare ground has been exposed recently.

Habitat Assemblages – Banks, Pits and Hollow Ways
Disturbed areas, where bare soil or banks have been produced in the past, are a very important habitat for heathland lichens. Many heathland species are most frequent in this habitat, or are confined to it. The disturbance can have very long lasting effects; Bronze Age barrows can have very rich assemblages on well lit steep sides.

The types of disturbance that create lichen rich habitats are varied. Natural disturbance includes slumping seepage step banks above mire springlines and rabbit holes. Man made sources of disturbance include prehistoric tumuli, medieval hollow ways, early modern and modern gravel pits, ground disturbance and construction during WWII and widespread recent track and path erosion. The scale of past disturbance was at times far higher than anything occurring now.

The continual development of paths and tracks is also important in providing fresh exposures for early pioneer species. The lichen assemblage of banks is distinguished by a high frequency of Heathtails and Pixie Cups (*Cladonia* spp.) compared to intact surfaces, occurring along with the typical smaller species of the undisturbed heaths.

Habitat Assemblages – Acid Grasslands
The more productive and moister acid grasslands typically lack lichens. Those that are less productive or summer parched do support limited assemblages and include specialist and rare species.

Within the acid grasslands, much richer lichen assemblages are found in open herb rich grasslands (U1d/f) that have been very heavily disturbed by major WWII constructions, especially airfield runways, and their subsequent removal. The assemblage can include some uncommon downland species, where broken concrete has raised the soil pH.

'Lichen sand grasslands' are lichen rich parched acid grasslands on well drained sands. The community is very rare on the open Forest. Just off the Forest, however, there is a remarkable area of recently developed lichen sand grassland at Blashford in a former gravel pit. This is unlike anything on the open Forest and includes species that are sparse or rare on the Forest. A similar type of lichen assemblage is also found on sand dunes, sandy heathland and coastal heathland regionally.

Habitat Assemblages – Ungrazed Heath
Two ungrazed heaths that were surveyed provided a useful contrast with the grazed heathland of the open Forest. In both, thick thatches of Moorgrass *Molinia* litter or dense closed heather canopies were suppressing lichen diversity. Lichen interest was limited to recently disturbed or burned areas.

Habitat Assemblages – Other Habitats
Flints and stems of old heather bushes add to the diversity of the New Forest lichen assemblage but these habitats are not species rich and the species are all widespread species. Flints are common but lichen colonised heather bushes are rare.

Air Pollution
Work in the Netherlands has shown that ammonia pollution is a severe threat to lichen rich heaths and acid dunes. The main mechanism is greatly increased cover by the invasive non-native moss *Campylopus introflexus*. In the Netherlands, local dominance of *Campylopus introflexus* was found to occur at or above atmospheric ammonia concentrations of 7 μg NH_3 m^3.

During this survey *Campylopus introflexus* was found to be widespread but the very vigorous tall growth form that displaces lichen diversity was very rare and associated with hot wildfire sites. Modelled atmospheric ammonia concentrations in the New Forest range from 0.72 NH_3 m^3, in the centre, to 1.51 NH_3 m^3 on the edges.

No significant correlation was found between ammonia concentrations and average CCP index scores.

At current levels, nitrogen pollution is not a major factor driving lichen diversity within the New Forest. Inherent environmental factors and management impacts are much more significant.

Comparison with other British Heathlands
There have been few systematic surveys of lichens on British heathlands, but some comparable site data is available from the Dorset Heaths. The robust Reindeer Moss *Cladonia portentosa* has a similar frequency in both Dorset and the New Forest. Otherwise there are marked differences, with all but one species less frequent in Dorset. Acid grassland lichens were very much poorer in Dorset as was found for vascular plants in the 1980s (Byfield & Pearman, 1996). In addition specialist dry heath lichen were also much less frequent in Dorset than in the New Forest. This strongly indicates that the serious 20th century decline in vascular plant diversity within habitats outwith dry heaths in Dorset also applies to lichens in the dry heaths. As with vascular plants a decline in management on the heaths is likely to be responsible. These data suggest that the New Forest may currently be twice as diverse as the Dorset heathland at a site/1km square scale. Other heaths, as in the Thames Basin, appear on the limited evidence available to be even more impoverished.

Comparison with Continental Europe
At a European level, the well studied heathlands of Netherlands and the north European Plain have lichen assemblages that are similar to lowland England. Many species that still have strong populations in the New Forest, however, are red listed in the Netherlands or extinct. For example, *Pycnothelia papillaria* in the Netherlands was a fairly common species in the Netherlands' heathlands until the 1970s but was thought extinct until refound at a single site in 2006. This hard humus specialist is still abundant in the New Forest but is seriously declining throughout the north European plain from Belgium to Latvia.

CONSERVATION INTEREST

Value of the New Forest Heathland Lichen Assemblage

- **The 2011 – 2015 New Forest Heathland Lichen Survey has supported the assessment by Fletcher et al (1984) that the New Forest is of international importance for its heathland lichen assemblage.**

The 2011 – 15 New Forest Heathland Lichen survey found the heathlands to have a very high lichen diversity. No indication was found of a significant decline within the New Forest heaths when compared to previous survey data. The diversity occurs mainly in discrete hot spots that are found widely through the heathland landscapes. The New Forest lichen assemblage is also very diverse compared to other lowland heathland areas in Britain and the north European plain.

Conclusion: Shifting Baselines and Conservation Management
The considerable decline in the quality of heathland lichen floras in heathland outside of the New Forest has not been generally recognised, even on heaths regarded as well managed for nature conservation.

The survival of the diverse lichen assemblages on the New Forest heathland is associated with the continued practice of traditional management. Without this surviving example it would be difficult to realise the extent to which high lichen diversity was dependent on aspects of extensive traditional management

COMMENTS ON MANAGEMENT

New Forest Heathland Management and Lichen Diversity
The results of this survey indicate that the current management of the New Forest heathlands, by grazing by commoners' stock and controlled burns, appears highly beneficial for lichen diversity. Hence, it is a clear recommendation of this report that this management is maintained.

Specific Issues – Hard Grazed Short Heaths
The continued presence of areas of short grazed heath, maintained for decades in this condition by localised high grazing pressure, is fundamental in creating the conditions that support the rich lichen assemblage of the New Forest heathlands. It is important that these now unique features of the New Forest are maintained.

- **Review methods of assessing condition of lowland heath to remove inappropriate upland biases. Incorporate assessments of lichen diversity, not just cover. For general use these could include counting the main morphological types of *Cladonia* (Annex 2) present rather than actual numbers of species.**
- **It is important not to overreact to periods of very high grazing, for instance by reducing grazing so much that lichen-poor tall heath is produced.**
- **Long term maintenance of the hard grazed short heaths is of vital importance for lichen heathland conservation. Therefore incentive schemes for commoners turning out more than 40 cattle, including financial support and initiatives to encourage a new generation of commoners, should be considered.**

Specific Issues – Burning Rotation and Heather Mowing

- **Maintain the current burning programme.**
- **Mowing is acceptable on a small scale but, across the open Forest as a whole, is not a suitable substitute for burning.**
- **The driest heaths in the Forest should not be treated any differently from the rest of the heaths and should be incorporated into the burning cycle.**
- **Rather than a policy of not burning very dry heath, specific fire refuges in areas of taller heath should be managed for the benefit of other interest features that would otherwise be harmed or damaged by burning.**
- **The boundary between burned and unburned short grazed heath shifts and should be allowed to shift in the future. It is best set by experienced FC staff using their field experience to determine what can and should be burned.**
- **Continue to ensure that lichen rich burn-dependent fringes of the mires are burnt and are not left unburnt as a result of cutting fire traces on drier ground.**

Specific Issues – Erosion and Soil Disturbance
Erosion and soil disturbance have been an integral part of the heathland landscape for millennia. Slowly recolonising bare ground supports rich lichen assemblages. It is important to allow some continued disturbance that creates new lichen habitat, while balancing this against potential damage to other interests caused by the erosion.

- **In assessing the impact of recreation on the biodiversity interest of the New Forest, it is important to realise that erosion has a complex impact as it is creative as well as destructive to biodiversity interest.**
- **Shifting small-scale path development caused by recreational access, grazing animals or vehicle access is very beneficial to lichen diversity and other species requiring bare ground. This type of disturbance should be accepted unless excessive or is proven to be damaging important features.**
- **Where restoration work is required, it is important, as far as possible, to minimise active repairs. Ideally measures to prevent further damage should be taken and slow natural vegetation recovery allowed.**
- **The impact of regular use by bicycle tyres appears to be very different from foot and hoof impact, producing a less varied micro terrain with less niches for lichen colonisation. The current unofficial access to wide areas by bicycle is a concern and curbing this is urged.**
- **Pathways and tracks should not be reinforced or surfaced in order to make them more resilient to high levels of use. Where possible, other methods should be employed to reduce erosion.**

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1.0 INTRODUCTION TO MAIN REPORT

1.1 Background

The New Forest is an exceptionally important site for nature conservation. It supports a wealth of wildlife including a large number of very scarce plants, animals, invertebrates, birds, lichens and fungi. The New Forest is the second largest terrestrial Site of Special Scientific Interest (SSSI) and its international importance is recognised through the additional designations of Special Area for Conservation (SAC), Special Protection Area (SPA) and Ramsar wetland. These afford the New Forest the highest level of statutory protection from damaging activities and development.

The New Forest is well known for its internationally important lichen assemblages in old growth pasture woodland but there is evidence to suggest that the heathlands also have an internationally important diverse lichen community but little published survey evidence exists.

Between 2011 and 2015, field surveys covering 100 1km squares across the New Forest have been undertaken in large part by ecologist, Neil Sanderson including work undertaken as part of the Natural History Museum New Forest Quantitative Inventory.

1.2 The Brief

1.2.1 Requirement

Natural England, the Forestry Commission and the National Trust commissioned Neil Sanderson Botanical Assessment & Survey to produce a report providing evidence and information about the richness, diversity and relative importance of the heathlands of the New Forest for lichens. The report should assess the importance of traditional heathland management on lichen diversity and make appropriate comments on management.

1.2.2 Outputs

A technical report that includes:

- Basic background information about the lichen assemblage and appraisal of existing evidence.
- Collation and analysis of survey data indicating the richness, diversity and distribution within the New Forest and highlighting any rarities identified, their conservation status and location.
- An overview of the lichen rich heathland sites within the New Forest with an assessment of current condition.
- Discussion to include elements such as the importance of New Forest Heathlands for lichens, the importance of traditional heathland management, current management practices and comparison with other UK lowland heaths.

- Comments on management both generally and at individual site level
- Supporting photographs and maps and references

1.3 The New Forest Heathland Lichen Survey 2011 – 2015

A great deal of survey work and research has been carried out on the epiphytic lichens of the ancient pasture woodlands of the New Forest (Sanderson, 2010). Much less work had been done on the lichen assemblage of the heathlands, although they were known to be rich and internationally important. The New Forest was the only lowland heathland that Fletcher et al, (1984) assessed as being of international importance for its lichen assemblage. Their description of the New Forest heathland lichen assemblage and its importance is given below (with the nomenclature updated):

> "The New Forest heaths form part of the series, known informally as the "Anglo-Norman" heaths, which stretch from Normandy to Wiltshire, Hampshire and Sussex. Gimingham (1971) refers to these sites as "Lowland-Oceanic with *Calluna/U. minor/Erica cinerea*". The wet-heath facies are also present. We cannot place these heaths exactly since quantitative angiosperm studies do not accompany any of our lichen data. It is estimated that less than 1200ha of these heaths remains in Normandy in a natural condition, and much of that is threatened. We consequently feel justified in according an international status to these sites.
>
> The best sites are at Handy Cross to Backley Plain (41/2107), Plaitford to Furzley Commons (41/2718 to 28151, Rushpole Warren from Foxhill to Fair Cross (41/3009), the Heaths about Beaulieu Road Station (41/3307 to 3605) and Ridley Wood area (Harvest Slade Bottom) (41/2106). Plaitford-Furzley is topographically diverse with wet and dry areas, is well grazed and is away from major tourist roads and concomitant fire hazards. The Handy Cross and Ridley Wood areas are comparable but more at risk. Foxhill-Fair Cross is also good but small in extent. Patches of lichen-rich heathland occur throughout the New Forest area.
>
> *Cladonia* species are numerous and luxuriant. Notable species include *C. arbuscula*, *C. ciliata*, *C. glauca*, *C. subulata*, *C. macilenta*, *C. subcervicornis* (unusual away from the western coastline), *C. strepsilis* and *Pycnothelia papillaria*. Wetter soil bears *Placynthiella icmalea* and *Placynthiella oligotropha*. *Cetraria aculeata* occurs on barer soi1s.
>
> The area benefits from management patterns where grazing is intense and reduces the fire risk, and *Calluna* is unburnt and allowed to reach over-maturity, making it non-flammable and offering open substrata for lichen colonisation.
>
> The site is backed-up by Ambersham Common and other Sussex heaths. It is well protected, though recent efforts to explore for natural gas are disturbing since sulphur dioxide "burn-off" and nutrient-rich dusts would be catastrophic to the lichen interest."

The author of this report last looked at the lichens of the New Forest heathlands in detail with Dr Francis Rose in the 1980s & 1990s. This included listing species in

about 12 locations and resulted in a report on the New Forest heathland lichen assemblage and heathland management (Sanderson, 1996).

In the autumn of 2011, however, the author received a contract to record lichens in randomly chosen plots on the heathlands for the Natural History Museum (NHM) as part of their New Forest Quantitative Inventory. This concentrated attention on the New Forest heaths again. The result has been a cascade of exciting finds, which emphasised that knowledge of the lichen diversity of the New Forest heaths was previously rather limited. The quantitative inventory work on the heaths stimulated a much wider survey of the New Forest heathland lichens by 1km national squares, run on a voluntary basis by Neil Sanderson. This aimed to cover at least 33% of the heathland of the New Forest grazings using 1km national grid squares as the recording unit.

The Natural History Museum's New Forest Quantitative Inventory, whilst it produced very useful data that will be subject to statistical analysis, it represented a very limited sample of the heathlands of the Forest. The New Forest Heathland Lichen Survey (NFHLS), by way of contrast was started to give a wider picture of the diversity of lichens on the New Forest heaths (Map 1) and to give results that can be easily compared to other heathland areas. The strategy for the NFHLS was to survey a representative sample of the New Forest by grid 1km squares, which are simple to define and the results can be easily integrated into national biodiversity recording schemes.

NFHLS survey built on the NHM's Quantitative Inventory and the Natural History Museum provided additional help, particularly in running TLC chemical analysis that have been of great help in getting to grips with the minefield of *Cladonia* taxonomy.

2.0 METHODS

2.1 Review of Existing Data

Previous surveys of the New Forest heathlands were not carried out systematically but localised data was recorded from selected sites in the 1980s & 1990s by Dr Francis Rose, with assistance from Neil Sanderson. Surveys were made at 12 sites on the open Forest and the data summarised on a table sent to NCC on 6/10/1989, with a copy preserved in the author's files. Some additional records and another site were added this table sites to the author's personal copy of the species lists in the early 1990s.

The ecological and conservation observations made during this survey were summarised in Sanderson (1996).

The sites with data are listed below (S = Resampled 2011 – 15):

- Plaitford Common, SU2718, F Rose, 1983 – 1991 (S).
- Black Hill & Common, SU1810 & Black Barrow, SU1910, F Rose & NA Sanderson, 1990 (S).
- Hampton Ridge, SU1913, NA Sanderson, 1989 – 1991.
- Redshoot Plain, SU1808, F Rose, 1980 – 1989.
- Handy Cross Plain, SU2107, F Rose, 1980 – 1989 (S).
- By pond west of Slufters Inclosure, SU2209, F Rose & NA Sanderson, 1989 – 1991 (S).
- Acres Down, SU2708, F Rose, 1980 – 1989 (S).
- Lyndhurst Golf Course, SU3008, F Rose & NA Sanderson, 1989 – 1991 (S).
- Fair Cross, SU3009, F Rose, 1988 (S).
- Dibden Bottom, SU3906, F Rose & NA Sanderson, 1989 – 1991 (S).
- Pig Bush, SU3605, F Rose, 1980 – 1991.
- East Beaulieu Heath, SU4003, F Rose, 1989 (S).
- Badminston Common, Fields Heath (N Solent SSSI), SU4501, NA Sanderson, 29/10/1989 (S).

The data was abstracted and sent to the British Lichen Society database, from which it will be exported to the NBN. Sanderson (2007) carried out a lower plant survey, including lichens on Hyde and Gorley Commons for Hampshire County Council. This data was also abstracted and sent to the British Lichen Society database.

There are likely to be some old herbarium records but these have not been systematically searched for. Coppins (1976), however, describes important early (1911) collections by the Rev. H. M. Livens of species that would be found to be

widespread by this survey such as *Icmadophila ericetorum* and *Cladonia zopfii*. Sandell & Rose (1996) also list some herbarium records.

2.2 New Forest Quantitative Inventory

2.2.1 The Quantitative Inventory

The New Forest Quantitative Inventory was a Natural History Museum project to explore biodiversity patterns in a quantitative way across the whole landscape of the New Forest (Website "NHM"). This work began in 2010 and was a cross-departmental programme involving scientists from Entomology, Botany, Zoology and Mineralogy. It built on the now 11-year continuous soil and litter sampling programme undertaken by the NHM Soil Biodiversity Group.

2.2.2 New Forest Quantitative Inventory Plots Surveyed for Heathland Lichens

The New Forest Quantitative Inventory included five or 10 randomly placed plots in habitats across the New Forest. The lichens within plots in heathlands habitats were recorded by Neil Sanderson and Pat Wolseley in October 2011. Dry heath (in the broad sense, including true dry heath and humid dry heath), the main heathland lichen habitat, was only sampled by five plots (**Table 1**). As this was clearly inadequate, a further five random dry heath plots were added. Unlike the sampling of the pasture woodlands by 10 similar plots, the heathland sampling failed to record any exceptional hot spots for heathland lichen diversity. To document the richest sites, two further plots were placed randomly within chosen outstanding sites. The latter two sites were not intended to be used in statistical calculations.

In contrast 10 wet heaths were included in the original New Forest Quantitative Inventory site list, but only six were recorded for lichens, as little was being recorded (**Table 2**). Six were recorded, as one (Half Moon Common, HMJ) was a very mixed stand in flux from wet heath to lawn and included much dry heath, so this was discounted as too heterogeneous and the sixth recorded. The transition from wet heath to humid dry heath can be very important for lichen diversity but clearly random sampling stratified to place plots with either dry heath or wet heath was missing this transition entirely.

All five New Forest Quantitative Inventory plots sampling acid grassland were recorded (**Table 3**). Of the wet grassland plots, three proved to actually be acid grasslands and were not surveyed but the three remaining plots were surveyed (**Table 4**). The mire plots were not sampled, as this is a generally poor lichen habitat. Interest occasionally occurs, but was very unlikely to be sampled by 10 randomly placed plots.

TABLE 1
Dry Heath Plots

Original Random Plots	Code	Grid Reference
Goatspen Plain	GPH	SU 22238 02226
Widden Bottom	WBH	SZ 28700 98800
Ober Heath	OHH	SU 28500 04000
Pilmore Gate Heath	PGH	SU 26784 09423
Ocknell Plain	OPH	SU 23401 11498
Added Random Plots		

Shatterford	SFH	SU 34928 05510
Bramshaw Telegraph *	BTH	SU 22212 16661
Red Hill	RHH	SU 27724 02060
Handy Cross Plain	HCH	SU 19485 06838
Little Cockley Plain	LCH	SU 19934 15285
Plots placed in rich areas		
White Moor	WMH	SU 31294 08283
Ogdens	ODH	SU 18760 12010

* = Location moved south west from original random location, as this was Wet Heath, until the plot was in fully within humid dry heath.

TABLE 2
Wet Heath Plots

Random Plots	Code	Grid Reference
Burley Lawn	BLJ	SU 23173 03274
Half Moon Common *	HMJ	SU 29700 17400
Ober Heath	OHJ	SU 27903 03535
Ocknell Plain	OPJ	SU 23103 11578
Whitten Bottom	WBJ	SU 20300 00900
White Moor	WMJ	SU 27742 07831

* = Was wet heath when originally mapped in 1980s, know largely converted into wet lawn, and includes significant area of dry heath.

TABLE 3
Acid Grassland Plots

Random Plots	Code	Grid Reference
Acres Down*	ADD	SU26656 09094
Balmer Lawn	BLD	SU 30690 03347
Clay Hill	CHD	SU 23971 02473
Janesmoor Plain	JPD	SU 24588 12805
Long Slade Bottom	LSD	SU 26400 00700

* = Location moved east from original random location, to avoid the plot including woodland.

TABLE 4
Wet Grassland Plots

Random Plots	Code	Grid Reference
Balmer Lawn	BUL	SU 30692 03623
Burley Lawn	BLL	SU 22962 03599
South Weirs	SWL	SU 28600 01500

2.2.3 Recorded New Forest Quantitative Inventory Plots

The plots were defined as a circular plot of one ha around the central grid reference, which was located using a GPS receiver. The plots were sampled using the method defined by Scheidegger et al (2002). This involves recording 12 quadrats placed at set distances from the centre point along set compass directions. The quadrats consisted of a grid of 10 x 10cm cells of four by five cells, to produce a quadrat of 20 cells.

Within the quadrats, all identifiable lichen species were recorded, with the numbers of cells recorded for each taxon. As identifying every single *Cladonia* individual is not easy, some groupings were made:

Cladonia coccifera s. lat.: this included both *Cladonia diversa* and *Cladonia coccifera* s. str. in the plots, with *Cladonia borealis* latter confirmed by TLC chemical analysis outside of the plots by The NFHLS.

Cladonia grayi s. lat.: this included *Cladonia grayi* s. str. and *Cladonia cryptochlorophaea* within the plots, confirmed by TLC chemical analysis. *Cladonia chlorophaea* s. str. was recorded separately during the plot survey and was confirmed by TLC chemical analysis.

For each quadrat the following environmental variables were recorded:

Burning Date: the date of last burning was obtained from the Forest Enterprise GIS system, with the help of Dave Morris of FE. The month (where known) and year of the burn or burns within the plot is described in the data spreadsheet. The age of the stand within the individual quadrat is given in the quadrat data. The GIS database extends back to 1991; areas of heath within the rotationally burned area but not recorded as burned after 1991 are recorded as <20. Areas of short grazed heath and grassland that are not recorded as burned after 1991 and are not likely to have been burned with living memory are marked NB (Not Burnable). In some short sward areas, where the heather sward has never been burned, the Gorse has been burned independently. As this leaves the heather swards untouched, these are still recorded as NB (Not Burnable). The grassland habitats recorded were also recorded as NB.

Sward Height: sward height was placed in three categories:

- **Low** (L): less than 10cm, either heavily browsed sites or recently burned
- **Medium** (M): between 10cm to 40cm high.
- **High** (H): over 40cm.

Browsing: browsing was assessed in three categories:

- **High** (H): heather height maintained prominently below 10cm. All heavily grazed areas are outside of the burning rotation, as the sward cannot practically be burned. Grass swards grazed shorter than 5cm.
- **Moderate** (M): heather increasing in height but slowly. Includes all recently burned sites as these attract grazing animals. Many of these may switch to low browsing pressure as the heather matures. Others are permanently moderately grazed. All sites were within the controlled burn-rotation but permanently moderately browsed sites are likely to be burned at longer intervals than lighter grazed stands.
- **Low** (L): heather is unbrowsed, becomes tall and dense. These were all stands within the burning rotation.

Vegetation: the NVC community type for each quadrat was recorded and then these were grouped in the following summary categories:

Summary Communities:

AD = Dry Heath, higher productivity heath with a high cover of sward forming grass cover from by high Bristle Bent *Agrostis curtisii* cover (NVC: H3a)

AG = Acid Grassland (NVC: U20, U1f, U1d/f, MG6c & M25a) (would be worth splitting up if other groups were being looked at but not for lichens)

BW = Area of recent wet woodland (NVC: W4)

DH = Dry Heath, low productivity communities without high cover of sward forming grass cover (NVC: H2a, H2c)

M = Mire (NVC: M14, M21a & M30)

TW = Tussock Wet Heath (NVC: M16b)

W = Typical Wet Heath (NVC: M16a)

WL = Wet Lawn

NVC Communities:

H2a *Calluna vulgaris – Ulex minor* Heath, typical sub-community
H2b *Calluna vulgaris – Ulex minor* Heath, *Vaccinium myrtillus*
H2c *Calluna vulgaris – Ulex minor* Heath, *Molinia* sub-community
H3a *Ulex minor – Agrostis curtisii* Heath, typical sub-community
H3c *Ulex minor – Agrostis curtisii* Heath, *Agrostis curtisii* sub-community
M14 *Schoenus nigricans – Narthecium ossifragum* Mire, (form without *Schoenus nigricans*, i.e. *Eleocharis multicaulis – Campylium stellarum* community)
M16a *Erica tetralix – Sphagnum compactum* Wet Heath, typical sub-community
M16b Erica *tetralix – Sphagnum compactum* Wet Heath, *Succisa pratensis – Carex panicea* sub-community
M21a *Narthecium ossifragum – Sphagnum papillosum* Mire, *Rhynchospora alba – Sphagnum auriculatum* sub-community
M23a *Juncus effusus/acutiflorus* Rush Pasture, *Juncus acutiflorus* sub-community M23a
M24c *Molinia caerulea – Cirsium dissectum* Fen Meadow, *Juncus acutiflorus - Erica tetralix* sub-community
M25b *Molinia caerulea – Potentilla erecta* Mire, *Anthoxanthum odoratum* sub-community
M30 *Hydrocotylo – Baldellion* vegetation of seasonally inundated habitats, *Eleocharis multicaulis – Sphagnum cuspidatum* community
MG6b *Lolium perenne – Cynosurus cristatus* Grassland, *Anthoxanthum odoratum* sub-community
U1a *Festuca ovina – Agrostis capillaris-Rumex acetosella* Grassland Cetraria *aculeata – Cladonia arbuscula* sub-community
U1b *Festuca ovina – Agrostis capillaris – Rumex acetosella* Grassland typical sub-community

U1d/f *Festuca ovina – Agrostis capillaris – Rumex acetosella* Grassland *Anthoxanthum odoratum – Lotus corniculatus/Hypochaeris radicata* sub-communities
U1f *Festuca ovina – Agrostis capillaris – Rumex acetosella* Grassland *Hypochaeris radicata* sub-community
U3 *Agrostis curtisii* Grassland
U4 *Festuca ovina – Agrostis capillaris – Galium saxatile* Grassland
U20 *Pteridium aquilinum – Galium saxatile* Community
W4 *Betula pubescens – Molinia caerulea* Woodland

2.2.4 Analysing the New Forest Quantitative Inventory Plots

The full dataset has yet to be analysed by the Natural History Museum. However, as there were clear and marked trends within the data some initial analysis has been carried out. The analysis carried out in this report was based on the relationship of species diversity to the measured environmental variables. In comparison, a full analysis using ordination and incorporating species data would elucidate species assemblages and separate responses by individual species to the measured environmental variables (as opposed to just species diversity).

The species data from the twelve quadrats were combined for each plot to compile constancy tables for the habitats sampled. One plot, wet heath plot at Half Moon Common (HMJ) was not used for this as it included a sizeable area on lichen rich humid dry heath within the plot. Constancy was calculated by occurrence of species in a plot, where recorded in at least one cell within a plot. Frequency is the number of cells a taxon was recorded in. Species noted within the plot but not in any cell were marked with a P (present) in the constancy tables but not used to calculate the constancy.

A separate analysis of the individual quadrat data, gave a measure of diversity. The environmental variables were listed per quadrat on an excel spreadsheet <NFHLS.xlsx> along with the numbers of species recorded per quadrat. Also, for each quadrat, the total number of cells in which a species was recorded, were added together to give a quadrat cover/diversity score. That is, a quadrat with six species, each only present in one cell would score 6, while a quadrat with 6 species found in every cell of 10 cells would score 60. The raw data is given in **Annex 1**.

Student T tests (two tailed) were made between pairs of categories within each of the environmental variables to test if the samples had statistically significant different means. The non-randomly placed plots (White Moor, WMH and Ogdens, ODH) were excluded from these tests.

2.3 New Forest Heathland Lichen Survey

2.3.1 The Survey

The data from the New Forest Quantitative Inventory was incorporated into the NFHLS data. Beyond this, the survey was undertaken as a voluntary activity, with additional help from the Wessex Lichen Group. All the people involved in the survey are thanked in the acknowledgements.

Wessex Lichen Group Meetings:

Website, "Wessex Lichen Group 2011":

Black Barrow, New Forest, 13 July 2011
Copythorne Common, New Forest, 27 August 2011
Ogdens, New Forest, 15 October 2011

Website, "Wessex Lichen Group 2012":

Race Plain, New Forest, 12 June 2012
Beaulieu Heath West, 25 August 2012
Heathland Lichen Training Day in the New Forest Saturday 1 December 2012
New Year Meeting, Ocknell Sling, 28th December 2012

Website, "Wessex Lichen Group 2013"

Wilverley, New Forest, Evening Meeting, Wednesday, 19th June
Rufus Stone, New Forest, Saturday, 26th October 2013
Frame Wood, New Forest, Monday, 30th December 2013

Website, "Wessex Lichen Group 2014"
Setley Common, Roydon Woods NR, Hampshire, Tuesday, 30th December 2014

All the field notes from the visits were entered into the author's journal, maintained in MacJournal software, with 228 separate entries matching the relevant tags, indicating the number of field visits involved in this survey. At a conservative two hours per visit, this amounts to 57 field days for the main surveyor.
Photographs: lichen surveys.

Photo 2011-10-13-02: Acres Down (SU 2609). Pat Wolseley recording the PGH Plot during the New Forest Quantitative Inventory Survey, 13th October 2011.

Photo 2011-10-15-13: Ogden's Purlieu (SU1812). The Wessex Lichen Group recording lichen at Ogden's Purlieu, 15th October 2011.

2.3.2 Ecological Scope

The survey encompassed a broad definition of heathland – taken to be all the open rough grazing within the open Forest not just the heather dominated heaths. This is the traditional holistic definition used by naturalists until about the 1970s. After this a narrow rather bureaucratic definition tended to be adopted describing heathland as only heather dominated communities (Sanderson, 1998). This latter definition was part of the unfortunate shifting baseline that occurred as lowland heathlands outside the New Forest became increasingly derelict and were redefined as only consisting of species poor heather dominated communities (Byfield & Pearman, 1996).

The species recorded were lichens and associated fungi found growing on the soil, on stones, including rubble left behind from wartime installations, and species epiphytic on heathers. Species epiphytic on other shrubs and trees and lichens on stumps and dead wood were not recorded. The rare and declining moss *Dicranum spurium* VU (NS/S41) was also recorded, as it was an integral part of lichen rich dry heath communities.

2.3.3 Areas Covered

The 1km squares chosen for survey were partly governed by the occurrence of existing data, including:

- One km squares already included within the New Forest Quantitative Inventory.
- One km squares with existing data from the 1990s.
- One km squares recorded whilst the author was refreshing his *Cladonia* identification in preparation for the New Forest Quantitative Inventory.

As the methodology did not incorporate random sampling, the numbers of 1km grid squares with heathland on the open Forest in each 10km national grid square were counted (ignoring squares with only a few hectares). Then the number required to get at least 25% coverage was calculated. The additional squares were placed to fill in gaps in geographic coverage and to cover the range of heathland types within the 10km national grid. In addition, any accessible heathlands off the open Forest (the common grazings of the New Forest) but within the New Forest SSSI (or other SSSIs in or very near the National Park) were surveyed. Coverage on the open Forest was later raised to 33% as good progress was made and some additional squares were added to even up coverage between the meta-sites.

This added up to 99 1km grid squares, which was rounded up to 100, with 94 on the open Forest (**Map 2**). Species of interest spotted in other 1km squares are also recorded but full surveys of these squares were not undertaken. By February 2015, 28 additional squares have had species of interest recorded on passing.

The coverage of one third of the open Forest is considered highly representative and it is unlikely further intensive survey would be productive. The search for rare species is still continuing on a casual basis. In future, the most important work is to extend similar surveys to other heathlands, with the priority on random plot sampling.

2.3.4 Meta-sites

As the survey progressed in late 2013, it was decided to divide up the heathland by meta-site as a more natural division than by 10km national grid squares. The following areas were devised (**Maps 1 & 2**):

Northern Commons: the block of heathlands stretching 4.5km from Plaitford Common to Cadnam Common, mostly owned by the National Trust. Extends eastwards to include relic areas at Copythorne Common.

Eastern Heaths: stretching 16 km from Fair Cross north of Lyndhurst to Beaulieu Heath East and Blackwell Common. Also including the isolated area east of Backfield at Fields Heath. Forestry Commission heathland management units 6 & 7 (Forestry Commission, 2008).

Beaulieu Heath West: a compact block of heathland about 4km across in the south of the Forest. Forestry Commission heathland management unit 8 (Forestry Commission, 2008).

South Western Heaths: stretches 11km from the east of Brockenhurst to the south west of Burley to Dur Hill Down. Includes isolated heathland at Setley Common to the east in the Roydon Wood Nature Reserve. Forestry Commission heathland management units 4, 9 & 10 (Forestry Commission, 2008).

Central Heaths: a wide band of heathland stretching 13km from Cranes Moor north west of Burley, to Janesmoor by Fritham, although bisected by the dual carriage way of the A31. Also extends south east down to Acres Down. Forestry Commission heathland management units 2, 3 & 5 (Forestry Commission, 2008).

North Western Heaths: the largest single block of lowland heathland remaining in England, stretching 11km unbroken north to south and 10km east to west, although with some internal bands of woodland in the latter direction. Forestry Commission heathland management units 6 & 7 (Forestry Commission, 2008). Forestry Commission heathland management unit 1 (Forestry Commission, 2008).

2.3.5 Progress

By 11th February 2015, all of the squares targeted for survey had been visited, and the level of survey brought to an adequate level (**Map 2**).

2.3.6 The CCP Index

Some years ago, when discussing with Bryan Edwards (of Dorset Environmental Records Centre and Conservation Officer for the British Lichen Society) what would constitute good way of measuring lichen species diversity within heathland, it was agreed that a good patch of heath would be expected to have at least 10 *Cladonia* species and related taxa. This has now developed into the CCP Index; that is the total numbers of terrestrial *Cetrelia*, *Cladonia* & *Pycnothelia* taxa recorded within a site. This index excludes the smaller terricolous crusts that are even more inconsistently recorded than *Cladonia* species. Hence it reduces the variation produced by recorder effort and removes inflated numbers caused by finding stray common species or intrusive habitats within heathland.

As applied to the New Forest the CCP index records various subspecies and varieties as separate taxa. This is a simple index to apply and gives useful assessments of the diversity of lichen rich heathland habitats. In a New Forest context, a discrete patch of heath would be expected to score at least 10 to be of high interest, while a 1km square, or a site of about 100ha, would be expected to score over 15. For this survey the coarsely sorediate pixie cups were recorded as: *Cladonia chlorophaea* s. str., *Cladonia grayi* s. str. (field identifiable by its strong UV+ fluorescence) and the *Cladonia cryptochlorophaea* group, which includes definite *Cladonia cryptochlorophaea* and potentially also *Cladonia merochlorophaea* and *Cladonia novochlorophaea*. The latter group of three species cannot practically be identified in the field.

2.3.7 Nomenclature and Taxonomy

For all but the genus *Cladonia* the nomenclature follows Woods & Coppins (2012). The latter is in need of review in Britain and the more modern treatment of Ahti & Stenros (2013), is largely followed, except that *Cladonia ciliata* var. *ciliata* and *Cladonia ciliata* var. *tenuis* are maintained at variety level and not reduced to forms. The main result is that the former subspecies of *Cladonia cervicornis* s. lat. are raised to species level: *Cladonia cervicornis* and *Cladonia verticillata*.

Identification of *Cladonia* species is not easy and the *Cladonia* section in the standard British lichen identification book (James, 2009) is in desperate need of revision and is at times misleading. Alternative identification resources used frequently were Burgaz & Ahti (2009), Aptroot et al (2011) and Ahti & Stenros (2013). Useful papers included Burgaz & Martínez (2008), Burgaz (2009), Pino-Bodas (2013), Steinová et al (2013) and Zarabska et al (2010). Useful websites included Diederich et al (2015), "BLWG Verspreidingsatlas Korstmossen", "Leif & Anita Stridvall, Lichen Gallery", "Lichenes maritimi Armoricae" and "Oslo Natural History Museum". *Cladonia* taxonomy is very much in a state of flux currently, so not all identifications of taxa made during this survey are necessarily secure.

Some English names are used to characterise the main morphological types of *Cladonia* and similar heathland lichens. These are defined in **Annex 2**.

2.3.8 Assessing the Conservation Status of Lichens

For lichens the definitions of Red Data Book status and International Responsibility Species follows Woods & Coppins, (2012). International Responsibility Species are defined as follows:

- **International Responsibility Species**: this is a new category that recognises that some species are commoner in Britain than elsewhere. They are absent, rare or threatened in the rest of Europe and are thought, on existing data, to have 10% or more of their European or World population in Britain. These could be considered as more important than some Red Data Book species, which are common elsewhere in the world. The significance of these species depends on their actual British and local rarity but special attention needs to be paid to them in management.

Nationally Rare and Nationally Scarce have now been reassessed since Woods & Coppins (2012), and these follow the status on the latest British Lichen Society NBN data import spreadsheet.

Biodiversity Action Plan species (Biodiversity Reporting and Information Group, 2007) are now listed as Species of Principal Importance in England in Section 41 of The Natural Environment and Rural Communities (NERC) Act. The S41 list is used to guide decision-makers such as public bodies, including local and regional authorities, in implementing their duty under section 40 of the Natural Environment and Rural Communities Act 2006, to have regard to the conservation of biodiversity in England, when carrying out their normal functions. The BAP list was simply imported into the S41 lists without review and as yet there has been no further assessment of what additional species could be added on the basis of their English only conservation status. Once this is done it is likely that several species, which have important populations on the New Forest heathlands, will be added to the S41 list.

Summary & RDB/Notable Scoring System: the above system, with three separate assessments, is rather complex, so the rarity and threat status of species is summarised in the text below as 'Red Data Book species' i.e., Near threatened or higher, with all other Data Deficient, Nationally Scarce or International Responsibility species called 'Notable species'. With both categories, the rarity or International Responsibility status is indicated in brackets e.g. Near Threatened (NS/IR) or Notable (IR). Very under recorded lichens and fungi parasitising lichens (lichenicolous fungi), which are not included within the lichen flora (Smith et al, 2009) are not regarded as Notable species.

This is not yet an official system but simply used as a presentational convenience. Any priority species listed in Section 41 are also indicated in the summary (S41).

It has, however, been used as the basis of a more appropriate SSSI scoring system than that given in Hodgetts (1992), which was proposed and tested while compiling Exmoor SSSI site dossiers (Sanderson, 2009) and is now published (Sanderson, 2011a). In this system the following scores are used:

- Red Data Book species with a threat level of Vulnerable or higher = 200
- Red Data Book species with a threat level of Near Threatened = 100
- Notable species (NR, NS, IR or S41/BAP species which are not RDB NT or higher. Includes species listed as Data Deficient in the RDB) = 50.

Trials with this system indicated that a score of 600 was a reasonable guideline threshold for SSSI quality across southern English woodland epiphytic sites. The system is less useful for heathlands, which are probably best assessed using the CCP index described above.

Abbreviations used in the text and tables are listed below:

RDB = Red Data Book Species, (CR, EN, VU & NT Species)
CR = Critically Endangered Red Data Book species
EN = Endangered Red Data Book species
VU = Vulnerable Red Data Book species
NT = Near Threatened Red Data Book species
DD = Species listed as Data Deficient in the Red Data Book

Nb = Notable species (NR, NS or IR species not RDB NT or higher)
NR = Nationally Rare
NS = Nationally Scarce
IR = International Responsibility species
BAP = Priority Biodiversity Action Plan species
S41 = Section 41 Species of Principal Importance in England

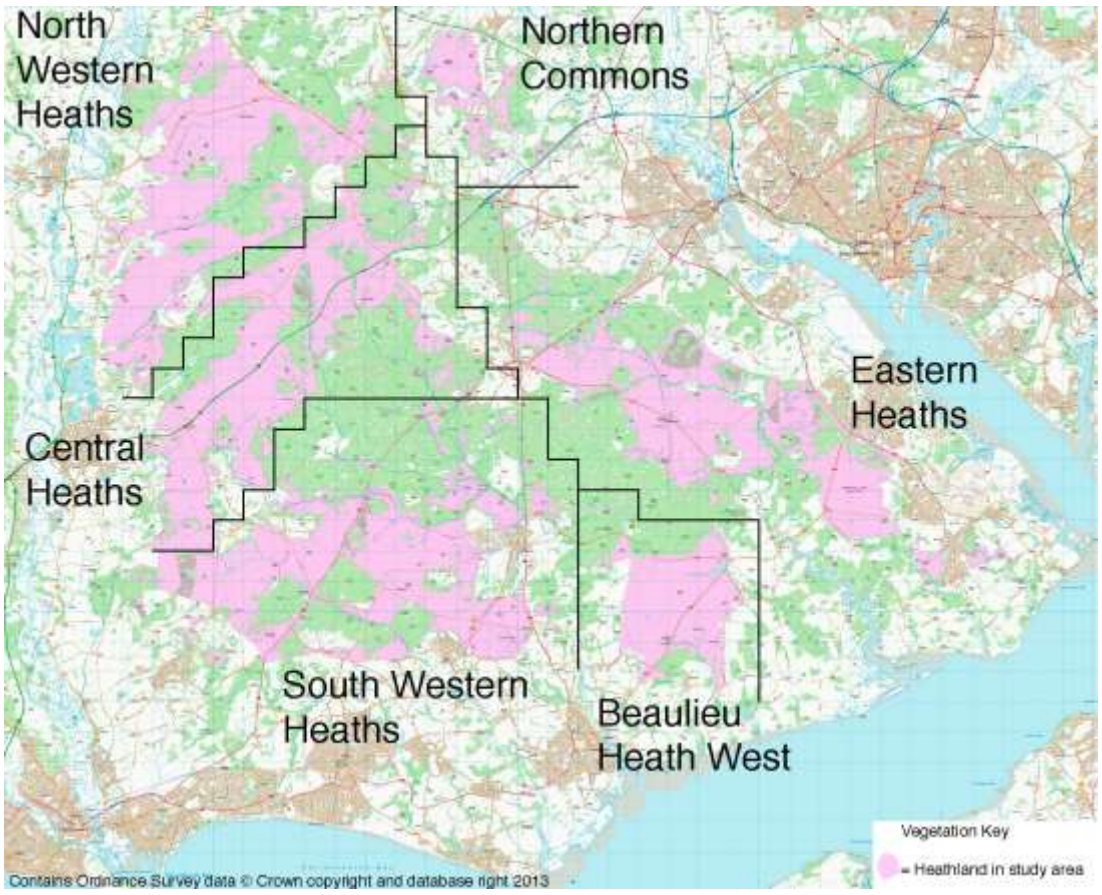
2.3.9 Data Handling

All records were recorded to at least 1km national grid square accuracy. Many were recorded as grid references to a six figure accuracy. Rare species were recorded to eight or ten figure grid reference using a GPS recorder. All data were entered into British Lichen Society NBN import spreadsheets and added to the BLS database. These records were combined into a single spreadsheet (BLS_General_v6d NF Heaths 2011-2015). Localised records (to eight or ten figure gird references) of the rarer species were imported as waypoints into Garmin BaseCamp and exported as .GDB and .CSV files to allow the import into of this data into a GIS programme. All the records of these species were also mapped on an OS map base using MacGPS Pro at 1: 50,000 scale for each heathland meta-site. These gave maps of the density of interest in the surveyed areas. The species use for these maps were: *Agonimia globulifera*, *Arthrorhaphis aeruginosa*, *Cladonia borealis*, *Cladonia callosa*, *Cladonia cariosa*, *Cladonia foliacea*, *Cladonia glauca*, *Cladonia grayi* s. str., *Cladonia incrassata*, *Cladonia mediterranea*, *Cladonia parasitica*, *Cladonia phyllophora*, *Cladonia rei*, *Cladonia strepsilis*, *Cladonia subcervicornis*, *Cladonia sulphurina*, *Cladonia zopfii*, *Dibaeis baeomyces*, *Epicladonia sandstedei*, *Icmadophila ericetorum*, *Leptogium palmatum*, *Leptogium schraderi*, *Leptogium tenuissimum*, *Micarea leprosula*, *Micarea xanthonica, Placidium squamulosum*, *Placynthiella oligotropha*, *Pycnothelia papillaria*, *Trapeliopsis glaucolepidea* and the moss *Dicranum spurium*.

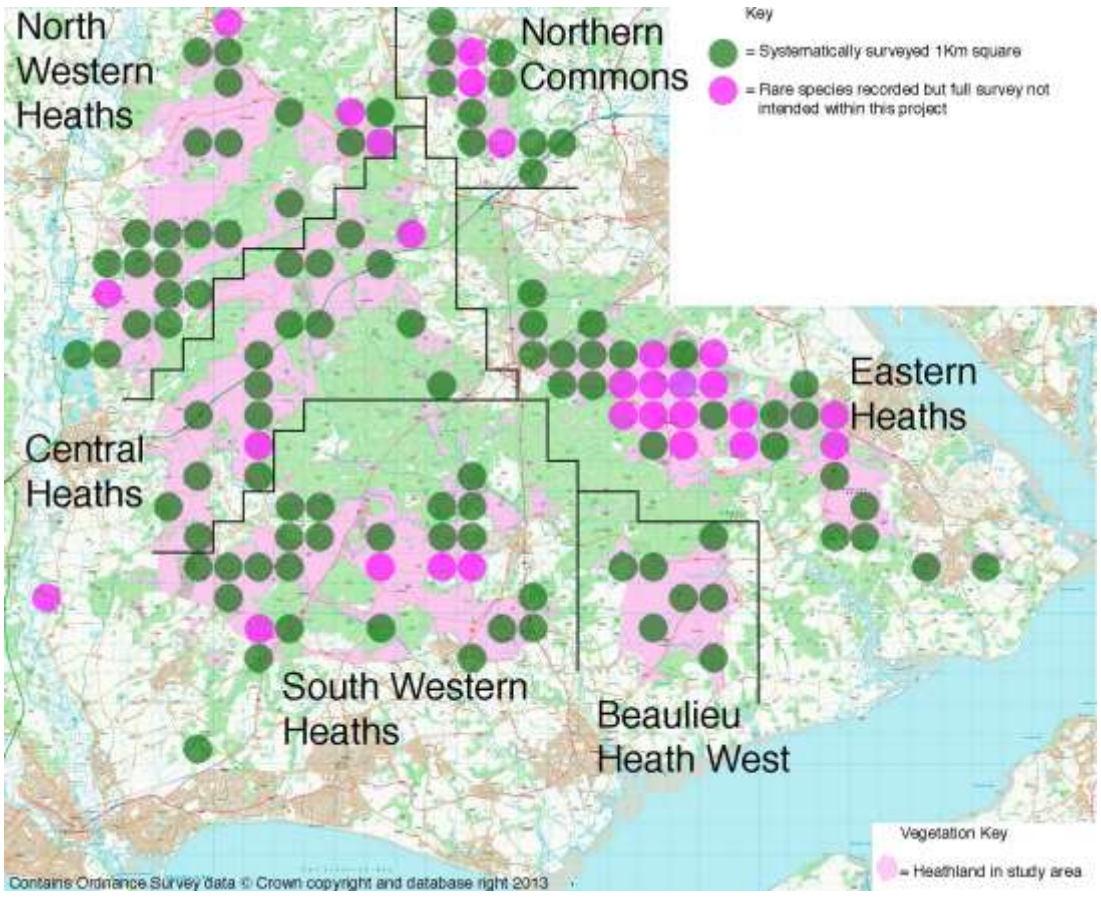
To manipulate and present the 1km species a data table of species against 1km squares was made in excel (NF Heathland Data.xlsx). The distribution of lichen interest and individual species of interest were mapped manually in Photoshop Elements.

2.3.10 Maps of Survey

MAP 1
New Forest Heathlands and Heathland Meta-sites



MAP 2
Distribution of Surveyed 1Km National Grid Squares



3.0 SURVEY RESULTS

3.1 New Forest Quantitative Inventory

3.1.1 Lichen Assemblages and Habitat Diversity

Full data analysis of the New Forest Quantitative Inventory has not yet been undertaken by the Natural History Museum. For the purposes of this report, the overall lichen assemblages and diversity have been analysed here.

The lichen diversity across the heathland habitats recorded is assessed using all the individual quadrats in **Table 5**, which shows that the lichen diversity in the randomly located dry heath plots is far higher than in the other habitats. The 24 quadrats from the two non–random plots produces much higher mean values than the randomly placed plots and illustrate how rich dry heath habitats can get in localised hot spots. Student T tests (two tailed) between the data from the individual vegetation types in randomly placed plots, indicates that the dry heath was significantly richer than all other main vegetation types sampled (Wet Heath W & TW, Acid Grassland AG, Wet lawn WL). The other main vegetation types were not significantly different from each other in terms of the diversity measures used.

A few quadrats were placed in mires but no lichens were found.

TABLE 5
Lichen Diversity in Heathland Vegetation

Heathland Vegetation	Mean No Species	Mean diversity/ cover score	No Quadrats
Dry Heath (random plots) (DH & AD)	2.73	14.31	105
Dry Heath (placed plots on rich stands) (DH)	7.75	45.42	24
Wet Heath (W & TW)	0.41	2.22	27
Acid Grassland (AG)	0.3	2.67	64
Wet lawn (WL)	0.27	1.82	49
Mire	0	0	6
DH & AD (random)/AG	p <0.01	p <0.01	
W & TW/DH & AD (random)	p <0.01	p <0.01	
WL/DH & AD (random)	p <0.01	p <0.01	
W & TW/AG	Not Sig	Not Sig	
W & TW/WL	Not Sig	Not Sig	
AG/WL	Not Sig	Not Sig	

The lichen species assemblages of the heathland vegetation types are presented using constancy tables compiled from the plot data. The dry heath plots can be local heterogeneous, with individual quadrats placed in small patches of wet heath, acid grassland or mire. As these do not have distinctive lichen assemblages, this has little impact as the majority of the individual quadrats were placed on dry heath. Within the other habitats all but the supposed wet heath plot (Half Moon Common, HMJ) were homogeneous. Half Moon Common (HMJ) was not used in the constancy table, as it is predominantly wet grassland, but with a significant area of lichen rich dry heath. In all habitats, a total of 61 taxa were recorded:

Species	**Conservation Status**
Agonimia globulifera	NS n
Bachmanniomyces uncialicola	[NS] n
Cetraria aculeata	
Cetraria muricata	
Cladonia arbuscula	
Cladonia callosa	NS n
Cladonia humilis "schizidiate form"	n
Cladonia chlorophaea s. str.	n
Cladonia ciliata f. *ciliata*	
Cladonia ciliata f. *tenuis*	
Cladonia coccifera s. lat. (inc. *Cladonia coccifera* s. str. [NS] n & *Cladonia diversa*)	
Cladonia coniocraea	
Cladonia cornuta	n
Cladonia crispata	
Cladonia digitata	
Cladonia fimbriata	
Cladonia floerkeana	
Cladonia furcata	
Cladonia glauca	
Cladonia gracilis	
Cladonia grayi s. lat. (inc. *Cladonia cryptochlorophaea* [NS] n & *Cladonia grayi* s. str. [NR] n)	
Cladonia incrassata	NS
Cladonia macilenta	
Cladonia mediterranea	CR NR S41 n
Cladonia ochrochlora	
Cladonia phyllophora	NT NS n
Cladonia polydactyla	
Cladonia portentosa	
Cladonia ramulosa	
Cladonia rei	NT NS n
Cladonia squamosa f. *squamosa*	
Cladonia squamosa f. *subsquamosa* (heathland morph)	
Cladonia strepsilis (including sorediate form)	
Cladonia subcervicornis	n
Cladonia subulata	
Cladonia uncialis	
Cladonia verticillata	
Cladonia zopfii	NS r
Collema auriforme	
Dibaeis baeomyces	
Graphis scripta (on *Calluna*)	
Hypogymnia physodes	
Icmadophila ericetorum	
Micarea erratica (on flint)	
Micarea leprosula	n
Micarea lignaria	
Micarea viridileprosa	NS n
Peltigera didactyla	
Placynthiella icmalea	
Porpidia crustulata (on flint)	
Porpidia tuberculosa (on flint)	
Protoblastenia rupestris (on concrete)	
Pycnothelia papillaria	
Rhizocarpon reductum	
Trapelia coarctata	

Trapeliopsis granulosa
Verrucaria muralis (on concrete)
Verrucaria nigrescens (on flint)

58 taxa, 1 Critically Endangered, 2 Near Threatened & 5 Notable species (all Nationally Scarce)

CR = Critically Endangered
NT = Near Threatened
NR = Nationally Rare
NS = Nationally Scarce
S41 = Section 41 Species of Principal Importance in England
[NR] = Nationally Rare parasite segregate of aggregate species, and likely to be very under recorded
[NS] = Nationally Scarce parasite, or critical segregate of aggregate species, and likely to be very under recorded
n = newly recorded from the New Forest heathlands
r = rediscovered species

This included 11 species newly recorded from the Forest and one species rediscovered, *Cladonia zopfii* Nb (NS) last recorded in 1911 (Coppins, 1978). These included several important records, which were new or rare in lowland England including *Cladonia callosa* Nb (NS), *Cladonia coccifera* s. str. [NS], *Cladonia phyllophora* NT (NS), *Cladonia subcervicornis*, *Cladonia zopfii* Nb (NS) and *Micarea leprosula*. Other species were rare throughout Britain: *Cladonia grayi* s. str. [NR], *Cladonia mediterranea* CR NR S41, *Cladonia rei* NT NS.

Dry Heath: the above new species were all recorded in the dry heath habitat and a constancy table for this habitat is given in **Constancy Table 1**. The plots were predominately humid heath (H2c), with locally frequent Bristle Bent heath (H3a). Very dry heath (H2a) is rare, as it is in the New Forest. The plot (Ober Heath, OHH) with tussock wet heath (M16b) dominant had smaller areas of humid heath (H2c), which is where the lichens occurred. The plots cover a good range of environmental factors, in burning history, sward height and browsing. The impact of these factors on lichen diversity is discussed in the next section.

A total of 40 taxa were recorded within the quadrats and a further 10 were only recorded in the plots and not the quadrats. Five of the random plots had a CCP Index score of 10 or more; 50% of the random plots had heathland lichen assemblages of high interest.

Constant species within the plots are *Cladonia portentosa*, *Cladonia crispata*, *Cladonia floerkeana*, *Cladonia coccifera* s. lat., *Cladonia fimbriata* (possibly over recorded for gracile *Cladonia cryptochlorophaea*) *Cladonia grayi* s. lat. and *Placynthiella icmalea*. None of these are uncommon species but form the background in which less frequent species of greater conservation interest are set. Frequent species include *Cladonia strepsilis*, a species threatened across lowland Europe along with a peculiar heathland morph of *Cladonia squamosa* var. *subsquamosa* which has every appearance of being an uncommon undescribed species and the heathland specialists *Cladonia verticillata* and *Cladonia macilenta* (both probably massively over recorded in the lowlands and probably uncommon declining species in England). Occasional and rare species within the plots include many species of conservation interest *Cetraria muricata*,

Cladonia subcervicornis, *Pycnothelia papillaria*, *Cladonia gracilis*, *Micarea lignaria*, *Dibaeis baeomyces*, *Micarea leprosula*, *Cladonia subulata*, *Cladonia arbuscula*, *Cladonia phyllophora* NT (NS), *Cladonia glauca*, *Cetraria aculeata*, *Cladonia callosa* Nb (NS), *Micarea erratica*, *Cladonia incrassata* Nb (NS), *Cladonia mediterranea* CR (NR, S41), *Cladonia zopfii* Nb (NS) and *Icmadophila ericetorum*.

Within the data there are clearly different assemblages. Particularly hard grazed prostrate heather stands which are not burnable (NB) have a high cover of the larger Reindeer Mosses especially *Cladonia portentosa* and *Cladonia ciliata* f. ciliata, with *Cladonia ciliata* f. *tenuis* and *Cladonia arbuscula* and Heaththorn, *Cladonia uncialis* and a lower diversity of smaller species. These are quite uniform communities. Within the richer areas situated in the rotationally burned stands the diversity and cover of Reindeer Mosses and Heaththorn is lower but there is higher diversity of smaller species in quite heterogeneous assemblages. Typical species of the latter group include *Cladonia strepsilis*, *Cladonia verticillata*, *Pycnothelia papillaria*, *Cladonia subcervicornis*, *Cetraria muricata*, *Micarea lignaria*, *Micarea leprosula* and *Cladonia callosa* Nb (NS).

Other rich lichen assemblages confined to small or linear hot spots, particularly those of banks and disturbed ground, are largely missed by the sampling method used in the New Forest Quantitative Inventory.

Wet Heaths: the wet heaths (M16a & M16b) were much poorer, with only eight species recorded in the quadrats with five additional species recorded in the plots but not the quadrats (**Constancy Table 2**). The assemblage was sparse, with no constants but *Cladonia portentosa* was frequent. Level ground within wet heaths is normally too winter wet for lichens to survive. The fringes of the habitat, where it grades into humid heath can be very rich and significant habitats, but the nested sampling method of the New Forest used by the New Forest Quantitative Inventory precluded sampling this habitat within the random quadrats. Within wet heaths some more diverse lichen habitats are found in tussocky wet heath (M16b) where the tussocks are tall and well browsed to let in light. These can support more uncommon bank specialist such as *Cladonia rei* NT (NR), *Cladonia grayi* s. str. [NR] and *Cladonia incrassata* Nb (NS).

Wet Grasslands: the wet grasslands were largely devoid of lichens, especially within the floodplain wet lawns (M23a). Occasionally, however, within the *Molinia* wet lawns (M24c & M25b) on slopes, similar tussocks could be found to those in tussocky wet heath (M16b) (**Constancy Table 3**). These tussocks support a similar lichen assemblage to those of the M16b, including the Heathtail *Cladonia rei* NT (NR). Tussocky wet heath M16b and *Molinia* wet lawns M24c/M25b grade imperceptibly into each over distance and time. The mixed stand at Half Moon Common (HMJ), which was not used in the constancy tables, in fact was mapped as wet heath in the 1980s but by 2011 increased grazing had pushed the stand over to *Molinia* wet lawn. The lichen rich tussocks survived this change intact.

Acid Grasslands: the acid grasslands sampled by the New Forest Quantitative Inventory survey were very mixed (**Constancy Table 4**). They included *Molinia* heathy acid grassland (M25b), moist acid grasslands (U4), reseeded herb rich grasslands (U1d/f) and herb rich grasslands developed on ripped up runways

(U1d/f). Several significant widespread acid grassland types were missed, including Bristle Bent heathy acid grasslands (U3) and parched acid grassland (U1f). Only seven species recorded in the quadrats and six additional species were recorded in the plots but not the quadrats. Some of the plots proved to be devoid of lichens, especially the reseeded herb rich grasslands (U1d/f) and moist acid grasslands (U4). These were both fairly productive grasslands with strong swards, which exclude lichens. In contrast the *Molinia* heathy acid grassland (M25b), sampled had quite a high cover of lichens, but a very limited diversity. *Cladonia furcata* ssp. *furcata* and *Cladonia portentosa* were abundant with no other associates. *Cladonia furcata* ssp. *furcata* is also widespread in the parched acid grasslands (U1f) that were not sampled by this survey. Both of these communities are less productive and have more open swards allowing some lichen colonisation.

Finally the sample plot at Janesmoor Plain (JPD) was on mixed acid grassland on the former WWII airfield, which included part the main runway, now with the concrete removed and restored to herb rich grasslands (U1d/f) and some areas of *Molinia* heathy acid grassland. This disturbed grassland was much richer in lichens than any other grassland sampled. *Cladonia furcata* ssp. *furcata* and *Cladonia rangiformis* were abundant; a standard pair of species on slightly base enriched open grasslands, also seen along the road verges. Much less frequent were specialists of disturbed ground, including the uncommon *Cladonia callosa* Nb (NS) and *Agonimia globulifera* Nb (NS). The enigmatic taxon *Cladonia humilis* "schizidiate form" also occurred. Also typical were very common ruderal species of soil such as *Collema auriforme* and concrete weeds such as *Protoblastenia rupestris* and *Verrucaria muralis*.

