Soils as cultural resources

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The papers presented at the Symposium aimed to review the environmental and cultural resources of small countries. This paper seeks to demonstrate that particular environmental resources are intimately related to past cultural processes; in essence, environmental and cultural resources should not be seen as separate themes. This paper briefly reviews the nature of cultural landscapes and then discusses one particular component, soils.

It is widely recognised that a holistic approach to landscapes is essential in order to integrate environmental and cultural resources. The concept of a *landscape* is cultural and thus subject to a variety of perspectives in space and time. As one example, the Scottish Highlands have been perceived in a variety of ways over the last 200 years. Smout (1981) traces the images of the Scottish Highlands from being alien, inhospitable, infertile in the early 18th century to the current situation where the region is visited annually by the order of a million people for many purposes. Although the varied topography and the distinctive land/water distributions make the Highlands so attractive to visitors, it is the superimposition of the cultural heritage which gives these and other Scottish landscapes their distinctive character. This is particularly the case in the more marginal areas of Scotland where there has been greater landscape continuity as well as better preservation of features from the past. In Scotland, as in Denmark, such marginal land has had to support considerably higher populations in the past than is the case today. The resultant landscape features are most clearly expressed in the occurrence of old field systems in upland Scotland, indicative of landscape antiquity and intense landscape management. This continuity of the past is most evident in more marginal and peripheral areas.

The nature of cultural landscapes

Knut Faegri, in a preface to the book *The Cultural Landscape: Past, Present and Future* (Birks *et al.* 1988), notes that the term cultural landscape has only become widely used since 1945. This book includes papers ranging from such topics as current traditional land management practices to anthropogenic impacts on vegetation during prehistoric times. Emanuelsson (1988) presents 'a cultural landscape model' with three parts: (1) a description of different levels of human use of the landscape with particular reference to soil nutrition, (2) the concept of ecological control to explain periods of regression in human populations, and (3) the role of climate as the differentiating factor for explaining spatial changes in land use. The overall thrust of the book is on changing anthropogenic impact, especially on vegetation. This reflects the considerable research tradition in palynology for unravelling links between human activity and vegetation change; the result is that the study of cultural landscapes is often perceived as being primarily concerned with the evolution of vegetation or land-use patterns. Instead, landscapes need to be approached in a much more integrative manner through appreciation of three key principles, (1) landscapes include a wide variety of components, all of which can be displayed as maps, (2) landscapes at one point in time will inevitably contain elements and traditions from earlier times, and (3) the nature of landscapes will inevitably vary depending upon the perception of individuals or human groups. The second principle can be very well illustrated by soils which can provide an intricate record of past human activity.

Soils as cultural artefacts

The traditional approach in pedology is to consider soils as subject to a range of factors, one being anthropogenic activity. Soils were often mapped as naturally occurring features, an approach, for example, adopted by the former Soil Survey for Scotland. The consequence is that the nature and properties of soils as they exist are often rather different from what might be expected if naturally occurring processes were the sole causes; instead, soils as landscape cultural components have many attributes which can only be explained with reference to

past land management practices. In essence, the nature and properties of soils can be considerably influenced by particular cultural processes; examples are as follows:

Stone clearance

A key constraint to the use of new agricultural implements in the 18th and 19th centuries was the high stone content in many Scottish soils; stones limit soil depth, increase implement wear and breakage as well as adding to labour costs. The stone content is high in most drift derived soils in Scotland, but this is particularly the case in granitic areas such as north-east Scotland where the cumulative effect of stone clearance is expressed in the presence of substantial stone walls known as consumption dykes. On the outskirts of Aberdeen, such dykes are up to 7m in width and 2m in height, indicative of the considerable effort made by generations of farmers. Although stone clearance accelerated with the introduction of new farming ways in the 18th and 19th centuries, clearance cairns are present in many upland areas and can date back to the third millennium BC as at Lairg in Sutherland (Carter, 1998).

Drainage

As with stone content, farmers have had a considerable cumulative effect on improving soil drainage for arable purposes. The most outstanding examples of land drainage in Scotland are the reclaimed Carselands of the Forth, Clyde and Tay. These low-lying estuarine deposits were colonised by peat following gradual uplift in post-glacial times and became the focus for peat removal and installation of drainage ditches from the 17th century. The legacy is some of the best agricultural land in Scotland. Cropping is also constrained by other poorly drained soils such as those derived from heavier textured drifts. These are particularly extensive in west and central Scotland where higher rainfalls also occur. Prior to the installation of stone and subsequently tile drains from the 17th century, drainage problems were tackled primarily by the creation of rigs. This involved either digging or ploughing to create ridges of soils with resultant improved drainage. In Scotland, such rigs are best preserved on improved pasture, golf courses or rough moorland,

where they can still be very striking landscape features. Such rigs can vary in width from narrow cord rig (c.1- 2m) to broad rig (up to c. 7m) and from being straight to highly sinuous. Dating evidence is sparse, but as with stone clearance features, rigs can date back to prehistoric times as in the Bowmont valley in south-east Scotland (Mercer and Tipping, 1994); Whyte and Whyte (1991) note that rigs continued to be formed in the first half of the 19th century in response to grain needs during the Napoleonic Wars.

