East Schiehallion
Mountain Woodland Project Consultation
Appendicies

Appendix x: Habitat monitoring plan for East Schiehallion

Dwarf Shrub Heath Plots

Heath plots enable monitoring of browsing impacts from deer and sheep on heather shrub vegetation across the site.

Background

30 2 x 2m plots were set up in 2008 and have been monitored regularly since then. Since 2018, 10 of these plots have been within a fenced area. In 2021, we expanded the area covered by the plots to provide feedback on grazing impacts across the area outwith the Schiehallion SSSI.

The Trust the best practice method to record impacts on its properties in Scotland: https://www.bestpracticeguides.org.uk/impacts/dwarf-shrub-heath/

Design

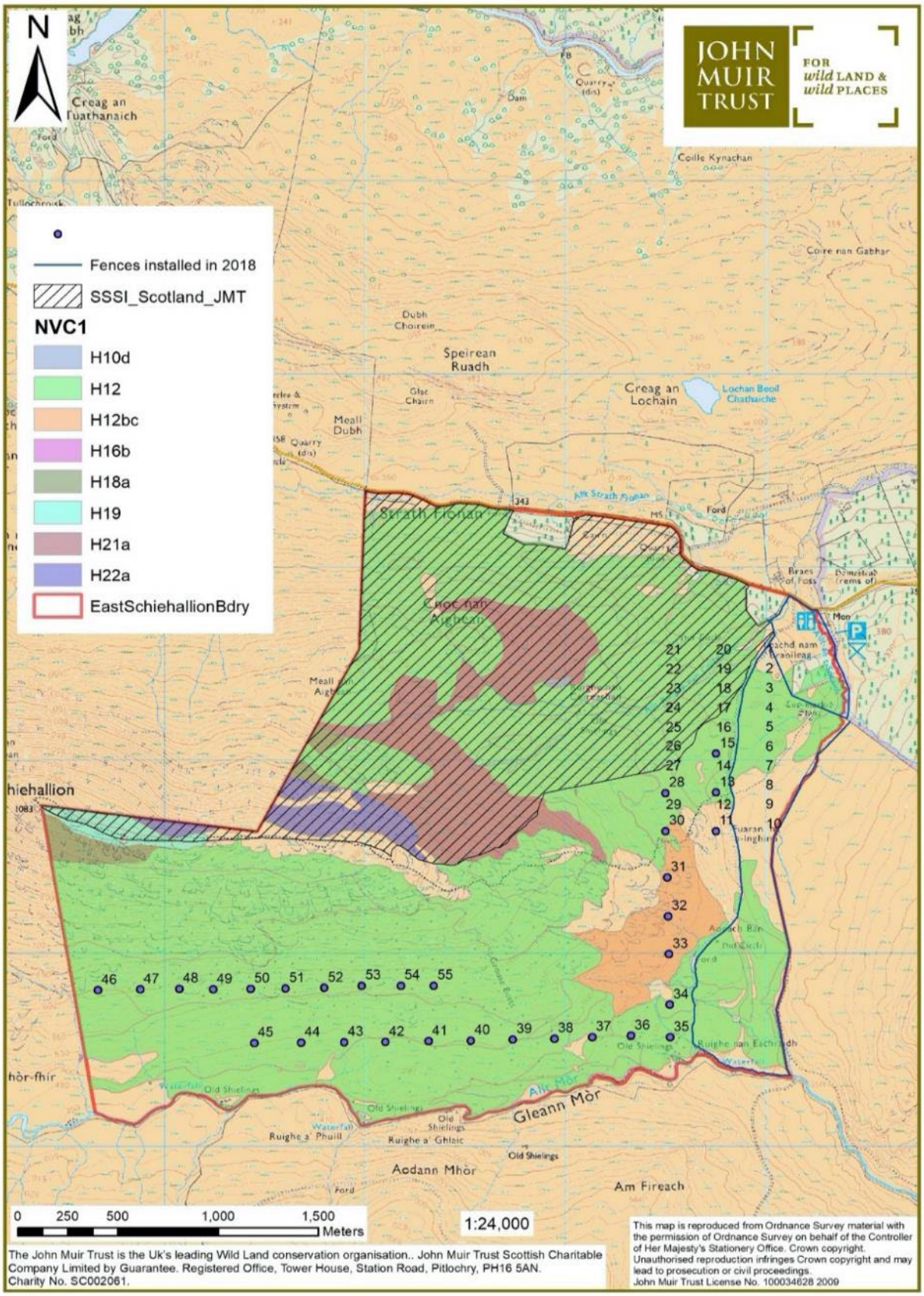
Three sets of 10 plots will be located on transects to improve time efficiency for monitoring across the heath habitat. From 2021 onwards, we plan to record five of the existing plots and have set up 25 new plots. The locations of the new plots are shown on map 1 below. Heath plot monitoring will take place every two years.

