Report on Glenquey Moss, Blanket Bogs of the Ochil Hills and Raised Bogs in Perth & Kinross

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Cover: Black Darter Dragonfly *Sympetrum danae* from site, fruit and unopened flower of Cranberry *Vaccinium oxycoccos* and sphagnum mat and hummocks among flowering Hare's-tail Cottongrass *Eriophorum vaginatum* on Glenquey Moss.

1.0 INTRODUCTION

The following report was compiled from site visits undertaken between 6th May to 17th November, 2012. Visits were undertaken to Glenquey Moss to gather information on its plant communities, ecology and topography. Site visits were also made to raised bogs and blanket bogs in the wider area around Glenquey Moss to place it in a wider context. A comparison between these sites follows later in this report using data from other sources, in particular *An Inventory of lowland raised bogs in Great Britain* (Lindsay and Immirizi, 1996). What emerges is the uniqueness of Glenquey Moss compared to any of the surrounding sites.

2.1 GLENQUEY MOSS

Glenquey Moss is situated in the Ochil Hills, close to the A 823. The grid reference for its centre is NN988 038, and its elevation ranges just above and below 270m aod (above ordnance datum). The site is listed in *An Inventory of lowland raised bogs in Great Britain* as a raised bog, but it is now recognised as a blanket bog, however its character is quite unlike any other blanket bog in the area. This section of the report gives an account of the geomorphological structure, the gravel delta, on which the blanket bog rests and the vegetation features and some of the plant communities found on the bog.

2.1.1 SITE FEATURES

Vegetation and hydrology

The blanket bog is situated on a post-glacial gravel delta, which is confined between the edges of the slopes above the Glenquey Burn to the north and west, the bottom of the slope of Auchlinsky Hill to the south, the Howcleuch Burn to the east and south-east and the terminal moraines of the post-glacial feature on the north and north-east. Large mats of continuous sphagnum are situated at about 270m aod within the bog, which gave way to a series of other vegetation communities rising to a height of about 273m aod. The lower levels of the bog occupy a series of basins, most of which are connected and between these there is movement of water.

The bog is generally higher around the edges, which contains most of the run-off, but the edges are cut by channels where water drains off at NN9879 0357 to the Howcleuch Burn and with seepage channels along the track to the east at NN9887 0358, NN9891 0362 and NN9897 0376. The bog also drains to the north-west where there are three channels, the largest being at the gate at NN9852 0368, and two to the east, one at NN9859 0375 and the other close-by.

Looking at the lower slopes of Auchlinsky Hill to the south of Glenquey Moss, there appears to be the possibility that water may run off the slopes into the bog, however on closer examination this was seen not to be the case. All water running off the lower slopes east of NN9883 0352, where the track to the gravel scrape starts, runs directly into the channel leading into the Howcleuch Burn, and from NN9847 0335 westwards, where the two access roads meet, all water flows into the Glenquey Burn. Between these two points just below the main access road, there are channels running parallel to it, taking water off in opposite directions to the two burns from a high point near the start of the access track to Auchlinsky Hill. Water drains off to the west from the bottom of the slope to a deep natural channel at NN9846 0341. In the past water flowed into the other channel from the bog, where there are lower levels on its surface at two places, NN9862 0347 and NN9873 0353, now cut off by the gravel scrape access track. Water draining

off from the lower slope in an easterly direction would have met bog water, which would have run a short distance through the edge of the bog before running into the channel leading to the Howcleuch Burn. This final section was diverted a short distance by the construction of the access track, where it makes a 90^0 turn around the small conifer plantation.

Photo 1: The east flowing channel, now cut off, between Auchlinsky Hill and Glenquey Moss at NN9873 **0353**

The sides of the gravel delta on which the bog sits are steep sided, with the Howcleuch Burn and Glenquey Burn coming together within a kilometre of each other along the bottom slope of Auchlinsky Hill. The interception of run-off from Auchlinsky Hill by the channels demonstrates that the bog is a completely self-sustained hydrological unit, unless there is movement of water underground, therefore the bog derives its water from precipitation, thus the bog community can be described as being totally ombrogenous as far as can be seen above ground level.

Photo 2: Outflow channel to the Howcleuch Burn in January 2011

The natural flow of water from the Moss to the Howcleuch Burn is shown on the 1860 survey of the Ordnance Survey First Edition six inch to the mile map (Perthshire, Sheet CXXVII) as can be seen from this link to the copy held by the National Library of Scotland.

Within the active bog water flows through the sphagnum carpet from all corners of the site to the channels leading to the Howcleuch Burn at NN9879 0357 and NN9887 0358, and there is usually a flow from both channels at all times. There can be a considerable flow after heavy rain, as can be seen from broken pieces of sphagnum moss that get caught high on the stems of Soft-rush *Juncus effusus* after having been bent over by a strong flow. Drainage from the north-west corner of the bog is more localised, but the loss of water from these channels is significant, especially the channel at the gate at NN9852 0368, which has influenced the vegetation at that corner of the site.

The large area dominated by Purple Moor-grass *Molinia caerulea* to the south of this channel suggests drying out of the peat and further to the south, Heather *Calluna vulgaris* is taller, also suggesting drying out. The formation of the gravel scrape to the south may have had some influence in the past, but there is currently no water running into it.

All of the channels are natural, and they are influenced by the underlying topography. Deeply incised notches cut into the gravel delta on the eastern side of the site and terminate at the edge of the bog or run under it, increasingly so in a westerly direction. At the north-western corner of the bog the channels are shallow spouts at the edges of depressions. Channels may have been deepened in the past to drain the bog, but there are no straight lined channels that are commonly found on bogs that have been dug in a determined effort to drain them. There are drains to the east of the site, but not on the current bog, but this area to the east may have been bog in the past which was drained for conversion to grass for grazing.

Photo 3: The steep-sided slopes of the Howcleuch Burn, Glenquey Moss is just to the left of the photograph

The range of plant communities reflecting drier peat on the slightly higher ground to wet peat on the lower suggests the possibility that the water table in the bog was higher in the past, but has since dropped leading to a certain amount of drying out of the peat. A drop in water level may have been achieved by drainage or the result of peat extraction or a combination of both, the result leading to the underlying topography having a stronger influence on the plant communities. Under natural development of the bog the growth of the sphagnum would have raised the water level to reduce the effect of the underlying topography, which would have had the least influence when the bog attained its maximum growth. Perhaps the bog was drained to provide accessible grazing for cattle and for access to peat for extraction.

Three transects were undertaken to arrive at a better understanding of the depth of the peat and the surface topography of the gravel delta underlying the bog. These were made by pushing a simple probe into the ground, and when the tip of the probe struck a solid surface, the depth of the penetration through the vegetation and peat was measured. The first transect crossed the channel leading to the Howcleuch Burn at NN9887 0358 from the south-west to the north-east, in line with Ben Thrush at the centre of the following photograph. At the bottom right hand corner of the photograph the channel can be seen before it exits the bog between the fence posts. The other transects ran from slightly higher ground across the sphagnum mat on the left hand side of the photograph, and the other ran adjacent to the sphagnum fill of the soakway. The results of the transects are displayed in table 1.

Photo 4: Line of first transect, 21.10.12

The greater depths of peat were found in the channels and open mats of sphagnum as might be expected, and there was a marked drop and rise in the depth of the peat in places over five metre sections. The shallower depths of peat were found on the slightly higher ground. The peat depths reflect changes in the underlying topography.

Over the site there are patches of sphagnum with the presence of the most water tolerant species *Sphagnum cuspidatum* giving the impression that there is a considerable depth of water below it, however some of these do not have a great deal of peat underneath and appear to indicate an impermeable layer in the gravel at a higher level. There are a few places where *S. cuspidatum* grows at the edge of open pools, and the dark water at the centre of the deepest indicates a considerable depth of water below.

The surface vegetation is very much a reflection of the underlying topography, which is extremely complex, and the inter-reaction between topography, peat and sphagnum is reflected in the hydrology. Other factors affecting the hydrology of the bog and the types of vegetation communities found will also reflect past management. There is likely to have been removal of peat in the past, but evidence of this is not easy to find. Beyond the north-east corner of the little plantation on the south-east side of the site there is a short section of bank in the bog with a straight face,

which might reflect peat cutting in the past. To the south-east of this there is a small, wet basin that sits apart from the rest of the bog, which might also reflect local peat extraction in the past.

