

## Origins of the Soil Survey of Scotland 50 cm threshold to define a Peat soil

### Executive summary

The Soil Survey of Scotland who were responsible for the systematic survey, classification, mapping and characterisation of Scotland's soils is unique in defining a Peat soil as one where the surface organic layer has more than 35% organic carbon and is at least 50 cm in thickness and have used this definition to classify Peat soils since 1970. Where mapped, peat soils were subdivided into two depth categories: Shallow peat (organic layers between 50 and 100 cm thick) and Deep peat (organic layers >100 cm thick).

A review of historical documentation suggests that the origins of the 50 cm threshold comes from work in the 1940s and 50s by the Scottish Peat Committee, a government body that evaluated peat deposits for commercial use, for example, burning in power stations to generate electricity. In general, the peat at depths shallower than 50 cm was likely to be too fibrous and of a lower calorific value than the peat below 50 cm. The Scottish Peat committee also recommended that if the land was to be used for agriculture following peat extraction, a minimum depth of 50 cm of organic material was to be left.

As well as the Soil Survey mapping, there was continued mapping of Peat deposits by the Peat Survey and by the early 1970s these two Surveys had harmonised the depth threshold of 50 cm to define Peat soils. They also recognised that there was a relationship between Peat soils and specific vegetation communities. Although Peat is also found under woodland, improved grassland, semi-natural grassland and moorland vegetation communities, around 90% of the area in Scotland with a Bog vegetation type has formed on Peat soil. This relationship between Peat soils and distinctive Bog vegetation patterns was identified by both the Soil Survey of Scotland and by the Peat Survey as key in mapping the distribution of Peat soils and Peat deposits using aerial photographs supported by ground-truth survey.

### Introduction

The Soil Survey of Scotland was responsible for the systematic survey, classification, mapping and characterisation of Scotland's soils. Soil maps at scales mainly from 1:25,000 to 1:250,000 (primarily published as hard copy paper maps at 1:50,000, 1:63,360 and 1:250,000 scale) were produced and subsequently [digitised](#) (Lilly *et al*, 2015). A systematic mapping programme relies on having a formal soil classification system to group soils into relatively uniform classes. Although the [classification system](#) used in Scotland evolved over time, it was formalised for the production of the [National soil map \(1:250,000\)](#) in 1984 and [revised in 2013](#). The Scottish soil classification system was developed to be field-based (Soil Survey of Scotland Staff, 1984) and relied on the recognition of a specific sequence and types of soil horizons (layers) rather than having specific diagnostic properties with only 2 main exceptions: Lithosols and Organic soils (Peat). While Lithosols are required to be 10 cm thick or less, the Soil Survey of Scotland defined Peat soils as soils with organic layers with more than 60% organic matter (around 35% organic carbon) and which extend from the surface to at least 50 cm deep (Soil Survey of Scotland Staff, 1984 and 2013). Soils with organic surface layers less than 50 cm thick are described by the Soil Survey of Scotland as 'Peaty' soils, for example, Peaty gleys or Peaty podzols.

In mapping the soils of Scotland, the Soil Survey of Scotland also divided the different Peat soil classes into two depth categories: Shallow peat (50-100cm thick) and Deep peat (>100 cm thick).

Note that the use of the 50 cm threshold by the Soil Survey of Scotland is to define a Peat soil and doesn't indicate the presence of a specific peat habitat. Peat soils are also found under forest, moorland, improved grasslands and arable fields.

The first recorded use of the definitions of Deep and Shallow peat appear on the Latheron and Wick soil map (Futty and Dry 1970) and in the accompanying Soil memoir ([Futty and Dry, 1977](#)). Since mapping such an extensive area would have taken a number of years plus the time taken to prepare the map for publication, this suggests that this definition of Peat soils was in use prior to 1970.

For soil maps published prior to 1970, Peat soils were often described as being greater than 12 inches (30 cm) thick which was an accepted international definition at the time (Fraser, 1943). However, there was a recognition in Scotland that Peat soils generally exceeded this depth and there was a transition zone from what we would recognise today as 'peaty' soils (where the organic layer overlies mineral material and is < 50 cm thick) to Peat. At this time the Soil Survey of England and Wales (Clarke, 1940) were using a threshold of 20 cm thickness of organic surface layers to delineate Peat soils.

To date, no published evidence from the Soil Survey of Scotland annual reports as to why the 50 cm threshold was adopted has been found but there is some evidence that the driver for using this depth threshold may have come from discussions with the Peat Survey. While the original focus of the Soil Survey was mapping mainly cultivated agricultural land, the Peat Survey was established to map and quantify peat deposits that could be exploited for fuel or other uses and operated in parallel to the Soil Survey at the Macaulay Institute. Earlier peat surveys were carried out by the Peat Survey team of the Department of Agriculture under the direction of the Scottish Peat Committee, a government body. It may be no coincidence that this threshold was adopted for mapping the soils around Wick where large tracts of land are covered in Peat.