Heath plot monitoring will not take within the SSSI, as plot monitoring within the SSSI area will focus on designated features key habitats: calcareous grassland, flushes and calcareous influenced heath.

Existing plots

Plots 1 to 10 (see map 1) will now be abandoned as there is now no browsing impacts in that area following fencing in 2018. The new plots will expand the area of the site covered to include more of the unfenced heathland areas to help inform ongoing herbivore management. The proposed transect arrangement of plots will enable efficient use of time moving between plots to cover a wider area of the site.

For now, the plot location pegs will be left on site to enable the potential for future recording if time allows.



Map 1: new and old dwarf shrub heath plots at East Schiehallion

East Schiehallion Dwarf Shrub Heath Plots		n=30								
		2008	**2009**	**2010**	**2012**	**2013**	**2014**	**2015**	**2017**	**2018**
% plots with light browsing		67	81	63	71	68	63	86	85	71
% plots with medium browsing		29	13	24	12	13	11	6	6	9
% plots with heavy browsing		4	7	13	17	19	26	8	9	20
% plots with deer dung present		77	60	83	30	80	57	43	60	73
Mean height of heather		25	26	27	32	30	27	30	32	32
Standard Deviation		9	10	10	12	11	9	10	10	10
Confidence limit (p=0.05)		2	2	2	2	4	2	2	2	2
Heather present in quadrats		80%	79%	81%	83%	83%	84%	84%	84%	82%

Table 1: Heath plot survey results 2008- 2018 (2011 and 2016 omitted due to incompleteness)

Table 1 presents the results of the completed heath plot surveys from years 2008- 2018. Mean heather height in the plots increased from 25cm to 32cm over the 10-year period which was found to be statistically significant. However, the data was variable over this time period with high standard deviation values and the % of medium / heavily browsed plots fluctuated across the time frame.

Ten of the heath plots were enclosed within a fence in 2018, so the 2019 data are not directly comparable so omitted from this table.

Appendix y: Soil survey for East Schiehallion

Assessing the soils of East Schiehallion ahead of mountain woodland restoration

June 2021

Introduction

The John Muir Trust have managed the East Schiehallion site since 1999; one of the primary objectives for the future of the site is the restoration and regeneration of mountain woodland (Mountain Woodland Vision). Due to decades of intense grazing pressure from deer and sheep, the potential for natural regeneration of the woodland is low, with many target species such as dwarf birch, montane willow and juniper in too small numbers to serve as a sufficient seedbank.

In order to restore the mountain woodland and scrub communities of Schiehallion with as much diversity and sustainability as possible (and bolster Scottish populations of endangered montane willow (*Salix*) species) a substantial tree planting effort will be required to provide an initial starting point for natural regeneration, following potential fencing and/ or increased deer culling measures. To provide the best possible outcomes for the forest restoration project, and minimise C loss from soil stores, a short survey of the soils across the site was undertaken. This study aims to allow the trust to make informed decisions about optimal locations to place tree species on site for best chances of successful woodland regeneration and minimise any potential C loss from peaty and/ or C rich soils across the site.