Table 1. Peat depth transects

Transect 1
Start: 0 @ NN 98886 03628
Finish: 50 @ NN98870 03678

Distance (m)	Depth (m)
0	0.41
5	0.28
10	0.20
15	0.64
20	0.95
25	0.90
30	0.68
35	0.51
40	0.21
45	0.20
50	0.30

Transect 2
Start: 0 @ NN 98819 03659

Distance (m)	Depth (m)
0	1.0+
5	1.0+
10	1.0+
15	1.0+
20	1.0+
25	1.0+
30	1.0+
35	0.75
40	0.70
45	0.69
50	0.70
55	0.63
60	1.0+
65	1.0+
70	1.0+
75	1.0+
80	0.48
85	0.52
90	0.28

Crossed transect 1 at 76.2m

Transect 3
Start: 0 @ NN 98834 03680
Finish: 70 @ NN98820 03627

Distance(m)	Depth(m)
0	0.61
5	1.0+
10	1.0+
15	1.0+
20	0.70
25	0.45
30	0.53
35	0.75
40	1.0+
45	0.69
50	1.0+
55	1.0+
60	1.00
65	0.75
70	0.25

Crossed transect 2 at 25.2m

Four rolls of what appear to be conveyor belt were found at NN9863 0356, close to the mound that rises above the bog, and there has also been considerable ground disturbance in this area, where there is an expanse of grass in the middle of the bog. These features may have some connection to peat extraction. A study of the past management of the site through enquiry of local sources would help to answer questions in relation to peat extraction.

Despite the run-off from the channels, the level of precipitation is sufficient to sustain the bog communities and promote peat building, although this growth could be improved by reducing the water loss from the channels. There is no peat erosion at present, only small wet patches of peat that are being colonised by vegetation. Even on the highest, drier parts of the bog there are patches of active, peat-building sphagnum *Sphagnum capillifolium*. The absence of Cladonia lichen over most of the bog surface apart from localised patches, and the absence of peat erosion demonstrates that there is little aerial drying out of the peat on the bog and that water levels within the peat range from relatively high levels through to saturation.

Geomorphology

The feature on which the bog rests is described as having formed 15,000 to 13,000 years ago. Glacial action over the southern shoulder of King's Seat Hill to the south-west brought melt-water and debris in a north-easterly direction along Glen Quey where sands, gravels and boulders were deposited at its junction with Glen Devon within a lake that had formed at a level of 269m aod (Russell, 1995). The lake was formed from glacial meltwater impounded by ice that blocked any exit to the south, and the southern ends of adjacent Glen Dey and Glen Queich to the east were also blocked by ice. Water was forced to flow further in a north-easterly direction into Glen Dey and then into Glen Queich.

Photo 5: Glen Quey. The summit of King's Seat Hill is just off the picture under cloud, Glen Devon running from left to right is partially hidden. Glenquey Moss is just visible beyond the green edge of Tormaukin Hill. The head of Glen Queich is just off the bottom left-hand corner of the picture with the head of Glen Dey showing in the foreground, which runs off to the left of the photograph following the road and out of sight.

The channels now occupied by the Glenquey Burn and Howcleuch Burn are said to be the erosional channels that formed after the level of the ice-dammed lake in Glen Devon dropped. The delta feature "represents the highest and best defined terrace present within Glen Devon" (Russell, 1995).

The route the glacial melt-water and debris travelled can be seen in photo 5, through Glen Quey where the reservoir is now, followed by the deposition of material on reaching the lake-filled Glen Devon at Glenquey Moss. The exit route for water out of Glen Devon was into Glen Dey then into Glen Queich. The head of Glen Dey is seen in the photograph, and the Glen runs off to the left of the photograph. The smaller glen below this reaches Glen Devon between Tormaukin Hill on the right and Down Hill (with the fort –Dun -on its summit) on the left.

Climate and Bog Morphology

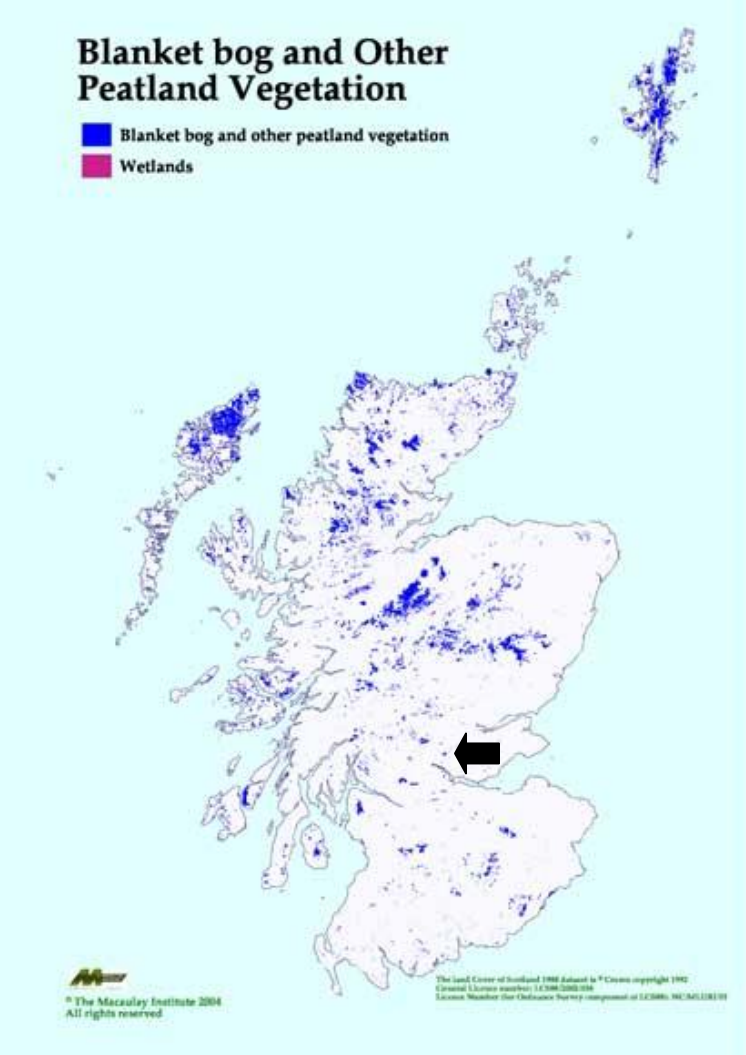
Glenquey Moss is at a relatively high elevation, but within the 300m aod limit recognised by Lindsay (1995) as being within the range of the formation of raised bog. One of the main divisions between the formation of raised bogs and blanket bogs is climate; raised bogs belong to a zone "with only moderate rainfall and fairly cold winters – a relatively continental climate," (Lindsay *et al* 1988, p22). The "conditions generally regarded as necessary for blanket bog formation" are "a minimal annual rainfall of 1000mm; a minimum of 140 wet days and a cool climate (mean temperature less than 15^0C for the warmest month) with relatively minor seasonal fluctuation."

These conditions are mapped by the authors, but more up to date data can be obtained from the Met Office. These indicate Glenquey Moss is within an average summer temperature of 12.5^0C to 13.5^0C, annual average rainfall of 1,200 – 1,500mm and average of 160 -180 days of rain of more than 1mm. Therefore, climatically the site falls within the conditions for the development of blanket bog.

This overlap of conditions for the formation of the two kinds of bog helps to explain why Glenquey Moss has been regarded as both kinds of bog at different times. In the accounts of the two kinds of bog that follow later in this report, the plant communities of Glenquey Moss will be seen to be more similar to raised bog that the other blanket bogs in the Ochils. Glenquey Moss sits at a level of transition between raised bogs and blanket bogs, and is also lower than the other blanket bogs in the Ochils by 100 metres.

The map in Fig. 1 is provided by the Macaulay Land Use Research Institute, now the James Hutton Institute. The approximate position of Glenquey Moss is marked on the map by the black arrow.

Fig. 1 Distribution of blanket bog in Scotland



Conditions in which blanket bog forms improve with an increase in the climatic values for rainfall and lower climatic value for temperature. Glenquey Moss is situated at the climatic margins required for the formation of blanket bog, therefore its location has a special relationship with the distribution of raised blanket bog in Scotland.

Blanket bogs have been classified into a number of sub-categories (Lindsay, 1995, p.46) but the similarities to Glenquey are few. The bog is self-contained on the gravel delta on which it rests, with no continuity to similar vegetation around it and with no discernible input of water other than from precipitation.

3. VEGETATION SURVEY

Five visits were made to survey the flora of Glenquey Moss on 6th May, 3rd June, 13th August, and 5th and 9th September. Records of mosses and liverworts, including species growing intimately with the sphagnum , were made on the first two visits, and on subsequent visits additional records were made and a survey was carried out to describe and map the bog communities at the level of the National Vegetation Classification. The records of plant species and NVC communities provided are not exhaustive, surveying effort was concentrated on the bog, not all of the grass communities were surveyed, and none of the rush pasture communities was surveyed, but a sufficient survey of the site was carried out to help evaluate its importance in terms of the bog habitat. The results tally well with a survey that was carried out by Scottish Natural Heritage in February 2011.