Soil depth

The 'natural' soil in many marginal areas of Scotland is a shallow peaty or peaty gleyed podzol with a subsoil characterised by the presence of a fragipan (Bx horizon which is compact). Soil depth is thus a major constraint to plant growth and again, farmers have left a legacy in many areas of substantial improvement through deep ploughing and soil additions on rigland. Improvements in soil depth have been particularly outstanding in North-East Scotland. As any gardener knows, working and fertilising soils gradually leads to an increase in soil depth.

Manuring

For arable cropping in Scotland, both present and past, the critical importance of manuring needs no emphasis. Crop yields are highly dependent upon the availability of the key nutrients (N, P and K). Prior to the growing availability of commercial fertilisers in the 19th century, farming in Scotland depended primarily on the interaction of livestock and crops – livestock sustained crop growth and vice-versa (Shaw, 1994). Shaw (*op.cit.*) states that sheep dung was the most highly prized followed by that of fowl, horses and cattle; prior to 1850 very few pigs were kept in Scotland. Farms near to towns also benefited from the availability of night soil or other forms of organic waste; seaweed was extensively used where available though its benefits were limited to one or two seasons. The midden heap was where all waste from byres and houses was dumped prior to ultimate spreading on surrounding fields; overall cattle dung was the main component. The rapid decay of organic matter in soils inevitably poses major problems to any attempt to reconstruct manuring practices in the past – any evidence appears to have

disappeared, though recent work on lipid biomarkers offers the potential for identifying the type and intensities of past manuring (Simpson *et al.*, 1999).

Another important manuring process was paring whereby upper organic layers of soil were stripped, dried, used for bedding cattle and then stored in the midden prior to application to fields. On the lowlands where the provision of bedding for cattle was not such a problem, the dried turves were frequently burnt as part of the land preparation process prior to cultivation; as Woodward (1994) notes, this was very extensive in lowland England during the late 18th century. The stripping also removed some mineral material from the upper part of the soil; it was this mineral component that gradually led to the deepening of soils by the plaggen process at the rate of c.1mm per year. The effect of paring on heathlands was the creation of breckland, still evident in parts of Orkney and Shetland. The process of transporting turf, peat or soil has been widely practised round the North Sea; Stoklund (1999) calls this 'concentration agriculture' and he estimates that the required area of stripping is between three and ten times that of arable land. Turf manuring has been used in the western and northern areas of Jutland where soils are least fertile; it was widely practised until the middle of the 19th century when there was extensive reclamation of the heathland. Stoklund (1999) reports that for the island of Læsø, cut heathland turves or meadowland sods (*hakkenmøg*) were piled into heaps, left to decompose and were periodically chopped before being added along with manure to form dunghills which were subsequently added to fields. This process continued on Læsø until the first decades of the 20th century with one farmer persisting until 1949.

Plaggen soils – a case study of cultural soils

A plaggen soil is a specific type of anthropogenic soil characterized by a deepened topsoil (up to 130cm), produced by the gradual addition of turves which were impregnated by animal dung; other additions could be sand or litter. The topsoil is distinguished by a black to dark grey/brown colour, a high phosphate content and the inclusion of pottery or brick fragments. The deep topsoil is known as the *Eschhorizont* in Germany whilst Dutch plaggen soils are called *Enk* soils. Plaggen soils occur extensively throughout the sand and gravel landscapes of north-western Europe, stretching from Denmark and Schleswig-Hol-

stein to northern Belgium (Pape, 1970); similar soils occur in Ireland (Conry, 1974), Orkney (Davidson and Simpson, 1984) and Shetland (Davidson and Carter, 1998). Spek (1992) collates the evidence of dating and concludes that the majority of the German and Dutch plaggen soils were initiated in the 7th to 13th centuries; in more peripheral localities such as Orkney, their formation began later, c. the 12th century. Blume (1998) notes that plaggen management has been practised in particular localities for about 3,000 years with the oldest known plaggen soil under a Late Bronze Age mound on the Island of Sylt.

In Denmark, the Ulfborg project in Western Jutland has brought together a group of historians and environmental scientists from the University of Aarhus in order to understand the effects of agricultural practices on vegetation change and soil development. As explained by Dalsgaard (pers.comm.), the critical need in this area was the import of turf material and manure in order to sustain agriculture, a process which was in progress by the 15th century. At his Staby sampling site, a plaggen soil was investigated with a topsoil of 48 cm and high in total phosphate. It is likely that plaggen soils are extensive in central, northern and western Jutland.

