A survey of *Sphagnum* moss at Butterfly Conservation Catfield Fen and comparison with past surveys. Redacted version.

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Parts of this report have been redacted to remove detail to protect the fen orchid population on Catfield Fen. This population is of national importance and such information could risk attempts to visit the colony to either view plants and/or to collect plants. Full details of the population have been made available to Natural England and the Environment Agency.

1. Introduction

Increasing cover of *Sphagnum* moss has been cited by RSPB and the Catfield Hall Estate as a possible indicator of drying and / or acidification at Sutton Fen. To date, no comparison of the change in *Sphagnum* cover over time has been completed at Butterfly Conservation's area of Catfield Fen (referred to as Catfield Fen in this report). RSPB have commented to Natural England and the Environment Agency that the increasing *Sphagnum* cover is of great concern due to the loss of calcareous fen plant communities as a result of this increase. Of particular concern is the loss of the S24e supporting fen orchid *Liparis loeselii* [redacted]. This increase has been noticed by RSPB staff and the site reed cutter, Andy Hewitt, and reported to NE and EA anecdotally in the past.

This report aims to formalise this anecdotal observation and provide a baseline for future comparison by mapping the current distribution of *Sphagnum* moss at Catfield Fen and relating this to past information on sphagnum distribution.

This report does not endeavour to link *Sphagnum* increase to local water abstraction or explain why reduction in groundwater input should lead to *Sphagnum* increase, as this has already been described elsewhere. However, the RSPB understands that reduced groundwater input is likely to increase the rate at which *Sphagnum* can spread and it is possible that local water abstraction is accelerating this process.

2. Methods

To collate past data on *Sphagnum* cover at Catfield Fen, a literature review was performed. Four historic map-based sources were found: 1986 (Giller & Wheeler 1986), 1991 (Fen Resource Survey, Parmenter 1991) 1993 (Catfield Fen Management Plan, Harris,1993) and 2003 (Catfield Fen Management Plan, Harris, 2003). Methods for collection of this data differed for each dataset.

a) 1986 – Giller and Wheeler:

Figure 1: 1986 Map of Catfield Fen, Giller and Wheeler.

Black areas and lines represent open water and dykes. Dashed lines represent overgrown dykes. Stipuled areas mark solid (i.e. uncut) peat; other portions are former turf ponds (Giller & Wheeler 1986a). Hatching shows distribution of *Sphagnum* stands: down slope to left, *Betulo-Dryopteridetum cristatae.* Down slope to right, *Betulo – Myricetum gale Sphagnum* variant.

A detailed method for this survey could not be found, but through discussion with those aware of the work, it is understood that of all the past surveys this was the most accurate. Whereas the 1991 fen resource survey and the 1993 and 2003 management plan surveys were general vegetation surveys of the area, the 1986 survey focussed specifically on identifying and mapping *Sphagnum* communities in the Catfield and Irstead fens, and therefore is likely to have reliably mapped all stands.

b) <u>1991 – Parmenter:</u>

Figure 2: 1991 map of Catfield Fen, Parmenter
Purple represents *Sphagnum – Dryopteris* mire.

Dark Pink and blues represent various open fen habitats

Black represents non-fen habitat (woodland, scrub, water etc.)

This was part of a huge survey mapping vegetation across open fen throughout the Broads. Quadrats were recorded to provide data for analysis using TWINSPAN and field survey mapped the perimeter of communities recorded.

As the target of the survey was the open fen habitats, areas of more mature closed-canopy *Betula- Sphagnum* scrub were not mapped.

c) <u>1993 – Harris:</u>

In the 1993 management plan there is no map, but there is a table showing hectarages of various vegetation types within each compartment. This is used to populate the table in the analysis section. These hectarages were made by ground truthing the Fen Resource Survey map and making alterations where necessary.

d) <u>1997 – English Nature:</u>

Figure 3: 1997 Catfield Fen Management Plan, English Nature

10 represents *Sphagnum – Dryopteris* mire
9 represents W2b (*Betula-Sphagnum* carr)

It is apparent that this map was made using the 1991 Fen Resource Survey data as the boundaries are almost identical, though with some simplification to make it more useful as a management map.

e) 2003 – Harris:

Figure 4: 2003 Catfield Fen Management Plan, Jane Harris.

From discussion with Jane Harris, this map was made using the Fen Resource Survey and knowledge of the site as a basis for field visits to ground truth and update.

Perimeters would have been mapped by hand, not GPS.

Key:
AC - Acidophilic boil/vegetation
CF – conservation fen
RB – reedbed
SN – Non-intervention Sedge
Sc – Maintain Scrub

3. 2014 sphagnum survey

To provide a new baseline and to allow comparison with the historical maps, a new survey was completed on 02/05/2014. The method was designed to be efficient and repeatable, whilst accurate enough to allow change to be picked up on a relatively small scale (10's of metres) in the future.