Existing information

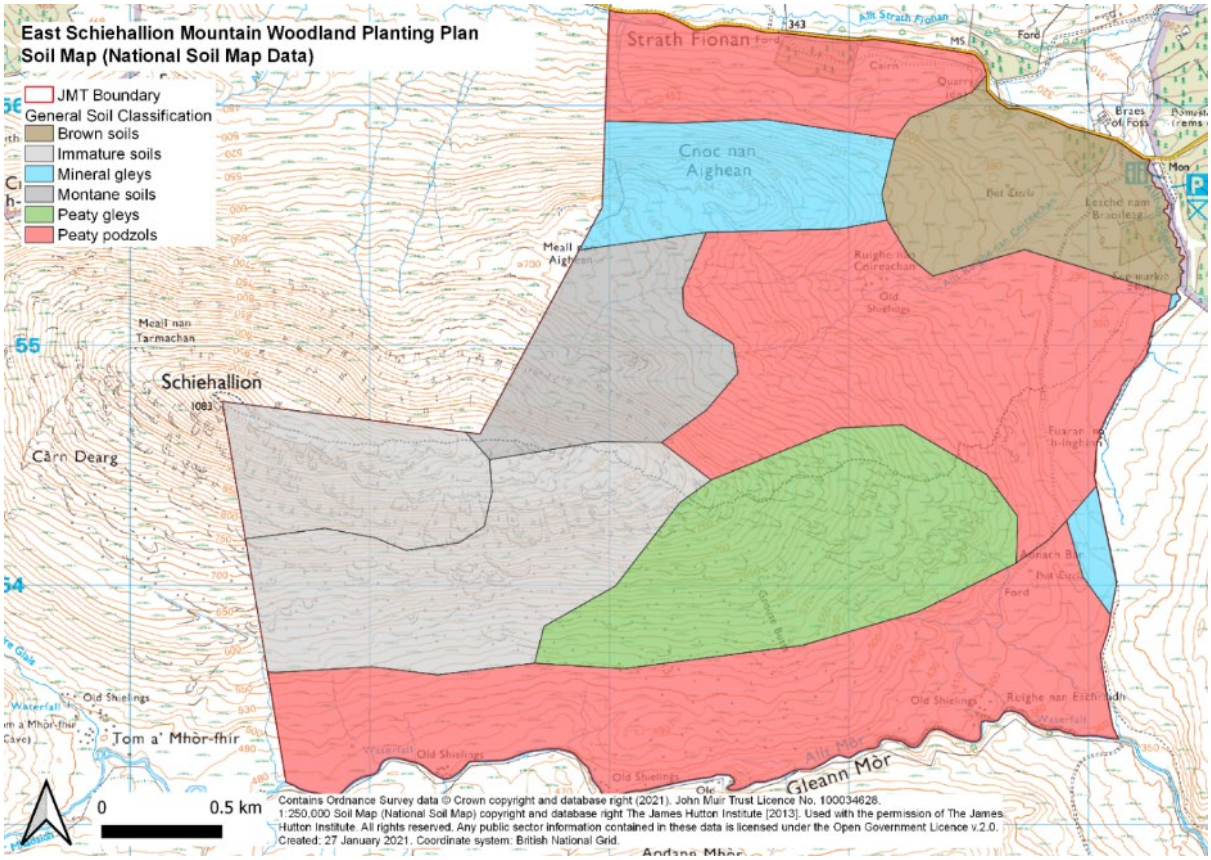
Broad scale soil data exists for the site from the National Soil Data Map (1:250 000 scale) from the James Hutton Institute. According to this map from data collected in the 1980s, the majority of the site is comprised of peaty podzols, stretching along the low levels of Glen Mor, Strathfionan and into the Ruighe nan Coireachan. The higher altitudes (from ~700m to the Schiehallion summit) are designated as immature or montane soils (very thin, undeveloped, and with little organic material). Peaty gleys (gleys are soils associated with wetter areas) are the main soil type at higher levels around the footpath and part of Glen Mor. A patch of mineral gleys is also recorded on Cnoc nan Aighean in the North of the site. Brown earths make up much of the area which has already been protected by fencing in the lowland area closest to the car park (see map 1).

Peatland

According to the National Soil Map, there are no areas of deep peat (>1m depth) on the East Schiehallion site, although there are some areas recorded on the Eastern side of Glen Mor. The carbon and peatland map gives more detailed classifications of areas of peatland. This shows

two small areas of class one peat (nationally important carbon-rich soils, deep peat and priority peatland habitat) both at Strathfionan and within the SSSI. There are no areas of class two peat, so only a small area of the site that should be avoided for planting on due to peat coverage.

Whilst the National Soil Map is a fantastic resource, the broad scale data collected in the late 1970s and 1980s masks smaller scale heterogeneity in soil type which can be useful in site-level decision and planning. Gaining a better understanding of the distribution of soil types (and peat depth) across the site is important to facilitate the best possible outcome for planned tree planting, and minimising soil C loss which may occur if planting takes place on peaty soils (Friggens et al., 2020). This study aims to survey and assess the soils of the East Schiehallion trust property, at a more precise scale than currently available from the current national datasets.



Map 1: Map of the Eat Schiehallion site with the James Hutton/ National Soil Map classification. Peaty podzols (red) dominate the lower elevations of the site, while montane/ immature soils (grey) cover most of the higher southwest area around the summit.

Initial study

The initial part of the study involved taking shallow samples using a standard gardening trowel from locations across the site to roughly verify correspondence with the below soil map. While the initial study revealed good correspondence of samples with the James Hutton data for some areas, for example in the eastern brown earths and eastern peaty podzols, other areas revealed

deeper peaty soils than anticipated, or localised soil patches that did not appear to correspond with the James Hutton map (Map 1).

This prompted a further investigation using a specialised steel auger.

