UNDERSTANDING THE LANDSCAPE OF THE SCOTTISH HIGHLANDS

A PHOTOGRAPHIC GUIDE

James Fenton

Draft 12 March 2026

CONTENTS

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Introduction to be written

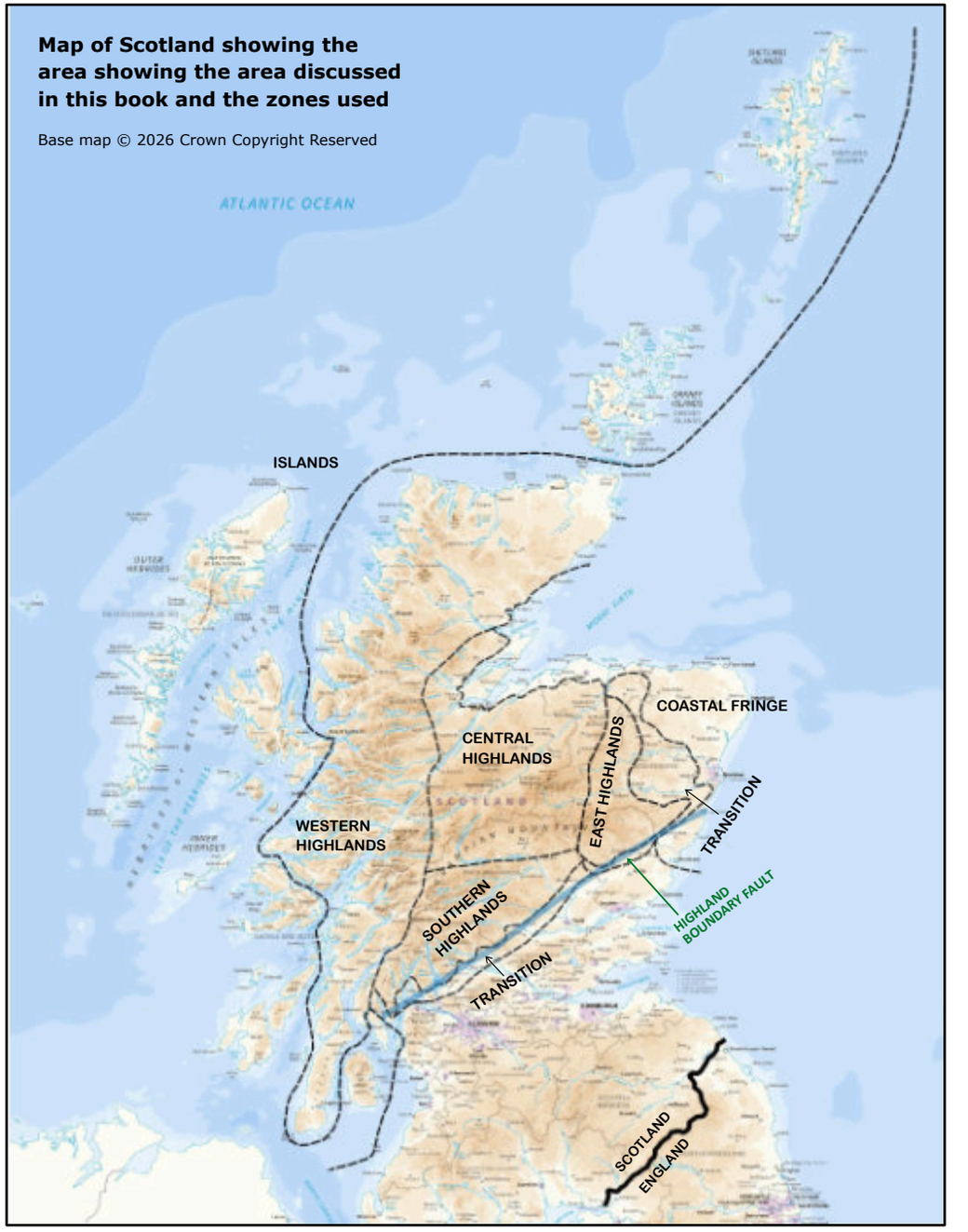
Add two more maps:

a) Main geological faults which divide up the Highlands:
-- Moine Thrust (referred to a lot in the text)
-- Great Glen Fault
-- Highland Boundary Fault (remove from current map)

b) Photograph locations (main pictures only)