Sphagnum was surveyed using a handheld GPS, with areas targeted based on site knowledge of main *Sphagnum* areas. Areas known not to have any *Sphagnum* (such as wet woodland, very wet sedge beds, open water and very wet swamp areas) were avoided. When *Sphagnum* was encountered this was recorded by grid reference as either a point location (if patch < 3m x 3m) or the boundary mapped by logging approximately every 2m around the perimeter (though less frequently for larger areas). Many smaller patches will have been missed, but the major areas will have been found and mapped. Although most areas of *Sphagnum* were quite defined, some areas had patchy *Sphagnum* and other mosses on their fringes. In these cases, the boundary was mapped at the point where cover was approx 50% *Sphagnum*. The GPS readings were then transferred to Mapinfo to produce maps showing *Sphagnum* areas and the smaller *Sphagnum* patches. This method will produce a relatively accurate map of *Sphagnum* distribution and total cover on the site as a whole to look for long term trends, but is unlikely to be accurate enough to pick up change from one year to the next unless change is very rapid. To detect annual change, it is likely that permanent transects that are accurately located to within a few centimetres would be required.

4. Analysis

To allow comparison between the maps shown in figures 1 to 4, the data were transferred into Mapinfo to produce maps of consistent scale and to allow measurement of areas. These maps are shown below in figures 5 to 8 with the 2014 survey shown in figure 9. In each figure, the red line is the boundary of the Butterfly Conservation Catfield Fen reserve, and the hatch areas are the mapped areas of acidophilic vegetation.

Figure 5: 1986, Giller & Wheeler

Figure 6: 1991, Parmenter

Figure 7: 1997, English Nature

Figure 8: 2003, Harris

Figure 9: 2014, RSPB
Green stars represent sphagnum patches < 3m x 3m

Figure 10: Catfield Fen compartment map

Table 1: Areas of acidophilic vegetation (dominated by sphagnum) in Hectares at BC Catfield Fen.

Compartment	1986	1991	1993	1997	2003	2014
[redacted]	0.11	0.04	0.10	0.11	0.12	0.06
	0	0	0.00	0.00	0.00	0.00
	0	0	0.00	0.00	0.00	0.00
	0	0	0.00	0.00	0.00	0.00
	1.17	0.65	0.65	0.48	0.62	1.31
	0.29	0.27	0.29	0.36	0.10	0.43
	0.25	0.34	0.35	0.33	0.35	1.13
	0	0	0.00	0.00	0.00	0.07
	0	0	0.00	0.00	0.00	0.00
	0	0	0.00	0.00	0.00	0.00
Catfield Fen Total	**1.82**	**1.30**	**1.39**	**1.28**	**1.19**	**3.00**

5. Comparison of change in extent of *Sphagnum* vegetation between 1986 to 2014

To compare *Sphagnum* cover between the 5 years for which data is available, the areas (in hectares) of acidophilic vegetation were measured using Mapinfo and are presented in Table 1. In the 1986 survey, the acidophilic vegetation was split into the open '*Betulo-Dryopteridetum cristatae'* community and the '*Betulo – Myricetum gale Sphagnum* variant' community, but for this analysis these areas were lumped and no attempt was made to separate these areas in the 2014 mapping. The comparison is between 'acidophilic' areas in general, which at Catfield has always been used to refer to communities dominated by *Sphagnum*, either in birch scrub or in open conditions.

6. Results

Due to the relative inconsistency between methods used in each year and the irregularity and small number of surveys, no attempt is made here to make a statistical analysis of change between years or to identify a trend. There appears to be a reduction from 1986 to the 1990s and 2000s, however this is likely to be due to the following factors:

- The mapping method and survey aims of the 1991 survey, which mapped open fen communities only, and would not have identified closed-canopy *Sphagnum* birch woodland.
- In 1991, 1993, 1997 and 2003 the habitat mapping at Catfield was not focussed on *Sphagnum* specifically (as was the case in 1986), but on mapping vegetation community types, and is therefore likely to have considerably under-represented the extent of *Sphagnum* distribution (i.e. *Sphagnum* could be present in quantity in S24e vegetation, but this vegetation would still be mapped as S24e.

Subsequent maps based on this data would have shown a similarly reduced pattern of *Sphagnum* distribution. The 2014 and 1986 surveys therefore probably provide the best long term comparative dataset.