The 1972-73 Macaulay Institute for Soil Research annual report by the Peat Survey reported that *'In collaboration with Soil Survey, an acceptable classification of peatland types in the Nairn area has been attained. Possible correlations between vegetation types and physical and chemical characteristics of surface horizons of peat are being examined in an attempt to devise a system of peatland classification that is meaningful in terms of site capability and to establish mapping units that are reflected by simple patterns on aerial photographs.'* This reference to patterns on aerial photographs hints at the link between Peat layers thicker than 50 cm having distinctive vegetation communities that could be readily seen on air photographs to aid mapping.

### Why was a 50 cm threshold used in peat surveys?

In 1943, G.K. Fraser describes the definition of peat as being in excess of 30 cm thick as being *'used by international soil scientists'*. However, Fraser also refers to the definition of Peat as being of the *'... practice long followed by the Geological Survey has been adopted, namely, to use a figure of 2 foot (60.97 cm)*. Fraser goes on to say *'The greater depth is more in line with the requirements of those industries most likely to make use of peat in this country'*. However, according to the Scottish Peat Committee report No.1 on the peat deposits of the Gardrum and Darnrig mosses (1956), areas where the organic layers were less than 50 cm were not surveyed. A peat corer was used to take samples at 50 cm intervals throughout the thickness of the peat deposit.

During these surveys, the peat was assessed for various uses such as a fuel and power production or as a substitute for straw in byres as they were deemed to be more absorbent than straw and had some aseptic qualities as well as being relatively dust free. However, where peat was to be used primarily as a fuel (either for domestic or commercial use in power plants), the requirements were for more

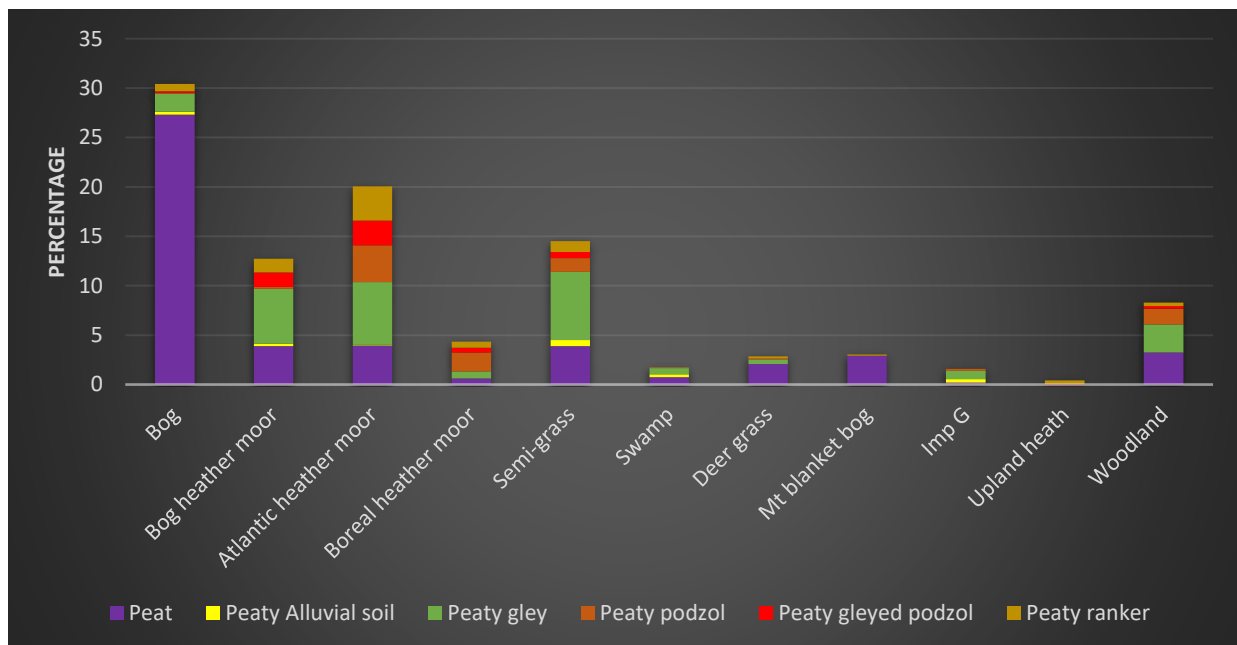
decomposed, amorphous material which was generally to be found deeper within the peat deposit. Thus, when quantifying the peat resources for fuel, the early peat surveys discounted the upper 50 cm of (potentially) more fibrous material and only quantified the amount of the more amorphous peat below this depth.

If the land was to be used for agriculture following peat extraction, a minimum depth of 50 cm of organic material was recommended to be left in order to maintain the 'function' of a peat soil (Scottish Peat Committee report, 1956), although, in some cases, there was the potential to mix the organic layer and subsoil to create a rudimentary topsoil.