CONSTANCY TABLE 1
Dry Heath Plots

Dry Heath Plots	**Original Plots**					**Additional Random Plots**					**Additional non-random plots**			
Site code	**GPH**	**WBH**	**OHH**	**PGH**	**OPH**	**LCH**	**HCH**	**BTH2**	**RHH**	**SFH**	**WMH**	**ODH**	**Constancy**	**Total Cells**
Years since burning (predominant)	7	10	<20	NB	13	3	<20	14	NB	12	12	NB		
Sward Height (predominant)	L	M	M	L	H	L	H	M	L	M	L	L		
Browsing (predominant)	M	M	M	H	L	H	L	L	H	L	M	H		
Vegetation summary (predominant)	DH	AD	TW	DH	AD	AD	DH	DH	DH	DH	DH	DH		
NVC type (predominant)	H2c	H3a	M16b	H2c	H3a	H3a	H2c	H2c	H3a	H2c	H2c	H2a		
Cladonia portentosa	8		3	75	3	10	P	4	85	29	45	172	V	434
Cladonia crispata	29	7	17	58	4	44			62	21	78	27	V	347
Cladonia floerkeana	2	16	25	40	11	52			5	7	62	6	V	226
Cladonia coccifera s. lat.	39			7	8	3			23	27	83	2	IV	192
Cladonia fimbriata		5	7	19	11	11		P	10	2	16	5	IV	86
Cladonia grayi s. lat.	3	1		4	5	P		P	4	4	41	2	IV	64
Placynthiella icmalea	3		1	P	2	P	P	3	2	1	3	4	IV	19
Cladonia strepsilis	9			2		4				27	62		III	104
Cladonia squamosa var. subsquamosa	11			18	4	4				26		9	III	72
Cladonia ramulosa			6	1		1			3	21	35	2	III	69
Cladonia verticillata	1		P	2		3	3		6	13	20		III	48
Cladonia macilenta	4	14	P					8	2		5		III	33
Cladonia uncialis				61					31		1	62	II	155
Cladonia ciliata f. ciliata				8					10		1	124	II	143
Cladonia squamosa var. squamosa						4					49	1	II	54
Cladonia furcata		6				P					2	35	II	43
Cladonia gracilis				8				P			1	24	II	33
Pycnothelia papillaria				P					1	24	7		II	32
Cladonia chlorophaea s. str.				1			1	24					II	26
Cladonia subcervicornis	1					P			1	4	17		II	23
Cetraria muricata				7					3		P	12	II	22
Cladonia ciliata f. tenuis				1					1		4	16	II	22
Micarea lignaria				2		P			5		7		II	14
Micarea viridileprosa	10	2	P						2	P	P		II	14
Cladonia cornuta	4		1								8		II	13
Dibaeis baeomyces									19				I	19
Micarea leprosula									1		17		I	18
Cladonia subulata										P	15		I	15
Cladonia arbuscula												10	I	10
Cladonia phyllophora											10		I	10
Bachmanniomyces uncialicola									2			5	I	7
Cladonia polydactyla	5							P					I	5
Cladonia strepsilis sorediate form	3									2			I	5
Cladonia glauca					2					2	P	P	I	4
Cladonia coniocraea								3					I	3
Cetraria aculeata												2	I	2
Cladonia callosa								P			2		I	2
Cladonia digitata	1												I	1
Hypogymnia physodes											1	P	I	1
Micarea erratica	1				P				P	P	P		I	1
Graphis scripta (on Calluna)	1												I	1
Cladonia incrassata										P				
Cladonia mediterranea												P		
Cladonia ochrochlora						P								
Cladonia zopfii												P		
Icmadophila ericetorum											P			
Trapeliopsis granulosa						P				P				
On pebbles														
Trapelia coarctata					P						P			
Rhizocarpon reductum					P	P			P					
Porpidia crustulata						P								
Porpidia tuberculosa					P									
Totals in quadrats	17	7	7	17	9	10	2	5	21	14	26	19		40
Totals in plots	17	7	10	19	13	19	4	10	23	19	32	23		50
CCP Index Quadrat	13	6	6	16	8	10	2	4	15	14	22	17		32
CCP Index Plot	13	6	8	17	8	14	3	9	15	16	24	20		36

NB. *Cladonia strepsilis* sorediate form is not counted separately in totals

CONSTANCY TABLE 2
Wet Heath Plots

Wet Heath Plots Site Code	BLJ	WMJ	WBJ	OHJ	OPJ	Total Cells	Constancy
Years since burning (predominant)	5	7	5	6	3		
Sward Height (predominant)	L	M	M	M	L		
Browsing (predominant)	M	L	M	L	M		
Vegetation summary (predominant)	TW	TW	WT	W	TW		
NVC type (predominant)	M16b	M16a	M16b	M16a	M16b		
Cladonia portentosa	P	25		14	15	54	III
Cladonia fimbriata	1			10	P	11	II
Cladonia crispata			2	3		5	II
Cladonia ramulosa	10					10	I
Cladonia rei	6					6	I
Cladonia uncialis		4			P	4	I
Cladonia furcata	3					3	I
Cladonia grayi s. lat.	P				1	1	I
Cladonia ciliata f. ciliata					P		
Cladonia floerkeana					P		
Cladonia incrassata					P		
Cladonia polydactyla			P				
Placynthiella icmalea	P						
Totals in quadrats	4	2	1	3	2		8
Totals in plots	8	2	2	3	8		13
CCP Index Quadrat	4	2	1	3	2		8
CCP Index Plot	6	2	1	3	7		11

CONSTANCY TABLE 3
Wet Grassland Plots

Wet Grassland Plots Site Code	BUL	BLL	SWL
Burning in years	NB	NB	NB
Sward Height	L	L	L
Browsing	H	H	H
Vegetation summary	WL	WL	WL
NVC type (predominant)	M23a	M24c	M24c
Cladonia fimbriata	P		
Cladonia furcata		P	
Cladonia grayi s. lat.	P		
Cladonia portentosa	P		
Cladonia rei	P		
Total Plot, 5	4	1	0
CCP Index Plot	4	1	0

CONSTANCY TABLE 4
Acid Grassland Plots

Acid Grassland Plots Site Code	ADD	JPD	LSD	CDH	BLD	Total Cells	Constancy
Years since burning (predominant)	NB	NB	NB	NB	NB		
Sward Height (predominant)	L	L	L	L	L		
Browsing (predominant)	H	H	H	H	H		
Vegetation summary (predominant)	AG	AG	AG	AG	AG		
NVC type (predominant)	U4	U1d/f	U1d/f	U1d/f	M25b		
Cladonia furcata ssp. furcata		18			69	87	II
Cladonia rangiformis		45				45	I
Cladonia portentosa					23	23	I
Verrucaria muralis		10				10	I
Peltigera didactyla		3				3	I
Collema auriforme		2				2	I
Verrucaria nigrescens		1				1	I
Agonimia globulifera		P					
Cladonia callosa		P					
Cladonia crispata		P					
Cladonia fimbriata	P	P					
Cladonia humilis "schizidiate form"		P					
Protoblastenia rupestris		P					
Totals in quadrats	0	6	0	0	2		7
Totals in plots	1	12	0	0	2		13
CCP Index Quadrat	0	3	0	0	2		3
CCP Index Plot	1	7	0	0	2		7

3.1.2 Lichen Diversity and Environmental Variables

Data from all the quadrat recorded as dry heath (Bristle Bent dry heath AD and low grass cover dry heath DH) were analysed further against the environmental variables recorded for each quadrat. The non random placed plots (White Moor, WMH and Ogdens, ODH) were excluded from this analysis. Student T tests (two tailed) were made between pairs of categories within each of the environmental variables to test if the samples had means which were statistically significant.

Dry Heath Vegetation Type: the quadrats with Bristle Bent *Agrostis curtisii* dry heath (AD, NVC community H3a) and dry heaths with low grass cover heath (DH, NVC communities H2a, H2b & H2c) were compared (**Table 6**). This found higher diversity scores for the heaths lacking Bristle Bent. This was expected from field observations, that a high Bristle Bent cover displaced lichens. However, only the numbers of species were actually significantly different, and then only weakly, the diversity/cover score was not. It was also observed during the fieldwork, that the soils under the Bristle Bent dry heath were perfectly capable of supporting diverse lichen assemblages if the sward was not too vigorous. This usually occurred where there had been past soil disturbance or grazing was particularly high

TABLE 6
Dry Heath Vegetation Type

Heath Vegetation	Mean No Species	Mean diversity/ cover score	No Quadrats
Heath with Bristle Bent (AD)	2.13	11.00	48
Heath without Bristle Bent (DH)	3.25	17.11	57

AD/DH	p <0.1	Not significant	

Controlled Burning: the dry heaths surveyed included areas so short as to be unburnable (NB), areas of taller heath capable of being burned but not burned for more than 20 years (>20) and areas control or spring burned[2] within the last 20 years (1 – 19). The latter were also divided into one to nine years old burns (1 – 9) and 10 to 19 year old burns (10 – 19) (**Table 7**). Within the controlled burns, the older (10 – 19) heaths did show lower diversity scores than the younger burns (1 – 9) but this decline was not actually significant. Within the wider categories very wide differences in diversity were clearly evident in the field and this is confirmed by the highly significant differences found between the diversity scores of the different ages of heaths. The unburnable short grazed heaths were significantly the richest at a quadrat level. Control-burned quadrats younger than 20 years were significantly less rich at a quadrat level than the not burnable short grazed heaths, but were much richer than the burnable heath over 20 years old. The latter were extremely species poor and impoverished indicating a rapid drop off in diversity 20 years after a burn.

The divergence between control-burned quadrats younger than 20 years and the unburnable short grazed heaths is partly related to heterogeneity. Short heaths have uniform high lichen cover and diversity. In lighter grazed burned heaths there was clearly much more heterogeneity. Even in the richest heaths, there are mixtures of open areas with high lichen cover and diversity between patches of denser heather with lower diversity. As can be seen from **Constancy Table 1**, at a plot level the richest burned plots are usually richer in species diversity (e.g. White Moor, WMH) than the richest short grazed heath (e.g. Ogdens, ODH) because there are more niches within the former plot.

The sharp drop off in lichen diversity after 20 years following a controlled burn, in heaths not heavily suppressed by grazing, is very marked. Field observations indicate two factors, of which the most obvious is that shade increases as the heather stand matures. More subtle is the impact of a build up of thick mats of litter and thick wefts of common late succession mosses, mainly *Hypnum jutlandicum*. These smother the hard humus surface produced by a controlled burn, which is clearly the preferred habitat of most heathland lichen species. This means that even when gaps in senescent heather stands allow in more light, there is limited habitat available for most heathland lichen species. A few robust species, especially the bulky but common *Cladonia portentosa* can get a hold in gaps in species poor lichen assemblages. The latter phenomena may have given rise to the erroneous impression in conservation that very old stands of senescent heather are lichen rich; they occasionally can have a high cover of a very few species.

The positive impact of a controlled burn on an old heather stand is to both let in light and to strip the thick mats of litter and wefts of late succession mosses to expose a surface of hard humus. Regeneration of lichens is rapid in this situation, with squamules frequent by the second summer and the three year old burn at Little Cockley Plain (LCH) already rich with, by then, just identifiable lichens (**Constancy Table 1**).

[2] One plot, Goatspen Plain, GPH, was an accidental burn but this occurred in spring and was indistinguishable from a controlled burn.

These results match those recorded for upland moorland (Davies, 2001, Davies & Legg, 2008 & Harris et al, 2011). Harris et al (2011) recorded relatively poor lichen assemblages in the Peak District (data with a CCP index score of 3), but even this limited assemblage was lost totally in stands more than 20 years old. Davies & Legg (2008) working in the Cairngorms with much richer assemblages (data with a CCP index score of 25) found that older stands, unburnt for 25 years or more, generally had lower diversity than stands 10 to 15 years old. They concluded that fire can be seen to play an important role in maintaining the diversity of lichens in heathland areas by providing a variety of stand-structures and ages across the landscape.

TABLE 7
Impact of Controlled Burns

Burning	Mean No Species	Mean diversity/ cover score	No Quadrats
Not Burnable (NB)	5.86	37.18	22
Controlled burn 1 – 19 years ago	2.54	11.05	59
Burnable but not burned in >20 years	0.33	1.38	24
Controlled burn 1 – 9 years ago	2.8	12.72	25
Controlled burn 10 – 19 years ago	2.35	9.8200	34
NB/>20	p <0.01	p <0.01	
1–19/>20	p <0.01	p <0.01	
1–19/NB	p <0.01	p <0.01	
1–9/10–19	Not sig	Not sig	

Sward Height: the sward height in the quadrats was measured as low swards, less than 10cm (L), medium height between 10 to 40cm (M) and 40cm and high sward over 40cm high (**Table 8**). Between all classes, the means of all diversity scores were significantly different. The short swards were richest, with the medium height sward about half as rich but with the tallest swards very species poor. The short swards occur on the unburnable short grazed heaths and recently burned pioneer stands, while the medium height swards occur on mainly older control-burned stands. The tall stands are either long unburned stands over 20 years old or older burn sites over 10 years old but in lightly browsed areas. Increasing sward height due to low grazing pressure results in both decreased light levels on the ground and a build up of loose litter covering the hard humus.

Harris et al (2011) recorded in the Peak District in upland moorland found that all species other that Heather *Calluna vulgaris* were lost is stand more than 40cm high; mirroring the results from the New Forest.

TABLE 8
Sward Height

Sward Height	Mean No Species	Mean diversity/ cover score	No Quadrats
Low (L)	4.34	24.93	44
Medium (M)	2.47	10.35	34
High (H)	0.44	2	27
L/M	p <0.01	p <0.01	

L/H	p <0.01	p <0.01	
M/H	p <0.01	p <0.05	

Browsing: high browsing (H) was defined as heather stands which were being permanently suppressed, medium browsing (M) as stands where the heather was being suppressed but was still managing to make slow height increments, while low browsing (L) was defined as stands were heather growth was unimpeded. The heavily browsed heather stands were the richest and significantly richer than either medium or low browsed stands (**Table 9**). The low browsed areas were on average poorer using the diversity scores than medium browsed areas, but this was not a significant difference. The low browsed areas were not nearly as species poor as either long unburned stands or very tall stands. This reflects that even in low browse areas, burning can open up the heather stands to allow colonisation by lichens. Field observations would suggest that moderate browsing will lengthen the time that canopy openings formed by controlled burning remain open but this effect is not as marked as some of the factors described above. Very heavy browsing produces very open short swards and this does significant enrich the diversity of the lichen assemblages over the more lightly browsed areas.

Davies & Legg (2008) also noted that browsing effects on control-burned heaths in the Cairngorms appeared to increase lichen diversity within the general recovery from burning. They also observed that long term checking of the heather canopy expansion by browsing may favour large bushy *Cladonia* species over smaller species. This was also the case in the New Forest.

TABLE 9
Browsing

Browsing	**Mean No Species**	**Mean diversity/ cover score**	**No Quadrats**
Low (L)	1.56	6.3	50
Medium (M)	2.22	10.22	23
High (H)	4.94	29.78	32
L/M	Not sig	Not sig	
L/H	p <0.01	p <0.01	
M/H	p <0.01	p <0.01	

Photographs: New Forest Quantitative Inventory.

Photo 2011-10-06-01. Goatspen Plain (SU2201), Plot GPH. This plot spanned a long unburned stand older than 20 years upslope and a much younger seven year old cool burn below. Looking downslope, with the latter visible beyond the Gorse Bush. The old heather lacked any lichens in the quadrats sampled, while the seven year old area was locally rich.

Photo 2011-10-06-02. Goatspen Plain (SU2201), Plot GPH. Looking upslope into the long unburned stand older than 20 years. This tall heather had shaded out any lichen growth.

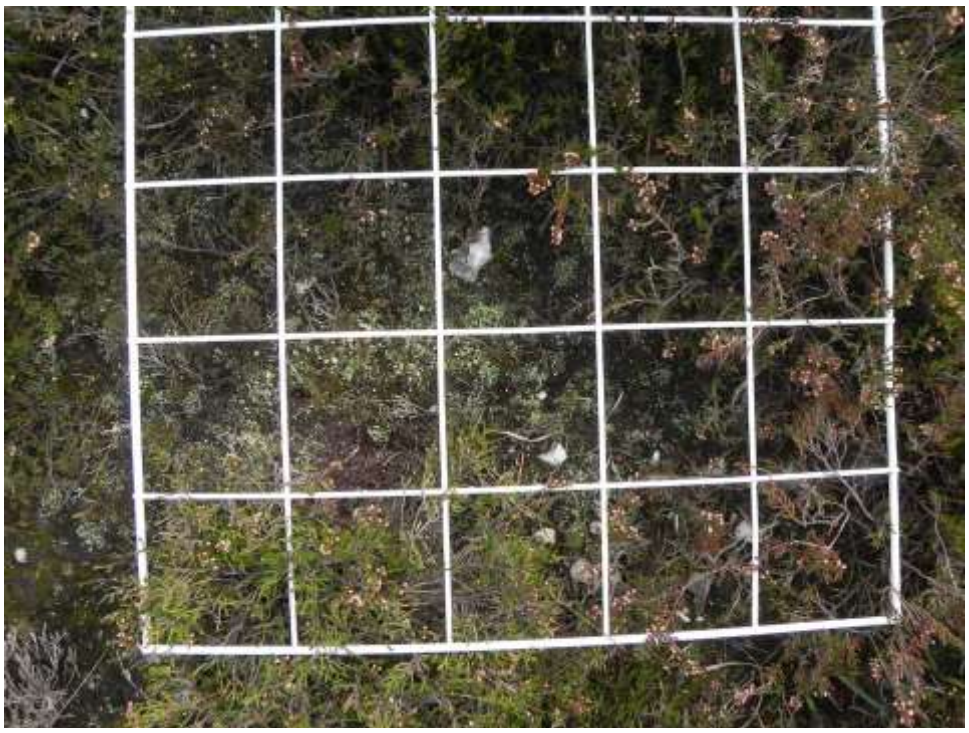


Photo 2011-10-06-05. Goatspen Plain (SU2201), Plot GPH. A lichen rich quadrat in the seven year old heather stand in H2c humid dry heath with low grass cover.

Photo 2011-10-06-04. Goatspen Plain (SU2201), Plot GPH. A lichen rich quadrat in the seven year old heather stand. With *Cladonia coccifera* s. lat. (here *C. diversa*), *Cladonia crispata* and *Cladonia squamosa* var. *subsquamosa*, heathland morph

Photo 2011-10-07-02. Ober Heath (SU2311), Plot OHH. A lichen rich patch of disturbed ground with Heathtooth *Pycnothelia papillaria* and *Cladonia foliacea* in a Bristle Bent Dry Heath (H3a). The undisturbed areas here were very species poor with the Bristle Bent smothering the bare ground. The disturbance here probably occurred in WWII.

Photo 2011-10-19-02. Little Cockley Plain (SU1915), Plot LCH. Bristle Bent Dry Heath (H3a) on a high terrace control-burned three years before. On the open patches of humus regenerating lichens were frequent.

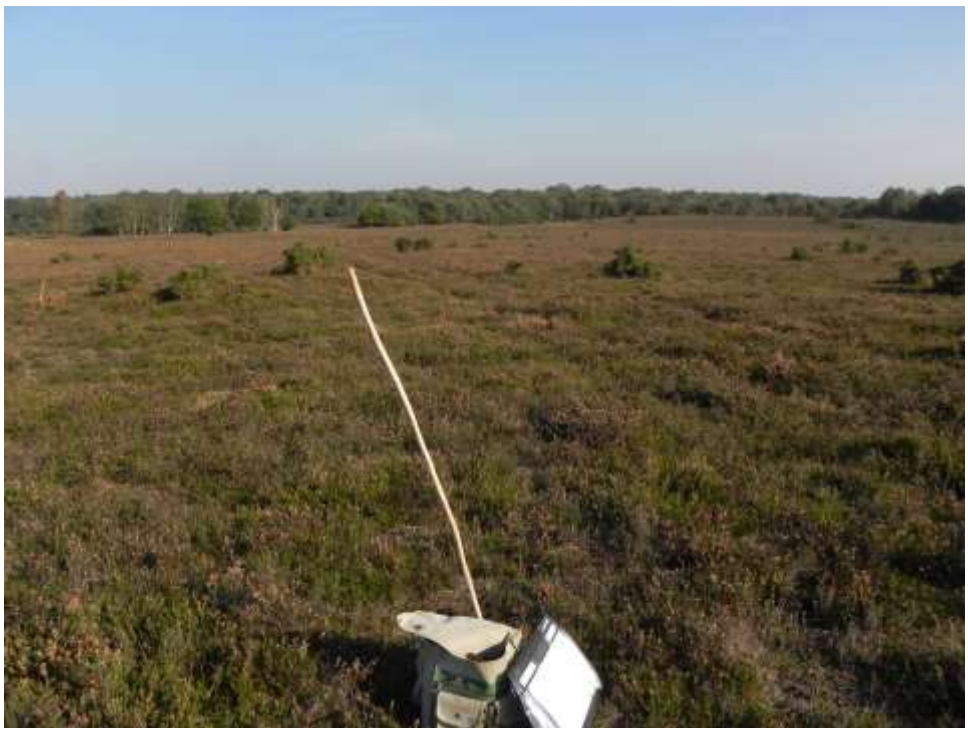


Photo 2011-10-14-01. White Moor (SU3108), Plot WMH, Boltons Bench. Moderately browsed, slowly regrowing humid dry heath (H2c) with a very rich lichen assemblage in the remaining open gaps. Possibly burned 12 years ago, but mapping for this area is not clear.

Photo 2011-10-14-10. White Moor (SU3108), Plot WMH, Boltons Bench. Very rich open patch in humid dry heath (H2c) with *Cladonia phyllophora* NT (NS), *Cladonia crispata* and *Cladonia floerkeana*.

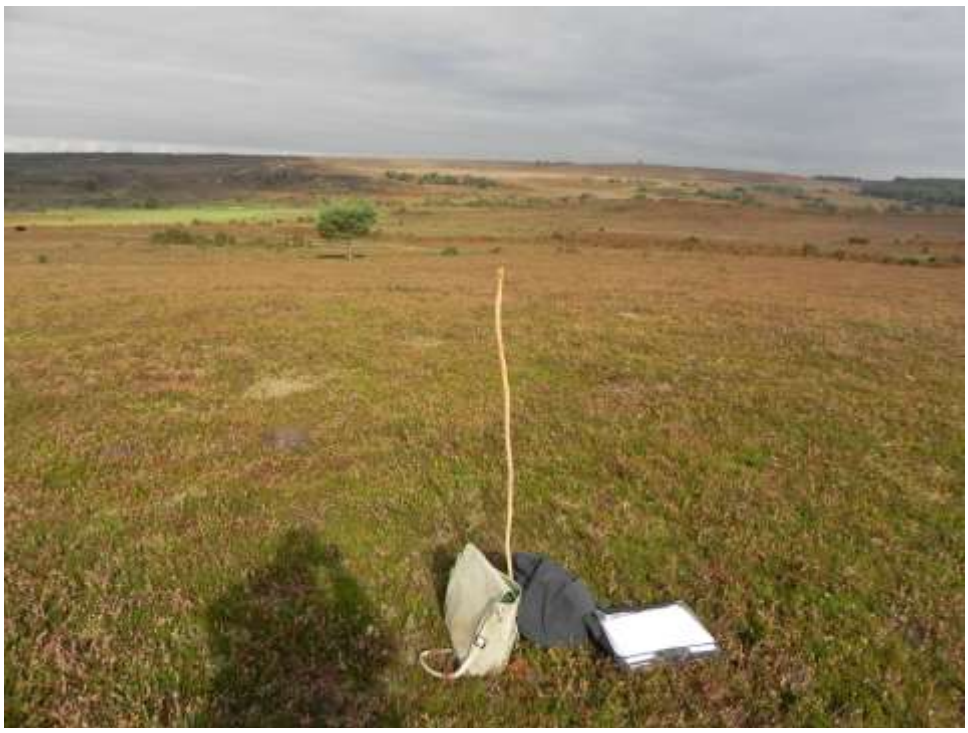


Photo 2011-10-21-07. Ogden's Purlieu (SU1812), Plot ODH. Ancient short browsed dry heath (H2a), with a rich lichen assemblage between the prostrate heathers.

Photo 2011-10-21-01. Ogden's Purlieu (SU1812), Plot ODH. Quadrat in ancient short browsed dry heath (H2a), with a high cover of Reindeer Mosses.

Photo 2011-10-15-17. Ogden's Purlieu (SU1812), Plot ODH. Ancient short browsed dry heath (H2a), with a high cover of Reindeer Mosses. With *Cladonia mediterranea* CR (NR/S41), pale grey to left, *Cladonia portentosa*, greener grey to right and *Cladonia ciliata* var. *ciliata*, dark grey, around them.

Photo 2011-10-21-05. Ogden's Purlieu (SU1812), Plot ODH. A patch of *Cladonia zopfii* Nb (NS) in an open area within ancient short browsed humid heath (H2a)/wet heath transition (M16a). The records of this species at Ogden's Purlieu were the first for the New Forest and England since 1911.

3.2 New Forest Heathland Lichen Survey

3.2.1 Total Assemblage 2011 – 2015

A total of 161 taxa were recorded from the New Forest heathlands between 2011 and 2015. These are listed in **Species List 1** in alphabetical order and in order of frequency of occurrence in **Species List 2**. Before 2011, only 82 lichen taxa were recorded from the heathlands (Sanderson, 2010), so the number known from the New Forest heathlands was doubled by the survey. Of the 161 taxa, 30 were totally or largely confined to lumps of concrete, limestone and brick, or moss growing upon these substrates. . Whilst the other species can be associated with concrete enriched soils, they are not confined to such artificial habitats. Natural flints and ironstone supports 16 taxa and 99 were recorded on the ground. A total of seven were parasitic fungi, some of which initially parasitic on lichens but develop into lichens at a latter stage.

This total includes a CCP heathland index score of 51, an exceptionally high total. The score was about 31 before the survey began. The numbers of rare species on a UK basis includes one Critically Endangered RDB species, *Cladonia mediterranea*, which is also Nationally Rare and a Section 41 species, three Near Threatened species *Cladonia phyllophora* NT (NS), *Cladonia rei* NT (NS) and *Leptogium palmatum* NT (NS). Sixteen Notable species were recorded as well as three Nationally Rare and five Nationally Scarce species that are very under recorded and data deficient. Some of the other species are frequent in the north, especially the Scottish Highlands, but are increasingly rare to the south. These include *Cladonia arbuscula* ssp. *squarrosa*, *Cladonia strepsilis*, *Cladonia sulphurina*, *Icmadophila ericetorum*, *Micarea leprosula* and *Pycnothelia papillaria*. Some of these are clearly rapidly declining in England outside of the New Forest and at least some are likely to be listed in the proposed English lichen RDB or in a revised English Section 41 list.

The average numbers of taxa, (including those which are terricolous, saxicolous or corticolous on heathers), recorded in systematically recorded 1km squares, is 29, ranging from 7 to 63 taxa. For the CCP score the average in systematically recorded 1km squares, is 21 with the range from 5 to 35 (**Map 3**). The numbers of taxa recorded by meta-sites and the whole Forest are given in **Table 10**.

TABLE 10
Number of Taxa and CCP Index Scores by Meta Areas

Meta-sites	Total Taxa		CCP Index		No 1km squares	
1km squares	Syst 1km	All 1km	Syst 1km	All 1km	Syst 1km	All 1km
Northern Commons	86	86	39	39	10	13
Eastern Heaths	125	126	46	46	22	36
Beaulieu Heath W	86	86	40	40	7	7
South Western Heaths	109	109	45	45	23	28
Central Heaths	106	107	44	44	16	18
North Western Heaths	111	111	47	47	22	26
New Forest	**160**	**161**	**51**	**51**	**100**	**128**

Syst 1km = Totals in systematically surveyed squares

Comparing with the 1ha dry heath plots (**Constancy Table 1**), the 1km squares constants (**Species List 2** taxa occurring in more than 60% of 1km squares) share ubiquitous species such as *Cladonia portentosa*, *Cladonia crispata*, *Cladonia floerkeana*, *Cladonia diversa* (as *Cladonia coccifera* s. lat.) and *Cladonia cryptochlorophaea* group (as *Cladonia grayi* s. lat.) and *Placynthiella icmalea*. Other heath species, however, such as *Cladonia uncialis* ssp. *biuncialis*, *Cladonia ciliata* var. *ciliata*, *Pycnothelia papillaria*, *Cladonia strepsilis* and *Cladonia verticillata* widespread but more localised species; occurring as constants in the 1km squares but are rarer when sampled at a 1ha basis. *Cladonia furcata* ssp *furcata* is the only species not frequent in the dry heaths, which is a constant; being mainly a species of acid grasslands and heavily disturbed heaths.

The frequency of species that are sparse or in decline in other lowland heaths is particularly noticeable, including Heathtooth *Pycnothelia papillaria*, *Cladonia strepsilis*, *Cladonia callosa*, *Cladonia arbuscula* ssp. *squarrosa*, *Cladonia subcervicornis*, *Cladonia phyllophora* NT (NS), *Cladonia zopfii*, *Cladonia incrassata* Nb (NS) and *Cladonia rei* NT (NS).

Rare species occurring in less than 10% of the 1km squares, includes some typical heath or acid grassland species, including significant records for *Cladonia grayi* s. str. [NR], *Arthrorhaphis aeruginosa* Nb (NS), *Arthrorhaphis grisea* [NR], *Cladonia mediterranea* CR (NR/S41), *Leptogium palmatum* NT (NS), *Trapeliopsis glaucolepidea* Nb (NS), *Placynthiella oligotropha* Nb (NS), *Epicladonia sandstedei* [NS] and *Cladonia borealis* Nb (NR/DD). However, there are many more species of concrete enriched grasslands and broken concrete in this group. Also in this category are common epiphytes found sparingly on heather stems and species of old trees and lignum found rarely on peaty banks. The latter include *Cladonia caespiticia* and *Cladonia parasitica*.

The numbers of new species of conservation interest found in the early part of the New Forest Heathland Lichen Survey was startling (Sanderson, 2011b). Many quite unexpected species were found as the result of close examination of the New Forest heathlands. The text of Sanderson (2011b) is reproduced in **Annex 3**, to give a flavour of the excitement and confusion of the early part of the survey.

The more significant new or rediscovered species found during the survey are listed below:

Arthrorhaphis aeruginosa	Nb (NS)
Arthrorhaphis grisea	[NR]
Bachmanniomyces uncialicola	[NS]
Catillaria atomarioides	Nb (NS)
Cladonia borealis	Nb (NR/DD)
Cladonia callosa	Nb (NS)
Cladonia cornuta	
Cladonia cryptochlorophaea	[NS]
Cladonia grayi s. str.	[NR]
Cladonia mediterranea	CR (NR/S41)
Cladonia phyllophora	NT (NS)
Cladonia rei	NT (NS)
Cladonia subcervicornis	
Cladonia sulphurina	
Cladonia zopfii	Nb (NS)

Dibaeis baeomyces	
Epicladonia sandstedei	[NS]
Leptogium palmatum	NT (NS)
Micarea leprosula	
Micarea xanthonica	Nb (NS/IR)
Porpidia macorcarpa	
Trapeliopsis glaucolepidea	Nb (NS)

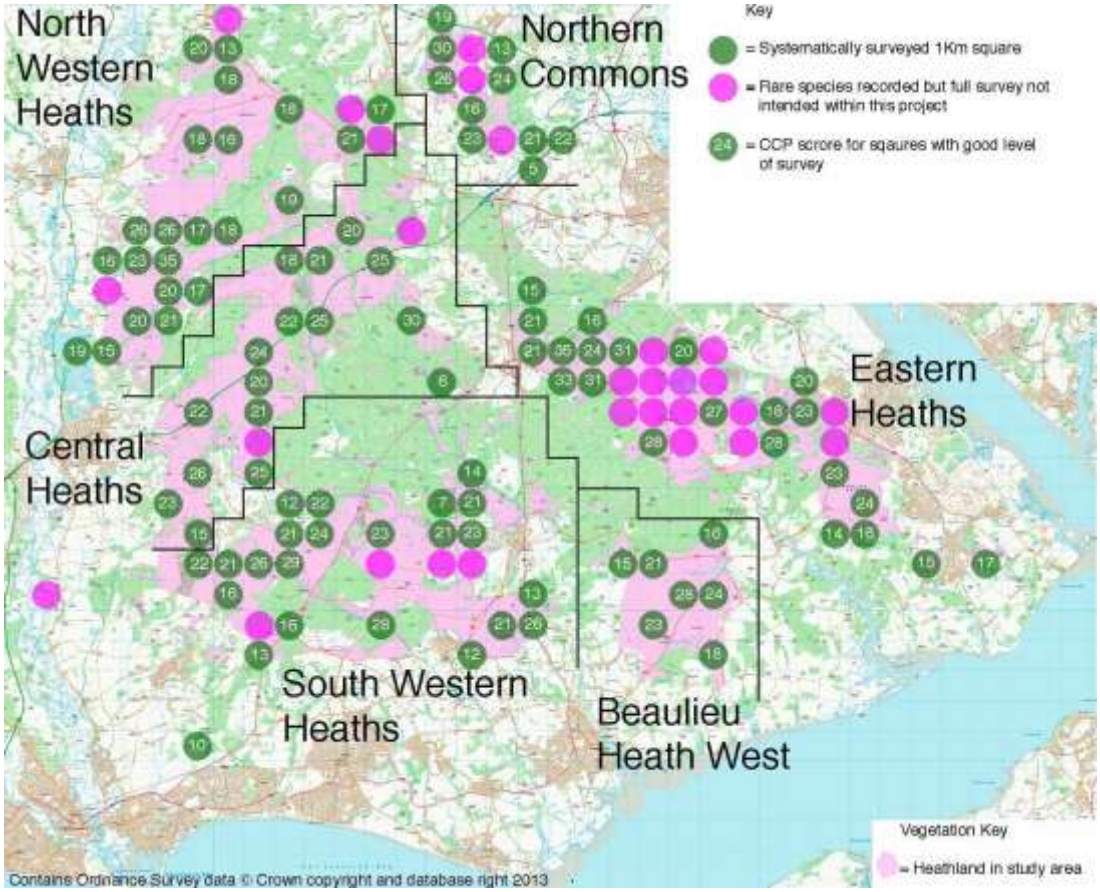
Further detailed discussion of the New Forest heathland lichen assemblage and its relationship to environmental variables, habitats, land use and other heathlands is given in sections **4.2.2** to **4.2.13**.

Photographs: new or rediscovered species, from White Moor, north east of Boltons Bench (SU3108).

Photo 2011-08-04-05: when this was photograph was taken, the lichen was identified as an odd coloured *Cladonia strepsilis*. Two days later it was realised that this was actually *Cladonia subcervicornis*.

Photo 2011-09-03-11: a month later this photograph was taken on the side of a hollow way, it is dominated by new or rediscovered species. The upper brown lichen is *Cladonia callosa* Nb (NS), formerly thought to be an exclusively upland species in Britain, and the pale lichen below is dry *Cladonia subcervicornis*.

MAP 3
Distribution of Surveyed 1Km National Grid Squares with CCP Index Scores



Keys to Species Lists 1 & 2

Key Habitat

Lic = Lichenicolous fungi
Cort = Epiphyte on dwarf shrubs
Sax = Saxicolous, found on natural flints or sandstone
Sax (Br) = Saxicolous only, brick or other acid artificial substrate
Sax (Cr) = Saxicolous only, or mainly, on concrete or calcium rich artificial substrate
Sax (Sd) = Calcareous sandstone, introduced rock
Sax (Lm) = Limestone, introduced rock
Terr = Terricolous
Terr (bry) = Terricolous, on bryophytes
Terr (lic) = Terricolous, initially lichenicolous

Key Status

NR = Nationally Rare lichen
NS = Nationally Scarce lichen
[NS] = Nationally Scarce but likely to be very under recorded
[NR] = Nationally Rare but likely to be very under recorded
CR = Critically Endangered Red Data Book Species
S41 = Section 41 species
CCP Index Score = total numbers of *Cetrelia*, *Cladonia* & *Pycnothelia* taxa.

Key Nomenclature

s. str. = *Sensu stricto*
s. lat. = *Sensu lato*
ssp. = Subspecies
var. = Variety
f. = Form

Notes (*)

The *Cladonia cryptochlorophaea* group includes definite *Cladonia cryptochlorophaea* [NS] (confirmed by TLC) and potentially also *Cladonia merochlorophaea* [NS] and *Cladonia novochlorophaea* [NR] (awaiting TLC conformation) but these three taxa do not appear to possible to clearly separate in the field.

Cladonia humilis "schizidiate form": this was previously recorded as *Cladonia pulvinella/hammeri* group, but now appears to be a schizidiate form of *C. humilis* of unclear taxonomic significance (Pino-Bodas et al, 2013).

SPECIES LIST 1
New Forest Heathland Lichen Survey 2011 – 2014, Alphabetical Order

New Forest Species	No Records in Systematic 1km	No All	Status	Habitat
Acrocordia salweyi	1	1		Sax (Sd)
Agonimia globulifera	1	1	Nb (NS)	Terr
Agonimia tristicula	2	2		Terr (bry)
Amandinea punctata	2	2		Sax
Arthonia apotheciorum	1	1	[NS]	Lic (Sax (Cr))
Arthopyrenia punctiformis	1	1		Cort
Arthrorhaphis aeruginosa	11	7	Nb (NS)	Lic
Arthrorhaphis grisea	5	5	Nb (NS)	Lic
Arrhenia peltigerina	0	1	[NR]	Lic
Aspicilia calcarea	1	1		Sax (Cr)

Aspicilia contorta spp contorta	12	12		Sax (Cr)
Bachmanniomyces uncialicola	12	12	[NS]	Lic
Bacidia bagliettoana	2	2		Terr (bry)
Baeomyces rufus	27	28		Terr
Buellia ocellata	2	2		Sax
Caloplaca flavescens	4	4		Sax (Cr & Lm)
Caloplaca flavocitrina	8	9		Sax (Cr)
Caloplaca limonia	2	2		Sax (Cr)
Caloplaca oasis	15	16		Sax (Cr)
Candelariella vitellina	12	13		Sax (Cr)
Catillaria atomarioides	5	5	Nb (NS)	Sax
Catillaria chalybeia	10	10		Sax (Cr)
Cetraria aculeata	51	52		Terr
Cetraria muricata	47	49		Terr
Cladonia arbuscula ssp. squarrosa	39	49		Terr
Cladonia borealis	1	1	Nb (NR/DD)	Terr
Cladonia caespiticia	1	1		Terr
Cladonia callosa	58	59	Nb (NS)	Terr
Cladonia cariosa	7	7	Nb (NS)	Terr
Cladonia cervicornis ssp. cervicornis	56	56		Terr
Cladonia chlorophaea s. str.	21	21		Terr
Cladonia ciliata var. ciliata	77	82		Terr
Cladonia ciliata var. tenuis	48	51		Terr
Cladonia coccifera s. str.	35	36	[NS]	Terr
Cladonia coniocraea	36	36		Terr
Cladonia cornuta	33	35		Terr
Cladonia crispata var. cetrariiformis	90	97		Terr
Cladonia cryptochlorophaea group *	96	100		Terr
Cladonia digitata	19	19		Terr
Cladonia diversa	86	88		Terr
Cladonia fimbriata	50	50		Terr
Cladonia floerkeana	93	97		Terr
Cladonia foliacea	8	9		Terr
Cladonia furcata ssp furcata	82	84		Terr
Cladonia furcata ssp subrangiformis	6	6		Terr
Cladonia glauca	10	10		Terr
Cladonia gracilis	36	40		Terr
Cladonia grayi s. str.	7	7	[NR]	Terr
Cladonia humilis	42	43		Terr
Cladonia humilis "schizidiate form" *	14	14		Terr
Cladonia incrassata	32	36	Nb (NS)	Terr
Cladonia macilenta	57	58		Terr
Cladonia mediterranea	3	3	CR (NR/S41)	Terr
Cladonia ochrochlora	12	12		Terr
Cladonia parasitica	3	3		Terr
Cladonia phyllophora	31	31	NT (NS)	Terr
Cladonia polydactyla var. polydactyla	29	30		Terr
Cladonia portentosa	99	110		Terr
Cladonia pyxidata	1	1		Terr
Cladonia ramulosa	82	82		Terr
Cladonia rangiformis	51	53		Terr
Cladonia rei	18	18	NT (NS)	Terr

Cladonia scabriuscula	13	13		Terr
Cladonia squamosa var. squamosa	25	26		Terr
Cladonia squamosa var. subsquamosa	77	82		Terr
Cladonia strepsilis	73	84		Terr
Cladonia subcervicornis	36	39		Terr
Cladonia subulata	17	18		Terr
Cladonia sulphurina	1	1		Terr
Cladonia uncialis ssp. biuncialis	85	93		Terr
Cladonia cervicornis ssp. verticillata	61	62		Terr
Cladonia zopfii	32	39	Nb (NS)	Terr
Collema auriforme	12	12		Terr
Dibaeis baeomyces	16	17		Terr
Diploschistes muscorum	2	2		Terr (lic)
Epicladonia sandstedei	2	2	[NS]	Lic
Evernia prunastri	4	4		Terr, Cort
Flavoparmelia caperata	4	4		Terr
Fuscidea lightfootii	6	6		Cort
Graphis elegans	2	2		Cort
Graphis scripta	2	2		Cort
Hypogymnia physodes	36	36		Terr
Hypotrachyna afrorevoluta	5	5		Cort
Hypotrachyna revoluta s. str.	1	1		Cort
Icmadophila ericetorum	17	18		Terr
Intralichen baccisporus	1	1	[NR]	Lic
Jamesiella anastomosans	1	1		Cort
Lecania erysibe	6	7		Sax (Cr)
Lecania inundata	4	4	[NS]	Sax (Cr)
Lecanora albescens	13	13		Sax (Cr)
Lecanora campestris ssp. campestris	9	10		Sax (Cr)
Lecanora confusa	3	3		Cort
Lecanora dispersa	3	3		Sax
Lecanora muralis	3	3		Sax (Cr)
Lecanora polytropa	1	1		Sax (Br)
Lecidella stigmatea	3	3		Sax (Cr)
Lepraria incana	2	2		Terr
Lepraria lobificans	1	1		Terr
Leptogium intermedium	4	5	Nb (NS)	Terr
Leptogium palmatum	4	4	NT (NS)	Terr
Leptogium schraderi	1	1		Terr
Leptogium tenuissimum	1	1	Nb (NS)	Terr
Lichenomphalia umbellifera	7	7		Terr
Melanelixia glabratula	4	4		Sax
Melanelixia subaurifera	2	2		Cort
Micarea erratica	16	16		Sax
Micarea leprosula	12	12		Terr
Micarea lignaria var. lignaria	33	35		Terr
Micarea melaena	1	1		Terr
Micarea peliocarpa	8	8		Terr
Micarea prasina s. lat.	8	8		Terr, Cort
Micarea viridileprosa	46	46	Nb (NS)	Terr
Micarea xanthonica	1	1	Nb (NS/IR)	Terr
Parmelia saxatilis	2	2		Terr

Parmelia sulcata	3	3		Cort
Parmotrema perlatum	1	1		Sax
Peltigera canina	14	15		Terr
Peltigera didactyla	17	17		Terr
Peltigera hymenina	44	45		Terr
Peltigera membranacea	2	2		Terr
Peltigera neckeri	7	8	Nb (NS)	Terr
Peltigera rufescens	8	8		Terr
Phaeophyscia orbicularis	5	5		Sax (Cr)
Physcia adscendens	9	9		Sax (Cr)
Physcia caesia	6	6		Sax (Cr)
Physcia dubia	1	1		Sax (Cr)
Physcia tenella	4	4		Cort
Placidium squamulosa	2	2		Terr
Placynthiella dasaea	23	24		Terr
Placynthiella icmalea	72	73		Terr
Placynthiella oligotropha	2	2	Nb (NS)	Terr
Placynthiella uliginosa	17	17		Terr
Placynthium nigrum	1	1		Sax (Cr)
Platismatia glauca	2	2		Terr
Porpidia crustulata	31	31		Sax
Porpidia macorcarpa	1	1		Sax
Porpidia soredizodes	10	10		Sax
Porpidia tuberculosa	11	11		Sax
Protoblastenia rupestris	16	17		Sax (Cr)
Psilolechia lucida	1	1		Terr
Punctelia jeckeri	1	1		Cort
Punctelia subrudecta s. str.	2	2		Cort
Pycnothelia papillaria	75	89		Terr
Ramalina fastigiata	1	1		Terr
Rhizocarpon reductum	44	44		Sax
Rinodina oleae	3	3		Sax (Cr)
Sarcogyne regularis	8	8		Sax (Cr)
Trapelia coarctata	13	13		Sax
Trapelia glebulosa	2	2		Sax (Sd)
Trapelia obtegens	5	5		Sax
Trapelia placodioides	1	1		Sax
Trapeliopsis flexuosa	14	14		Terr
Trapeliopsis glaucolepidea	3	3	Nb (NS)	Terr
Trapeliopsis granulosa	38	38		Terr
Trapeliopsis pseudogranulosa	2	2		Terr
Verrucaria baldensis	1	1		Sax (Lm)
Verrucaria macrostoma f. macrostoma	2	2		Sax (Sd & Lm)
Verrucaria muralis	17	17		Sax
Verrucaria nigrescens	25	26		Sax
Xanthoria calcicola	4	4		Sax (Cr)
Xanthoria parietina	8	8		Sax (Cr)
Mosses				
Dicranum spurium	14	16		Terr

SPECIES LIST 2
New Forest Heathland Lichen Survey 2011 – 2014,
Ordered by frequency of Occurrence in Systematically Surveyed 1km Squares

New Forest Species	No Records in Systematic 1km	No All	Status	Habitat
Cladonia portentosa	99	110		Terr
Cladonia cryptochlorophaea group *	96	100		Terr
Cladonia floerkeana	93	97		Terr
Cladonia crispata var. cetrariiformis	90	97		Terr
Cladonia diversa	86	88		Terr
Cladonia uncialis ssp. biuncialis	85	93		Terr
Cladonia furcata ssp furcata	82	84		Terr
Cladonia ramulosa	82	82		Terr
Cladonia ciliata var. ciliata	77	82		Terr
Cladonia squamosa var. subsquamosa	77	82		Terr
Pycnothelia papillaria	75	89		Terr
Cladonia strepsilis	73	84		Terr
Placynthiella icmalea	72	73		Terr
Cladonia cervicornis ssp. verticillata	61	62		Terr
Cladonia callosa	58	59	Nb (NS)	Terr
Cladonia macilenta	57	58		Terr
Cladonia cervicornis ssp. cervicornis	56	56		Terr
Cladonia rangiformis	51	53		Terr
Cetraria aculeata	51	52		Terr
Cladonia fimbriata	50	50		Terr
Cladonia ciliata var. tenuis	48	51		Terr
Cetraria muricata	47	49		Terr
Micarea viridileprosa	46	46	Nb (NS)	Terr
Peltigera hymenina	44	45		Terr
Rhizocarpon reductum	44	44		Sax
Cladonia humilis	42	43		Terr
Cladonia arbuscula ssp. squarrosa	39	49		Terr
Trapeliopsis granulosa	38	38		Terr
Cladonia gracilis	36	40		Terr
Cladonia subcervicornis	36	39		Terr
Cladonia coniocraea	36	36		Terr
Hypogymnia physodes	36	36		Terr
Cladonia coccifera s. str.	35	36	[NS]	Terr
Cladonia cornuta	33	35		Terr
Micarea lignaria var. lignaria	33	35		Terr
Cladonia zopfii	32	39	Nb (NS)	Terr
Cladonia incrassata	32	36	Nb (NS)	Terr
Cladonia phyllophora	31	31	NT (NS)	Terr
Porpidia crustulata	31	31		Sax
Cladonia polydactyla var. polydactyla	29	30		Terr
Baeomyces rufus	27	28		Terr
Cladonia squamosa var. squamosa	25	26		Terr
Verrucaria nigrescens	25	26		Sax
Placynthiella dasaea	23	24		Terr
Cladonia chlorophaea s. str.	21	21		Terr
Cladonia digitata	19	19		Terr

Cladonia rei	18	18	NT (NS)	Terr
Cladonia subulata	17	18		Terr
Icmadophila ericetorum	17	18		Terr
Peltigera didactyla	17	17		Terr
Placynthiella uliginosa	17	17		Terr
Verrucaria muralis	17	17		Sax
Dibaeis baeomyces	16	17		Terr
Protoblastenia rupestris	16	17		Sax (Cr)
Micarea erratica	16	16		Sax
Caloplaca oasis	15	16		Sax (Cr)
Peltigera canina	14	15		Terr
Cladonia humilis "schizidiate form" *	14	14		Terr
Trapeliopsis flexuosa	14	14		Terr
Cladonia scabriuscula	13	13		Terr
Lecanora albescens	13	13		Sax (Cr)
Trapelia coarctata	13	13		Sax
Candelariella vitellina	12	13		Sax (Cr)
Aspicilia contorta spp contorta	12	12		Sax (Cr)
Bachmanniomyces uncialicola	12	12	[NS]	Lic
Cladonia ochrochlora	12	12		Terr
Collema auriforme	12	12		Terr
Micarea leprosula	12	12		Terr
Porpidia tuberculosa	11	11		Sax
Arthrorhaphis aeruginosa	11	7	Nb (NS)	Lic
Catillaria chalybeia	10	10		Sax (Cr)
Cladonia glauca	10	10		Terr
Porpidia soredizodes	10	10		Sax
Lecanora campestris ssp. campestris	9	10		Sax (Cr)
Physcia adscendens	9	9		Sax (Cr)
Caloplaca flavocitrina	8	9		Sax (Cr)
Cladonia foliacea	8	9		Terr
Micarea peliocarpa	8	8		Terr
Micarea prasina s. lat.	8	8		Terr, Cort
Peltigera rufescens	8	8		Terr
Sarcogyne regularis	8	8		Sax (Cr)
Xanthoria parietina	8	8		Sax (Cr)
Peltigera neckeri	7	8	Nb (NS)	Terr
Cladonia cariosa	7	7	Nb (NS)	Terr
Cladonia grayi s. str.	7	7	[NR]	Terr
Lichenomphalia umbellifera	7	7		Terr
Lecania erysibe	6	7		Sax (Cr)
Cladonia furcata ssp subrangiformis	6	6		Terr
Fuscidea lightfootii	6	6		Cort
Physcia caesia	6	6		Sax (Cr)
Arthrorhaphis grisea	5	5	Nb (NS)	Lic
Catillaria atomarioides	5	5	Nb (NS)	Sax
Hypotrachyna afrorevoluta	5	5		Cort
Phaeophyscia orbicularis	5	5		Sax (Cr)
Trapelia obtegens	5	5		Sax
Leptogium intermedium	4	5	Nb (NS)	Terr
Caloplaca flavescens	4	4		Sax (Cr & Lm)
Evernia prunastri	4	4		Terr, Cort

Flavoparmelia caperata	4	4		Terr
Lecania inundata	4	4	[NS]	Sax (Cr)
Leptogium palmatum	4	4	NT (NS)	Terr
Melanelixia glabratula	4	4		Sax
Physcia tenella	4	4		Cort
Xanthoria calcicola	4	4		Sax (Cr)
Cladonia mediterranea	3	3	CR (NR/S41)	Terr
Cladonia parasitica	3	3		Terr
Lecanora confusa	3	3		Cort
Lecanora dispersa	3	3		Sax
Lecanora muralis	3	3		Sax (Cr)
Lecidella stigmatea	3	3		Sax (Cr)
Parmelia sulcata	3	3		Cort
Rinodina oleae	3	3		Sax (Cr)
Trapeliopsis glaucolepidea	3	3	Nb (NS)	Terr
Agonimia tristicula	2	2		Terr (bry)
Amandinea punctata	2	2		Sax
Bacidia bagliettoana	2	2		Terr (bry)
Buellia ocellata	2	2		Sax
Caloplaca limonia	2	2		Sax (Cr)
Diploschistes muscorum	2	2		Terr (lic)
Epicladonia sandstedei	2	2	[NS]	Lic
Graphis elegans	2	2		Cort
Graphis scripta	2	2		Cort
Lepraria incana	2	2		Terr
Melanelixia subaurifera	2	2		Cort
Parmelia saxatilis	2	2		Terr
Peltigera membranacea	2	2		Terr
Placidium squamulosa	2	2		Terr
Placynthiella oligotropha	2	2	Nb (NS)	Terr
Platismatia glauca	2	2		Terr
Punctelia subrudecta s. str.	2	2		Cort
Trapelia glebulosa	2	2		Sax (Sd)
Trapeliopsis pseudogranulosa	2	2		Terr
Verrucaria macrostoma f. macrostoma	2	2		Sax (Sd & Lm)
Acrocordia salweyi	1	1		Sax (Sd)
Agonimia globulifera	1	1	Nb (NS)	Terr
Arthonia apotheciorum	1	1	[NS]	Lic (Sax (Cr))
Arthopyrenia punctiformis	1	1		Cort
Aspicilia calcarea	1	1		Sax (Cr)
Cladonia borealis	1	1	Nb (NR/DD)	Terr
Cladonia caespiticia	1	1		Terr
Cladonia pyxidata	1	1		Terr
Cladonia sulphurina	1	1		Terr
Hypotrachyna revoluta s. str.	1	1		Cort
Intralichen baccisporus	1	1	[NR]	Lic
Jamesiella anastomosans	1	1		Cort
Lecanora polytropa	1	1		Sax (Br)
Lepraria lobificans	1	1		Terr
Leptogium schraderi	1	1		Terr
Leptogium tenuissimum	1	1	Nb (NS)	Terr
Micarea melaena	1	1		Terr

Micarea xanthonica	1	1	Nb (NS/IR)	Terr
Parmotrema perlatum	1	1		Sax
Physcia dubia	1	1		Sax (Cr)
Placynthium nigrum	1	1		Sax (Cr)
Porpidia macorcarpa	1	1		Sax
Psilolechia lucida	1	1		Terr
Punctelia jeckeri	1	1		Cort
Ramalina fastigiata	1	1		Terr
Trapelia placodioides	1	1		Sax
Verrucaria baldensis	1	1		Sax (Lm)
Arrhenia peltigerina	0	1	[NR]	Lic

3.3 Species Accounts

Individual species accounts are given in **Annex** 4. Detailed accounts are given of the core heathland species recorded during the survey, with distribution maps where relevant. Other species are more briefly described.

3.4 Description of Heathland Meta-sites

3.4.1 Introduction

The lichen habitats of the major stretches of heathland (**Map 2**) are described below and the full species lists with 1km square data given in **Annex 5**.

3.4.2 Northern Commons

The block of heathlands stretching 4.5km from Plaitford Common to Cadnam Common, mostly owned by the National Trust. The area is extended eastwards to include relic areas at Copythorne Common. Low rolling terrain in the Bracklesham Group with no gravel terraces. Mostly hard grazed heaths with short swards that have not been burned in living memory, including the western part of Copythorne Common. The eastern section of Copythorne Common, however, is unmanaged and dominated by tall rank vegetation. There was very little military disturbance in WWII in this area. A detailed report was made on the heathland lichen assemblage of the National Trust heaths by Sanderson (2014).

The 2011 – 15 New Forest Heathland Lichen Survey surveyed 10 1km squares systematically and a further three had some records recorded from them. A total of 86 taxa were recorded with a CCP Index score of 39. The systemically recorded 1km squares ranged from 13 to 42 taxa and averaged 27.6, while the CCP Index scores ranged from 5 to 30 and averaged 19.9 for systematically surveyed squares. The full species lists are given in **Species List 3**, **Annex 5**. One Near Threatened species and six Notable species were recorded, giving a RDB/Nb score of 400.

The area is dominated by extensive short grazed heathland with large sections of this exceptionally lichen rich, with a high cover of Reindeer Mosses including large populations of *Cladonia arbuscula* ssp. *squarrosa* along with large spreads of the Heath Thorn *Cladonia uncialis* ssp. *biuncialis*. With short heaths specialist such as *Cetraria aculeata*, *Cladonia ciliata* var. tenuis and *Cladonia gracilis* as abundant as anywhere in the Forest. Special features are a large population of *Cladonia zopfii* Nb (NS) on Plaitford Common, with outlying populations in Cadnam, Furzley and Copythorne Commons (**Map 43**). Other species of interest include *Arthrorhaphis aeruginosa* Nb (NS), *Bachmanniomyces uncialicola* [NS], *Cladonia callosa* Nb (NS), *Cladonia coccifera* [NS], *Cladonia grayi* s. str. [NR], *Cladonia incrassata* Nb (NS), *Cladonia phyllophora* NT (NS), *Cladonia strepsilis*, *Dibaeis baeomyces*, *Epicladonia sandstedei* [NS] *Icmadophila ericetorum*, *Pycnothelia papillaria* and *Trapeliopsis glaucolepidea* Nb (NS). The short grazed heathland specialist moss *Dicranum spurium* VU (NS/S41) occurs locally. The localised records for species of interest are mapped on **Map 42**. Areas of high interest visited during the survey are:

- **Plaitford Common** (SU2717, SU2718 & SU2719): the west of Plaitford Common has the largest single area of lichen rich short grazed heath in the New Forest. This is also the richest area within the meta-site. The common was rather heavily grazed to the east and may still be a bit over trampled by humans here but is in very good condition to the west. There are more occurrences of humid

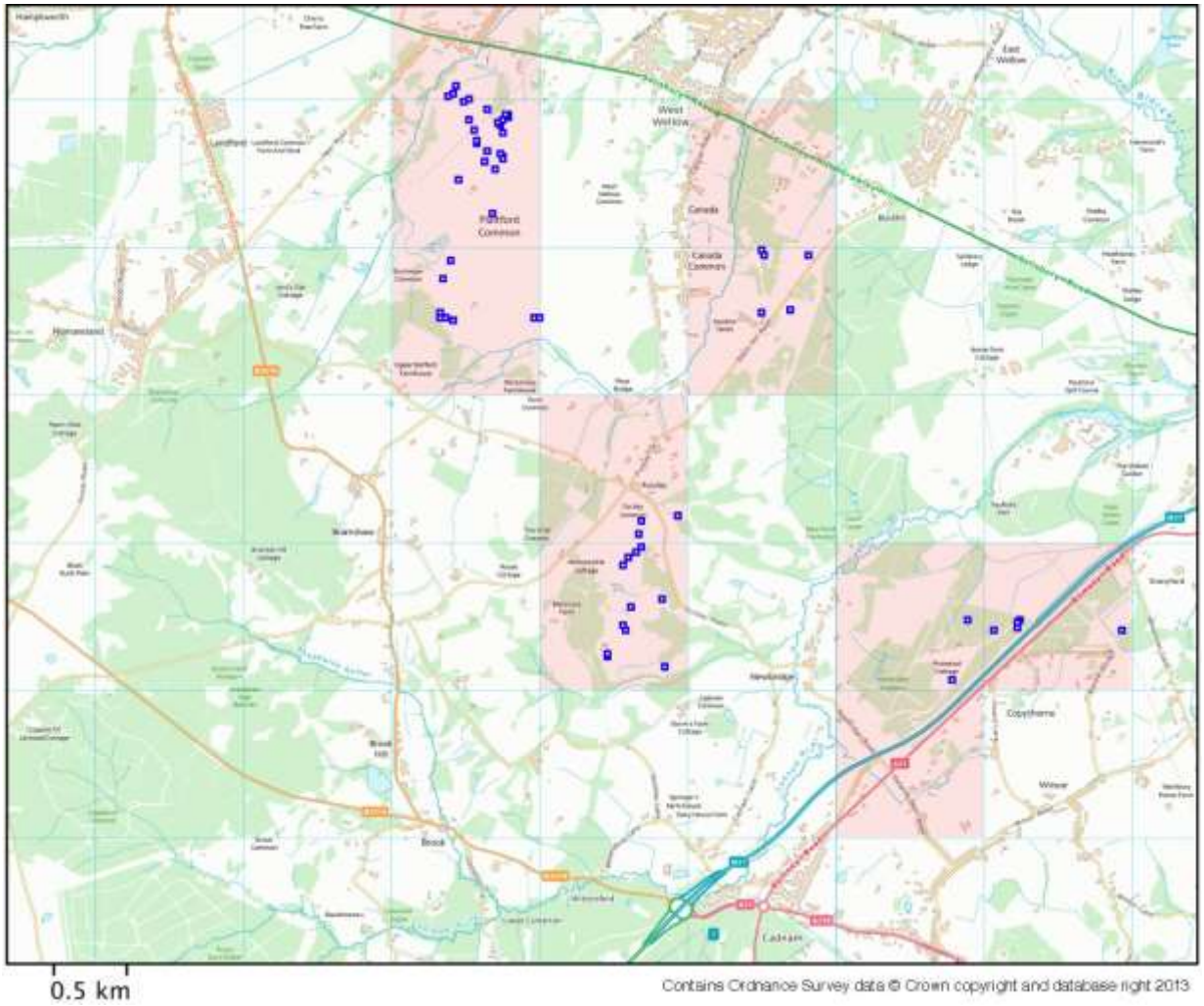
hard humus specialists compared to other short heaths, however, probably due to past over grazing.

- **Cadnam & Furzley Commons** (SU2815 & SU2816): a second more compact area of short heath, with a very rich lichen assemblage. The sward is more typically mossy, with few small *Cladonia* species, having not been affected by the increase of grazing pressure that affected Plaitford Common in the 1990s. There is however an extensive old hollow way complex to the north which provides habitats for the smaller species.

- **Half Moon Common & Black Hill** (SU2917 & SU2918): more patches of short grazed heath. Rather battered in recent decades by increased grazing pressure as turning out started from a new farm. Colonies of *Dicranum spurium* VU (NS/S41) known in the 1990s were not refound. Still a great deal of lichen interest survives but ideally reduced grazing pressure should be reduced.