Full study

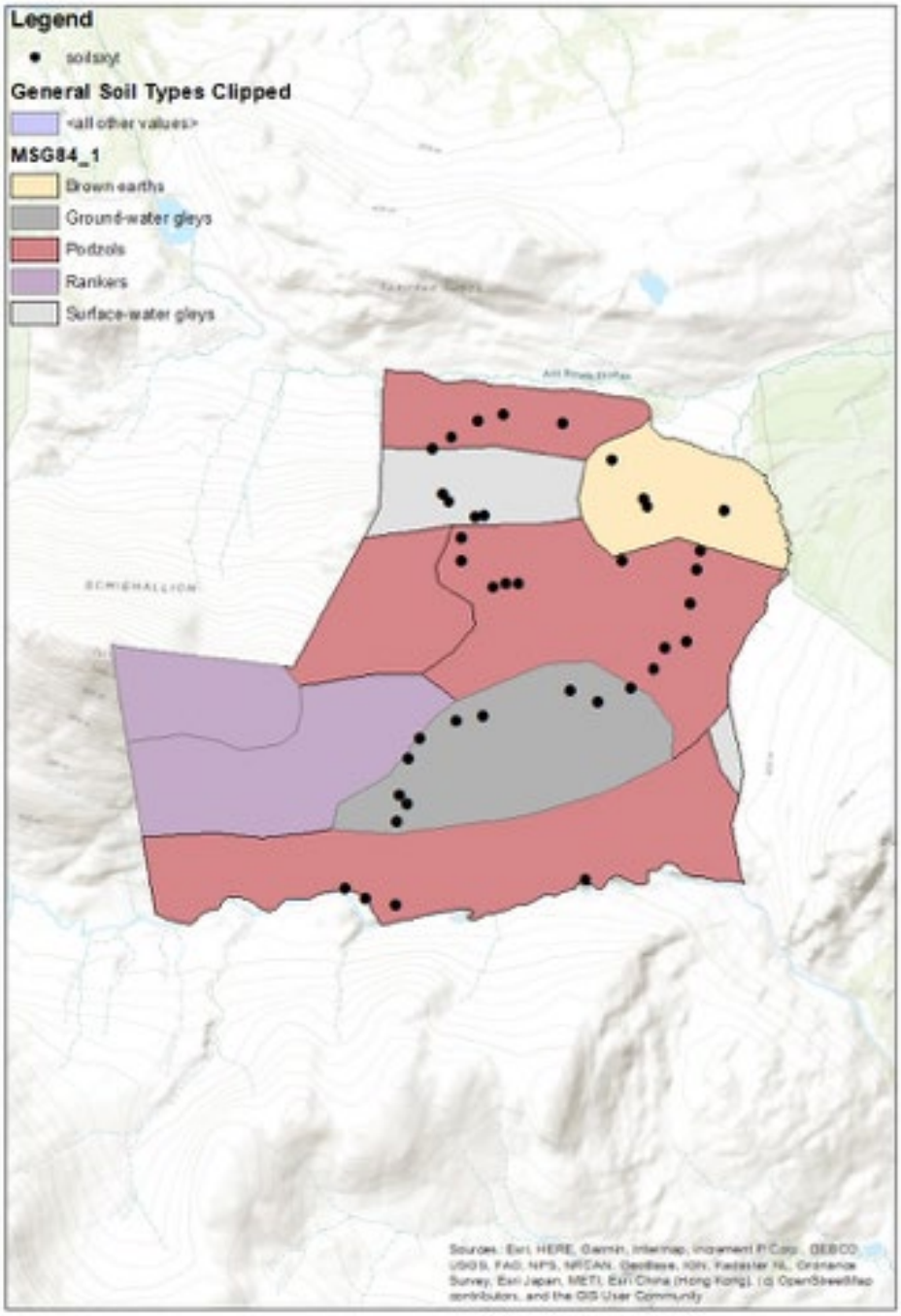
Methods

A soil coring study took place on 29 and 30 April 2021 across the East Schiehallion site. While most samples were focused around the potential planting areas on the SE slopes, sampling across the breadth of the site (including the SSSI, following permissions from NatureScot) offered further insight into the nature of the soils across the site and highlight suitable locations for mountain woodland restoration, minimising any potential soil C loss or favourable habitat damage.

In total 35 disturbed samples were be taken using a steel, 10cm open-face auger. At an additional 5 plots, photos were taken of the exposed soil/ peat bedrock, but no cores were taken. The samples (usually 8- 12 cm but some were shorter if the bedrock was reached) were extracted and photographed, and the upper organic layer (peat) was measured. The soil type and peat depth (if present) were recorded. The disturbed sample was then replaced in the ground and covered over with vegetation. In the event that one full auger sample (up to ~14cm) reached the full depth of the peat, this was noted, the sample returned, and no further disturbance took place. No material was removed from the site.

Results

The soil sampling took place over two days, covered the entire site (except exposed rock/ areas without soil) with samples focussed around the potential planting areas around the lower elevations of the site. Map 2 (below) depicts the location of 35 sampling points across the site (some of these were areas of exposed soil rather than soil core sampling locations).



