

SCOTTISH
NATURAL
HERITAGE



Boglands

SCOTLAND'S LIVING LANDSCAPES



Contents

Introduction	1
Climate, <i>Sphagnum</i> and the Boglands	2
A blanket of bog-moss	4
Raised in the Lowlands	6
Walking on water into pre-history	8
The thin red line	8
Life on the boglands	10
It's not all plants . . .	13
The 'Dark Casket'	14
Bogland distribution and landscapes	16
The changing pattern of pressures	18
Boglands – valuable wetlands, not wastelands	20



Introduction

What single image encapsulates 'Scotland' for most people? Perhaps the swirl of tartan, or maybe Landseer's famous red stag in 'Monarch of the Glen'. For some it might be rolling moorland, for others perhaps 'a wee dram' of whisky, or an image of a small croft beneath a brooding sky and, with it, the sharp tang of peat-smoke.

All these classic scenes have one thing in common – other than being quintessentially Scottish – yet this common element is so little regarded that few people now realise the major part it plays in Scottish life. It is the Scottish *bogland*. Dyes for tartan originate here, it is home to the red deer, the rolling moorland is part of it, whisky wouldn't be the same without it, and the tang of peat smoke is, effectively, hewn from it. In addition to all this, it also forms an outstanding part of Scotland's natural heritage.

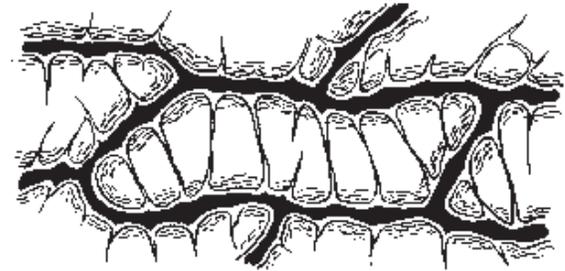


Climate, *Sphagnum* and the boglands

Throughout the year the atmosphere in Britain is generally more humid than in much of continental Europe. This can be all too apparent in some parts of Scotland where rain falls on two days out of three. Even in dry summer months, moisture-laden air is carried across Britain from the Atlantic or the North Sea.

This high humidity, coupled with regular rainfall throughout the year, produces conditions which are ideal for the group of lowly plants known as bog-moss or *Sphagnum*. These simple plants have no roots, nor any structures for controlling water loss. They are the botanical equivalent of a sponge, absorbing water and nutrients through the surfaces of their leaves, which are arranged along branches that occur in bunches along a simple stem. With a microscope it is possible to see that much of the leaf consists of huge water storage flasks while the chlorophyll is squeezed into thin strands. For such a plant to survive, conditions must be sufficiently damp throughout the year to keep these storage flasks topped up.

Under a microscope, the leaf has large empty cells for storing water and the chlorophyll is squeezed into narrow strands in between. Spirals of thicker cell wall prevent the cells from collapsing.



View from above



Cross-section

Individual bog-moss
(*Sphagnum capillifolium*).
The spreading branches
give it structure while the
hanging branches,
pressed to the stem,
draw up water.



When alive, this plant can absorb more than eight times its own weight in water which makes it too heavy for its tiny stem to support. As a result Sphagnum only grows as a mat of many individual plants which support each other. This produces a soft, spongy carpet which is typically a riot of colour because each Sphagnum species has its own vivid hue. The multi-coloured patchwork of simple mosses is the powerhouse of the bog.

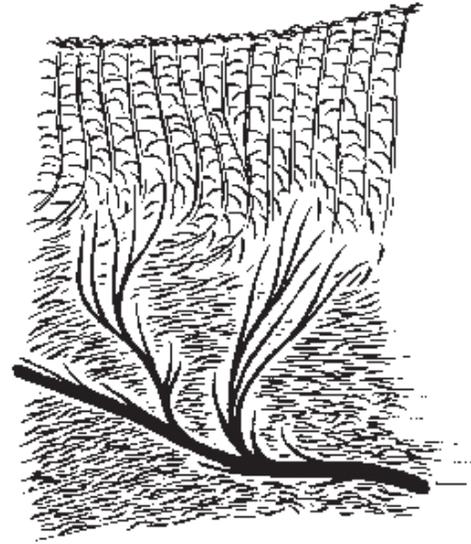


A blanket of bog-moss

Where rainfall, mists and fogs are frequent, as for example in western and northern Scotland, the soluble nutrients in the soil are gradually flushed out, or leached, to leave the ground waterlogged and infertile. Many species of *Sphagnum* are ideally suited to these conditions because they survive on very little nourishment. Gradually the mosses smother the ground with their colourful carpets and radically change the nature of the landscape and their environment.