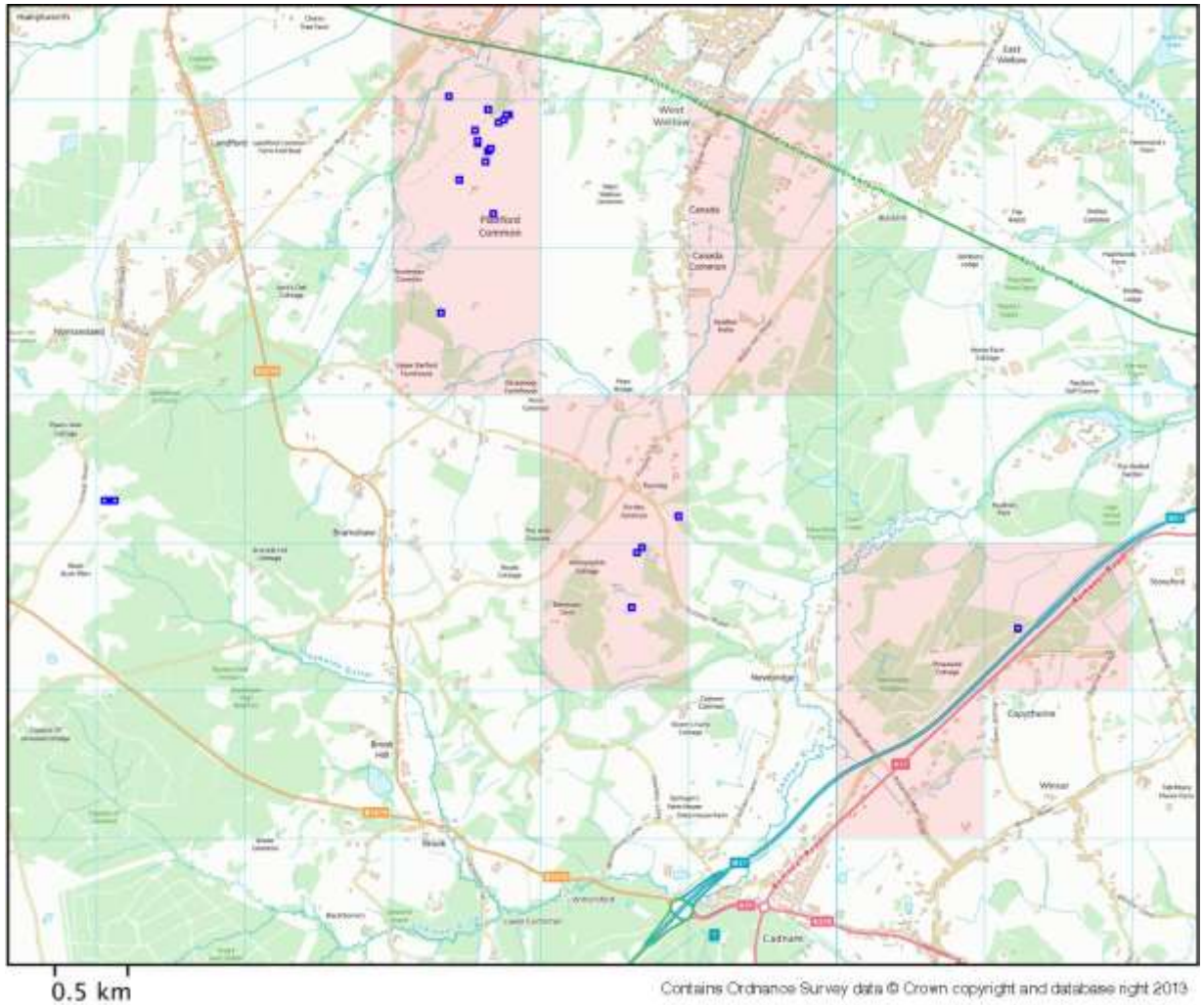
- **Copythorne Common west** (SU3015, SU315): an area of common land, formerly directly attached to the New Forest, but left open as a poors plot (an area left unenclosed for the benefit of the poor of the parish) when the main areas of common were enclosed here in about 1810. Likely to be grazed by stray Forest stock up to 1964. The heathland is heavily invaded by Pine, but is also well grazed. The surviving open areas support a rich and typical assemblage of short grazed heath lichens with *Cladonia arbuscula* ssp. *squarrosa* frequent. The site supports the only recorded locations of *Cladonia zopfii* Nb (NS), Heathtooth *Pycnothelia papillaria* and the moss *Dicranum spurium* VU (NS/S41) known off the open Forest grazings in south Hampshire. Part owned by the Hampshire Wildlife Trust and under active management. The site requires much more Pine clearance and the grazing will need to be maintained at a suitably high level.

MAP 42
Localised records of Species of Interest in the Northern Commons



Pink shaded squares = systematically surveyed 1km squares in the Northern Commons.

MAP 43
Records of *Cladonia zopfii* Nb (NS) in the Northern Commons



Pink shaded squares = systematically surveyed 1km squares in the Northern Commons.
Adjacent records of *C. zopfii* from the North Western Heaths added for completeness.

3.4.3 Eastern Heaths

These stretch 16 km from Fair Cross north of Lyndhurst to Beaulieu Heath East and Blackwell Common. Also includes the isolated area east of Backfield at Fields Heath. Low dissected gravel river terraces with extensive areas of slopes in the sands and clays of the Barton Group, with more extensive gravel river terrace burying the clays of the Headon Formation on Beaulieu Heath East to the south east. Includes areas of short grazed heaths near fertile grassland and woods, grading into taller control-burned heaths more distant from richer grazings. Localised disturbance in WWI and WWII, leaving shell craters, old gravel pits and areas with broken concrete.

The 2011 – 15 New Forest Heathland Lichen Survey surveyed 22 1km squares systematically and a further 14 had some records recorded from them. A total of 126 taxa were recorded with a CCP Index score of 46. The systemically recorded 1km squares ranged from 15 to 59 taxa and averaged 30.8 while the CCP Index scores ranged from 14 to 35 and averaged 22.8 for systematically surveyed squares. The full species lists are given in **Species List 4a & 4b**, **Annex 5**. Three Near Threatened species and nine Notable species were recorded, giving a RDB/Nb score of 750.

This large area has many significant gradients of grazing pressure with areas of more heavily browsed heath near settlements and woods, but there are no very extensive areas of short grazed heath. Rich areas of short grazed heath occur at Fair Cross in the north west and north of Matley Wood and frequent smaller patches elsewhere. More extensive are areas of moderately browsed heath still within the burning programme. These are frequent to the west, from Matley to Lyndhust and are locally exceptionally species rich. These rich areas are also located on the rolling areas of exposed Tertiary deposits on slopes which are invariably richer that the dominant terraces to the east. There are also large hollow way systems associated with the abandoned medieval Salt Way and other traffic heading to Lyndhurst in the west adding to the habitat diversity. To the east, heaths are generally less heavily browsed but are still locally rich on Tertiary slopes in the right phase of development after burning. WWII disturbance at Yew Tree Heath, has produced lichen hot spots, both of concrete enriched soil and heath interest in a very rich WWII gravel pit.

Short grazed humid dry heath with a high cover of the Reindeer Moss large *Cladonia arbuscula* ssp. *squarrosa* is rare but occurs at Fair Cross to the north west of the area. Otherwise there are only small patches of this Reindeer Moss in short humid dry heath, but it is also scattered in wet heath in the west and centre of the area. There is also a substantial population of *Cladonia zopfii* Nb (NS) scattered though the damper humid heaths and transitions to wet heath in the upper basin of the Beaulieu River, with small path side populations and a single population in wet heath on the plateau of Beaulieu Heath east (**Map 44**). The spectacularly rich area of moderately browsed burned heaths with patches of short grazed heath between Lyndhurst and Matley Wood have strong populations of *Cladonia callosa* Nb (NS), *Cladonia grayi* s. str. [NR], *Cladonia incrassata* Nb (NS), *Cladonia phyllophora* NT (NS), *Cladonia rei* NT (NR), *Cladonia strepsilis*, *Cladonia subcervicornis*, *Dibaeis baeomyces*, *Icmadophila ericetorum*, *Micarea leprosula* and *Pycnothelia papillaria*. A major proportion of the New Forest and English population of the moss *Dicranum spurium* VU (NS/S41) also occurs between the east of Matley Wood and Bolton's Bench. At Bolton's Bench there is small colony of *Leptogium palmatum* NT (NS).

The eastern part of the basin of the Beaulieu River, has similar heathland but with lower browsing levels and fewer hollow ways. It is not as rich overall, but similar assemblages are found on the slopes at the right stage of the burning cycle. There are rich areas associated with the WWII disturbance at Yew Tree Heath, including *Cladonia cariosa* Nb (NS) and *Cladonia foliacea* in concrete enriched grassland and a large population of *Cladonia subcervicornis* in a nearby gravel pit.

To the far east, the heathland is dominated by gravel plateaus on Beaulieu Heath east, the density of interest is lower here, but the diversity is still locally high where conditions for lichens are good. Blackwell Common at the eastern end of the open Forest grazings has extensive short grazed heath, but this is surprisingly species poor; the reasons are not clear.

Finally there are some small areas of rich short grazed heath developed in an abandoned gravel pit dug into heathland at Fields Heath off the Forest to the east. This is on the North Solent NNR and has some records of Forest specialities such as *Cladonia rei* NT (NR) and *Cladonia strepsilis*. The localised records for species of interest are mapped on **Map 44**. Areas of high interest visited during the survey are:

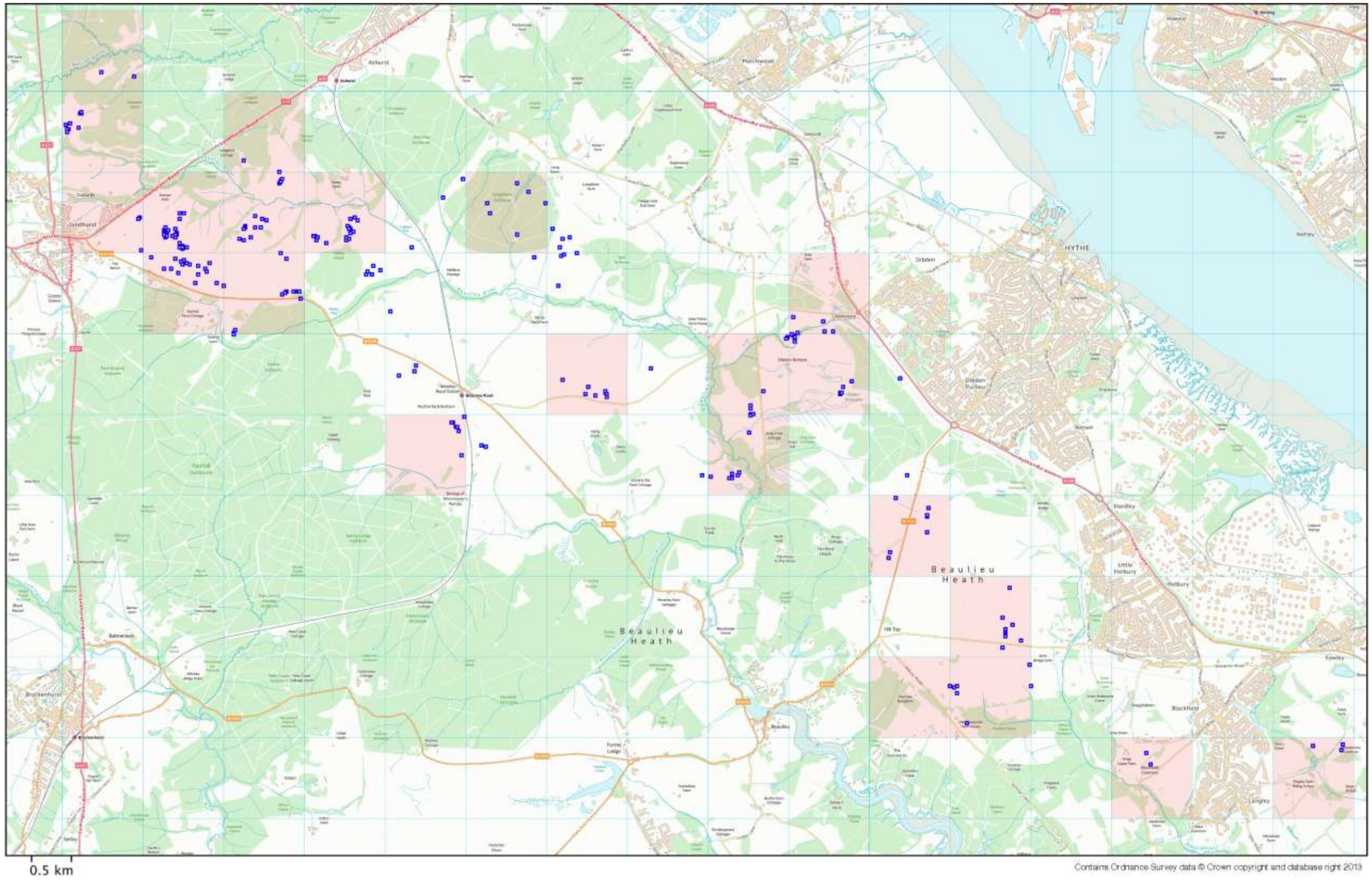
- **Fair Cross** (SU3009): areas of short grazed humid dry heath on the edge of ancient woodlands. Notable for the largest populations of the Reindeer Moss *Cladonia arbuscula* ssp. *squarrosa* in the Eastern Heaths, also with *Cladonia grayi* s. str. [NR] and *Dicranum spurium* VU (NS/S41). The richest area is centred on SU300095.

- **Boltons Bench to Matley Wood** (SU3008 – SU3308): one of the most spectacularly rich areas of heathland for lichens in the New Forest as described above. Hot spots are widespread, but there is a particularly spectacular area of moderately browsed heath about SU313 083, White Moor. Other areas in the west include Fox Hill (SU314 085), hollow ways about SU310085, *Leptogium palmatum* NT (NS) in parched acid grassland (SU309 080), and an area of moderately browsed heath on the north side of The Ridge (SU314 078) along with relatively recently burned heaths still to reach their peaks (SU315 082 & SU318 077). South of Longwater Lawn, a relatively recently burned heath developing towards rich heath occupies part of the Salt Way hollow way complex. Around Matley Wood interest is again high (SU329 075, SU335 081 to SU335 084 and SU335 074).

- **Denny Wood to Dibden Bottom** (SU3406 – SU3906): more dispersed interest but with some significant hot spots, including, well browsed humid heath and wet heath with *Cladonia zopfii* east of Denny Wood (SU3306 - SU3307), generally lichen rich heath around Shatterford within the burning cycle (SU3405), concrete enriched grassland and a WWII gravel pit at Yew Tree Heath (SU3606), well browsed but burned heaths west of the Beaulieu River (SU3705) and similar at Dibden Bottom (SU3806 & SU3807). Further north there is some short grazed heath east of Longdown Inclosure grading into wet heath (SU3608 & SU3607). There are certainly more areas of interest within the general area.

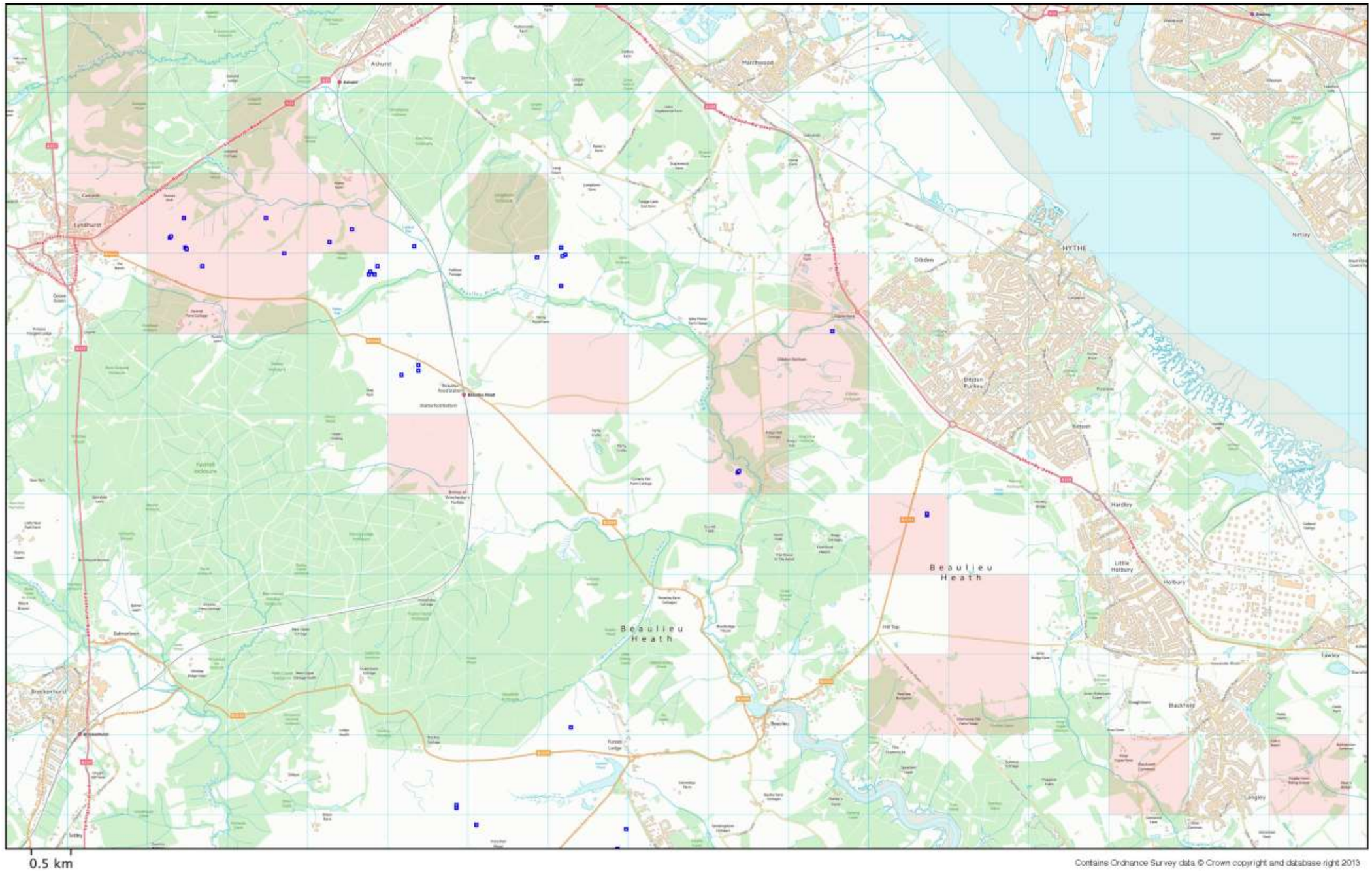
- **Fields Heath, Blackfield** (SU4501): a significant area of lichen rich short grazed heath and some grassland on the bases of former gravel pits, of the Forest Grazing, includes one of only two populations off the New Forest of *Cladonia strepsilis* and the only population of *Cladonia rei* NT (NR) off the Forest grazings.

MAP 44
Localised records of Species of Interest in the Eastern Heaths



Pink shaded squares = systematically surveyed 1km squares in the Eastern Heaths.

MAP 45
Records of *Cladonia zopfii* Nb (NS) in the Eastern Heaths



Pink shaded squares = systematically surveyed 1km squares in the Eastern Heaths.
Adjacent records of *C. zopfii* from Beaulieu Heath west added for completeness.

3.4.4 Beaulieu Heath West

A compact block of heathland about 4km across with an extensive gravel river terrace largely burying the more base rich clays of the Headon Formation. Short grazed low productivity heath is rare except the along the eastern edge close to common edge settlements. Gorse is particularly frequent in the drier, productive and generally taller heaths. Military disturbance in WWII was extensive around the Beaulieu Airfield, with base enriched areas with broken concrete widespread along the sites of the old runways. In addition large areas of heath were levelled within the airfield, stripping the topsoil.

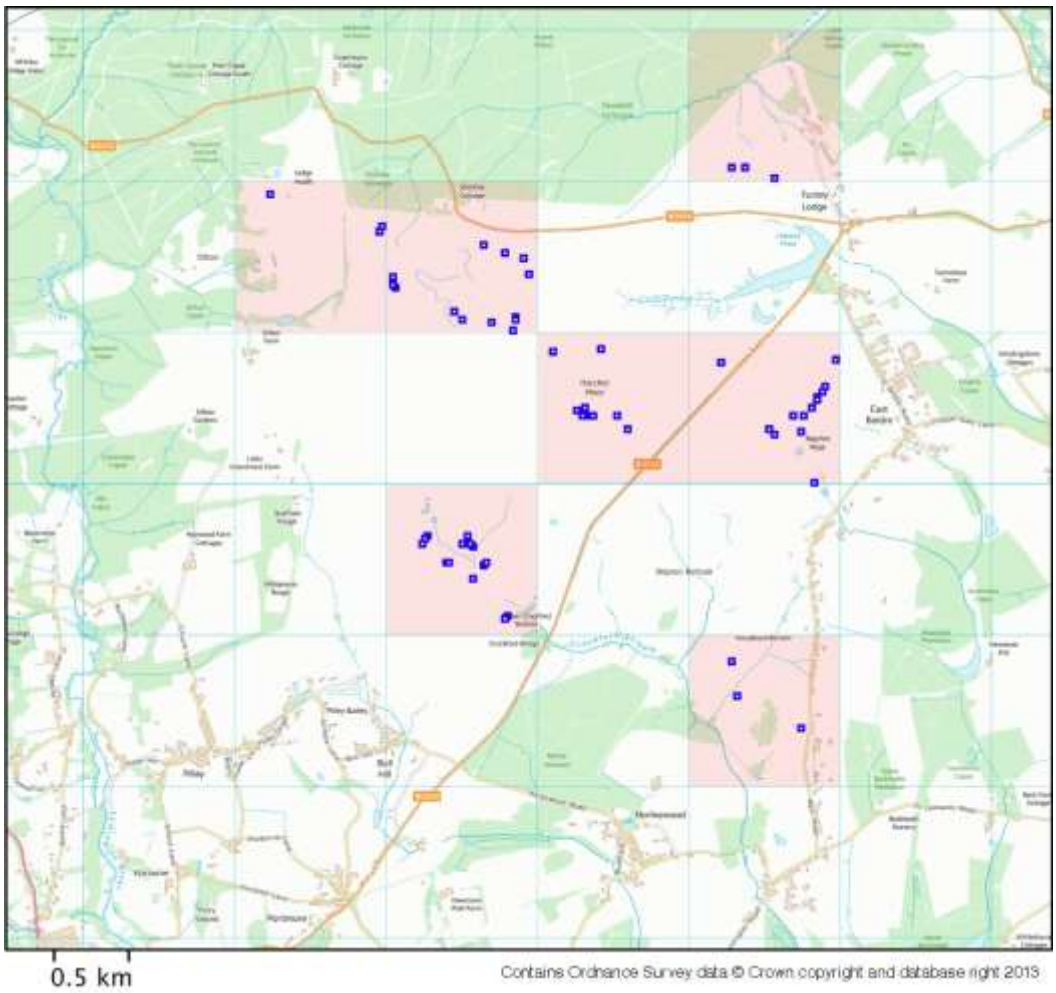
The 2011 – 15 New Forest Heathland Lichen Survey surveyed seven 1km squares systematically. A total of 86 taxa were recorded with a CCP Index score of 40. The systemically recorded 1km squares ranged from 18 to 63 taxa and averaged 31.4 while the CCP Index scores ranged from 15 to 28 and averaged 20.7 for systematically surveyed squares. The full species lists are given in **Species List 5**, **Annex 5**. Two Near Threatened species and seven Notable species were recorded, giving a RDB/Nb score of 550.

Areas of short grazed heath are mainly found along the eastern edge, close to the settlements of East Bolder and Furzey Lodge. These include local patches of *Cladonia arbuscula* dominated heath, especially west of Furzey Lodge. At East Bolder this grades into the moderately browsed plateau wet heath, with large population of *Cladonia zopfii* Nb (NS) (**Map 47**) around Bagshot Moor. There is also some short grazed heath about Round Hill, to the north west, although this is quite trampled close to the campsite and lacks *Cladonia arbuscula*. Beyond this the extensive productive dry heath with abundant Gorse on brick earth (H3c) is very poor in lichens, as is typical of this type of community. Where damper and lacking Gorse the lichens diversity picks up but is not high. There are much richer hot spots on the plateau slopes, at least where the upper slopes are not smothered by head deposits. The best areas seen were around Upper Crockford Bottom. This area also has good hollow ways by a bog crossing, with *Cladonia callosa* Nb (NS), along with exceptional low productivity humid and wet heath around the mire edges with abundant *Pycnothelia papillaria* and *Cladonia strepsilis* along with *Cladonia arbuscula* ssp. *squarrosa*, *Cladonia subcervicornis* and *Cladonia zopfii* Nb (NS).

Although most of the drier areas of the plateau are not rich, the disturbed areas around the former airfield are an exception. These include areas of heath that had the topsoil bulldozed off between the runways, which are exceptionally rich for plateau heath. These include classic New Forest species including *Pycnothelia papillaria* and *Cladonia strepsilis* along with *Cladonia callosa* Nb (NS), *Cladonia subcervicornis*, *Cladonia zopfii* Nb (NS), *Cladonia phyllophora* NT (NS), *Dibaeis baeomyces*, *Cladonia rei* NT (NR) and *Micarea leprosula*. The actual sites of the former runways, which are an important vascular plant sites, support a significant assemblage of lichen of base enriched soils, which is richer than most Hampshire downlands. This includes *Bacidia bagliettoana*, *Cladonia cariosa* Nb (NS), *Cladonia humilis* "schizidiate form", *Leptogium schraderi*, *Leptogium tenuissimum* Nb (NS), *Peltigera neckeri* Nb (NS), *Peltigera rufescens* and *Placidium squamulosa*. The localised records for species of interest are mapped on **Map 46**. Areas of high interest visited during the survey are:

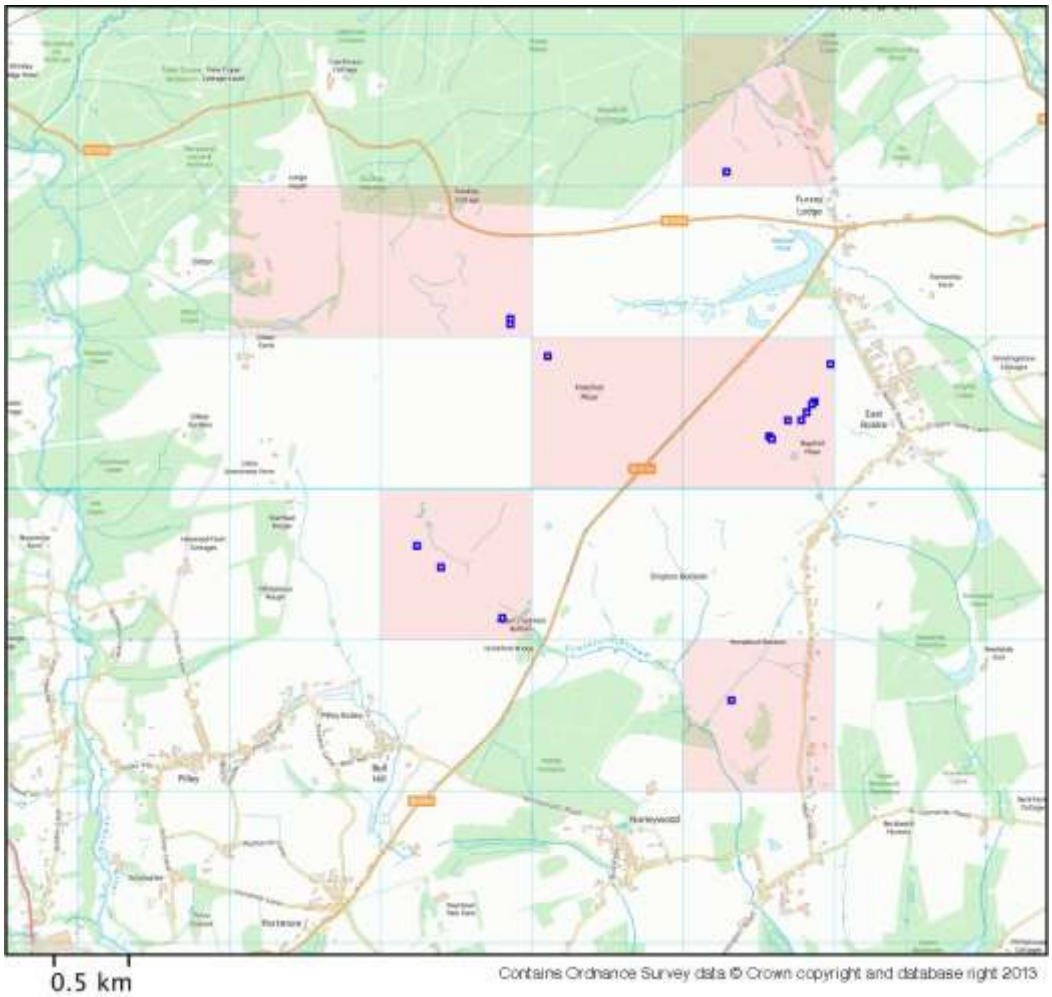
- **Furzey Lodge** (SU366 022 to SU366 020): an area of lichen rich short grazed heath with abundant *Cladonia arbuscula*.
- **Bagshot Moor** (SU365 003 to SU368 005 and SU366 004): an area of moderately browsed wet heath and humid heath. Includes a spectacularly large population of *Cladonia zopfii* Nb (NS) along with typical associates.
- **Upper Crockford Bottom** (core area from SZ345 993 to SZ341 997): an area of rich humid and wet heath marginal to the mire, along with hollow ways at a bog crossing.
- **Beaulieu Airfield** (SU35 00 & SU34 01): areas of rich heath, bulldozed in WWII and concrete enriched grassland, the latter has the richest downland assemblage found on the New Forest. The richest area seen was the runway from SU355003 to SU353006 and the heathland to the east.

MAP 46
Localised records of Species of Interest in Beaulieu Heath West



Pink shaded squares = systematically surveyed 1km squares in Beaulieu Heath west.

MAP 47
Records of *Cladonia zopfii* Nb (NS) in Beaulieu Heath West



Pink shaded squares = systematically surveyed 1km squares in Beaulieu Heath west.

3.4.5 South Western Heaths

This area stretches 11km from the east of Brockenhurst to the south west of Burley to Dur Hill Down. Includes isolated areas of heathland at Setley Common to the east in the Roydon Wood Nature Reserve and the even more isolated Burton Common to the south west. Low dissected gravel river terraces with extensive areas of slopes in the sands and clays of the Barton Group to the north, with more extensive gravel river terrace burying the clays of the Headon Formation to the south. Localised areas of short grazed heaths near fertile grasslands, grading gradually into taller control-burned heaths more distant from richer grazings. Setley Common has restored grazing after a long absence of grazing, while Burton Common appears to be in the process of restoring grazing but is not yet effectively grazed. Localised disturbance in WWII, leaving old gravel pits and areas of broken concrete, with Holmsley Airfield in the south west of the area.

The 2011 – 15 New Forest Heathland Lichen Survey surveyed 23 1km squares systematically and a further five had some records recorded from them. A total of 109 taxa were recorded with a CCP Index score of 45. The systemically recorded 1km squares ranged from seven to 49 taxa and averaged 26.4 while the CCP Index scores ranged from 7 to 29 and averaged 19.2 for systematically surveyed squares. The full species lists are given in **Species List 5**, **Annex 5**. One Critically Endangered, three Near Threatened species and 12 Notable species were recorded, giving a RDB/Nb score of 1100.

The terrain is very similar to the eastern heaths meta-site, with a similar distribution of richer heathland on Tertiary and much poorer on the terraces. There are, however, fewer areas of short grazed heath than other areas, but there are grazing gradients from the major reseeded areas west of Brockenhurst. These include impressive short grazed to moderately browsed and occasionally burned damp humid heath at North Weirs, with a large population of *Cladonia zopfii* Nb (NS) (**Map 47**), some *Cladonia arbuscula* and the only confirmed recent record of *Cladonia borealis* Nb (NR/DD) from England. In general *Cladonia arbuscula* is much rarer in this area than in other areas and was only found near Brockenhurst. There appears to be limited turn out of stock, especially cattle from the south of Burley and hence a lack of suitable short grazed heath to the west. There are some short grazed heaths east of Holmsley Airfield, but these are probably a post war feature and lack *Cladonia arbuscula*.

West of Brockenhurst, there is plenty of good lichen rich heath within the burning cycle. Significant areas were recorded along the slopes above the Ober Water/Mill Brook and the Avon Water. The latter is locally very rich, as for example south of Shappen Hill. The typical New Forest specialists of this habitat are widespread and include *Cladonia strepsilis*, *Cladonia subcervicornis*, *Micarea leprosula* and *Pycnothelia papillaria*. Scattered pits and hollow ways add to the diversity. The recently abandoned Forestry Commission gravel pit Holmsley has a massive population of *Cladonia callosa* Nb (NS) dominating parts of the pit base. A superb hollow way, with natural rock outcrops at Rock Hill has one of the few *Cladonia zopfii* Nb (NS) populations found in the west of this area and there are occurrences of species such as *Cladonia incrassata* Nb (NS), *Cladonia parasitica*, *Cladonia phyllophora* NT (NS), *Icmadophila ericetorum* and *Micarea xanthonica* Nb (NS/IR) in hollow ways while *Cladonia rei* NT (NS) is characteristic of well grazed hummocks in tussocky wet heath

as well. One special find was a patch of the very rare *Cladonia mediterranea* CR (NR/S41) in a humid heath to wet heath transition at Wootton Bridge.

Two isolated heaths were included within the survey. The heathland of Setley Common is part of Roydon Wood Nature Reserve. It had been long ungrazed but has had grazing restored for sometime. It has a reasonable lichen assemblage, but has lost the New Forest specialists, potentially from past under grazing and no controlled burning. It is developing good short browsed heath locally with an abundance of species such as *Cladonia gracilis* but *Cladonia arbuscula* appears to have been lost. Burton Common, more distant from the Forest and long ungrazed proved to be very species poor and degraded. The localised records for species of interest are mapped on **Map 48**. Areas of high interest visited during the survey are:

- **Race Plain** (SZ2999 & SZ3099): the heathland north of the gravel pit includes area of rich short grazed heath (SZ301992) and lichen rich tumuli (SZ298998) in moderately browsed burned heath. A path side near the car park has a small colony of the rare *Leptogium palmatum* NT (NS).

- **North Weirs to Red Hill** (SU2802 to SU2701): to the east, there is an area of very species rich damp humid heath to wet heath with important populations of rare species (centred on SU281020) as described above. Some very open areas with high lichen cover may be developed on a former hot fire site. Grading west into drier short grazed and moderately browsed humid heath, with local rich areas and interesting hollow ways.

- **Ober Slade** (SU284 038): the level low terraces in this area are generally species poor, but a medieval leat crossing the heath here is much richer, including a rare occurrence of *Cladonia arbuscula.*

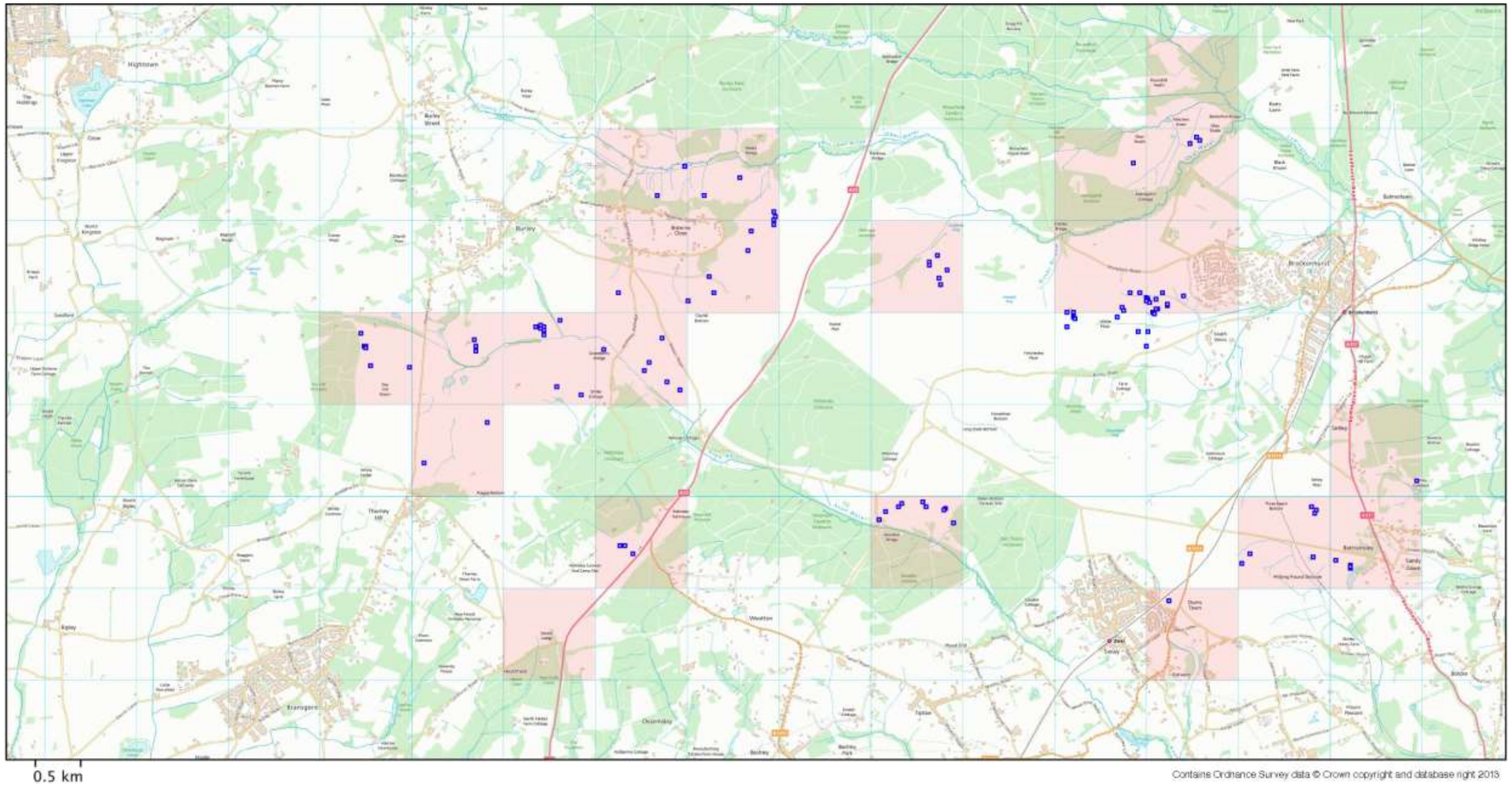
- **Duck Hole & Holm Hill** (SU256 025 & SU257 023): generally lightly grazed heathland in this area, but some ruts and hollow ways on the slopes down to a bog crossing are important, including the only heathland occurrence of *Micarea xanthonica* Nb (NS/IR) in the New Forest.

- **Hollow way at Rock Hills** (SU239 029 & SU239 030): one of the finest hollow ways in the New Forest, with natural rock outcrops, includes *Cladonia zopfii* Nb (NS), *Cladonia callosa* Nb (NS), *Cladonia phyllophora* NT (NS) and *Cladonia rei* NT (NR).

- **Wootton Bridge** (Z257 998 to SZ252 998): a generally rich area with wet heath to humid heath transitions with *Cladonia zopfii* Nb (NS) and *Cladonia mediterranea* CR (NR/S41) and well developed humid heath with hollow ways above.

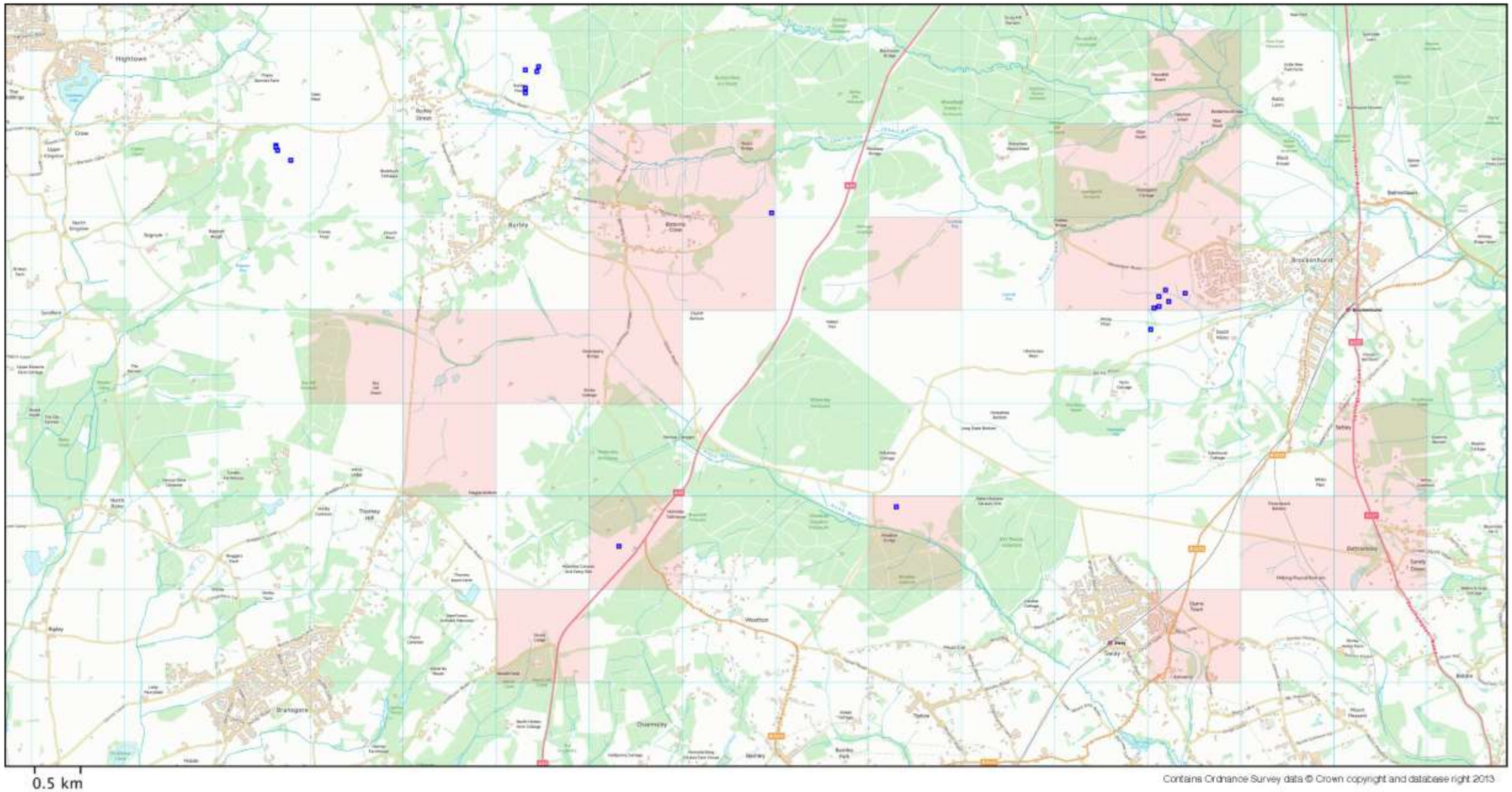
- **Holmsley Walk** (SU1901 to SU1901): an extensive area with locally rich heathland on the slopes above Holmsley Bog at the right stages in the burning cycle. Rich hot spots include the heath and hollow ways at Shappen Hill (about SU213018), an area known to Dr Francis Rose, and still good. Includes the only record of *Icmadophila ericetorum* in the meta-site, found by Dr Rose and refound during this survey. The old gravel pit at Goatspen Plain (SU227016) and the recently abandoned gravel pit at Holmsley Ridge (about SU215010) provide hot spots. Finally, the extensive low productivity heath at Durhill Down (SU1901) was patchily of interest.

MAP 48
Localised records of Species of Interest in the South Western Heaths



Pink shaded squares = systematically surveyed 1km squares in the South Western Heaths.

MAP 49
Records of *Cladonia zopfii* Nb (NS) in the South Western Heaths



Pink shaded squares = systematically surveyed 1km squares in the South Western Heaths.
Adjacent records of *C. zopfii* from the Central Heaths added for completeness.

3.4.6 Central Heaths

A wide band of heathland stretching 13km from Cranes Moor north west of Burley, to Janesmoor by Fritham, although bisected by the dual carriageway of the A31. Also extends south east down to Acres Down. Dominated by dissected high gravel terraces with sands and clays of the Barton Group on slopes but these are often buried by deep head deposits except on more eroded upper parts of slopes. Large areas are lightly grazed, but shorter more heavily grazed heaths occur near Burley and south of Fritham and at Acres Down. Rather localised WWII disturbance, except to the north east where Stoney Cross Airfield had a major impact, leaving large areas of concrete enriched ground.

The 2011 – 15 New Forest Heathland Lichen Survey surveyed 16 1km squares systematically and a further two had some records recorded from them. A total of 107 taxa were recorded with a CCP Index score of 44. The systemically recorded 1km squares ranged from seven to 43 taxa and averaged 31.5 while the CCP Index scores ranged from six to 30 and averaged 21.4 for systematically surveyed squares. The full species lists are given in **Species List 5**, **Annex 5**. Two Near Threatened species and 10 Notable species were recorded, giving a RDB/Nb score of 700.

This area has quite marked grazing gradients from well grazed areas near Burley, Acres Down and Fritham to the central plateaus, which are lightly grazed. The richest heaths were on the low lying ground around Burley, especially at Burley Moor, where there are small areas of short grazed heath with *Cladonia arbuscula*, grading into moderately browsed heath in the burning cycle with rich flora including *Cladonia zopfii* Nb (NS). There are also islands of very lichen rich wet heath within the mire of Strodgemoor, again with *Cladonia arbuscula* and *Cladonia zopfii* Nb (NS). Another rich area of short grazed heath occurs on Acres Down and on the edge of Stonycross Airfield, the latter with *Cladonia arbuscula* and *Cladonia glauca*. The disturbed ground at Stonycross Airfield, has some species of base enriched soils of interest, but is not as rich as Beaulieu Airfield.

The lightly grazed heaths distant from the settlements have large areas of low interest, especially in the seasonally wet centres of the plateaus. The plateaus edge slopes are richer, less so than the slopes in the south of the Forest but can be quite diverse at the right stage of the burning cycle. The most interesting sites, however, are on path edges, seepage step banks and old quarries. The localised records for species of interest are mapped on **Map 50**. Areas of high interest visited during the survey are:

- **Strodgemoor** (SU186 038 & SU186 036 & SU189 036 to SU188 036): islands of very lichen rich wet heath within the mire of Strodgemoor, with *Cladonia arbuscula* and *Cladonia zopfii* Nb (NS) and an abundance of *Cladonia strepsilis*. The humid dry heath ridge to the east of the mire is also rich, with locally high cover of *Cladonia strepsilis*, *Cladonia subcervicornis* and *Pycnothelia papillaria*, with *Cladonia callosa* Nb (NS) present.

- **Burley Common** (about 300m around SU214 045): small areas of short grazed heath with *Cladonia arbuscula*, grading into moderately browsed heath in the burning cycle with rich flora including *Cladonia zopfii* Nb (NS) along with an

abundance of other characteristic species. A rut supported one of only two colonies of *Icmadophila ericetorum* in the meta-site.

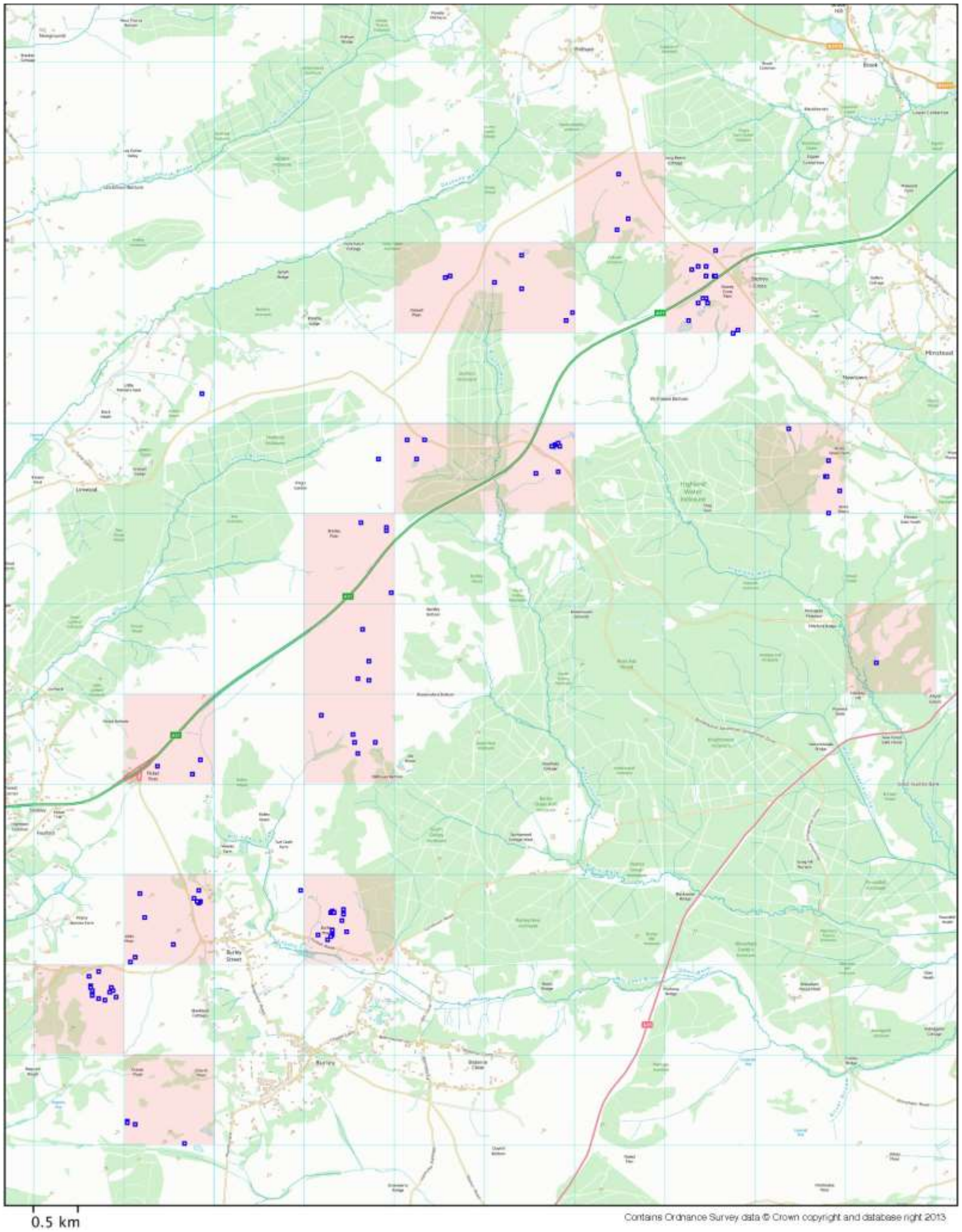
- **Mogshade Hill** (around SU238 097): a 20th century quarry with rich areas in the base of the pit. There is abundant *Pycnothelia papillaria*, along with *Cladonia callosa* Nb (NS), *Cladonia strepsilis*, *Dibaeis baeomyces*, *Cladonia phyllophora* NT (NS) and *Cladonia subcervicornis*.

- **Andrew's Mare** (around SU252 111): a 20th century quarry with very rich areas in the base of the pit. There is abundant *Cladonia strepsilis* and large sheets of *Dibaeis baeomyces* along with *Pycnothelia papillaria*, along with, *Cladonia phyllophora* NT (NS) and *Cladonia subcervicornis*.

- **Acres Down** (SU268092 to SU269 089): a sizable area of short grazed heath, with a good general lichen assemblage. A notable feature was large patches of *Icmadophila ericetorum* on level ground, an unusual habitat for the Forest.

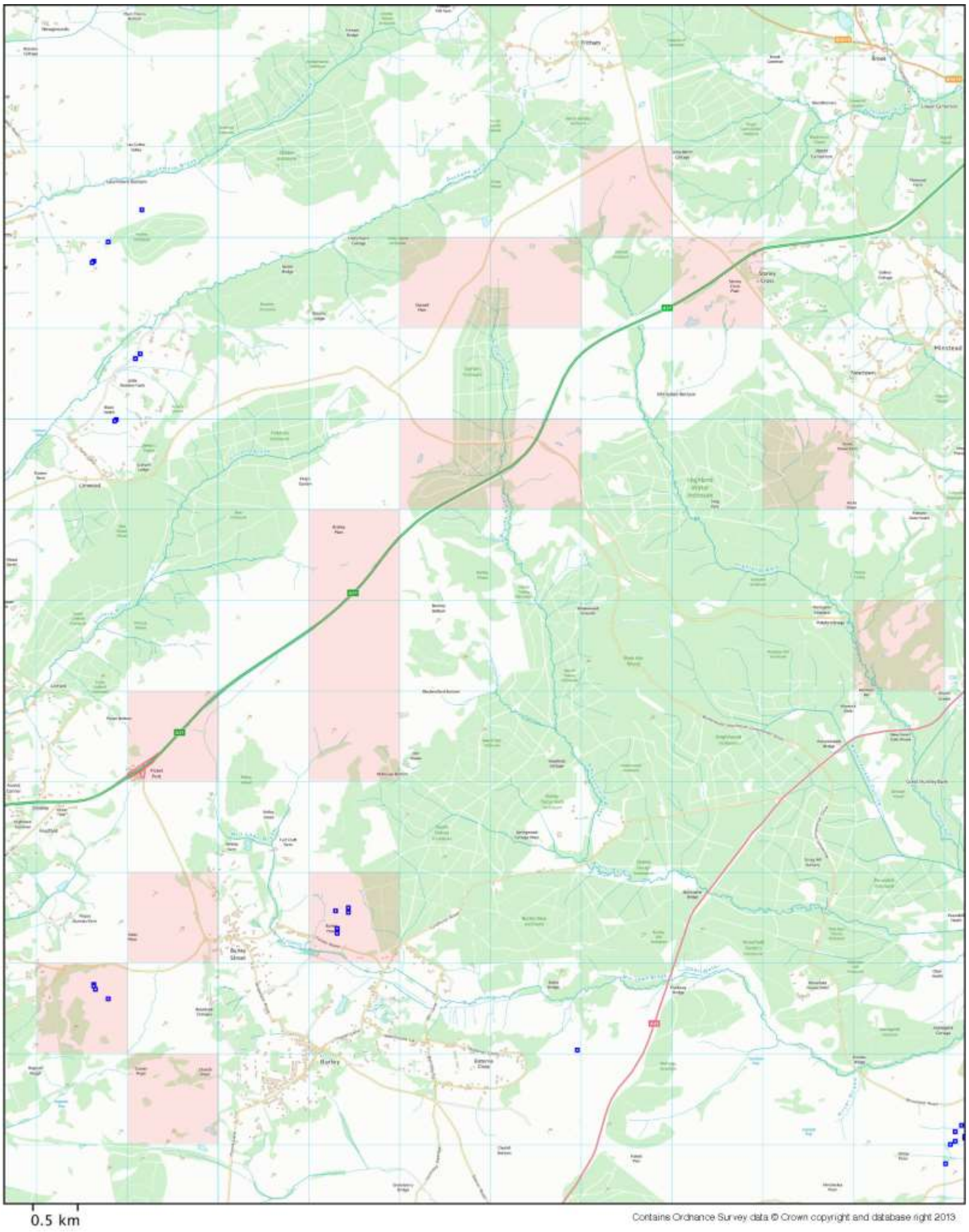
- **Stonycross Airfield** (SU2412 to SU2311): large areas of concrete enrich ground, but wetter than Beaulieu Airfield, so less rich but included *Agonimia globulifera* Nb (NS) and *Cladonia cariosa* Nb (NS). There are some good short grazed heaths on the edge of the airfield (SU245 121 & SU244 121) with *Cladonia arbuscula* subsp. *squarrosa*, *Cladonia glauca* and *Cladonia gracilis*.

MAP 50
Localised records of Species of Interest in the Central Heaths



Pink shaded squares = systematically surveyed 1km squares in the Central Heaths.

MAP 51
Records of *Cladonia zopfii* Nb (NS) in the Central Heaths



Pink shaded squares = systematically surveyed 1km squares in the Central Heaths.
Adjacent records of *C. zopfii* from the South Western & North Western Heaths added for completeness.

3.4.7 North Western Heaths

The largest single block of lowland heathland remaining in England, stretching 11km unbroken north to south and 10km east to west, although with some internal bands of woodland in the latter direction. Dominated by dissected high gravel terraces with sands and clays of the Bracklesham Group on slopes but these are often buried by deep head deposits except on more eroded upper parts of slopes. Grazing pressure very varied with extensive hard grazed heaths with short swards about Ogden's and Linwood with smaller areas about Fritham but rather lightly grazed on the more extensive gravel plateaus with taller control-burned heathlands dominating. Localised WWII disturbances occurred when the north western area was used as a bombing range.

The 2011 – 15 New Forest Heathland Lichen Survey surveyed 22 1km squares systematically and a further four had some records recorded from them. A total of 111 taxa were recorded with a CCP Index score of 47. The systematically recorded 1km squares ranged from 14 to 48 taxa and averaged 28.6 while the CCP Index scores ranged from 13 to 35 and averaged 19.7 for systematically surveyed squares. The full species lists are given in **Species List 5**, **Annex 5**. One Critically Endangered, three Near Threatened species and nine Notable species were recorded, giving a RDB/Nb score of 950.

Like the Central Heaths meta-site, this area has marked grazing gradients from well grazed areas around Ogden's Purlieu and around Fritham to the north western plateaus, which are lightly grazed. The short heaths around Ogden's Purlieu, extending from Black Heath to Hyde Common, are particularly spectacular. There are extensive areas with *Cladonia arbuscula*, with rare species present including two colonies of the very rare *Cladonia mediterranea* CR (NR/S41) along with species such as *Cladonia zopfii* Nb (NS), a single patch of the northern *Cladonia sulphurina* and the moss *Dicranum spurium* VU (NS/S41). There are large hollow way complexes within this area, supporting species such as *Icmadophila ericetorum*, *Cladonia incrassata* Nb (NS), *Cladonia callosa* Nb (NS), *Cladonia glauca*, *Cladonia phyllophora* NT (NS) and *Cladonia rei* NT (NR). Other areas of short grazed heath occur north of Fritham, where *Cladonia zopfii* Nb (NS) reappears and Hale Purlieu, where a new colony of the moss *Dicranum spurium* VU (NS/S41) was found.

Into the core of the area are extensive areas of lightly grazed heath distant from the settlements. These have very large areas of low interest, especially in the seasonally wet centres of the plateaus. The slopes down from the plateaus are richer, but less so than the slopes in the rest of the Forest. There are also fewer disturbed areas, such as hollow ways or extensive WWII disturbance to add diversity. The interior of the North Western meta-site lacks many of the New Forest specialist lichens and is noticeably poorer than areas to the south and east.

Off the Forest grazings is a spectacular stand of lichen sand grassland (U1a) developed on sand infilling an old pit in the Blashford gravel pits was also surveyed. This was very different from the standard assemblages of the New Forest, with frequent *Leptogium palmatum* NT (NS) and species rare on the open Forest such as *Diploschistes muscorum*.

The localised records for species of interest are mapped on **Map 52**. Areas of high interest visited during the survey are:

- **Blashford** (SU152080): an exceptionally lichen rich parched acid grassland developed in sand dumped in a gravel pit 1992. This has a very different lichen assemblage from the open Forest. The site included *Cladonia foliacea*, *Cladonia cariosa* Nb (NS), *Diploschistes muscorum* and *Leptogium palmatum* NT (NS), in the largest known population in lowland England.

- **Black Heath and Black Barrow** (SU1809, SU1810 & 1910): an extensive area of short grazed heath, long known as being of lichen interest. This supports large populations *Cladonia arbuscula*, along with species such as *Cladonia zopfii* Nb (NS) and *Icmadophila ericetorum* on path ruts.

- **Ogden's Purlieu** (SU1811 & SU1812): one of the richest areas of heath for lichens in the New Forest, previously unknown before the 2011 – 15 survey, the interest is described in the text above. Consist of an extensive area of short grazed lichen rich heath with a very large old hollow way system cutting through it.

- **Hyde Common** (SU1712): another area of short grazed heath on the upper parts of a terrace slope, which includes *Cladonia arbuscula* (SU176 125, SU175 126 & SU174 126) and *Cladonia zopfii* Nb (NS) (SU175 125). Acid grassland near the pond by the car park supported the rare *Leptogium palmatum* NT (NS) (SU177 128).

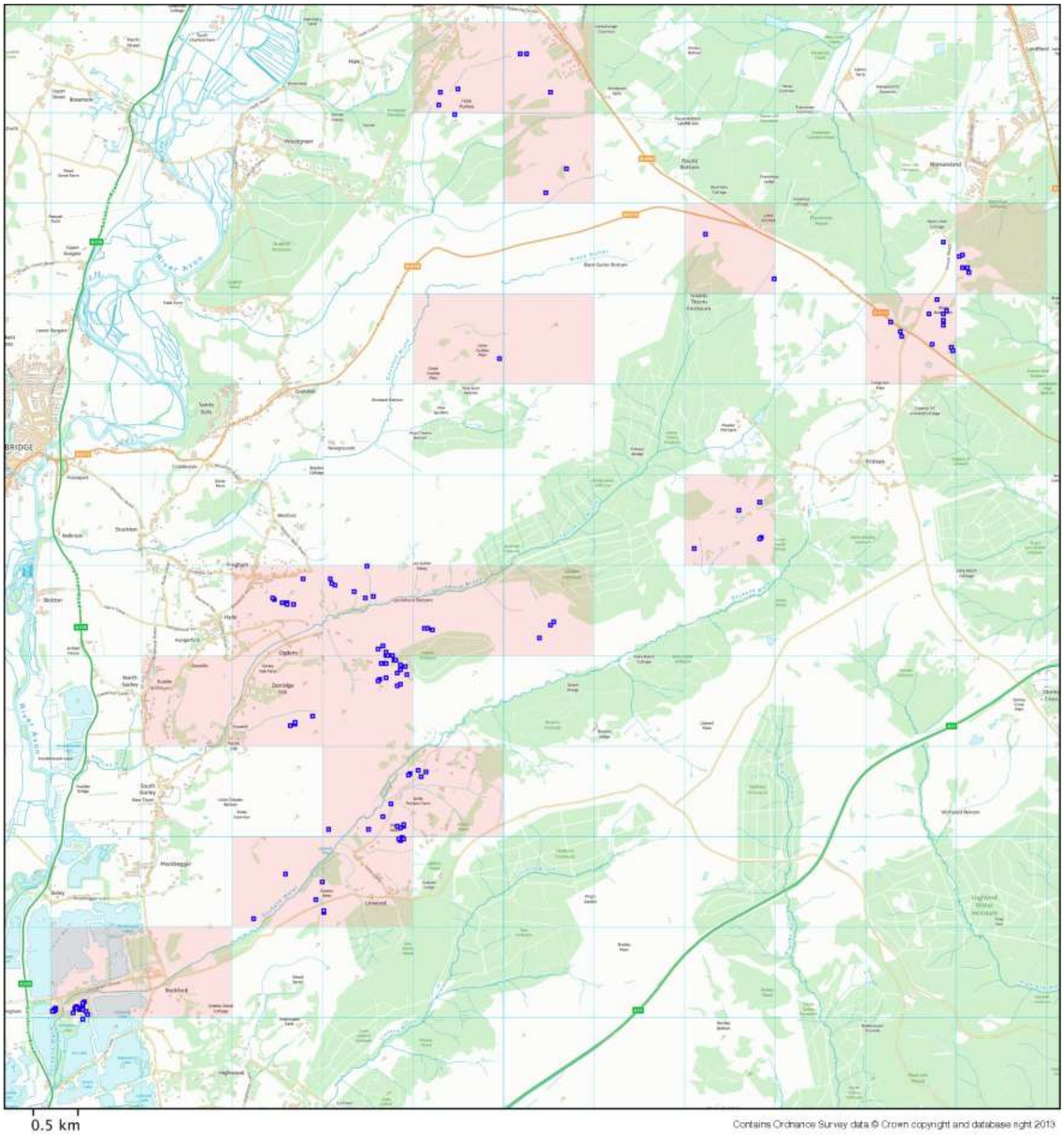
- **Gorley Common** (SU1611): the floor of a modern gravel pit, with relic short grazed heath on the side of the terrace. Unusual in that the strongly dispersal limited *Cladonia arbuscula* is recolonising into lichen rich grassland (U1a) on the quarry floor.