Map 2: Sampling points (black) across the East Schiehallion site overlaid across the national soil map categories.

Photo log

Sampling started along the NE of the site adjacent to the woodland creation planting area. These samples were consistent with the mapped data as brown earth soils. (image 1)

Image 1: Low elevation brown earth soils close to the fence line in the east of the site.

Continuing along to the sheep fank, peaty podzol was recorded, as predicted by the National Soils Map (red colour on Map 1).

Image 2: Peaty podzol exposed by path works along the new fence line.

Image 3: Brown earth soils under bracken adjacent to the Schiehallion footpath

Following the footpath up the east side of Schiehallion, a patchwork of brown earth and peaty podzol associated with short grasses and heath respectively. The brown earths appeared to be associated with the bracken and short, dry grass areas (image 3), while the peatier soils were associated with heath, vaccinium and long grasses/ rushes (image 4).

Image 4: Peaty soils associated with heath vegetation and wetter conditions (adjacent to Schiehallion footpath

Progressing further up the footpath, some patches of deeper, peaty soils were recorded (see map 3) which were often associated with wetter areas and exposed bedrock. Other areas featured exposed rock and thin, immature montane soils (increasing frequency with elevation gain).

Image 5: Deeper peat soils recorded around 600m adjacent to the mountain footpath.

At around 700m, the sampling team descended the slope on the south side of the mountain dropping into Glen Mor. Above 700m, the ground was predominately bare rock, so no sampling was necessary or possible. According to the National Soil Map the southern slope is a combination of gleys and immature soils (rankers on map 3). The observed samples were a combination of deeper peaty soils and immature montane soils, with no peaty gleys recorded until dropping to around 500m in elevation. (See elevation figure in appendix for further details)

Sampling across the SSSI area followed a more restricted pattern, in order to avoid sensitive habitats. Samples were collected near the Strathfionan plantation along the Northern boundary of the site. Several areas of brown earths were observed (see map 3) despite being listed as a peaty podzol zone on the National Soils Map, demonstrating good potential for woodland regeneration if grazing pressure was reduced.

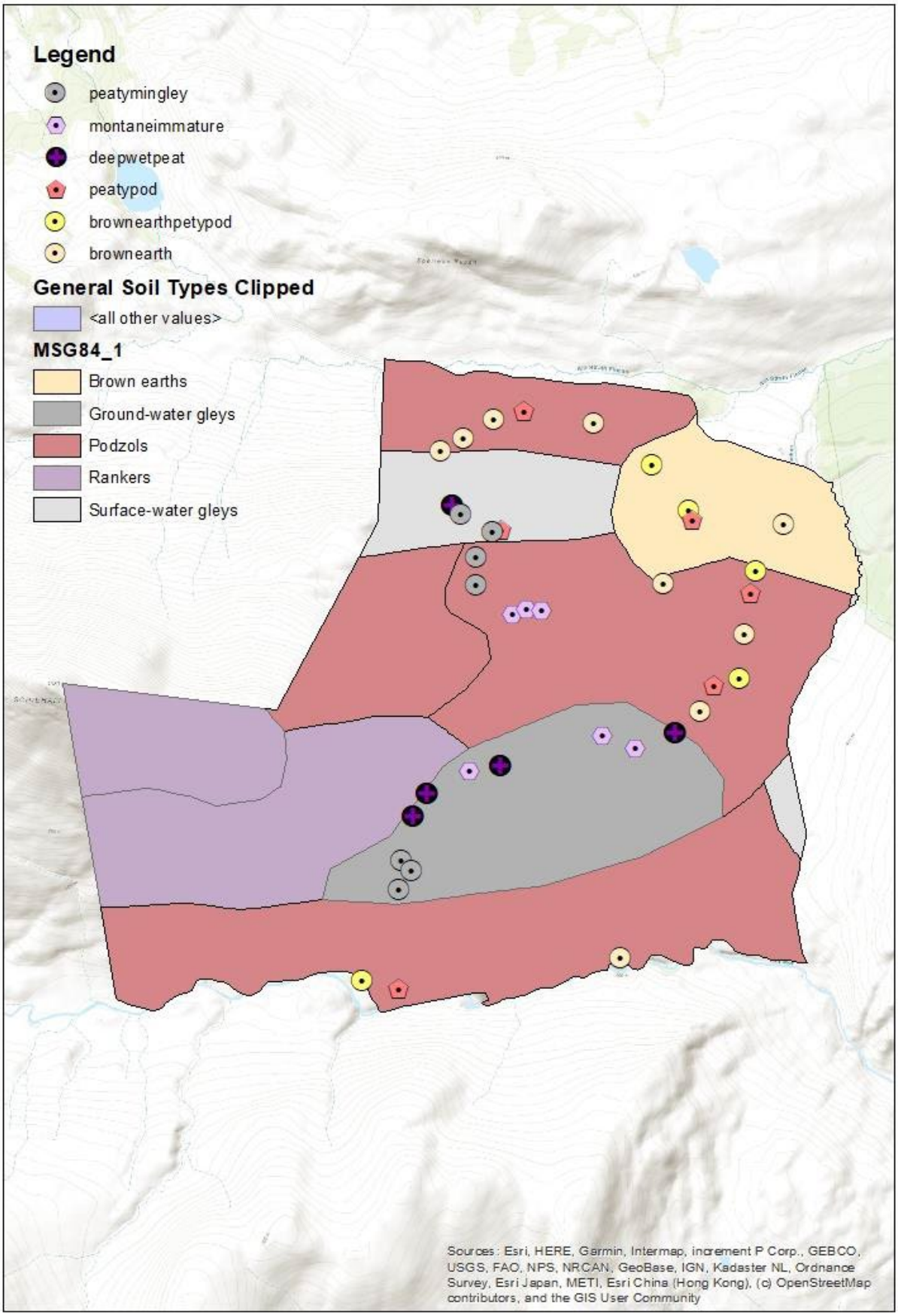
With increasing elevation on the northern side, the soils generally became peatier, again coinciding with wetter heath areas. As the topography levelled out to a plateau (Cnoc nan Aighean), a large area of partially eroded deep peat was observed (see image below). This could have some potential for peatland restoration but should be avoided for future planting.

