

Display  
28 April 2003

## Lichen survey of selected Breckland SSSIs 2002

English Nature Research Reports



working today  
for nature tomorrow



# Contents

Summary .....	7
1. Introduction .....	8
2. Methods .....	8
3. Results .....	9
3.1 Lakenheath Warren .....	9
3.2 Little Heath, Barnham .....	11
3.3 Weeting Heath NNR .....	13
3.4 Thetford Heath .....	16
3.4.1 Thetford Heath NNR .....	16
3.4.2 RAF Barnham Training Area .....	17
3.5 Deadman's Grave .....	18
4. Discussion .....	20
5. Management proposals .....	21
6. Appendix (Maps, Plans, Photographs) .....	23

## List of tables

Table 3.1	Results from permanent quadrats, Lakenheath Warren .....	10
Table 3.2	Results from permanent quadrats, Little Heath, Barnham .....	12
Table 3.3	Summary of change at Little Heath, Barnham .....	13
Table 3.4	New quadrat recorded in compartment 3; Weeting Heath 2002 .....	14
Table 3.5	New quadrat recorded in compartment 2; Weeting Heath 2002 .....	15
Table 3.6	Results from permanent quadrat, Thetford Heath NNR .....	16
Table 3.7	Results from permanent quadrat, RAF Barnham Training Area .....	18
Table 3.8	Results from permanent quadrat, Deadman's Grave .....	19
Table 4.1	Summary of changes .....	20

English Nature Research Reports

Number 503

**Lichen Survey of selected Breckland SSSIs 2002**

O. L. Gilbert

Suffolk Team

You may reproduce as many additional copies of this report as you like, provided such copies stipulate that copyright remains with English Nature, Northminster House, Peterborough PE1 1UA

If this report contains any Ordnance Survey material, then you are responsible for ensuring you have a licence from Ordnance Survey to cover such reproduction.

ISSN 0967-876X  
© Copyright English Nature 2003

## Summary

The last eleven years have seen a dramatic contraction in the distribution of the three rare and five notable Breckland lichens. Between 1991 and 2002 three lichens have become extinct while the rest have been lost from half or more of their former sites. The situation is even more critical as several species, though still present at a site, have greatly reduced populations. The cause of this decline is a result of the previously open grassland having closed up due to the spread of higher plants and bryophytes denying the lichens the calcareous mineral soil they require as a substrate. After reviewing possible causes it is concluded that increased aerial inputs of nitrogen are chiefly responsible for sward closure. The only management that might help recovery of the remaining species is large scale, deep, soil stripping to initiate new primary successions. Grazing by rabbits is preferred; sheep are second best. On no account should important lichen sites be exposed to cattle.



# 1. Introduction

This survey is a repeat of the one carried out in 1991 that assessed the distribution and condition of the rarer lichens of the Breckland heaths.

## Sites surveyed

Lakenheath Warren  
Little Heath, Barnham  
Weeting Heath  
Thetford Heath  
RAF Barnham Training Area  
Deadman's Grave

## Lichens

### Breckland rarities

*Buellia asterella*  
*Fulgensia fulgens*  
*Squamarina lentigera*

### Notable

*Catapyrenium squamulosum*  
*Diploschistes muscorum*  
*Psora decipiens*  
*Toninia sedifolia* (*T. caeruleonigricans*)  
*Toninia lobulata*

# 2. Methods

Methods were similar to those used in 1991. These included a general walk-over inspection of each locality followed by a detailed survey of the richest areas. At five of the six sites permanent quadrats had been set up. These were resurveyed each lichen being given a cover/abundance rating on the Domin Scale and notes made on the condition of the rarer species. Changes that have taken place over the last 11 years are reported and discussed, and recommendations for management made. Since 1991 the surveyor has carried out other contract work for English Nature in Breckland.

In particular:

**Species Recovery Programme: Breckland Lichen Transplant Project.** Set up in 1992, involving *Buellia asterella*, *Fulgensia fulgens* and *Squamarina lentigera* being transplanted to three sites. The transplants were monitored in 1993, 1994, 1995, 1997, and 1999.

**Baseline Lichen Monitoring: Thetford Heath NNR 1996, 1997** which investigated the effect of increased road traffic passing the site.

This regular involvement with the Breckland lichen flora means that, in many instances, it is possible to provide a history and time scale to the changes that have occurred over the last 11 years.

All quadrats measured 1 m x 1 m.

Domin scale: 10 = 91-100% cover; 9 = 76 - 90%; 8 = 51-75%; 7 = 34-50%; 6 = 26-33%; 5 = 11-25%; 4 = 4-10%; 3 = <4% many individuals; 2 = <4% several individuals; 1 = <4% few individuals.

A = abundant, C = common, F = frequent, Occ = occasional, R = rare, VR = very rare.

The re-survey concentrated on terricolous (ground dwelling) lichens. *Cladonia furcata* subsp. *furcata* and *C. furcata* subsp. *subrangiformis* have not been separated; frequently both were present.

### 3. Results

#### 3.1 Lakenheath Warren

Lakenheath Warren has been the lichenological 'jewel' of Breckland. Between 1958 and 1984 it was the place to go to see all the rare and notable species. However, at some time between 1984 and 1988 a serious decline set in which was investigated through the 1991 Breckland Lichen Survey. This led to the Species Recovery Programme of 1992 that involved transplanting *Buellia*, *Fulgensia* and *Squamarina* to a wider range of sites in Breckland; this turned out not to be the answer. In 1991 this was still the best site in Breckland with all the rarer species present among a total of 18 terricolous lichens. Four permanent quadrats were established in the richest areas to show what the communities had been like in their heyday; three of these were resurveyed in 2002, the fourth could not be relocated.