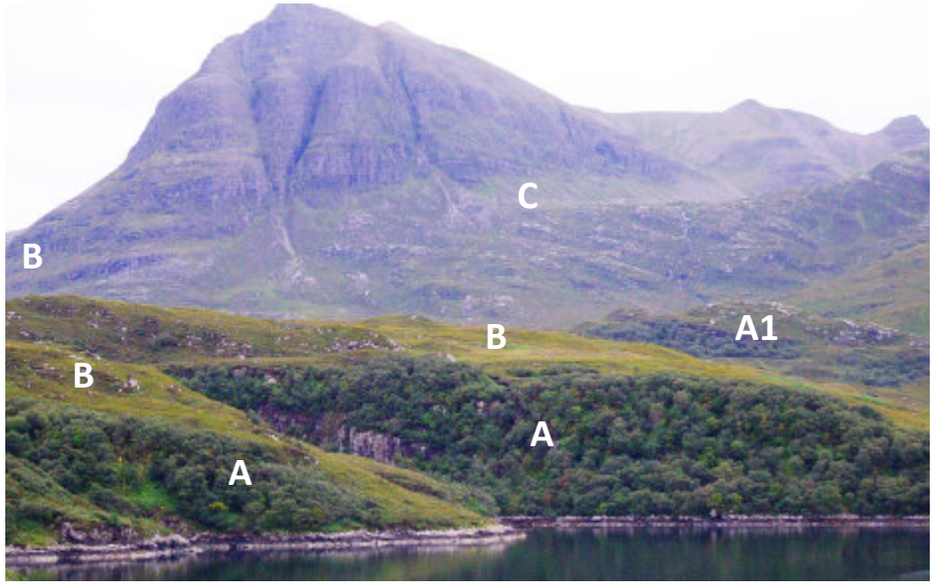
Add at end:

List of species mentioned with Latin names (necessary for foreign visitors)
Further reading



Map of Scotland showing the area showing the area discussed in this book and the zones used

NATURAL HABITATS: COASTAL WOODLAND & SCRUB
Kylesku, Sutherland

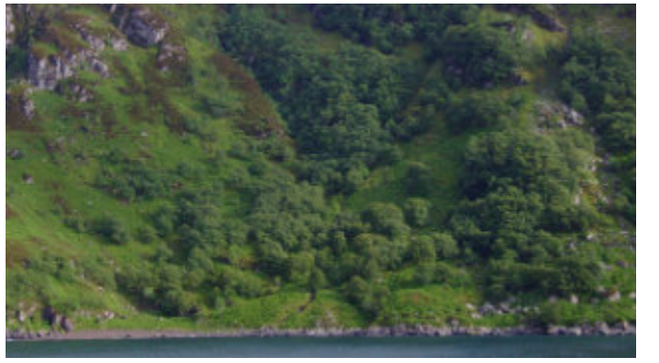


Much of the landscape of the Scottish Highlands is dominated by treeless moorland [xx]. However, there are pockets of natural woodland here and there, particularly on coastal slopes along the west coast. This shows an example of a birchwood on the shores of a sea loch in Sutherland (A), also with a small wood behind on a steep inland slope (A1) [see xx].

Such coastal woods are present because the steeper slopes have a better soil than the surrounding moorland (A), being well-drained and nutrient-rich. The mild climate along the coast results in some plant growth throughout the winter, which means that grazing animals, such as sheep and red deer, can feed on this winter-green herbage rather than having to eat the buds of trees.