An individual *Sphagnum* plant does not die, in the normal sense, because it is constantly growing from a bud at the tip of its stem. Below the tip, it is possible to find dormant but living buds among the branches about 20cm along the stem. Below this the old plant is dead. The normal organisms which break down dead plant material cannot survive in this soggy mat of plants, which is without air, very acidic and almost devoid of nutrients. Consequently layers of dead *Sphagnum* beneath the living surface do not decompose, but accumulate slowly, forming a new soil which we know as *peat*.

Cross-section through the surface layer of a bog. Showing the layer of living *Sphagnum* on top with the denser *Sphagnum* peat below, where plants such as bog cotton take root.



The accumulation process is very slow, perhaps no more than 1 mm every year, but the process has been going on for some 3,000 to 7,000 years, with the result that in some places almost the entire original landscape is now hidden beneath a blanket of up to 7 metres of peat bog. Such landscapes are known as *blanket bog*, and form the major part of Scotland's *boglands*.

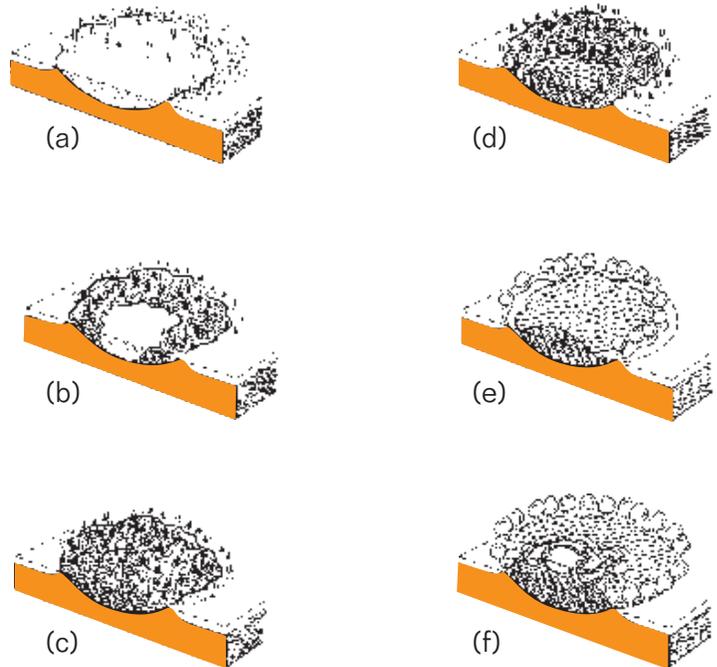


Raised in the lowlands

Soil leaching is much rarer in the gentler conditions of the lowlands, but bogs have an even more remarkable method of forming. When the glaciers retreated from Scotland 10,000 years ago, they left a landscape smeared with quite impermeable clays, dotted with lochs. Many of these lochs were slowly covered by with reeds (a) until, in time, no open water remained. In much the same way as *Sphagnum* fragments produce peat in a blanket bog, some fragments of dead reeds and other plants were preserved in the waterlogged swamp forming fen peat (b). As the peat accumulated, plants could no longer root in the mineral soils below (c). Plants in the outer fringes of the swamp soaked up all the nutrients flowing in from the surrounding ground, leaving the centre of the swamp waterlogged and with few nutrients – just the right combination of conditions to encourage a bog to form. Some species of *Sphagnum* started to dominate the vegetation and peat began to accumulate (d) – then something rather surprising happened!

The steady upward growth of the living *Sphagnum* carpet and the slow accumulation of the dead remains below together produced a peat deposit which began to rise above the local soil water-table. Instead of drying out, this rising accumulation, with its living surface, remained saturated, trapping all the rain which fell regularly and directly onto the low mound (e). The rainwater was released only very, very slowly. In this way, waterlogged conditions were maintained, and the only nutrients were those dissolved in the rain. Thus conditions for decomposer

organisms became even worse than in blanket bogs, and virtually all the fresh growth of bog-moss was retained as peat.