Image 6: Exposed peat under tussock at Cnoc nan Aighean

Image 7: Exposed mineral soils following erosion from water runoff, weathering and heavy sheep/ deer trampling.

Image 8: Peaty soil sample from the northern slopes

Descending again from Ruighe nan Coireachan, following the National Soil Map boundary between gleys and podzols, a patchwork of soil types was observed (see map 3) likely linked to hydrology and underlying geology. Some areas presented the predicted brown earth or peaty podzol, while other samples were peatier, sometimes waterlogged (see image 8) or drier brown earth and mineral soils. Generally, the presence of bracken was associated with the drier mineral and brown earth soils as bracken cannot tolerate waterlogging of rhizomes, particularly when young (Whitehead, 1993).



Map 3: adherence of the observed soil types from this study compared to existing data from the National Soils Map. Deep peat areas are highlighted with a purple/black cross.

It is clear from the above figure that while the National Soils Map provides a good general picture of soil types, it masks much of the heterogeneity across the site, typical of a mountain environment. Brown Earths for instance were found at higher elevations than anticipated, presenting good potential for mature woodland species, such as oak and elm.

Meanwhile, patches of deep, and sometimes degraded peats were also observed across the site (highlighted by black/ purple crosses on map 3) which were not predicted by the soil map. These areas of deeper and wet peat should be completely avoided in any planting plans in order to avoid any further degradation/ erosion and C losses.

Recommendations/ Conclusions

Soil Type Summary

Brown Earth

Brown earth soils have the greatest suitability for woodland of all soils present on site. Brown earths are well drained and nutrient rich, providing suitable substate for mature woodland species such as oak, beech and elm which cannot tolerate waterlogged or highly acidic upland soil. Typically, at the Schiehallion site, the brown earth soils can be found in drier areas of the NE of the site, at lower elevations (yellow on map). This soil type is often associated with bracken and dry grasses and small flowering herbs (bracken cannot tolerate waterlogging).

Peaty Podzols

Peaty podzols are a common soil type on site but have more limited prospect for tree growth. Peaty podzols can be more acidic and often lower nutrient than brown earths. These soils are suitable for Scots Pine, Willow, Juniper, Rowan, Hazel and Birch, but care must be taken to avoid any waterlogged areas and/ or areas with deeper peaty layers. Peaty podzols were most often found beneath heath vegetation including heather (*Calluna vulgaris*) and *Vaccinium* species. Wetter areas of this type were associated with areas of sedges and cross leaf heather *(Erica tetralix*).

Peaty Gleys

Peaty gley soils are potentially more suitable for planting than peaty podzols as they often do not contain as much labile C from undecomposed material and are more mineral rich. Water tolerant species such as montane willow, rowan, hazel and dwarf birch can survive in peaty gley soils. Peaty gleys were found in a patchy distribution across glen mor, and commonly associated with the typical heather and vaccinium heath found above peaty podzols. Gleys form because of waterlogging in mineral soils, so can be found in wetter areas such as close to the large burn in glen mor. Very wet areas, often covered by mosses and sedges, again, should be avoided to minimise C loss.