This allows trees to regenerate whereas inland, which is cooler with no winter-green herbage, grazing animals can target the buds of young trees – eventually killing them, and so preventing the woodland surviving.

These coastal woods are often rich in mosses, liverworts, lichens and ferns owing to the mild, damp and humid conditions. Some of these are internationally rare.



A. COASTAL WOOD

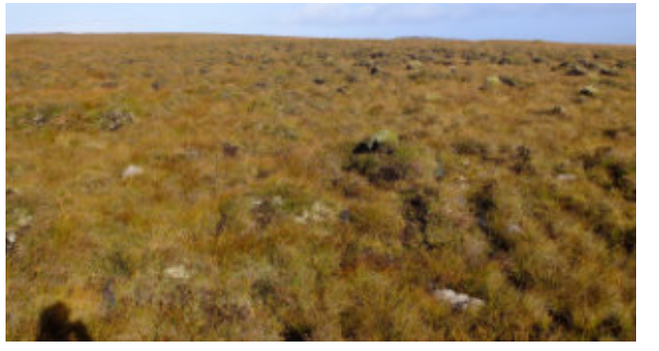
A coastal birchwood on the steep slopes of Loch Nevis. Much of this wood is grazed because it is accessible to red deer. There are also some inaccessible cliffs, which contain core areas of woodland – able to survive whatever the grazing.

A. COASTAL WOOD

A broadleaved woodland on the steep slopes along the Sound of Mull. Trees on cliffs which are inaccessible to deer can regenerate without being eaten. Such trees can also provide a permanent seed source for other areas, allowing trees to colonise out from the cliffs if conditions allow.

A. COASTAL SCRUB (WINTER)

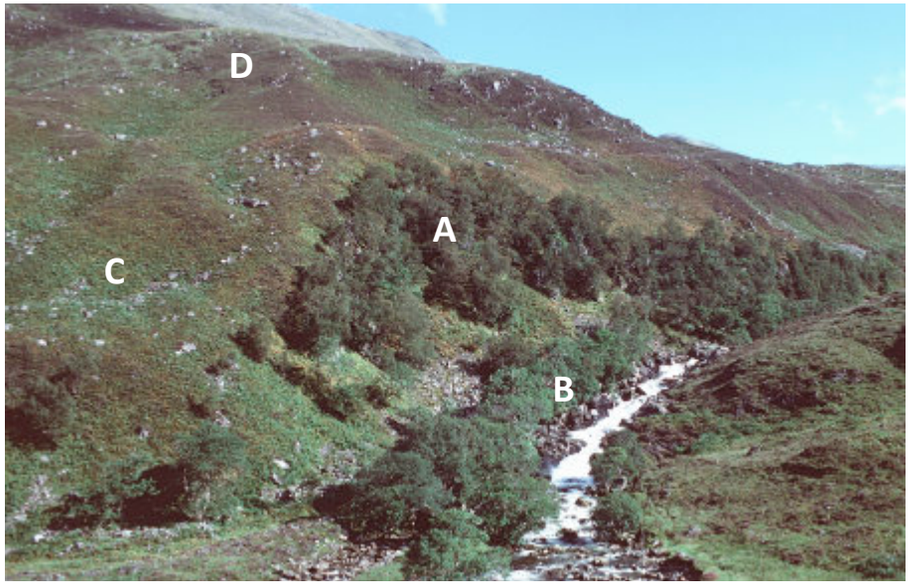
Scrub woodland in Argyll, the trees kept short by the wind. In the southwestern Highlands, coastal woods often have a wider range of species than further north, including birch, oak, ash, wych elm, hazel and sloe (blackthorn). A green patch of ivy is also visible here.



B. MOORLAND (WET HEATH)

Open moorland, *i.e.* natural vegetation without trees, is the dominant vegetation of the Highlands. Although at first glance all appearing uniform, there are in fact many different types of moorland [xx].