Stages in the formation of a raised bog.

Over the millennia, a mound of peat rises above the surrounding landscape by anything up to 10 metres (30 ft) high. The bog seems to be a dramatic upwards swelling of the local groundwater, although it is actually trapped rain which has yet to filter down into the surrounding ground (f). For obvious reasons this water-filled mound is known as a raised bog.



Walking on water into pre-history

Walking on a bog involves walking on a soft living carpet which floats on a material which is nearly all water – in fact it has less solids than milk. By weight, a raised bog may be up to 98 per cent water and only 2 per cent solid peat. Blanket bogs are rather more solid with as little as 85 per cent water. This great volume of water is held within the dead *Sphagnum* fragments. This ability to retain water is one of the properties which makes *Sphagnum* peat such a prized horticultural material.

There are very few parts of Scotland, particularly in the lowlands, where the view today resembles that seen by Bronze Age man – indeed a view which was even then

several thousand years old. Traditionally people avoid bogs because a careless footstep can plunge the unwary visitor at least knee-deep into the watery *Sphagnum* carpet. The high water content also makes it extremely difficult to turn this ground into farmland. As a result, many such areas which survive today retain the same character as they have done for thousands of years. It is possible to share a real sense of timelessness when gazing out across the Scottish boglands. Here is a landscape as old as, or in many cases several thousand years older than, the oldest man-made structures in Scotland. For millennia the bogs have stood as open landscapes while all around the great forests have come and gone.

The thin red line

A bog consists of two layers: the upper, very thin layer, known as the *acrotelm*, is only some 30cm deep, and consists of upright stems of the *Sphagnum* bog mosses, largely still alive and colourful with their red, yellows and ochres. Water can move rapidly through this layer.

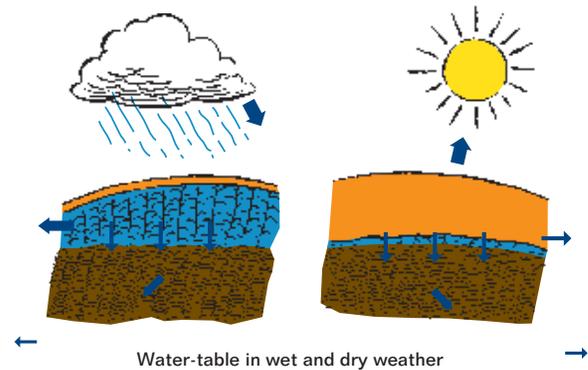


Below this is a very much thicker bulk of peat, known as the *catotelm*, where individual plant stems have collapsed under the weight of mosses above them to produce an amorphous, chocolate-coloured mass of *Sphagnum* fragments. Water movement through this amorphous peat is very slow indeed – typically less than a metre a day. This is where most of the rainwater is stored. From here the water slowly seeps down through the bog over several weeks or even months.

The catotelm resembles the lower layers of a tropical rainforest, or the abyssal depths of the oceans, environments which enjoy constant, unvarying conditions because they are protected from the turbulent environment above by a relatively thin canopy or surface layer. In the same way, the living layer, or acrotelm, shields the catotelm from direct contact with the atmosphere, sealing it in and providing it with a steady supply of water.

Under normal circumstances, the water-table within the bog never drops down into the catotelm. Even drainage merely empties the acrotelm of its water more quickly. Generally the water-table is very stable, spending some 95 per cent of its time within a few centimetres of the bog's surface. Because the surface of a bog typically consists of low hummocks and ridges, scattered with

hollows or pools, this stable water-table produces intense competition for living-space between species. And so, several zones of characteristic vegetation have evolved, each depending on their proximity to the water-table. In increasingly wet climates, bogs have adapted interesting surface patterns of pools to hold the surplus water which can not seep away before the next rainstorm. The pools are formed in the peat and do not go down to the underlying soil. They are unique to bogs and totally devoid of fish. However, they are home to a wide variety of insects. These peaty-pools or *dubh lochain* display dramatic differences in their patterns – size, distribution and orientation – across the country and provide much of the structural diversity of Scotland's boglands on which the living flora and fauna then depend.