- **Fritham Plain** (SU2213): area of short grazed heath on a high terrace, not outstanding compared to short grazed heath on the lower Tertiary slopes. Does include a rare occurrence of *Cladonia arbuscula* ssp *squarrosa* on the high terraces (SU228 135).

- **Piper Wait to Longcross Plain** (SU2415 & SU2516): similar to Fritham Plain, suggesting that short grazed heath may be inherently poorer on the high terraces. There is some *Cladonia arbuscula* ssp *squarrosa* (SU243 155) on Longcross Plain and a very large spread of *Cladonia zopfii* Nb (NS) (SU250 163 & SU251 163) at Piper Wait in the base of an old gravel pit. The latter may be the 1911 Livens (Coppins, 1978) location for this species.

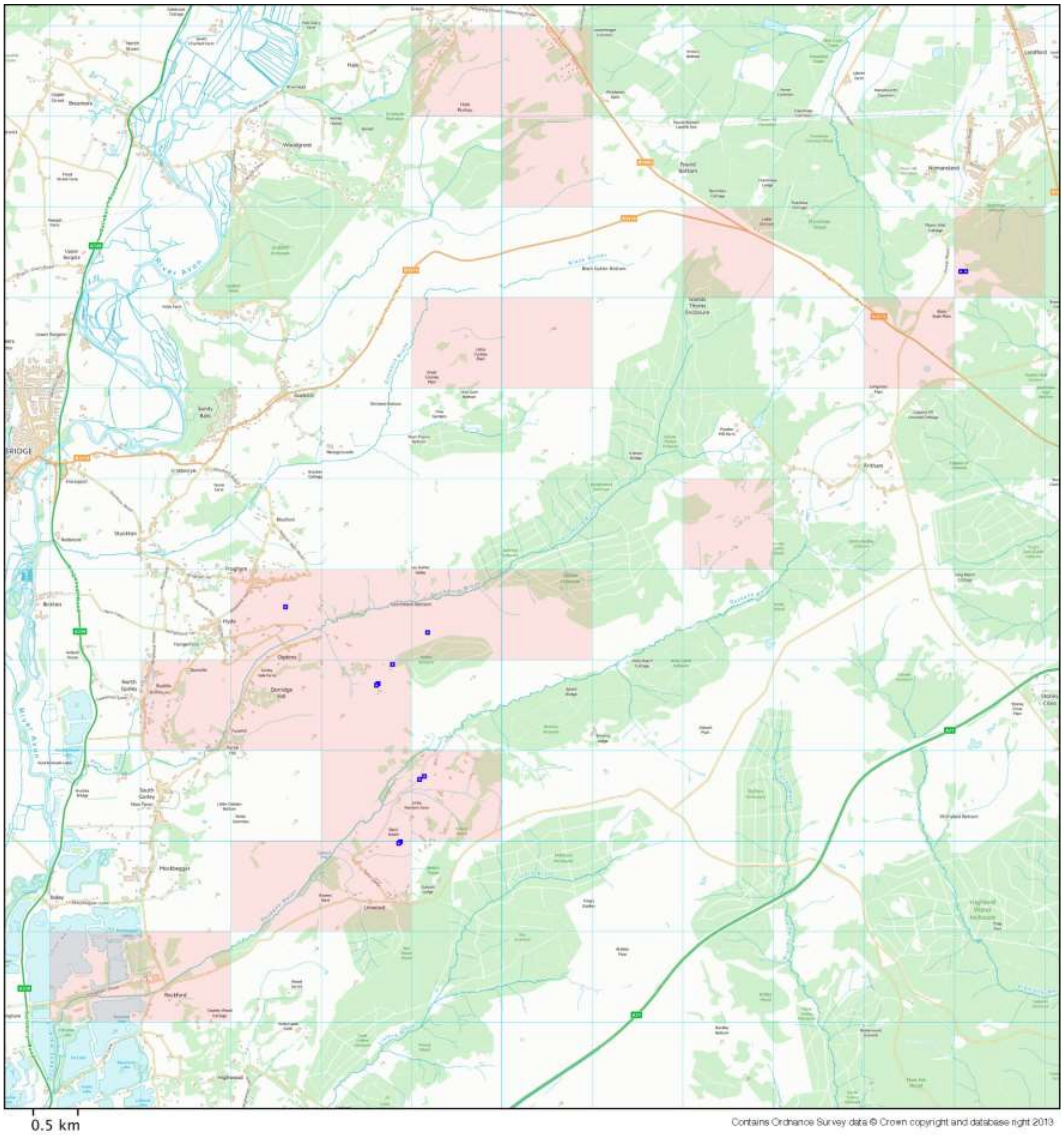
- **Hale Purlieu** (SU193 182): an area suggested to the author as being of interest in the late 1990s by Diana Westerhoff but not looked at until 2015. Provides an interesting transect across a species poor high terrace to lichen rich terrace slopes. On the terrace there is very low lichen diversity, except where there are shallow hollow ways. Here species such as *Cladonia callosa* Nb (NS) and *Cladonia rei* NT (NR) provide very local interest. On the terrace slopes there are moderately browsed heaths and short grazed heaths and lichen rich with species such as *Cladonia strepsilis*, *Cladonia verticillata*, *Cladonia incrassata* Nb (NS), *Cladonia ciliata* var. *ciliata*, *Cladonia ciliata* var. *tenuis* and *Pycnothelia papillaria* appearing along with *Dicranum spurium* VU (NS/S41).

MAP 52
Localised records of Species of Interest in the North Western Heaths



Pink shaded squares = systematically surveyed 1km squares in the North Western Heaths.

MAP 53
Records of *Cladonia zopfii* Nb (NS) in the North Western Heaths



Pink shaded squares = systematically surveyed 1km squares in the North Western Heaths.

4.0 DISCUSSION

4.1 Introduction

The results of the New Forest Heathland Lichen Survey are discussed in relation to environmental variables, habitats, land use and other heathlands in section 4.2. The nature conservation value of the New Forest heathland lichen assemblage is discussed in section 4.3 and the relation between lichen diversity and New Forest heathland management in section 4.4.

4.2 The New Forest Heathland Lichen Survey

4.2.1 Comparison with Old Records

A single significant historic record remains unfound; *Rinodina aspersa* NT (NR), on pebbles, Lyndhurst Moor, collected by the Rev. J. M. Crombie 1906 (Sandell & Rose, 1996). It may still exist on the Forest as it is a sterile species that is easily overlooked unless already well known by the surveyor, or it is frequent on a site. Two other historic records were both recorded again during the 2011 – 15 survey: *Cladonia zopfii* Nb (NS), collected previously once near Bramshaw Wood, H. M. Livens, 1911 (Coppins, 1978) and *Leptogium palmatum* NT (NS), previously collected near Stoney Cross, E M Holmes, 1930 (Sandell & Rose, 1996).

The majority of the sites looked at in the 1980 and early 1990s by Dr Francis Rose and Neil A Sanderson were included within the 2011 – 15 survey. In the main, nearly all the species were recorded previously were refound, along with many additional species added. Issues with evolving concepts of species within *Cladonia* make exact comparisons impossible. However, for more obvious species a few losses were recorded. Francis Rose recorded *Cladonia arbuscula* ssp. *squarrosa* from three locations where it was not refound in 2011 – 15: SU3000 Setley Common N., SU2107 Backley Plain and SU2609 Acres Down (**Map 8**). The latter has highly suitable short grazed heath, so it was surprising not to refind it; the record may therefore be erroneous. Backley Plain is never likely to have had much of this species but it could have occurred in a bog edge location, wild fires have occurred in this area, which could account for the loss. The SU3000 Setley Common N. record was from the Roydon Woods NR and the heathland was long ungrazed; again likely to account for the loss.

From Sanderson (1997) all significant records except *Cladonia incrassata* Nb (NS) (**Map 19**) were refound from Hyde Common. The seepage step bank this grew on appeared to have become overgrown by Bramble. From Gorely Common *Cladonia incrassata* Nb (NS) and Heathtooth *Pycnothelia papillaria* (**Map 37**) were not refound. The former had probably also been lost to Bramble growth over a seepage step bank. The latter was a small population on a fragment of unquarried ground. In contrast, at Gorley Common *Cladonia arbuscula* ssp. *squarrosa* had considerably increased within the acid grassland and was recolonising the quarry floor here.

Other recorded losses included *Cladonia foliacea* (**Map 15**), seen in the early 1990s on the edges of the abandoned railway in SU2101 Holmsley. The increased recreational use of the old railway track has eliminated the fringe of parched acid grassland (U1d/f) that used to occur along the edge of the track. Finally *Cladonia cariosa* (**Map 10**) was recorded from the edge of the ripped up runway at Plain Heath at SZ220992

in 1998. In 2015 it was found that in this section of the ripped up runway, the open edge habitat was more grassy and partly over gown by thorny scrub. *Cladonia cariosa* is an early succession disturbance dependant species that is typically lost from sites as they mature.

These losses are very minor compared to the losses recorded in areas such as the Sussex Greensand heaths (Rose, 1992, Sanderson, 1995 & Cox et al, 2015).

4.2.2 Habitat Assemblages – Dry Heaths within the Burning Rotation

Sanderson (1996) described the relation between controlled heath burning and lichen diversity. These observations have been confirmed by the random sampling of the New Forest Quantitative Inventory. Two factors appear to link most lichen rich heaths:

- Low soil productivity, this prevents a significant grass sward forming.
- Long-lasting gaps in the heather canopies that allow light demanding lichens to survive.

The first is inherent in the soil; the second is very much a feature created by management. It is the development of dense tall heather stands in protected but neglected West Sussex heaths such as Lavington Common which have led to the crashes in lichen species diversity observed by Rose (1992). Here a rich and diverse lichen flora has been replaced by one with little other than *Cladonia portentosa* and *Cladonia chlorophaea* s. lat. present. This decline was latter repeated on Ambersham Common (Sanderson, 1995 & Cox et al, 2015). The "Air Pollution Information System" website gives the local modelled ammonia deposition in this area of Sussex as, 0.89 μg m^3 in 2010 – 2012, well below the critical level calculated from observational data in the Netherlands of 7 μg m^3 (Sparrius, 2011). There appears to be no reason to invoke pollution by nitrogen deposition (rather than simple habitat neglect to account for this decline in lichen diversity; it occurs in areas of low nitrogen deposition. Raised nitrogen deposition could, however, exacerbate the decline in other areas.

Most of the heather stands in the New Forest require controlled burning if a balanced structure is to be maintained; an average rotation length of 25 years is aimed for (Westerhoff, 1992). It is important to separate the effects of controlled burning from those of wild fire. The latter typically occurs in summer and sterilises the soil. Here lichen regeneration appears to occur by colonisation from beyond the burnt area and has been shown to take about 13 years (Coppins & Shimwell, 1971). With controlled burning, the lower layers of compacted humus are unburned and survive with an intact propagule bank. In the latter circumstances, the pattern of lichen regeneration is much more rapid. The most striking example is *Cladonia strepsilis*. The thallus of this species has been frequently observed to survive controlled burns intact but totally bleached and apparently dead, only to produce abundant new growth of green squamules by the first spring after the burn. *Cladonia portentosa* can occasionally do this as well. The thalli of other species do not normally survive burns, but abundant regrowth of new squamules from bare humus is normally seen in the second spring after a burn. Exactly what these squamules regenerate from is not at all clear. Looking closely with a lens suggest that they may be regenerating from fungal hyphae in the soil. These certainly could not survive hot fires. Many

other species can survive controlled fires in small scale fire refuges where there are larger canopy brakes; as larger glades or along paths. Some moderately fire sensitive species such as *Cladonia uncialis* are confined to this habitat within the burned heaths.

In the first summer after a spring fire both *Calluna* and *Erica* species regenerate; the *Calluna* mostly as coppice regrowth from existing root stocks, the *Erica* species largely as seedlings. Any grass and the *Calluna* are grazed heavily in the first few years but the *Erica* species are not. Heather regeneration is patchy and many small bare patches appear that are the locus of the lichen regeneration. The lichens appear to take about five seasons to fully develop and achieve high ground cover. During this period, however, the gaps can be lost to heather seedlings. *Calluna* flowers in the second summer after the burn and in the third spring masses of *Calluna* seedlings can be found. Potentially this seedling regeneration could close up existing gaps, but usually the gaps remain; most of the seedlings dying, apparently mainly from drought. Casual observations suggest that such persistent gaps are rare in the uplands in wetter climates.

New gaps in the heather cover are also created in the pioneer phase by the parasitic plant dodder *Cuscuta epithymum*. This frequently kills off patches of young *Calluna* at this stage.

If the gaps remain open until the *Cladonia* dominates, then further seedling establishment does not occur, possibly due to an allelopathic effect on *Calluna* seeds from chemicals produced by the *Cladonia* (Hobbs, 1985). The lichens probably also probably simply physically excluding the seedlings. From this stage on, only the shade from the growth of adjacent heather bushes can destroy the lichen dominated patches. If the ageing of the heather is slowed by grazing, then the gaps will survive longer and the lichen flora become better developed, but all such lichen rich stands will eventually be shaded out. The occurrence of lichen rich heathland beyond the heavily grazed prostrate heaths, therefore, is a relatively temporary phenomenon. Lichen rich patches develop where the effects of burning, grazing and climate combine to allow the survival of canopy gaps in the heather for a decade or more but most patches are probably lost after about twenty or so years. Overall on large managed heathlands such as the New Forest lichen rich patches are normally developing in one area, as they are lost in another.

The long length of the burning rotation in comparison to most upland Grouse moors is probably significant; these grouse moors are burned on roughly a 10 year or so cycle and here the regular controlled fire appears to impoverish the lichen assemblages (B. Coppins, pers. com.).

Revisits to sites recorded in the early 1990s and during this project, however, suggest that favourable locations for lichen diversity are actually quite fixed in the landscape but reappear at suitable stages in the burning cycle. An example was seen in SU3906 & SU3806 Dibden, which was control-burned shortly after the lichen assemblage was recorded in 1991 and then resurveyed twenty years later in 2011. It was still lichen rich in the more heavily browsed areas in 2011 but was then control-burned again shortly after the resurvey. Doubtless it will once more be lichen rich in a few years.

The richest burned sites show a strong association with certain positions within the landscape; mainly those areas with low productivity soils that are not prone to very long periods of surface water ponding. Lichen rich patches are typically found on slopes with thin or no head deposits (redeposited periglacial eroded material including much brick earth) or nearer plateau edges. The interiors of the plateaus are prone to winter surface flooding, even where this surface ponding is not sufficient to create wet heath. The northern higher terraces are wetter than the low terraces in the south. The interiors of the terraces also seem to retain deeper layers of more fertile brick earth (deposits formed of fine windblown periglacial dust) producing more vigorous heath with fewer canopy gaps and more grass. Stands of more fertile heath with Common Gorse or Bracken are invariably lichen poor. The edges of plateaus are drier and the brick earth mostly washed down slope at these locations. The richest areas for lichens on slopes are usually the upper sections of ground sloping away from terraces, especially above any spring lines. The head deposits have usually been eroded off these higher slopes exposing raw gravel. In the south of the Forest, and in the Northern Commons, there are extensive areas of rolling heathland with large areas of Tertiary sands and clays exposed with thin or no superficial deposits. Lichen rich heaths are widespread in these areas where very low productivity soils occur more frequently.

The degree of browsing may partly determine how long gaps remain open and lichen rich in the lighter grazed heaths. There are certainly clear browsing impacts in very rich transitional stands close to short grazed heaths. These are browsed quite short but grow up enough to be occasionally controlled burned. The lower biomass means the fire temperatures are likely to be relatively low. A very rich example of this habitat occurs north east of Boltons Bench (SU3108 White Moor). The New Forest Quantitative Inventory, however, did not find the effect of browsing as marked as the impact of burning or sward height. The absence of grazing nevertheless does have a large impact, however, as can be seen on some heathlands outside of the Forest grazings looked at by the New Forest Lichen Survey. In particular grazing effectively suppresses Moorgrass *Molinia caerulea* across the Forest grazings, even in the mostly lightly grazed areas. Off the Forest, *Molinia* growth is clearly a significant negative factor in suppressing lichen diversity. This can be seen in the ungrazed and unburned Forest fringe heaths looked at SZ1995 Burton Common and Copythorne Common east (SU3115 Copythorne W & E) (See **Section 4.2.11** for more detail).

The open areas in heaths within the burning cycle have a distinctive assemblage of lichens. Typically present are *Cladonia portentosa*, *Cladonia floerkeana*, *Cladonia crispata* var. *cetrariiformis*, *Cladonia diversa* (or *Cladonia coccifera* s. str. [NS] in rich areas) and *Cladonia squamosa* var. *subsquamosa* (heathland morph). More localised but typical of burned heaths are *Cladonia ciliata* var. *ciliata*, *Pycnothelia papillaria*, *Cladonia strepsilis*, *Placynthiella icmalea*, *Cladonia verticillata*, *Cladonia subcervicornis*, *Cladonia callosa* Nb (NS), *Cetraria muricata*, *Micarea lignaria* var. *lignaria*, *Micarea leprosula* and *Micarea peliocarpa*. Other species typical of banks can occur, especially on drier heaths and slight ridges such as *Cladonia cryptochlorophaea* [NS] and *Cladonia macilenta*. Some more burn-sensitive species such as *Cladonia uncialis* ssp. *biuncialis* and *Cetraria aculeata* occur but usually in small fire refuges, such as along paths or areas with thin heather growth. The rare moss *Dicranum spurium* VU (NS/S41) can survive controlled fires in relative highly browsed heather but is absent from taller burned

heaths. Other highly fire sensitive species, especially *Cladonia arbuscula* ssp. *squarrosa* are totally absent from control-burned areas of dry heath.

There is a transition from the driest dry heaths (H2a & H3c) through to damper humid dry heaths (H2c & H3a). At the dry end Reindeer Mosses tend to be more prominent with smaller species predominating into wetter dry heaths.

Comparison with Heather Mowing: as noted by Sanderson (1996) some heather mowing is carried out within the New Forest where burning is not possible and to provide heather bales. It is, however, much less satisfactory than burning for promoting lichen diversity. Even if the smothering cut litter is removed, the previously accumulated litter and the shade bearing robust dominants such as the moss *Hypnum jutlandicum* are not. Without the removal of these, there will be no hard bare black humus for lichen rich vegetation to regenerate on. Beyond lichen diversity, *Erica* species fail to regenerate from seed in mown stands and are also largely eliminated by competition in older heather stands. A regime of mowing only will tend to eliminate *Erica* species entirely from heather stands over time, with serious implications for biodiversity reaching far beyond lichens.

Comparison with Wild Fire: there is a great deal of confusion between wild fire and controlled burning. The few wild fires arising in damper conditions in spring are indistinguishable in their impact from controlled burning, other than scale. Later wild fires, especially if they occur after long dry periods are very different. These burn deep into the hard old humus and can burn right down to the mineral soil. Many species that regenerate immediately after a cool controlled fire do not survive hot wild fires and clearly have to recolonise in, if they are able to at all. Hot wild fires do reduce the lichen diversity in the short term and are likely to eliminate more sensitive species. In unmanaged heaths, however, the sites of hot wild fires may, after about 15 to 20 years, be the only areas with any lichen diversity at all.

Unmanaged Dry Heath: there is a widely held theory that if heathlands are left unmanaged, then stable steady-state stands will eventually result, with young Heather *Calluna vulgaris* regenerating in gaps in senescent heaths – without the need for management by burning or mowing. This seems to be driven by an assumption (rather than any scientific evidence) that fire is bad and that there must be a better way of managing heaths. Observations suggest that regeneration can indeed result from non-intervention at a small scale. It can be seen in Heather stands over 20 years old on the New Forest. The gaps created, however, are choked with deep litter and any recolonising lichen diversity is low. Only the common robust *Cladonia portentosa* and some smaller woodland epiphytic species appear in the New Forest. The results of the New Forest Quantitative Inventory strongly support these observations, with a statistically highly significant decline in lichen diversity in Heather stands over 20 years old. These results match those recorded by recent studies in upland moorland (Davies, 2001, Davies & Legg, 2008 & Harris et al, 2011). As well as having a very low lichen diversity such senescent heaths are vulnerable to tree invasion and their higher biomass makes them more susceptible to damaging hot wild fires. Old heather stands are likely to be of value to locally maintaining other species of conservation interest, and are likely to be of value as a minor part of heathland management. However, if applied widely across a site or sites, a no burning/mowing policy would result in an impoverishment of the lichen diversity.

Photographs: dry heaths within the burning rotation

Photo 2013-06-21-03: Holm Hill & Duckhole Bog (SU2502). A landscape of mostly mature dry heath within the burning cycle but all quite late in the cycle. The plateau in the foreground, and to the right, has relatively fertile soils, with bracken in the heather. This has no surviving canopy gaps and lacks surviving lichens. The slope beyond is more eroded and has pure heather on more infertile soils. This stand did still have lichen interest in some surviving gaps. The lower slopes are of fertile head deposits and support herb rich Bracken and acid grasslands without any lichens.

Photo 2011-10-02-03: Brogenslade Bottom, (SU1711): pioneer heath regrowing after a controlled burn. The pale patch on the bank is *Cladonia incrassata* Nb (NS), which had survived the burn, if somewhat scorched, in its protected position and was regrowing.

Photo 2012-06-30-20: The Ridge, east of Lyndhurst (SU3107). An area of recently control-burned humid dry heath (H2c). The surface has been cleared of loose litter and late succession weft forming mosses. The pale mounds are mounds of the moss *Leucobryum glauca*, which generally survive these burns and regrows. By 2015, not only had the *Leucobryum* hummocks begun to regrow, some regeneration of the declining moss *Dicranum spurium* VU (NS/S41) was found. This declining moss is said to be fire sensitive but survives cool burns in the Forest.

Photo 2013-06-21-14: Holm Hill (SU2502) (Wessex Lichen Group meeting). An area of plateau heath (H2c) mown recently for heather bales. In contrast to the burned heathland above, there is a deep layer of loose litter and common weft-forming mosses smothering the surface. This inhibits the regrowth of early succession lichens and rare mosses.

Photo 2013-09-22-02: The Ridge, east of Lyndhurst (SU3107). A close up of a recently burned heath (H2c), showing a regenerating cushion of the declining moss *Dicranum spurium* VU (NS/S41) and areas of hard black humus cleared of litter. The declining hard humus specialist lichen Heathtooth *Pycnothelia papillaria* was regenerating nearby.

Photo 2013-06-21-15: Holm Hill (SU2502) (Wessex Lichen Group meeting). A close up of recently mown heath (H2c), showing surviving weft mosses (*Hypnum jutlandicum*) and loose brown fibrous humus. This is a poor environment for lichen regeneration.

Photo 2011-09-05-02: by Mallard Wood SU3109). A magnificent *Dicranum spurium* VU (NS/S41) hummock in humid dry heath (H2c), which shows scars from a previous burn.

Photo 2012-05-17-02: by Mallard Wood SU3109). A year later this *Dicranum spurium* VU (NS/S41) hummock was subject to another controlled burn. By 2014 the hummock had recovered but was showing more burn scars. This supposed burn-sensitive moss has survived at least two controlled burns at this location.

Photo 2012-07-14-25: Dibden Bottom (SU3806). Young squamules of *Cladonia subcervicornis* (blueish) with some *Cladonia strepsilis* (more green, bottom left of clump) regenerating on hard black humus after a controlled burn in wet humid heath (H2c)

Photo 2012-08-25-21: Beaulieu Heath West (SU3500). A glade maintained in maturing control-burned heath (H2c), with strong growths of Heathtooth *Pycnothelia papillaria* and *Cladonia squamosa* var. *subsquamosa* (heathland morph) on hard black humus.

Photo 2011-08-04-06: White Moor, north east of Boltons Bench. A glade maintained in mature burned heath (H2c), the Spinyheath *Cetraria muricata* in a rich assemblage.

Photo 2011-08-04-04: White Moor, north east of Boltons Bench. A glade maintained in mature burned heath (H2c), the black apothecia of *Micarea lignaria* var. *lignaria* on humus.

Photo 2014-01-11-09: Harvest Slade Bottom (SU2106). A mature growth of *Cladonia verticillata* in an old control-burned heath (H2c) where the canopy gaps are beginning to close.

Photo 2014-03-05-03: Yew Tree Heath (SU3606). A large glade on the side of a tumulus in controlled burn dry heath (H2c), with a quite baroque proliferating *Cladonia cryptochlorophaea* [NS] (confirmed by TLC) growing among the moss *Polytrichum piliferum*, a species of dry low productivity soils.

4.2.3 Habitat Assemblages – Wet Heath Transition and Mires

Wet heaths are generally poor in lichens, as recorded by the random sampling of the New Forest Quantitative Inventory. Very locally, however, a very specialised version of the control-burned heath lichen assemblage is found in the transition from wet humid dry heath (H2c) into wet heath (M16a). This occurs where the Bog Mosses are not frequent in the higher parts of wet heaths. Within this habitat *Pycnothelia papillaria*, *Cladonia strepsilis*, *Cladonia verticillata*, *Cladonia subcervicornis* and *Cladonia callosa* Nb (NS) are typically more abundant than in the drier heath above. Very characteristic but very local is *Cladonia zopfii* Nb (NS). Some burn-sensitive species become more widespread including *Cladonia uncialis* ssp. *biuncialis* and even occasionally the very sensitive *Cladonia arbuscula* ssp. *squarrosa*. At one location (SZ2599 Wootton Bridge) the very rare *Cladonia mediterranea* CR (NR/S41) was found in this habitat. These species presumably experience cooler burn temperatures due to the wet soil of the wet heaths than in the humid dry heath.

Very occasionally the Reindeer Mosses also extend onto hummocks within valley mires (M21a), including *Cladonia ciliata* var. *ciliata*, *Cladonia ciliata* var. *tenuis* and *Cladonia arbuscula* ssp. *squarrosa*.

Photographs: wet heaths and mires.

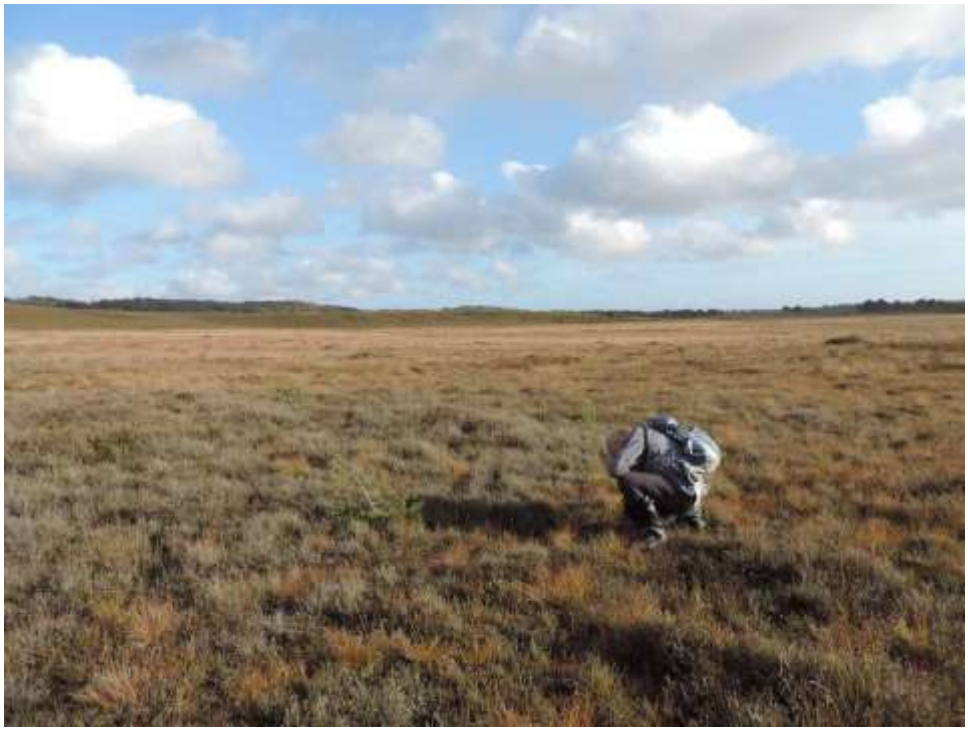


Photo 2014-10-19-23: Strodgemoor (SU0803). Lichen rich open low productivity wet heath (M16a), an island of drier ground with the valley mire (M21a), with Andy Cross photographing a lichen. In heathland within the burning cycle.

Photo 2014-10-19-22: Strodgemoor (SU0803). *Cladonia verticillata* with *Pycnothelia papillaria* in lichen rich open low productivity wet heath (M16a) pictured above.

Photo 2015-01-03-02: Wootton Bridge (SZ2599). Extensive wet heath with patchy lichen interest. In heathland within the burning cycle.

Photo 2015-01-03-01: a thallus of *Cladonia zopfii* Nb (NS), well into the wet heath, located in the foreground in the above photograph.

Photo 2013-12-01-05: Burley Moor (SU2104). Open low productivity heath in the transition from humid dry heath (H2c) to wet heath (M16a), with a very rich lichen assemblage, dominated by *Cladonia crispata*, with *Cladonia portentosa*, *Cladonia uncialis*, *Cladonia zopfii* Nb (NS) and *Cladonia coccifera* s. lat. In heathland within the burning cycle.

Photo 2011-12-22-01: Plaitford Common (SU2718). A fine clump of *Cladonia zopfii* Nb (NS) on the junction between humid dry heath (H2c) and wet heath (M16a), in short grazed heathland.

Photo 2013-12-22-23: Beaulieu Heath east (SU4004). A patch of *Cladonia strepsilis* in an open patch in wet heath (M16a). This is a frequent species at the outer limit of lichen growth within wet heaths.

Photo 2014-01-03-02: east of Matley Wood (SU3307). *Cladonia arbuscula* in short grazed wet heath (M16a) adjacent to ancient woodland. Here the wet heath is too short to burn, but this fire sensitive species does occasionally survive in burned wet heath, but never in burned dry heath.

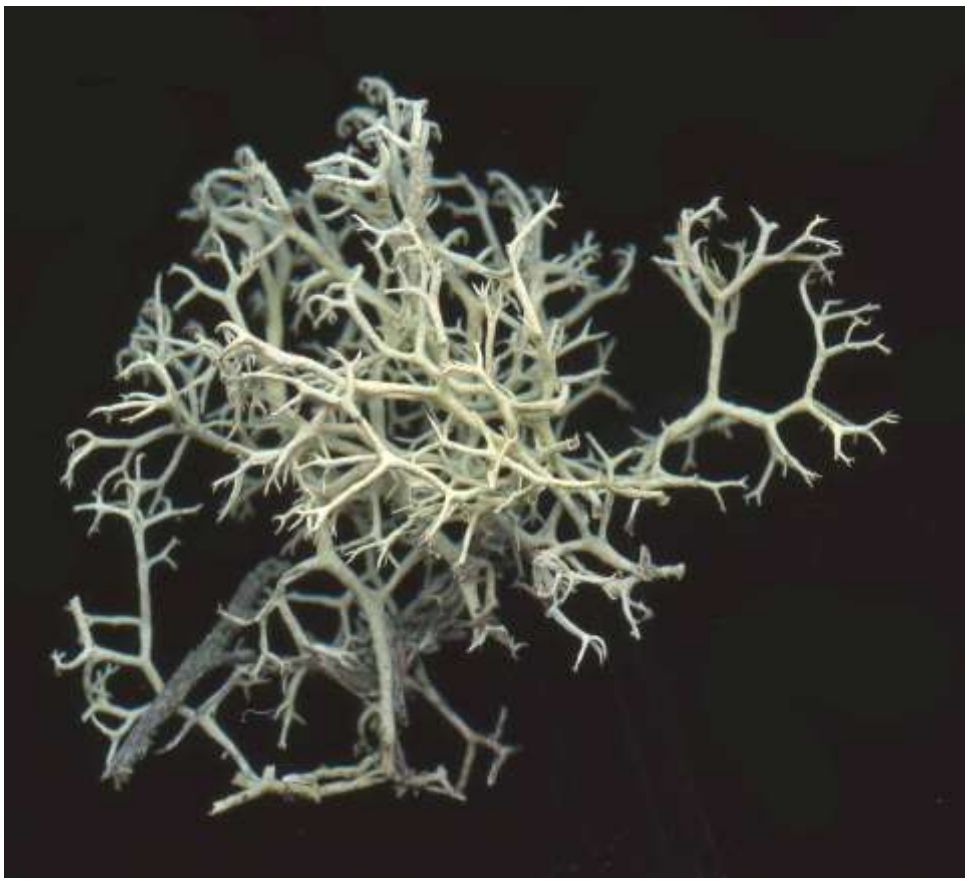


Photo 2015-01-30-03: Wootton Bridge (SZ2599). A scan of *Cladonia mediterranea* CR (NR/S41) collected from a sizable patch transition from humid dry heath (H2c) to wet heath (M16a). In heathland within the burning cycle.

Photo 2012-10-28-09: Burley Rocks (SU2303). A clump of *Cladonia ciliata* var. *ciliata* on a hummock in a mire (M21a). This is an odd form of *Cladonia ciliata*, in which the tips of the branches are not bent over to one side; it does not appear to have been noted before.

4.2.4 Habitat Assemblages – Short Grazed Dry Heaths

Short grazed dry heaths are a distinctive habitat, which appears to be very rare or extinct outside of the New Forest in southern English heaths. Many such areas are exceptionally lichen rich. The 1986-1988 New Forest vegetation survey found 16% of heather stands were so heavily grazed that the heather was reduced to a prostrate creeping growth form (Westerhoff, 1992), similar to that developed by heather in exposed montane heaths. Pony and cattle grazing does not kill heather and it can survive in this condition for decades, potentially centuries. In fact, many of the large areas of prostrate heather in the Forest have been in this condition for living memory. Aerial photographs from 1946 held by the Lyndhurst office of Forest Enterprise, which show the short heaths at Ogden's Purlieu, Black Heath & Black Barrow (SU1811 Ogdens, SU1810 Black Heath & SU1910 Black Barrow) were examined. These photos show evidence of frequent rabbit warrens in the area, suggesting that they were hard grazed then. The clearer Black Heath & Black Barrow photographs also large areas of definite short grazed heath at the time. As both the nearest areas of small holdings (Ogden's Grounds and Lynwood Grounds) are ancient enclosures, these areas may have been short grazed for centuries. Other areas, however, have probably become suppressed heaths quite recently as grazing patterns shift. On Dorridge Hill (SU1711), west of the Ogden's Purlieu area of short grazed heath increased browsing is reducing long unburned heath to prostrate heath. Similarly other areas of short grazed heath have recently begun to get longer and have been brought into the burning programme. An example of the latter is at part of Faircross (SU3009 Fair Cross). The short grazed heath areas probably have stable cores, with shifting boundaries as grazing patterns and intensities change. These heavily grazed heaths are on a knife edge; a small increase in grazing pressure can begin to damage the heaths. This has happened in parts of the Northern Commons since the 1980s (Sanderson, 2014), but most is now recovering and such incidents are likely to be part of the formation of the short grazed heaths in the past.

These short grazed heaths are kept permanently in the pioneer stage and are very important for species that depend on this stage of heather regrowth such as woodlark. These stands also have much bare ground that remains open for decades; ideal conditions for many lichen species. The level of grazing typically found in these heaths does not adversely affect the lichens, a certain amount of fragmentation of bushy *Cladonia* podetia occurs due to trampling, but this does not kill the lichens.

Within the heathland landscape these short heaths have a very distinct position. They are invariably found where low productivity podzols occur in close proximity with much more fertile soils. The richer grazings produce much higher concentrations of grazing stock on the adjacent low productivity soils than is normally found on these soils. The main areas of short grazed heath are found on the edges of the Forest grazings especially in areas with several adjacent holdings turning out stock. Cattle are probably important in creating and maintaining short heaths as they browse much more on heathers (Tubbs, 2001 & Richard Reeves, pers. com.). The largest areas of short grazed heath found are in the Northern Commons, with 52 ha of continuous lichen rich heath measured in the 1990s in the west of Plaitford Common (Sanderson, 1997 & 2014), which is likely to be the most extensive lichen heath in lowland England. Other extensive areas of lichen rich heath exist in the Northern Commons in Cadnam Common, Furzley Common, Half Moon Common and Black Hill. Beyond the Northern Commons, major similar areas occur

around Fritham (Fritham Plain, Longcross Plain and Janesmoor Plain), from Hyde Common, through Ogden's Purlieu to Black Heath and Black Barrow, north of Burley (Burley Moor), west and south of Brockenhurst and along the eastern edge of Beaulieu heath west.

The habitat also occasionally occurs where acid heath abuts on to ancient pasture woodlands (the Ancient and Ornamental Woods) as around Fair Cross, Rushpole Wood and north and east of Matley Wood.

The grazed heathlands off the open Forest grazings include two sites Copythorne Common west (SU3014 Copythorne W, SU3015 Copythorne W SU3115 & Copythorne W & E) and Badminston Common (SU4501 Badminston Common) which are short grazed lichen rich heaths. The former was long in this condition; the latter has developed in the base of a gravel pit dug into heathland since the 1980s. The third grazed heath off the Forest is Setley Common at Roydon Woods Nature Reserve (SU3000 Setley Common N & part of SZ3099 Race Plain), was long ungrazed, but is now grazed and is evolving areas of short grazed lichen rich heath. Some lichen rich short grazed heath was with *Dicranum spurium* VU (NS/S41) also recorded in Shirley Heath (SZ1999) in 2000 (Sanderson, 2000), but this area was not revisited for the New Forest Heathland Lichen Survey. It appears that, for the smaller areas of heathland off the open Forest, the dry heaths are inherently likely to become heavily grazed due to the relatively tiny areas of land involved compared to the open Forest. To adequately graze the associated grassland and mire communities requires grazing levels that are likely to lead to short grazed heath developing.

The lichen assemblage of short grazed heath is characterised by an abundance of Reindeer Mosses with *Cladonia portentosa* often dominant, but with locally abundant *Cladonia arbuscula* ssp. *squarrosa*, *Cladonia ciliata* var. *ciliata* and *Cladonia ciliata* var. *tenuis* along with sheets of the Heaththorn *Cladonia uncialis* ssp. *biuncialis*. The large population of the latter preferentially support the obligate patristic fungi *Bachmanniomyces uncialicola* [NS]. The very rare *Cladonia mediterranea* CR (NR/S41) occurs in the Ogden's Purlieu area (SU1811 Ogden's & SU1812 Hasley). Other shrubby species include both Spinyheaths *Cetraria aculeata* and *Cetraria muricata* and patchy occurrence of the False Reindeer Moss *Cladonia furcata* ssp *furcata*. The smaller species are less varied than in burned heath and can be sparse in mossier stands. In the most hard-grazed stands more bare ground appears and then smaller lichens can become more prominent. *Cladonia crispata* and *Cladonia squamosa* var. *subsquamosa* (heathland morph) are shared with the burned heaths, but *Cladonia gracilis* and *Cladonia glauca* are more frequent in these heaths. Other species typical of banks can occur, especially on slight ridges such as *Cladonia cryptochlorophaea* [NS], *Cladonia floerkeana Cladonia macilenta* and *Cladonia ramulosa*. In the most trampled areas *Pycnothelia papillaria* and *Cladonia strepsilis* and rarely *Cladonia subcervicornis* reappear. The leafy common epiphytic *Hypogymnia physodes* occurs regularly with *Platismatia glauca* a rare feature of Plaitford Common. In damper areas grading to wet heath (M16a) occasional have patches of *Cladonia zopfii* Nb (NS).

Cladonia arbuscula ssp. *squarrosa*, although very locally abundant has a curiously patchy distribution (**Map 8**). It is almost completely absent from recently grazed down short heaths and is abundant in clearly ancient areas. There are rare

occurrences in mid 20th century quarry floors (SU1608 Rockford & SU1611 Gorley) so it is mobile, but it seems to be a slow colonising species and large populations are an indication of long continuity of hard grazing.

Photographs: short grazed dry heaths.

Photo 2014-02-01-10: Plaitford Common (SU2718). The western side of the common is the largest area of lichen rich short grazed heath in the New Forest. Here with a high cover of Reindeer Mosses in humid dry heath (H2c). Shallow hollow ways from a medieval tack system can be seen to the left. These have more exposed humus and provide niches for smaller lichens.

Photo 2013-11-23-02: Plaitford Common (SU2718). A patch of *Cladonia arbuscula* within the extensive lichen rich short heath. The larger and long established short grazed heaths have

large populations of this species but it is absent from more recent stands. It appears to have a dispersal limited distribution within the New Forest.

Photo 2014-02-15-02: Fields Heath, Blackfield (SU4502). Lichen rich short grazed dry heath) (H2a in grazed quarry floor off the open Forest grazing, probably abandoned in the 1970s. A very rich site but lacks *Cladonia arbuscula*, which is found in older short heaths.

Photo 2014-02-15-06: Fields Heath, Blackfield (SU4502), South Solent NNR. An open stony patch with a remarkable fertile thallus of *Cladonia strepsilis*, with unusually

pale apothecia. The more open and less mossy nature of this recent short grazed heath allows a higher diversity of smaller lichens to occur.

Photo 2011-07-26-02: Cadnam Common west (SU2815). Typical old short grazed heath with a mixed population of *Cladonia arbuscula* and *Cladonia ciliata* var. *ciliata*, with the common moss *Dicranum scoparium* and Heathers. There is little exposed bare hard humus for smaller lichens in these old stands unless there has been some recent disturbance.

Photographs: Reindeer Moss species in short grazed dry heaths.

Photo 2011-08-27-03: Copythorne Common west (SU3015). *Cladonia portentosa*, ubiquitous throughout the heaths.

Photo 2011-09-12-02: Copythorne Common west (SU3015). *Cladonia ciliata* var. *ciliata* (brown), the main form in the burnt heaths, but also in short heaths, here with *Cladonia ciliata* var. *tenuis* (pale grey)

Photo 2011-09-12-02: Copythorne Common west (SU3015). *Cladonia ciliata* var. *tenuis*, less frequent and mainly in short heaths.

Photo 2011-09-12-02: Copythorne (SU3015). *Cladonia arbuscula* with some *Cladonia ciliata* var. *ciliata* (brown and smaller to right), abundant on ancient in short heaths, absent from recent short heaths and burned dry heaths. Does occasionally occur in the transition to wet heath within the burned heaths.

Photo 2011-10-22-11: Ogden's Purlieu (SU1811). *Cladonia mediterranea* CR (NR/S41), very rare in short grazed heath and in the transition to wet heath.

4.2.5 Habitat Assemblages – Banks, Pits and Hollow Ways

Disturbed areas where bare soil or banks have been produced in the past, but there has not been any introduction of nutrients, are a very important habitat for heathland lichens. Many species are most frequent in this habitat or are confined to it. Freshly disturbed areas are poor; some time is needed for colonisation to occur. The speed of colonisation has not been studied but it appears to start within a few years of abandonment and certainly less than 10 years. To develop rich lichen assemblages the open ground needs to remain that way for decades. The disturbance can have very long lasting effects. Bronze Age barrows can very rich assemblages on well lit steep sides and a medieval mill leat across heath from Ober Slade to Queen Bower (SU2803 Ober Slade & SU2804 Ober Slade) provides a local hot spot in otherwise species poor terrace heath.

The types of disturbance that create lichen rich habitats are varied. Natural disturbance includes seepage step banks and the sides of tussocks in wet heath. Seepage step banks are the steep eroding banks found above spring lines on slopes below the terraces. These are still active and bank collapses with fresh exposures were found several times during the survey. Tall wet heath tussocks can also be of interest where well grazed, so letting in light. Abandoned rabbit holes are also occasionally an interesting habitat.

Man made sources of disturbance include prehistoric tumuli to medieval banks, 19th century or older gravels pits, WWII gravel pits and general earth moving and a multitude of track and path erosion. The latter include massive hollow complexes, which potentially have prehistoric origins but were in use until the 19th century. These represent a scale of erosion well in excesses of any modern path erosion and are major topographical features in places. The largest, such as the Salt Way were effectively medieval main roads.

The continual development of paths and tracks is also important in providing fresher exposures for earlier pioneer species. Path erosion comes in two main types; one created primarily by grazing stock and another by human use. The grazing stock produce narrow deep ruts; animals tend to walk nose to tail on narrow paths and erode narrow steep sided slots before abandoning them completely. Humans in contrast, spread out more and erode wider tracks, which they are then more ready to abandon for immediately adjacent tracks. On slopes, as occurred frequently in the past, human tracks are vulnerable to gullying; the beginnings of the formation of new hollow ways. In both cases lichen colonisation occurs after the paths have been abandoned. Slow natural colonisation is important; repairs to erosion damage invariably result in the loss of actual or potential open lichen rich habitat.

The lichen assemblage of banks is distinguished by a high frequency of Heathtails and Pixie Cups compared to intact surfaces, occurring along with the typical smaller species of the undisturbed heaths. *Cladonia macilenta* is an especially characteristic species with *Cladonia* species found almost entirely in this habitat including *Cladonia incrassata*, Nb (NS), *Cladonia grayi* s. str. [NR], *Cladonia polydactyla* var. *polydactyla*, *Cladonia rei* NT (NS) and *Cladonia sulphurina*. The northern species *Icmadophila ericetorum* is almost totally confined to vertical banks. *Cladonia zopfii* Nb (NS) also occurs in undisturbed wet heath transitions, but in dry heath is entirely confined to disturbed areas, especially old quarries and hollow ways, but also on level formerly

bulldozed ground around Beaulieu airfield. Typical species of banks and disturbed heath, also found in other habitats are *Cetraria muricata*, *Cladonia callosa* Nb (NS), *Cladonia cryptochlorophaea* [NS], *Cladonia digitata*, *Cladonia glauca*, *Cladonia phyllophora* NT (NS), *Cladonia ramulosa*, *Cladonia scabriuscula*, *Cladonia subcervicornis*, *Cladonia subulata*, *Cladonia cervicornis* s. str. and *Cladonia furcata* ssp *furcata*. The latter two are markedly more frequent along paths than in undisturbed heath, probably reflecting marginally increased nutrient levels in recently disturbed path edges. *Cladonia parasitica*, a lignum specialist common in the old woods of the Forest is a surprising, if rare occurrence, on vertical humus in hollow ways.

Compacted bases of hollow ways often support *Cladonia strepsilis* and *Pycnothelia papillaria* when mature and *Dibaeis baeomyces* on younger surfaces with *Cladonia callosa* Nb (NS) sometimes abundant in the intermediate stages. Very raw steep faces are often rapidly colonised by sheets of the common *Baeomyces rufus*, which is sometimes colonised by the fungal parasite *Arthrorhaphis grisea* [NR]. Maturing younger banks support a number of crust forming lichens including widespread *Micarea viridileprosa* Nb (NS), *Trapeliopsis granulosa* and *Placynthiella icmalea* along with *Micarea lignaria* var. *lignaria*, *Micarea melaena*, *Micarea prasina* s. lat., *Micarea xanthonica* Nb (NS/IR), a rare oceanic species, *Lepraria incana* s. str. *Placynthiella dasaea*, *Placynthiella oligotropha* Nb (NS), *Placynthiella uliginosa*, *Trapelia obtegens* and *Trapeliopsis glaucolepidea* Nb (NS). *Cladonia callosa* Nb (NS) is also very typical of this habitat.

Banks in more nutrient enriched situations within grassland or Bracken vegetation have more limited assemblages, which include *Cladonia chlorophaea* s. str., *Cladonia coniocraea*, *Cladonia fimbriata*, *Cladonia humilis* and *Cladonia ochrochlora*. Banks heavily shaded by vegetation, or north facing, have a distinctive assemblage of species shared with damp lignum in woodland including *Cladonia polydactyla* var. *polydactyla*, *Cladonia coniocraea*, *Cladonia ochrochlora*, *Lepraria lobificans*, *Lichenomphalia umbellifera* and *Trapeliopsis pseudogranulosa*.

Photographs: lichen habitat created by disturbance.

Google Earth: a very lichen rich short grazed heath at Ogden's Purlieu (SU1811), showing a complex of ancient hollow ways, with a modern active human path system imposed on top. Faint lines of stock tracks are just visible on side of the hill in the north centre. These all contribute significantly to the exceptionally high lichen interest of this area.

Photo 2012-05-19-04: Great Witch, east of Ogden's Purlieu (SU1912). A lichen rich old hollow way, with *Cladonia zopfii* Nb (NS) and *Cladonia subcervicornis*. In heathland within the burning cycle, but the open vegetation on the side is probably a partial fire refuge.

Photo 2012-05-19-01: Great Witch, east of Ogden's Purlieu (SU1912). In the lichen rich hollow way pictured above, with *Cladonia zopfii* Nb (NS) and *Cetrelia muricata*.

Photo 2011-10-15-21: Ogden's Purlieu (SU1811). Fertile *Icmadophila ericetorum* on the side of an old hollow way. *Icmadophila ericetorum* is an upland species, which is now rare and declining outside of the New Forest in England. In short grazed heath.

Photo 2014-01-22-06: The Ridge, east of Boltons Bench (SU3108). A typical bank lichen assemblage on the side of a hollow way. With a small amount of *Cladonia glauca* in the centre, with Devil's Matchstick *Cladonia floerkeana*, *Cladonia coccifera* and the heathland morph of *Cladonia squamosa*. In heathland within the burning cycle.

Photo 2012-05-26-10: Rock Hills (SU2302). A well developed sward of *Cladonia callosa* Nb (NS) squamules, with some podetia in a large ancient hollow way. The latter are rare and the species is mostly found as sterile mats. It is easily identified by its distinctive UV fluorescence. It is widespread in ruts, path edges and quarry floors and occasional in undisturbed heath in the New Forest but was not found until 2011.

Photo 2011-10-21-17: Clay Hill (SU2302). Recent erosion on a predominantly human used path near a car park. The abandoned rut to the right is beginning to be colonised by lichens. This erosion represents incipient hollow way formation and, from a lichen diversity point of view, is a positive feature. It is also a process that has repeatedly occurred throughout the existence of the heathlands. In heathland within the burning cycle.

Photo 2013-06-21-11: Holm Hill (SU2502) (Wessex Lichen Group meeting). A rut on an abandoned stock path, with an interesting assemblage colonising the sides. In heathland within the burning cycle.

Photo 2013-06-21-1o: Holm Hill (SU2502) (Wessex Lichen Group meeting). A rut on an abandoned stock path, with an interesting assemblage colonising the sides. The pale green crust is *Micarea xanthonica* Nb (NR/IR), a scarce oceanic species mainly found on acid bark, including in the New Forest woodlands. Rare on heathland and moorland and recorded once on the New Forest.

Photo 2013-06-21-04: Holm Hill (SU2502) (Wessex Lichen Group meeting). Small paths mainly used by stock, the open patch behind is on an abandoned section and is being colonised by an interesting lichen assemblage. In heathland within the burning cycle.

Photo 2013-06-21-06: Holm Hill (SU2502) (Wessex Lichen Group meeting). Heathtooth *Pycnothelia papillaria* and *Cladonia strepsilis* colonising the abandoned path pictured above. In heathland within the burning cycle.

Photo 2011-09-26-05: south of Longwater Lawn (SU3208). A compacted path edge with a colony of the regionally uncommon *Dibaeis baeomyces*.

Photo 2011-09-26-05: south of Longwater Lawn (SU3208). *Dibaeis baeomyces* on compacted path edge.

Photo 2013-07-16-10: Pipers Wait, on edge of Bramshaw Wood (SU2516). The floor of an old small scale gravel pit in short grazed heath. The floor has abundant *Cladonia zopfii* Nb (NS) in the largest single spread of this species known in the New Forest and England with two patches extending over 6m and 8m respectively. This may be the location where the species was first collected from the New Forest in 1911.

Photo 2014-02-26-05: Yew Tree Heath (SU3606). A rich community on damp compacted ground in the base of a WWII gravel pit, with *Cladonia strepsilis* (including the sorediate form), *Cladonia subcervicornis* and Heathtooth *Pycnothelia papillaria*. In heathland within the burning cycle.

Photo 2012-07-21-01: Race Plain, (SZ2999). A tumulus with a *rich* lichen assemblage on the steep open banks, including *Cladonia phyllophora* NT (NS), *Cladonia strepsilis*, *Cladonia subcervicornis* and Heathtooth *Pycnothelia papillaria*. In heathland within the burning cycle.

Photo 2012-08-09-02: Shatterford, (SU3405). A mat of *Cladonia subcervicornis* squamules on low ridge with hollow way complex. In heathland within the burning cycle.

Photo 1946-04-20-01: Beaulieu Heath West (SU3500 & SU3600). A 1946 aerial photograph, showing extensive bulldozing of terrace heathland between the runways. The areas bulldozed then are now very lichen rich, however, the adjacent areas of undisturbed terrace heath are rather sparsely colonised by lichens. The runways are now removed and support base enriched grassland with a distinctive lichen assemblage.

Photo 2013-05-11-03: Beaulieu Heath West (SU3500). *Cladonia zopfii* Nb (NS) in open Bristle Bent Heath (H3a) developed in terrace heathland bulldozed during WWII. In heathland within the burning cycle.

Photo 2014-02-01-08: Black Hill, Northern Commons (SU2917). *Cladonia grayi* s. str. [NR] on well grazed tall hummock in Valley Bog seepage mire. In short grazed heathland.

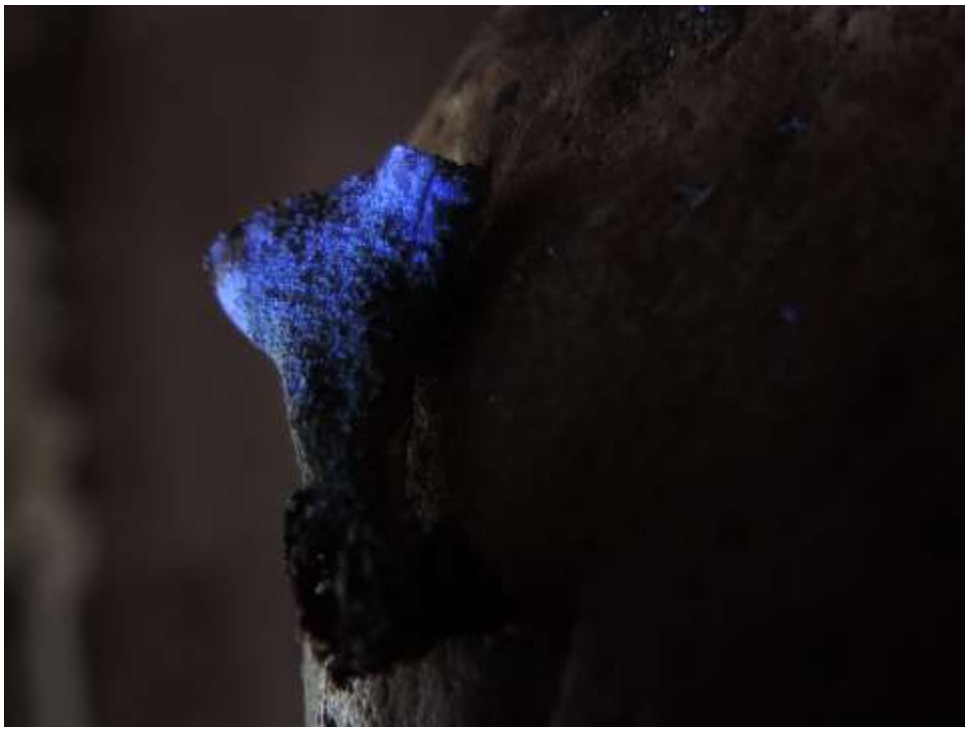


Photo 2014-02-03-02: Black Hill, Northern Commons (SU2917). *Cladonia grayi* s. str. [NR] on well grazed tall hummock in Valley Bog seepage mire, showing characteristic blue-grey UV fluorescence from grayanic acid. In short grazed heathland.

4.2.6 Habitat Assemblages – Acid Grasslands

As found by the New Forest Quantitative Inventory the lichen assemblages of the acid grasslands are very variable. Two richer types, calcium and concrete enriched road verges and airfields and lichen sand heath are localised or very rare in the Forest respectively and are dealt with separately below. The now very herb rich reseeded grassland (U1f/d) have strong intact grass swards that do not allow in any lichen growth at all. Moist acid grasslands (U4) are similar. Heathy acid grassland (U3 & M25b) are less productive and can be more open. Areas with some lichen cover, usually have some heather as well and these are usually just rather impoverished transitions to dry heath.

More distinctive but not very rich are the Parched Acid grasslands (U1f & U1b). These can have more open swards, especially where somewhat disturbed. Typical species are *Cladonia furcata* ssp *furcata* and *Cladonia cervicornis* s. str. and occasionally *Cladonia rangiformis*, *Cladonia scabriuscula*, and *Cladonia humilis*. One rare species is *Leptogium palmatum* NT (NS), unknown in the lowlands outside of the New Forest area, which was found rarely on the edges of paths through parched acid grassland. Dogtooths can be frequent and included the widespread *Peltigera hymenina* and *Peltigera didactyla* along with the more local *Peltigera canina* and *Peltigera neckeri* Nb (NS). *Peltigera membranacea*, which is typical of damper grasslands, is rare. The uncommon parasitic mushroom *Arrhenia peltigerina* [NR] was found once on *Peltigera hymenina*.

Photographs: lichens of parched acid grasslands (U1f)

Photo 2014-12-30-22: Setley Common, Roydon Woods NR (SZ3099) (Wessex Lichen Group meeting). The local *Cladonia scabriuscula*, growing through the characteristic U1 grassland species *Peltigera canina*.

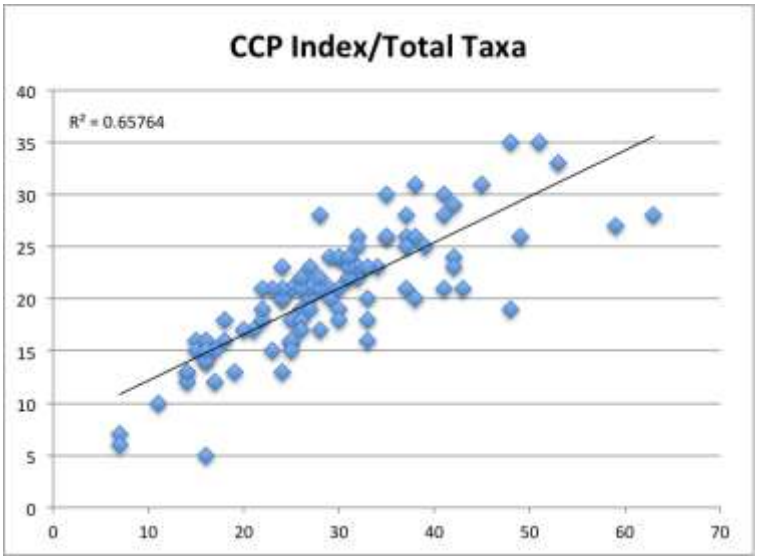
Photo 2007-10-11-0: Boltons Bench (SU3108). Two species rare in the lowlands, the lichen *Leptogium palmatum* NT (NR), black grey material in the centre with the moss, *Racomitrium elongatum* dominant. In parched acid grassland (U1f) disturbed in WWII and moderately trampled now.

4.2.7 Habitat Assemblages – Road Verges and Airfields

Much richer lichen assemblages are found in open herb rich grasslands (U1d/f) that have been very heavily disturbed by major WWII constructions, especially airfield runways, and their subsequent removal. The result is open grasslands with their pH raised by residual broken concrete. Remaining larger lumps of concrete also provide a further habitat. The habitat occurs in other situations including, in a reduced form, along road verges. The drier soils have a high cover of the False Reindeer Mosses *Cladonia rangiformis* and *Cladonia furcata* ssp *furcata*. On highly calcareous substrates, such as dumped chalk or crumbling concrete, the latter is replaced by the contorted morph *Cladonia furcata* ssp *subrangiformis*. Associated larger species include *Cetraria aculeata*, *Cladonia callosa* Nb (NS), *Cladonia cariosa* Nb (NS), *Cladonia cervicornis* s. str., *Cladonia foliacea*, *Cladonia humilis* and, on more base rich ground, the enigmatic taxon *Cladonia humilis* "schizidiate form". Blue green algae containing species are more prominent than in any other habitat and include *Collema auriforme*, *Leptogium intermedium* Nb (NS), *Leptogium schraderi* and *Leptogium tenuissimum* Nb (NS). As well as all the Dogtooths of parched acid grassland, *Peltigera rufescens* is also recorded. There are also a few small species on compacted soil or moss: *Agonimia globulifera* Nb (NS), *Agonimia tristicula*, *Bacidia bagliettoana* and *Placidium squamulosa*. This is a reasonable lichen assemblage for base rich grassland; richer than all but the best chalk downlands but lacks any very rare species. This is not surprising, as the entire habitat has colonised since WWII. The ripped up runways of Beaulieu Heath west airfield is easily the richest location for this assemblage.

As well as the above terricolous species, lumps of concrete, bits of brick and limestone add a lot of species to the heathland lichen diversity but these are all widespread common species. These concrete weeds are also found on other structures in the heathland, such as trig points, cable covers and boundary stones. This habitat does markedly raise the number of total number of taxa found in a 1km square where it occurs. In **Graph 1**, the CCP index score is graphed against the total number of taxa. The two totals are significantly correlated against each other (Probability <0.0001) but all the noticeable outliers below the main group are sites with substantial amounts of broken concrete. This illustrates the usefulness of the CCP index in assessing the conservation value of heathland lichen assemblages, by ignoring intrusive habitats supporting mainly common species.