NATURAL HABITATS: HILLSIDE WOODLAND
Glenshiel, Inverness-shire



Natural woodland across the Highlands is often confined to steep slopes on hillsides and along burns and rivers. This is because such areas are free-draining and nutrient-rich, but also less accessible to sheep and deer.

On gentle slopes, long-term soil change brought about by leaching (from rain) can result in wet, nutrient-deficient soils, less suitable for trees. On these slopes, any young trees get eaten by grazing animals, particularly in winter and early spring when there is little palatable vegetation for animals to eat: tree buds are relatively nutritious.

Woodland can survive indefinitely on cliffs and in gullies because of the absence of grazing, so these can be seen as 'core areas'. However, if conditions change, such as a period of lower grazing, the woods can expand outwards from these core areas – later retreating back to the core if grazing again increases.

Research has shown that, thousands of years ago, there was significantly more woodland across the Highlands, but, over the millennia this declined to about 5% of the landscape owing to changes in soil and climate. In some places, destruction of forest by humans may have been a factor, but modern research shows a largely natural decline.

Surrounding these woods are bracken stands (C) [xx] and dry heath (D) [xx].

A. HILLSIDE WOOD

Birch woodland confined to cliffs and steep slopes in Glencoe. These north-facing woods are humid and amongst the richest in Britain for rare oceanic mosses and liverworts.

A. HILLSIDE WOOD

Another birchwood on a steep hillside in Torridon, with occasional Scots pine [xx]. The dense woodland on more level ground at the bottom of the photograph indicates a recent episode of woodland regeneration, presumably dating from when the number of grazing animals was reduced.

A. HILLSIDE WOOD

Birch woodland confined to the steepest slopes and gullies above Loch a' Chroisg in Wester Ross. There appear to be no young trees away from these slopes, indicating any trees are eaten by red deer and/or sheep.

B. GULLY WOOD

An example of trees being confined to a burnside gully at a site near Bridge of Orchy. This is a very common situation in the Highlands. Alder trees are often associated with streamsides and riversides [xx], although not visible here.

NATURAL HABITATS: MOORLAND TYPES

Ben Chapull, Argyll

Moorland vegetation dominates the landscape of the Scottish Highlands: this is natural, low-growing vegetation without trees. Although trees are absent or rare, there can still be woody plants present, albeit short in stature: these are dwarf shrubs such as heather, bell heather, cross-leaved heath, bog myrtle and willows such as the eared-sallow and the creeping willow.

At first glance, as in the picture here, all moorland looks much the same. But close scrutiny can show significant variations in the vegetation. Drier slopes can be dominated by heather (A), with gentle and moderate slopes dominated by wet heath (B), particularly in the west.

Well-drained and mineral-flushed slopes are dominated by smooth grassland (C), and, because these are relatively nutrient-rich, they provide the best grazing – and so are a magnet for sheep and deer, kept short by grazing. The dominant grasses here are sheep's fescue and common bent, so they are known as bent-fescue grasslands.

Where the soils are damper and less nutrient-rich, then damp grassland can be common (D), often dominated, as here, by tussocky purple moor grass. These are less heavily grazed than the smooth grassland (C).

On level ground and gentle slopes, then peatland often dominates (E) [xx].

A. DRY HEATH

This has heather (*Calluna*) as the dominant plant which, when in bloom [xx], gives the moors a purple colour, so characteristic of the Highlands. It can be tall (as here) if grazing is low, but can be prostrate, either from grazing, or, at higher altitudes, from wind.

B. WET HEATH

Wet heath can be the dominant moorland type, particularly in the Western Highlands. The main plants are cross-leaved heath and deer grass: it is deer grass which gives the moors their orange glow in late summer and autumn.