Life on the boglands

In this remarkable environment, everything is waterlogged and floating on an immensely deep soup of peat. Yet there is often relatively little open water at the bog surface and nutrient levels are barely above that of distilled water. It is not surprising that bogs host some remarkable species.

Perhaps the most spectacular and best-known adaptation to life on the bog is the carnivorous plant. Several species have developed the ability to trap and eat animals as a means of supplementing their meagre diet. The animals are very small and almost exclusively insects, although the sundews (*Drosera* species) are able to trap the big darter dragonflies which have wingspans as wide as a human hand.

The sweet-scented bog myrtle (*Myrica gale*), typical of western boglands, forms a partnership with bacteria in its roots to obtain extra nitrogen, while the common bog-cotton (*Eriophorum angustifolium*) uses a 'snorkel technique', relying on large air-filled cells in its roots and leaf-bases to survive in the oxygen-poor environment beneath the living carpet of *Sphagnum*. A family of tiny, brilliantly-coloured 'jewel' beetles (*Donacia* species) use these air-spaces as living quarters.

Contrary to popular belief, boglands are not dreary places: a close examination reveals a wealth of colour and mixture of distinctive scents. The *Sphagnum* bog mosses themselves each have a vivid colour, some are deep wine-

Contrary to popular belief, boglands are not dreary places: a close examination reveals a wealth of colour and mixture of distinctive scents.

red, others are brilliant orange or gingery brown, while yet other have brilliant greens mixed with delicate salmon-pinks. They combine to form a scene as intricate and colourful as a Persian rug. Dotted through this soft carpet you can find the greens and pinks of heaths and heathers (*Erica* and *Calluna*), bright splashes of yellow and orange from the bog asphodel (*Narthecium ossifragum*), fuschia-pinks and ruby reds of the cranberry flowers and berries (*Vaccinium oxycoccos*), the delicate white and pink frothy flowers of the bog-bean (*Menyanthes trifoliata*), or the white rose-like flower of the cloudberry (*Rubus chamaemorus*) with its scarlet or orange fruit.

As the summer draws to a close, the boglands stand out most distinctively from the rest of the landscape. The leaves of both the common bog-cotton and, in particular, the deer grass (*Scirpus cespitosus*) turn the sward to a brilliant russet which seems to glow in the low winter light. These russet patches, swathes, or even entire landscapes, are sure indicators of bogland.



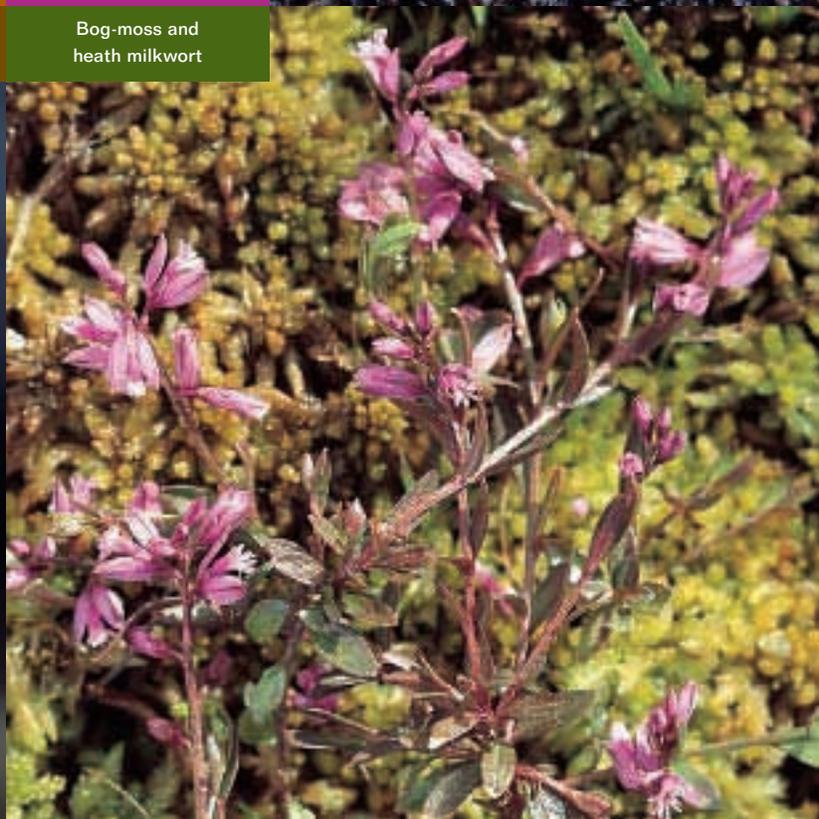
Common bog cotton



Round-leaved sundew



Great sundew



Bog-moss and
heath milkwort



Red-throated diver

It's not all plants ...