Descriptions of NVC communities follow, and the compositions of sample communities and other species records are shown in appendix 2 of this report. The distribution of the communities across the site is shown on the map in appendix 1, which was compiled from the samples and walk-over observations. Common and botanical names are used for vascular plants as currently accepted (Stace, 2010) but only botanical names are given for mosses and liverworts, because most of the common names are recent and have not been fully accepted. Some botanical names have changed since the NVC descriptions came into use, and currently accepted botanical names are given in brackets. A list of bird and invertebrate species recorded from observations made in passing during the survey is provided at section 3.3.

3.1 Glenquey Moss Plant Communities

M2b Sphagnum *cuspitdatum/recurvum* (*fallax*) bog pool community, S. *recurvum* (*fallax*) sub-community

Survey observations

This community is found in the M2b/M18a communities shown on the attached map in appendix 1. The M2b community occupies much of the basins within which this complex is found and is dominated by *S. fallax,* which is reflected in the bright, yellow green carpet that can be seen from a considerable distance. Where the bog is under greater tension from the movement of water through it, or where water tension is greater in the centre of the sphagnum basins, *S. fallax* gives way to *S. cuspitdatum*. This species is more frequent in soakways and becomes dominant at the edges of and in water channels and where the peat is extremely saturated in the bottom of basins. There is one deep pool on the site, at NN9882 0363, where *S. cuspitdatum* is found with little other vegetation. Open water occurs sporadically within the movement of water through the sphagnum carpet that drains to the Howcleuch Burn.

The M2b community has few associates on the bog, the most frequent are solitary spikes of Common Sedge *Carex nigra,* that punctuate the surface of the *S. fallax* mat at regular intervals. There is a noticeable change in the botanical structure where water flow is greatest; lines of Soft-rush *J. effusus* define the edges of water channels in the sphagnum carpet in a few places where there is greater movement of water. Bogbean *Menyanthes trifoliata* is present at the open channel at NN9879 0350, and Common Cottongrass *Eriophorum angustifolium* grows there. This species occurs as scattered shoots or in small groups, such as the distinct patch within open saturated peat within the community at NN9883 0352. There is no White-beaked Sedge *Rhynchospora alba* on the site, and with few other associates, therefore the sub-community is quite clearly M2b.

The margins of the M2b and M18a communities are part of a continuum, and are not always discrete, but on the slightly higher margins of the concave basins where sphagnum is found or on the more level sphagnum mats, *S. papillosum*, S*. magellanicum* and *S. capillifolium* always dominate.

Literature references

This sub-community is described (Rodwell, 1991, vol. 2 p 52) as well represented in raised bogs from the Scottish Borders, Northumberland, Welsh Borders and other locations. But the community has a wider range and "forms pools on the surface of wet, base-poor blanket mires or raised mires. In the lowlands it is mostly associated with raised mires but in the uplands it can occur in *Erica-Sphagnum papillosum* mire M18, *Trichophorum-Eriophorum* mire M17 or *Calluna-Eriophorum* mire M19" (Averis *et al*, p 136).

The distribution maps in both publications indicate that this community is predominantly lowland, and in Central-eastern Scotland is very rare, with only one other station in this part of Scotland, which is in the 10km x 10km square immediately to the south-east of the site.

M15d *Scirpus cespitosus* (*Tricophorum germanicum*)-*Erica tetralix* wet heath, *Vaccinium myrtillus* sub-community

Survey observations

This community was found adjacent to other communities, M17c *Scirpus cespitosus* (*Tricophorum germanicum*)-*Eriophorum vaginatum* blanket mire *Juncus squarrosus-Rhytidiadelphus loreus* sub-community and M25a *Molinia caerulea-Potentilla erecta* mire, *Erica tetralix* sub-community. The M15d community occupies slightly higher ground than the M17c community, which is a series in transition from the slightly lower M18a community, reflecting the reduction of moisture within the peat with a rise in elevation. *S. capillifolium* remained a constant within the M15d community and on broken peat *S. tenellum* was established. They and the presence of Hard Rush *J. squarrosus* reflect wetter conditions in places, but the presence of Heather *Calluna vulgaris* and Blaeberry *V. myrtillus* reflect drier conditions elsewhere, which is also reflected by Deergrass *Trichophorum germanicum* becoming more localised.

Literature references

The juxtaposition and relationship between this community and the following one have been described in the same context in which they were observed at Glenquey Moss (Rodwell*,* vol. 2 p 149) and in particular at the sub-community level (p 146). In distribution maps (Rodwell and Averis *et al*) there is no recorded locality for this

community between the Scottish Highlands and Southern Uplands, with only a few coastal locations in the south-west, which might demonstrate that this is an unusual community for its location but the maps are probably lacking data.

M17c *Scirpus cespitosus* (*Tricophorum germanicum*)-*Eriophorum vaginatum* blanket mire, *Juncus squarrosus-Rhytidiadelphus loreus* sub-community

Survey observations

This community is co-dominant with the M18a *Erica tetralix-Sphagnum papillosum* community across the entire site, occupying a slightly higher position around the M18a community. There remains a distinctive mat of sphagnum in the ground layer, although the composition of the M17c community is different from the M18a/M2b complex; *S. magellanicum* was not recorded, and *S. papillosum* and *S. cuspidatum* were only recorded as occasional. The contrast of the overlying associates between the two communities is quite different; ericoid shrub species are more vigorous and numerous in the M17c community, the presence of Hare's-tail Cottongrass *E. vaginatum* is much reduced and Deergrass *T. germanicum* is dominant, a species which is largely absent from the M18a community. The presence of *T. germanicum* in late autumn is particularly noticeable, a time when the green leaves turn golden-brown and add colour to the lost summer bloom of the field layer. There is often a fairly short transition between the two communities where *T. germanicum* is found around the margins of the M18a community.

Literature references

This sub-community is described (Rodwell, vol. 2 p174 & p178) as blanket mire of lower altitudes with a strongly western distribution. There is no record for the M17 community in lowland eastern Scotland on the distribution maps of Rodwell and Averis *et al*, and the same comments about distribution can be made as those relating to the M15d community. Because both of these communities were recorded elsewhere in the Ochils during this survey, this area appears not to have been surveyed in the past, or records for communities which were made have not been mapped.

The M17 community is said to receive almost all of its nutrients from precipitation (Averis *et al*, p 180). The authors also say: "Because it is so rare globally, *Trichophorum-Eriophorum* mire [M17] is one of the most important types of British upland vegetation. Lindsay *et al*. (1988) estimate that 13% of the blanket bog in the world occurs in Great Britain and Ireland: this includes *Erica-Sphagnum papillosum* [M18] and *Calluna-eriophorum* [M19] mires, as well as *Trichophorum-Eriophorum* [M17] mires."

M18a *Erica tetralix-Sphagnum papillosum* raised and blanket mire, *Sphagnum magellanicum –Andromeda polifolia* sub-community

Survey observations

As discussed above, the M17c and M18a communities across the mire are co-dominant. The majority of the M18a community lies at levels slightly below the M17c community where there can be a transition between the two communities, particularly in the frequency of Deergrass *T. germanicum*, which is absent from most of the M18a community, and its occurrence is usually at the edge of this community where its frequency increases in the

transition to the M17c community. The edges of the M18a community are also where other species occur, the majority of the community having few associates. The highest frequencies recorded for Cranberry *V. oxycoccos*, were in this community, either sprawling across the bog surface or over hummocks. This species was recorded in only one of the M17 communities.

S. magellanicum is found frequently in the M18a community across the mire, and similarly *S. papillosum*, which is probably commoner. They form hummocks along with *S. capillifolium*, which are often colonised by other species, particularly Cranberry *V. oxycoccos* and the moss *Polytrichum strictum.* Where Hare's- tail Cottongrass *E. vaginatum* and Purple Moor-grass *Molinia caerulea* occur in this community they do not form tussocks and are represented by diffuse shoots, and more especially by the latter as single shoots.

On the attached map in appendix 1, the M18a community is shown in a complex with the M2b complex, because the boundaries between the two are very hard to distinguish, and they have been considered together in appendix 2 as the M18a community.

Literature references

Rodwell, vol. 2 p 184 states that Cranberry *V. oxycoccos*, has a strong association with the M18 community in Britain. This species becomes less frequent in Scotland north of the Glenquey site, its distribution becomes restricted to the Central Highlands in the north, and it is currently not recorded from mainland Scotland north of the Great Glen (Preston, Pearman and Dines *et al* 2002, p 293).

The M18 community is said to be "pre-eminently a community of raised bogs", but not exclusively (Rodwell, vol. 2 p 186) and conditions of the raised bog "approaching those of the blanket bog" are described (p 190). These conditions are matched at Glenquey where the M18 community is central and the M17 peripheral, and the transition from the M18 community to other mire communities is marked by the continuity of the same species between communities, but in changing levels of abundance. This suggests that the M18a community is the climax vegetation of this site.