Montane and Immature Soils

Montane soils are thin, skeletal or poorly developed soils occurring at high altitudes. At East Schiehallion, montane soils were found above 700m and at scree/ rocky area through the far west of glen mor. The observed montane soils were associated with alpine vegetation, such as cloudberry, club mosses, some vaccinium species and small alpine herbs as well as lichens. Deeper pockets may support heather and small shrub or tree species such as creeping willow

and juniper, however, montane soils are not usually suitable for tree planting due to low nutrients and the characteristic extreme conditions preventing soil formation.

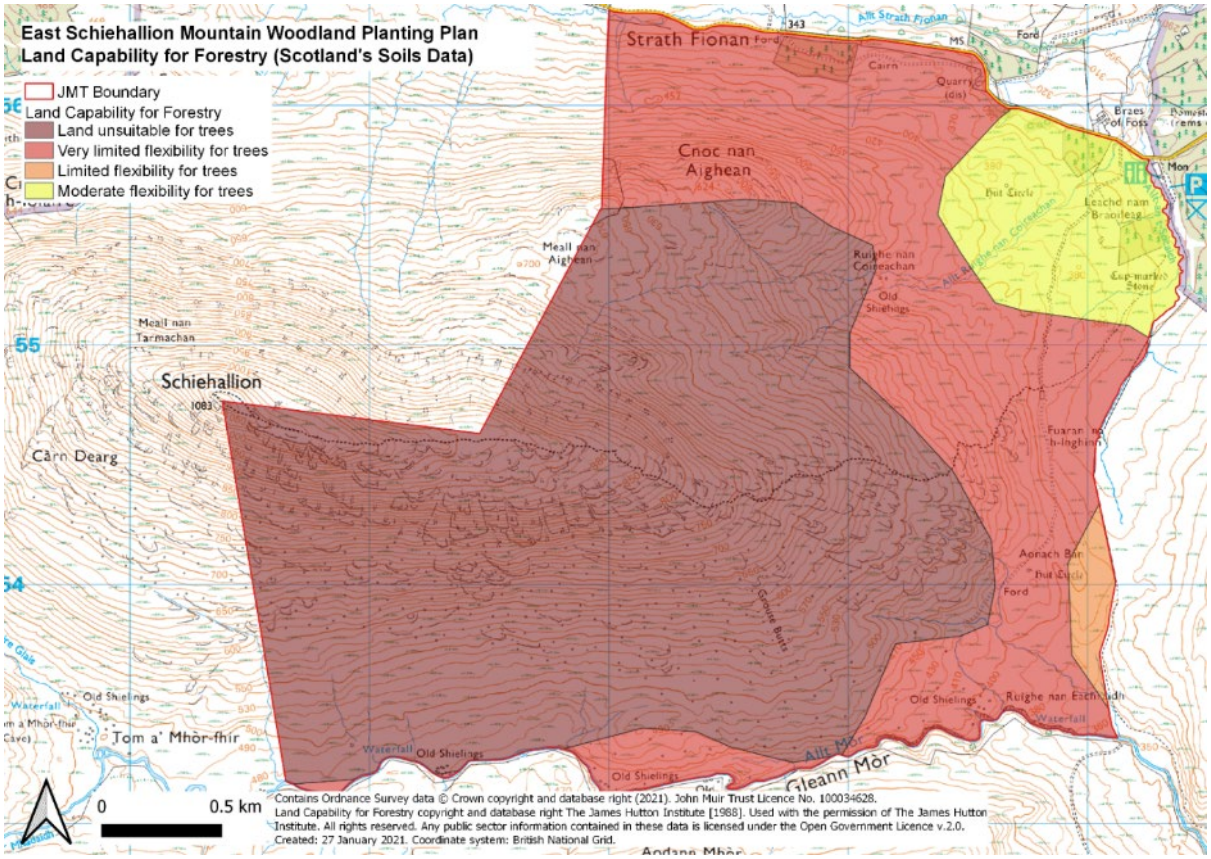
Deeper Peats

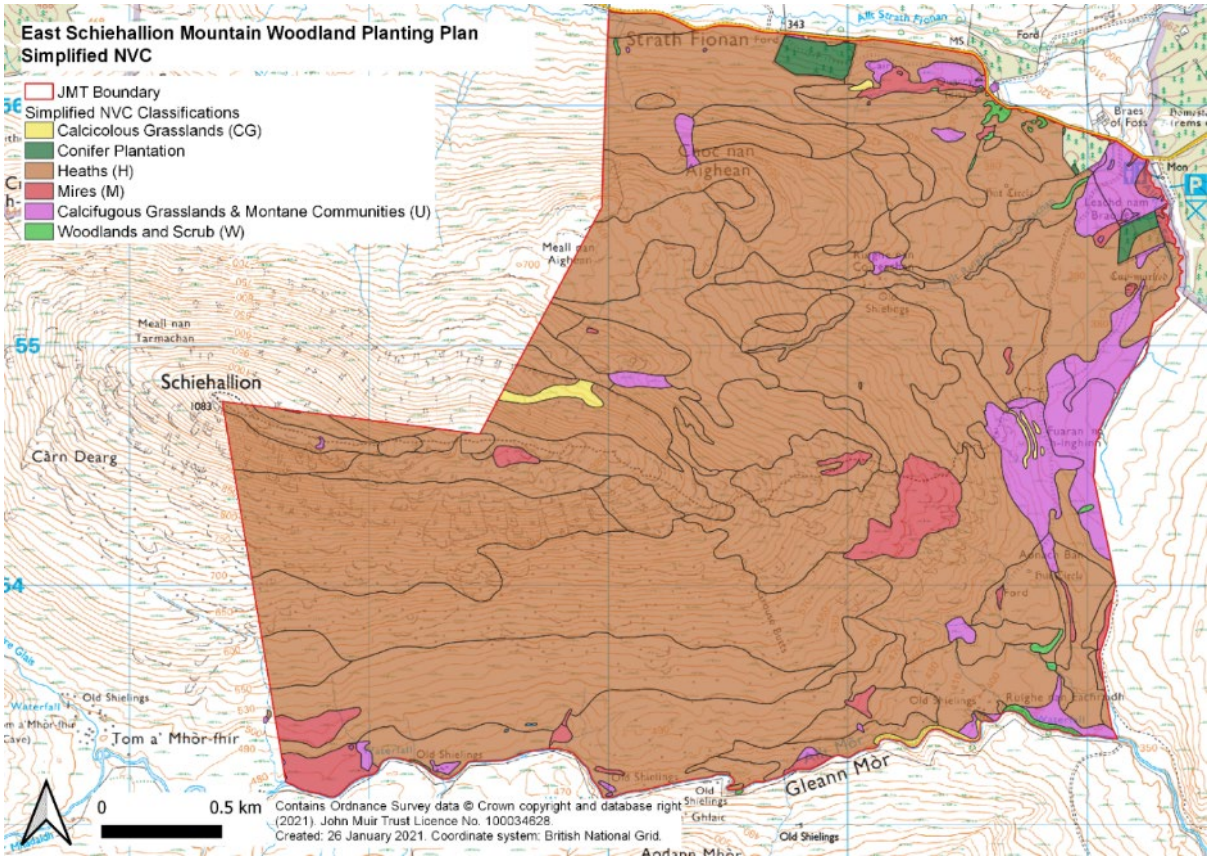
Deep (> 50cm) and wet peat soils exist in sporadic patches across the site. As discussed, deeper peats should be avoided for tree planting to avoid disturbance, drying and loss of soil C. Deeper peaty soils were associated with heather, as well as sphagnum mosses, cotton grass and water tolerant species including yellow mountain saxifrage and sedges. These soils have a patchy distribution across the site, but were more common at higher elevations (~700m) in both the Northern part of the site and Glen Mor.

Conclusions