**Table 3.1 Results from permanent quadrats, Lakenheath Warren**  
(Unless otherwise stated, values are on the Domin scale)

Quadrat	1991			2002		
	Q1	Q2	Q3	Q1	Q2	Q3
Cover of higher plants %	35	27	40	95	70	85
Cover of bryophytes %	10	27	15	5	40	25
Cover of lichens %	35	27	20	1	10	20
Bare ground %	20	20	24	<1	5	<1
<b>Breckland rarities</b>						
<i>Buellia asterella</i>	-	-	1	-	-	-
<i>Squamarina lentigera</i>	3	2	2	-	-	-
<b>Notable</b>						
<i>Catapyrenium squam.</i>	3	-	3	-	-	-
<i>Diploschistes muscorum</i>	2	2	2	-	-	-
<i>Psora decipiens</i>	2	2	1	-	-	-
<i>Toninia sedifolia</i>	4	2	3	-	-	-
<i>Toninia lobulata</i>	-	2	-	-	-	-
<b>Others</b>						
<i>Bacidia muscorum</i>	-	-	2	-	-	-
<i>Bacidia sabuletorum</i>	3	4	2	1	1	-
<i>Cladonia foliacea</i>	4	1	-	-	-	1
<i>Cladonia furcata</i>	2	2	1	-	1	2
<i>Cladonia pocillum</i>	-	2	2	-	-	-
<i>Cladonia rangiformis</i>	5	5	5	2	4	5
<i>Coelocaulon aculeatum</i>	2	2	2	-	-	1
<i>Collema tenax</i>	2	-	-	-	1	-
<i>Leptogium schraderi</i>	1	-	-	-	-	-
<i>Peltigera rufescens</i>	2	2	2	-	-	-

In 1991 *Buellia* and *Squamarina* were thinly scattered over a considerable area. The colonies were firmly attached to the soil and in good condition. The following year there was no reluctance to remove eight specimens of *Squamarina* and four of *Buellia* for transplanting to other sites. At that time *Fulgensia* was represented by a single tiny thallus. The notable species were well established, particularly *Toninia sedifolia* and *Catapyrenium*. In 2002 the resurvey of the permanent quadrats followed by a prolonged walkover survey failed to find any of the rarer terricolous lichens. Though lichens remained present, with up to 20% cover, these were all common species of no particular interest.

### Analysis

Since 1991 the structure of the grassland at Lakenheath Warren has changed from being open, with 20-25% bare chalk soil exposed, to being almost closed. It is still a short rabbit



grazed turf but today higher plants are growing much more densely and any remaining space is mostly occupied by bryophytes. All the lichens present, mostly *Cladonia* spp., are growing caught up in the vegetation. All the Breckland rarities and notables require stable chalky soil as a substrate and this habitat is no longer available. The small amounts of bare ground are rabbit scrapes or result from cattle trampling and have a loose 'puffy' nature.

The history of decline of the Breckland rarities over the last eleven years at this site is as follows:

*Fulgensia fulgens* was present as a single small thallus in September 1991. By April 1993 this had broken into three fragments, in July 1994 the fragments had become detached from the soil and two were lying upside-down; this was the last time it was seen.

*Buellia asterella* was well established in limited areas in 1991 with many colonies fruiting abundantly. On subsequent visits up to 1997 the impression was that the slow decline was continuing but the grassland was open and providing suitable habitat and it was believed that conservation measures such as pine clearance or a long dry summer might reverse this. In October 1997 a timed survey located 46 colonies/small patches concentrated on the summits of two whale-backed mounds. The survey was repeated in October 1999 when only 19 colonies could be found, a drop of 60% over two years. This led to a prediction that it might become extinct by 2005. The end came earlier than this as in winter 2001/02 heavy cattle grazing on the site turned the grassland into a sea of mud; no thalli survived this.

*Squamarina lentigera* was always far commoner than *Buellia* and this was the situation in 1991. By 1993 a proportion of the thalli were showing a tendency to fragment, become discoloured and detached from the soil and were often found as plates lying upside down. It was considered that this might be a method of propagation as some became reattached, though others became moribund. 1994 was a good year for the species and a number of vigorous new colonies established. The slow decline and contraction in area recommenced in 1995 but there were always too many thalli to count. The end came in winter 2001/02 caused by the heavy cattle trampling which the site had not previously been subjected to within living memory.

The five notable species were slower to decline being still easy to find in 1999. None survived the cattle trampling. By 2002 no terricolous lichens of any interest remained at Lakenheath Warren.

### 3.2 Little Heath Barnham

In 1991 a brief walk-over lichen survey was made of this site which is a locality where mustard gas was buried after the Second World War. It supported a very short, very open, rabbit grazed grassland containing extensive swards of *Toninia sedifolia* which locally coloured the ground grey. Despite its promising appearance, no Breckland rarities were discovered, but the notable species *Catapyrenium* and *Diploschistes* (each seen three times), and *Toninia sedifolia* (A) were present. No permanent quadrats were set up. In 1992, when selecting a suitable site for transplants, two well-separated populations of *Squamarina* were discovered each consisting of a compact group of c10 healthy looking colonies; they were thought to be recent arrivals.

The transplants were monitored every other year, so the general condition of the lichen flora was regularly appraised until 1999 when it was still in much the condition it had been in



1991. The *Squamarina* colonies continued to spread and were believed to be the healthiest in Breckland.

The 2002 survey discovered that there had been a rapid and catastrophic decline of the lichen flora between September 1999 and November 2002. A closed vegetation composed of higher plants and bryophytes now dominated the site leaving very little bare ground. A cover survey of the three permanent quadrats used for the transplant work, which were known to have been open lichen rich grassland from 1992 to 1999, gave the following results:

**Table 3.2 Results from permanent quadrats, Little Heath Barnham**

Quadrat	Q1(2002)	Q2(2002)	Q3(2002)
Cover of higher plants %	40	60	30
Cover of bryophytes %	90	60	95
Cover of lichens %	1	15	10
Bare ground %	0	3	0

The results show that at this site it is bryophytes that have spread to rapidly to close the sward smothering the lichens and denying them the chalky mineral soil that the rarer ones demand. The species involved are pleurocarpous mosses, chiefly *Homalothecium lutescens* which forms deep carpets, also *Pseudoscleropodium purum*, *Rhytidiadelphus squarrosus* and *Rhytidium rugosum*. The lichen cover, which is variable, is mostly composed of *Cladonia rangiformis* and *C. furcata* which can grow caught up within the moss/higher plant sward and do not require contact with the soil. There are very small amounts of *Cladonia pocillum* and *Collema tenax* which do require contact with calcareous soil; *Bacidia sabuletorum* (Occ) is present colonising vegetation debris, and *Cladonia foliacea* is locally abundant but probably decreasing as it prefers contact with mineral soil though can exist for a time raised up among the vegetation. Small amounts of the notable lichen *Toninia sedifolia* have survived in two 20 x 20 m dished areas where the soil appears to be more compact and has remained semi-open, it is also present along 3 m of a vehicle track that runs by the pines along the west side of the site. The amount of *Toninia* remaining is less than 1% of that present in 1999. *Catapyrenium squamulosum* and *Diploschistes muscorum* were not seen in 2002.

### Analysis

The rapid decline of what in 1999 was one of the best lichen sites in Breckland is disturbing. It is a result of the expansion of pleurocarpous bryophytes but the trigger for their spread is conjectural and will be discussed later. Sheep were recently seen grazing the site for the first time in many years.