M18b *Erica tetralix-Sphagnum papillosum* raised and blanket mire, *Empetrum nigrum ssp. nigrum-Cladonia spp. sub-community*

Survey observations

This sub-community is quite different from theM18a sub-community and is marked by the dominance of tall Heather *C. vulgaris* and the only records for Crowberry *Empetrum nigrum* for the site. The M18b community is quite different from the M17c community dominated by Deergrass *T. germanicum*, with the herbs Tormentil *Potentilla erecta* and Milkwort *Polygala serpyllifolia* and from the M15d community by Mat-grass *Nardus stricta* and absence of Hare's- tail Cottongrass *E. vaginatum*. There is a close resemblance between this type of community and the M19 *Calluna vulgaris- Eriophorum vaginatum* blanket mire, which this was considered to be at first, but in comparison with the other blanket bogs in the area and with reference to texts, the vegetation features are thought to make a better fit with the M18b community. There is no doubt that the changes in the M18 community are caused by some drying out of the peat, such as at the west end of the site.

Photo 6: Sphagnum Hummock. *S. papillosum* has been colonised by the green tussocky shoots of *P. strictum*; Common Cottongrass *E. vaginatum* is in flower on the left side of the photograph, shoots of Common Cottongrass on the right, and shrubby shoots of Cross-leaved Heath *Erica tetralix* poke out of the top among the fruiting capsules of the Polytrichum moss.

M25a *Molinia caerulea-Potentilla erecta* mire, *Erica tetralix* sub-community

Survey observations

This community is found slightly higher than neighbouring communities and forms a continuum with them, although there can be an abrupt difference in height with the wetter end of the vegetation continuum, such as on the east – west running ridge, where at NN9880 0368 there is a drop in height of about one metre between the M25a above and M18a below. The difference in height is due to the underlying topography, and in these locations the M25a community has probably developed separately, much in the same way that the M25a community on the lower slopes of Auchlinsky Hill have developed separately. On Glenquey Moss where this community is found adjacent to other bog communities, such as on the north and east sides of the site, and at the north-west and south-west corners,

where there are extensive patches, the community has probably arisen from the modification of others by loss of moisture from the underlying peat, as may be seen on other bogs.

Literature references

The distribution maps in Rodwell and Averis *et al* would seem to demonstrate that this is a rare community in Central-eastern Scotland, but there are fairly extensive stands in the Ochils, and again there appears to be a lack of data expressed in the mapping. This community is not without its conservation interest : "These tussocky grasslands are also among the most important upland habitats for Field *Voles Mictous agrestis*, which in turn sustain populations of Short-eared Owls *Asio flammeus*, Kestrels *Falco tinnunculus* and Hen Harriers *Circus cyaneus"* (Averis *et al)*.

***U5b Nardus stricta – Galium saxatile* grassland**

This community was quite distinctive with the glaucous, spreading shoots of Carnation Sedge *Carex panacea* forming a continuous cover in the vegetation. It was sampled on the southern margins of the bog and found again on the drier peat margins in a similar situation on the north side. This was a difficult community to classify, but it fits best with the description as a transition from the M17 community (Rodwell , vol. 3 p 359).

3.2 Peat associated vegetation in Glen Quey

Glenquey Hill and Auchlinsky Hill on the north and south sides of Glenquey Moss were examined to find out if there were any similar plant communities to those found on the Moss. On the Ordnance Survey First Edition map the location of Peat Hill is shown at the 1,250' (381m) contour, NN976 043. Peat Hill is to the north of Glenquey Hill and is now under conifer plantation, but the plant community was probably continuous with Glenquey Hill.

The dry heath community H12 *Calluna vulgaris -Vaccinium myrtillus* of the typical sub-community occurs on some of the lower slopes of Glenquey Hill. Deergrass *T. germanicum* is found upwards from 394m aod at NN9818 0410 and increases in frequency beyond that height. A depth of 150mm of peat was found below the path at 430m aod ; the broad shoulder of the hill at this level and beyond has fairly extensive peat. Sphagnum mosses growing beside the path around this height were *S. cuspidatum* and *S. russowii*. *S. capillifolium* was frequent in the heath vegetation a little higher up among Heather *C. vulgaris*, Deergrass *T. germanicum*, Wavy Hair-grass *D. flexuosa,* Cowberry *V. vitus-idaea* , Hard Rush *Juncus squarrous* and where the mosses *Polytrichum commune*, *Pleurozium schreberi* and *Hylocomium splendens* were found.

The lower slopes of Auchlinsky Hill are dominated by the M25a *Molinia caerulea-Potentilla erecta* mire. In Autumn and Winter the golden brown shoots of Purple Moor-grass can be seen covering these slopes from quite a distance. Patches of M15 *Scirpus cespitosus* (*Tricophorum germanicum*)-*Erica tetralix* wet heath occur locally, such as at NN9889 0346, 351m aod, where Deergrass *T. germanicum* and Heather *C. vulgaris* become frequent, with a little Cross-leaved Heath *E. tetralix* and also Hard Rush *Juncus squarrous*, Blaeberry *V. myrtillus* and Bog Asphodel *Narthecium ossifragum.* Sphagnum mosses include *S. capillifolium*.

3.3 Records of other species made during survey

On 6th May, three Short-eared Owls *Asio flammeus* were seen over the site, one flew in from the north and was countered by two flying in from the south, suggesting a territorial encounter. There is a strong possibility that this species breeds on the site. Other surveyors visiting the site during the survey period found owl pellets at feeding stations. Sand martins *Riparia riparia* appeared overhead on the same day.

On 3rd June, five Lapwings *Vanellus vanellus* were seen at the same time, with three calling and patrolling territory at NN 9886 0365, suggesting at least two nesting territories. One pair of Mallard *Anas platyrhynchos* alighted on the wetter ground on the south of the site, one pair of Curlew *Numenius arquata* arose from east of the mound on the west of the site and I was mobbed by a pair of Common Gull *Larus canus* at NN 9868 0352.

One Common Snipe *Gallinago gallinago* was flushed in alarm from an area of rush at NN 9891 0384. Other snipe were flushed during the survey period, one or two at the same location on 10th August, a solitary snipe at NN9862 0361on 8th September and seven on 21st October within an area 200m x 100m near the centre of the bog. SNH noted the presence of snipe on the site in the winter of 2010/11 and the site appears to be important for breeding, passage and wintering for this species.

Singing Skylarks *Alauda arvensis* were present across the site, and what was noticeable was that there was none beyond, because the grass is too short and holds no cover. Meadow Pits *Anthus pratensis* were also heard. On 13th August two kestrels were seen hovering at the south-east end of the site and swallows were seen feeding overhead.

Black Darter Dragonfly *Sympetrum danae* (seen on the front cover) were on the wing on 13th August over the south side of the site and one was seen on 8th September. On 13th August a pair of Wood Tiger moths *Parasemia plantaginis* were mating on the south side of the site. The sightings of both these insect species appear to be the first for this 10 x 10km square in which Glenquey Moss is located.

Short-eared Owl is listed in Annex I of the European Birds Directive 2009/147/EC as amended and the condition of the European population is currently listed as unfavourable. The European Birds Directive was adopted “as a response to increasing concern about the declines in Europe's wild bird populations resulting from pollution, loss of habitats as well as unsustainable use. The directive recognises that habitat loss and degradation are the most serious threats to the conservation of wild birds. It therefore places great emphasis on the protection of habitats for endangered as well as migratory species (listed in Annex I), especially through the establishment of a coherent network of Special Protection Areas (SPAs) comprising all the most suitable territories for these species” (EC website).

The UK’s leading bird conservation organisations have used population trend data and European conservation concern listings to identify species at risk, the greater being a red listing and the lesser an amber listing. Short-eared Owl , Skylark and Lapwing are on the on the red list and Meadow Pipit, Snipe, Curlew, Common Gull and Mallard are on the amber list. The RSPB reports “the UK population of snipe has undergone moderate declines overall in the past twenty-five years, with particularly steep declines in lowland wet grassland”, that lapwing “has suffered significant declines recently”, that skylarks have suffered “ recent and dramatic population declines” and “Meadow pipit numbers in the UK have been declining since the mid-1970s”.

All but Common Gull and Mallard are breeding species on the site, but have the potential to do so. Some of the breeding species have other listings, such as being included in the UK Biodiversity Action plan. All birds, their eggs and nests are protected under the Wildlife and Countryside Act 1981 as amended. The only exception for those recorded here would be Mallard and Snipe outside the closed season.