GRAPH 1
CCP Index & Total Taxa



Photographs: airfield lichens

Photo 2012-08-25-01: Beaulieu Heath West (SU3500) (Wessex Lichen Group meeting). The calcareous grassland blue-green algae containing *Leptogium tenuissimum* Nb (NS) on the site of a ripped up runway. The moss is the downland species *Campyliadelphus chrysophyllus*.

Photo 2012-08-25-01: Beaulieu Heath West (SU3500) (Wessex Lichen Group meeting). The calcareous grassland blue-green algae containing *Leptogium schraderi* Nb (NS) on the site of a ripped up runway. With the downland mosses *Campyliadelphus chrysophyllus* and *Ditrichum gracile*.

Photo 2011-09-24-08: Yew Tree Heath (SU3606). An extreme form of *Cladonia humilis* "schizidiate form". Normal *Cladonia humilis* has very fine soredia, in this form they are replaced by large corticate granules. The form occurs in more base rich sites than *Cladonia humilis* and is associated with concrete enriched grassland and road verges in the New Forest. Here the specimen was collected from a WWII anti-aircraft battery site.

Photo 2012-08-25-24: Beaulieu Heath West (SU3500) (Wessex Lichen Group meeting). A concrete boulder with common "concrete weeds" including the yellow *Xanthoria calcicola*.

Broken concrete greatly increases the total species lists for sites but only common species occur, unlike on base enriched soil where some local downland species have colonised.

4.2.8 Habitat Assemblages – Lichen Sand Grassland & Heath

Lichen sand grasslands (U1a) are lichen rich parched acid grasslands, with a diversity of species, not just a high cover of *Cladonia furcata* ssp *furcata*. It is confined to well drained acid sands. Well developed stands are characterised by the presence of *Cladonia arbuscula* ssp. *squarrosa*, but this may be absent in recent stands. The community is rare on the open Forest but a tiny patch with *Cladonia arbuscula* ssp. *squarrosa* was spotted in a rabbit warren at Black Heath (SU1810) and there is a larger developing stand on the floor of Gorley Common gravel pit, also with *Cladonia arbuscula* ssp. *squarrosa*. Typical associates are *Cladonia portentosa*, *Cladonia ciliata* var. *ciliata*, *Cladonia ciliata* var. *tenuis*, *Cladonia furcata*, *Cladonia uncialis*, *Cladonia cervicornis* s. str., *Cetraria aculeata* and *Cetraria muricata*.

Just off the Forest there is a remarkable area of recently developed lichen sand grassland (U1a) at Blashford, part of which was included within the New Forest Heathland Lichen survey (SU1508 Blashford). This has developed on an area of washed waste sand used to infill a sand pit and then sown with grass seed in 1992. It is partly now within a Hampshire Wildlife Trust nature reserve and partly within the compound of a Wessex Water treatment works (Sanderson, 2005 & 2011c). The substrate is probably very nutrient impoverished and is also heavily rabbit grazed and has developed a very rich lichen sand grassland. This secondary site lacks *Cladonia arbuscula* but has a high cover of bushy species with *Cladonia portentosa*, *Cladonia ciliata* var. *ciliata*, *Cladonia ciliata* var. *tenuis*, *Cetraria aculeata*, *Cladonia rangiformis*, *Cladonia scabriuscula* and *Cladonia furcata* ssp *furcata*. Other species include *Cladonia foliacea*, *Cladonia cariosa* Nb (NS), *Cladonia subulata* and an abundance of the semi-parasitic *Diploschistes muscorum*, a rare species on the Forest grazings. The particular speciality of the site is frequent *Leptogium palmatum* NT (NS), in the largest known population in lowland England.

A similar type of lichen assemblage is also found on sand dunes and coastal heathland in southern England.

Photographs: Lichen sand heath at Blashford.

Photo 2011-06-10-17: lichen sand heath at Blashford (SU1508). Extensive lichen rich parched grassland (U1a) within the water treatments works compound.

Photo 2011-06-10-22: lichen sand heath at Blashford (SU1508). A vagrant (a live unattached ball of lichen) *Cetraria aculeata* thallus in lichen rich parched acid grassland (U1a).

Photo 2005-12-09-18: lichen sand heath at Blashford (SU1508). *Leptogium palmatum* NT (NS) thallus in lichen rich parched acid grassland (U1a), showing the typical rolled up tips. Now a very rare species in the lowlands.

Photo 2011-06-10-13: lichen sand heath at Blashford (SU1508). *Cladonia cariosa* Nb (NS) podetia in recently disturbed patch within lichen rich parched acid grassland (U1a), showing the typical fenestrations in the podetia. An early colonist of less acidic to neutral bare ground.

4.2.9 Habitat Assemblages – Flints

Frequent to abundant flints and rare ironstone are the only natural rocks in the New Forest heathlands. Small flints on acid soils are a harsh environment for lichens and the assemblage on the flints is very limited, with 17 species recorded. *Rhizocarpon reductum*, *Micarea erratica* and *Porpidia crustulata* are the most frequent species. The only local species found were *Porpidia macorcarpa* and *Catillaria atomarioides* Nb (NS).

Photo 2014-12-06: Ocknell Plain (SU2311). A scan of a flint collected from the edge of a path on plateau in humid dry heath (H2c). As well as the ubiquitous *Rhizocarpon reductum* (pale grey with larger black apothecia) there is abundant *Catillaria atomarioides* Nb (NS) (dark green-black thallus with small black apothecia). The latter is a much rarer species, occurring on flints in disturbed locations.

4.2.10 Habitat Assemblages – Epiphytes on Heathers

Epiphytes are rare on heathers within the New Forest. There were mainly found where old *Calluna* bushes occurred as isolated bushes, as in tussocks in well grazed tussock wet heath (M16b) or as old bushes in acid grassland. The species found were entirely common epiphytes of the area and had no conservation significance. This contrasts with some Dorset and Isle of Wight coastal heathlands, where a few rare species are found on old heather bushes.

4.2.11 Habitat Assemblages – Ungrazed Heath

There were two ungrazed heaths, which provided a useful contrast with grazed heathland dominating the vast majority of the area. Copythorne Common east (part of SU3115 Copythorne W & E), is especially useful as it can be compared to the nearby well grazed Copythorne Common west (SU3014 Copythorne W, SU3015 Copythorne W & SU3115 Copythorne W & E). The latter is an area of short grazed heathland, with a rich and important lichen assemblage in open humid dry heath (H2c). This includes significant species such as the only colonies of *Cladonia zopfii* Nb (NS) and Heathtooth *Pycnothelia papillaria* found during this survey off the open Forest grazings along with *Cladonia arbuscula* ssp *squarrosa*, *Cladonia glauca*, *Cladonia*

gracilis, *Cladonia incrassata* Nb (NS) and *Cladonia strepsilis*. The grazed area had a total CCP index score of 32. On Copythorne Common east, similar heath occurred with humid dry heath (H2c), which would have been grazed up to 1964 by stray Forest stock. By the 2000s no lichens survived at all within the undisturbed heath. Much of the heathland had been lost to recent scrub, but even where it was still open heath, it had a dense smothering growth of *Molinia* that was outcompeting the heathers, let alone the lichens. There is an old gravel pit in the east of the heathland and this did have a few lichens, including a sizable population of *Cladonia callosa* Nb (NS), giving a CCP index score of 5. Here grazing has made a very marked difference between the sites but it is interesting to note that disturbance in the form of an old gravel pit was allowing limited lichen diversity to survive.

The other ungrazed heath was Burton Common (SZ1995), on a lower gravel terrace south west of the Forest. It was contiguous though unenclosed common land contiguous with the New Forest in the late 18th century but has long been isolated by enclosed land. It has been fenced for grazing but is clearly ungrazed at present and has been for some time. The lichen assemblage was very poor with a total CCP index score of 10. Most of the heath had either a very dense heather canopy with hardly any glades or was dense thatched *Molinia*; both totally lacked lichens. The relic lichens were mainly found along the edges of the tracks. The presence of *Cladonia ciliata* var. *ciliata*, suggest that the heath would once have had an interesting lichen assemblage. The most diverse area was on the site of a fairly recent burn (presumably a wild fire) with eight taxa. The lichen cover was not high here and there was a very high cover of the invasive exotic moss *Campylopus introflexus*, although the moss sward height was not very high and the lichens survived. The high cover of this invasive moss indicates raised nutrient levels, either from the impact of the wild fire, or from air pollution. Without grazing the heath was now lichen poor, but trampling and wild fire were maintaining some lichen diversity, even if it was unimpressive compared to the open Forest heaths.

Photographs: Grazed and ungrazed heath.

Photo 2015-02-24-02: Copythorne Common east (SU3115). Long ungrazed humid dry heath (H2c). All lower plant diversity is smothered but the dense growth of Moorgrass *Molinia caerulea*.

Photo 2015-02-24-04: Copythorne Common west (SU3015). Long hard grazed humid dry heath (H2c). The suppression of the heathers and Moorgrass allows a diverse assemblage of lichens and bryophytes.

Photo 2015-02-24-01: Copythorne Common east (SU3115). Long ungrazed humid dry heath (H2c). All lower plant diversity is smothered but the dense growth of Moorgrass *Molinia caerulea*.

Photo 2015-02-24-03: Copythorne Common west (SU3015). Long hard grazed humid dry heath (H2c). The suppression of the heathers and Moorgrass allows a diverse assemblage of lichens and bryophytes. The *Cladonia* species here includes the declining *Cladonia arbuscula*.

4.2.12 Air Pollution

Sparrius (2011) has shown that ammonia pollution is a severe threat to lichen rich inland acid mobile dunes in the Netherlands. The main mechanism is greatly increased cover by the invasive exotic moss *Campylopus introflexus*, although in dispersal experiments, the declining species *Cladonia strepsilis* performed less well with increasing ammonia levels even without completion from *Campylopus introflexus*. Serious *Campylopus introflexus* problems involve dense growths of the moss several centimetres high. In the Netherlands, local dominance of *Campylopus introflexus* was found to occur at or above nitrogen deposition levels of 30-32 kg N ha^1 yr^1 or atmospheric ammonia concentrations of 7 µg NH3 m^3. Below these levels *Campylopus introflexus* is still present but is not a problem species. There is no evidence that other forms of nitrogen have any impact on heathland lichens and this needs to be taken into account in interpreting total N deposition figures. The total nitrogen deposition estimates are only a useful proxy for ammonia levels at a regional level, where the proportions of ammonia to other forms of nitrogen are the same. Regions with different ratios cannot be compared using total N deposition.

During this survey *Campylopus introflexus* was found to be widespread but extensive stands of the very vigorous tall growth form that displaces lichen diversity were only seen once. This was north east of Buckherd Bottom (SU2108, Bratley Plain), on the site of a very hot summer wildfire dating to the late 1980s. Its dominance here marked residual patches of humus that survived the fire. Where the humus layer had been burned away completely leaving bare gravel, very open lichen rich communities were still present, even after over 25 years. The humus that had survived the hot fire had been "cooked" liberating nitrogen making it more fertile; where the humus had been burned off completely, the bare gravel was very nutrient poor.

The "Air Pollution Information System", website was consulted for estimates of the levels of air pollution within the New Forest. The pollution is modelled on a 5 x 5km grid square basis. As ammonia is rapidly scrubbed out of the air and 1km can be a sufficient buffer from a high point source to minimise impacts, a 5 x 5km grid is barely fit for purpose. That as may be, the atmospheric ammonia concentrations in the 5 x 5km squares covering the NFHL survey ranged from 0.72 NH3 m^3, (SU30NW) in the centre of the Forest, to 1.51 NH3 m^3 (SZ19NE) around Burton Common in the south west. There was a clear pattern of higher modelled levels in edge squares that supported enclosed agricultural land. The levels of nitrogen deposition ranged from 11.76 kg N ha^1 yr^1 (SZ39NE) to 16.8 kg N ha^1 yr^1 (SU31NW). The latter show a similar, but less marked, pattern to the ammonia levels (**Table 11**). Both of these are much lower than the levels described as damaging to similar lichen assemblages in the Netherlands, even at their highest.

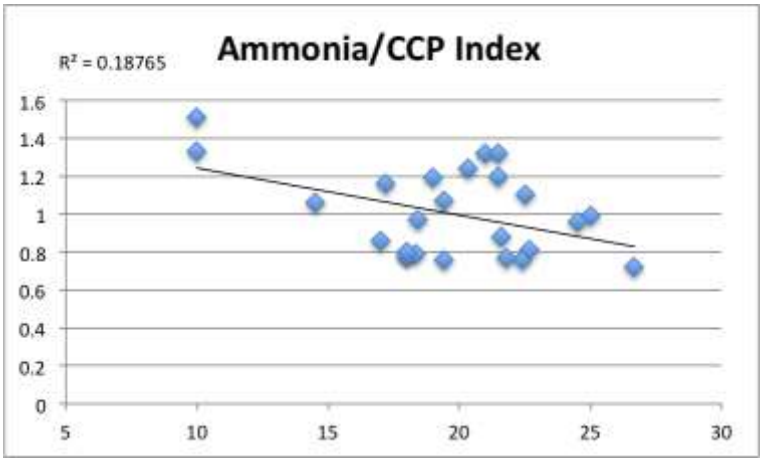
Out of interest the average number of CCP index scores for each 5 x 5km squares were graphed against the modelled levels of pollution (**Graphs 2** & **3**). The atmospheric ammonia concentrations do show a negative correlation with the average CCP index scores, but this trend is not significant. For total Nitrogen deposition the correlation is even weaker.

It does not appear that nitrogen pollution is a major factor driving lichen diversity within the New Forest. Inherent environmental factors and management impact are certainly much more significant.

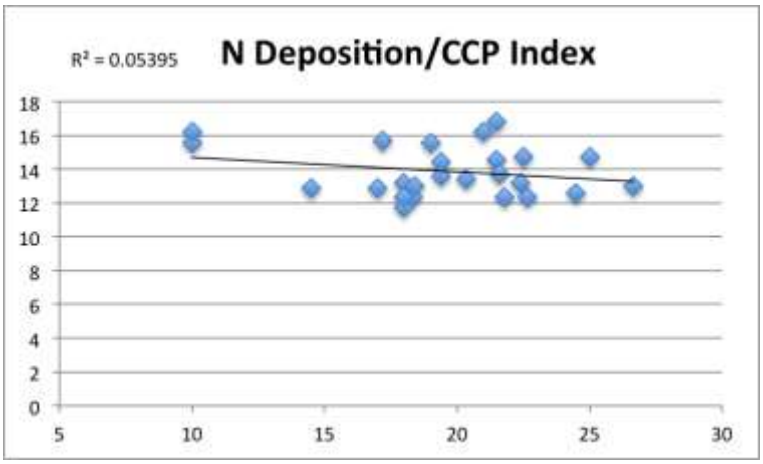
TABLE 11
Modelled Nitrogen Pollution Levels in 5 x 5km Squares
Compared with Average CCP Index Scores

5 x 5km Square	NH3 $NH3\ m^3$	Total N $N\ ha^1\ yr^1$	Average CCP Index Score
SZ19NE	1.51	15.54	10
SU10SE	1.20	14.56	22
SU10NE	1.07	14.42	19
SU11SE	1.10	14.70	23
SU11NE	1.19	15.54	19
SZ29NW	1.06	12.88	15
SZ29NE	1.24	13.44	20
SU20SW	0.77	12.32	22
SU20SE	0.79	12.32	18
SU20NW	0.76	13.16	22
SU20NE	0.78	13.16	18
SU21SW	0.76	13.58	19
SU21SE	0.99	14.70	25
SU21NW	1.16	15.68	17
SU21NE	1.32	16.24	21
SZ39NW	0.96	12.60	25
SZ39NE	0.78	11.76	18
SU30SW	0.80	12.32	18
SU30SE	0.81	12.32	23
SU30NW	0.72	13.02	27
SU30NE	0.88	13.72	22
SU31SW	1.33	16.24	10
SU31NW	1.32	16.80	22
SU40SW	0.97	13.02	18
SU40SE	0.86	12.88	17

GRAPH 2
Atmospheric Ammonia Concentrations Against Average CCP Index Scores in 5 x 5km Squares



GRAPH 3
Total Nitrogen Deposition Against Average CCP Index Scores in 5 x 5km Squares



Photographs: 1980s hot fire site showing nutrient enhanced and impoverished areas.

Photo 2013-05-06-19: the plateau edge NE of Buckherd Bottom (SU2108) burned by a hot wild fire in the later 1980s. The residual "cooked" humus that survived the hot burn is nutrient rich and supports dense tall *Campylopus introflexus*, which excludes lichen growth. This was the only time that *Campylopus introflexus* this vigorous was seen during the NFHLS.

Photo 2013-05-06-06: the plateau edge NE of Buckherd Bottom (SU2108), a nearby area in the same burn site. Here the humus was burned off completely leaving a very infertile gravel surface that is dominated by the native low nutrient dependent moss *Polytrichum piliferum* and frequent lichens, including an, as yet, unidentified but distinctive taxon.

4.2.13 Comparison with Other Heathlands

There have been few systematic surveys of lichens on British heathlands, but Bryan Edwards has maintained a spreadsheet of records from the Dorset Heaths. In 2013 this covered 36 sites. The total CCP score for the whole survey was 32 as opposed to 51 for the New Forest. By sites, the CCP index scores for the Dorset heaths ranged from zero to 21 and averages eight, while the New Forest range from 5 to 35 and average 21. All of the CCP Index species that have been recorded in the Dorset heaths have also been found in the New Forest. It should be noted, however, that some of the new species recorded in the New Forest such as *Cladonia callosa* Nb (NS) and *Cladonia zopfii* Nb (NS) have been found in Dorset since 2013 and the level of survey is not as high for the Dorset heaths. Comparisons with the frequency per site for better-known species can be compared with frequency per 1km square and these are probably fairer comparisons (**Table 12**).

TABLE 12
Comparison between the Frequency of Occurrence of Selected Species Recorded from the Dorset Heaths and the New Forest (NF)

Species	Dorset	NF
Cetraria aculeata	0.39	0.51
Cetraria muricata	0.06	0.47
Cladonia arbuscula	0.33	0.39
Cladonia cariosa	0.03	0.07
Cladonia ciliata var. ciliata	0.06	0.77
Cladonia ciliata var. tenuis	0.25	0.48
Cladonia crispata var. cetrariiformis	0.58	0.90
Cladonia foliacea	0.06	0.08
Cladonia floerkeana	0.50	0.97
Cladonia furcata subsp. furcata	0.36	0.81
Cladonia glauca	0.03	0.10
Cladonia gracilis	0.19	0.36
Cladonia humilis	0.06	0.42
Cladonia incrassata	0.08	0.32
Cladonia portentosa	0.97	0.99
Cladonia scabriuscula	0.06	0.13
Cladonia strepsilis	0.56	0.73
Cladonia subcervicornis	0.03	0.36
Cladonia subulata	0.19	0.17
Cladonia uncialis subsp. biuncialis	0.58	0.85
Dibaeis baeomyces	0	0.16
Icmadophila ericetorum	0	0.17
Micarea lignaria	0.14	0.33
Pycnothelia papillaria	0.42	0.75

The robust survivor *Cladonia portentosa* has a similar frequency in both Dorset and the New Forest. Otherwise there are marked differences, with all but one species less frequent in Dorset. One group of acid grassland species, *Cladonia furcata* subsp. *furcata*, *Cladonia humilis* and *Cladonia scabriuscula* are very much scarcer in Dorset. This reflects the high differential loss of quality and extent of highly grazing dependent acid grassland on the Dorset Heaths and is similar to that found for

vascular plants (Byfield, & Pearman, 1996). This was very much expected but there were also very strong differences within a group of specialist heath species, which were also much less frequent in Dorset than in the New Forest. These include *Cetraria muricata*, *Cladonia ciliata* var. *ciliata*, *Cladonia floerkeana*, *Cladonia gracilis*, *Cladonia strepsilis*, *Cladonia subcervicornis*, *Cladonia uncialis* subsp. *biuncialis*, *Dibaeis baeomyces*, *Icmadophila ericetorum*, *Micarea lignaria* and *Pycnothelia papillaria*. This strongly indicates that the serious decline in vascular plant diversity within habitats outwith dry heath noted by Byfield & Pearman (1996) also applies to lichens in the dry heaths. As with vascular plants, a decline in management on the heaths is likely to be responsible. This data suggests that the New Forest may be twice as diverse as the Dorset heathland at a site/1km square basis but more detailed sampling would be required in Dorset to confirm this. It would be especially informative to use the same plot sampling method used by the New Forest Quantitative Inventory (Scheidegger et al, 2002) to randomly sample the Dorset Heaths. This is likely to show even higher differences than a site/1km square basis. It appears very unlikely that any other southern heathland would exceed the 50% of the random New Forest plots that had CCP Index scores of over 10 and therefore had heathland lichen assemblages of high interest.

Some more detailed surveys have been carried out by the Wessex Lichen Group on heathland sites outside of the New Forest during the same period of the New Forest Heathland Lichen Survey (Website: "Wessex Lichen Group 2012", "Wessex Lichen Group 2013" & "Wessex Lichen Group 2014"). Four of these were to coastal heaths or inland sand heaths. These had lichen assemblages that were very similar to those of the lichen sand heath surveyed at Blashford (SU1508) described above and had very little in common with the general assemblage found on the New Forest.

The sites were:

- **Woolmer Ranges**, Hampshire (SU7832 & SU7932), 2/9/2012: a very rich lichen sand grassland and heath with U1a and H1 communities, survived through rabbit grazing, but now cattle grazed as well. CCP index score 29.
- **Browndown**, Hampshire (SZ5799 & SZ5899), 27/3/2013: a rich heathland and some parched acid grassland developed on coastal single, ungrazed, low productivity heath with rabbit grazing. CCP index score 17.
- **Studland Dunes**, Dorset (SZ0385), 26/6/2013: rich sand heath on younger first dune ridges, including rich epiphyte assemblages on heather twigs, ungrazed, diversity maintained by disturbance. CCP index score 20.
- **Headon Warren**, Isle of Wight (SZ3186 & SZ3185), 4 /9/2013: a rich heathland on a coastal slope, including rich epiphyte assemblages on heather twigs. Rabbit grazed and exposed. CCP index score 20.

Three were more conventional heathland closer to the bulk of the New Forest:

- **Studland Dunes**, Dorset (SZ0385). 26/6/2013: reasonably rich acid heathland assemblage on the older second dune ridges, ungrazed but on very low productivity soils and previously burned. Lacking many of the characteristic species of the New Forest, probably as it was a very dry site. CCP index score 17.

- **Holt Heath**, Dorset (SU0504, SU0404, SU0604), 23/3/2014: a range of humid and humid to wet heath transition communities very similar to the New Forest, two New Forest specialists, *Cladonia zopfii* NB (NS) and *Cladonia callosa* Nb (NS) were added to the Dorset heath list. Now grazed but lightly and there is no controlled burning. Rich areas associated with very low productivity patches, old gravel pits and former wild fire sites. Heathtooth *Pycnothelia papillaria* appeared to be on the verge of dying out on the site and much of the lichen interest looked to be relics of past land use, not the current use, but a rich site comparable with the New Forest. CCP index score 26.

- **Hazeley Heath**, Hampshire (SU7656 & SU7558) 17/8/2014: a typical north Hampshire heathland, long ungrazed and damaged by wild fire and tree colonisation. The site is now under restoration, with some grazing by cattle restored. The heathland lichen assemblage was impoverished, but had doubled since restoration management commenced. CCP index score 12.

Other briefer examinations of southern heaths were made, especially in the Weald (Cox et al, 2015) and in the Thames basin. These observations suggest that outside of the New Forest sand heath lichen assemblages have survived quite well. More typical heathlands outside of the New Forest have not fared nearly as well. Enough survives in the Dorset heaths to indicate that they are likely to have been very similar to those of the New Forest but are now markedly less rich. In the Thames Basin and Wealden heaths, beyond some rich surviving sand heaths, the lichens assemblages have been devastated and are largely very impoverished. There are just hints of a similar assemblage with relict *Cladonia subcervicornis* and *Cladonia callosa* Nb (NS) found in fire refuges in wild fire ravaged heathland at Chobham Common (SU9763 & SU9764).

Either lack of grazing, or restored lighter grazing which is lighter than the New Forest, along with lack of controlled fires are likely to account for the reduced diversity apparent on the Dorset heaths. The Thames basin and Wealden heaths appear even poorer but are also more severely fragmented and degraded than the Dorset heaths.

No other up to date detailed information about English heathland lichens has been see, but there has been a lot of work on the heathland lichen assemblages of the Netherlands (Aptroot et al, 2011 & Sparrius, 2011). The assemblages of heathland specialists are actually very similar to England, but there are some continental species that are absent from the New Forest, including *Cetraria islandica*, *Cladonia monomorpha*, *Cladonia pulvinata* and *Stereocaulon condensatum*. The Mediterranean-Atlantic *Cladonia mediterranea* CR (NR/S41) is absent from the Netherlands. Some notable shared species are *Cladonia borealis* Nb (NR/DD), *Cladonia callosa* Nb (NS) and *Cladonia zopfii* Nb (NS). Some species that still have strong populations in the New Forest, however, are red listed in the Netherlands: *Cladonia arbuscula* VU, *Cladonia cariosa* VU, *Cladonia ciliata* s. lat. EN, *Cladonia squamosa* CR, *Cladonia strepsilis* VU, *Cladonia uncialis* VU, *Dibaeis baeomyces* CR, *Peltigera canina* VU, *Peltigera neckeri* EN and *Pycnothelia papillaria* EN. Some New Forest species are now lost from the Netherlands: *Cladonia sulphurina*, *Cladonia subcervicornis*, *Icmadophila ericetorum* and *Leptogium palmatum*.

The condition of Heathtooth *Pycnothelia papillaria* in the Netherlands is particularly interesting; it used to be a fairly common species in the Netherlands heathland until the 1970s (Haveman & Ronde, 2013). After this it rapidly declined (Ketner-Oostra et al, 2010) and was thought extinct until refound at a single site in 2006. At its single site it survived on damp humus rich open heath kept open by regular controlled winter fire on a military firing range. It was not able to colonise bare ground created by recent conservation turf cutting, as this produced unsuitable humus free soils (Haveman & Ronde, 2013). This corresponds with the habitat in the New Forest, where it is very much a specialist of hard humus. This hard humus habitat appears to be in rapid decline in lowland Europe outside of the New Forest. *Pycnothelia papillaria* is also in serious decline in Poland (Zarabska, & Rosadziński, 2011), where it is being ousted from inland dune communities by dense growth of the nitrogen loving exotic moss *Campylopus introflexus*. It is listed in the Latvian lichen red list (Website: "Lichen flora of Latvia"), which states that it is also listed in the red lists of Denmark, Germany, Austria and Poland as well.

4.3 Conservation Interest

4.3.1 Value of the New Forest Heathland Lichen Assemblage

The 2011 – 15 New Forest Heathland Lichen survey found the heathlands to have a high lichen diversity (**Table 13**). No indication was found of a significant decline within the main New Forest heaths, including direct comparisons of sites covered by previous surveys. The diversity occurs mainly in discrete hot spots but these are found widely through the heathland landscapes (**Maps 3**, **42**, **44**, **46**, **48**, **50** & **52**).

TABLE 13
Number of Taxa and CCP Index Scores by Meta Areas

Meta-sites	Total Taxa		CCP Index		RDB/Nb Score		No 1km squares	
1km squares	Syst 1km	All 1km	Syst 1km	All 1Km	Syst 1km	All 1km	Syst 1km	All 1km
Northern Commons	86	86	39	39	400	400	10	13
Eastern Heaths	125	126	46	46	750	750	22	36
Beaulieu Heath W	86	86	40	40	550	550	7	7
South Western Heaths	109	109	45	45	1100	1100	23	28
Central Heaths	106	107	44	44	700	700	16	18
North Western Heaths	111	111	47	47	950	950	22	26
New Forest	**160**	**161**	**51**	**51**	**1250**	**1250**	**100**	**128**

Syst 1km = Totals in systematically surveyed 1km squares

The heaths support a high number of specialist heathland lichens, and high scores were obtained using the *Cetrelia*, *Cladonia* & *Pycnothelia* Index (CCP), indicating the widespread occurrence of species rich lichen heath and other heathland habitats (**Map 3**, **42**, **44**, **46**, **48**, **50** & **52**). These specialist species included many species that are of conservation significance within England and in lowland northern temperate Europe. This is not fully expressed by UK national Red Lists, as these also cover upland/boreal areas. Some of the species that are highly threatened in northern temperate Europe still have stable populations in the north. In the proposed England Lichen Red Data Book several frequent New Forest heathland lichens will

be added, and some might also be listed on Section 41 pending a review. Significant species recorded during the survey are listed in **Table 14**.

The RDB/Nb Scores are not nearly as high as those found for the New Forest woodlands, but are likely to be the highest recorded for English lowland heaths. The CCP Index is probably a more efficient method of assessing the conservation significance than the RDB/Nb Score.

The most significant group of species in European terms, are those of humid hard humus surfaces. These include *Cladonia strepsilis* and Heathtooth *Pycnothelia papillaria*, which are highly burning- and grazing-dependent. These species have largely disappeared from the northern European plain from the Netherlands to Latvia (Haveman & Ronde, 2013 & website "Lichen flora of Latvia"). Similar in this respect are *Cladonia callosa* Nb (NS), *Cladonia zopfii* Nb (NS), *Cladonia subcervicornis*, *Dibaeis baeomyces* and *Icmadophila ericetorum*. These are all species of open damp black humus, which are declining in lowland Europe.

TABLE 14
Significant Heathland Species Recorded 2011 – 15

New Forest Species	Freq	Status	Comment
Agonimia globulifera	0.01	Nb (NS)	Lowland species of disturbed base rich soils
Arthrorhaphis aeruginosa	0.11	Nb (NS)	Upland Species, R in lowlands
Arthrorhaphis grisea	0.05	Nb (NS)	Upland Species, R in lowlands
Bachmanniomyces uncialicola	0.12	[NS]	Upland Species, R in lowlands
Cladonia arbuscula	0.39		Declining in England
Cladonia borealis	0.01	Nb (NR/DD)	Upland Species, R in lowlands
Cladonia callosa	0.58	Nb (NS)	Internationally important population of Atlantic endemic
Cladonia cariosa	0.07	Nb (NS)	Ephemeral of
Cladonia coccifera s. str.	0.35	[NS]	Probably a mainly upland species, probably rare in the lowlands
Cladonia grayi s. str.	0.07	[NR]	Rare but easily identified member of the Cladonia grayi s. lat. group
Cladonia incrassata	0.32	Nb (NS)	Among the largest British populations
Cladonia mediterranea	0.03	CR (NR/S41)	Only known from one other area in England, Section 41 species
Cladonia phyllophora	0.31	NT (NS)	A mainly upland species
Cladonia rei	0.18	NT (NS)	Only known from SE England, New Forest has largest known population
Cladonia strepsilis	0.73		Likely to be the largest population in lowland temperate northern Europe
Cladonia subcervicornis	0.36		Very rare in lowland England outside of the New Forest
Cladonia sulphurina	0.01		Very rare in lowland England
Cladonia zopfii	0.32	Nb (NS)	New Forest supports the vast majority of the English population
Dibaeis baeomyces	0.16		Uncommon in the lowlands
Epicladonia sandstedei	0.02	[NS]	Upland Species, R in lowlands
Icmadophila ericetorum	0.17		Upland species, very rare or extinct outside of the New Forest in the lowlands
Leptogium palmatum	0.04	NT (NS)	Rare generally and confined to the New Forest area in the lowlands
Leptogium tenuissimum	0.01	Nb (NS)	Scarce species of base rich soils
Micarea leprosula	0.12		Upland Species, R in lowlands
Micarea xanthonica	0.01	Nb (NS/IR)	Scarce oceanic species, rare on heaths
Peltigera canina	0.14		Largest inland population in lowland England
Peltigera neckeri			Lowland species of disturbed base rich soils
Placynthiella oligotropha	0.02	Nb (NS)	Little recorded heathland species
Pycnothelia papillaria	0.89		The largest population in lowland temperate northern Europe & the only one not declining
Trapeliopsis glaucolepidea	0.03	Nb (NS)	Upland Species, R in lowlands

The evidence of this survey suggests that the heathland assemblage of the New Forest is very diverse compared to other lowland heathland areas in Britain. Provisional comparisons suggest that the New Forest heathland is twice as rich at a site or 1km square level as the Dorset heathlands. More limited observations from the Thames basin and Wealden heaths suggest that these are even poorer (Sanderson, 2011).

- **The 2011 – 2015 New Forest Heathland Lichen Survey has supported the assessment by Fletcher et al (1984) that the New Forest is of international importance for its heathland lichen assemblage.**

An initial examination of the data collected for the New Forest Quantitative Inventory makes it clear that the mechanisms driving this high diversity are extensive but uneven grazing pressure and controlled burning. These act primarily though the sward height of the heather, with high diversity associated with shorter swards. These include areas where the sward is kept permanently short by hard browsing of the heathers or areas that where the swards are periodic short after controlled burning of the heather.

The lichen rich short dry heath grazed swards appear to be very rare outside of the New Forest, but occupy hundreds of hectares in the New Forest (Sanderson, 1996). The author is not aware of any short grazed Dwarf Gorse *Ulex minor* type heaths (H2) surviving outside of the Forest. They must once have been a feature of most heaths, wherever low productivity soils abutted better grazings.

Systematic controlled burning is not carried out on any other lowland heath at present. It is clear in Dorset that the latter is a major factor in the lower lichen diversity; there was no sign of healthy young colonising lichen communities, even on heathlands that are well grazed, as on Holt Heath (Website "Wessex Lichen Group 2014"), other than on wild fire sites. In other areas such as Chobham Common in Surrey, wild fire is so frequent as to be suppressing the lichen diversity. The history of fire in southern English lowland heathlands is obscure. There is little written evidence about heath fires at all and this absence of evidence is often used to state that controlled burning was not used traditionally on southern lowland heaths. However, there are two interesting observations from 18th century commentators Gilpen (1808), for the New Forest and Gilbert White in 1788 (Website: "Gilbert White") for Woolmer Forest. Both of these make it clear that fires to improve the pasture on the heathlands were regularly set by commoners but that these often got out of hand. The lack of other documentary evidence for what is clearly described as a regular occurrence in the 18th century is quite typical for an activity carried out by illiterate mangers, which was not regulated or of much concern to the literate (Rackham, 2006). Out of control fires where presumably an irritant but the culprits could not be found even where the fires spread off heathlands (Gilpen, 1808). Richard Reeves (pers. com.) points out that the area of burnable heath, however, will likely have been lower then. Many accessible areas would have been cut for Gorse faggots, Heather bedding and tuft cut for fuel on a large scale. The shift from fires set at the whims of commoners to fires carefully controlled by the landowner is the main difference between traditional and modern practice (Tubbs, 2001).

The New Forest is now the only area supporting extensive lichen rich heathlands of both hard browsed and control-burned and grazed lowland heathland. The main type of lichen rich acid heaths or grasslands surviving beyond the New Forest are lichen sand heaths and grasslands or coastal heaths. These have distinctly different assemblages, in particularly they lack the humid hard humus specialist species. This extends into lowland Europe, where shifting lichen assemblages of blown sand heaths are much better conserved that those of normal heaths (Ketner-Oostra, 2010).

Large scale soil disturbance in the presence of grazing and controlled burning is also responsible for many lichen rich hot spots. This has interesting implications for the future, even on the New Forest; many current features of conservation interest are result of disturbance events that are no longer regarded acceptable on conserved heathlands.

4.3.2 Shifting Baselines and Conservation Management

In nature conservation, there is the potential that large scale changes to habitats have already occurred prior to systematic habitat surveys and data collection being undertaken, which can lead to false assumptions being made about what constitutes 'original' habitat conditions. This can, in turn, lead to misdirected conservation management, targeted at re-creating this 'original' condition. What could be termed the 'shifting baseline syndrome' encompasses these false assumptions about baseline conditions, which could apply both to habitats that have become less species rich between cessation of traditional management and commencement of field recording but also where some species of conservation interest have become more abundant in that intervening period.

An important aspect of the New Forest is that it has changed less than other heathlands in the lowlands in the last 150 years (Tubbs, 2001). As such, it could provide an important baseline for biodiversity conservation against which to measure changes that may have occurred on other heathlands before detailed recording began.

At the beginning of the New Forest Heathland Lichen Survey Sanderson (2011b) (Annex 3) commented that the reduction in lichen diversity from most heathlands in lowland England has in all likelihood been underestimated, due to false assumptions about historic baseline conditions. The considerable decline in the quality of heathland lichen floras in those areas outside of the New Forest had been observed during NVC surveys in Surrey in the early 2000s and has been also described in Sussex (Rose, 1992, Sanderson, 1995 & Cox et al, 2015). This decline had not been apparent in the New Forest (Sanderson, 1996 & 2010), and was thought to reflect the continuity of grazing and careful controlled long rotation burning there.

However, at present there seems to be little general recognition that there might be a problem with declining lichen diversity in England's heaths. Searching the internet produced nothing concerning lowland heathland management and lichen diversity. The standard methods for carrying out condition assessments in lowland heaths are concerned only with cover of lichens, not species diversity (JNCC, 2004). This is problematic, as species poor heaths can still have an abundance of one species, *Cladonia portentosa*; a great deal of lichen diversity can be lost long before the criteria would indicate that lichens were in unfavourable condition.

This survey has reinforced these conclusions. Without the continued practice of traditional management on the New Forest, the high level of lichen diversity that is produced would be exceptionally difficult to appreciate, in the absence of other examples. In particular the very rich lichen heath produced by hard grazing of the short heaths, goes against all received wisdom about conservation heathland management. Analogies with upland moorland, where such hard grazing may well be largely damaging, are proving to be inappropriate to lowland heath. The benefit of controlled burning to lichen diversity is beginning to be understood as well in the

uplands (Davies, 2001, Davies & Legg, 2008 & Harris et al, 2011) but is not generally accepted.

A recent large scale study of vascular plant diversity in Denmark (Timmermann et al, 2015) has found similar results. Here conservation management by careful controlled summer grazing on Natura 2000 sites had failed to halt the loss of species of conservation value of low growing swards while increases in tall competitive species of lower value had occurred. The main driver of decline was considered to be the replacement of traditional land use (i.e. previously widespread livestock grazing) by more prescriptive conservation management (e.g. summer grazing by livestock). They also report other studies across Europe showing similar results. This suggests there is a systemic problem with conservation-driven land use failing to achieve its aims. In the past, traditional management led to exploitation at larger scales, typically more intensive but also lighter management in more distant parts of management units. A greater range of treatments occurred, with some now rare or absent on conservation managed heaths.

4.4 New Forest Heathland Management and Lichen Diversity

4.4.1 Introduction

In discussing heathland management it is important to take a holistic view. The major activities such as grazing and controlled burning are closely linked together and cannot be considered separately. Too often in heathland management guides, as in Gimingham (1992), the different treatments are listed and treated as if they were completely independent of each other. Their interactions are often just as important as the direct effects of the treatments. This is especially so in the New Forest; the primary factors of grazing and controlled burning are completely interrelated.

The results of this survey indicate that the current management of the New Forest heathlands (Forestry Commission, 2008) mainly by grazing and controlled burning appears highly beneficial for lichen diversity so, in this respect, it is more effective than any other more purely conservation based management found on other heathlands in southern England.

4.4.2 General Principles of New Forest Heathland Management & Lichens

The primary requirement needed to maintain lichen diversity is to sustain the current mix of extensive but very uneven grazing combined with a long burning rotation, that takes in the majority of the burnable heaths. Uneven grazing pressure is a vital factor, which appears not to have been stressed enough in the past and probably needs more study. There are important gradients from unburned hard grazed heaths near fertile grazings through burned and moderately browsed to burned and lightly browsed heaths. Lichen diversity is highest in the hard and moderate grazed heath, but interest extends into lightly grazed heaths but is more localised. The hard grazed heaths provide important refuges for fire sensitive species but there are also many important fire dependant species that benefit from controlled burning. In international terms the latter are the most important single feature of the lichen assemblage.

Photo 2014-10-05-05: Bagshot Moor, Beaulieu Heath (SU3600). A patch of *Cladonia zopfii* Nb (NS) in moderately browsed plateau wet heath, with a cowpat. The grazing stock, along with controlled burning, is crucial to maintaining the lichen rich heaths of the New Forest.

Localised major soil disturbance that is then left to slowly colonise naturally is also very important. This is still being produced at a good rate, mainly creation of new paths that are subsequently abandoned, but this is often regarded as damaging rather than a positive feature. It is certainly impossible to imagine that the scale of disturbance caused by medieval hollow ways or WWII airfields would be acceptable now, but all of these have added to the lichen diversity of the Forest.

4.4.3 Specific Issues – Short Grazed Heaths

The localised high grazing pressure that creates lichen rich grazed heath is with prostrate heather a fundamental component of the important lichen assemblage in the New Forest. Such lichen rich short grazed heaths are also a very special feature of the New Forest. They are likely to have been standard feature of the edges of lowland heaths in general but, as far as the author is aware, are now confined to the New Forest. Most importantly, these are going to be very difficult to recreate in abandoned heathlands outside the New Forest. There is a general prejudice against grazing heath this hard, so such heaths are not likely to be created any time soon beyond the New Forest. In addition, there appears to be a continuity factor involved in the richness of the short heaths on the Forest. There are areas where short grazed heath has been produced recently out of taller heath locally in the New Forest but these can be easily distinguished by the absence of *Cladonia arbuscula*. The abundance of this species in particular appears to be the result of many decades of stability in the short grazed heath habitat. It is important to ensure therefore that the Forest short heaths are maintained in the long term and are not converted into a more typical heathland structure by reduced grazing pressures.

This habitat is formed and maintained by grazing levels that are at the edge of acceptability for heathlands in any terms. They are well beyond those recommended in typical prescriptions for heathland management, and especially moorland management. Using standard methods to assess condition assessment, such short grazed heaths could easily be assessed as being in unfavourable condition, while derelict lichen poor heaths are routinely passed.

- **Review methods of assessing condition of lowland heath to remove inappropriate upland biases. Incorporate assessments of lichen diversity, not just cover. For general use these could include counting the main morphological types of *Cladonia* (Annex 2) present rather than actual numbers of species.**

The high level of grazing does mean that the short grazed heath habitat is on a knife edge. A small increase in grazing pressure can begin to damage the heaths and create bare compacted ground. This however, has probably occurred before and may be part of the dynamics of the habitat. The east of Plaitford Common for example was given a bit of a battering in the 1990s, but is now recovering. In fact the very hard grazing here may have increased bare ground and, with the ongoing recovery, may represent a diversification of the habitat. For example, what looked like former cattle feeding points on short grazed heath were being densely colonised by *Cladonia arbuscula* as part of the recovery. Also the internationally threatened hard humus lichen assemblage was more prominent in the Plaitford Common short heaths than in less battered areas such as Cadnam Common.

- **It is important not to overreact to periods of very high grazing, for instance by reducing grazing so much that lichen poor tall heath is produced.**

Maintaining the current pattern of uneven grazing will be very much bound up with the pattern of animal turn out by commoners. In particular cattle may be important in maintaining short heather swards (Richard Reeves, pers. com.). As discussed in Chatters et al (2014) in relation to the conservation of Small Fleabane *Pulicaria vulgaris*, medium sized enterprises turning out turning out forty or more head of cattle are under particular pressure. Many areas of old rich short grazed heath including those at Plaitford Common, Ogden's Purlieu, north of Matley Wood and Acres Down and others are close to commoner's holdings turning out significant numbers of cattle. The recommendations in Chatters et al (2014) for supporting such enterprises are likely also be significant for lichen conservation.

- **Long term maintenance the hard grazed short heaths is of vital importance for lichen heathland conservation. Therefore special support for commoner enterprises turning out more than 40 cattle, including financial support and measures to encourage a new generation of commoners, should be considered.**

4.4.3 Specific Issues – Burning Rotation and Heather Mowing

Continuing the current well managed and high quality burning programme is fundamental for the conservation of lichen biodiversity in the New Forest.

- **Maintain the current burning programme.**

There are issues to consider with the balance between burning and mowing and other marginal issues to the burning programme. Mowing is no substitute for burning and produces a very poor habitat for lichens. There is no problem with the relatively small scale (Forest Enterprise, 2008) of the current cutting programme but any major expansion would be problematic. Also it may be advisable to rotate cut areas though a burn every so often, to ensure the long term survival of nutrient poor heath. Fire is a far more efficient remover of nutrients than cutting. In practical terms, there is probably a synergy between areas that are practically suitable for mowing heather and less lichen rich heather stands; both are flatter areas with strong growths of Heather on more productive plateau sites.

- **Mowing is acceptable on a small scale but, across the open Forest as a whole, is not a suitable substitute for burning.**

Recent management plans (Wright & Westerhoff, 2001 & Forest Enterprise, 2008) mention potentially damaging effects of burning on the driest heaths and recommend that these are not burned. No actual evidence that burning these habitats would be damaging or to what, specifically, it would be damaging is presented. There seems to be an a priori assumption of biodiversity damage. This report and other work (Davies, 2001, Davies & Legg, 2008 & Harris et al, 2011) shows that heathland lichen and vascular plant diversity would be greatly reduced by a no burn policy on any particular heath type. Beyond the loss of lichen rich burned heath at the dry end of the series of heaths, such no burn treatments would eliminate Bell Heather, a highly fire dependant species; a serious biodiversity loss. The no burn treatments would result in monospecific heath stands with a cold damp under storey. This is hardly an appropriate treatment for the driest and warmest heaths on the Forest.

- **The driest heaths in the Forest should not be treated any differently from the rest of the heaths and should be incorporated into the burning cycle.**

There could be no objection to systematically applying a no burning policy to specific patches on the heaths to protect specific features, such as Adder *hibernacula* (Richard Reeves, pers. com.), as long as the main burning programme is maintained. Providing fire refuges is not necessary for lichens as the short grazed heaths provide these, but other biodiversity interests are likely to require refuges within longer vegetation.

- **Rather than a policy of not burning very dry heath, specific fire refuges in areas of taller heath should be managed for the benefit of other interest features that would otherwise be harmed or damaged by burning.**

The boundary between the short grazed heaths and the burnable heaths is shifting; tall heaths can be converted to short heaths by increased grazing and vice-versa. For example at Fair Cross (SU3009) part of an area of what was short grazed heath in the 1980s had begun growing away by the 2000s and was burned on 25th March 2002 (Dave Morris, pers. com.). When this area was examined 30th January 2011, it was found to have lots of the highly threatened declining moss *Dicranum spurium* VU (NS/S41) regrowing across the burned area. This is a moderately burn-sensitive moss found mainly in short grazed heaths but is tolerant of controlled burning in moderately browsed heaths. It is highly shade intolerant and certainly would have been lost to shade if the heather had been left to get taller. Here the decisions by the

Forestry Commission staff as to what to burn based on site condition worked well; there seems to be no reason to change this.

- **The boundary between burned and unburned short grazed heath will be shifting and should not be set in stone. It is best set by experienced FC staff using their field experience to determine what can be burned and needs to be burned.**

Prior to Wright & Westerhoff (2001) there were issues with ensuring the transition from humid heath through wet heath to mire was burned. Traces were often cut parallel to the mire edge, in drier ground missing out areas of burnable wetter heaths. The transition zone that is likely to be cut off by the traces often has a very rich lichen assemblage of burning tolerant to burning dependent species. Wright & Westerhoff (2001) recommended that wherever possible the mire edge be used as the stop to the fire. This appears to have been largely adhered to since.

- **Ensure that lichen rich burning-dependent fringes to the mires are continue to be burned and are not left unburned as a result of cutting fire traces on drier ground.**

4.4.4 Specific Issues – Erosion and Soil Disturbance

Erosion and soil disturbance have been an integral part of the heathland landscape for millennia. This reached a crescendo of destruction during WWII and continued with the digging of large commercial gravel pits post war. The result is a legacy of lichen rich hot spots on Bronze Age barrows, medieval banks, medieval to early modern hollow ways, early modern small scale gravel pits, medium scale WWII gravel pits, WWII airfield sites and large scale post war Forestry Commission (on the crown lands) and commercial (off the crown lands) gravel pits.

With increasing protection of the heathland there is no large scale disturbance now, but there is still plenty of small scale linear disturbance due to path and track creation caused by people, vehicles and animals. This, however, can damage other important features of interest, especially archaeological features, can be unsightly and is generally viewed as a bad thing. However, localised erosion, which receives negative attention, may actually be less damaging to biodiversity than widespread trampling. Erosion normally occurs in longer vegetation in the burned heaths, where traffic is concentrated. This generally results in the temporary loss of small strips of low diversity heathland, an abundant feature, to be replaced by recolonising bare ground as the path moves, which is a rare feature and of biodiversity importance. Heavy human trampling on short swards, however, although it leaves the sward intact, grossly reduces the species diversity in the swards (Pascoe, 2014) and can eliminate lichens from parched acid grasslands (U1f) and short grazed heath (H2c) (Sanderson, 2003). Lichen short grazed heath is vulnerable to trampling, but most areas are not close to heavily used areas. The eastern side of Plaitford Common and very close to Round Hill Campsite were the only areas where trampling was noted as an issue in this survey. Far larger areas of the New Forest are likely to be suffering from trampling than are being damaged by erosion from a biodiversity point of view but attract little attention. If solutions are possible, they are likely to involve reducing numbers of people by managing access.

- **In assessing the impact of recreation on the biodiversity interest of the New Forest, more attention should be given to localised intense trampling that**

reduces sward diversity without creating any new valuable habitat, but has been largely over looked. Erosion, which has attracted much more attention, is much more complex as it is creative as well as destructive to biodiversity interest.

As well as lichens, many invertebrate groups depend on disturbance to create bare ground (Kirby, 1992). Maintaining bare ground and naturally recolonising heath on bare ground is very important if heath biodiversity is to be conserved. For lichens the impact of disturbance can be very long term; the sides of Bronze Age barrows are still more interesting than the adjacent flat heath. There is, however, a suite of species earlier succession species that depend on colonising fresh exposures of bare soils. These include significant species such as *Cladonia callosa* Nb (NS), an Atlantic endemic for which the Forest appears to have very large population, and *Dibaeis baeomyces*. *Icmadophila ericetorum*, now very rare in England, is dependent on vertical banks found in recent path ruts or reactivated old hollow ways.

If the international importance of the New Forest's lichen assemblage is to be maintained new exposures of bare ground are required. On heaths beyond the New Forest, this has been produced by artificial disturbance. This can work well for some lichens but in the Netherlands has proved to have mixed results for lichens (Ketner-Oostra et al, 2010 & Haveman & Ronde, 2013). Some species of hard black humus such as Heathtooth *Pycnothelia papillaria*, which is a frequent colonist of disturbed areas in the New Forest, have conspicuously not been conserved by artificial disturbance in the Netherlands. Another example, *Cladonia subcervicornis*, which is extinct in the Netherlands. These species probably require continued declining use as occurs on semi-abandoned pathways but is absent from artificially created bared ground. Currently, path and track creation through erosion processes is providing plenty of suitable habitats for free. This only works where the resultant bare ground is left to colonise naturally. During the 2011 – 15 survey it was noted that LIFE 2 work repairing path erosion had invariably eliminated any potentially interesting lichen habitats.

- **Small scale and shifting path rutting by recreation access, grazing animals or vehicle access is very beneficial to lichen diversity and other species requiring bare ground. This activity provides patches and banks of bare ground for lichen colonisation and is an integral part of the heathland cultural landscape. This type of disturbance should be accepted unless excessive or is proven to be damaging important features.**

- **Where restoration work is required it is important, as far as possible, to minimise active repairs. Take measures to prevent further damage and allow slow natural vegetation colonisation.**

- **The impact of regular use by bicycle tyres appears to be different from foot and hoof impact and produce less varied micro terrain. The current unofficial access to wide areas by bicycle is a concern and curbing this is urged.**

- **Excessive damage should be tackled by reducing use, if at all possible, and certainly not by regularising pathways into fixed and maintained suburban style paths.**

Finally during the 2011 – 15 survey it was noted that some tumuli that are scheduled as ancient monuments within grasslands in heavily used areas on the common grazings had been fenced off from grazing totally. These were fenced after being restored and covered with rabbit proof netting; the fencing is to prevent damage from livestock during recovery (Jen Thomas, pers. com.). A fenced off tumuli at Round Hill, which had the Section 41 vascular plant Wild Chamomile *Chamaemelum nobile* in 2003 (Sanderson, 2003) by 2014 was overgrown and Bramble invaded and had lost the Section 41 species. There was no evidence that any aftermath management was being carried out to prevent scrub invasion, which is potentially just as damaging to the tumuli as unfettered access. The impact of this archaeological conservation appears to be entirely negative to the biodiversity interest of the New Forest. Should tumuli within the heaths be treated similarly, this would be very damaging to the lichen interest of the heaths. Putting fences around the tumuli would also damage the very landscape setting that was certainly in the minds of the original builders of the monuments.

- **Fencing off tumuli within heaths should be avoided and other methods of archaeological conservation investigated if action is thought necessary.**

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ANNEX 1 Lichen Diversity and Environmental Variable Data

The lichen diversity and environmental variable data collected from all the New Forest Quantitative Inventory quadrats is listed below.

Quadrat	No Species	Diversity/ cover score	Veg	Burn	Sward Height	Browsing
WMH1	12	75	DH	12	L	M
WMH2	9	37	DH	12	L	M
WMH3	11	37	DH	12	L	M
WMH4	5	14	DH	12	L	M
WMH5	10	46	DH	12	L	M
WMH6	10	54	DH	12	L	M
WMH7	12	72	DH	12	L	M
WMH8	13	85	DH	12	L	M
WMH9	12	57	DH	12	L	M
WMH10	10	54	DH	12	L	M
WMH11	1	3	DH	12	L	M
WMH12	7	66	DH	12	L	M
ODH1	4	26	DH	NB	L	H
ODH2	6	49	DH	NB	L	H
ODH3	5	51	DH	NB	L	H
ODH4	8	62	DH	NB	L	H
ODH5	13	58	DH	NB	L	H
ODH6	5	24	DH	NB	L	H
ODH7	7	62	DH	NB	L	H
ODH8	3	21	DH	NB	L	H
ODH9	4	25	DH	NB	L	H
ODH10	5	40	DH	NB	L	H
ODH11	7	36	DH	NB	L	H
ODH12	7	36	DH	NB	L	H
LCH1	3	6	AD	3	L	H
LCH2	4	21	AD	3	L	H
LCH3	2	5	AD	3	L	H
LCH4	6	44	AD	3	L	H
LCH5	2	7	AD	3	L	H
LCH6	1	2	AD	3	L	H
LCH7	3	7	AD	3	L	H
LCH8	0	0	AD	>20	M	M
LCH9	1	1	AD	>20	M	M
LCH10	5	35	AD	3	L	H
LCH11	2	6	AD	3	L	H
LCH12	1	2	AD	3	L	H
RHH1	10	44	DH	NB	L	H
RHH2	0	0	DH	NB	L	H
RHH3	5	16	AD	NB	L	H
RHH4	13	58	AD	NB	L	H
RHH5	8	38	AD	NB	L	H
RHH6	2	7	AD	NB	L	H
RHH7	0	0	DH	NB	L	H
RHH8	6	48	AD	NB	L	H
RHH9	3	21	AD	NB	L	H

Quadrat	No Species	Diversity/ cover score	Veg	Burn	Sward Height	Browsing
RHH10	7	47	AD	NB	L	H
RHH11	2	7	AD	NB	L	H
RHH12	5	31	AD	NB	L	H
HCH1	0	0	DH	>20	H	L
HCH2	0	0	DH	>20	H	L
HCH3	0	0	DH	>20	H	L
HCH4	0	0	DH	>20	H	L
HCH5	1	1	DH	>20	H	L
HCH6	0	0	DH	>20	H	L
HCH7	0	0	DH	>20	H	L
HCH8	0	0	DH	>20	H	L
HCH9	0	0	DH	>20	H	L
HCH10	0	0	DH	>20	H	L
HCH11	0	0	DH	>20	H	L
HCH12	0	0	DH	>20	H	L
BTH1	0	0	W	14	M	L
BTH2	0	0	DH	14	M	L
BTH3	0	0	DH	14	M	L
BTH4	0	0	DH	14	M	L
BTH5	0	0	DH	14	M	L
BTH6	2	15	DH	14	M	L
BTH7	2	3	DH	14	M	L
BTH8	0	0	AD	14	M	L
BTH9	0	0	AD	14	M	L
BTH10	5	22	DH	14	M	L
BTH11	3	11	DH	14	M	L
BTH12	0	0	DH	14	M	L
SFH1	1	2	DH	12	M	L
SFH2	6	16	DH	12	M	L
SFH3	8	35	DH	12	M	L
SFH4	3	11	DH	19	M	L
SFH5	8	26	DH	19	M	L
SFH6	11	66	DH	12	M	L
SFH7	1	1	DH	12	M	L
SFH8	1	6	DH	12	M	L
SFH9	0	0	W	12	M	L
SFH10	6	16	DH	12	M	L
SFH11	8	27	DH	12	M	L
SFH12	1	4	DH	12	M	L
OPH1	0	0	AD	>20	H	L
OPH2	0	0	AD	>20	H	L
OPH3	0	0	AD	>20	H	L
OPH4	0	0	AD	>20	H	L
OPH5	0	0	AD	>20	H	L
OPH6	0	0	AD	13	H	L
OPH7	0	0	AD	13	H	L
OPH8	0	0	AD	13	H	L
OPH9	0	0	AD	13	H	L
OPH10	0	0	AD	13	H	L
OPH11	0	0	AD	13	H	L

Quadrat	No Species	Diversity/ cover score	Veg	Burn	Sward Height	Browsing
OPH12	9	50	AD	13	H	L
PGH1	0	0	M	NB	L	H
PGH2	5	34	DH	NB	L	H
PGH3	8	62	DH	NB	L	H
PGH4	0	0	DH	NB	L	H
PGH5	0	0	AG	NB	L	H
PGH6	9	36	DH	NB	L	H
PGH7	9	45	DH	NB	L	H
PGH8	10	52	DH	NB	L	H
PGH9	7	52	DH	NB	L	H
PGH10	6	33	DH	NB	L	H
PGH11	0	0	M	NB	L	H
PGH12	0	0	TW	NB	L	H
OHH1	0	0	TW	>20	M	M
OHH2	0	0	TW	>20	M	M
OHH3	2	11	TW	>20	M	M
OHH4	5	21	DH	6	M	M
OHH5	3	10	DH	6	L	M
OHH6	3	18	AD	6	M	M
OHH7	0	0	TW	>20	M	M
OHH8	0	0	TW	>20	M	M
OHH9	0	0	TW	>20	M	M
OHH10	0	0	TW	>20	M	M
OHH11	0	0	TW	>20	M	M
OHH12	0	0	TW	>20	M	M
WBH1	0	0	AD	>20	M	M
WBH2	4	28	AD	>20	M	M
WBH3	0	0	AD	2	L	M
WBH4	0	0	AD	2	L	M
WBH5	0	0	AD	2	L	M
WBH6	0	0	AD	2	L	M
WBH7	0	0	AD	10	M	M
WBH8	0	0	AD	10	M	M
WBH9	0	0	AG	10	M	M
WBH10	5	23	AD	10	M	M
WBH11	0	0	AD	10	M	M
WBH12	0	0	AD	10	M	M
GPH1	0	0	DH	>20	H	L
GPH2	2	3	DH	>20	H	L
GPH3	0	0	AD	7	L	M
GPH4	0	0	AG	7	L	M
GPH5	8	37	DH	7	L	M
GPH6	7	28	DH	7	L	M
GPH7	0	0	DH	7	L	M
GPH8	0	0	DH	7	L	M
GPH9	11	59	DH	7	L	M
GPH10	4	10	DH	7	L	M
GPH11	0	0	DH	>20	H	L
GPH12	0	0	AG	>20	H	L
HMJ1	3	36	WL	NB	L	H

Quadrat	No Species	Diversity/ cover score	Veg	Burn	Sward Height	Browsing
HMJ2	1	13	WL	NB	L	H
HMJ3	0	0	WL	NB	L	H
HMJ4	3	17	WL	NB	L	H
HMJ5	0	0	WL	NB	L	H
HMJ6	6	23	WL	NB	L	H
HMJ7	0	0	WL	NB	L	H
HMJ8	7	97	DH	NB	L	H
HMJ9	7	90	DH	NB	L	H
HMJ10	0	0	WL	NB	L	H
HMJ11	0	0	WL	NB	L	H
HMJ12	0	0	WL	NB	L	H
BLJ1	0	0	M	5	L	M
BLJ2	0	0	M	5	L	M
BLJ3	3	10	TW	5	L	M
BLJ4	0	0	TW	5	L	M
BLJ5	0	0	TW	5	L	M
BLJ6	0	0	M	5	L	M
BLJ7	0	0	TW	5	L	M
BLJ8	0	0	M	5	L	M
BLJ9	0	0	TW	5	L	M
BLJ10	1	10	TW	5	L	M
BLJ11	0	0	WL	5	L	M
BLJ12	0	0	WL	5	L	M
WMJ1	0	0	TW	7	M	L
WMJ2	1	4	TW	7	M	L
WMJ3	1	6	TW	7	M	L
WMJ4	0	0	TW	7	M	L
WMJ5	2	18	TW	7	M	L
WMJ6	0	0	TW	7	M	L
WMJ7	1	1	TW	7	M	L
WMJ8	0	0	DH	7	M	L
WMJ9	0	0	BW	NB	L	L
WMJ10	0	0	TW	7	M	L
WMJ11	0	0	TW	7	M	L
WMJ12	0	0	WL	NB	L	H
BLD1	1	25	AG	NB	L	H
BLD2	0	0	AG	NB	L	H
BLD3	0	0	AG	NB	L	H
BLD4	1	3	AG	NB	L	H
BLD5	1	2	AG	NB	L	H
BLD6	1	9	AG	NB	L	H
BLD7	0	0	AG	NB	L	H
BLD8	0	0	AG	NB	L	H
BLD9	2	38	AG	NB	L	H
BLD10	0	0	AG	NB	L	H
BLD11	1	4	AG	NB	L	H
BLD12	1	11	AG	NB	L	H
CHD1	0	0	AG	NB	L	H
CHD2	0	0	AG	NB	L	H
CHD3	0	0	AG	NB	L	H

Quadrat	No Species	Diversity/ cover score	Veg	Burn	Sward Height	Browsing
CHD4	0	0	AG	NB	L	H
CHD5	0	0	AG	NB	L	H
CHD6	0	0	AG	NB	L	H
CHD7	0	0	AG	NB	L	H
CHD8	0	0	AG	NB	L	H
CHD9	0	0	AG	NB	L	H
CHD10	0	0	AG	NB	L	H
CHD11	0	0	AG	NB	L	H
CHD12	0	0	AG	NB	L	H
LSD1	0	0	AG	NB	L	H
LSD2	0	0	AG	NB	L	H
LSD3	0	0	AG	NB	L	H
LSD4	0	0	AG	NB	L	H
LSD5	0	0	AG	NB	L	H
LSD6	0	0	AG	NB	L	H
LSD7	0	0	AG	NB	L	H
LSD8	0	0	AG	NB	L	H
LSD9	0	0	AG	NB	L	H
LSD10	0	0	AG	NB	L	H
LSD11	0	0	AG	NB	L	H
LSD12	0	0	AG	NB	L	H
JPD1	0	0	AG	NB	L	H
JPD2	2	28	AG	NB	L	H
JPD3	0	0	AG	NB	L	H
JPD4	3	5	AG	NB	L	H
JPD5	0	0	AG	NB	L	H
JPD6	2	11	AG	NB	L	H
JPD7	2	17	AG	NB	L	H
JPD8	0	0	AG	NB	L	H
JPD9	0	0	AG	NB	L	H
JPD10	2	18	AG	NB	L	H
JPD11	0	0	AG	NB	L	H
JPD12	0	0	AG	NB	L	H
ADD1	0	0	AG	NB	L	H
ADD2	0	0	AG	NB	L	H
ADD3	0	0	AG	NB	L	H
ADD4	0	0	AG	NB	L	H
ADD5	0	0	AG	NB	L	H
ADD6	0	0	AG	NB	L	H
ADD7	0	0	AG	NB	L	H
ADD8	0	0	AG	NB	L	H
ADD9	0	0	AG	NB	L	H
ADD10	0	0	AG	NB	L	H
ADD11	0	0	AG	NB	L	H
ADD12	0	0	AG	NB	L	H
BUL1	0	0	WL	NB	L	H
BUL2	0	0	WL	NB	L	H
BUL3	0	0	WL	NB	L	H
BUL4	0	0	WL	NB	L	H
BUL5	0	0	WL	NB	L	H

Quadrat	No Species	Diversity/ cover score	Veg	Burn	Sward Height	Browsing
BUL6	0	0	WL	NB	L	H
BUL7	0	0	WL	NB	L	H
BUL8	0	0	WL	NB	L	H
BUL9	0	0	WL	NB	L	H
BUL10	0	0	WL	NB	L	H
BUL11	0	0	WL	NB	L	H
BUL12	0	0	WL	NB	L	H
BLL1	0	0	WL	NB	L	H
BLL2	0	0	WL	NB	L	H
BLL3	0	0	WL	NB	L	H
BLL4	0	0	WL	NB	L	H
BLL5	0	0	WL	NB	L	H
BLL6	0	0	WL	NB	L	H
BLL7	0	0	WL	NB	L	H
BLL8	0	0	WL	NB	L	H
BLL9	0	0	WL	NB	L	H
BLL10	0	0	WL	NB	L	H
BLL11	0	0	WL	NB	L	H
BLL12	0	0	WL	NB	L	H
SWL1	0	0	WL	NB	L	H
SWL2	0	0	WL	NB	L	H
SWL3	0	0	WL	NB	L	H
SWL4	0	0	WL	NB	L	H
SWL5	0	0	WL	NB	L	H
SWL6	0	0	WL	NB	L	H
SWL7	0	0	WL	NB	L	H
SWL8	0	0	WL	NB	L	H
SWL9	0	0	WL	NB	L	H
SWL10	0	0	WL	NB	L	H
SWL11	0	0	WL	NB	L	H
SWL12	0	0	WL	NB	L	H

ANNEX 2 A method to identify *Cladonia* Species and Associated Lichens

This is the method of identifying English *Cladonia* species used for this survey, it covers mostly those of heathland but with other *Cladonia* species added for completeness, along with similar and associated heathland lichens. It is split into mostly artificial groups based on general characteristics. This is intended as a rough key but, in identifying *Cladonia*, reading through and comparing descriptions of the potential species can produce better results, than using dichotomous keys. The *Cladonia* key in the Lichens of Great Britain and Ireland for example tends to key out well developed specimens only, for example immature or stunted specimens of *Cladonia polydactyla* without cups will key out as *Cladonia macilenta*, in spite of both species being quite distinct in their cortex characters.