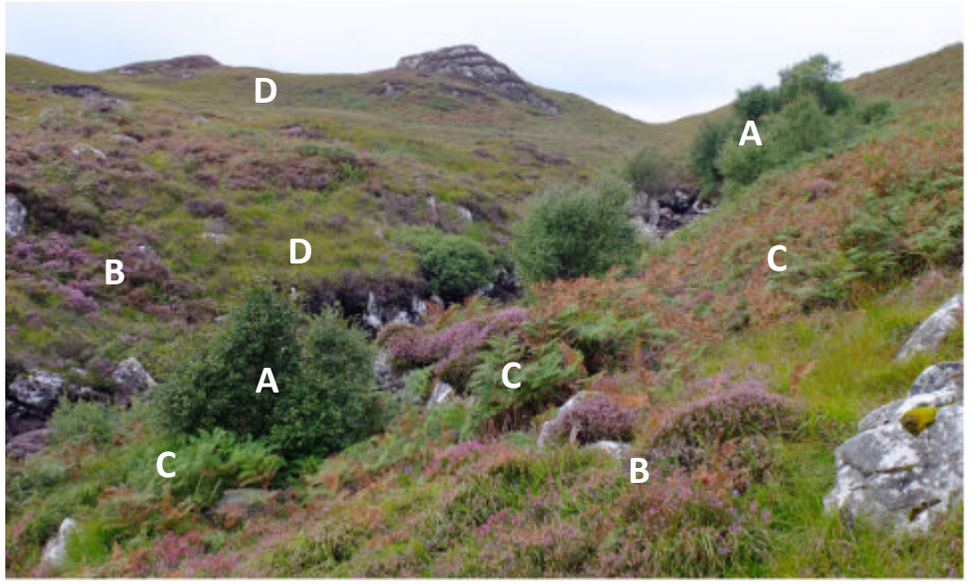
C. GRASSY MOORLAND (DRY)

This is the type preferred by grazing animals owing to the presence of palatable grasses on relatively dry and nutrient-rich soils. It is green and grazed short all year round. The extent of such grassland in the landscape determines how many animals the land can hold.

D. GRASSY MOORLAND (DAMP)

This is on ground which is more nutritious than wet heath, but less so than dry grassy moorland. The dominant plant is the tussock-forming purple moor grass, which is not very palatable to animals. The dead leaves are white in winter, but turn the hills green in summer.

NATURAL HABITATS: MOORLAND TYPES
Loch Ewe, Wester Ross



This is a typical area of moorland at low altitudes in northwest Scotland.

Trees, in this case birch trees (A), are restricted to the steep burnside.

Dry heather moorland (B) is on the better drained slopes. The heather is in flower, giving the moor a purple colour, indicating that this picture was taken in late summer.

Stands of bracken (C) are also present on well-drained slopes, here just beginning to turn brown in late summer. Bracken is a fern which is found throughout the Highlands, below 500-600 metres, on areas with better soil. It is notable because, although it has always been present, it has been expanding rapidly in recent decades – see [xx]. It is not popular because it invades the best grazing land, dry grassland [xx], and is not eaten by livestock. Indeed, as most ferns, it is poisonous to animals.

Ferns, which reproduce with minute spores rather than flowers, evolved before the advent of flowering plants, and so have had millions of years to evolve defences against grazing animals – in this case, being toxic to them. Bracken, which is a cosmopolitan species, rarely spores in Britain, most reproducing through the spread of its underground shoots.

A. GULLY WOOD

Trees are commonest in the Highlands along the sides of burns and rivers, where there is better soil and less grazing. This picture was taken on the island of Mull.

B. MOORLAND (DRY HEATH)

The main picture shows heather (also called ling, *Calluna* in Latin) in flower. This shows the two other common heaths: the darker purple bell heather which prefers the driest areas, and the paler cross-leaved heath, which prefers damper areas.