Appendix 3 of this report provides a list of invertebrates collected by David Pryce in 2011 and 2012. One of these species is on the UK Red Data List, and one is on the Scottish Biodiversity List and the Clackmannanshire Local Biodiversity Action Plan. The distribution in Scotland of the remaining beetle species were provided by Adam Garside who identified the collection; one is sparse, two are local, three are very local and one has been recorded only in south-west Scotland previously. The array of unusual species for the site demonstrates that Glenquey Moss is very important for invertebrates, which is also supported by a recent survey of spiders. These surveys are by no means a complete survey of the site, and several unusual species would likely to be found if further surveys were undertaken. Many of the species included in appendix 3 have a very strong affinity for wetland habitats, and Glenquey Moss reflects the importance of the site as a natural wetland in a wider area which is otherwise free-draining.

The sum of plant communities, vertebrates and invertebrates demonstrates that the site is very important for conservation and biodiversity

4. SURVEY OF BLANKET BOGS IN THE OCHIL HILLS AND RAISED BOGS IN PERTH & KINROSS

4.1 Blanket Bogs

In order to put Glenquey Moss in the context of other bogs in the area, a survey was carried out between 6th and 17th November, covering two of the blanket bogs in the Ochils and all of the raised bogs listed in *An Inventory of lowland raised bogs in Great Britain* (Lindsay and Immirizi, 1996).

Bald Hill NN 926 036

This hill lies to the south of Lower Glendevon Reservoir reaching 500m aod. An area of wet heath, M15 *Scirpus cespitosus* (*Tricophorum germanicum*)-*Erica tetralix* of the typical community grows at the bottom of the hill on a fairly steep slope at NN9327 0438, 313m aod. The wet heath is dominated by Deergrass *T. germanicum* which overtops Heather *C. vulgaris* that is almost equally dominant. Hard Rush *J. squarrous* was fairly extensive, a little more so than Purple Moor-grass *M. caerulea* which was equal in cover to Mat-grass *N. stricta* and a little more so than Wavy Hair-grass *D. flexuosa* and Bent Grass *Agrostis* sp. The sphagnum cover was almost continuous, composed largely of *S. capillifolium*.

Blanket bog starts at NN9267 0406, 431m aod on Bald Hill. On Wether Hill opposite, blanket bog starts at a similar lower limit of 470m aod, and extends eastwards along tops and on the sheltered less steeper slopes in broken patches, ending at about 400m aod on Common Hill. On Berry Hill opposite, to the south, remains of blanket bog start at about 450m aod.

On the raised peat of the blanket bog of Bald Hill, Heather *C. vulgaris* and Deergrass *T. germanicum* are dominant with Hare's-tail Cottongrass *E. vaginatum* reduced to about 10% cover. Cross-leaved Heath *E. tetralix,* Blaeberry (*V. myrtillus,* Wavy-hair Grass *D. flexuosa* and Bog Asphodel *Narthecium ossifragum* were frequent, with Crowberry *E. nigrum* ssp. *nigrum* Hard Rush *J.squarrosus* and Common Cottongrass *E. angustifolium* occasional at low cover. Sphagna were well represented; *S. papillosum* and *S. capillifolium* were frequent at low cover, *S. magellanicum* occasional at low cover, but greater in cover than *S. fallax* and *S. tenellum*. This represents the M17 *Trichophorum germanicum – Eriophorum vaginatum* blanket mire, and in particular the M17c *Juncus squarrosus - Rhytidiadelphus lorreus* sub-community.

On lower peat immediately below this community there were expanses of U2 *Deschampsia flexuosa* grassland of the *Festuca ovina – Agrostis capillaris* sub-community. Bent grass *Agrostis* sp. was dominant with more than twice the cover of Wavy-hair Grass *D. flexuosa* ; Mat-grass *N. stricta* and Sheep's Fescue *Festuca ovina* were occasional at low cover and Tormentil *P. erecta* and Heath Bedstraw *Galium saxatile* were frequent at moderate cover. Mosses were represented by *Polytrichum commune*, *Pleurozium schreberi*, *Psuedosclerum purum* and *Rhytidiadelphus squarrosus*.

Photo 7: M17c *Trichophorum germanicum – Eriophorum vaginatum* blanket mire on the slopes of Bald Hill. Weather Hill is seen opposite with a broken mantle of blanket bog on the less steep eastern flank. The bright golden colour of the U2 *Deschampsia flexuosa* grassland can be seen below the edges of the peat hags.

From NN9261 0375 at 483m aod to the summit of Bald Hill the blanket bog community shifted to M20 *Eriophorum vaginatum* blanket mire. A sample at this point revealed 70% cover by Hare's-tail Cottongrass *E. vaginatum* with Wavy-hair Grass *D. flexuosa* and Bent Grass *Agrostis* sp. frequent at low cover. Heather *C. vulgaris*, Deergrass *T.*

germanicum, Blaeberry *V. myrtillus*, Common Cottongrass *E. angustifolium* and Tormentil *P. erecta* were occasional at very low cover. Moss cover exceeded the vascular plant cover except for Hare's-tail Cottongrass; *S. papillosum* and *Polytrichum commune* were the most frequent with the greatest cover, followed by *P. strictum* and *S. cuspidatum* and then *Aulocomnium palustre*. Elsewhere *S. papillosum* and *S. capillifolium* were seen in their hummock form and *S. capillifolium* was found growing among the vegetation at the summit of the hill.

Third Hill and Mellock Hill

These hills lie to the north-east of Glenquey. On the lower slopes of Third Hill after the B934 at the South Queich Burn, a number of mire communities are present along the fence-line reflecting differences in pH levels and wet heath appears at the bottom at NO0135 0681 at 284m aod. The next level of sphagnum community is M20 *Eriophorum vaginatum* blanket mire extending down the north hollow of the slope to 374m aod at NO0176 0685 from 399m aod at NO0193 0670. The M20 community also extends upwards around the east shoulder of Mellock Hill to meet rising blanket bog at 413m aod at NO0227 0662.

The M20 community was sampled at NO0193 0670. It was similar to but poorer in composition than the community sampled on Bald Hill. Hare's-tail Cottongrass *E. vaginatum* was at 85% cover with Wavy-hair Grass *D. flexuosa* frequent at low cover and Heather *C. vulgaris*, Heath Bedstraw *G. saxatile*, Blaeberry *V. myrtillus* and Cowberry *V. vitus-idaea* occasional at very low cover. The only two sphagna represented were *S. cuspidatum* with the same cover as Wavy-hair Grass and S. *capillifolium* much less so, but among the mosses *Pleurozium schreberi* was almost as common as *S. cuspidatum* ; *Aulocomnium palustre* and *Hypnum jutlandium* were present at very low cover.

Photo 8: Peat hags of M19b *Calluna vulgaris* – *Eriophorum vaginatum* blanket mire at the foot of Mellock Hill and M20 *Eriophorum vaginatum* blanket mire in the hollow near the summit of Third Hill and capping higher ground to the right.

The blanket bog on the raised peat which extends to just short of the summit at 465m aod is generally very dried out. Sometimes Heather *C. vulgaris* and Hare's-tail Cottongrass *E. vaginatum* are co-dominant and sometimes Heather is dominant. Deergrass *T. germanicum* is restricted to hollows and sheltered slopes of exposed peat. Purple Moor-grass *M. caerulea* was scarce and sphagna were restricted to gentler slopes and the protected bases of exposed peat banks. Sphagna were also infrequent; *S. capillifolium* was the commonest with *S. cuspidatum*, the latter on very wet peat, *S. magellanicum* was very scarce and *S. papillosum* rare. Vascular plant associates were few and restricted and included Wavy-hair Grass *D. flexuosa*, Blaeberry *V. myrtillus*, Cross-leaved Heath *E. tetralix*, Heath Bedstraw *G. saxatile* and Crowberry *E. nigrum* ssp. *nigrum*. *Pleurozium schreberi* often formed extensive cover greater than any of the lesser associates. *Aulocomnium palustre*, *Hypnum jutlandium* and *Rhytidiadelphus loreus* were recorded at very low cover. The co-dominance or dominance of Heather in this community reflects the nature of this M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire and specifically the M19b *Empetrum nigrum* ssp. *nigrum* community.