Boglands are home to only a few types of animals, yet they can boast the largest animal in Britain today – the red deer. Red deer can be found wallowing in peat baths to rid themselves of flies and parasites. Otters and badgers occasionally venture out into the bogs in search of the eggs and chicks of ground-nesting birds. You may also see pine martens, stoats and weasels, and even the very occasional wildcat.



Dragonflies



Dunlin

The songs of skylarks and meadow pipits provides incessant background noise on the boglands. But perhaps the two most characteristic sounds of the boglands are, first, the rustle and buzz of dragonfly wings on a still, sunny day as these huge insects patrol the pools and hollows that are dotted across the bogs of north and west Scotland, and the cries of the birds. Most evocative of all, however, is the combination of bird-songs: the sad 'wheep' of the golden plover as a plaintive background either to the delightful descending trill of a dunlin settling onto its nesting territory, or to the mournful cry of the rain-goose, or red-throated diver caterwauling in the evening sunset and adding to the haunted nature of the bogs.

The 'Dark Casket'

So called by the Irish poet Seamus Heaney, the 'dark casket' of the boglands bring their past with them to the present day. They are history books which can be opened page by page and then read word for word, browsed from chapter to chapter, or appreciated for one or two beautiful passages.

Stored within the peat, there is the complete record of the bog's history, and much more besides. By taking a downward core cut through the peat, it is possible to determine from the plant remains, many of which look as fresh as the day they died thousands of years ago, what species were growing on the bog at any time. Scientists have been able to link changes in the bog vegetation to shifts in the climate, showing that bogs are extremely sensitive historical indicators of climatic change. The snap shots from a range of bogs have helped us to piece together the small-scale changes in climate which have occurred during the last 10,000 years.



Late Bronze
Age Situla
(bucket)

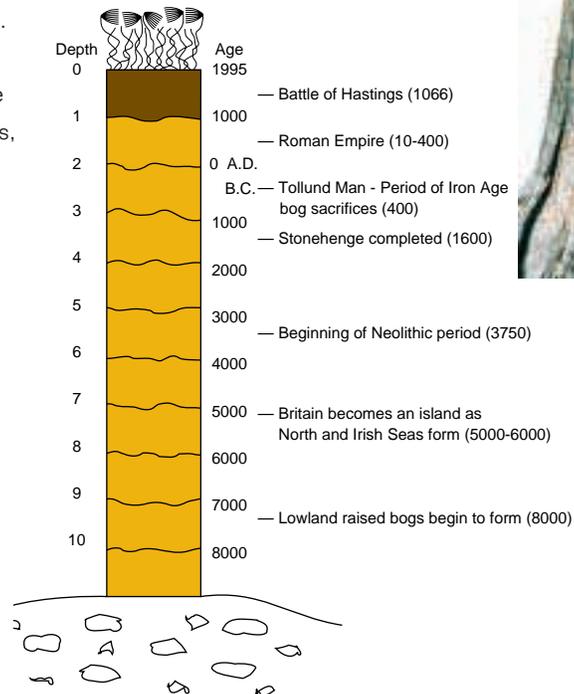


However, the 'dark casket' contains much more than just the history of the bog and its climate. Pollen grains from the surrounding countryside fall continuously onto the surface of the bog. Analysis of this 'pollen rain' from different layers in the peat reveals the composition of the vegetation dominating both the terrain around the bog and landscapes further afield. This pollen record has made it possible to reconstruct the history of the Scottish landscape far back before written records, almost to the end of the last ice age. We know from this record that the boglands have always been largely open areas in the landscape while around them a succession of forests have come and gone.