### Peat soil associated with vegetation communities

As previously mentioned, there is a relationship between Peat soils as defined in Scotland and specific vegetation communities. Analyses of the objective 5 km National Soil Inventory of Scotland data (Lilly et al, 2010) shows that 90% of the soils described as being on Bog vegetation community (defined by Robertson, 1984) are Peat soils. Bog vegetation community is dominated by heather (*Calluna vulgaris*), bog heather (*Erica tetralix*), cotton-grasses (*Eriophorum* species), deer-grass (*Trichophorum cespitosum*) or flying bent (*Molinia caerulea*) and bog mosses such as *Sphagnum* species dominate the ground layer. This vegetation community forms recognisable and distinctive patterns on aerial photographs.

Analyses of the National Soil Inventory of Scotland 5 km dataset of soils with peaty surface layers less than 50 cm thick and Peat soils where the surface organic layer is at least 50 cm thick showed that some of the Peat soils do also occur along with other 'peaty' soils with other vegetation communities.



**Figure 1:** Distribution of vegetation communities found on peat and peaty soils based on National Soil Inventory of Scotland 5 km grid data.

## Conclusions

Although the use of 50 cm threshold to define Peat soils is unique to Scotland it has its origins in practical applications, whether to identify exploitable peat resources or improve mapping of peat deposits and has been the recognised definition by the Soil Survey of Scotland for over 50 years and by the Peat Survey since the 1940s. There is a clear relationship between Peat as a soil type and Peatland vegetation comprising dwarf shrubs, sedges, coarse grasses and *Sphagnum* moss but it is worth noting that Peat soils also exist where there is no current peatland or Bog vegetation.

## References

Clarke, G.R. 1940. Soil Survey of England and Wales: Field Handbook. Oxford University Press.

Fraser, G.K. 1943. Peat deposits of Scotland: Part 1. War time pamphlet No. 36. Department of Scientific & Industrial Research. Geological Survey of Great Britain: Scotland. Geological Survey and Museum. London.

Futty, D. W. and Dry, F.T. 1970. Soil map of Scotland. Scale 1:63 360. Sheets 110 and 116 and part 117 (Latheron and Wick). Ordnance Survey. Southampton. Available on line at <https://maps.nls.uk/series/soils/>. Accessed 28/06/23.

Futty, D. W. and Dry, F.T. 1977. The soils of the country round Wick (Sheets 110, 116 and part 11 7). Macaulay Institute for Soil Research. Aberdeen. [https://www.hutton.ac.uk/sites/default/files/files/soils/142141013 THE SOILS OF THE COUNTRY ROUND WICK.PDF](https://www.hutton.ac.uk/sites/default/files/files/soils/142141013_THE_SOILS_OF_THE_COUNTRY_ROUND_WICK.PDF). Accessed 28/06/23.

Lilly, A., Bell, J.S., Hudson, G., Nolan, A.J. & Towers. W. (Compilers). 2010. National soil inventory of Scotland (NSIS\_1); site location, sampling and profile description protocols. (1978-1988). Technical Bulletin. Macaulay Institute, Aberdeen. DOI:10.5281/zenodo.4650230. <https://www.hutton.ac.uk/sites/default/files/files/soils/46%20-%20SOIL%20SURVEY%20OF%20SCOTLAND%20HANDBOOK%208.PDF>. Accessed 28/06/23.

Lilly, A. Miller D, Towers W., Donnelly D, Pogio L, & Carnegie P. 2015. Mapping Scotland's soil resources, SoC Bulletin vol 48. [https://www.hutton.ac.uk/sites/default/files/files/soils/183151002 Mapping Scotlands Soil Resources.pdf](https://www.hutton.ac.uk/sites/default/files/files/soils/183151002_Mapping_Scotlands_Soil_Resources.pdf). Accessed 28/06/23.

Robertson, J. S. 1984. A Key to the Plant Communities of Scotland. Soil Survey of Scotland Monograph. The Macaulay Institute for Soil Research, Aberdeen.

Scottish Peat Committee. 1956. Survey of Peat deposits, report No.1 (Gardrum and Darnrig Mosses). HMSO. Edinburgh

Soil Survey of Scotland Staff. 1984. Organization and methods of the 1:250 000 Soil Survey of Scotland. Macaulay Institute for Soil Research. Aberdeen. <https://www.hutton.ac.uk/sites/default/files/files/soils/46%20-%20SOIL%20SURVEY%20OF%20SCOTLAND%20HANDBOOK%208.PDF> . Accessed 26/06/23

Soil Survey of Scotland Staff. 2013. Unified soil classification of Scotland's soils. <https://www.hutton.ac.uk/learning/soilshutton/soil-classification>. Accessed 14/04/2023.

Allan Lilly,  
Honorary Associate, James Hutton Institute  
July 2023  
Doi: 10.5281/zenodo.8315816