4.2 Raised Bogs

Table 2. Comparison of Inventory data and survey of sites in Perth & Kinross

			Area in Hectares				
Site	**Grid Ref**	**Peat**	**Site**	**Bog**	**Good Bog**	**Degraded**	**Restoration**
Raised Bog							
Glenquey Moss	NN986036	11	15.00	11.80	11.20	0.60	
Claysike Moss	NO035021	29	6.53	5.24	3.44	1.80	
Crook Moss	NO040001	13	11.52	10.16	10.16		
Muirhead Moss	NT000950	5	18.00			18.00	
Muirmill	NS994960	1		0.00			
Powmill	NT021974	27		0.00			
Lambhill Moss	NT004955	2		0.00		7.51	
Whitegates Moss	NS994968	3		0.00			
Coldrain Farm Wood	NO088001	13	8.41			8.41	
Coldrain Meadow	NO090006	17		0.00			
Red Moss Wood	NT131976	25	11.53			8.75	
Waterbutts Plantation	NT146989	6	21.33				10.00
Portmoak Moss	NO180014	198	43.18				14.35
Bog Wood	NO920091	14	8.55	0.00			
Shelforkie Moss	NN860091	57	111.37	111.37	79.00	31.63	
Methven Moss	NO010235	142	83.70	74.00	74.00		
Connachan Marsh	NN895268	9	23.31	9.00	9.00		
Cairnleith Moss	NO076367	17	80.66	5.00	5.00		
Totals		589		**226.77**	**192.60**	**76.70**	**24.35**

Intermediate Bog					
Dun Moss	NO183565	258	130.81	130.81	**130.81**

Surveys of the raised bogs were conducted by a mixture of site visits, aerial photography and available literature, especially *An Inventory of lowland raised bogs in Great Britain* (Lindsay and Immirizi, 1996). The Inventory has to be read very carefully, because the sites listed as raised bogs include former bogs as well as ones that are extant, and while the Inventory provides some information on condition, it is far from complete. The area of peat shown in the Inventory is derived from the British Geological Survey mapping of drift cover and from other sources. What was found during the current survey was that the area of bog was often less than the area of peat, and sometimes there was no bog at all. The results of the current survey are shown in table 2 above.

Table 3. Current condition of the bogs identified in the Inventory in Perth & Kinross

Site	Grid Ref	
Raised Bog		
Glenquey Moss	NN986036	Active blanket bog
Claysike Moss	NO035021	Active raised bog, birch scrub, deep tree shading
Crook Moss	NO040001	Active raised bog, birch scrub, small area of fen
Muirhead Moss	NT000950	Wooded
Muirmill	NS994960	Wooded
Powmill	NT021974	No bog, extensive area of rush pasture
Lambhill Moss	NT004955	Wooded
Whitegates Moss	NS994968	Wooded
Coldrain Farm Wood	NO088001	Wooded
Coldrain Meadow	NO090006	Bog lost by the time the Inventory was published
Red Moss Wood	NT131976	Peat deeply drained & colonised by thick birch stand
Waterbutts Plantation	NT146989	Bog restoration in progress
Portmoak Moss	NO180014	Bog restoration in progress
Bog Wood	NO920091	Wooded or not bog
Shelforkie Moss	NN860091	Active raised bog
Methven Moss	NO010235	Active raised bog
Connachan Marsh	NN895268	Active raised bog
Cairnleith Moss	NO076367	Active raised bog
Intermediate Bog		
Dun Moss	NO183565	Active raised bog

Table 3 summarises the condition of the bogs included in the current survey. An account of each site follows, except Glenquey Moss which has been covered already. Sites have been grouped by geographical area; those to the south of the Ochils have been grouped with Glenquey.

John Bell's 1796 map of the County of Kinross available on the National Library of Scotland website gives a good indication of the extent of raised bogs in the area at that time. http://maps.nls.uk/counties/detail.cfm?id=628 . Not all of the sites shown above are mapped by Bell; the raised bogs of Coldrain and Claysike are not shown. A 15ha raised bog to the west of the Waterbutts Plantation site shown on the map has since been destroyed, and all that remains is the black peaty residue on the mineral soil. There is no comparative map for the Perthshire raised bogs sites, at least none is available on the NLS website.

The extent of the raised bogs on Bell's map was compared to modern OS data and measured using GIS. The measurements of the historic extent are approximate, because the background features useful for comparative reference points are not always consistent between the two sets of mapping. Comparative results are provided in the following table.

Table 4. Comparison of site coverage using Inventory data and historic and modern mapping

		Site Extent in Hectares		
Site	**Grid Ref**	**Site 1796**	**Peat 1996**	**Site 2012**
Raised Bog				
Crook Moss	NO040001	67.00	13.00	11.52
Red Moss Wood	NT131976	22.00	25.00	11.53
Waterbutts Plantation	NT146989	47.00	6.00	21.33
Portmoak Moss	NO180014	275.00	198.00	43.18
Totals		411.00	242.00	87.56

The type and condition of the bogs are not possible to determine from the historic mapping, but an account of the Scotlandwell Moss from about the same time as Bell's map indicates what it would have been like. The measurement given above for Portmoak Moss is for the larger Scotlandwell Moss, Portmoak Moss now being the only remainder. The Commonty of Scotlandwell Moss was used for grazing, turf and peat (Munro, 1994). Exploitation of the peat can also be found from this reference.

Comparison of mapping over a 200 year period demonstrates the loss of raised bog by human exploitation during that time and helps to support some of the peat soil data in the 1996 Inventory.

4.3 Surveys of Inventory Sites

Claysike Moss, NO 035 021

Survey methods:	Site visit, aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 29.00 ha	Site: 6.53 ha	Good bog: 3.44 ha	Poor bog: 1.80 ha	Elevation: 170m+

This site (it is spelled 'Claysyke' on OS maps) is located between Carnbo and Yetts o' Muckhart, just off the A91. There is a deep ditch on the north and east boundaries of the site draining the bog. The northern edge of the bog has

been planted with Sitka Spruce *Picea sitchensis* and Scots pine *Pinus sylvestris* and birch has colonised this area. The ground cover is made up of Blaeberry *V. myrtillus* Heather *C. vulgaris* and Wavy Hair-grass *Deschampsia flexuosa* with some *Sphagnum palustre*. Where the tree cover opens out there are criss-crossing drains in the peat where *S. cuspidatum*, *S. fallax*, *S. fimbriatum* and *Polytrichum commune* grow with Bottle Sedge *Carex rostra*.

A bog community extends under a canopy of Downy Birch *Betula pubescens* to the south of a deeper ditch and into the open as the canopy thins out. This community is predominant over most of the ground on the north side of another ditch, which runs North-West to South-East, and it is wider and deeper than the other. Well developed Heather *C. vulgaris* and Hare's-tail Cottongrass *E. vaginatum* are co-dominant with patches of Crowberry *E. nigrum* ssp. *nigrum*; Cross-leaved Heath *E. tetralix* is at a low frequency, but Cranberry *V. oxycoccos* is frequent across this community. The commonest sphagnum species is *S. capillifolium*, but only a little more so than *S. magellanicum*, which is frequent over open or semi-open ground. *S. fallax* reaches a similar frequency, but *S. papillosum* is infrequent, being encountered mostly on the east side of the site. These components match the M18b *Erica tetralix-Sphagnum papillosum, Empetrum nigrum ssp. nigrum – Cladonia* sub-community of the National Vegetation Classification.

Photo 9: The contrast between the M18b *Erica tetralix-Sphagnum papillosum, Empetrum nigrum ssp. nigrum – Cladonia* sub-community in the foreground and the M25 *Molinia caerulea-Potentilla erecta* community in the background is very apparent on Claysike Moss, with birch scrub and a strip of planted conifers immediately behind.

There is a little Deergrass *T.germanicum* at the north-west end of the wide, deep ditch, but nowhere else. On each side of this and on much of the south side of the ditch Purple Moor-grass *M. caerulea* is dominant in a species poor M25 *Molinia carulea-Potentilla erecta* community. This grades to Soft-rush *J. effusus* with some Common Bent *Agrostis capillaris* and Brown Bent *A. vinealis* at the edge.

Crook Moss, NO 040 001

Survey methods:	Site visit, aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 13.00 ha	Site: 11.52 ha	Good bog: 10.16 ha	Poor bog: 0	Elevation: 150m+

This site on the south side of Crook of Devon is much more complex than Claysike Moss. The north and south boundaries of Crook Moss are lined with a scattering of planted trees and beyond this planting is wet birch woodland with some *S. palustre* at least on the north side. The site is modified on the north-east side where grasses and rushes are surrounded by willows and alder. The remains of the former railway cut the site in half, the railway line has been colonised by birch, grasses and herbs, and below the line on each side are water-filled ditches with *S. fallax*. A ditch on the south boundary drains the ground there, and excess rainwater runs off the bog on the north side into the adjacent fields. There is local, substantial drying of the peat on the south-west side where Wavy Hair-grass *D. flexuosa* and Bottle Sedge *C. rostrata* are found in quantity.

There are two levels of peat on each side of the railway line, the central core was cut through when the railway line was built, and the core is about one metre higher than the surrounding lower level. On the north side of the railway line the lower bog community is equally dominated by Heather *C. vulgaris* and Hare's-tail Cottongrass *E. vaginatum*. Peat building sphagnum species were infrequent, and in the wet hollows around cottongrass tussocks, *S. fallax* was the commonest sphagnum by far with *S. capillifolium* still frequent, but *S. papillosum* was only observed at one location. Cranberry *V. oxycoccos* was found at one location only, on the east side of this community at the edge of the interface with the higher peat. The community at the lower level on the wetter peat appears to be a degraded M18 *Erica tetralix-Sphagnum papillosum* NVC community that is affected by run-off and influx of nutrients from standing water.