**Table 3.3 Summary of change at Little Heath Barnham**

	1992	1999	2002
<i>Squamarina lentigera</i>	Occ	Occ	-
<i>Catapyrenium squamulosum</i>	R	Occ	-
<i>Diploschistes muscorum</i>	R	R	-
<i>Toninia sedifolia</i>	A	A	R

### 3.3 Weeting Heath NNR

Weeting Heath NNR is divided into five Compartments. In the 1950s and 60s Ted Ellis discovered the Breckland rarities *Buellia asterella* and *Squamarina lentigera* in Cpt 4. They were particularly associated with disturbed soil produced when anti-glider trenches were dug across the site during the war. These two lichens persisted until at least 1984 when P W Lambley reported them to be in good condition. Soon after this they experienced a severe decline; the *Buellia* was not seen again and the last record of *Squamarina* was made in 1990. However in 1993 a rich lichen flora was discovered in limited areas of Cpts 2 and 3.

#### Compartment No 4

The 1991 survey revealed the Compartment to have a poor lichen flora. The only notable lichens present were *Toninia sedifolia* that was rare in the neighbourhood of the glider trenches, and a single detached thallus of *Diploschistes muscorum* was seen. Though lichens were conspicuous they were common species such as *Cladonia rangiformis* (A), *Cladonia furcata* (F), *Coelocaulon aculeatum* (F), *Bacidia sabuletorum* (R) and the slightly more demanding *Cladonia foliacea* (O). By 2002 there had been a further decline, with both notable lichens having disappeared. *Coelocaulon aculeatum* was now very rare. One new lichen, *Peltigera hymenina* had appeared in small amount, it is capable of growing on top of a moss sward so does not require open soil conditions. Nine terricolous lichens were present.

#### Compartment No 3

This was not known to have any lichen interest until 1993 when a botanist, Lindsay Moore, carrying out a higher plant survey recorded *Squamarina* on a track running along the east margin of the compartment. The site was surveyed by B Nichols on 26 November 1998 who counted 178 discrete thalli spread along 60 m of track and recorded their position in relation to 1 m sections. He and I repeated the survey four years later on 15 November 2002. Many of the thalli were young and healthy being well coloured and covered with fruits, but their numbers had dropped to 56. The distribution of the species had changed somewhat since the original survey, suggesting that populations may be more dynamic than previously thought. The community was similar to species-rich assemblages that were widespread in Breckland in the 1970s, so a 1 m x 1 m re-locatable quadrat was recorded in 2002 between sections 11 and 12 of the transect. *Bacidia muscorum* and *Leptogium schraderi* were present outside the quadrat adding to the diversity.



**Table 3.4 New Quadrat recorded in Compartment 3; Weeting Heath 2002**  
 (Unless otherwise stated, values are on the Domin scale)

Cover of higher plants %	80
Cover of bryophytes %	10
Cover of lichens %	20
Bare ground %	14

**Breckland rarities**

<i>Squamarina lentigera</i>	3
-----------------------------	---

**Notable**

<i>Catapyrenium squamulosum</i>	1
<i>Diploschistes muscorum</i>	2
<i>Toninia sedifolia</i>	3

**Others**

<i>Bacidia sabuletorum</i>	2
<i>Cladonia foliacea</i>	4
<i>Cladonia furcata</i>	1
<i>Cladonia pocillum</i>	1
<i>Cladonia rangiformis</i>	4
<i>Collema tenax</i>	2

**Compartment No 2**

In 1997 I was shown the series of three chalk pits in Compartment 2 where interesting lichens, including *Psora decipiens*, had recently been discovered. No detailed recording was carried out at that time but during the November 2002 survey the opportunity was taken to establish a permanent quadrat on the south-facing side of Pit 3A where the *Psora* occurred. This appeared to be the richest of the chalk pits. Most pits supported populations of *Diploschistes muscorum*.

**Table 3.5 New Quadrat recorded in Compartment 2; Weeting Heath 2002**  
(Unless otherwise stated, values are on the Domin scale)

Cover of higher plants %	80
Cover of bryophytes %	10
Cover of lichens %	15
Bare ground %	10

**Notable**

<i>Diploschistes muscorum</i>	3
<i>Psora decipiens</i>	3
<i>Toninia sedifolia</i>	3

**Others**

<i>Bacidia sabuletorum</i>	2
<i>Cladonia foliacea</i>	2
<i>Cladonia pocillum</i>	1
<i>Cladonia rangiformis</i>	1
<i>Collema tenax</i>	1
<i>Peltigera rufescens</i>	2
<i>Polyblastia gelatinosa</i>	1

It is encouraging that the notable species are present in considerable quantity.

**Analysis**

That Compartment 4 lost its residual lichen interest between 1991 and 2002 was not unexpected as it had been in decline for a while. This may be a result of relaxed grazing due to low rabbit numbers in the late 1980s. It is now once again heavily grazed by rabbits, and in winter by sheep. The subsequent discovery of rich lichen communities over limited areas in Compartments 2 and 3 more than made up for the loss and makes Weeting Heath NNR the richest lichen site in the Brecklands. It is currently the only site for *Psora decipiens* and one of only two supporting *Squamarina lentigera*. It may be significant that at both the Weeting sites man has disturbed the chalk to a considerable depth. Pit 3A is around 3 m deep and the 30 degree sloping sides provide highly calcareous bare mineral soil which the rarer lichens require. The track is an old hollow-way that has become incised into the chalk, there the *Squamarina* is mostly present between the tyre marks with a few in a lateral position. Its distribution along the track is not continuous (see Appendix), it is concentrated where stone-stripes cross the path.



### 3.4 Thetford Heath

#### 3.4.1 Thetford Heath NNR

In 1991 a permanent quadrat (Q 1) was set up to record the richest part of the site. A further dozen quadrats were established in 1996 to monitor the effect of an increase in road traffic. One of these (Q2) contained a Breckland rarity. Both were resurveyed in 2002.