The first important split is whether the lichen has squamules or not.

1. Without Squamules

The subgroups devised here are natural groups, except Heaththorns, where the two species, *Cladonia uncialis* and *Cladonia zopfii*, are apparently not closely related. The large robust much branched **Reindeer Mosses** have podetia which originate from ephemeral granular crusts. With **Heathtooth** *Pycnothelia papillaria* the crust is dominant and perennial with the podetia small and molar or rice grain like. The **Heaththorns** *Cladonia uncialis* and *Cladonia zopfii* are quite like Reindeer Mosses but are much more sparsely branched with more inflated podetia. Finally the **Spinyheaths** *Cetraria* species look like brown Reindeer Mosses but are actually not related, with some other *Cetraria* species being leafy (foliose) lichens. The shrubby *Cetraria* species are an example of convergent evolution.

1a. Reindeer Mosses, *Cladonia* group *Cladina*

Distinctive robust and much branched lichens. The key feature is the lack of squamules; in this group the podetia originates from an ephemeral granular crust not from squamules. They also have diffuse a cortex, which is fuzzy and mat. Some confusion is possible with the False Reindeer Mosses, especially *Cladonia rangiformis*. These are also tall and much branched but always have some squamules present somewhere and a well developed cortex. The Heaththorns (*Cladonia uncialis* and *Cladonia zopfii*) also have no squamules but have more inflated hollow podetia and like the False Reindeer Mosses they have a well developed cortex; the surface is smooth and hard. Reindeer Mosses have no true cortex and the outer algae containing layer is finely fibrous on the surface. Separating the individual species is not at all easy, with spot tests, UV florescence and subtle branching patterns important.

Cladonia arbuscula ssp. *squarrosa*
Cladonia azorica
Cladonia portentosa
Cladonia ciliata var. *ciliata*
Cladonia ciliata var. *tenuis*
Cladonia mediterranea
Cladonia rangiferina

1b. Heaththorns *Cladonia uncialis* and *Cladonia zopfii*
These differ from the Reindeer Mosses by their more sparingly branched podetia, which are more inflated below, with abruptly tapered at apices. The effect is a stiff and spiky thallus as opposed to the more elegant tufts of the Reindeer Mosses. The most upright and bushy *Cladonia zopfii* specimens, are easily overlooked as Reindeer Mosses, but otherwise form a distinctive group. Within the group, identification is made by branching angle, cortex colour and patterning, the presence of open and closed axils in podetia, and the type of surface observed on the inner surface of the hollow podetia when split open.

Cladonia uncialis ssp. *biuncialis*
Cladonia zopfii

1c. Spinyheaths Shrubby *Cetraria* species
Also shrubby lichens superficially like the Reindeer Mosses but brown and shiny and with a very different anatomy if looked at closely. The thallus is angular rather than rounded, with lateral spinules and has small holes in the cortex (pseudocyphellae), which show as pale patches. The pycnidia are also stalked. The two species are sometimes not regarded as separate species but can be found growing together, when the differences between them are quite apparent. Identification is by the branching pattern, podetia cross section and the shape of the pseudocyphellae.

Cetraria aculeata
Cetraria muricata

1d. Heathtooth *Pycnothelia papillaria*
This group includes only one species, the very distinctive *Pycnothelia papillaria*. It is characterised by its thick persistent thallus from which small rounder molar or rice grain like podetia develop. A declining species across lowland Europe.

Pycnothelia papillaria

2. With Squamules
The subgroups devised for lichens with squamules are not natural groups, these are still being sorted out for these groups, but are convenient groupings based on general physical characteristics. Some species are found in more than one group. The **False Reindeer Mosses** have large well branched podetia, which could be confused with the true Reindeer Mosses, but always have some squamules. Very distinctive and well known are the **Pixie Cups**, with their robust goblet like podetia with cups much wider than the stem with deep hollows. Most have brown apothecia, but there are also Pixie Cups with red apothecia. Also with cups are the **Stacking Cups**, but these have narrower and shallower cups and prominent basal squamules mats. The core species in the group, *Cladonia cervicornis* s. str. and *Cladonia verticillata* have distinctive tiers of cups poliferating from the centre of the cup below. These species and the others in the group are often sterile and are included within the **Squamule Mats** group. The largest group is the **Heathtails**, which have little branched upright podetia, with no or small neat cups. The **Devil's Matchstick** group is defined by the presence of red apothecia or pycnidia. The final group, the **Squamule Mats**, are those *Cladonia* species with prominent mats of basal squamules

that either have small podetia, are rarely fertile or are sometimes sterile but can still be identified.

2a. False Reindeer Mosses
These have large well branched podetia, which could be confused with the true Reindeer Mosses, but always have some squamules. At times these need to be searched for with care. Another feature that distinguishes these from Reindeer Mosses is that the False Reindeer Mosses have well developed cortex with a firm shiny surface, while the Reindeer Mosses have a diffuse cortex, which is fuzzy and mat.

Cladonia furcata ssp. *furcata*
Cladonia furcata ssp. *subrangiformis*
Cladonia rangiformis
Cladonia scabriuscula

2c. Brown Pixie Cups
Lichens with well developed typically goblet shaded cups, with deep hollows inside the cups. Mostly with brown apothecia or pycnidia but there are Pixie Cups type lichens with red apothecia or pycnidia. Podetia cortex often with abundant soredia, sorediate granules or small squamules. Basal squamules not prominent in most species. Lichens with smaller cups referenced here as well but the Stacking Cup group species are not. These have narrower cups, with shallower barely indented cups and usually prominent basal squamules mats.

Cladonia chlorophaea s. str.
(Cladonia borealis)
(*Cladonia coccifera*)
Cladonia cyathomorpha
(*Cladonia diversa*)
Cladonia cryptochlorophaea
Cladonia fimbriata
Cladonia grayi s. str.
Cladonia humilis
Cladonia humilis schizidiate form
Cladonia ramulosa

2d. Stacking Cups
Also with cups, but they have narrower and shallower cups and usually prominent basal squamules mats. The core species in the group, *Cladonia cervicornis* s. str. and *Cladonia verticillata* can have distinctive tiers of cups proliferating from the centre of the cup below, others can rarely proliferate from the rim. Podetia cortex usually smooth, at most some large squamules. These species and the others in the group are often sterile and are also included within the **Squamule Mats** group

Cladonia cervicornis s. str.
(*Cladonia firma*)
(*Cladonia foliacea*)
Cladonia phyllophora
(*Cladonia strepsilis*)
(Cladonia subcervicornis)

Cladonia verticillata

2e. Heathtails
The largest group, which have little branched upright podetia, with no or small neat cups. Overlaps with the **Devil's Matchstick group**, with red apothecia, the more branched **False Reindeer Mosses** and the **Squamule Mats group** for plants that are mainly sterile.

Cladonia callosa
Cladonia cariosa
Cladonia coniocraea
Cladonia cornuta
Cladonia crispata var. *cetrariiformis*
(*Cladonia furcata* ssp. *furcata*)
(*Cladonia furcata* ssp. *subrangiformis*)
Cladonia glauca
Cladonia gracilis
(*Cladonia macilenta*)
Cladonia ochrochlora
(*Cladonia polydactyla* var. *polydactyla*)
(*Cladonia ramulosa*)
Cladonia rei
(*Cladonia scabriuscula*)
Cladonia squamosa var. *squamosa*
Cladonia squamosa var. *subsquamosa*
Cladonia subulata
(*Cladonia sulphurina*)

2f. Devil's Matchsticks
A group distinguished by the presence of red apothecia or pycnidia on Heathtail type podetia, smaller narrow and shallow cups can be present but the group excludes species with deep goblet shaped cups (see **Red Pixie Cups**), but includes a single species also included in the **Squamule Mats Group**.

Cladonia digitata
Cladonia floerkeana
(*Cladonia incrassata*)
Cladonia macilenta
Cladonia polydactyla var. *polydactyla*
Cladonia sulphurina

2f. Red Pixie Cups
Species with similar deep goblet shaped cups to the **Brown Pixie Cup Group** but with red apothecia or pycnidia. Also differs from the **Brown Pixie Cup Group** by the pale yellow-grey colour of the podetia from the presence of usnic acid.

Cladonia coccifera
Cladonia borealis
Cladonia diversa

2h. Squamule Mats

The final group are those *Cladonia* species with prominent mats of basal squamules that either have small podetia, are rarely fertile or are sometimes sterile but can still be identified.

(*Cladonia cervicornis* s. str.)
(*Cladonia callosa*)
Cladonia firma
(*Cladonia floerkeana*)
Cladonia incrassata
Cladonia parasitica
(*Cladonia ramulosa*)
(*Cladonia strepsilis*)
(*Cladonia subcervicornis*)
(*Cladonia verticillata*)

ANNEX 3 The Text of Sanderson (2011b)

The numbers of new species of conservation interest found in the early part of the New Forest Heathland Lichen Survey was startling. The following is a text of an article written in response to this for the British Lichen Society Bulletin.

Dazed and Amazed in the New Forest

Since carrying out NVC based vegetation surveys of lowland heathland SACs in the Thames Basin and the Weald in the early 2000s, I have been concerned that there has been a considerable decline in the quality of heathland lichen floras in these areas compared to the New Forest. This reinforced concerns expressed by Francis Rose (Rose, 1992) about the disappearance of some sensitive species from the Sussex heathlands, including *Cladonia arbuscula*, which appears to be extinct in that county. This decline had not been apparent in the New Forest (Sanderson, 1996 & 2010), possibly reflecting a continuity of grazing and careful controlled long rotation burning.

There is the potential for the shifting baseline phenomenon, with the impoverishment of many lowland heaths being regarded as normal. Certainly there seems to be little general appreciation that there might be a problem and searching the internet produced nothing concerning lowland heathland management and lichen diversity. The standard methods for carrying out condition assessments in lowland heaths are concerned only with cover of lichens, not species diversity (JNCC, 2004). As species poor heaths can still have sheets of one species, *Cladonia portentosa*, this would seem to be sure fire recipe to produce a shifting baseline in heathland lichen diversity.

As a result of this I believe that the BLS ought to consider organising a survey of lowland heathland lichens so we can get a more accurate picture of what is going on. We desperately need an update on the comprehensive study of Fletcher et al (1984). As a first step, however, this summer I started looking closely at lichen heaths on the New Forest which I had looked at with Francis Rose in the 1990s as well as some new sites. This was mainly to work out what could be recorded but also just to be sure things really were still OK in the New Forest.

It rapidly emerged that not only were the New Forest heaths in fine fettle but that I had clearly being neglecting the New Forest heaths for the woods. In particular one new site has completely blown me away with several new species for the New Forest found, one of them new to the lowlands. This is a not especially striking looking area of open short grazed heath looking like it had been burned within the last 10 years north east of Lyndhurst at White Moor SU3108. Actually, Forestry Commission records suggest it was control-burned 15 years ago, and the site is probably quite heavily browsed which has kept the stand in the building stage longer than usual. There are numerous canopy gaps with lichen dominance on thin hard humus and varying sized banks in ruts and hollow ways.

The survey of this site started curiously; during a lunchtime walk I took some pictures in damp and strongly lit conditions in an area with high cover of species such as *Cladonia strepsilis* and *Pycnothelia papillaria* on 4th August 2011. Some rather

bluish looking wet "*Cladonia strepsilis*" was photographed. Clearly this was a good area in need of a closer look.

A couple of days later Andy Cross and I had a detailed look at the lichens in a separate area. In a WWII gravel pit at Yew Tree Heath (SU3606) where we found more of the bluish "*Cladonia strepsilis*", this time dry and reacting C–. My first thought of "odd *C. cervicornis*" was dispelled by Andy asking of the same taxon nearby "what is this?" On the second look the penny dropped, this was probably *Cladonia subcervicornis*; later proved by the K + yellow reaction. This was a surprise; there is a previous record on the BLS dot maps for old Hampshire in new Dorset (SZ19), but this was apparently not accepted by Francis Rose in the 1996 Hampshire Flora (Sandell & Rose, 1996), who had no records of this species. Otherwise there are a few lowland records, none apparently recent and none from the New Forest. Curiously in Fletcher et al (1984), the presence of *Cladonia subcervicornis* is mentioned as an unusual feature of the New Forest heaths for a lowland site; so someone had seen it before. However, no records seem to have got into the BLS system and I had assumed this was some sort of error; apparently not!

On the 1st September, I went back to White Moor during lunchtime to check if the photograph from White Moor was really another *Cladonia subcervicornis* site. I confirmed it was present in some local abundance. In addition, back in the lab associated with a *Cladonia diversa* specimen were some squamules that I thought might be just be *Cladonia callosa*, which would have been even more exiting. So I went back the next lunch and confirmed it by finding fertile material, on small banks in old vehicle ruts (WWII vintage?). As this was new to the lowlands this was quite something. It did not stop, next was *Cladonia cornuta*, new to Hampshire, and material of the *Cladonia coccifera* agg that had the appearance of being possibly *Cladonia borealis*, if correct also new to the lowlands, but only TLC will tell. East of this the sides of an ancient hollow way produced *Cladonia incrassata* (NS), which is widespread in the New Forest, and a very odd lichen indeed that I took a bit of time to work out and was an object lesson on the difficulties of *Cladonia* identification. The determination of this wandered through odd *Cladonia pyxidata*, *C. monomorpha* and *Cladonia phyllophora* before ending at the more prosaic determination of big exuberant *C. ramulosa* with wide cups.

Finally on Saturday 3rd September, Andy Cross and I went back for an afternoon session on the site and found more. As well as new magnificent colonies of *Cladonia callosa*, growing with *Cladonia subcervicornis* on the banks of an ancient hollow way, further new species to the New Forest were found. On the way to the rich area, at stop to admire some fertile *Icmadophila ericetorum* I found earlier, material of what seems to be *Cladonia rei*, was spotted. If correct, new to Hampshire. This has corticate podetia bases, with curved and twisted podetia but not as forked as *C. subulata*, weekly Pd + yellow and a UV + medulla. Again this needs TLC to be sure. Within the rich area another new to Hampshire turned up, the mainly upland *Micarea leprosula*. This unassuming crust also had the honour of being the 500th lichen, related fungi and lichenicolous fungi recorded from the New Forest common grazings since the 1960s.

No more new species were found at this amazing site but the new species confirmed from here have all turned up in other sites, with both *Cladonia callosa* and *Cladonia*

subcervicornis appearing quite widespread. Other new species have turned up; *Arthrorhaphis grisea* parasitizing *Baeomyces rufus* and, just as this was being written, real *Dibaeis baeomyces*, all previous records of this species being sterile *Icmadophila ericetorum*. Another curiosity is out for expert determination.

It seems the description by Fletcher et al (1984) of the New Forest as an internationally important site for heathland lichens still stands. On current data some of the new records seem anomalous in a British context but comparisons with the Netherlands (Aptroot et al, 1998 & BLWG, 2011) shows species such as *Cladonia callosa* and *Micarea leprosula* are widespread there. There are interesting differences, however: *Cladonia subcervicornis* and *Icmadophila ericetorum* were extinct before 1900 in the Netherlands and I have failed to find any *Stereocaulon condensatum*, a signature species of lichen rich heathland in the Netherlands, in the New Forest.

I am still not sure what to make of all this, and am still quite stunned by the number of new species found, but there is clearly a lot more work to do in lowland heathland in England. What are the environmental conditions and management that encourages lichen diversity? I have ideas but these need further investigation. Are there more areas quite as spectacular as this in the New Forest? Is anything like this surviving outside of the New Forest? Well we can look and see.

Apparently strongly declining species for which records would be very helpful are *Cladonia arbuscula*, a fire sensitive specialist of grazed short grazed heath and grassland, and *Cladonia strepsilis* and *Pycnothelia papillaria*, which are open ground and fire dependant species. This would be a focused way of getting a good indication of the severity of the apparent declines. Beyond this surveying on a 1km grid square basis would also be useful. The best New Forest heathland squares have produced over 40 terricolous taxa, over 25 Cladonia taxa and a score of up to 29 using a index adding together the total number of *Cladonia*, *Cetraria* and *Pycnothelia* species. Finding out what survives is fascinating, exiting, requires quite a bit of field concentration, produces some hair pulling over identification and involves some stunningly beautiful lichen species.

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ANNEX 4 Species Accounts

A4.1 Introduction

Detailed accounts are given of the core heathland species recorded during the survey, with distribution maps where relevant. Other species are more briefly described.

A4.2 Heathland Terricolous Species

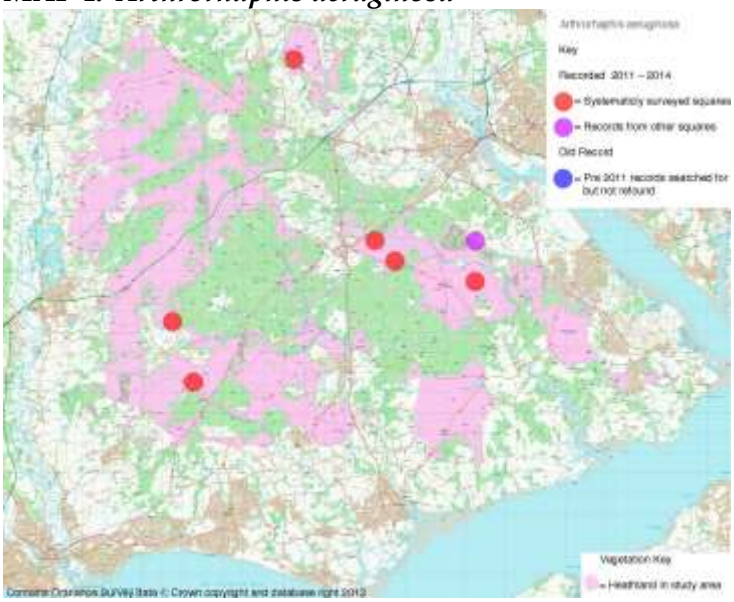
Agonimia globulifera Notable (NS): a tiny terricolous crust forming species of base enriched soils in lowland situations. **NFHLS**: recorded once on the site of the old runway at Stonycross Airfield. **New to the Forest in the 2001 – 15 survey**.

Agonimia tristicula: a common species of moss on base rich soil. **NFHLS**: recorded twice on moss over disturbed ground with concrete at Wootton Bridge and Yew tree Heath.

Arrhenia peltigerina [NR]: a parasitic basidiomycetes (mushroom) parasite confined to the widespread lichen *Peltigera hymenina*. **NFHLS**: recorded once on *Peltigera hymenina* in acid grassland.

Arthrorhaphis aeruginosa Notable (NS): a parasitic fungi infecting various *Cladonia* species and Heathtooth *Pycnothelia papillaria*, which stains the host green. A mainly upland species only known from the New Forest in the lowlands. **NFHLS**: recorded from seven 1km squares. **New to the Forest in the 2001 – 15 survey**. Mainly found on hosts in short grazed heath. The occurrence on *Pycnothelia papillaria*, appears to be the first record from this species (**Map 4**).

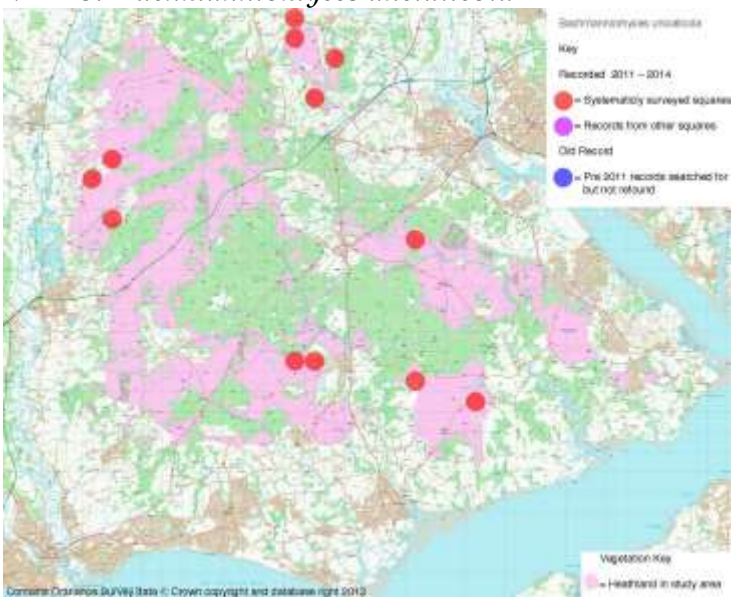
MAP 4: ***Arthrorhaphis aeruginosa***



Arthrorhaphis grisea [NR]: a parasitic fungi infecting *Baeomyces rufus* which is a widespread early colonist of acid soil on banks. The parasite is mainly upland, with only two records outside of the Forest in the lowlands and is much rarer than its host. **NFHLS**: **New to the Forest in the 2001 – 15 survey**. Rarely recorded in spite of the abundance of the host and noted in five 1km squares. All were on hollow way or trackside banks.

Bachmanniomyces uncialicola [NS]: a near obligate fungal parasite of *Cladonia uncialis*, only known from the New Forest in the lowlands. **NFHLS**: recorded from 12 1km squares, all on short grazed heaths where there are large populations of *Cladonia uncialis*. A single collection was made where *Bachmanniomyces uncialicola* was parasitising *Cladonia furcata* on Furzley Common in the Northern Commons. Most frequent in the Northern Commons. **New to the Forest in the 2001 – 15 survey**.

MAP 5: ***Bachmanniomyces uncialicola***

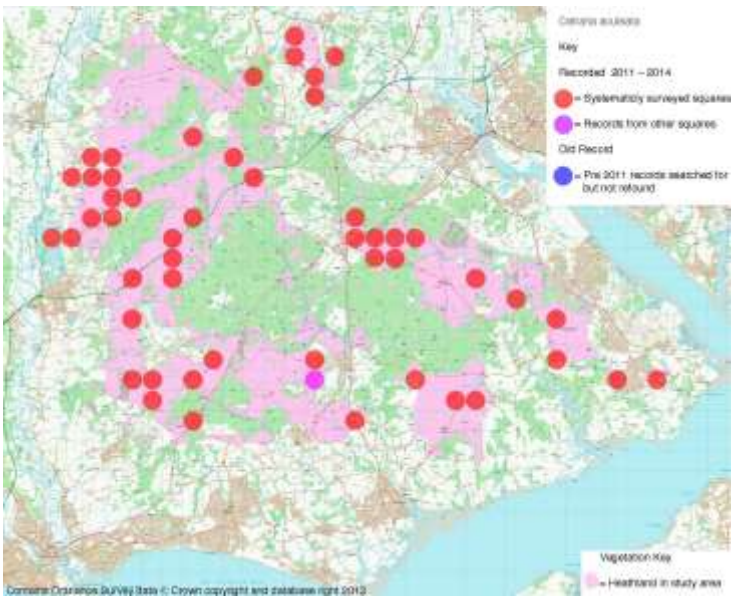


Bacidia bagliettoana: a widespread species of moss on base rich soil. **NFHLS**: recorded twice at Beaulieu Airfield and Yew Tree Heath on ripped up runways and on soil developing over a concrete base.

Baeomyces rufus: a widespread early colonist of acid soil on banks. **NFHLS**: recorded from 28 1km squares, almost entirely found on banks in actively eroding path systems.

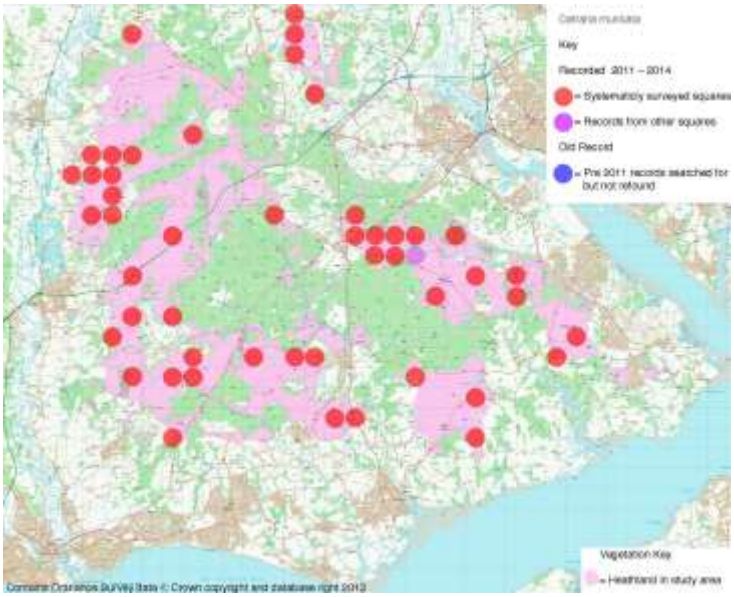
Cetraria aculeata: this robust but sparsely branched Spinyheath is a common in the uplands and widespread in acid soil areas in the lowlands. **NFHLS**: recorded from 52 1km squares, it is a characteristic species of high quality short grazed heaths and acid grasslands. Confined to fire refuges such as path edges in the burned heaths (**Map 6**).

MAP 6: ***Cetraria aculeata***



Cetraria muricata: this more richly branched Spinyheath is a common in the uplands and but rather uncommon in acid soil areas in the lowlands outside of the New Forest. **NFHLS**: recorded from 49 1km squares, it is a characteristic heathland specialist, usually absent from acid grasslands and is probably more tolerant of burning (**Map 7**).

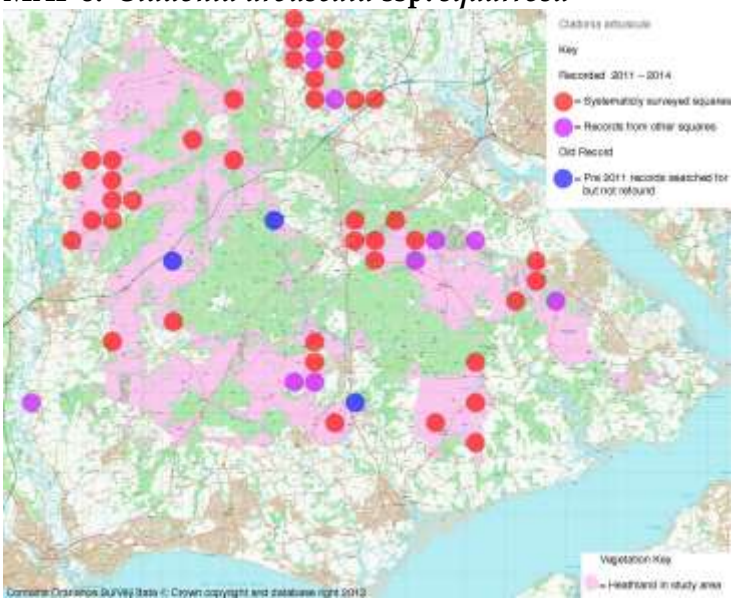
MAP 7: ***Cetraria muricata***



Cladonia arbuscula* ssp. *squarrosa: a robust Reindeer Moss, common in the uplands, but declining seriously in the lowlands. **NFHLS**: recorded from 49 1km squares, it is very a fire sensitive Reindeer Moss and is confined to long established short grazed heaths and wet heaths (where the impact of fire is mitigated) in the New Forest. There are exceptionally large populations on the short grazed heaths of the Northern Commons and about Ogden's Purlieu, with smaller patches on short grazed heaths and burned wet heath elsewhere. Conspicuously absent from recent developed short heaths, suggesting the species is significantly dispersal limited, but has colonised quarry floors in the west of the Forest so is not totally immobile. A few

old records were not refound, suggesting possible losses from the centre of the Forest, for reasons that are not clear (**Map 8**).

MAP 8: *Cladonia arbuscula* ssp. *squarrosa*

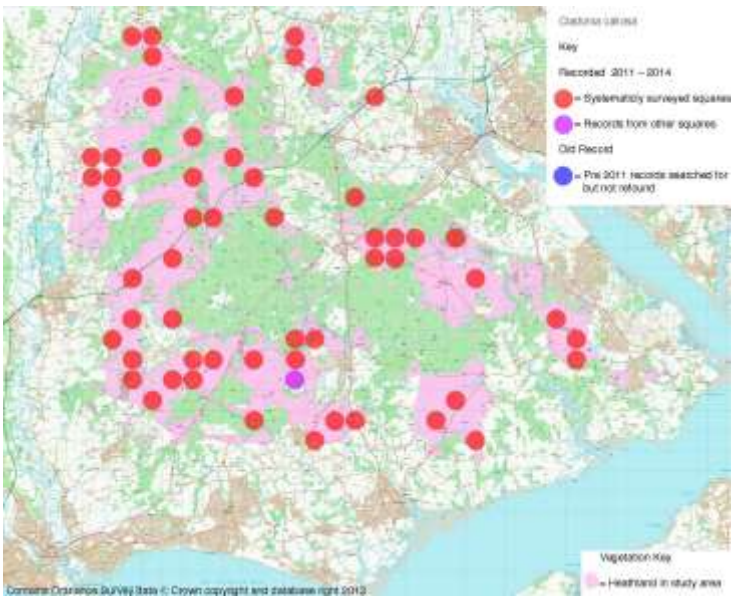


Cladonia borealis Notable (NR/DD): a difficult to identify red fruited Pixie Cup lichen, there are slight physical differences with *Cladonia coccifera* s. lat but the species requires TLC to confirm. It is probably a mainly upland species. Very rare in England. **NFHLS**: confirmed once from short grazed heath west of Brockenhurst at Red Hill, **new to the New Forest and the first modern record from England**. Clearly rare as quite a lot of specimens of the red fruited pixie where tested, but only one was *Cladonia borealis*. There are a few as yet to be tested potential specimens.

Cladonia caespiticia: a western lichen, mainly found on acid tree bark in humid woods, rare on moorland in the west. **NFHLS**: recorded once on the side of a hollow way near the edge of Bramshaw Wood. Frequent inside the woods on trees and on rare soil on root plates of fallen trees.

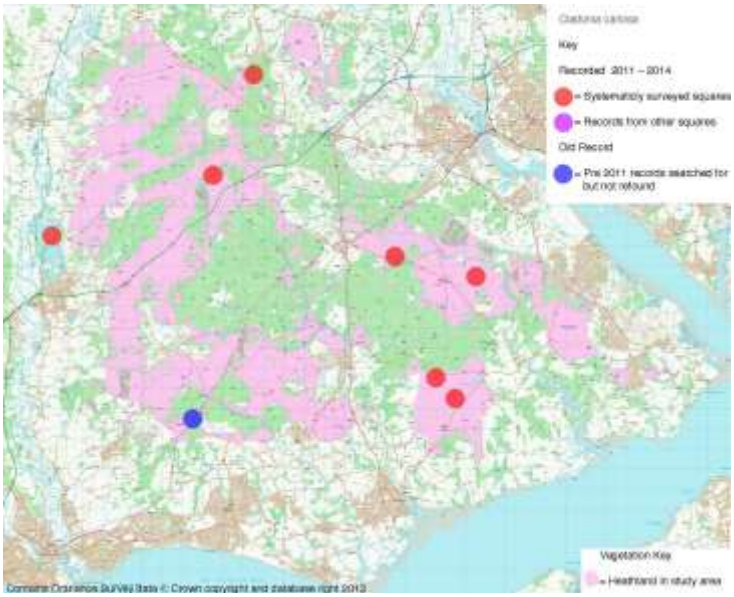
Cladonia callosa Notable (NS): a western European endemic, which was thought to be exclusively upland until recently, but now recorded on acid banks in heathland and rarely post industrial sites. **NFHLS**: found **new to the New Forest and the lowlands** during this survey, it is now recorded from 59 1km squares. Highly characteristic of banks in ruts and hollow ways and on the floors of gravel pits. It also occurs more sparingly in canopy gaps in humid and wet heaths within the burning cycle. It appears to be quite a rapid coloniser of disturbed ground and was found on recently restored heath in Longdown Inclosure and in abundance in the floor of the recently abandoned Holmsley gravel pit. The New Forest certainly holds the largest known population in Britain and probably one of the largest in the world. (**Map 9**):

MAP 9: *Cladonia callosa*



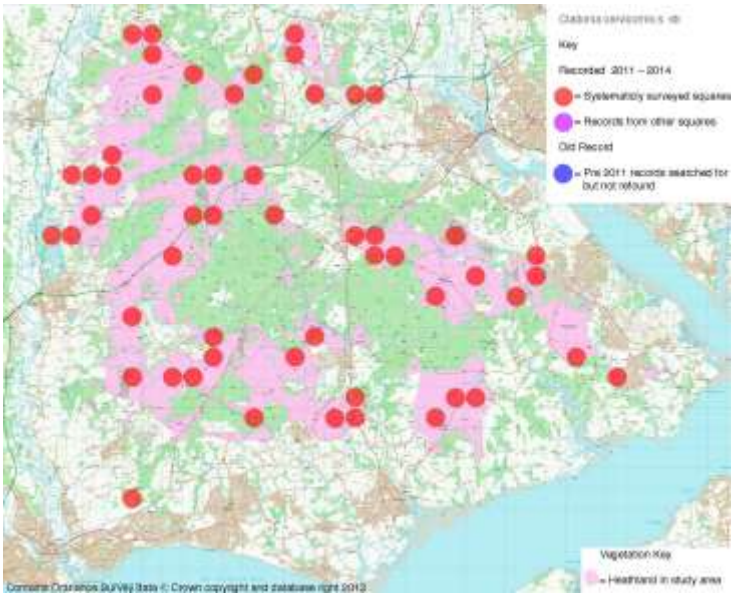
Cladonia cariosa Notable (NS): a small but distinctive heathtail of somewhat base enriched post industrial sites, such as quarries and mines, scattered and mainly lowland. An ephemeral early succession species. **NFHLS**: scattered in disturbed sites and recorded from seven 1km squares in old airways and quarries. The largest populations were at Blashford and Beaulieu Airfield. An old site at Plain Heath was not refound, here the habitat had become less open (**Map 10**).

MAP 10: *Cladonia cariosa*



Cladonia cervicornis s. str.: a common Stacking Cup *Cladonia* of less acidic locations. The species has been much confused with *Cladonia verticillata*, and is separated by squamule characters not podetia characteristics, which are often used. **NFHLS**: recorded from 56 1km squares across the Forest. Most frequent in grasslands, in the heaths mainly limited to disturbed areas and path edges. Replaced by *Cladonia verticillata* on more acidic soils. Potentially a bit under recorded at the beginning of the survey (**Map 11**).

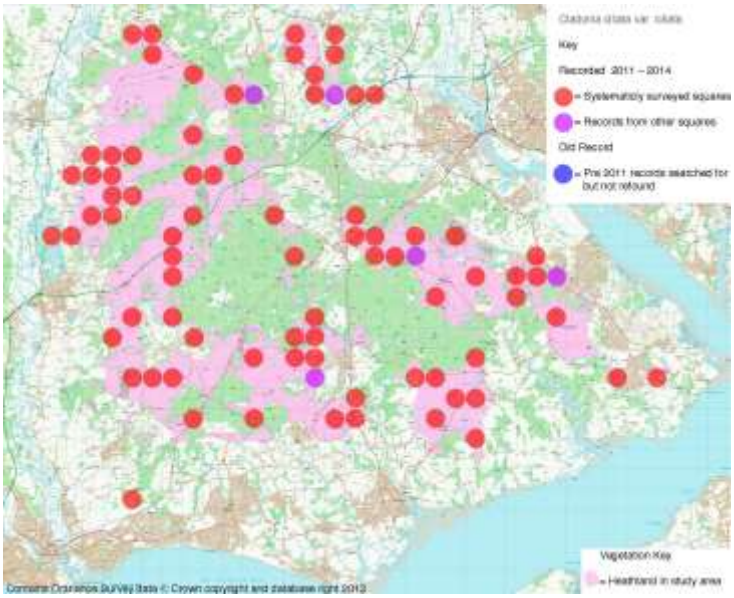
MAP 11: *Cladonia cervicornis* s. str.



Cladonia chlorophaea s. str.: most granular-sorediate Pixie Cups formerly included in *Cladonia chlorophaea* s. lat. are in the *Cladonia cryptochlorophaea – grayi* group, which has turned out to be genetically unrelated to this taxon. *Cladonia chlorophaea* s. str. is a species of less acidic soils. **NFHLS**: scattered and recorded in 21 1km squares across the Forest. Confined to enriched and disturbed sites such as bonfire sites, rabbit warrens and banks in brown earth soils.

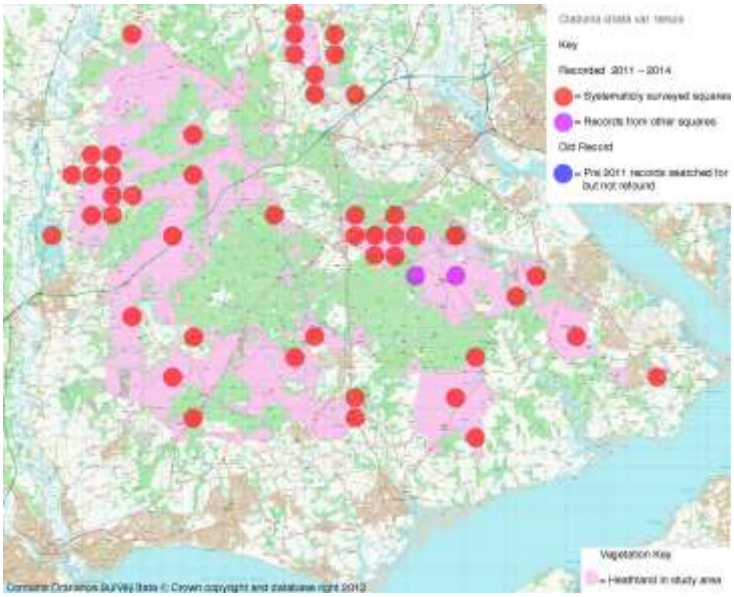
Cladonia ciliata* var. *ciliata: the form of the finer common Reindeer Moss that lacks usnic acid. In the lowlands *Cladonia ciliata* var. *tenuis* is generally the commonest form, especially in sandy heaths and acid grasslands. **NFHLS**: widespread and recorded in 82 1km squares. In contrast to the rest of the lowlands, in the New Forest var. *ciliata* is more frequent than var. *tenuis*. Frequent in short grazed heath, but extends into taller burned heaths and is fairly fire tolerant.

MAP 12: *Cladonia ciliata* var. *ciliata*



Cladonia ciliata* var. *tenuis: the usnic acid containing form of this Reindeer Moss, which commoner in the lowlands than var. *ciliata*. **NFHLS**: less frequent than var. *ciliata* and recorded in 51 1km squares. It is more strictly confined to short grazed heaths and appears more burn-sensitive than var. *ciliata* (**Map 13**).

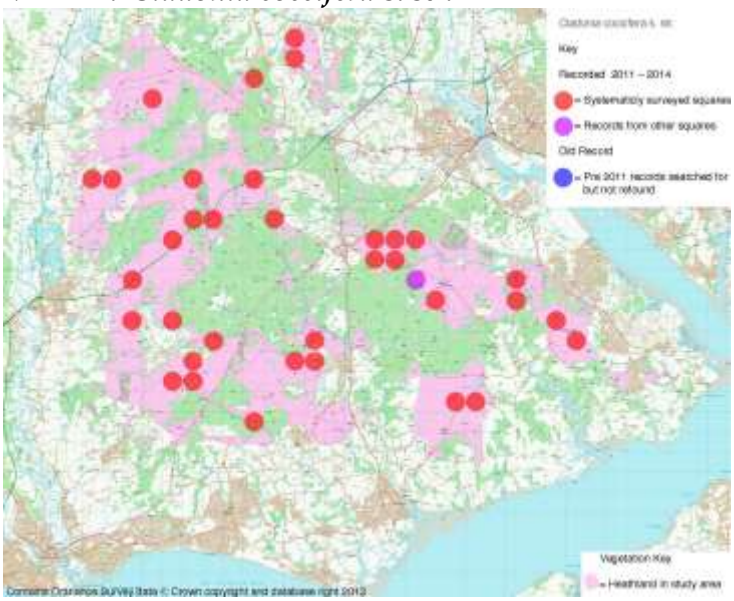
MAP 13: *Cladonia ciliata* var. *tenuis*



***Cladonia coccifera* s. str.** [NS]: a pixie cup with red apothecia that is similar to the common *Cladonia diversa* but distinguished by the larger plate like granules in the cup and podetia. Well marked forms are clearly different, but it is difficult to draw

the line between this and *Cladonia diversa*. *Cladonia coccifera* s. str., was regarded as an arctic alpine species until recently, but forms that match its description are local in high quality heathlands in the lowlands as well as the uplands. **NFHLS**: recorded in 36 1km squares in the Forest. **New to the Forest in the 2001 – 15 survey**. Confined to open low productivity heaths in high quality lichen assemblages (**Map 14**).

MAP 14: *Cladonia coccifera* s. str.



Cladonia coniocraea: a very common epiphytic lichen. **NFHLS**: recorded in 36 1km squares in the Forest. Widespread but localised on heaths mainly on shaded humus rich banks and the like.

Cladonia cornuta: a mainly northern and eastern Heathtail. **NFHLS**: recorded in 35 1km squares in the Forest. **New to the Forest in the 2001 – 15 survey**. A difficult species to partition from *Cladonia ochrochlora*. Larger brown forms with few or no cups were allocated to *Cladonia cornuta*. Mainly found on lichen rich dry heath banks in hollow ways or similar habitats.

Cladonia crispata var. cetrariiformis: a Heathtail *Cladonia* which is a characteristic heathland species. **NFHLS**: recorded in 97 1km squares in the Forest. Ubiquitous in the heaths of the New Forest and often a major dominant in the burned heaths. Present but less frequent in short grazed heaths

Cladonia cryptochlorophaea group: most granular-sorediate Pixie Cups formerly included in *Cladonia chlorophaea* s. lat. are in the *Cladonia cryptochlorophaea – grayi* group, which has turned out to be genetically unrelated to *Cladonia chlorophaea* s. str. **NFHLS**: recorded in 100 1km squares in the Forest. The *Cladonia cryptochlorophaea* group includes definite *Cladonia cryptochlorophaea* [NS] (confirmed by TLC) and potentially also *Cladonia merochlorophaea* [NS] and *Cladonia novochlorophaea* [NR] (awaiting TLC conformation) but these three taxa do not appear to be possible to clearly separate in the field. *Cladonia cryptochlorophaea* [NS] is a finer granular Pixie Cup belonging to the *Cladonia grayi* group, and definitely the commonest heathland Pixie Cup in the Forest. The main habitat is banks, and it can be quite rare in heathland with smooth surfaces, but will occur on the slightest bank.

Cladonia digitata: a widespread epiphytic species typical of large pieces of dead wood but also found on acid bark. Occurs occasionally on heathland. **NFHLS**: recorded in 19 1km squares in the Forest. Confined to humus banks, typically in hollow ways.

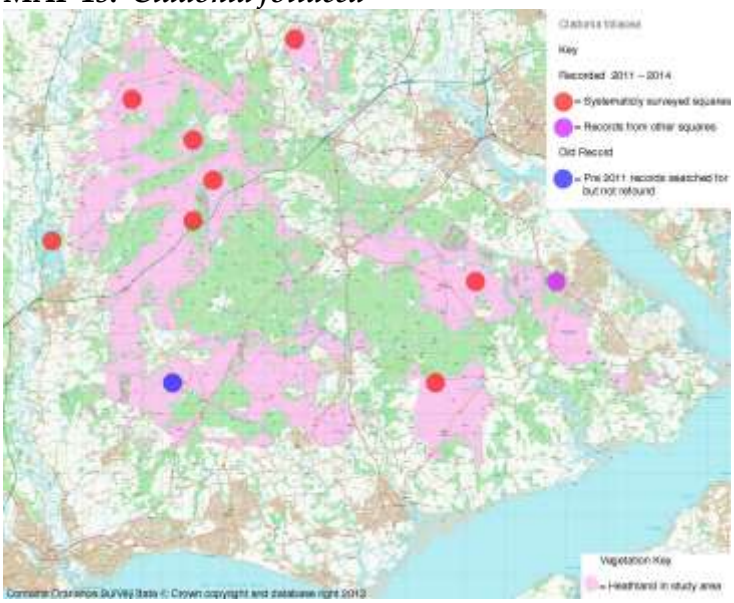
Cladonia diversa: the commoner of the two Pixie Cups with red apothecia included within *Cladonia coccifera* s. lat. **NFHLS**: recorded in 88 1km squares in the Forest. Widespread in burned and short grazed heath.

Cladonia fimbriata: a common epiphytic Pixie Cup, localised to lose humus and dead heather and similar habitats in heaths. **NFHLS**: recorded in 50 1km squares in the Forest. Possibly somewhat over recorded at the beginning of the survey.

Cladonia floerkeana: the Devils Matchstick is a ubiquitous heathland species. **NFHLS**: recorded in 97 1km squares in the Forest. More frequent in taller burned heaths, especially on banks, but still widespread in short heath.

Cladonia foliacea: a yellowish *Cladonia* with the basal squamules dominant. Mainly found in mildly base enriched acid grasslands and confined to high quality sites inland. **NHLS**: recorded in nine 1km squares in the Forest. Rare on the New Forest, where it was recorded in disturbed and enriched habitat on the sites of WWII installations, quarries and similar sites. A few somewhat anomalous colonies were found on grassy hummocks in heath (**Map 15**):

MAP 15: ***Cladonia foliacea***

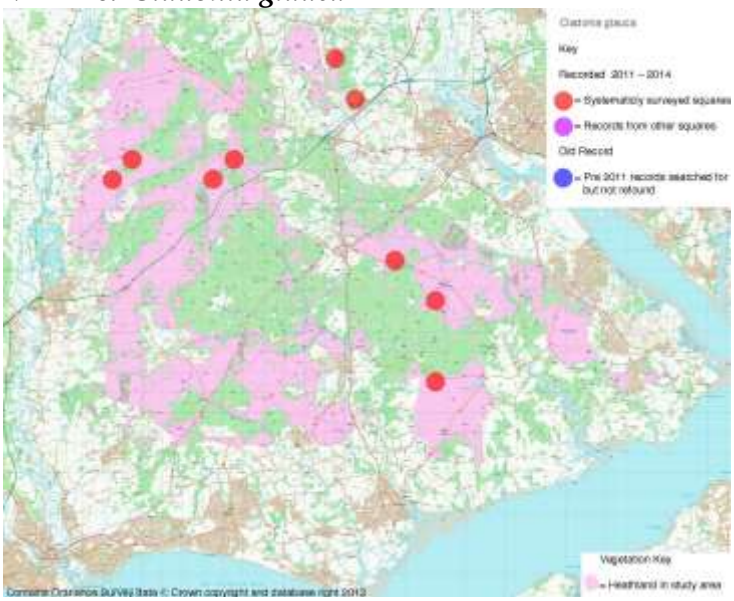


Cladonia furcata* ssp *furcata: a False Reindeer Moss, which is a very common *Cladonia* less acidic grassy heaths and acid grasslands. **NHLS**: recorded in 84 1km squares in the Forest. Generally absent from strongly podzolised soils in the New Forest but frequent in grasslands and along tracks and paths through the heaths.

Cladonia furcata* ssp *subrangiformis: a form of the False Reindeer Moss, *Cladonia furcata* with a distorted thallus caused by calcium oxalate crystals found on highly lime rich substrates. Probably just a form rather than a subspecies. **NHLS**: recorded in 6 1km squares in the Forest. Confined to highly calcareous substrates such as dumped chalk and rotting concrete bases.

Cladonia glauca: a rather local (and possibly over recorded) Heathtail species in the lowlands. **NHLS**: recorded in 10 1km squares in the Forest. Found mainly on banks or tussocks in short grazed heaths but also in hollow ways in burned heaths.

MAP 16: ***Cladonia glauca***

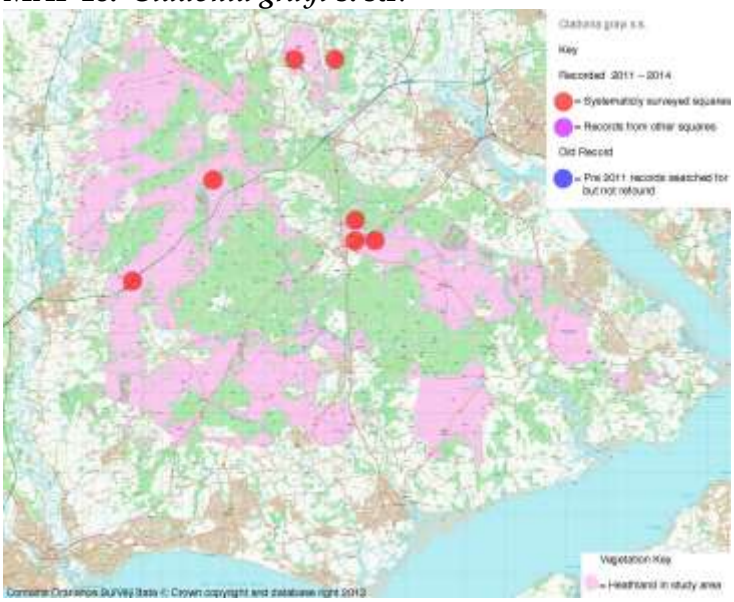


Cladonia gracilis: a striking tall Heathtail, local in the lowlands and confined to high quality habitat. **NHLS**: recorded in 40 1km squares in the Forest. It is typical of short grazed heaths and is probably moderately fire intolerant but occurs rarely within the burned heaths (**Map 17**).

MAP 17: ***Cladonia gracilis***

***Cladonia grayi* s. str.** [NR]: a coarse granular Pixie Cup belonging to the *Cladonia grayi* group, and appears to be the rarest of the heathland pixie cups. Part way through the survey it was realised that this species was actually quite distinctive in its bright UV fluorescence. **NHLS**: recorded in seven 1km squares in the Forest. **New to the Forest in the 2001 – 15 survey**. A look back though likely habitats latter in the survey, did not produce many sites. Confined to hollow way banks and tussocks (**Map 18**).

MAP 18: *Cladonia grayi* s. str.



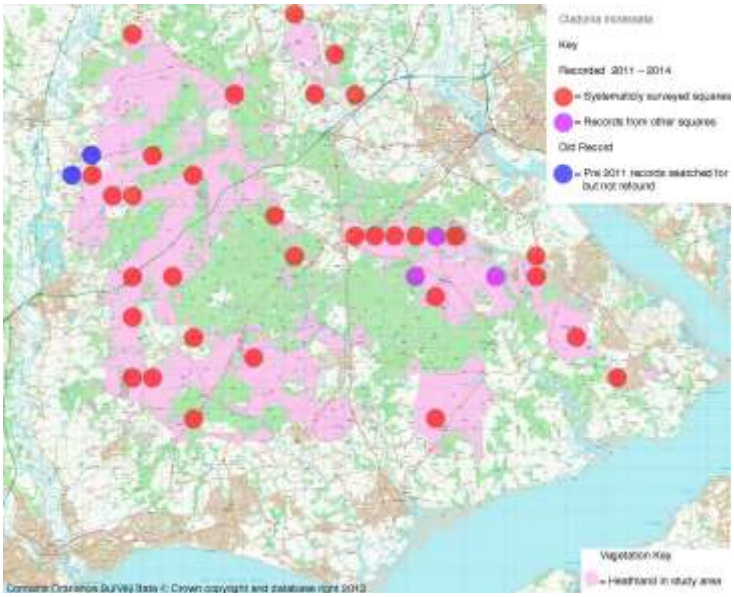
Cladonia humilis: a common Pixie Cup of less acidic soils. **NHLS**: recorded in 43 1km squares in the Forest. Found in more enriched and disturbed sites, such as road verge banks, rabbit warrens and bonfire sites.

Cladonia humilis "schizidiate form": this odd *Cladonia* **was detected first in Britain** during this survey. It is probably a widespread taxon of dry disturbed soils which are quite base rich but not calcareous soils. It has mostly probably been recorded as *Cladonia pocillum* in the past, and certainly was on the New Forest, but lacks the appressed down turned brown basal squamules of this taxon of calcareous soils. It is similar to *Cladonia humilis*, with large basal squamules, with green upper surfaces and white undersides that are displayed by the upturned tips. The podetia have corticate bases but unlike *Cladonia humilis*, rather than very fine soredia, the upper section of the podetia have large corticate granules (schizidia). This type of lichen was being called *Cladonia pulvinella* or *Cladonia hammeri* but Pino-Bodas et al (2013) has shown these to be purely American taxa and that the schizidiate European taxa to be very closely related to *Cladonia humilis*. **NHLS**: recorded in 14 1km squares in the Forest. Nearly all are on road verges and on the sites of WWII installations where the soils are enriched by concrete. The taxon is more strongly associated with base enriched soils than the typical morph of *Cladonia humilis*.

Cladonia incrassata Nb (NS): a small *Cladonia* with highly dissected squamules and red apothecia on short podetia found on humus on vertical banks in heathlands, damp shaded rocks and damp dead wood in scattered locations, mainly southern and western. **NHLS**: recorded in 36 1km squares in the Forest, probably one of the largest populations in Britain. Strongly associated with banks in hollow ways and seepage step banks on the heaths (**Map 19**). It was also very locally abundant on pine stumps on Half Moon Common, a feature not seen elsewhere in the New Forest. It is very rare on Oak lignum within the New Forest woodlands. It also colonises forestry road cuttings so appears quite mobile. In Dorset *Cladonia incrassata* is now very rare on the heathlands and occurs more on forestry road banks (B. Edwards, pers. com.). It appears to have been shaded out of heathland banks by tall heather. On the Forest the species is quite fire tolerant and clearly benefits from controlled burning opening up shaded banks. Two sites recorded by Sanderson (1997) on Hyde

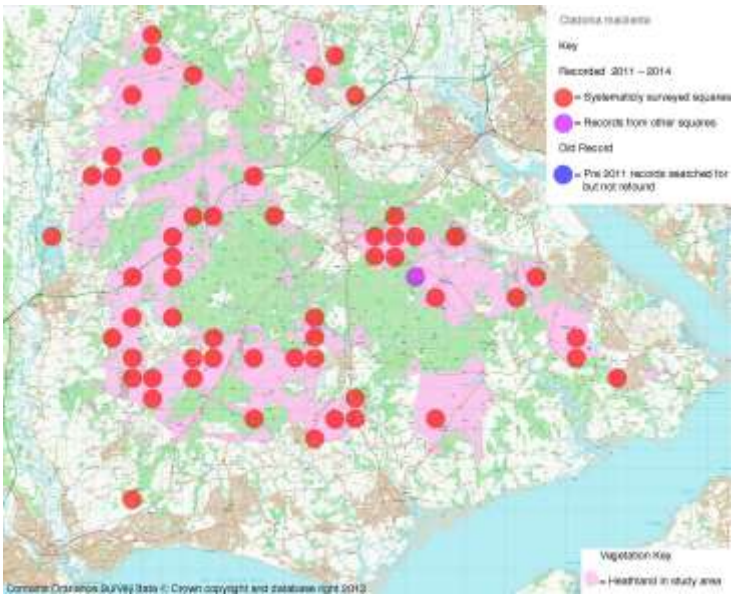
and Gorley Common were found to have been lost to shade from Bramble scrub. These were in hard grazed heaths without the fire rotations.

MAP 19: *Cladonia incrassata*



Cladonia macilenta: a Heathtail with red apothecia and fine soredia, much confused with poorly developed *Cladonia polydactyla* without cups, but this has coarse soredia. Probably massively over recorded in error for *Cladonia polydactyla* and *Cladonia macilenta* in the strict sense is probably a local species of higher quality heathland, where it is characteristic of banks. **NHLS**: recorded in 58 1km squares in the Forest. Frequent in areas with hollow way complexes, much less frequent in undisturbed heaths.

MAP 20: *Cladonia macilenta*



Cladonia mediterranea Critically Endangered (NR/S41): a rare Mediterranean-Atlantic species, which is very similar to the common *Cladonia portentosa* but branches mainly in twos and has a thicker cortex. The latter gives the lichen a silvery colour, compare to the greenish-yellow of *Cladonia portentosa*. Previously only accepted as occurring in heaths in the Lizard, Cornwall but identical material has been collected from Pembroke (A. Orange, pers. com.). **NHLS**: recorded in three 1km squares in the Forest. **New to the Forest in the 2001 – 15 survey**. First recorded

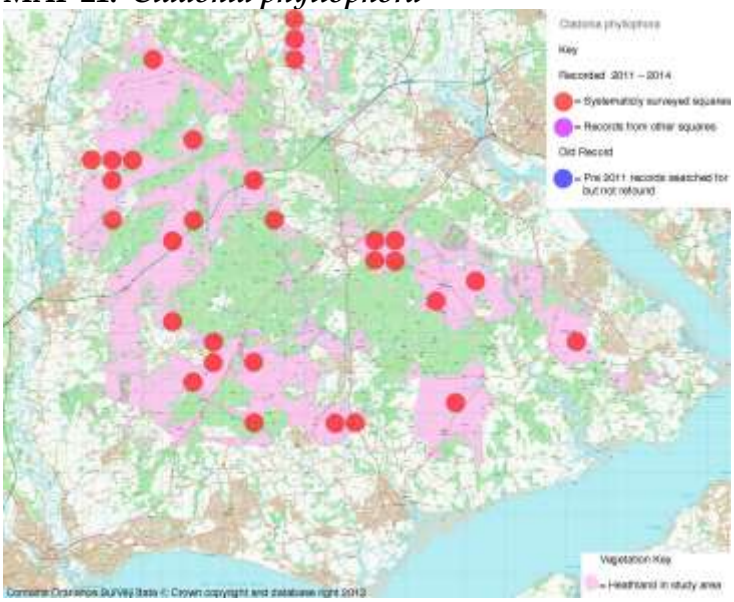
during this survey in two areas of ancient short grazed heath in the Ogden's Purlieu area. Subsequently a third patch was found in the transition to wet heath at Wootton Bridge. The morphology of the collection is very similar to the Lizard taxa, which is stragglier than typical Spanish *Cladonia mediterranea*. A specimen from the first location was sent to Ana Rosa Burgaz in Spain who stated "looking through it carefully this sample could be *Cladonia mediterranea*". The English and Breton (Website: "Lichenes maritimi Armoricae") material assigned to this species appears to be more suppressed and less bushy than material from further south. On the available evidence the New Forest taxon would seem to be the same taxon as occurs in the Lizard, which does appear to be *Cladonia mediterranea*, but has a somewhat atypical morphology. Some transitional forms with thicker cortex, and hence a silvery look, but branching mostly in threes and medullas that were not as thick as expected were occasionally observed as single thalli. These were recorded as *Cladonia portentosa*.