The pollen record shows phases when the first inhabitants began to clear the forests, but sometimes the human interaction was more direct. The magnificent bronze cauldron found buried in Flanders Moss may well have been a votive offering, whereas the Rotten Bottom Bow, Britain's oldest bow, was probably thrown aside into the bog when it broke while hunting game. There are buried tracks, coins, whole villages, jewellery and even 'bog butter' – a kind of soft cheese preserved by the acids in the peat.

But it is the people, the 'bog bodies', which really capture the imagination. Several have been found in Scottish bogs, but none has been subsequently preserved. Undoubtedly the best preserved are the bog bodies from Denmark, where Tollund Man, skin blacked by the acids and tannin from the bog, appears to be asleep, even though he was sacrificed and buried in the bog almost 2,000 years ago. Lindow Man, from a bog in Cheshire and dating from the same time, can be seen in the British Museum.

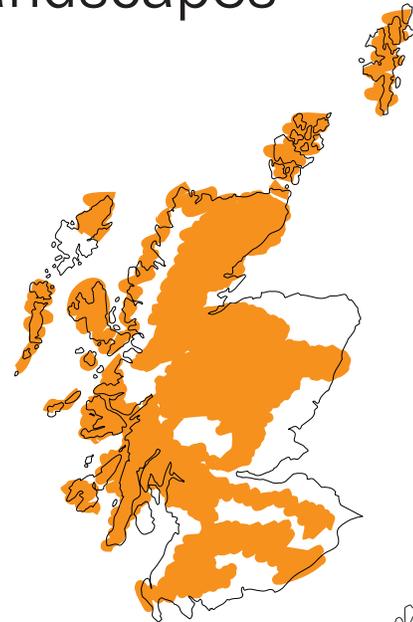
Late Bronze Age female figure (Detail) Votive statues were placed near treacherous stretches of track to ward off evil spirits and to ensure safe passage.



Bogland distribution and landscapes

Scotland has more than one million hectares of bogland, which represents two-thirds of the total bogland resource in Britain. Caithness and Sutherland possess a significant proportion of the blanket bog in Britain, and indeed Europe. Indeed the area of the 'Flow Country' in these two districts has been recognised by international specialists as unique and of global importance. In part this is because the world distribution of blanket bog is confined to a few oceanic coastal regions around the globe, and the Scottish blanket bogs are seen as the characteristic type by which all others are judged.

In the lowlands, the boglands are much more restricted, originally covering less than 30,000 hectares. Raised bogs were formerly found on the Grampian coastal plain, along the north Solway shore, and throughout the Central Belt of Scotland.



Distribution of blanket bogs.



Distribution of raised bogs.



The changing pattern of pressures

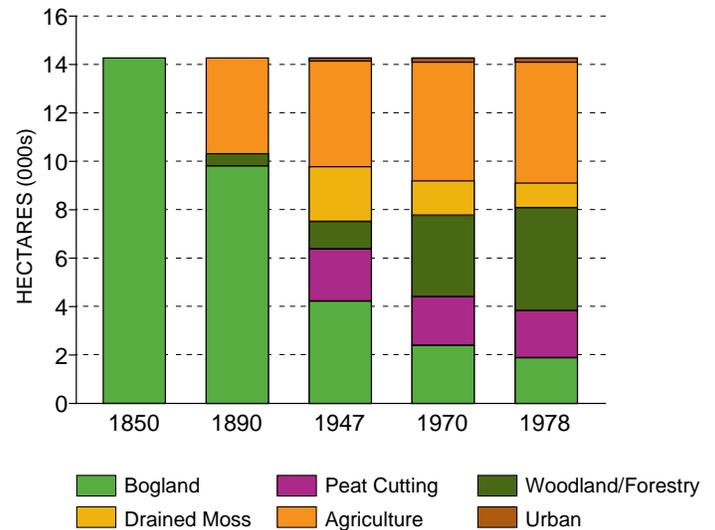
Until the turn of the century, the major land-use pressure on bogland came from agriculture and many of the smaller sites in the lowlands were entirely changed. Going back at least to Roman times, there has been a steady but small-scale cutting of peat for fuel, a practice which continues today.