**Table 3.6 Results from permanent quadrats, Thetford Heath NNR**  
(Unless otherwise stated, values are on the Domin scale)

	Q1(1991)	Q2(1996)	Q1(2002)	Q2(2002)
Cover of higher plants %	40		50	65
Cover of bryophytes %	33		60	80
Cover of lichens %	7		5	15
Bare ground %	20		5	0
<b>Breckland rarity</b>				
<i>Squamarina lentigera</i>	1	1	-	-
<b>Notable</b>				
<i>Toninia sedifolia</i>	3	2	-	-
<b>Others</b>				
<i>Bacidia sabuletorum</i>	-	-	2	-
<i>Bacidia muscorum</i>	1	-	-	-
<i>Cladonia foliacea</i>	2	1	-	-
<i>Cladonia furcata</i>	3	-	2	4
<i>Cladonia pocillum</i>	-	3	2	1
<i>Cladonia rangiformis</i>	4	4	2	4
<i>Coelocaulon aculeatum</i>	-	1	-	-
<i>Collema tenax</i>	1	-	-	-
<i>Leptogium schraderi</i>	1	-	-	-
<i>Peltigera rufescens</i>	-	1	-	-

In 1991 Breckland rarities were restricted to the extreme SE corner of the NNR where chalk subsoil was exposed in c1945 as a result of road building. In 1991 *Buellia* had just become extinct (last seen 1990) and *Squamarina* was present as a few broken and discoloured colonies. By 1996 *Squamarina* was reduced to a single thallus which was last seen in 1997. The 2002 survey failed to locate any Breckland rarity.

In 1991 a dozen patches of the notable lichen *Toninia sedifolia* were present, many of them fruiting, and one small colony of *Catapyrenium*. These persisted until 1997, however by 2002 both had disappeared from the site. A disturbed site a few hundred metres to the north where *Catapyrenium* had been recorded in the past was searched with no success. So by 2002 no terricolous lichens of any interest could be found in the NNR.

## Analysis

Since 1991 the structure of the vegetation has changed from being locally open, with around 20% exposed chalky soil to being closed. The 5% bare ground in Q1 is composed of soft worm casts. This increased cover is partly the result of an expansion of higher plants but even more from the spread of pleurocarpous bryophytes which in 11 years have doubled their cover. *Rhytidium rugosum*, a rather rare moss of calcareous grassland is the dominant species. The current lichen flora is composed of widespread species several of which (*Cladonia furcata*, *C. rangiformis*) can grow in the moss carpet. *Bacidia sabuletorum* colonises dead vegetation. Relic species from the previous more open sward are *Cladonia pocillum* (Occ), *Cladonia foliacea* (Occ), *Collema tenax* (VR) and *Peltigera rufescens* (VR); these all require contact with mineral soil and are declining.

### 3.4.2 RAF Barnham Training Area

The area of interest is a strip of lichen-rich vegetation developed along the line of an ancient track that is shallowly incised into the close-cropped calcareous grassland. The compacted soil is kept in that condition by occasional use; small flints show through the turf. The lichenological history of the site is not known, but the locality was included in the 1991 survey because it supported a strong population of *Squamarina lentigera*. The 1991 survey recorded a permanent quadrat at one of the richer points along the track. This contained nine lichens including *Squamarina* and two Breckland notables. *Squamarina* extended a measured 59 m along the track with *Toninia sedifolia* distributed slightly more widely along 65 m. A visit in July 1994 showed no change. This was resurveyed in 2002.



**Table 3.7 Results from permanent quadrat RAF Barnham Training Area (Unless otherwise stated, values are on the Domin scale)**

Quadrat	1991	2002
Higher plant cover %	45	65
Bryophyte cover %	1	40
Lichen cover %	34	15
Bare ground %	20	1
<b>Breckland rarity</b>		
<i>Squamarina lentigera</i>	4	3
<b>Notable</b>		
<i>Catapyrenium squamulosum</i>	4	1
<i>Toninia sedifolia</i>	3	3
<b>Others</b>		
<i>Cladonia foliacea</i>	1	1
<i>Cladonia furcata</i>	4	2
<i>Cladonia rangiformis</i>	1	1
<i>Coelocaulon aculeatum</i>	1	1
<i>Collema tenax</i>	1	1
<i>Peltigera rufescens</i>	1	1

*Polyblastia gelatinosa* recorded outside the quadrat in 1991 was not seen in 2002.

The distance that *Squamarina* spread along the track was re-measured in 2002. It had reduced from 59 m to 43 m, the withdrawal being 1.6 m at the North end and 9.3 m at the South end. The sections from which it had retreated supported very few colonies in 1991, so the main concentrations of the species were still intact.

### Analysis

This is now an extremely important site being, with Weeting Heath, one of only two sites with *Squamarina*, the last surviving Beckland rarity. During the eleven years since the original recording the general cover of lichens in the permanent quadrat has fallen from 34% to 20% and the amount of bare ground from 20% to 1%. This is due to an expansion of higher plants and particularly bryophytes which began sometime after the interim visit in July 1994. So far this has had only a minor effect on the terricolous lichen flora which is still in good condition but if the trend continues, ie a closing up of the vegetation, this site will go the same way as the others. There appear to have been no changes in management or grazing regime at the site.

### 3.5 Deadman's Grave

This locality is isolated from others where the Breckland rarities have been recorded so is less often visited. It is the site of a flint mine, last worked around 1880, consequently the ground

is covered with shallow pits. In 1974 James and Swinscow reported strong populations of *Buellia asterella* and *Squamarina lentigera*. By 1990 *Buellia*, always the more exacting of the pair, was extinct, and *Squamarina* reduced to a few scattered thalli. The 1991 survey failed to locate *Squamarina* but four notable lichens were present: *Diploschistes muscorum* (Occ, ten well developed colonies), *Catapyrenium squamulosum* (Occ), *Psora decipiens* (seen once), and *Toninia sedifolia* (Occ). At that time the site supported a short, open, grassland grazed by sheep and rabbits, the summits of hillocks carried an open sward with bare chalk showing through. A permanent quadrat was set up to record one of the richer areas of lichen vegetation. It was resurveyed in 2002.

**Table 3.8 Results from permanent quadrat Deadman's Grave**  
(Unless otherwise stated, values are on the Domin scale)

Quadrat	1991	2002
Cover of higher plants %	65	85
Cover of bryophytes %	7	55
Cover of lichens %	8	1
Bare ground %	20	5
<b>Notable</b>		
<i>Catapyrenium squamulosum</i>	1	-
<i>Diploschistes muscorum</i>	3	-
<i>Psora decipiens</i>	1	-
<i>Toninia sedifolia</i>	3	-
<b>Others</b>		
<i>Bacidia muscorum</i>	3	-
<i>Bacidia sabuletorum</i>	-	2
<i>Cladonia foliacea</i>	1	-
<i>Cladonia furcata</i>	3	3
<i>Cladonia pocillum</i>	4	1
<i>Cladonia rangiformis</i>	1	1
<i>Coelocaulon aculeatum</i>	1	-
<i>Collema tenax</i>	1	-
<i>Peltigera rufescens</i>	1	-
<i>Polyblastia gelatinosa</i>	1	-

During an hour-long visit with Peter Lambley in October 1997, we were concerned at the decline of the lichen flora since 1991. Notable lichens had all but disappeared; we found just three small patches of *Toninia sedifolia* and four of *Diploschistes muscorum*. Any bare soil still present on the mounds was loose, 'puffy', and unsuitable for lichen colonisation.