Cladonia ochrochlora: a somewhat obscure taxon, which is potentially just a robust form of *Cladonia coniocraea* (Pino-Bodas et al, 2011). This taxon was recorded where greenish, gracile and with strong development of cups. **NHLS**: recorded in 12 1km squares in the Forest. These were mainly found on shaded banks and tussocks.

Cladonia parasitica: a widespread species of lignum in old woods, rarely on earth banks in woodland. **NHLS**: recorded in three 1km squares in the Forest. This common species of dead wood in the New forest woods was found rarely on humus on banks in hollow ways within heaths.

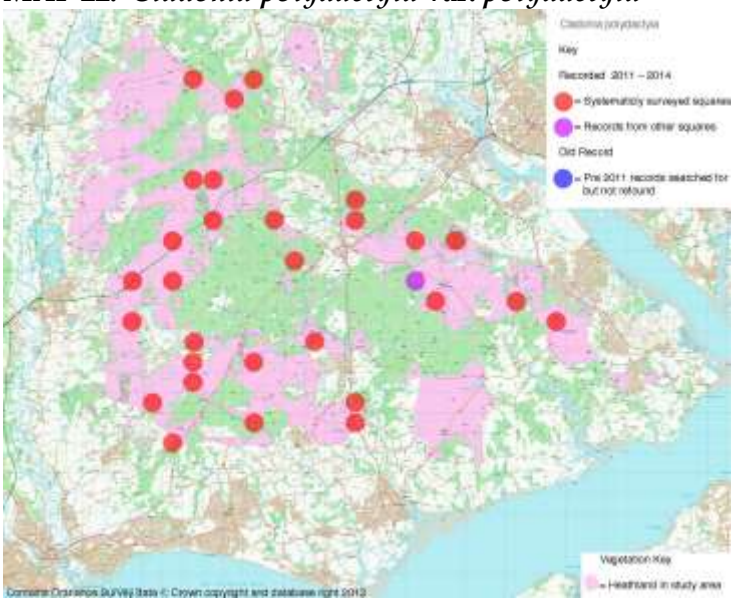
Cladonia phyllophora Near Threatened (NS): this Stacking Cup was a regarded as a mainly upland species with only some doubtful lowland records, but it was known as a special species of lowland heath in the Netherlands. **NHLS**: recorded in 33 1km squares in the Forest. **New to the Forest in the 2001 – 15 survey**. In 2011 material similar to that pictured from Netherlands was found on the New Forest and has since proved to be widespread in high quality heath. This material does merge in into *Cladonia cervicornis* s. str. and some over recording may have occurred at points in the survey. Mainly found on rut sides, banks and hummocks (**Map 21**).

MAP 21: ***Cladonia phyllophora***



Cladonia polydactyla* var. *polydactyla: a very common species on acid bark, lignum and shaded earth banks. Much confused with *Cladonia macilenta* and separated in this survey by the presence of coarse soredia. **NHLS**: recorded in 30 1km squares in the Forest. Mainly found on shaded banks and local on the open heaths, even if abundant in adjacent woods. On the heaths absent from areas without frequent deep hollow ways or seepage step banks, such as the Northern Commons (**Map 22**).

MAP 22: *Cladonia polydactyla* var. *polydactyla*



Cladonia portentosa: a ubiquitous Reindeer Moss, found throughout Britain in acid soil areas. **NHLS**: recorded in 110 1km squares in the Forest. Found throughout the heaths and easily the most abundant lichen on the heaths. A resistant species that survives longest when rich stands in burned heaths decline in diversity as they mature and the sward height increases. Frequent *Cladonia portentosa* in older heaths within the burning cycle can be taken to indicate areas likely to become lichen rich after the next burn.

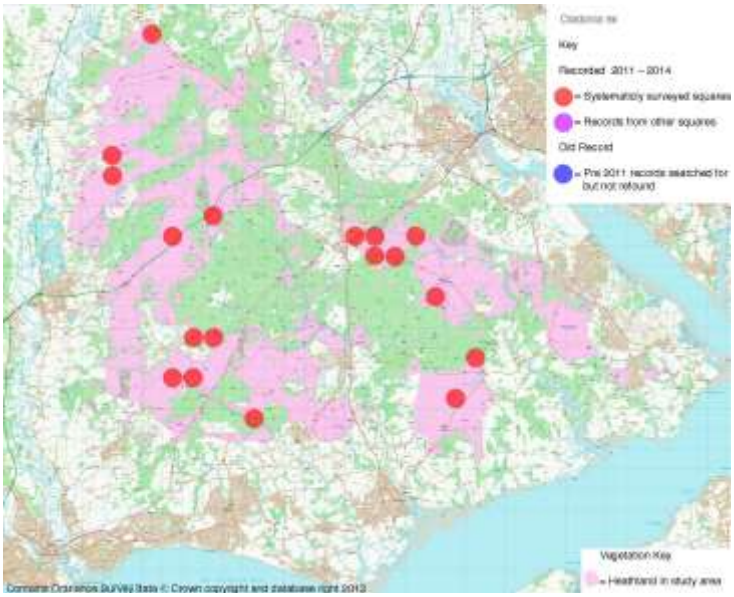
Cladonia pyxidata: a common Pixie Cup of neutral to base rich soils and tree bark. Most records from acid substrates are errors for other Pixie Cups with frequent squamules on the podetia. **NHLS**: recorded in one 1km squares in the Forest. This survey defined *Cladonia pyxidata* as brown fruited Pixie Cups with only squamules and corticate granules on the podetia. Pixies Cups with both squamules and coarse sorediate granules were recorded as *Cladonia chlorophaea* s. str. This follows Ahti & Stenros (2013). Thus defined *Cladonia pyxidata* was recorded only once in the transition between heath and acid grassland in an old quarry on Goatspen Plain, growing with *Cladonia humilis*.

Cladonia ramulosa: a ubiquitous small Heathtail of heathlands. **NHLS**: recorded in 82 1km squares in the Forest. Most frequent in banks but found =in open bare habitats throughout the heaths.

Cladonia rangiformis: a False Reindeer Moss of somewhat base enriched grasslands. **NHLS**: recorded in 53 1km squares in the Forest. Typical of well drained road verges and areas with concrete from broken up military instillations in the New Forest and rare beyond these habitats.

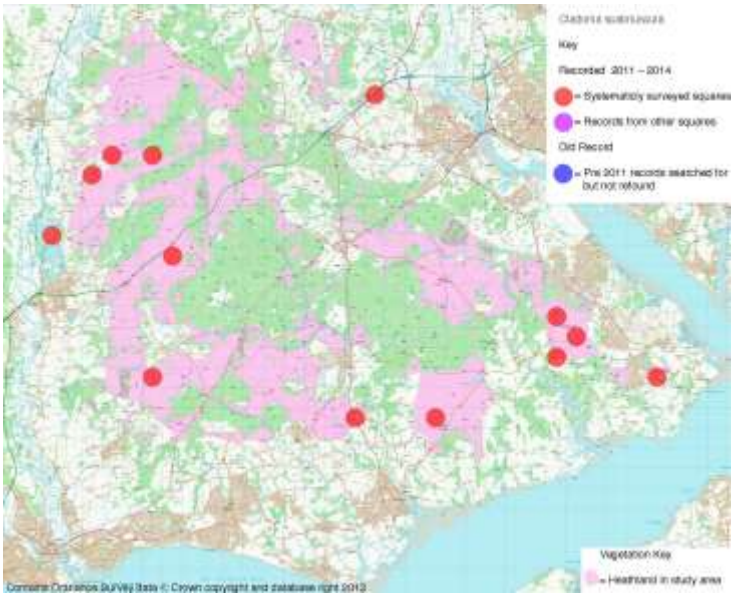
Cladonia rei Near Threatened (NS): a rarely recorded Heathtail , so far recorded in the south and east of England. **NHLS**: recorded in 18 1km squares in the Forest. **First recorded from the New Forest during this survey**. A specialist of banks, found particularly on the sides of hollow ways, seepage step banks and on well lit wet heath tussocks (**Map 23**).

MAP 23: ***Cladonia rei***



Cladonia scabriuscula: a False Reindeer Moss, close to *Cladonia furcata*, but predominately eastern in distribution. Found mainly in acid grasslands. **NHLS**: recorded in 13 1km squares in the Forest. **New to the Forest in the 2001 – 15 survey**. Scattered occurrences, mainly in acid grasslands, although with rare occurrences in heaths (**Map 24**).

MAP 24: ***Cladonia scabriuscula***



Cladonia squamosa **Taxonomic Note**: *Cladonia squamosa* is a widespread common species, especially as an epiphyte in the west. There are two varieties separated on a minor chemical difference, one var. *squamosa* which is K– and UV+ and var. *subsquamosa* which is K+ and UV–. In the New Forest, the situation with *Cladonia squamosa* is complex. The heathlands have an abundance of material of both chemical varieties, which does not fit with the description of typical material. It has wide flaring cups, often shining chestnut inside, with a grey cortex, which only peels off to a minor extent. Typical material should lack cups and have a white cortex that largely peels to form squamules. Both chemical types occur in the typical and

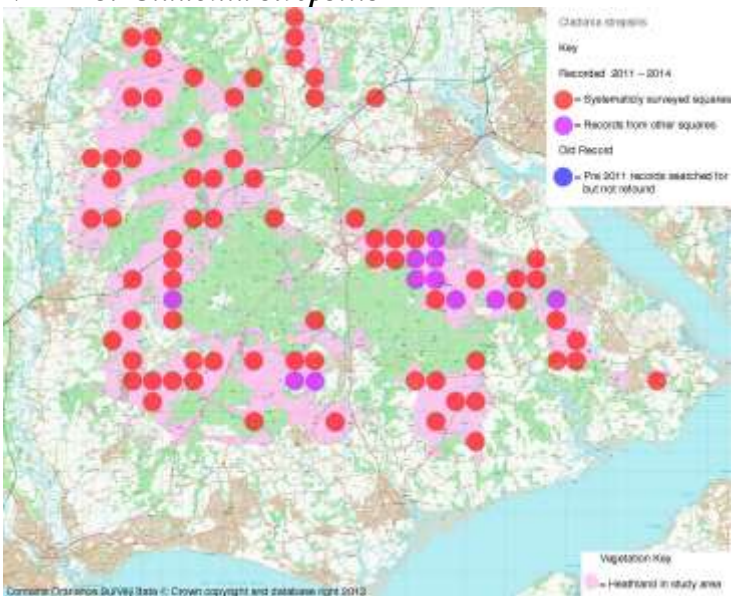
heathland morphs, but the abundances are reversed locally. The heathland morph is mainly var. *subsquamosa* but the typical morph is mainly var. *squamosa*. The heathland morph is confined to high quality heaths and has every appearance of being a separate species, but this will need to be tested by genetic analysis. If confirmed it is likely to be an uncommon declining species outside of the New forest

Cladonia squamosa* var. *squamosa: **NHLS**: recorded in 25 1km squares in the Forest. Of these 21 were the typical morph typically recorded on banks and tussocks. The other four records were of the heathland morph and were usually mixed with the var. *subsquamosa* type of the heathland morph.

Cladonia squamosa* var. *subsquamosa: **NHLS**: recorded in 82 1km squares in the Forest. An abundant taxon on the Forest heaths, often a dominant species in burned heaths earlier in the succession from burning. All material was referable to the heathland morph.

Cladonia strepsilis: a characteristic heathland species that is in serious decline outside of the New Forest in lowland England and lowland Europe but still frequent in the uplands and north. In Britain it was frequent in the lowland heaths of the south and east, North Wales and the Scottish Highlands but rare between these areas. Shows a similar distribution to other species such as *Cladonia zopfii*, *Icmadophila ericetorum* and Heathtooth *Pycnothelia papillaria*. **NHLS**: recorded in 84 1km squares in the Forest, in what is probably the largest surviving population in lowland Europe (**Map 12**). It is a specialist of hard open damp humus found in both hard grazed and control-burned heathlands and is probably the most fire resistant *Cladonia*. It is typically less frequent in short grazed heaths. A distinctive sorediate form occurs rarely but it not thought to have taxonomic significance.

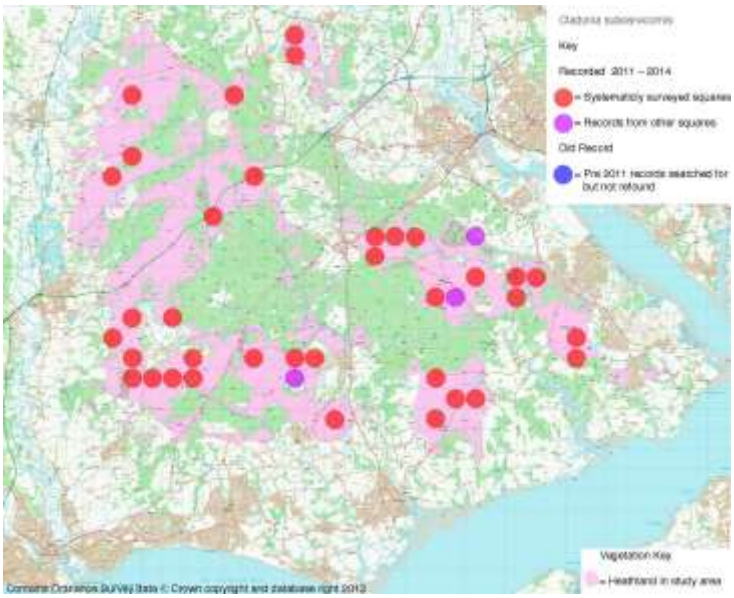
MAP 25: ***Cladonia strepsilis***



Cladonia subcervicornis: a common upland species of rock slabs and thin soils. Rare in the lowlands, on sandrocks and very locally on heaths. **NHLS**: recorded in 39 1km squares in the Forest. **The species was confirmed as growing in the New Forest during this survey**. There was a vague mention of its presence being a special feature of the New Forest heaths in Fletcher et al (1984). *Cladonia subcervicornis*,

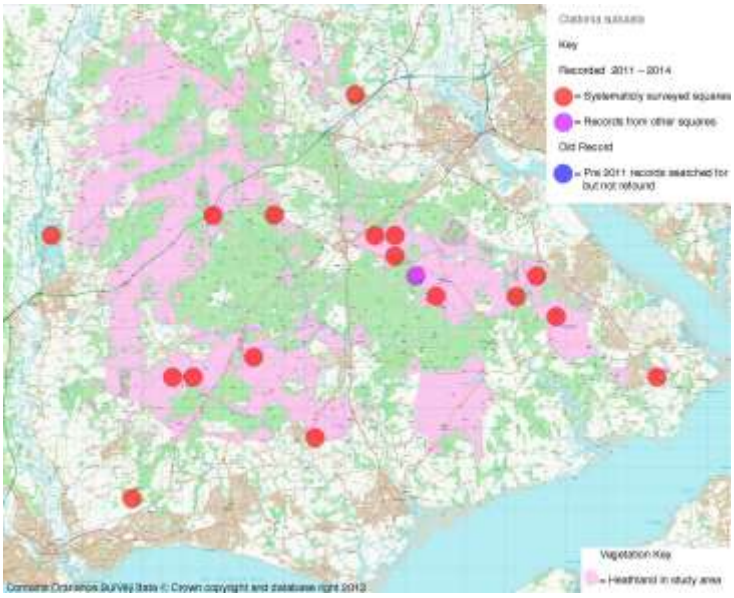
however, was overlooked in the surveys of the 1980s and 1990s as *Cladonia strepsilis*, mainly as it was so unexpected as a terricolous species and had no Forest records in national databases. It has proved to be widespread in the New Forest. Found mainly on banks and ground disturbed in the past but also in open areas in low productivity heathland. Typically on damp well lit hard humus and more frequent on the south and east. Rare on the high terraces of the north west of the Forest (**Map 26**).

MAP 26: ***Cladonia subcervicornis***



Cladonia subulata: a widespread Heathtail of acid to mildly acid soils. **NHLS**: recorded in 18 1km squares in the Forest. Surprisingly scarce in the New Forest and confined to banks, mainly in hollow ways. More frequent on the south and east and rare on the high terraces of the north west of the Forest (**Map 27**).

MAP 27: ***Cladonia subulata***



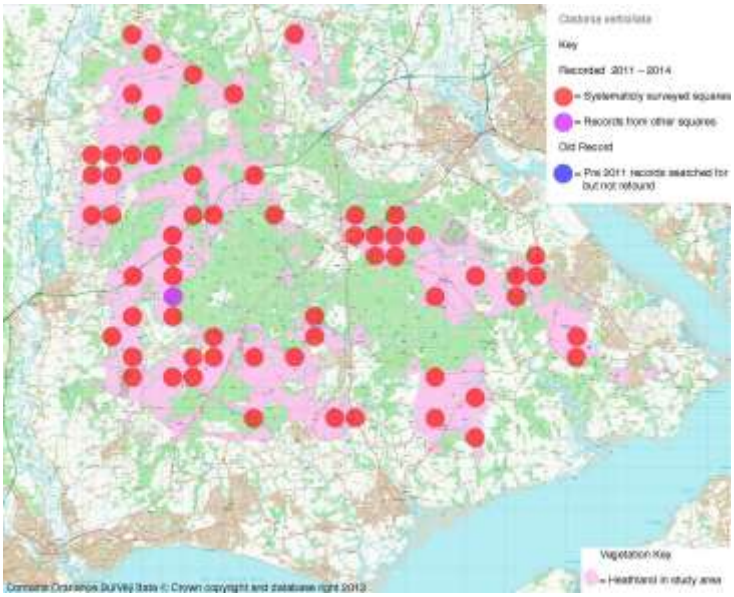
Cladonia sulphurina: a strongly north eastern species, with red apothecia. Rare in England south of Northumberland. **NHLS**: recorded in one 1km square in the

Forest. **New to the Forest in the 2001 – 15 survey**. A very surprising discovery in 2011 at Ogden's Purlieu where a small colony was found on a bank created in WWII on the edge of the bombing range in the north west of the Forest. This may be the only extant southern English site. Not seen in another site, but it would be easy to over look without podetia.

Cladonia uncialis ssp. ***biuncialis***: a widespread Heaththorn, common in the uplands but potentially in decline in the lowlands. **NHLS**: recorded in 93 1km squares in the Forest. A moderately fire sensitive species but well able to survive in slight fire refuges in the burned heath such as along path edges, open patches and in wet heaths. It is characteristically abundant in short grazed heath.

Cladonia verticillata: this Stacking Cup is a much misunderstood and actually best identified by the basal squamules, as both *Cladonia verticillata* and *Cladonia cervicornis* can have proliferating podetia. Probably a local and declining heathland species and over recorded in the lowlands. **NHLS**: recorded in 93 1km squares in the Forest. Characteristic and common on taller heaths in the New Forest and rare in short grazed heath. Confined to low productivity soils and replaced by *Cladonia cervicornis* in more disturbed situations (**Map 28**).

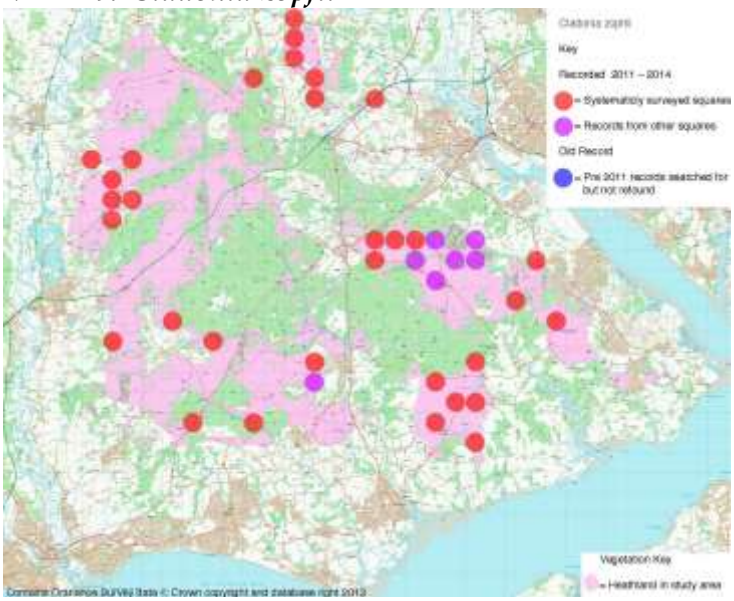
MAP 28: ***Cladonia verticillata***



Cladonia zopfii Notable (NS): this Heaththorn is very rare in England and was thought lost until recently. It has scattered recent records from the Scottish Highlands, but other than one Welsh record had not been seen south the Highlands for nearly a century. Shows a similar distribution to other species such as *Cladonia strepsilis*, *Icmadophila ericetorum* and Heathtooth *Pycnothelia papillaria*. **NHLS**: recorded in 39 1km squares in the Forest. **The rediscovery of *Cladonia zopfii* was one of the most exiting discoveries of the New Forest Heathland Lichen Survey**. The species had an old record from the New Forest, when it was collected as *Cladonia uncialis* from near Bramshaw Wood by Livens in 1911 (Coppins, 1978). Since then there had been no records from England, although there are 19th century records from the Pennines. It can be easily overlooked as *Cladonia uncialis* ssp. *biuncialis*, but is quite distinct once known. It is now recorded widely from the more heavily grazed heaths in the New Forest where it occurs in two distinct habitats. These are

open heaths at the transition from wet to humid heaths and in hollow ways or other disturbed areas in humid dry heaths. It appears quite fire sensitive in drier heaths but survives well in wetter burned heaths. There are large populations in the Northern Commons, about Ogden's Purlieu, in wet heaths east of Lyndhurst, on Beaulieu Heath west and in a small area south west of Brockenhurst. Beyond this there are scattered patches in wet heath (**Map 29**).

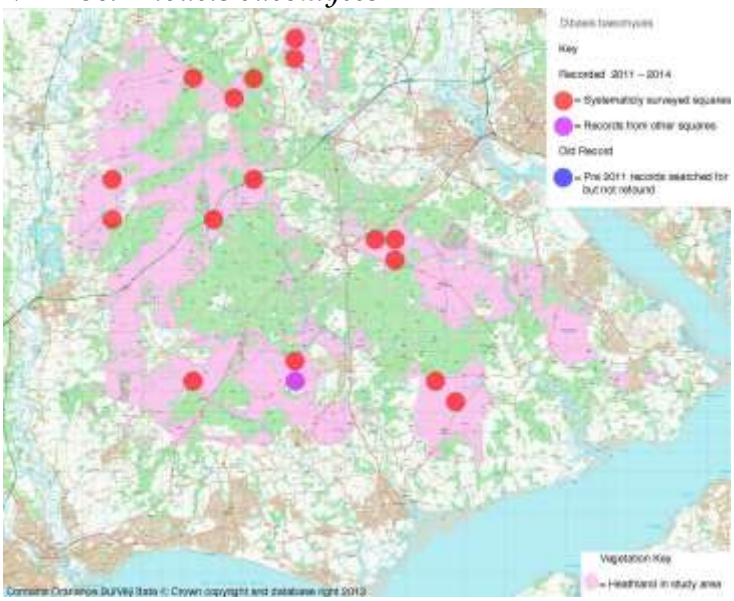
MAP 29: *Cladonia zopfii*



Collema auriforme: common species of base rich soil. **NHLS**: recorded in 12 1km squares in the Forest. Occasional in areas with broken concrete in the soil.

Dibaeis baeomyces: a crust forming species found on bare acid soils, common in the uplands but local in the lowlands. **NHLS**: recorded in 17 1km squares in the Forest. Old records in the New Forest were confused with misidentifications of *Icmadophila ericetorum* but they can be easily separated by UV fluorescence. The 2011 – 2015 survey found *Dibaeis baeomyces* to be somewhat less common than *Icmadophila ericetorum* and generally confined to level compacted and disturbed ground in old quarries or along paths. Scattered through the Forest but absent from more remote areas (**Map 30**).

MAP 30: *Dibaeis baeomyces*



Diploschistes muscorum: a frequent but scattered species mainly lowland but occurring on upland limestone areas. This crust forming lichen starts life as a parasite of *Cladonia* species but latterly forms an independent lichen. Mainly in

neutral to base rich grasslands but also on wall tops. **NHLS**: recorded in two 1km squares in the Forest. Abundant in the lichen sand grassland (U1a) at Blashford off the Forest grazings, mainly parasitising *Cladonia subulata*. Recorded once, parasitising *Cladonia coccifera* s. str. on The Ridge east of Boltons Bench.

Epicladonia sandstedei [NS]: a parasitic fungi of *Cladonia*, rarely recorded in the lowlands. **NHLS**: recorded in two 1km squares in the Forest. It had previously been recorded rarely from the New Forest woodlands but was found, new to the heaths, twice during the 2011 – 15 survey; in the south of Plaitford Common and from Setley Common. Both were parasitising Pixie Cups of the *Cladonia cryptochlorophaea* group.

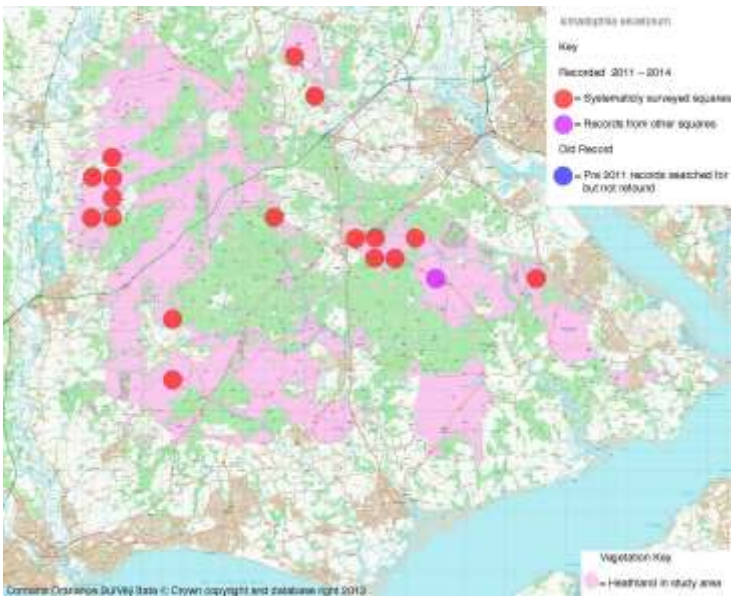
Evernia prunastri: a common epiphyte, which occasionally colonises the ground in short vegetation in little disturbed places. **NHLS**: recorded in four 1km squares in the Forest. Frequent in the rabbit grazed lichen sand heath at Blashford, only as an epiphyte on heather in the open Forest.

Flavoparmelia caperata: a common epiphyte, which occasionally colonises the ground in short vegetation in little disturbed places. **NHLS**: recorded in four 1km squares in the Forest. Frequent in the rabbit grazed lichen sand heath at Blashford, very rare beyond this area.

Hypogymnia physodes: a common epiphyte that colonises high quality open heaths, both short grazed heaths and older control-burned heaths. **NHLS**: recorded in 36 1km squares in the Forest. Most frequent in short grazed heaths but also within the burned heaths.

Icmadophila ericetorum: a crust forming species of acid soils, common in the Scottish Highlands but rare beyond and showing a similar distribution to other species such as *Cladonia strepsilis*, *Cladonia zopfii* and Heathtooth *Pycnothelia papillaria*. Recent lowland records are mainly from the New Forest. **NHLS**: recorded in 18 1km squares in the Forest. Only recorded twice previously from the Forest in 1911 and 1989. On the Forest it is mainly found on vertical humus banks and is only occasionally. Most sites are on hollow way sides or in more recent path rut sides, only seen a couple of time on level humus. A very patchy distribution in the new Forest and concentrated in areas with large hollow way complexes or many active paths (**Map 31**).

MAP 31: ***Icmadophila ericetorum***



***Lepraria incana* s. str.**: a very common species of acid trees, rocks and occasionally soil banks. **NHLS**: recorded in two 1km squares in the Forest. On sandy banks.

Lepraria lobificans: a very common species of shaded acid trees, rocks and occasionally soil banks. **NHLS**: recorded in one 1km square in the Forest. Recorded on a shaded north facing bank in an old gravel pit on Longcross Plain.

Leptogium intermedium Notable (NS): a recently described small black shrubby lichen blue-green algae containing lichen of base rich soils. Little recorded but probably local but widespread in disturbed base rich soils that are not too nutrient enriched. **NHLS**: recorded in five 1km squares in the Forest. **New to the Forest in the 2001 – 15 survey**. Confined to disturbed soils enriched with broken concrete on the sites of WWII installations and road verges.

Leptogium palmatum Near Threatened (NS): a mainly upland medium sized black shrubby lichen blue-green algae containing lichen of seasonally of seasonally damp sandy ground, including little used farm tracks and boulder tops, mainly found in Devon and central Wales. Always very rare in the lowlands, it was rediscovered from the New Forest area at the sand pit at Blashford in 2005 (Sanderson, 2005). This was the first record from the lowlands for 70 years. **NHLS**: recorded in four 1km squares in the Forest. Still abundant in the lichen sand heath at Blashford but also found as small populations by paths in parched acid grassland (U1f) at three sites (Bolton Bench, Hyde Common and Race Plain). Curiously at the open Forest sites it was always growing with the moss *Racomitrium elongatum*, which is also rare in the lowlands.

Leptogium schraderi: a widespread lowland small black shrubby lichen blue-green algae of base rich soils, typical of high quality calcicolous grasslands. **NHLS**: recorded in one 1km square in the Forest. Confined to the well developed base rich grassland on the site of the former runway of Beaulieu Airfield.

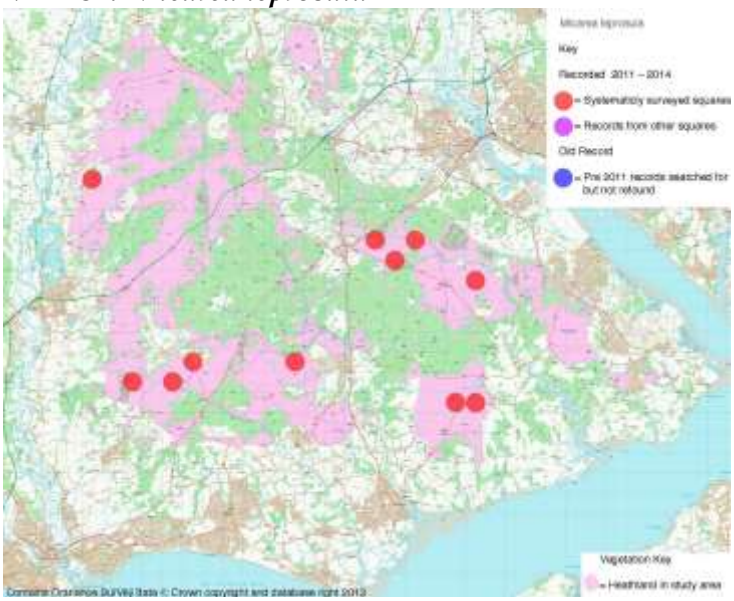
Leptogium tenuissimum Nb (NS): a uncommon lowland small black shrubby lichen blue-green algae of base rich soils, including calcicolous grassland and post industrial sites. **NHLS**: recorded in one 1km square in the Forest. Confined to the

well developed base rich grassland on the site of the former runway of Beaulieu Airfield.

Lichenomphalia umbellifera: a basidiomycetes (mushroom) with a lichenised thallus, found on damp humus and lignum and mainly upland. **NHLS**: recorded in seven 1km squares in the Forest. Found entirely on humus on shaded banks, typically north facing.

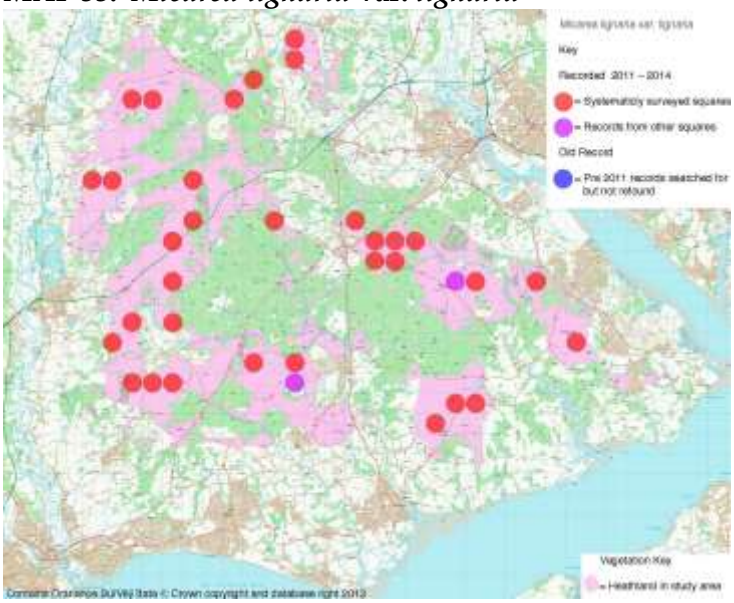
Micarea leprosula: a common upland species of acid soil but very rare in the lowlands outside of the New Forest. **NHLS**: recorded in eleven 1km squares in the Forest. **New to the Forest in the 2001 – 15 survey**. An uncommon species mainly found in winter flooded pans in humid dry heath in heaths within the burning rotation. Absent from the higher terraces (**Map 32**).

MAP 32: ***Micarea leprosula***



Micarea lignaria* var. *lignaria: a common upland species, which is a local heathland and sandrock species in the lowlands. **NHLS**: recorded in 35 1km squares in the Forest. Widespread in the New Forest on open damp humus, pans in undisturbed heath and on hollow way sides. Mainly in the heaths within the burning rotation.

MAP 33: ***Micarea lignaria* var. *lignaria***



Micarea melaena: a common upland species, which is local in the lowlands, where it is mainly found on lignum. **NHLS**: recorded in one 1km square in the Forest. Only found once in the New Forest heaths (older records from the heaths are errors for *Micarea lignaria* var. *lignaria*), at Furzley Common. Here it was found on a damp humus rich bank on the edge of an old quarry in short grazed heath.

Micarea peliocarpa: a very common species of acid substrates, mainly on bark and wood, but more infrequent on the ground. **NHLS**: recorded in eight 1km squares in the Forest. Rare in the New Forest on open damp humus, in the heaths within the burning rotation.

Micarea prasina s. lat.: a common taxon on acid substrates. **NHLS**: recorded in eight 1km squares in the Forest. On hummus banks and on heather twigs, most material is probably referable to *Micarea micrococca*, the commonest member of this group.

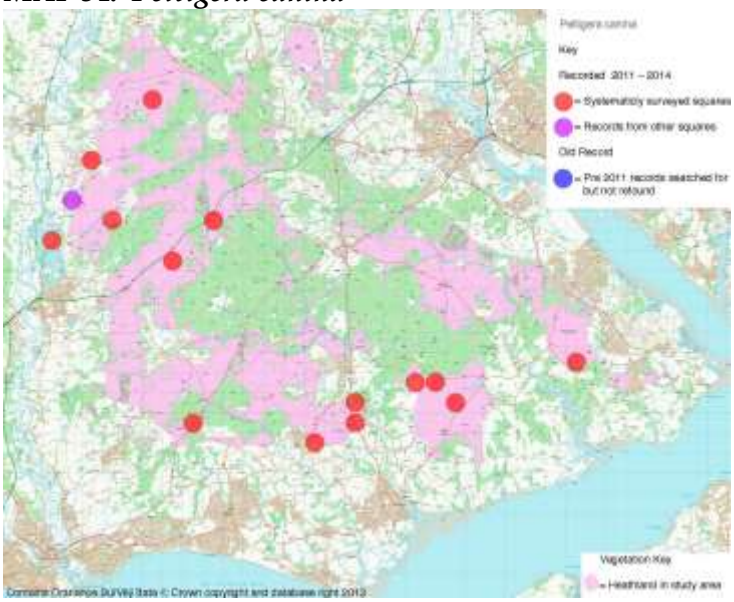
Micarea viridileprosa Notable (NS): a recently described species, widespread on acid substrates including bark, lignum and soil, which may not be Nationally Scarce. **NHLS**: recorded in 46 1km squares in the Forest. Widespread on banks, the commonest *Micarea* on acid humus in the New Forest.

Micarea xanthonica Notable (NS/IR): an uncommon oceanic species, mainly found on acid bark in old woodlands, rare on moorland in the west. **NHLS**: recorded in one 1km square in the Forest. **New to the Forest heaths in the 2001 – 15 survey**. This species is a characteristic species of acid bark in the old woodland of the Forest, but was only found once on the heaths. On humus on the side of a rut on a stock track near Duckhole Bog.

Parmelia saxatilis: a common epiphyte, which occasionally colonises the ground in short vegetation in little disturbed places. **NHLS**: recorded in two 1km squares in the Forest. Frequent in the rabbit grazed lichen sand heath at Blashford. Seen once on humus on a pit side in the open Forest at Moonhills.

Peltigera canina: a local Dogtooth species of dry acid grasslands that is mainly coastal in England and uncommon in parched acid grasslands inland. **NHLS**: recorded in 15 1km squares in the Forest. Scattered through the Forest on well developed parched acid grasslands (**Map 34**).

MAP 34: ***Peltigera canina***



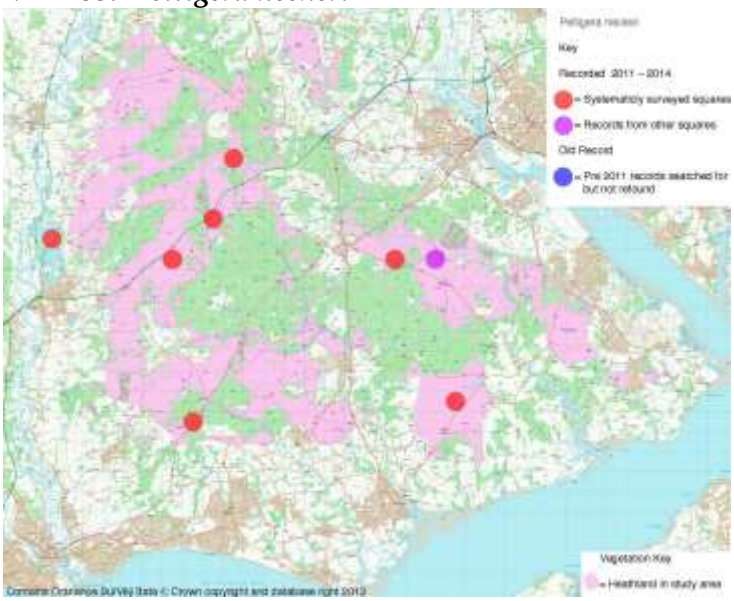
Peltigera didactyla: a common Dogtooth species of disturbed ground and bonfire sites. **NHLS**: recorded in 17 1km squares in the Forest. Mainly on track verges and bonfire sites.

Peltigera hymenina: a common Dogtooth species of grasslands and trees. **NHLS**: recorded in 45 1km squares in the Forest. Ubiquitous in dry grasslands and path sides.

Peltigera membranacea: a common Dogtooth species of moist grasslands and trees. **NHLS**: recorded in two 1km squares in the Forest, in moist grasslands.

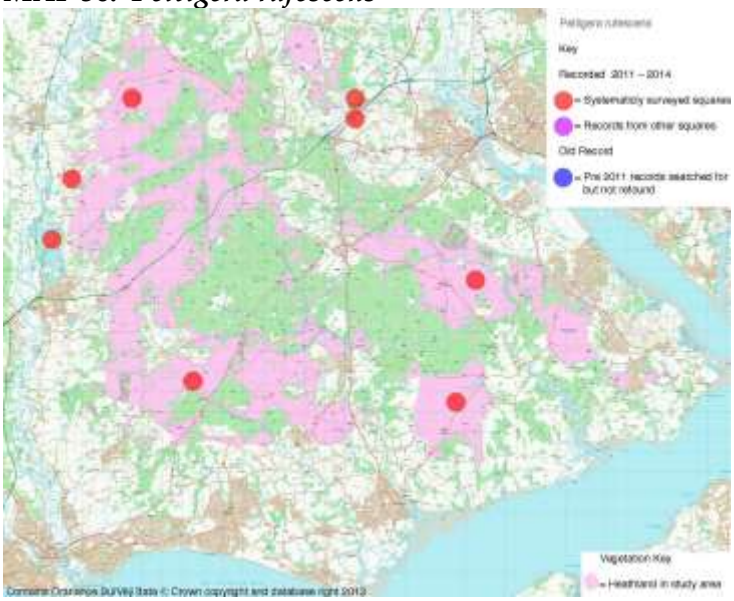
Peltigera neckeri Notable (NS): a local species of base rich grasslands and post industrial sites. **NHLS**: recorded in eight 1km squares in the Forest. Rare in base enriched grassland on the sites of WWII installations and disturbed parched acid grasslands (**Map 35**).

MAP 35: ***Peltigera neckeri***



Peltigera rufescens: a common species of base rich grasslands and post industrial sites. **NHLS**: recorded in eight 1km squares in the Forest. Rare in concrete enriched parched acid grasslands.

MAP 36: ***Peltigera rufescens***



Placidium squamulosa: a local species of base rich grasslands, usually high quality sites. **NHLS**: recorded in two 1km squares in the Forest. Rare, found in parched grasslands, enriched with broken concrete at Blashford and on the site of the ripped

up Beaulieu Airfield runway. Otherwise only recorded from downland in Hampshire.

Placynthiella dasaea: a characteristic species acid humus banks and dead wood, very under recorded until recently. **NHLS**: recorded in 24 1km squares in the Forest. **New to the Forest in the 2001 – 15 survey**. Scattered though the Forest on humus banks, typical of the sides of old hollow ways.

Placynthiella icmalea: a very common species of acid humus and dead wood. **NHLS**: recorded in 73 1km squares in the Forest. Common on bares hard humus on banks and generally after fires.

Placynthiella oligotropha Notable (NS): a local species of acid humus. Not easy to spot when dry so probably under recorded, but not frequent either. **NHLS**: recorded in two 1km squares in the Forest, one a hollow way side at Clay Hill, east of Burely, and the second a seepage step bank at Harvest Slade Bottom.

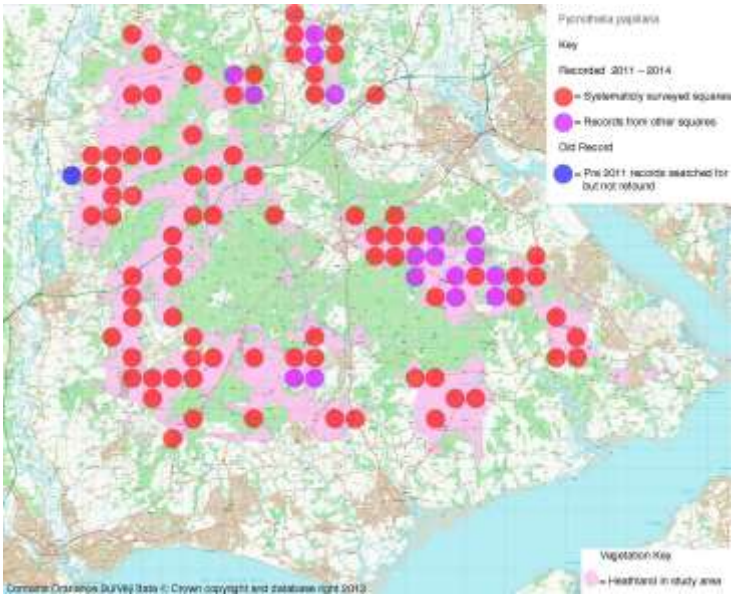
Placynthiella uliginosa: a widespread species of acid humus on heathland but difficult to spot. **NHLS**: recorded in 17 1km squares in the Forest. Mainly found on humus on vertical banks.

Platismatia glauca: a common species of acid bark on trees but rare in heathland in heathland in the lowlands. **NHLS**: recorded in two 1km squares in the Forest. Only recorded from short grazed heathland on Plaitford and Half Moon Commons in the New Forest.

Psilolechia lucida: a common species of shaded humid acid rock and earth banks. **NHLS**: recorded in one 1km square in the Forest, on a steep bank above a forestry road in restored heathland at Longdown Inclosure.

Pycnothelia papillaria: Heathtooth is a characteristic heathland species that is in serious decline outside of the New Forest in lowland England and Europe. Originally frequent in lowland heaths from Dorset to the Thames basin, but then rare until the Scottish Highlands, where it is still frequent; a similar distribution as shown by other species such as *Cladonia strepsilis*, *Cladonia zopfii* and *Icmadophila ericetorum*. This distribution may reflect in higher inheriting fertility of the shale and sandstone derived soils of the English and Welsh uplands but has probably been emphasised by past pollution and habitat degradation. **NHLS**: recorded in 89 1km squares in the Forest. Heathtooth is a specialist of hard black well lit damp humus found in both hard grazed and control-burned heathlands. It is mainly found on level ground but does occasionally occur on slopes and banks where these are well lit. It is still frequent throughout the New Forest. It is typically less frequent in short grazed heaths, than the burned heaths but was locally abundant in parts of Plaitford Common as the hard grazing here had produced much bare compact humus. The New Forest now has the bulk of the lowland European population of this species (Ketner-Oostra et al, 2010, Zarabska, & Rosadziński, 2011, Haveman & Ronde, 2013 & Website: "Lichen flora of Latvia").

MAP 37: *Pycnothelia papillaria*



Ramalina fastigiata: a common epiphyte, which occasionally colonises the ground in short vegetation in little disturbed places. **NHLS**: recorded in one 1km square in the Forest. Occasional in the rabbit grazed lichen sand heath at Blashford.

Trapeliopsis flexuosa: a common species of damp lignum, much less frequent on the ground, and then on damp shaded humus. **NHLS**: recorded in 14 1km squares in the Forest. On north facing and or shaded banks or deep humus.

Trapeliopsis glaucolepidea Notable (NS): a mainly upland species of humus banks, which is rare in the lowlands. **NHLS**: recorded in three 1km squares in the Forest. **New to the Forest in the 2001 – 15 survey**. Rare, recorded in an old rabbit hole on Plaitford Common, and on path ruts at Ogden's Purlieu and east of Burley.

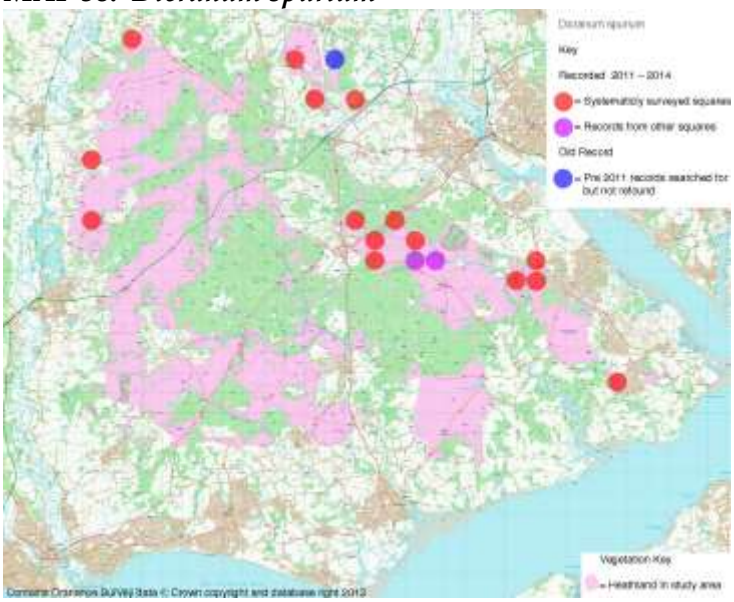
Trapeliopsis granulosa: a common species of well lit acid soil and humus, less so on lignum. **NHLS**: recorded in 38 1km squares in the Forest. Generally common on banks in the New Forest heathlands, but rare in areas like the Northern Commons with few banks.

Trapeliopsis pseudogranulosa: a mainly upland species of damp shaded humus and lignum, local in the lowlands. **NHLS**: recorded in two 1km squares in the Forest. Widespread in the Forest woods, but rare on the heaths on north facing or shaded banks.

Dicranum spurium Vulnerable (NS/S41): a characteristic moss of short grazed heaths, which is still widespread in the New Forest but nearly lost in the rest of lowland England. Intolerant of hot burns and shade. **NHLS**: recorded in 16 1km squares in the Forest. Recorded when seen as it shares the same habitat with rich lichens assemblages. As it is not so easy to spot when wet, this was not a full survey, which is still required for this threatened moss. However, the species is still clearly still widespread on the Forest, with several totally new sites found (one a new 10km square record, SU10). The exception is Half Moon Common, where it appears lost from areas where it was known in the 1990s, due to localised but excessive cattle poaching when cattle started being turned out from a new location. Characteristic of short grazed heaths but also extends into moderately browsed and occasionally

burned heaths, where it easily survives cool controlled burns. Not seen in tall heaths, where it is probably excluded by shade and hotter fires.

MAP 38: ***Dicranum spurium***

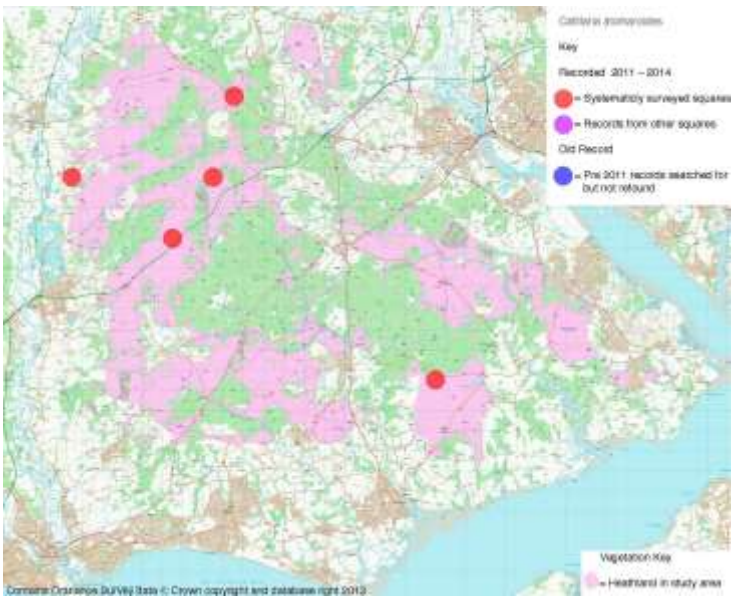


After the fieldwork stage was complete, *Dicranum spurium* was refound at a known site at Chibden Bottom (SU1610 & SU1710, not mapped above), where a huge population is stung out for 300m along a major braded cattle track from a Forest holding into the heath. Here it was absent from the most churned areas, but recently disturbed but now recolonising paths had frequent colonising small plants. Older recolonised areas had large mature plants. Undisturbed short grazed heath adjacent lacked any *Dicranum spurium*. This raises interesting questions about the ecology and reproduction of this moss that require further research.

A4.3 Species on Flints

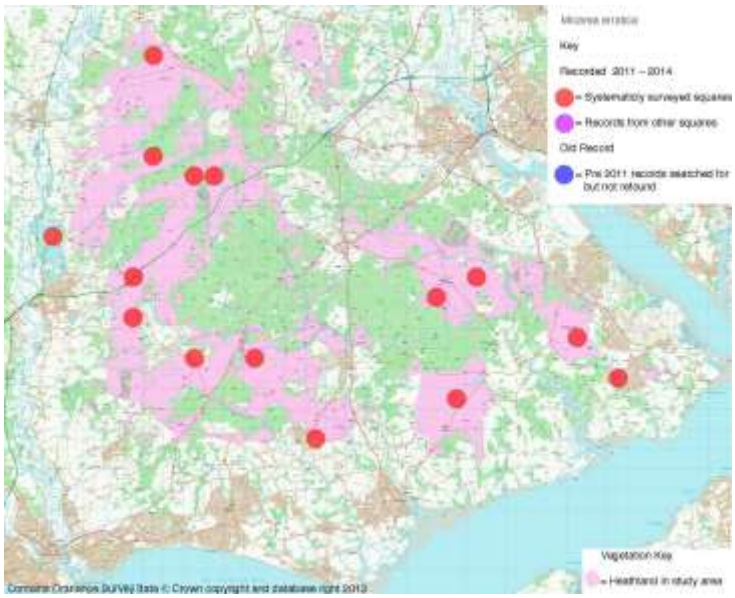
Catillaria atomarioides Notable (NS): on hard, siliceous rocks, including pebbles, under recorded and perhaps not Nationally Scarce. **NHLS**: recorded in five 1km squares in the Forest. **New to the Forest in the 2001 – 15 survey**, on flints in disturbed heaths in gravel pits, path side and a WWII airfield (**Map 39**).

MAP 39: ***Catillaria atomarioides***


Key
Recorded 2011 – 2014
= Systematicly surveyed squares
= Records from other squares
Old Record
= Pre 2011 records searched for but not refound
Vegetation Key
= Heathland in study area

Micarea erratica: a mainly lowland species of siliceous pebbles. **NHLS**: recorded in 16 1km squares in the Forest. Scattered through the Forest on flint pebbles, but absent from the Northern Commons, where flints are rare.

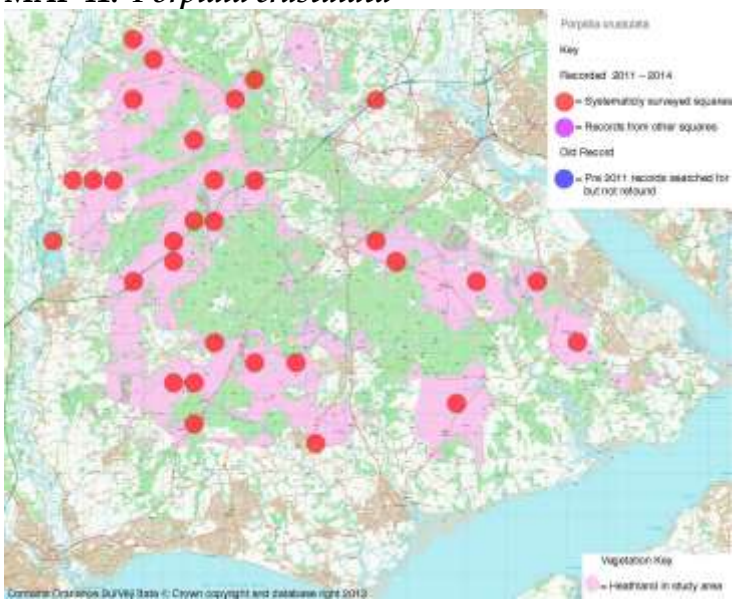
MAP 40: ***Micarea erratica***



Micarea peliocarpa: mainly found on humus on the ground (see account above), but recorded rarely on flint.

Porpidia crustulata: a widespread species of siliceous rock including pebbles. **NHLS**: recorded in 31 1km squares in the Forest. Widespread in the Forest on flints and rarely ironstone. Most frequently found on flints that are flushed by water in winter but dry in summer but also found on drier rocks. Absent from the main Northern Commons, where flints are rare.

MAP 41: ***Porpidia crustulata***



Porpidia macorcarpa: a common upland species of siliceous rock, uncommon and probably over recorded in the lowlands. **NHLS**: recorded in one 1km square in the

Forest. A single collection was made, **new to the Forest**, on a fragment of ironstone in an old quarry in Ogden's Purlieu.

Porpidia soredizodes: a common species of damp acid rocks. **NHLS**: recorded in 10 1km squares in the Forest. Typically found on flints that are flooded in winter but dry in summer.

Porpidia tuberculosa: a very common species of acid rocks. **NHLS**: recorded in 11 1km squares in the Forest. Scattered in the Forest on dry flints.

Rhizocarpon reductum: a ubiquitous species of siliceous rock. **NHLS**: recorded in 44 1km squares in the Forest. Dominant on stable well lit flints all over the Forest. Only rare in the Northern Commons, where flints are rare.

Trapelia coarctata: a common species of non calcareous damp rock. **NHLS**: recorded in 13 1km squares in the Forest. Occasional on flints ion damp locations, also rarely on broken bricks.

Trapelia obtegens: a widespread species of acid rock. **NHLS**: recorded in five 1km squares in the Forest. Occasional on flints and ironstone, usually by paths.

Trapelia placodioides: a widespread species of acid rock. **NHLS**: recorded in one 1km square in the Forest. On a natural ironstone outcrop in a hollow way at Rocks Hill.

A few species were found on both flints and concrete. All are common species:

Amandinea punctata, **NHLS**: recorded in two 1km squares in the Forest.
Lecanora dispersa, **NHLS**: recorded in three 1km squares in the Forest.
Verrucaria muralis, **NHLS**: recorded in 17 1km squares in the Forest.
Verrucaria nigrescens, **NHLS**: recorded in 26 1km squares in the Forest.

Two common epiphytes were recorded very rarely on flints:

Melanelixia glabratula, **NHLS**: recorded in four 1km squares in the Forest.
Parmotrema perlatum, **NHLS**: recorded in one 1km square in the Forest.

A4.4 Epiphytes on Heathers

Epiphytes are rare on heathers in the New Forest, and were they occurred, they simply consisted of impoverished assemblages of common lichens:

Arthopyrenia punctiformis, **NHLS**: recorded in one 1km square in the Forest.
Evernia prunastri, **NHLS**: recorded in four 1km squares in the Forest.
Fuscidea lightfootii, **NHLS**: recorded in six 1km squares in the Forest.
Graphis elegans, **NHLS**: recorded in one 1km square in the Forest.
Graphis scripta, **NHLS**: recorded in one 1km square in the Forest.
Hypotrachyna afrorevoluta, **NHLS**: recorded in five 1km squares in the Forest.
Hypotrachyna revoluta s.str., **NHLS**: recorded in one 1km square in the Forest.
Jamesiella anastomosans, **NHLS**: recorded in one 1km square in the Forest.
Lecanora confusa, **NHLS**: recorded in three 1km squares in the Forest.
Melanelixia subaurifera, **NHLS**: recorded in one 1km square in the Forest.
Parmelia sulcata, **NHLS**: recorded in three 1km squares in the Forest.
Physcia tenella, **NHLS**: recorded in four 1km squares in the Forest.

Punctelia jeckeri, **NHLS**: recorded in one 1km square in the Forest.
Punctelia subrudecta s. str., **NHLS**: recorded in one 1km square in the Forest.

A4.5 Species on Concrete

The following species were recorded on concrete or other imported rocks. Some are under recorded species, but none are of conservation significance, they are likely to be frequent on concrete and similar artificial habitats in Britain:

Acrocordia salweyi, **NHLS**: recorded in one 1km square in the Forest.
Amandinea punctata, **NHLS**: recorded in two 1km squares in the Forest.
Arthonia apotheciorum, **NHLS**: recorded in one 1km square in the Forest.
Aspicilia calcarea, **NHLS**: recorded in one 1km square in the Forest.
Aspicilia contorta spp contorta, **NHLS**: recorded in 12 1km squares in the Forest.
Caloplaca flavescens, **NHLS**: recorded in four 1km squares in the Forest.
Caloplaca flavocitrina, **NHLS**: recorded in nine 1km squares in the Forest.
Caloplaca limonia, **NHLS**: recorded in two 1km squares in the Forest.
Caloplaca oasis, **NHLS**: recorded in 16 1km squares in the Forest.
Candelariella vitellina, **NHLS**: recorded in 13 1km squares in the Forest.
Catillaria chalybeia, **NHLS**: recorded in 10 1km squares in the Forest.
Intralichen baccisporus [NR], **NHLS**: recorded in one 1km square in the Forest.
Lecania erysibe, **NHLS**: recorded in seven 1km squares in the Forest.
Lecania inundata [NS], **NHLS**: recorded in four 1km squares in the Forest.
Lecanora albescens, **NHLS**: recorded in 13 1km squares in the Forest.
Lecanora campestris ssp. *campestris*, **NHLS**: recorded in 10 1km squares in the Forest.
Lecanora dispersa, **NHLS**: recorded in three 1km squares in the Forest.
Lecanora muralis, **NHLS**: recorded in three 1km squares in the Forest.
Lecanora polytropa, **NHLS**: recorded in one 1km square in the Forest.
Lecidella stigmatea, **NHLS**: recorded in three 1km squares in the Forest.
Phaeophyscia orbicularis, **NHLS**: recorded in five 1km squares in the Forest.
Physcia adscendens, **NHLS**: recorded in nine 1km squares in the Forest.
Physcia caesia, **NHLS**: recorded in six 1km squares in the Forest.
Physcia dubia, **NHLS**: recorded in one 1km square in the Forest.
Placynthium nigrum, **NHLS**: recorded in one 1km square in the Forest.
Protoblastenia rupestris, **NHLS**: recorded in 17 1km squares in the Forest.
Rinodina oleae, **NHLS**: recorded in three 1km squares in the Forest.
Sarcogyne regularis, **NHLS**: recorded in eight 1km squares in the Forest.
Trapelia glebulosa, **NHLS**: recorded in two 1km squares in the Forest.
Verrucaria baldensis, **NHLS**: recorded in one 1km square in the Forest.
Verrucaria macrostoma f. *macrostoma*, **NHLS**: recorded in two 1km squares in the Forest.
Verrucaria muralis, **NHLS**: recorded in 17 1km squares in the Forest.
Verrucaria nigrescens, **NHLS**: recorded in 26 1km squares in the Forest.
Xanthoria calcicola, **NHLS**: recorded in four 1km squares in the Forest.
Xanthoria parietina, **NHLS**: recorded in eight 1km squares in the Forest.