This traditional use involves the removal of the living skin of vegetation, then slicing through the lower peat with a blade (known by various local names, such as a *tushkar* in Shetland). The peat is then stacked above the peat face for the summer months to dry, before being gathered in at the end of the summer and stored for use in the winter. The soft *mossy* or *white* peat of *Sphagnum*-rich bog is good for starting a fire, but the hottest, finest-burning peat is the *blue* peat from the lower layers of a bog.

When horses were the main form of transport, peat was cut commercially as an absorbent bedding for stables, but this practice died out after the First World War. However, at about this time, the need for pit-timbers gave rise to a programme of planting conifer forests on peat. Since then, very considerable areas of both raised bog and blanket bog have been planted, but the rate of planting has declined significantly in recent years. It is important that future forestry policies continue to take account of the conservation value of peat bogs and that the areas of national and international significance are not lost through planting.

Since the 1960s the horticultural industry has used peat as its favoured growing-medium, largely because of its water-retaining properties and its consistently low nutrient content. As a result, more boglands have been subjected to commercial peat extraction. With only a limited peatland extent, in future the industry will have to move increasingly to sustainable growing-media based on recycled organic materials.

Changes in land use on selected bogs over a 150 year period.

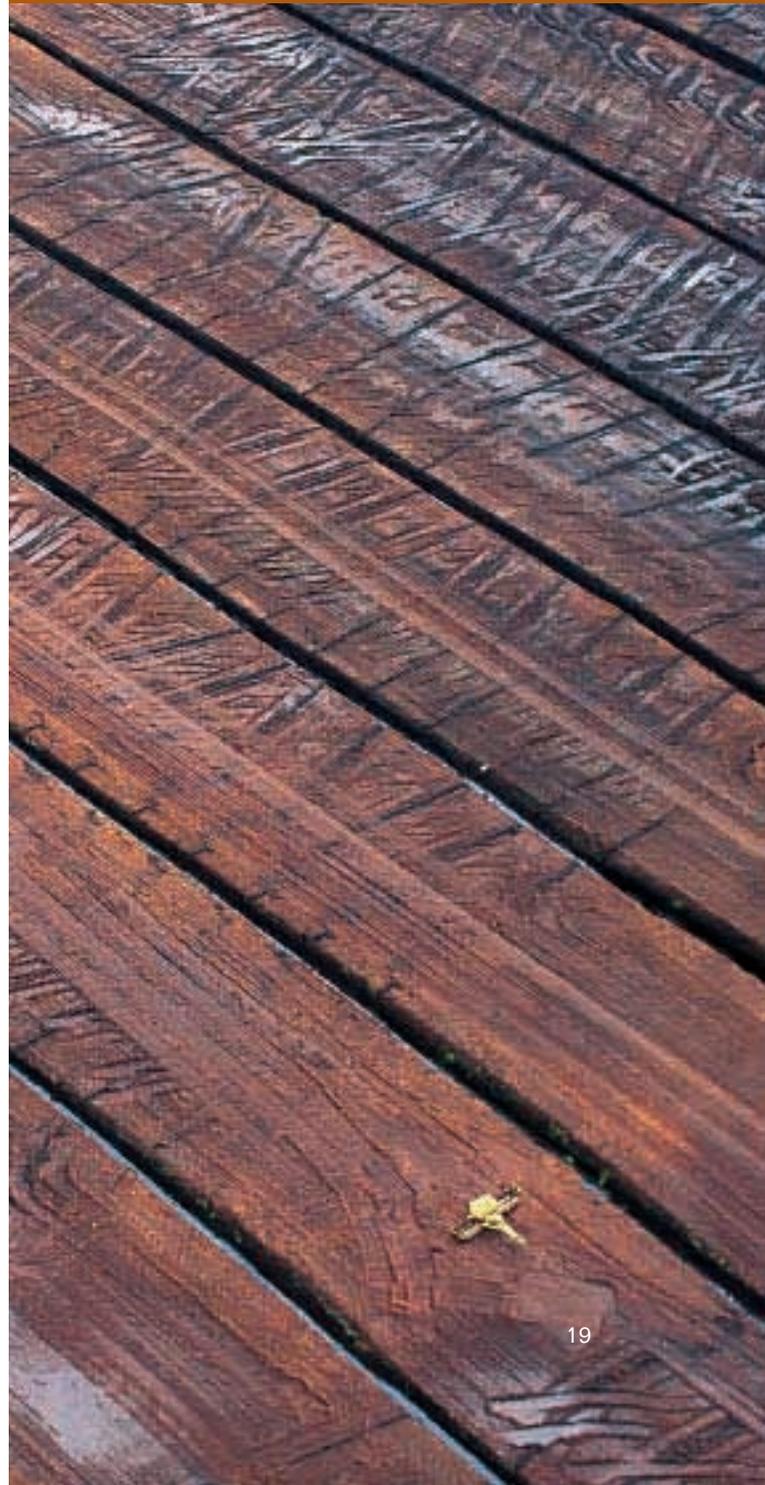


In the lowlands of Scotland, only 5 per cent of the original area of raised bog now remains in a relatively intact state.

In the 1950s ploughing on deep peat became technically possible, and made general drainage for agricultural purposes much easier. As a result, it is now difficult to find areas of blanket bog below 500 metres without at least one or two drains dug across part of the site. It is important that future afforestation policies continue to take account of the conservation values of bogs.

Considerable areas of blanket bog are eroding, especially bogs lying at 300 metres or higher. The deep gulying and haggging may be, in part, natural, but it is clear that the process is being accelerated by practices such as burning and over-grazing by both red deer and sheep.

Commercial peat extraction with a mechanical harvester.



Boglands – valuable wetlands, not wastelands

Since the time of the Clearances and the agricultural revolutions of the eighteenth and nineteenth centuries, the Scottish boglands have, like the Irish 'blacklands', been regarded as barriers to progress – bleak 'wet deserts' which offer little in the way of immediate financial return. Conversion to some other type of landscape has been the general practice. However, this has often proved more difficult than anticipated. Many schemes have been tried, but few have delivered any lasting benefits. Consequently a great deal of the bogland in the Highlands and the Southern Uplands has been modified, but still persists in varying degrees of naturalness and in varying states of recovery.