### Analysis

By 2002 the few areas of interesting lichen vegetation present in 1991 had disappeared. Though the site was still grazed by rabbits and sheep producing a short turf, this was now much denser, and as Little Heath Barnham, contained a high proportion of luxuriant mat-



forming bryophytes such as *Homalothecium lutescens*, *Rhytidium rugosum* and *Thuidium philibertii*. The lichen flora is now dominated by common species of *Cladonia* able to grow among dense vegetation without contact with mineral soil. *Bacidia sabuletorum* colonises dead vegetation, especially the decaying stems of *Thymus*. The walk-over survey confirmed that *Cladonia rangiformis* and *Cladonia furcata* were the only common lichens with a frequency varying from occasional to locally abundant. Species present additional to those in the quadrat were *Collema tenax* and *Cladonia foliacea*; both are scarce. The lack of stable chalky soil among the dense vegetation is responsible for the lack of variety in the lichen flora. The few existing bare areas are all unstable rabbit scrapes. The main decline took place between 1991 and 1997. The lichen interest of the site is now very low.

## 4. Discussion

The last eleven years have seen a dramatic contraction in the distribution of the three rare and five notable Breckland lichens. The changes are summed up in the Table below that shows three are now extinct while the rest have been lost from half or more of their former sites.

**Table 4.1 Summary of changes**

### Rarities

<i>Buellia asterella</i>	Extinct
<i>Fulgensia fulgens</i>	Extinct
<i>Squamarina lentigera</i>	4 localities down to 2

### Notable

<i>Catapyrenium squamulosum</i>	6 localities down to 2
<i>Diploschistes muscorum</i>	6 localities down to 1
<i>Psora decipiens</i>	2 localities down to 1
<i>Toninia lobulata</i>	Extinct
<i>Toninia sedifolia</i>	6 localities down to 3

The situation is even more critical as several species, though still present at a site, have greatly reduced populations. For example, at Little Heath Barnham, the frequency of *Toninia sedifolia* has fallen from abundant to rare with less than 1 % of the 1991 population now present. At only two sites, RAF Barnham and Weeting Heath NNR, are the lichen communities still reasonably well developed and thought to have a future.

The reason for the decline is that the formerly very open calcareous grassland, classified by the NVC as CG7c *Festuca ovina-Hieracium pilosella-Thymus praecox* grassland: *Ditrichum flexicaule-Diploschistes scruposus* var. *bryophilous* sub-community has closed up. This is due to an expansion of the higher plants and even more to a luxuriant growth of pleurocarpous mosses which have spread over the surface eliminating the network of bare mineral soil that formerly existed between the tufts of *Festuca*. All the Breckland rare and notable species require a compact, highly calcareous mineral soil on which to grow and at many sites this niche has been eliminated. Rabbit scrapes and hoof marks are no substitute. Though the lichen cover of the permanent quadrats may not have fallen, it now comprises ubiquitous species of *Cladonia* that are able to grow caught up in the vegetation and do not require contact with the soil. But what has been responsible for this change?



## The onset of sward closure

The onset of sward closure has been proceeding for several years and is the subject of much debate. Suggested causes have been a reduction in grazing, climate change, natural succession, the growth of surrounding pine trees rendering the sites more sheltered, nitrogen inputs from air pollution, and the jettisoning of aviation fuel. Having carefully considered these alternatives, and being aware that a combination of factors may be at work, it is thought that aerial nitrogen inputs from industry/transport and agricultural sources is the most likely cause. The reasons are: this is not a site specific phenomenon – it acts at a regional scale; nitrogen deposition over East Anglia is known to be particularly heavy, and it is consistent with certain features of the vegetation. Trees in the reserves with naturally acid bark eg oak, birch have lost their acid-loving epiphytic flora which has been replaced with a community composed of nitrophytic species of *Physcia* and *Xanthoria*. Lichenologists regard this species substitution as a clear sign of excessive ammonia concentrations.

When nitrogen is added to low-nitrogen systems, competitive and aggressive species that may originally be only a minor component of the vegetation, expand and out-compete the slower growing ones with only a limited potential to respond. The formerly open Breckland grasslands dominated by *Festuca ovina* now contain mesotrophic species such as *Agrostis capillaris*, *Festuca rubra*, *Holcus lanatus* and *Trifolium repens* which contribute to a greatly increased biomass. In NVC terms the *Festuca ovina*-*Hieracium pilosella*-*Thymus praecox* grassland subcommunity *Ditrichum flexicaule*-*Diploschistes scruposus* var *bryophillous* is rapidly being replaced by sub-community *Cladonia* spp.

## Grazing

In addition a low nutrient status, grazing is also required to maintain the short open turf required by the rarer lichens. This has been by a mixture of rabbits and sheep with the former preferred as they graze more closely. Rabbits rarely venture more than 100 m from their warren so produce approximately circular areas of very short turf, when they are abundant these overlap and cover the whole site. Rabbit numbers have fluctuated, they were abundant in the 1970s, declined in the late 1980s and early 1990s and are now abundant again. This does not correspond to the pattern of deterioration of the lichens. Sheep grazing is more site-specific. They have not been seen at Lakenheath Warren or RAF Barnham. At Little Heath Barnham winter sheep grazing has recently started and Weeting Heath is intermittently grazed, while Thetford Heath and Deadman's Grave have a long history of sheep. Some ecologists regard sheep grazing as causing a thickening up and closure of the sward so they could be responsible for the rapid decline at Little Heath Barnham. The winter cattle grazing at Lakenheath Warren during winter 2001/2002 turned the site into a sea of mud and brought about the widespread changes there, including the extinction of *Buellia asterella* at its last locality in the UK.

## 5. Management Proposals

There is no reliable technique for removing nitrogen from the system and only action on a national or international scale can reduce current inputs. Reversing the succession is therefore not an option. It is significant that all localities and former localities for the Breckland rarities, except for Lakenheath Warren, are man-made sites where the ground has been disturbed, often to a considerable depth, bringing raw chalk soil to the surface. The only management likely to be effective in reversing the fortunes of the rare and notable lichens is to initiate new primary successions at selected sites. This can be achieved by soil



stripping to a considerable depth. It will not be sufficient just to remove the A horizon of the rendzina soils, the C horizon must also be stripped down to fresh unweathered chalky boulder clay or the break-off layer of the chalk. At Weeting and Thetford Heaths there is patterned ground of stone stripes so the stripped areas will not be uniform. The surplus fill produced can be piled into whale-backed mounds as occurred at Deadman's Grave flint mine; the tops and steep sides of these are another potential site for lichen colonisation. The 'floor' of stripped areas should be left as compact as possible and locally could be given a 'hillock-hollow' structure to increase the range of niches available.