The change from 1986 to 2014 appears significant (61% increase) and consistent with the anecdotal evidence that has been much debated in recent months. Below, each compartment containing *Sphagnum* is assessed with some compartment specific background.

a) [redacted] – 45% decrease:

Here there has been some loss of *Sphagnum*, apparently in recent years, the 1991 survey under-represents the *Sphagnum* because a 0.06ha area was recorded as S24g/W2b (shown as the small green area in figure 2) and was not included in Table 1. The loss from 1986 to 2014 appears to be due to succession to mature birch scrub over a former hovered over dyke which has pushed the buoyant surface down into the surface water. This has caused the loss of the *Sphagnum* moss (a process discussed in Giller & Wheeler, 1988). The remainder of this compartment is largely un-dug peat and is therefore very unlikely to ever become colonised by *Sphagnum*, which tends to colonise previously dug peat with a buoyant surface. There are some small areas to the south not recorded in 1986, but these could easily have been missed in the past.

b) [redacted] -12% increase:

In all years, the compartment with the most *Sphagnum* moss. This area contains a great variety of successional stages of previously turf ponded fen, with remaining open water through to mature carr woodland. There appears to have been both some loss of *Sphagnum* and some expansion from 1986 to 2014. This part of the site is known as 'the badlands' and is particularly difficult to access which may explain the significant apparent reduction from 1991 – 2003. The new area of most significance is the expansion to the East of the major block. In recent memory, this area was largely *Sphagnum* free. Expansion has led to the loss of S24e habitat, and it is likely that this expansion will continue to the West until it reaches the much wetter, S8 and S2 communities on the areas of more recent open water.

c) [redacted] – 48% increase:

This area is complicated by the occasional exclusion of the area to the North East of the main *Sphagnum* boil. This area was heavily scrubbed until 2011, when the scrub was removed. The vegetation present currently has not yet regenerated sufficiently to classify. It is possible that this area was *Sphagnum* dominated in the past, but that scrub growth led to submersion of the buoyant layer and loss of *Sphagnum* moss. The main boil appears to have expanded slightly in recent years and this is consistent with anecdotal evidence this expansion is at the expense of S4. Of particular note is that the small turf ponds hand dug in 2007 to study crested buckler-fern *Dryopteris cristata* germination have largely been colonised by *Sphagnum* moss. The area to the North West of the compartment is new, it was not present as recently as 2009, this area has been managed for a number of years through annual cutting to encourage plant species diversity, despite this *Sphagnum* colonisation here has been rapid and is continuing. This expansion is at the expense of S24e.

d) [redacted] – 452% increase:

This compartment has seen by far the most significant increase in *Sphagnum*. The main boil has been known for decades and has now developed to mature *Betula* – *Sphagnum* scrub. However, the recent expansion was not noted until 2009 when *Sphagnum* was first recorded in the commercial reed bed. Since then, expansion has continued (based on informal survey and anecdotal evidence) in areas of cut reed as well as uncut fen. This area is focussed on in more detail in a separate report discussing the threat of *Sphagnum* expansion on the large fen orchid colony in [redacted]. The recent expansion has been at the expense of S24e. Beyond the major boil are many smaller patches which were not noted until 2009, though they could have been present and undetected due to their small size.

e) [redacted] – unknown change:

No *Sphagnum* was recorded in this compartment until 2014. This could be due to the scattered nature and small patches, so no conclusions can be drawn on change in this compartment at present.

f) *Summary* – except for [redacted], which is unique as the only largely un-dug compartment on the site to contain *Sphagnum*, *Sphagnum* has increased in each compartment where it was present in 1986 and appeared on one additional compartment. This expansion has almost exclusively been into S24e, but also in places into other communities, the figures below are estimated using the 1991 fen resource survey maps (Parmenter, 1991).

7. Conclusions

Despite the limitations of comparing maps made using different survey methods, it is unequivocal that cover of *Sphagnum* moss has increased at Butterfly Conservation Catfield Fen and that this has caused the loss of other fen habitats, most significantly, S24e. In addition, anecdotal evidence as well as the lack of any significant change recorded by 2003 suggests that this process is relatively recent. It was clear from the site visit during the survey that in large areas of the site there is no apparent barrier to this expansion, in particular in [redacted], [redacted] and [redacted]. Consequently, we might expect to see the expansion continue until a significant barrier such as carr, pools or dykes are reached, this would see significant further loss of open fen habitats, in particular the S24e community most abundant on [redacted] and [redacted].

This spread of *Sphagnum* should be considered in combination with the RSPB report in 2013 identifying decrease in RWPFSS values, moisture, and pH Ellenberg values, which demonstrate that **there is a decrease in conservation value of areas of fen unaffected by *Sphagnum* expansion,** as well as the loss of fen area to *Sphagnum* expansion.

Figure 11: Loss of fen habitat to *Sphagnum* moss 1986 to 2014

Red line = BC Catfield Fen site boundary

Orange hatch = Open fen in 1986, *Sphagnum* in 2014.

Total area = 1.73Ha

S24e = 1.25Ha
S24f = 0.05Ha
S24g = 0.01Ha
S8a = 0.1Ha
S4 = 0.2Ha
Non fen (bank, scrub etc.) = 0.1Ha

8. References

Giller and Wheeler (1986). Past Peat Cutting and Present Vegetation Patterns in an Undrained Fen in the Norfolk Broadland. *Journal of Ecology* (1986), 74,219-247

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