The difficulty of bogland reclamation has much to do with the character of Scotland (particularly its climate), combined with the nature of the boglands themselves. A better understanding of these very special places not only helps us to understand why so many of these schemes have had limited success, but also leads to a greater appreciation of the very real benefits to be gained from maintaining boglands in their natural state.

In many areas, without the bogland to form a protective layer over the underlying soils, the high rainfall would erode the soils and wash many of the less stable soils off the hill and into the rivers, causing severe problems downstream. De-stabilisation of the peat cover by burning or drainage can cause rapid peat erosion; and many reservoirs with



Lagavulin whisky distillery

peat catchments are now more than two-thirds full with peat sediments. Most of Scotland's drinking water comes from catchments which are dominated by bogland.

The whisky industry has recognised the importance of bogland water for more than 200 years – the water coming from the boglands is of such a special quality that it forms a vital ingredient in the mysterious art of the whisky distiller.

The Scottish boglands have a sense of timelessness. Dismissed as useless wastelands yet supplying most of Scotland's drinking water, they are often thought of as drab, dreary and lifeless, but in truth they are rich with vivid splashes of colour and species straight from the world of science fiction. These remarkable landscapes form one of the defining elements of Scotland's natural heritage, so we must take active steps to ensure that they are safeguarded for the benefit of future generations.



Further copies are available from:
Publications Section, Scottish Natural Heritage,
Battleby, Redgorton, Perth PH1 3EW.
Telephone 01738 444177.

Scottish Natural Heritage

Scottish Natural Heritage is a government body established by Parliament in 1992, responsible to the Secretary of State for Scotland.

Our task is to secure the conservation and enhancement of Scotland's unique and precious natural heritage – the wildlife, the habitats and the landscapes which have evolved in Scotland through the long partnership between people and nature.

We advise on policies and promote projects which aim to improve the natural heritage and support its sustainable use.

Our aim is to help people to enjoy Scotland's natural heritage responsibly, understand it more fully and use it wisely so that it can be sustained for future generations.

Designed and produced by Tayburn.

Photography: Laurie Campbell, Lorne Gill,
Patricia Macdonald, Steve Moore.

ISBN:1 85397 102 0

TH5000201

February 2001

Printed on environmentally-friendly paper

Price £3.95