Large areas up to 100 m x 100 m should be stripped, these will then act as a 'sticky fly-paper' forming a habitat that is receptive to the propagules of slow growing, stress tolerant species. The new surface should be ideal for *Toninia sedifolia* that fruits abundantly. Once this species has established it will form a framework among which the other lichens will start to grow. It is unlikely that the extinct species *Buellia asterella*, *Fulgensia fulgens* and *Toninia lobulata* will reappear rapidly but Breckland is probably being seeded with lichen propagules originating from the continent so the lack of a local population is not as serious as might be thought.

The small area (15 m x 6 m) of stripping carried out at Lakenheath Warren in Autumn 1999 was surveyed to get an idea of rates of colonisation. This has been very rapid as the area, being mostly edge, is highly accessible to propagules. The unfenced section already has a cover comprising higher plants 25%, bryophytes 50%, lichens 5% and bare ground 25%. It appears to be an early stage of NVC grassland CG7c. The presence of untypical species such as *Agrostis capillaris*, *Poa annua* and *Plantago major* are related to last winter's cattle grazing. The lichen cover is comprised entirely of *Collema tenax*. The fenced section still has 75% bare ground; *Cladonia rangiformis* is colonising from the margins. The rapid rate of colonisation of this shallowly stripped area (A horizon only) is evidence that much deeper disturbance is required if a primary succession is to be initiated.

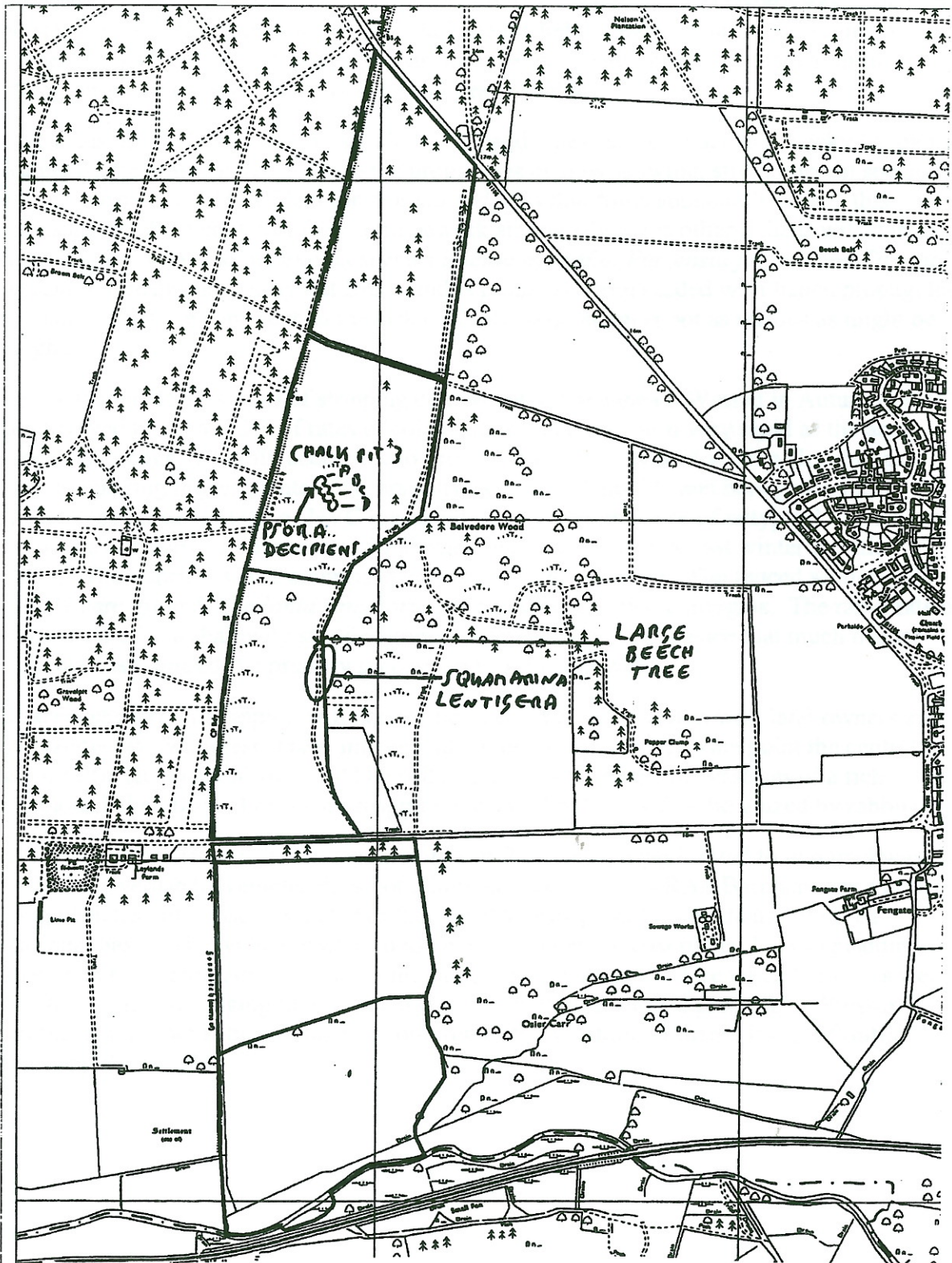
The areas chosen for stripping will need to be selected in consultation with land-owners and other conservation interests taken into consideration. From a lichen viewpoint the central area of Little Heath Barnham would be suitable as the site retains the vestiges of a rich terricolous lichen flora. Following stripping the site should be left to be grazed by rabbits.

With the finest terricolous lichen communities in Breckland being limited to two trackways it is vital that overuse by vehicles does not eliminate them. That at RAF Barnham has a notice asking vehicles not to use the route but the one at Weeting Heath is made use of on an occasional basis. The warden will need to be extra vigilant to ensure that heavy episodic use for eg timber extraction or a fencing contract does not churn it up. Use when the soil is wet is many times more damaging than when dry, so summer utilization is preferable. Pressure from the human foot is beneficial as it compresses the substrate. Current levels of traffic seem to be about right.