In contrast, the higher level of bog has a much thicker cover of Heather *C. vulgaris* and reduced cover of Hare's-tail Cottongrass *E. vaginatum*. Scattered shoots of Common Cottongrass *E. angustifolium* occur and the sphagnum cover is fairly continuous with an extended range of species; *S. fimbriatum* and *S. tenellum* reflecting exposure and breaks in the peat. Other mosses become more important, including *Hypnum jutlandicum*, *Aulocomnium palustre* and the frequency of *Polytrichum strictum* increases from the lower bog.

There is a similar situation on the higher bog on the south side of the railway line, although the sphagnum cover is less frequent and sometimes absent. Only along the south-western edges of the higher bog are *S. magellanicum* and *S. papillosum* found in localised patches with *S. capillifolium* and *S. fallax*, which are also found on the higher bog with *S. fimbriatum* and *S.tenellum.*

The south-east corner of the lower bog has an area of Downy Birch scrub *B. pubescens*, where Blaeberry *V. myrtillus* and Cross-leaved Heath *Erica tetralix* share the ground cover with Hare's-tail Cottongrass *E. vaginatum* ; Heather *C. vulgaris* is largely absent. Crowberry *Empetrum nigrum* ssp. *nigrum* appears where the edge of this community is drying out and beyond this the birch scrub opens out. This is where the best preserved M18 *Erica tetralix-Sphagnum papillosum* community is to be found. Hare's-tail Cottongrass *E. vaginatum* makes up 80% of the ground cover, Cross-leaved Heath *E. tetralix* is frequent at low cover and Heather *C. vulgaris* remains scattered. *S. fallax* is the commonest sphagnum, S*. magellanicum* is frequent, *S. capillifolium* is occasional and *S. papillosum* is rare and is generally infrequent across the whole site.

Hare's-tail Cottongrass *E. vaginatum* on the south edge at one point is shaded under taller birch canopy and solid sheets of *S. fallax* and S*. magellanicum* spread out on the ground beneath. On the lower ground below the peat that has dried out next to self-sown Scots Pine *P. sylvestris*, the proportion of cover of Heather *C. vulgaris* to Hare's-tail Cottongrass *E. vaginatum* varies from co-dominant to dominant.

Photo 10 Crook Moss: The red and green tones of a hummock of *Sphagnum capillifolium* are interspersed with shoots of Cross-leaved Heath *E. tetralix,* and behind and in the inset is *S. magellanicum.*

Generally, drying of the peat on the higher level of the bog reflects a degraded M18b *Erica tetralix-Sphagnum papillosum* raised mire community. Although all the bog of Crook Moss has been described as "good", much of its nature is degraded, but not to the extent where it has been replaced by the M25 *Molinia caerulea-Potentilla erecta* community.

Muirhead Moss, NT 000 095

Survey methods:	Aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 5.00 ha	Site: 18.00 ha	Good bog: 0 ha	Poor bog: 18.00 ha	Elevation: 100m+

Time has not permitted every site to be surveyed, but the wood is seen to be almost entirely wooded from aerial photographs, with a combination of planted trees and birch scrub. This is reflected in comments provided in the Inventory. The ground conditions would be expected to be similar to the account of Red Moss Wood which follows, where little sphagnum cover remains.

Muirmill, NS 994 960

Survey methods:	Aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 1.00 ha	Site: 1.00ha	Good bog: 0 ha	Poor bog: 0 ha	Elevation: 100m+

This small area is wooded and contiguous with other woodland. This is reflected in comments provided in the Inventory. The ground conditions would be expected to be similar to the account of Red Moss Wood which follows.

Powmill, NT 021 974

Survey methods:	Roadside visit, aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 27 ha	Site: 27ha	Good bog: 0 ha	Poor bog: 0 ha	Elevation: 80m+

This site is located to the south of the village beside the A823 and was recognised as having no remaining bog at the time the Inventory was published. The relatively flat area lies in a depression that is now largely an expanse of marsh dominated by Soft-rush *J. effusus*. The original bog probably extended across both sides of what is now the road.

Lambhill Moss, NT004 955

Survey methods:	Roadside visit , aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 2.00 ha	Site: 7.51ha	Good bog: 0 ha	Poor bog: 7.51ha	Elevation: 120m+

This small area is wooded and contiguous with other woodland. This is reflected in comments provided in the Inventory. The grid reference for the centre of this bog is more accurately given as NT005 956.

Whitegates Moss, NS994 968

Survey methods:	Aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 3.00 ha	Site: 3.00ha	Good bog: 0 ha	Poor bog: 0 ha	Elevation: 135m+

This small area is wooded and contiguous with other woodland. This is reflected in comments provided in the Inventory.

Coldrain Farm Wood, NT 000 095

Survey methods:	Roadside visit, aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 13.00 ha	Site: 8.41 ha	Good bog: 0 ha	Poor bog: 8.41 ha	Elevation: 135m+

This site has been planted with Scots pine *P. sylvestris* and Beech *Fagus sylvatica*, the remainder of the site has been colonised by Birch *Betula* sp. and there is a spread of Rhododendron *Rhododendron ponticum* along the western boundary. This is reflected in comments provided in the Inventory. The ground conditions would be expected to be similar to the account of Red Moss Wood which follows, where little sphagnum cover remains.

Coldrain Meadow, NO 090 006

Survey methods:	Aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 17.00 ha	Site: 17.00ha	Good bog: 0 ha	Poor bog: 0 ha	Elevation: 80m+

This site was recognised as having no remaining bog at the time the Inventory was published, a position that can be recognised from aerial imagery.

Red Moss Wood, NT 131 976

Survey methods:	Site visit, aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 25.00 ha	Site: 11.53 ha	Good bog: 0 ha	Poor bog: 8.75 ha	Elevation: 125m+

One of the grid references in the Inventory is incorrect, NT181995. The area measurement for this location has been included with the other part of the site at the grid reference given in the Inventory. The Inventory records both sites as wooded and the bog vegetation to have been lost.

The site is located to the south of Loch Leven, just off the B996, and is divided by a deep ditch running East to West, with higher ground up to 14m above to the south, dominated by wet grassland, willow and other scrub. The lower level is occupied by a layer of peat which is crossed by ditches; drains remain to the west along the line of the former railway and a deep drain provides the northern boundary where water flows out of the site.

The canopy of the peat level is dominated almost solely by Downy Birch *B. pubescens* with an almost equally dominant sole cover of Broad Buckler-fern *Dryopteris dilatata* in the field layer. The commonest moss is *Polytrichum commune* and the commonest sphagnum is *S. squarrosum*. *S. cuspidatum* grows in the water-filled ditches and *S. squarrosum* grows along the edges of the ditches. Other mosses encountered were *Hypnum jutlandicum* and *Rhytidiadelphus lorreus*. An NVC community description cannot be applied to this area, its original bog vegetation has gone, but the peat remains suitable for restoration to something approaching the original vegetation cover.

Photo 11: Red Moss Wood. The lack of diversity is a sad reflection of what the former cover would have been like. *Sphagnum squarrosum* (inset) growing by the ditches is one of the few plants to be seen at ground level.

Waterbutts Plantation, NT 146 989

Survey methods:	Aerial photography (Google Earth), measurements using GIS.		
Peat Inventory: 6.00 ha	Site: 21.33ha	Bog restoration :10.00ha	Elevation: 110m+

This site at Vane Farm on the reserve of the Royal Society for the Protection of Birds was cleared of its trees, and the restoration of the bog vegetation began in 1996. The RSPB Site Manager described the site as a surviving half dome of peat, and that the bog vegetation is in very poor condition. Ditches have been blocked to reduce water loss and raise water levels and there have been some successes, but there is a long way to go before the bog can be restored to something like a previous condition of bog vegetation. There is a constant battle against birch and willow regeneration that colonise the peat surface; applying herbicides and grazing by Jacob's Sheep have been used to keep this under control.

Portmoak Moss, NO 180 014

Survey methods:	Site visit, Woodland Trust data, aerial photography (Google Earth), measurements using GIS.		
Peat Inventory: 198.00 ha	Site: 43.18ha	Bog restoration : 14.35ha	Elevation: 110m+

Photo 12: Portmoak Moss. The results of the bog regeneration are very encouraging, sphagnum is filling in the ditches and the drains; the drains have been blocked with plastic shuttering to raise water levels in the peat.