In Scotland, examples of plaggen soil are also found in remote localities, for example the western mainland of Orkney and the small island of Papa Stour, located off the west coast of Shetland. Papa Stour provides an excellent illustration of the cultural legacy through manuring to present day soils. This island was the focus for the pioneering ethnographic studies of Fenton (1978) in the 1960s; he recorded the final years of the traditional mixed farming system based on cattle and sheep with crops of cereals, kale and potatoes. Thirty years later, an historically low human population in the island and sheep-dominated agriculture involving a grass-based forage system have ensured that most of the former arable land has gone out of cultivation, thereby preserving substantial areas of old arable soils unaffected by current agricultural practices. Therefore the island offers the opportunity to study cultivated soils that were the product of a distinctive set of traditional agricultural practices, unaffected by recent changes in farming (Davidson and Carter, 1998); it is also the focus of a current project involving micromorphology and biomarkers.

In the preliminary study, nine soil profiles were chosen to provide a wide variety of cultivated soils within the enclosed land of the island. Three were within rigs that formed part of the pre-1860 outfield of the enclosed land whilst another three were separate outsets. The remaining

three were from contrasting locations within one recently abandoned farm – a planticrue (a small stone enclosure for the raising of seedling kale plants), an enclosed kaleyard, and from adjacent uncultivated pasture land.

The documentary, ethnographic and soil evidence for turf manuring in Papa Stour indicates that the deep cultivated topsoils are true plaggen soils achieving topsoil depths of up to 80 cm. Turf was stripped from common lands and, after drying, was used for fuel or bedding for cattle before being applied to arable soils. There were three sources of organic manures in the traditional agricultural system of Papa Stour: peat and peaty turf, seaweed and animal dung. Fragments of carbonised and uncarbonised peat, noted in soil thin section, must relate only to the first of these three. The presence of carbonised residues reflects the use of peat and peaty turf as fuel with the ashes subsequently used as manure. Uncarbonised residues could derive from the direct use of peaty turves as manure or some more complex route via the byre or midden.

All fragments of peat (carbonised and uncarbonised), larger than 1 mm, were measured on soil thin sections and classified according to their internal structure, percentage mineral content, maximum mineral grain size and mineralogy/lithology. Results are summarised in Table 1 and are given as averages per group of thin sections in order to permit easy comparison. All of the fragments consist of organic matter or dominantly organic organo-mineral mixtures. In all profiles the dominant structural type (carbonised and uncarbonised) is amorphous organic matter with randomly arranged mineral grains. A substantial minority

Sample	Carbonised		Uncarbonised		Total area per slide (mm^2)
	Number of fragments per slide	Area per slide (mm^2)	Number of fragments per slide	Area per slide (mm^2)	
Deepened topsoils (n=16)	23.1	121.9	14.1	47.5	169.4
Kaleyard sample	10.0	29.0	190.0	1099.3	1128.3
Planticrue topsoil	3.5	11.3	13.0	42.0	53.3
Heathland Ah Horizon	3.0	10.6	0.0	0.0	10.6

Table 1. Summary statistics on peat fragments >1 mm recorded from soil thin sections (4,500 mm^2)

of fragments in all profiles are structured, in most cases this comprised parallel, convoluted layers of highly degraded plant tissue. In all samples, with one exception, tissue fragments are very rare. The proportion of mineral to organic matter in the fragments differ between carbonised and uncarbonised material. The majority of uncarbonised fragments contain less than 2% mineral components but for carbonised material there are roughly equal numbers of fragments with less than 2% and 2-20%. Very few fragments contain over 20% mineral components. The mineral grains are angular and most fragments contain grains up to fine sand size. Very few coarse sand grains are present.

Virtually all of this material may be interpreted as fragments of amorphous to semi-fibrous peat that is derived from the O horizon of a soil rather than an Ah horizon. The higher mineral content of the carbonised fragments is thought to be the product of shrinkage of the organic matter during combustion. Therefore the carbonised and uncarbonised material is essentially the same. The rare carbonised tissue fragments derive from woody plants and probably result from the burning of heathy turves. Average figures are given in Table 1 for deepened topsoils which demonstrate the overall dominance in soil thin sections of carbonised rather than uncarbonised fragments. Similar amorphous to semi-fibrous peat was applied to all of the cultivated soils. The slides from the topsoil in the planticrue are exceptional through having low concentrations of organic fragments and with the dominance of uncarbonised peat. This matches the documented practice of only manuring planticrues with fresh turf and only to a limited extent.

Conclusions

The distinctive feature about many Scottish landscapes is the imprint of past cultural processes; this continuity of the past is particularly evident in the more marginal and peripheral areas. Landscapes thus need to be perceived in terms of cultural rather than natural heritage. Fragments of ancient field systems as systematically surveyed by the Royal Commission on the Ancient and Historical Monuments of Scotland are the most obvious features of cultural inheritance on poorer land. However, the example quoted of plaggen soils as occurring in Scotland, Denmark and other areas of northwest Europe illustrates the importance of cultural processes in explaining present day environmental resources as well as for guiding landscape management strategies.

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