**6. Appendix**







Weeting Heath NNR: Map showing position of the track supporting *Squamarina lentigera* and Chalk Pit 3A with *Psora decipiens*. Both locations contain several notable species.



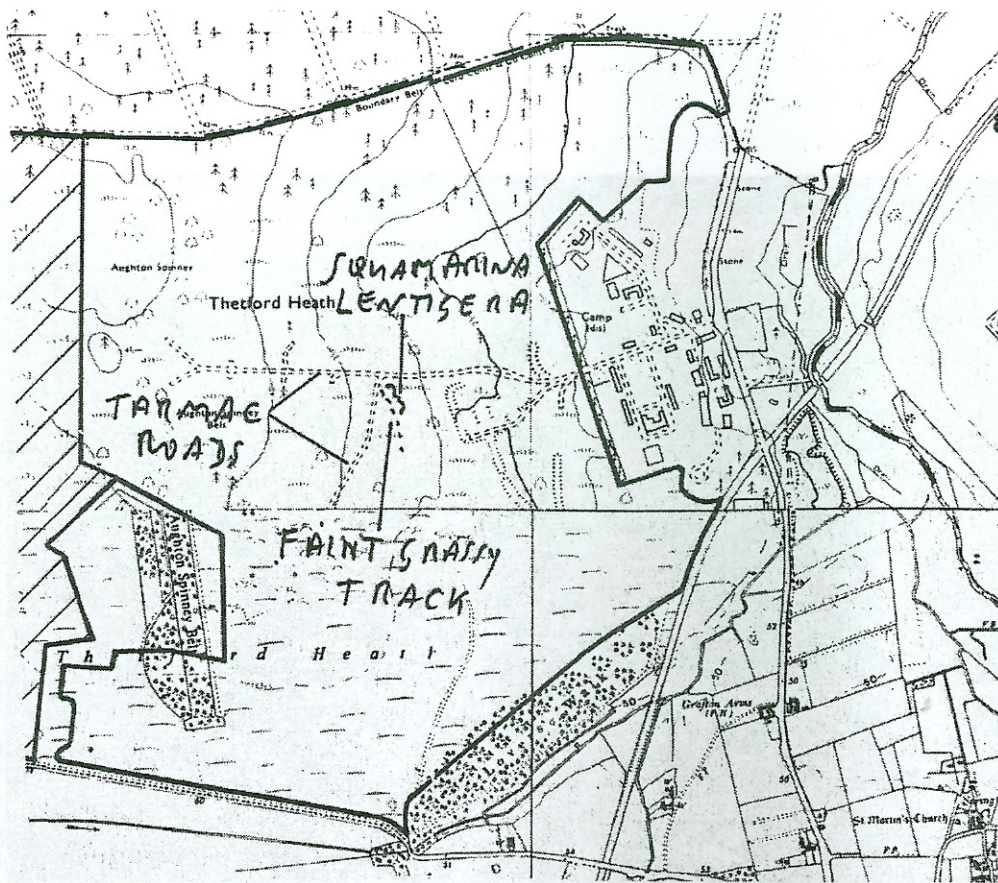


Weeting Heath NNR: Looking South down the track supporting *Squamarina lentigera*.



Weeting Heath NNR: Chalk Pit 3A photographed from the South side showing the 1 x 1 m quadrat containing *Psora decipiens*





RAF Barnham Training Area: Map showing position of the grassy track that supports *Squamarina lentigera* and several other notable species

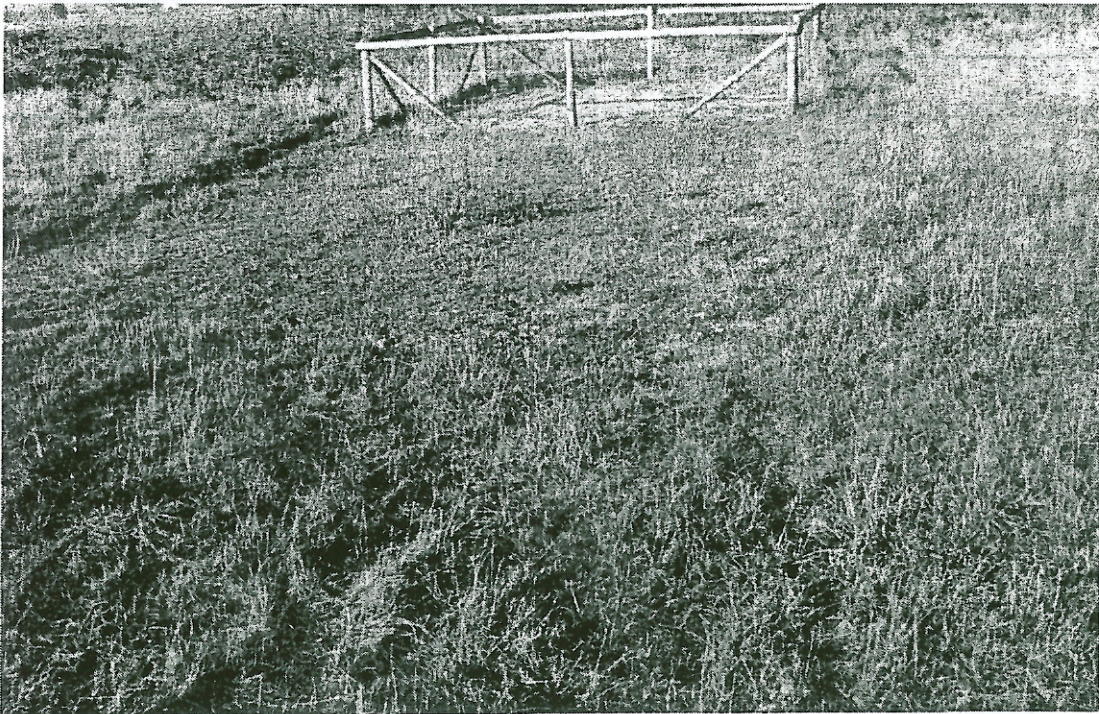


RAF Barnham Training Area: Possibly the best group of *Squamarina lentigera* thalli remaining in Britain





Deadman's Grave: Photograph showing the closed nature of the sward at this, and most other, previously open Breckland grassland sites.



Lakenheath Warren: The shallowly stripped area showing rapid higher plant invasion after three years.



## Weeting Heath NNR

## Compartment 3

The occurrence of *Squamarina lentigera* along a 60 m length of track divided into one metre sections. The number of thalli in each section is shown. Transect starts by large beech tree close to the eastern fence of the Compartment. Recorded November 1998 by Bev Nichols and November 2002 by Bev Nichols and Oliver Gilbert. Section 11-12 recorded as a permanent quadrat in November 2002.