This site was cleared of its trees by the Woodland Trust, which is working with the Portmoak community to restore bog vegetation to the site. There are a number of records stretching over centuries relating to peat extraction, which continued actively until the 1960s. This was followed by tree planting, including Scots Pine *P. sylvestris,* Lodgepole Pine *P. contorta* and Sitka Spruce *Picea sitchensis*. Downy Birch *B. pubescens* colonised more open peaty soils and Grey Willow *Salix cinerea* colonised the wetter margins. On the lower levels the peat is criss-crossed by several drains and ditches, which can also be seen on the higher peat remains of the raised bog, the edges of which sometimes rise vertically over two metres where peat has been cut and removed.

The surface of the raised level of peat has been colonised largely by Wavy Hair-grass *D. flexuosa*, which ranges from dominant to co-dominant. Heather *C. vulgaris* is regenerating on the surface, but Cross-leaved Heath *E. tetralix* is very occasional. Hare's-tail Cottongrass *E. vaginatum* is restricted, but is regenerating in some places. Blaeberry *V. myrtillus* and the moss *Hylocomnium splendens* provide dominant patches at the edge of one ditch, elsewhere Blaeberry is found scattered as small shoots.

Sphagnum species encountered were: *S. cuspidatum* at the foot of the raised peat and in ditches; *S. papillosum* was frequent in the remains of shallow ditches and in the blocked drains or spreading out from them; *S. magellanicum* was almost as frequent as *S. papillosum*; *S. fimbriatum* and *S. capillifolium* were found at the edges of ditches and the latter was also frequent in the shallow ditches and also found pushing up through the Wavy Hair-grass, and *S. fallax* was also present across the site.

The regeneration of the sphagnum species is a heartening sight, but its continued growth will not be achieved without further management to control the spread of birch, conifers and other tree species across the site. Finding a suitable NVC community description for these plant communities is difficult, but good progress is being made in restoring the peat building M18 *Erica tetralix – Sphagnum papillosum* community.

Bog Wood, NO 900 091

Survey methods:	SNH data, Aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 14.00 ha	Site:8.55ha	Good bog: 0 ha	Poor bog: 0 ha	Elevation: 80m+

This site is situated to the south-west of Auchterarder, and has no remaining bog, but it has other botanical interest and for this reason is a Site of Special Scientific Interest.

Shelforkie Moss, NO 860 091

Survey methods:	Site visit, SNH data, Aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 57.00 ha	Site:111.37ha	Good bog:79.00ha	Poor bog: 31.63ha	Elevation: 105m+

This site is part of the Carsebreck and Rhynd Lochs Site of Special Scientific Interest lying to the west of Blackford, and Shelforkie Moss has been designated a Special Area of Conservation for its active raised bog and degraded raised bog still capable of natural regeneration. Measurements for areas of active and degraded bog cover have been estimated by using aerial mapping and GIS mapping and measurements.

The area of active raised bog is occupied by the M18 *Erica tetralix – Sphagnum papillosum* community. An area of the east bog surveyed showed that Hare's-tail Cottongrass *E. vaginatum* tended to be the dominant element of the field layer above the sphagnum, in places almost exclusively so and in others sharing the cover with ranging frequencies of Heather *C. vulgaris* ,where the latter becomes strongly dominant on drier areas of peat. Deergrass is restricted, *T. germanicum*, Crowberry *E. nigrum* ssp. *nigrum* can be frequent and Cowberry *V. vitus-idaea* was observed in a few places.

Methven Moss, NO 010 235

Survey methods:	Site visit, SNH data, Aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 142.00 ha	Site:83.70ha	Good bog:74.00ha	Poor bog: 0	Elevation: 35m+

Methven Moss has been designated a Special Area of Conservation for its active raised bog and degraded raised bog still capable of natural regeneration. The measurement for the area of bog cover has been estimated from previous knowledge of the site and by using aerial mapping and GIS mapping and measurements . Methven Moss is unusual in having White Beaked-sedge *Rhynchospora alba*, which is now very rare in Eastern Scotland.

Connachan Marsh, NN 895 268

Survey methods:	SNH data, Aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 142.00 ha	Site:23.31ha	Good bog:9.00ha	Poor bog: 0	Elevation: 230m+

This site is situated between Crieff and the Sma' Glen, and it has been designated a SSSI for its active raised bog and other mire and wetland communities. The measurement for the area of bog cover has been estimated by using aerial mapping and GIS mapping and measurements.

Dun Moss, NO 183 565

Survey methods:	SNH data, Aerial photography (Google Earth), measurements using GIS.			
Peat Inventory: 57.00 ha	Site:111.37ha	Good bog:79.00ha	Poor bog: 31.63ha	Elevation: 350m+

Dun Moss has been properly classified since the Inventory was published and forms part of the Dun More and Forest of Alyth Mires Special Area of Conservation. These are the combination of two Sites of Special Scientific Interest, the latter extending to 339.15 ha, which is largely raised bog.

5. CONCLUSIONS ON THE STATUS OF GLENQUEY MOSS

Annex I of the *European Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora*, known as the Habitats Directive lists the natural habitat types of Community interest. Two of these priority habitats are found on Glenquey Moss. The first is 7130 Blanket bog, which is active bog. The Joint Nature Conservation Committee of the UK defines active as "supporting a significant area of vegetation that is normally peat-forming. Typical species include the important peat-forming species, such as bog-mosses Sphagnum spp. and cottongrasses Eriophorum spp., or purple moor-grass *Molinia caerulea* in certain circumstances, together with Heather *Calluna vulgaris* and other ericaceous species. Thus sites, particularly those at higher altitude, characterised by extensive erosion features, may still be classed as 'active' if they otherwise support extensive areas of typical bog

vegetation, and especially if the erosion gullies show signs of recolonisation." JNCC recognises the following NVC communities as falling within this priority habitat:

- M17 *Scirpus cespitosus (Trichophorum germanicum) – Eriophorum vaginatum* blanket mire
- M18 *Erica tetralix – Sphagnum papillosum* raised and blanket mire
- M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire
- M20 *Eriophorum vaginatum* blanket and raised mire
- M25 *Molinia caerulea – Potentilla erecta* mire.

The M17, M18 and M25 communities on Glenquey Moss have sphagnum components, the most diverse are the M18 communities, the M17 and M25 communities were almost exclusive in having just *S. capillifolium*, but this is a peat building species. The M17 community on Bald Hill had a greater variety of sphagnum species than the same community on Glenquey Moss, and the M20 community there had peat building sphagnum species. The M20 and M19 communities on Third Hill and Mellock Hill had very poor cover of sphagnum building species. Glenquey Moss was the only blanket bog where the M18 community was found. While the M25 community might be found within blanket bog, this community on its own without any other bog community cannot be considered to be blanket bog.

The other priority habitat found on Glenquey Moss is 4010, Northern Atlantic wet heaths with Erica tetralix. JNCC recognises the NVC M15 *Scirpus cespitosus* (*Trichophorum germanicum*) – *Erica tetralix* wet heath community as representing this priority habitat. This community was found separate from blanket bog at the foot of Bald Hill, within the M25 community on the lower slopes of Auchlinsky Hill and within the blanket bog of Glenquesy Moss.

From surveying Glenquey Moss and comparing it to other sites, Glenquey Moss has been shown to be very different from any of the other sites surveyed. The following conclusions have been reached:

- The geomorphology of the site, with which the bog forms a complex, is different form any of the other sites, and the gravel delta of post-glacial origin is the best surviving example in Glen Devon, which is central to the understanding of the deglaciation of the Ochil Hills.
- The hydrology of the bog is different form any of the other sites, not like the raised bogs and quite different from the other blanket bogs on the slopes of higher ground 100 metres above.
- The site provides a transition between raised bogs and the higher blanket bogs, its bog vegetation communities are richer, more varied and in better condition than any of blanket bogs and most of the raised bogs surveyed.
- The bog communities of the site are the same as those on raised bogs and blanket bogs. At 11.60 ha of active bog, this represents 45% of the active bog south of and including Glenquey Moss in *An Inventory of lowland raised bogs in Great Britain*, and has more active bog than either of the two sites to the south and two others included in the Inventory, which are Sites of Special Scientific Interest.
- The site has no tree regeneration on its surface, no more than five struggling saplings were seen during the survey. All of the raised bogs surveyed, including Methven Moss and Shelforkie Moss Special Areas of Conservation, suffer from varying levels of tree colonisation which affect moisture levels in the peat.
- The site is on the south-eastern distribution of blanket bog in Scotland, and has a special relationship to other blanket bogs for that reason.

- The blanket bog of Glenquey Moss is about the same size as it would have been when the bog achieved its maximum natural growth. Its lateral growth is restricted by the geomorphological structure on which it grows, and the only reduction in its size is around the margins, in particular with modern drainage on the east side and the removal of bog and gravel from the west side.
- From this and other surveys the site has been shown to be very important for supporting other species, including, birds, spiders and beetles. The site has an Annex I species included in the European Birds Directive and several other species are of conservation concern.
- In many ways Glenquey Moss is a unique site and entirely irreplaceable.

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