Overall, because the East Schiehallion site presents such high heterogeneity in soil types across the potential planting area, the future tree planting efforts taking place over the next 5 –10 years must account for soil type and make efforts to avoid any peaty areas. This could be done by planting in patches marked out using GIS beforehand or by using vegetation associated with mineral and less peaty soils (such as bracken) in the field during a planting day.

Looking to restore degraded peat areas on the site could also mitigate any potential C losses that may arise from planting in unsuitable soils/ site disturbance.





Map 5: East Schiehallion rough NVC categories

Figure A: Recorded Soil Types with elevation.

Figure A key

BrE- Brown Earths

Alluvial- alluvial (riverine) soils

BrE- PP Brown Earth: Peaty podzol mix

DP- Deep Peat

Montane: Montane and immature soils

Min Gley- Mineral Gley soil

Pe Gley- Peaty Gley

Pe Podz- Peaty podzol

References

Friggens, N. L., Hester, A. J., Mitchell, R. J., Parker, T. C., Subke, J. A., & Wookey, P. A. (2020). Tree planting in organic soils does not result in net carbon sequestration on decadal timescales. ***Global Change Biology*****,** ***26*****(9), 5178-5188**

Whitehead, S. J. (1993). ***The morphology and physiology of moorland bracken (Pteridium aquilinum (L.) Kuhn) and their implications for its control*** **(Doctoral dissertation, University of York).**

Soil Map

https://soils.environment.gov.scot/maps/soil-maps/national-soil-map-of-scotland/