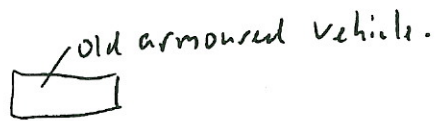
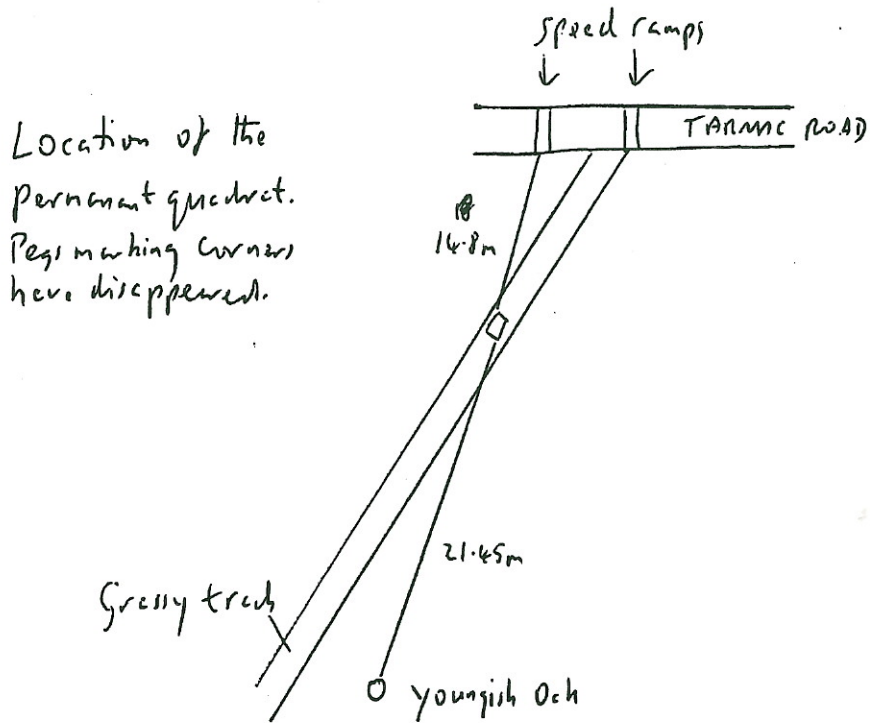
Distance along transect (m)	Nov. 1998	Nov. 2002
0-1		
1-2		
2-3		
3-4	10	
4-5		
5-6		
6-7	4	2
7-8	1	1
8-9	12	
9-10	2	
10-11	6	
11-12	2	8
12-13	6	2
13-14	1	1
14-15	9	
15-16	6	6
16-17	6	
17-18	10	1
18-19	1	1
19-20	2	1

Distance along transect (m)	Nov. 1998	Nov. 2002
20-21		
21-22	5	
22-23		
23-24		
24-25		
25-26		
26-27		
27-28	14	8
28-29	59	
29-30	2	2
30-31	2	
31-32		
32-33		
33-34		
34-35		1
35-36		1
36-37	4	
37-38	2	2
38-39		14
39-40	1	

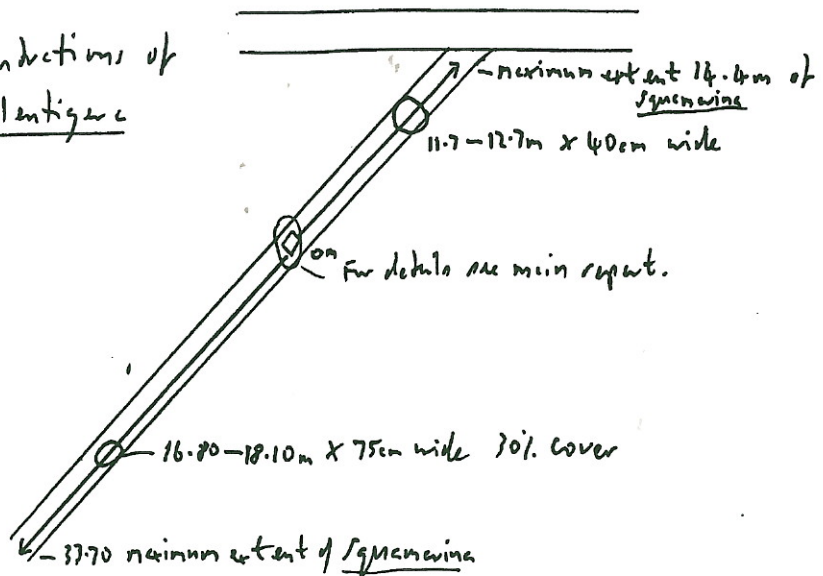
Distance along transect (m)	Nov. 1998	Nov. 2002
40-41	4	
41-42		
42-43	2	
43-44	3	
44-45		
45-46		
46-47		
47-48		
48-49		
49-50		
50-51		
51-52		
52-53		
53-54		
54-55		
55-56		
56-57	1	
57-58	1	
58-59		
59-60		

# RAF Barnham Training Area

Field notes to relocate the permanent quadrat and to show the distribution of *Squamaria lentigera* in November 2002.



Main concentrations of *Squamaria lentigera* Nov 2002







# ENGLISH NATURE

English Nature is the Government agency that champions the conservation of wildlife and geology throughout England.

This is one of a range of publications published by:  
External Relations Team  
English Nature  
Northminster House  
Peterborough PE1 1UA

[www.english-nature.org.uk](http://www.english-nature.org.uk)

© English Nature 2002/3

Cover printed on Character Express,  
post consumer waste paper, ECF.

ISSN 0967-876X

Cover designed and printed by  
Status Design & Advertising,  
2M, 5M, 5M.

You may reproduce as many copies of this report as you like, provided such copies stipulate that copyright remains with English Nature,  
Northminster House,  
Peterborough PE1 1UA

If this report contains any Ordnance Survey material, then you are responsible for ensuring you have a license from Ordnance Survey to cover such reproduction.

Front cover photographs:  
Top left: Using a home-made moth trap.  
Peter Wakely/English Nature 17,396  
Middle left: Co<sub>2</sub> experiment at Roudsea Wood and Mosses NNR, Lancashire.  
Peter Wakely/English Nature 21,792  
Bottom left: Radio tracking a hare on Pawlett Hams, Somerset.  
Paul Glendell/English Nature 23,020  
Main: Identifying moths caught in a moth trap at Ham Wall NNR, Somerset.  
Paul Glendell/English Nature 24,888



Awarded for excellence