ANNEX 5 Full Meta-site Species Lists by 1km Square

SPECIES LIST 3
Northern Commons

Species	SU2717 Plaitford S	SU2718 Plaitford N	SU2719 Plaitford N	SU2815 Cadnam	SU2816 Furzley	SU2817 W Wellow	SU2818 W Wellow	SU2915 Cadnam	SU2917 HMC	SU2918 Black Hill	SU3014 Copythorne W	SU3015 Copythorne W	SU3115 Copythorne W & E	Systematic	All
Acrocordia salweyi				1										1	1
Arthrorhaphis aeruginosa	1													1	1
Aspicilia calcarea											1			1	1
Aspicilia contorta spp contorta											1			1	1
Bachmanniomyces uncialicola		1	1	1					1					4	4
Baeomyces rufus													1	1	1
Caloplaca flavescens					1									1	1
Caloplaca flavocitrina				1	1									2	2
Caloplaca limonia				1										1	1
Caloplaca oasis					1						1			2	2
Candelariella vitellina					1									1	1
Catillaria chalybeia				1							1			2	2
Cetraria aculeata	1	1		1	1				1					5	5
Cetraria muricata	1	1	1	1										4	4
Cladonia arbuscula ssp. squarrosa	1	1	1	1	1	1	1	1	1	1		1	1	8	12
Cladonia callosa	1	1			1								1	4	4
Cladonia cervicornis ssp. cervicornis	1	1		1								1	1	5	5
Cladonia chlorophaea s.s.		1	1									1	1	4	4
Cladonia ciliata var. ciliata	1	1		1	1			1	1	1		1	1	8	9
Cladonia ciliata var. tenuis	1	1	1	1	1				1	1		1		8	8
Cladonia coccifera s. str.	1	1												2	2
Cladonia coniocraea				1					1			1	1	4	4
Cladonia cornuta									1	1				2	2
Cladonia crispata var. cetrariiformis	1	1	1	1	1			1	1	1		1	1	9	10
Cladonia cryptochlorophaea group	1	1	1	1	1			1	1		1	1	1	9	10
Cladonia cryptochlorophaea	1	1	1	1	1			1	1			1		7	8
Cladonia merochlorophaea	1										1	1	1	4	4
Cladonia digitata												1		1	1
Cladonia diversa	1	1	1	1	1				1	1		1	1	9	9
Cladonia fimbriata	1	1		1					1	1	1	1	1	8	8
Cladonia floerkeana	1	1	1	1	1				1	1		1	1	9	9
Cladonia foliacea		1												1	1
Cladonia furcata ssp furcata	1	1	1	1					1	1	1	1	1	9	9
Cladonia glauca									1			1		2	2
Cladonia gracilis	1	1	1	1	1		1		1			1	1	7	9
Cladonia grayi s.s.	1								1					2	2
Cladonia humilis		1							1		1		1	4	4
Cladonia incrassata			1	1					1			1		4	4
Cladonia macilenta					1				1			1		3	3
Cladonia phyllophora	1	1	1											3	3
Cladonia portentosa	1	1	1	1	1		1	1	1	1		1	1	8	11
Cladonia ramulosa	1	1	1	1					1	1		1		7	7
Cladonia rangiformis		1									1			2	2
Cladonia scabriuscula													1	1	1
Cladonia squamosa var. squamosa	1	1		1				1	1				1	5	6
Cladonia squamosa var. subsquamosa	1	1	1	1				1	1	1			1	7	8
Cladonia strepsilis	1	1	1	1	1								1	6	6
Cladonia subcervicornis	1	1												2	2
Cladonia subulata												1		1	1
Cladonia uncialis ssp. biuncialis	1	1	1	1	1			1	1	1		1	1	9	10
Cladonia verticillata		1												1	1
Cladonia zopfii	1	1	1	1	1								1	6	6
Dibaeis baeomyces	1	1												2	2
Epicladonia sandstedei	1													1	1
Hypogymnia physodes	1	1	1	1					1		1			6	6

Species	SU2717 Plaitford S	SU2718 Plaitford N	SU2719 Plaitford N	SU2815 Cadnam	SU2816 Furzley	SU2817 W Wellow	SU2818 W Wellow	SU2915 Cadnam	SU2917 HMC	SU2918 Black Hill	SU3014 Copythorne W	SU3015 Copythorne W	SU3115 Copythorne W & E	Systematic	All
Icmadophila ericetorum	1			1										2	2
Lecania erysibe											1			1	1
Lecania inundata				1										1	1
Lecanora albescens				1	1									2	2
Lecanora campestris ssp. campestris				1							1			2	2
Lepraria incana			1											1	1
Lichenomphalia umbellifera					1									1	1
Micarea lignaria var. lignaria	1	1												2	2
Micarea melaena				1										1	1
Micarea peliocarpa		1												1	1
Micarea viridileprosa		1		1					1	1		1		5	5
Peltigera didactyla											1	1		2	2
Peltigera hymenina	1	1									1	1	1	5	5
Peltigera membranacea											1			1	1
Peltigera rufescens											1	1		2	2
Phaeophyscia orbicularis				1										1	1
Placynthiella dasaea	1	1	1	1					1			1		6	6
Placynthiella icmalea	1	1		1	1				1			1	1	7	7
Placynthiella uliginosa				1										1	1
Platismatia glauca	1								1					2	2
Porpidia crustulata													1	1	1
Pycnothelia papillaria	1	1	1	1	1		1		1				1	6	8
Rhizocarpon reductum		1											1	2	2
Trapelia coarctata				1										1	1
Trapelia glebulosa				1										1	1
Trapeliopsis flexuosa				1										1	1
Trapeliopsis glaucolepidea		1												1	1
Trapeliopsis granulosa		1												1	1
Verrucaria baldensis					1									1	1
Verrucaria macrostoma f. macrostoma				1	1									2	2
Verrucaria nigrescens					1						1			2	2
Dicranum spurium	1			1									1	3	3
Total Spp	35	41	22	42	25				29	14	16	26	26	27.6	
CCP Index Score	26	30	19	23	16				24	13	5	21	22	19.9	

SPECIES LIST 4a
Eastern Heaths, Western Squares

Species	SU3008 Bolton B	SU3009 Fair Cross	SU3107 Ridge	SU3108 White Moor	SU3207 Matley Heath	SU3208 Longwater	Mallard SU3209	SU3306 Stag Park	SU3307 Matley	SU3308 Matley	SU3405 Shatterford	SU3406 Shatterford	SU3407 Kings's Passage	SU3408 Longdown	SU3505 Stephill Bottom	SU3506 Blackdown	SU3507 Decoy Pond	SU3508 Longdown Inclosure	SU3606 Yew Tree Heath
Agonimia tristicula																			1
Amandinea punctata																			1
Arthonia apotheciorum																			
Arthopyrenia punctiformis																			
Arthrorhaphis aeruginosa				1	1														1
Arthrorhaphis grisea																		1	
Arrhenia peltigerina														1					
Aspicilia contorta spp contorta																			1
Bachmanniomyces uncialicola										1									
Bacidia bagliettoana																			1
Baeomyces rufus				1		1												1	1
Caloplaca flavocitrina																			
Caloplaca limonia																			
Caloplaca oasis																			1
Candelariella vitellina																			1
Catillaria chalybeia																			
Cetraria aculeata	1	1	1	1	1	1				1								1	1
Cetraria muricata	1	1	1	1	1	1			1	1	1								1
Cladonia arbuscula ssp. squarrosa	1	1	1	1			1		1	1				1					
Cladonia callosa			1	1	1	1				1								1	1
Cladonia cariosa					1														1
Cladonia cervicornis s. str.	1		1	1	1						1							1	1
Cladonia cervicornis ssp. verticillata	1	1	1	1	1	1	1			1	1								1
Cladonia chlorophaea s .str.			1	1	1						1							1	
Cladonia ciliata var. ciliata	1	1	1	1	1				1	1	1							1	1
Cladonia ciliata var. tenuis	1	1	1	1	1	1	1	1		1						1		1	
Cladonia coccifera			1	1	1	1		1		1	1								
Cladonia coniocraea	1	1			1						1							1	1
Cladonia cornuta		1	1		1	1	1			1	1		1						
Cladonia crispata var. cetrariiformis	1	1	1	1	1	1	1	1	1	1	1					1			1
Cladonia cryptochlorophaea group	1	1	1	1	1	1	1	1		1	1					1		1	1
Cladonia cryptochlorophaea	*1*	*1*	*1*	*1*	*1*	*1*	*1*				*1*					*1*		*1*	*1*
Cladonia merochlorophaea		*1*	*1*	*1*	*1*	*1*				*1*	*1*							*1*	
Cladonia novochlorophaea				*1*															
Cladonia digitata	1			1			1			1	1								
Cladonia diversa	1	1	1	1	1	1	1			1	1					1			1
Cladonia fimbriata		1	1	1		1	1			1	1								1
Cladonia floerkeana	1	1	1	1	1	1	1		1	1	1					1		1	1
Cladonia foliacea																			1
Cladonia furcata ssp furcata	1		1	1	1					1	1							1	1
Cladonia furcata ssp subrangiformis					1														
Cladonia glauca			1	1							1								
Cladonia gracilis	1		1	1	1			1	1									1	1
Cladonia grayi s.s.	1	1		1															
Cladonia humilis			1		1			1		1								1	
Cladonia humilis "schizidiate form"					1														1
Cladonia incrassata	1			1		1		1		1	1			1				1	
Cladonia macilenta			1	1	1	1	1	1		1	1							1	
Cladonia ochrochlora				1														1	

Species	SU3008 Bolton B	SU3009 Fair Cross	SU3107 Ridge	SU3108 White Moor	SU3207 Matley Heath	SU3208 Longwater	Mallard SU3209	SU3306 Stag Park	SU3307 Matley	SU3308 Matley	SU3405 Shatterford	SU3406 Shatterford	SU3407 Kings's Passage	SU3408 Longdown	SU3505 Stephill Bottom	SU3506 Blackdown	SU3507 Decoy Pond	SU3508 Longdown Inclosure	SU3606 Yew Tree Heath
Cladonia parasitica			1																
Cladonia phyllophora			1	1	1	1				1	1								1
Cladonia polydactyla var. polydactyla		1						1		1	1							1	
Cladonia portentosa	1	1	1	1	1	1	1	1	1	1	1					1		1	1
Cladonia ramulosa		1	1	1	1	1				1	1							1	1
Cladonia rangiformis			1	1	1					1								1	1
Cladonia rei	1		1	1	1					1	1								
Cladonia scabriuscula																			
Cladonia squamosa var. squamosa					1		1												1
Cladonia squamosa var. subsquamosa	1	1	1	1		1	1	1		1	1					1			1
Cladonia strepsilis		1	1	1	1	1		1	1	1	1	1	1	1	1				1
Cladonia subcervicornis			1	1		1				1	1				1				1
Cladonia subulata				1	1	1		1			1								
Cladonia uncialis ssp. biuncialis	1	1	1	1		1	1	1	1	1		1				1		1	1
Cladonia zopfii			1	1		1			1	1		1		1			1		
Collema auriforme			1		1														1
Dibaeis baeomyces				1	1	1													
Diploschistes muscorum			1																
Evernia prunastri																			
Flavoparmelia caperata																			
Fuscidea lightfootii			1																
Graphis elegans			1																
Hypogymnia physodes	1		1							1									1
Hypotrachyna afrorevoluta			1															1	
Hypotrachyna revoluta s.str.			1																
Icmadophila ericetorum	1		1	1	1					1		1							
Intralichen baccisporus																			
Jamesiella anastomosans											1								
Lecania erysibe																			1
Lecania inundata																			1
Lecanora albescens																			1
Lecanora campestris ssp. campestris																			1
Lecanora confusa			1																
Lecidella stigmatea																			1
Lepraria incana																		1	
Leptogium intermedium																			1
Leptogium palmatum	1																		
Melanelixia glabratula			1																
Melanelixia subaurifera			1																
Micarea erratica											1								1
Micarea leprosula				1	1					1									1
Micarea lignaria var. lignaria		1	1	1	1	1				1						1			1
Micarea prasina s.l.											1								
Micarea viridileprosa			1	1						1	1							1	1
Parmelia saxatilis																			
Parmelia sulcata			1																
Peltigera canina																			
Peltigera didactyla			1																1
Peltigera hymenina				1	1													1	1
Peltigera neckeri					1								1						
Peltigera rufescens																			1
Phaeophyscia orbicularis																			
Physcia adscendens			1																
Physcia caesia																			

Species	SU3008 Bolton B	SU3009 Fair Cross	SU3107 Ridge	SU3108 White Moor	SU3207 Matley Heath	SU3208 Longwater	Mallard SU3209	SU3306 Stag Park	SU3307 Matley	SU3308 Matley	SU3405 Shatterford	SU3406 Shatterford	SU3407 Kings's Passage	SU3408 Longdown	SU3505 Stephill Bottom	SU3506 Blackdown	SU3507 Decoy Pond	SU3508 Longdown Inclosure	SU3606 Yew Tree Heath
Physcia tenella			1																
Placynthiella dasaea				1							1							1	
Placynthiella icmalea		1	1	1		1	1			1	1					1		1	1
Placynthiella uliginosa				1		1					1								1
Placynthium nigrum																			1
Porpidia crustulata				1	1														1
Porpidia soredizodes																			
Protoblastenia rupestris					1														1
Psilolechia lucida																		1	
Punctelia jeckeri			1																
Punctelia subrudecta s. str.			1																
Pycnothelia papillaria		1	1	1	1	1	1	1	1	1	1		1	1	1	1			1
Rhizocarpon reductum				1	1														1
Rinodina oleae																			
Sarcogyne regularis				1															
Trapelia coarctata											1								
Trapelia glebulosa			1																
Trapeliopsis flexuosa				1	1	1					1							1	1
Trapeliopsis granulosa				1	1	1				1	1								1
Verrucaria muralis					1														
Verrucaria nigrescens					1														1
Xanthoria calcicola																			
Xanthoria parietina																			1
Dicranum spurium		1	1	1			1		1	1			1						
Total	23	22	53	51	45	30	16			38	37							29	59
CCP Index Score	21	21	33	35	31	24	16			31	28							20	27

SPECIES LIST 4b
Eastern Heaths, Eastern Squares

Species	SU3607 Pottern Ford	SU3608 Longdown	SU3705 Gurnetfields	SU3706 E of Ipley	SU3805 Starpole	SU3806 Dibden	SU3906 Dibden	SU3907 Dibden	SU3010 Stubby Hat	SU4002 BH East	SU4004 BH East	SU4005 BH East	SU4006 Hoarstone	SU4102 BH East	SU4103 BH East	SU4301 Blackwell	SU4501 Badminston Common	Systematic	All
Agonimia tristicula																		1	1
Amandinea punctata																	1	2	2
Arthonia apotheciorum								1										1	1
Arthopyrenia punctiformis											1							1	1
Arthrorhaphis aeruginosa		1																3	4
Arthrorhaphis grisea																		1	1
Arrhenia peltigerina																		0	1
Aspicilia contorta spp contorta																		1	1
Bachmanniomyces uncialicola																		3	3
Bacidia bagliettoana																		1	1
Baeomyces rufus							1										1	6	6
Caloplaca flavocitrina											1							1	1
Caloplaca limonia								1										1	1
Caloplaca oasis											1							2	2
Candelariella vitellina						1		1			1							4	4
Catillaria chalybeia								1										1	1
Cetraria aculeata					1					1	1					1	1	14	14
Cetraria muricata		1			1		1			1					1			13	15
Cladonia arbuscula ssp. squarrosa		1			1		1	1				1						9	13
Cladonia callosa									1		1			1	1			11	11
Cladonia cariosa																		2	2
Cladonia cervicornis s. str.					1		1	1						1		1		12	12
Cladonia cervicornis ssp. verticillata					1	1	1	1						1	1			16	16
Cladonia chlorophaea s .str.								1		1	1						1	9	9
Cladonia ciliata var. ciliata					1	1	1	1			1		1			1	1	16	18
Cladonia ciliata var. tenuis					1			1					1		1		1	13	16
Cladonia coccifera					1	1					1				1			10	11
Cladonia coniocraea							1		1					1			1	10	10
Cladonia cornuta				1	1	1	1		1							1		12	14
Cladonia crispata var. cetrariiformis						1	1	1	1	1	1			1	1	1	1	20	23
Cladonia cryptochlorophaea group					1	1	1	1	1	1	1			1	1	1	1	22	24
Cladonia cryptochlorophaea					*1*	*1*	*1*	*1*	*1*		*1*					*1*	*1*	*18*	*19*
Cladonia merochlorophaea					*1*		*1*		*1*	*1*				*1*	*1*		*1*	*15*	*15*
Cladonia novochlorophaea							*1*											*2*	*2*
Cladonia digitata					1	1	1		1							1		10	10
Cladonia diversa					1	1	1	1	1		1			1	1	1	1	20	21
Cladonia fimbriata						1			1						1			11	11
Cladonia floerkeana					1	1	1	1	1	1	1			1	1	1	1	22	24
Cladonia foliacea													1					1	2
Cladonia furcata ssp furcata					1		1	1	1	1	1		1		1	1	1	17	18
Cladonia furcata ssp subrangiformis																		1	1
Cladonia glauca																		3	3
Cladonia gracilis					1													7	9
Cladonia grayi s.s.																		3	3
Cladonia humilis					1	1		1		1	1				1		1	11	12
Cladonia humilis "schizidiate form"								1										3	3
Cladonia incrassata		1		1			1	1							1	1		10	14
Cladonia macilenta					1		1							1	1	1		13	14
Cladonia ochrochlora											1							3	3
Cladonia parasitica							1											2	2
Cladonia phyllophora															1			8	8

Species	SU3607 Pottern Ford	SU3608 Longdown	SU3705 Gurnetfields	SU3706 E of Ipley	SU3805 Starpole	SU3806 Dibden	SU3906 Dibden	SU3907 Dibden	SU3010 Stubby Hat	SU4002 BH East	SU4004 BH East	SU4005 BH East	SU4006 Hoarstone	SU4102 BH East	SU4103 BH East	SU4301 Blackwell	SU4501 Badminston Common	Systematic	All
Cladonia polydactyla var. polydactyla					1				1		1							7	8
Cladonia portentosa					1	1	1	1	1	1	1		1	1	1	1	1	22	26
Cladonia ramulosa					1		1		1		1			1	1	1	1	17	17
Cladonia rangiformis					1	1				1			1				1	10	11
Cladonia rei																		6	6
Cladonia scabriuscula										1	1				1		1	4	4
Cladonia squamosa var. squamosa									1		1				1			6	6
Cladonia squamosa var. subsquamosa					1	1	1	1	1		1			1	1	1		18	20
Cladonia strepsilis			1		1	1	1	1		1	1	1		1	1		1	17	25
Cladonia subcervicornis		1			1	1	1							1	1			11	13
Cladonia subulata					1		1				1						1	8	9
Cladonia uncialis ssp. biuncialis					1	1	1	1		1	1			1	1			17	21
Cladonia zopfii	1	1			1			1			1							7	13
Collema auriforme																		3	3
Dibaeis baeomyces																		3	3
Diploschistes muscorum																		1	1
Evernia prunastri																	1	1	1
Flavoparmelia caperata																	1	1	1
Fuscidea lightfootii																		1	1
Graphis elegans																		1	1
Hypogymnia physodes							1								1	1	1	8	8
Hypotrachyna afrorevoluta																		2	2
Hypotrachyna revoluta s.str.																		1	1
Icmadophila ericetorum							1											6	7
Intralichen baccisporus											1							1	1
Jamesiella anastomosans																		1	1
Lecania erysibe																		1	1
Lecania inundata											1							2	2
Lecanora albescens								1			1							3	3
Lecanora campestris ssp. campestris																		1	1
Lecanora confusa											1							2	2
Lecidella stigmatea											1							2	2
Lepraria incana																		1	1
Leptogium intermedium																		1	1
Leptogium palmatum																		1	1
Melanelixia glabratula																		1	1
Melanelixia subaurifera																		1	1
Micarea erratica															1	1		4	4
Micarea leprosula															1			5	5
Micarea lignaria var. lignaria							1								1			9	10
Micarea prasina s.l.							1											2	2
Micarea viridileprosa						1								1				8	8
Parmelia saxatilis										1								1	1
Parmelia sulcata																	1	2	2
Peltigera canina										1								1	1
Peltigera didactyla						1												3	3
Peltigera hymenina							1	1		1							1	8	8
Peltigera neckeri																		1	2
Peltigera rufescens																		1	1
Phaeophyscia orbicularis								1										1	1
Physcia adscendens						1												2	2
Physcia caesia						1												1	1
Physcia tenella																		1	1
Placynthiella dasaea		1												1				4	5
Placynthiella icmalea						1								1	1		1	13	14
Placynthiella uliginosa																		4	4
Placynthium nigrum																		1	1

Species	**SU3607 Pottern Ford**	**SU3608 Longdown**	**SU3705 Gurnetfields**	**SU3706 E of Ipley**	**SU3805 Starpole**	**SU3806 Dibden**	**SU3906 Dibden**	**SU3907 Dibden**	**SU3010 Stubby Hat**	**SU4002 BH East**	**SU4004 BH East**	**SU4005 BH East**	**SU4006 Hoarstone**	**SU4102 BH East**	**SU4103 BH East**	**SU4301 Blackwell**	**SU4501 Badminston Common**	**Systematic**	**All**
Porpidia crustulata								1							1			5	5
Porpidia soredizodes																	1	1	1
Protoblastenia rupestris						1		1										4	4
Psilolechia lucida																		1	1
Punctelia jeckeri																		1	1
Punctelia subrudecta s. str.																		1	1
Pycnothelia papillaria	1	1	1		1	1	1	1		1	1			1	1			17	26
Rhizocarpon reductum								1							1		1	6	6
Rinodina oleae								1										1	1
Sarcogyne regularis							1											2	2
Trapelia coarctata																		1	1
Trapelia glebulosa																		1	1
Trapeliopsis flexuosa																		6	6
Trapeliopsis granulosa					1		1		1						1			10	10
Verrucaria muralis								1			1							3	3
Verrucaria nigrescens						1		1			1							5	5
Xanthoria calcicola								1										1	1
Xanthoria parietina						1												2	2
Dicranum spurium						1	1	1								1		9	11
Meta-site	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths	Eastern Heaths		
Total					28	26	32	33	15	16	33			18	31	16	26	30.8	
CCP Index Score					28	18	24	20	15	14	23			16	24	15	17	22.8	

SPECIES LIST 5
Beaulieu Heath West

Species	SZ3499 U Crockford	SZ3698 Broom Hill	SU3301 Round Hill	SU3401 B Airfield NW	SU3500 B Airfield SE	SU3600 Bagshot Moor	SU3602 Furzy Lodge	Systematic	All
Aspicilia contorta spp contorta			1		1			2	2
Bachmanniomyces uncialicola			1			1		2	2
Bacidia bagliettoana					1			1	1
Baeomyces rufus				1				1	1
Buellia ocellata					1			1	1
Caloplaca flavocitrina					1			1	1
Caloplaca oasis				1	1			2	2
Catillaria atomarioides				1				1	1
Catillaria chalybeia					1			1	1
Cetraria aculeata			1		1	1		3	3
Cetraria muricata		1	1			1		3	3
Cladonia arbuscula ssp. squarrosa	1	1				1	1	4	4
Cladonia callosa	1	1			1			3	3
Cladonia cariosa				1	1			2	2
Cladonia cervicornis s. str.	1				1	1		3	3
Cladonia cervicornis ssp. verticillata	1	1		1		1		4	4
Cladonia chlorophaea s .str.				1		1		2	2
Cladonia ciliata var. ciliata	1	1	1	1	1	1	1	7	7
Cladonia ciliata var. tenuis		1			1		1	3	3
Cladonia coccifera					1	1		2	2
Cladonia coniocraea		1					1	2	2
Cladonia cornuta					1			1	1
Cladonia crispata var. cetrariiformis	1		1	1	1	1	1	6	6
Cladonia cryptochlorophaea group	1	1	1	1	1	1	1	7	7
Cladonia cryptochlorophaea	1		1		1	1		4	4
Cladonia merochlorophaea	1					1	1	3	3
Cladonia diversa	1		1	1	1		1	5	5
Cladonia fimbriata	1							1	1
Cladonia floerkeana	1	1	1	1	1	1	1	7	7
Cladonia foliacea				1				1	1
Cladonia furcata ssp furcata	1	1	1	1	1	1	1	7	7
Cladonia furcata ssp subrangiformis				1	1			2	2
Cladonia glauca				1				1	1
Cladonia gracilis		1			1	1	1	4	4
Cladonia humilis		1	1		1	1		4	4
Cladonia humilis “schizidiate form”				1	1	1		3	3
Cladonia incrassata	1							1	1
Cladonia macilenta	1							1	1
Cladonia phyllophora					1			1	1
Cladonia portentosa	1	1	1	1	1	1	1	7	7
Cladonia ramulosa	1	1			1	1		4	4
Cladonia rangiformis	1		1	1	1	1		5	5
Cladonia rei					1		1	2	2
Cladonia scabriuscula	1							1	1
Cladonia squamosa var. squamosa						1		1	1
Cladonia squamosa var. subsquamosa	1	1	1	1	1		1	6	6

Species	SZ3499 U Crockford	SZ3698 Broom Hill	SU3301 Round Hill	SU3401 B Airfield NW	SU3500 B Airfield SE	SU3600 Bagshot Moor	SU3602 Furzy Lodge	Systematic	All
Cladonia strepsilis	1	1	1	1	1	1	1	7	7
Cladonia subcervicornis	1			1	1	1		4	4
Cladonia uncialis ssp. biuncialis	1	1	1	1	1	1	1	7	7
Cladonia zopfii	1	1		1	1	1	1	6	6
Collema auriforme				1	1			2	2
Dibaeis baeomyces				1	1			2	2
Hypogymnia physodes	1		1					2	2
Lecania erysibe					1			1	1
Lecanora albescens					1			1	1
Leptogium schraderi					1			1	1
Leptogium tenuissimum					1			1	1
Micarea erratica					1			1	1
Micarea leprosula					1	1		2	2
Micarea lignaria var. lignaria	1				1	1		3	3
Micarea peliocarpa			1			1		2	2
Micarea viridileprosa					1			1	1
Peltigera canina			1	1	1			3	3
Peltigera didactyla				1	1			2	2
Peltigera hymenina	1	1	1	1	1	1		6	6
Peltigera neckeri					1			1	1
Peltigera rufescens					1			1	1
Phaeophyscia orbicularis					1			1	1
Physcia adscendens				1	1			2	2
Physcia caesia				1	1			2	2
Physcia dubia				1				1	1
Placidium squamulosa					1			1	1
Placynthiella icmalea	1		1	1		1		4	4
Placynthiella uliginosa	1							1	1
Porpidia crustulata					1			1	1
Porpidia soredizodes				1	1			2	2
Porpidia tuberculosa				1	1			2	2
Protoblastenia rupestris			1	1	1			3	3
Pycnothelia papillaria	1		1	1	1	1		5	5
Rhizocarpon reductum			1	1	1		1	4	4
Sarcogyne regularis				1	1			2	2
Trapelia coarctata				1	1			2	2
Verrucaria muralis			1	1	1	1		4	4
Verrucaria nigrescens			1	1	1			3	3
Xanthoria calcicola					1			1	1
Xanthoria parietina				1	1			2	2
Total	27	18	25	41	63	30	16	31.4	
Cladonia, Cetraria & Pycnothelia	23	18	15	21	28	24	16	20.7	

SPECIES LIST 6a
South Western Heaths, Western Squares

Species	SZ1995 Burton Common	SZ2198 Plain Heath	SZ2198 Plain Heath	SZ2299 Plain Heath	SZ2599 Wootton Bridge	SZ2898 Durns Town	SZ2999 Milking Pound	SZ3099 Race Plain	SU1400 Bistern Warren	SU1901 Dur Hill Down	SU2000 Whitten S	SU2001 Whitten N	SU2101 Holmsley	SU2201 Goatspen P	SU2202 Pigsty Hill
Agonimia tristicula					1										
Arthrorhaphis aeruginosa														1	
Arthrorhaphis grisea										1				1	
Aspicilia contorta spp contorta				1	1			1							
Bachmanniomyces uncialicola															
Baeomyces rufus					1		1			1			1	1	
Caloplaca flavescens								1							
Caloplaca flavocitrina				1				1	1						
Caloplaca oasis		1		1				1	1						
Candelariella vitellina		1		1				1	1						
Catillaria chalybeia		1													
Cetraria aculeata				1				1		1	1		1	1	
Cetraria muricata				1			1	1		1			1	1	1
Cladonia arbuscula ssp. squarrosa							1		1						
Cladonia borealis															
Cladonia callosa					1	1	1	1		1	1		1	1	1
Cladonia cervicornis s. str.	1				1		1	1		1			1	1	
Cladonia cervicornis ssp. verticillata					1		1	1		1			1	1	1
Cladonia chlorophaea s .str.					1	1									
Cladonia ciliata var. ciliata	1			1	1		1	1		1		1	1		
Cladonia ciliata var. tenuis				1				1					1		
Cladonia coccifera					1								1	1	1
Cladonia coniocraea	1												1		
Cladonia cornuta							1	1		1		1		1	1
Cladonia crispata var. cetrariiformis		1		1	1	1	1	1		1	1	1	1	1	1
Cladonia cryptochlorophaea group	1	1		1	1	1	1	1		1	1	1	1	1	1
Cladonia cryptochlorophaea	1	1		1	1	1	1	1			1	1	1	1	1
Cladonia novochlorophaea															
Cladonia digitata					1							1			1
Cladonia diversa		1		1			1	1		1	1	1	1	1	1
Cladonia fimbriata		1				1				1		1	1		1
Cladonia floerkeana	1	1		1	1	1	1	1		1	1	1	1	1	1
Cladonia furcata ssp furcata	1				1	1	1	1		1		1		1	1
Cladonia furcata ssp subrangiformis		1						1							
Cladonia gracilis								1						1	
Cladonia humilis					1			1			1		1	1	
Cladonia humilis "schizidiate form"				1											
Cladonia incrassata				1						1		1			
Cladonia macilenta	1				1	1	1	1		1	1	1	1	1	1
Cladonia mediterranea					1										
Cladonia ochrochlora					1										
Cladonia parasitica					1										
Cladonia phyllophora					1		1	1						1	
Cladonia polydactyla var. polydactyla		1			1			1			1			1	1
Cladonia portentosa	1	1		1	1	1	1	1	1	1	1	1	1	1	1
Cladonia pyxidata														1	
Cladonia ramulosa	1	1			1	1	1	1		1	1	1	1	1	1
Cladonia rangiformis		1		1	1	1		1		1	1	1	1	1	
Cladonia rei					1								1	1	
Cladonia scabriuscula								1				1			
Cladonia squamosa var.		1			1							1		1	

Species	SZ1995 Burton Common	SZ2198 Plain Heath	SZ2198 Plain Heath	SZ2299 Plain Heath	SZ2599 Wootton Bridge	SZ2898 Durns Town	SZ2999 Milking Pound	SZ3099 Race Plain	SU1400 Bistern Warren	SU1901 Dur Hill Down	SU2000 Whitten S	SU2001 Whitten N	SU2101 Holmsley	SU2201 Goatspen P	SU2202 Pigsty Hill
squamosa															
Cladonia squamosa var. subsquamosa				1	1		1	1		1	1	1	1	1	1
Cladonia strepsilis					1		1			1	1	1	1	1	1
Cladonia subcervicornis							1			1		1	1	1	1
Cladonia subulata	1					1							1	1	
Cladonia uncialis ssp. biuncialis		1		1	1		1	1			1	1	1	1	1
Cladonia zopfii				1	1										
Collema auriforme				1	1			1							
Dibaeis baeomyces														1	
Epicladonia sandstedei															
Flavoparmelia caperata														1	
Fuscidea lightfootii															
Graphis elegans															
Graphis scripta															
Hypogymnia physodes				1				1					1		1
Icmadophila ericetorum													1		
Lecania erysibe		1		1				1	1						
Lecanora albescens		1		1	1			1							
Lecanora campestris ssp. campestris		1			1			1	1						
Lecanora dispersa								1							
Lecanora muralis		1						1							
Leptogium intermedium			1		1										
Leptogium palmatum								1							
Micarea erratica						1									1
Micarea leprosula										1			1		1
Micarea lignaria var. lignaria										1		1	1		
Micarea peliocarpa															1
Micarea prasina s.l.															1
Micarea viridileprosa						1	1			1		1	1	1	1
Micarea xanthonica															
Peltigera canina				1		1		1							
Peltigera didactyla								1						1	
Peltigera hymenina	1	1						1	1	1			1	1	
Peltigera membranacea				1											
Peltigera neckeri				1											
Peltigera rufescens														1	
Phaeophyscia orbicularis		1													
Physcia adscendens								1							
Placynthiella dasaea						1		1						1	
Placynthiella icmalea	1			1	1	1	1	1		1		1	1	1	1
Placynthiella oligotropha															
Placynthiella uliginosa								1		1					
Porpidia crustulata				1		1							1	1	
Porpidia tuberculosa															
Protoblastenia rupestris				1	1			1	1						
Pycnothelia papillaria		1		1	1		1	1		1	1	1	1	1	1
Rhizocarpon reductum		1		1	1		1			1			1	1	
Rinodina oleae				1											
Sarcogyne regularis		1											1		
Trapelia coarctata													1		
Trapelia obtegens															
Trapelia placodioides															
Trapeliopsis flexuosa										1		1			
Trapeliopsis glaucolepidea															
Trapeliopsis granulosa							1	1					1	1	1
Verrucaria muralis				1	1										
Verrucaria nigrescens		1		1	1			1	1						
Xanthoria calcicola					1										
Xanthoria parietina					1			1							
Total	11	24		33	41	17	25	49		31	15	24	38	42	28

Species	SZ1995 Burton Common	SZ2198 Plain Heath	SZ2198 Plain Heath	SZ2299 Plain Heath	SZ2599 Wootton Bridge	SZ2898 Durns Town	SZ2999 Milking Pound	SZ3099 Race Plain	SU1400 Bistern Warren	SU1901 Dur Hill Down	SU2000 Whitten S	SU2001 Whitten N	SU2101 Holmsley	SU2201 Goatspen P	SU2202 Pigsty Hill
Cladonia, Cetraria & Pycnothelia	10	13		16	28	12	21	26		22	16	21	26	29	21

SPECIES LIST 6b
South Western Heaths, Eastern Squares

Species	SU2203 Burley Rocks	SU2302 Clay Hill	SU2303 Rock Hill	SU2501 Wilverley	SU2502 Duck Hole	SU2701 5 Thorns Hill	SU2702 Red Hill	SU2703 Ober Heath	SU2801 The Wiers	SU2802 North Wiers	SU2803 Ober Slade	SU2804 Ober Slade	SU3000 Setley Common N	Systematic	All
Agonimia tristicula														1	1
Arthrorhaphis aeruginosa														1	1
Arthrorhaphis grisea					1									3	3
Aspicilia contorta spp contorta														3	3
Bachmanniomyces uncialicola							1			1				2	2
Baeomyces rufus			1		1	1	1							8	9
Caloplaca flavescens														1	1
Caloplaca flavocitrina														2	3
Caloplaca oasis														3	4
Candelariella vitellina														3	4
Catillaria chalybeia														1	1
Cetraria aculeata		1							1	1				8	9
Cetraria muricata					1		1			1				10	10
Cladonia arbuscula ssp. squarrosa						1			1	1	1			3	6
Cladonia borealis							1							1	1
Cladonia callosa		1	1		1	1	1	1			1			15	16
Cladonia cervicornis s. str.		1	1				1				1		1	12	12
Cladonia cervicornis ssp. verticillata		1	1		1		1				1	1		13	13
Cladonia chlorophaea s .str.														2	2
Cladonia ciliata var. ciliata	1				1		1	1	1	1	1	1	1	16	17
Cladonia ciliata var. tenuis	1						1				1		1	7	7
Cladonia coccifera			1				1			1	1			8	8
Cladonia coniocraea		1	1		1								1	6	6
Cladonia cornuta		1			1						1	1		10	10
Cladonia crispata var. cetrariiformis		1	1		1	1	1	1	1	1	1	1		20	22
Cladonia cryptochlorophaea group	1	1	1		1		1			1	1	1	1	22	22
Cladonia cryptochlorophaea	1	1	1		1		1			1	1	1	1	21	21
Cladonia novochlorophaea												1		1	1
Cladonia digitata		1												4	4
Cladonia diversa		1	1		1		1			1	1	1		17	17
Cladonia fimbriata	1	1	1				1	1			1	1		13	13
Cladonia floerkeana		1	1		1		1		1	1	1	1	1	21	22
Cladonia furcata ssp furcata	1	1	1		1					1	1	1	1	17	17
Cladonia furcata ssp subrangiformis														2	2
Cladonia gracilis			1						1	1			1	5	6
Cladonia humilis		1								1				7	7
Cladonia humilis "schizidiate form"														1	1
Cladonia incrassata			1		1									5	5
Cladonia macilenta		1	1		1		1			1	1	1	1	19	19
Cladonia mediterranea											1			1	1
Cladonia ochrochlora	1		1										1	4	4
Cladonia parasitica														1	1
Cladonia phyllophora		1	1		1									7	7
Cladonia polydactyla var. polydactyla	1				1						1		1	10	10
Cladonia portentosa	1	1	1		1	1	1	1	1	1	1	1	1	23	26
Cladonia pyxidata														1	1
Cladonia ramulosa	1	1	1		1		1			1	1	1		20	20
Cladonia rangiformis		1		1						1				12	13
Cladonia rei	1		1											5	5
Cladonia scabriuscula														2	2
Cladonia squamosa var. squamosa		1						1		1				7	7
Cladonia squamosa var. subsquamosa	1	1	1		1		1		1	1	1		1	18	19
Cladonia strepsilis		1			1	1	1		1	1		1		13	15

Species	SU2203 Burley Rocks	SU2302 Clay Hill	SU2303 Rock Hill	SU2501 Wilverley	SU2502 Duck Hole	SU2701 5 Thorns Hill	SU2702 Red Hill	SU2703 Ober Heath	SU2801 The Wiers	SU2802 North Wiers	SU2803 Ober Slade	SU2804 Ober Slade	SU3000 Setley Common N	Systematic	All
Cladonia subcervicornis					1	1	1			1				9	10
Cladonia subulata					1									5	5
Cladonia uncialis ssp. biuncialis	1	1	1		1		1	1	1	1	1	1		19	20
Cladonia zopfii			1						1	1				4	5
Collema auriforme														3	3
Dibaeis baeomyces						1	1							2	3
Epicladonia sandstedei													1	1	1
Flavoparmelia caperata														1	1
Fuscidea lightfootii	1	1												2	2
Graphis elegans												1		1	1
Graphis scripta	1													1	1
Hypogymnia physodes										1				5	5
Icmadophila ericetorum														1	1
Lecania erysibe														3	4
Lecanora albescens														4	4
Lecanora campestris ssp. campestris														3	4
Lecanora dispersa														1	1
Lecanora muralis														2	2
Leptogium intermedium														1	2
Leptogium palmatum														1	1
Micarea erratica					1		1							4	4
Micarea leprosula							1							4	4
Micarea lignaria var. lignaria					1	1	1							5	6
Micarea peliocarpa														1	1
Micarea prasina s.l.														1	1
Micarea viridileprosa	1	1	1				1				1	1	1	14	14
Micarea xanthonica					1									1	1
Peltigera canina													1	4	4
Peltigera didactyla													1	3	3
Peltigera hymenina		1			1									8	9
Peltigera membranacea														1	1
Peltigera neckeri														1	1
Peltigera rufescens														1	1
Phaeophyscia orbicularis														1	1
Physcia adscendens														1	1
Placynthiella dasaea		1											1	5	5
Placynthiella icmalea		1	1		1		1				1		1	17	17
Placynthiella oligotropha		1												1	1
Placynthiella uliginosa											1			3	3
Porpidia crustulata			1		1		1							7	7
Porpidia tuberculosa			1											1	1
Protoblastenia rupestris														3	4
Pycnothelia papillaria		1			1	1	1		1	1	1			16	18
Rhizocarpon reductum			1		1		1							10	10
Rinodina oleae														1	1
Sarcogyne regularis														2	2
Trapelia coarctata			1								1			3	3
Trapelia obtegens			1								1			2	2
Trapelia placodioides			1											1	1
Trapeliopsis flexuosa														2	2
Trapeliopsis glaucolepidea		1												1	1
Trapeliopsis granulosa		1	1		1								1	9	9
Verrucaria muralis														2	2
Verrucaria nigrescens														4	5
Xanthoria calcicola														1	1
Xanthoria parietina														2	2
Total	14	31	31		32		30	7		24	26	16	19	26.4	
Cladonia, Cetraria & Pycnothelia	12	24	22		23		21	7		23	22	14	13	19.2	

SPECIES LIST 7
Central Heaths

Species	SU1803 Strodgemoor	SU1902 Brown Loaf	SU1904 Broad Bottom	SU1906 Picket Post	SU2104 Burley Moor	SU2105 White Moor	SU2106 Harvest Slade Bottom	SU2107 Backley Plain	SU2108 Bratley Plain	SU2209 Bratley Plain NE	SU2309 Mogshade	SU2609 Acres Down W	SU2707 Whitemoor	SU2211 Ocknell	SU2311 Ocknell	SU2412 Ocknell	SU2511 Andrews Mare	SU2612 Stricknage	Systematic	All
Agonimia globulifera																1			1	1
Arthrorhaphis aeruginosa					1														1	1
Aspicilia contorta spp contorta															1				1	1
Baeomyces rufus			1				1		1		1			1					5	5
Caloplaca flavescens															1	1			2	2
Caloplaca flavocitrina									1						1				2	2
Caloplaca oasis									1							1			2	2
Candelariella vitellina															1	1			2	2
Catillaria atomarioides									1						1				2	2
Catillaria chalybeia									1						1	1			3	3
Cetraria aculeata			1	1			1	1	1	1						1	1		8	8
Cetraria muricata	1		1	1	1				1			1							6	6
Cladonia arbuscula ssp. squarrosa	1				1											1			3	3
Cladonia callosa	1	1	1	1	1			1		1	1	1		1		1	1		12	12
Cladonia cariosa															1				1	1
Cladonia cervicornis s. str.			1	1				1	1	1	1	1		1	1		1		10	10
Cladonia cervicornis ssp. verticillata	1	1	1	1	1	1	1	1	1	1	1	1		1			1		13	14
Cladonia chlorophaea s .str.	1		1																2	2
Cladonia ciliata var. ciliata	1		1		1		1	1	1	1		1	1	1	1	1			12	12
Cladonia ciliata var. tenuis			1						1			1		1					4	4
Cladonia coccifera			1	1	1				1	1	1	1		1			1		9	9
Cladonia coniocraea	1		1	1			1		1	1	1	1	1						9	9
Cladonia cornuta											1	1					1		3	3
Cladonia crispata var. cetrariiformis	1	1	1	1	1		1	1	1	1	1	1		1	1	1	1		15	15
Cladonia cryptochlorophaea group	1	1	1	1	1		1	1	1	1	1	1		1	1	1	1	1	15	16
Cladonia cryptochlorophaea	1		1	1	1		1	1	1	1	1	1		1	1	1	1	1	14	15
Cladonia merochlorophaea	1		1				1	1		1				1	1				7	7
Cladonia digitata											1	1							2	2
Cladonia diversa	1	1	1	1	1		1	1	1	1	1	1			1	1	1	1	14	15
Cladonia fimbriata	1	1		1								1			1	1	1		7	7
Cladonia floerkeana	1	1	1	1	1		1	1	1	1	1	1		1	1	1	1	1	15	16
Cladonia foliacea										1					1				2	2
Cladonia furcata ssp furcata	1	1	1	1	1		1	1	1	1	1	1		1	1	1	1	1	15	16
Cladonia glauca															1	1			2	2
Cladonia gracilis					1							1				1			3	3
Cladonia grayi s.s.				1											1				2	2
Cladonia humilis	1		1		1		1	1	1		1	1					1		9	9
Cladonia humilis "schizidiate form"										1				1	1	1	1		5	5
Cladonia incrassata			1	1			1					1	1		1				6	6
Cladonia macilenta	1	1	1	1	1		1	1	1	1	1	1					1		12	12
Cladonia ochrochlora				1	1		1												3	3
Cladonia phyllophora					1				1		1	1					1		5	5
Cladonia polydactyla var. polydactyla			1	1			1		1		1	1	1	1	1				9	9
Cladonia portentosa	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	16	17
Cladonia ramulosa	1	1	1	1	1		1	1	1	1	1	1		1		1	1		14	14
Cladonia rangiformis			1		1		1			1	1	1		1	1	1	1		10	10
Cladonia rei									1		1								2	2
Cladonia scabriuscula								1											1	1
Cladonia squamosa var. squamosa																	1		1	1
Cladonia squamosa var.	1	1	1		1		1	1	1	1		1		1	1	1	1	1	13	14

subsquamosa																				
Cladonia strepsilis	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1		15	16
Cladonia subcervicornis	1	1	1		1						1						1		6	6
Cladonia subulata											1	1							2	2
Cladonia uncialis ssp. biuncialis	1		1	1	1		1	1	1	1	1	1	1	1	1	1	1		15	15
Cladonia zopfii	1				1														2	2
Collema auriforme											1					1			2	2
Dibaeis baeomyces											1						1		2	2
Evernia prunastri	1																		1	1
Flavoparmelia caperata	1																		1	1
Fuscidea lightfootii	1							1			1								3	3
Graphis scripta	1																		1	1
Hypogymnia physodes	1		1	1	1				1								1		6	6
Hypotrachyna afrorevoluta								1						1	1				3	3
Icmadophila ericetorum					1							1							2	2
Lecania inundata															1				1	1
Lecanora albescens									1						1				2	2
Lecanora campestris ssp. campestris									1							1			2	2
Lecanora confusa														1					1	1
Lecanora polytropa																1			1	1
Leptogium intermedium											1								1	1
Lichenomphalia umbellifera				1							1		1				1		4	4
Melanelixia glabratula									1					1	1				3	3
Melanelixia subaurifera								1											1	1
Micarea erratica			1	1										1	1				4	4
Micarea lignaria var. lignaria	1		1		1		1		1	1		1		1					8	8
Micarea peliocarpa				1	1		1												3	3
Micarea prasina s.l.	1				1														2	2
Micarea viridileprosa	1	1	1	1	1		1		1		1								8	8
Parmelia sulcata	1																		1	1
Peltigera canina								1			1								2	2
Peltigera didactyla																1	1		2	2
Peltigera hymenina	1		1		1			1	1		1				1		1		8	8
Peltigera neckeri								1			1					1			3	3
Phaeophyscia orbicularis									1										1	1
Physcia adscendens								1							1				2	2
Physcia caesia															1	1			2	2
Physcia tenella	1							1							1				3	3
Placynthiella dasaea											1	1				1	1		4	4
Placynthiella icmalea			1	1			1	1	1	1	1	1			1	1	1		11	11
Placynthiella oligotropha							1												1	1
Placynthiella uliginosa			1	1				1								1	1		5	5
Porpidia crustulata				1				1	1	1	1				1		1		7	7
Porpidia soredizodes																1	1		2	2
Porpidia tuberculosa										1				1	1				3	3
Protoblastenia rupestris										1						1			2	2
Punctelia subrudecta s. str.								1											1	1
Pycnothelia papillaria	1	1			1		1	1	1	1	1	1		1	1	1	1		13	13
Rhizocarpon reductum			1	1			1		1	1	1				1	1	1		9	9
Rinodina oleae									1										1	1
Trapelia coarctata			1				1							1	1				4	4
Trapelia obtegens				1			1												2	2
Trapeliopsis flexuosa		1										1							2	2
Trapeliopsis granulosa	1	1		1					1			1							5	5
Trapeliopsis pseudogranulosa																	1		1	1
Verrucaria muralis										1					1	1	1		4	4
Verrucaria nigrescens									1		1				1	1			4	4
Xanthoria parietina															1				1	1
Total	34	17	35	32	32		29	30	42	28	39	35	7	26	43	38	37		31.5	
Cladonia, Cetraria & Pycnothelia	23	15	26	22	25		21	19	24	22	25	30	6	19	21	20	25		21.4	

SPECIES LIST 8a
North Western Heaths, Western Squares

Species	SU1508 Blashford	SU1608 Rockford	SU1709 Digden	SU1809 Black Heath	SU1610 Gorley	SU1611 Gorley	SU1711 Dorridge	SU1712 Hyde	SU1810 Black Heath	SU1811 Ogdens	SU1812 Hasley	SU1910 B Barrow	SU1912 Great Witch	SU1915 Cockley
Arthrorhaphis grisea										1				
Aspicilia contorta spp contorta	1	1	1											
Bachmanniomyces uncialicola				1			1				1			
Baeomyces rufus		1				1				1	1			
Buellia ocellata	1													
Caloplaca oasis	1	1	1											
Candelariella vitellina			1											
Catillaria atomarioides						1								
Catillaria chalybeia	1													
Cetraria aculeata	1	1	1	1		1	1	1	1	1	1	1		
Cetraria muricata			1	1		1	1	1	1	1	1		1	
Cladonia arbuscula ssp. squarrosa		1	1	1		1		1	1	1	1	1		
Cladonia caespiticia														
Cladonia callosa			1				1	1	1	1	1			
Cladonia cariosa	1													
Cladonia cervicornis s. str.	1	1	1			1	1			1	1			
Cladonia cervicornis ssp. verticillata			1	1			1	1		1	1		1	1
Cladonia chlorophaea s .str.						1								
Cladonia ciliata var. ciliata	1	1	1	1		1	1	1	1	1	1	1	1	
Cladonia ciliata var. tenuis	1	1	1	1		1	1	1	1	1	1	1		
Cladonia coccifera							1			1				
Cladonia coniocraea	1							1			1			
Cladonia cornuta							1			1				
Cladonia crispata var. cetrariiformis			1	1		1	1	1	1	1	1	1	1	1
Cladonia cryptochlorophaea group		1	1	1		1	1	1	1	1	1	1	1	1
Cladonia cryptochlorophaea		1	1			1	1	1	1	1	1	1		
Cladonia merochlorophaea														
Cladonia digitata										1				
Cladonia diversa	1	1	1	1		1	1	1	1	1	1		1	1
Cladonia fimbriata	1	1	1					1		1	1			1
Cladonia floerkeana	1	1		1				1	1	1	1	1	1	1
Cladonia foliacea	1													1
Cladonia furcata ssp furcata	1	1	1	1		1	1	1	1	1		1		1
Cladonia furcata ssp subrangiformis														
Cladonia glauca										1			1	
Cladonia gracilis			1					1	1	1	1	1	1	
Cladonia humilis	1	1				1	1	1		1				
Cladonia humilis “schizidiate form”	1							1						
Cladonia incrassata							1		1			1		
Cladonia macilenta	1						1			1	1			1
Cladonia mediterranea										1	1			
Cladonia ochrochlora														1
Cladonia phyllophora				1				1		1	1		1	
Cladonia polydactyla var. polydactyla														
Cladonia portentosa	1	1	1	1		1	1	1	1	1	1	1	1	1
Cladonia ramulosa	1	1	1	1		1	1	1	1	1	1			1
Cladonia rangiformis	1	1		1		1	1	1		1		1		1
Cladonia rei										1	1			
Cladonia scabriuscula	1						1				1			
Cladonia squamosa var. squamosa				1					1	1		1		1
Cladonia squamosa var. subsquamosa			1	1			1	1	1	1	1	1	1	1
Cladonia strepsilis			1	1				1		1	1		1	1
Cladonia subcervicornis										1			1	1

Species	SU1508 Blashford	SU1608 Rockford	SU1709 Digden	SU1809 Black Heath	SU1610 Gorley	SU1611 Gorley	SU1711 Dorridge	SU1712 Hyde	SU1810 Black Heath	SU1811 Ogdens	SU1812 Hasley	SU1910 B Barrow	SU1912 Great Witch	SU1915 Cockley
Cladonia subulata	1													
Cladonia sulphurina										1				
Cladonia uncialis ssp. biuncialis		1	1	1		1	1	1	1	1	1	1	1	1
Cladonia zopfii				1				1	1	1		1	1	
Collema auriforme	1													
Dibaeis baeomyces				1						1				
Diploschistes muscorum	1													
Evernia prunastri	1													
Flavoparmelia caperata	1													
Hypogymnia physodes	1			1			1	1		1	1	1		
Icmadophila ericetorum			1	1			1		1	1		1		
Lecanora albescens														
Lecanora campestris ssp. campestris			1											
Lecanora dispersa	1													
Lecanora muralis														
Lecidella stigmatea			1											
Lepraria lobificans														
Leptogium intermedium	1													
Leptogium palmatum	1							1						
Lichenomphalia umbellifera		1												
Micarea erratica	1													
Micarea leprosula							1							
Micarea lignaria var. lignaria							1			1				1
Micarea peliocarpa														
Micarea prasina s.l.								1						
Micarea viridileprosa							1	1	1	1		1	1	
Parmelia saxatilis	1													
Parmotrema perlatum														
Peltigera canina	1			1	1			1						
Peltigera didactyla	1							1		1				1
Peltigera hymenina	1	1		1		1		1	1		1	1		
Peltigera neckeri	1													
Peltigera rufescens	1					1								1
Physcia adscendens														
Physcia caesia														
Placidium squamulosa	1													
Placynthiella dasaea		1				1							1	
Placynthiella icmalea	1	1		1		1	1	1	1	1	1	1		1
Placynthiella uliginosa										1				
Porpidia crustulata	1					1	1			1				1
Porpidia macorcarpa										1				
Porpidia soredizodes		1				1								
Porpidia tuberculosa	1					1		1						
Protoblastenia rupestris	1													
Pycnothelia papillaria			1	1			1	1	1	1	1	1	1	
Ramalina fastigiata	1													
Rhizocarpon reductum	1					1	1	1					1	1
Sarcogyne regularis	1													
Trapelia coarctata										1				
Trapelia obtegens								1						
Trapeliopsis flexuosa														1
Trapeliopsis glaucolepidea											1			
Trapeliopsis granulosa			1				1	1	1	1	1		1	1
Trapeliopsis pseudogranulosa														
Verrucaria muralis	1	1												
Verrucaria nigrescens	1		1											

Species	**SU1508 Blashford**	**SU1608 Rockford**	**SU1709 Digden**	**SU1809 Black Heath**	**SU1610 Gorley**	**SU1611 Gorley**	**SU1711 Dorridge**	**SU1712 Hyde**	**SU1810 Black Heath**	**SU1811 Ogdens**	**SU1812 Hasley**	**SU1910 B Barrow**	**SU1912 Great Witch**	**SU1915 Cockley**
Xanthoria calcicola														
Xanthoria parietina														
Dicranum spurium			1					1						
Total	48	23	27	27		25	32	37	24	48	32	21	20	25
Cladonia, Cetraria & Pycnothelia	19	15	20	21		16	23	26	20	35	26	17	17	18

Species	SU1918 Hale Purlieu	SU2012 Hallickshole	SU2015 Leaden Hall	SU2017 Turf Hill	SU2018 Hale Purlieu	SU2019 Hale Purlieu	SU2213 Fritham Plain	SU2216 Bramshaw Tel	SU2415 Longcross	SU2416 Pipers Wait	SU2515 Black Bush	SU2516 Pipers Wait	Systematic	All
Arthrorhaphis grisea													1	1
Aspicilia contorta spp contorta								1					4	4
Bachmanniomyces uncialicola													3	3
Baeomyces rufus									1			1	6	6
Buellia ocellata													1	1
Caloplaca oasis								1					4	4
Candelariella vitellina								1					2	2
Catillaria atomarioides									1				2	2
Catillaria chalybeia								1					2	2
Cetraria aculeata							1					1	13	13
Cetraria muricata	1						1						11	11
Cladonia arbuscula ssp. squarrosa							1		1				11	11
Cladonia caespiticia												1	1	1
Cladonia callosa	1	1	1	1	1		1		1				13	13
Cladonia cariosa												1	2	2
Cladonia cervicornis s. str.	1		1	1	1			1	1			1	14	14
Cladonia cervicornis ssp. verticillata	1	1	1	1				1	1				14	14
Cladonia chlorophaea s .str.	1												2	2
Cladonia ciliata var. ciliata	1			1	1		1	1	1		1		18	19
Cladonia ciliata var. tenuis	1						1						13	13
Cladonia coccifera			1									1	4	4
Cladonia coniocraea	1							1					5	5
Cladonia cornuta		1		1				1					5	5
Cladonia crispata var. cetrariiformis	1	1	1	1	1		1	1	1		1	1	20	21
Cladonia cryptochlorophaea group	1	1	1	1	1		1	1	1			1	21	21
Cladonia cryptochlorophaea	1	1		1	1			1	1				15	15
Cladonia merochlorophaea									1			1	2	2
Cladonia digitata		1											2	2
Cladonia diversa	1	1	1	1	1		1	1	1			1	21	21
Cladonia fimbriata			1					1	1				10	10
Cladonia floerkeana	1	1	1	1	1		1	1	1			1	19	19
Cladonia foliacea							1						3	3
Cladonia furcata ssp furcata		1	1	1			1		1			1	17	17
Cladonia furcata ssp subrangiformis			1										1	1
Cladonia glauca													2	2
Cladonia gracilis		1						1					9	9
Cladonia humilis				1									7	7
Cladonia humilis “schizidiate form”													2	2
Cladonia incrassata	1	1							1				6	6
Cladonia macilenta		1		1	1			1					9	9
Cladonia mediterranea													2	2
Cladonia ochrochlora	1												2	2
Cladonia phyllophora				1			1						7	7
Cladonia polydactyla var. polydactyla								1	1			1	3	3
Cladonia portentosa	1	1	1	1	1		1	1	1		1	1	22	23
Cladonia ramulosa	1	1	1	1	1		1	1	1			1	20	20
Cladonia rangiformis			1				1		1				12	12
Cladonia rei					1								3	3
Cladonia scabriuscula		1											4	4
Cladonia squamosa var. squamosa													5	5
Cladonia squamosa var. subsquamosa	1	1		1				1	1				15	15
Cladonia strepsilis	1		1	1	1		1	1	1			1	15	15
Cladonia subcervicornis									1				4	4
Cladonia subulata													1	1
Cladonia sulphurina													1	1

Species	SU1918 Hale Purlieu	SU2012 Hallickshole	SU2015 Leaden Hall	SU2017 Turf Hill	SU2018 Hale Purlieu	SU2019 Hale Purlieu	SU2213 Fritham Plain	SU2216 Bramshaw Tel	SU2415 Longcross	SU2416 Pipers Wait	SU2515 Black Bush	SU2516 Pipers Wait	Systematic	All
Cladonia uncialis ssp. biuncialis	1	1			1	1	1		1		1	1	18	20
Cladonia zopfii												1	7	7
Collema auriforme			1										2	2
Dibaeis baeomyces								1	1			1	5	5
Diploschistes muscorum													1	1
Evernia prunastri			1										2	2
Flavoparmelia caperata													1	1
Hypogymnia physodes							1					1	9	9
Icmadophila ericetorum													6	6
Lecanora albescens								1					1	1
Lecanora campestris ssp. campestris													1	1
Lecanora dispersa								1					2	2
Lecanora muralis								1					1	1
Lecidella stigmatea													1	1
Lepraria lobificans									1				1	1
Leptogium intermedium													1	1
Leptogium palmatum													2	2
Lichenomphalia umbellifera									1				2	2
Micarea erratica		1		1									3	3
Micarea leprosula													1	1
Micarea lignaria var. lignaria			1						1			1	6	6
Micarea peliocarpa												1	1	1
Micarea prasina s.l.	1											1	3	3
Micarea viridileprosa				1	1			1	1				10	10
Parmelia saxatilis													1	1
Parmotrema perlatum				1									1	1
Peltigera canina			1										4	5
Peltigera didactyla				1									5	5
Peltigera hymenina												1	9	9
Peltigera neckeri													1	1
Peltigera rufescens													3	3
Physcia adscendens								1	1				2	2
Physcia caesia							1						1	1
Placidium squamulosa													1	1
Placynthiella dasaea		1											4	4
Placynthiella icmalea	1	1	1	1	1		1	1	1			1	20	20
Placynthiella uliginosa		1	1										3	3
Porpidia crustulata	1			1			1		1			1	10	10
Porpidia macorcarpa													1	1
Porpidia soredizodes								1	1			1	5	5
Porpidia tuberculosa	1						1						5	5
Protoblastenia rupestris			1	1					1				4	4
Pycnothelia papillaria	1	1	1	1			1	1	1	1	1	1	17	19
Ramalina fastigiata													1	1
Rhizocarpon reductum	1		1	1			1	1	1			1	13	13
Sarcogyne regularis				1									2	2
Trapelia coarctata							1						2	2
Trapelia obtegens													1	1
Trapeliopsis flexuosa				1					1				3	3
Trapeliopsis glaucolepidea													1	1
Trapeliopsis granulosa		1		1			1		1			1	13	13
Trapeliopsis pseudogranulosa									1				1	1
Verrucaria muralis			1	1									4	4
Verrucaria nigrescens			1	1			1	1	1				7	7
Xanthoria calcicola								1					1	1
Xanthoria parietina								1					1	1

Species	SU1918 Hale Purlieu	SU2012 Hallickshole	SU2015 Leaden Hall	SU2017 Turf Hill	SU2018 Hale Purlieu	SU2019 Hale Purlieu	SU2213 Fritham Plain	SU2216 Bramshaw Tel	SU2415 Longcross	SU2416 Pipers Wait	SU2515 Black Bush	SU2516 Pipers Wait	Systematic	All
Dicranum spurium	1												3	3
Total	24	22	25	30	14		27	33	37			28	28.6	
Cladonia, Cetraria & Pycnothelia	20	18	16	18	13		19	18	21			17	19.7	