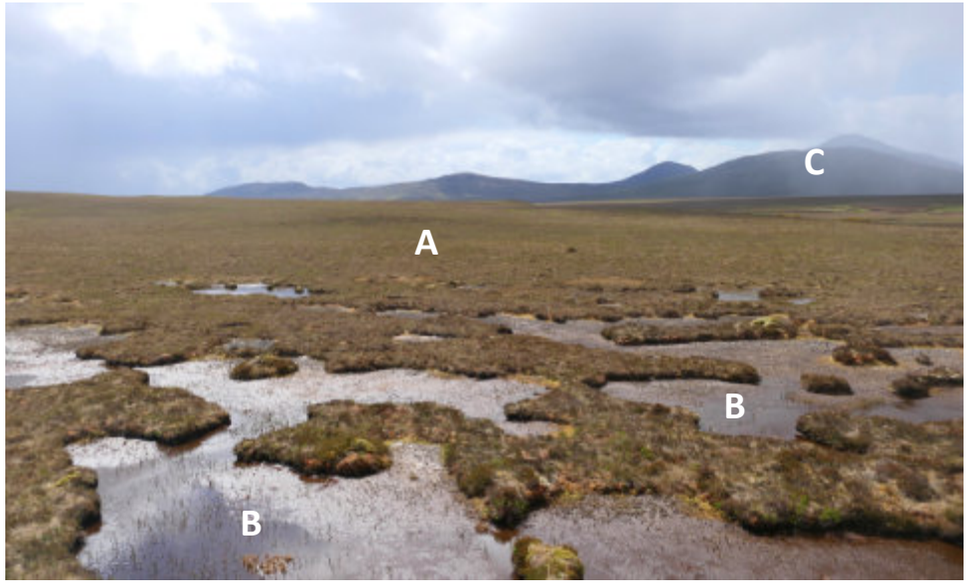
C. BRACKEN

Shoots of bracken spreading through a stand of heather. Bracken, being a fern, has shoots which grow by uncurling, as visible here. It dies down in the autumn, leaving brown, dead stems which are visible throughout the winter. Once its shoots are fully open, they shade out the other plants.

D. MOORLAND (WET HEATH)

Wet heath [xx] is the dominant vegetation across much of the far northwest of the Highlands, here with the deer grass just beginning to turn orange in the late summer. The soil consists entirely of humus, which can sit directly on the bedrock.

NATURAL HABITATS: MOORLAND (PEATLAND)
Flow Country, Caithness and Sutherland



'Peat' consists of undecomposed plant material. The cool, wet climate of Scotland means that plants decay slowly and, over time, their remains build up to form a thick layer which can cover the whole landscape. Because such peat 'blankets' the landscape (A), it is called 'blanket peat', and Scotland is a world centre for this internationally rare habitat. Peat accumulates slowly, of the order of 1mm depth increase *per* year. So peat 1 metre thick could be at least 1,000 years old.

At deeper levels, the peat is permanently waterlogged, indicated by the fact than any hollows are permanently filled with water (B). But if the peat is cut out, and then dried, it provides a good source of fuel. Indeed because trees have always been rare in the Scottish landscape in historical times, it has been peat which has provided the main fuel for heating houses [xx].

Peat cannot form on steeper slopes (C) because these are better drained, and, additionally, gravity would cause any peat which did form to flow downhill.

In depressions in the landscape, then 'valley peat' forms, kept waterlogged by water collecting in the hollows. On level ground, a 'raised bog' can form, characteristically dome-shaped. These were once common on coastal flats, but are now rare in the Highlands owing to centuries of cutting for fuel and drainage for agriculture.

A. BLANKET PEAT

Much of East Sutherland and Caithness has only gentle slopes, resulting in the most extensive tract of blanket peat remaining in the UK. It is known as the Flow Country, and recognised internationally as a World Heritage Site.

A1. VALLEY PEAT

This is an example of a peat-filled hollow, the depth of the peat indicated by the remains of an old peat-cutting on the left [xx]. The deepest peat in Scotland is 11 metres thick, in a hollow at a site on Islay. Around settlements, much of the valley peat has been removed over the centuries to provide fuel.

A2. RAISED BOG

A raised bog at a low altitude site on Islay. These were once common on raised beaches [xx] and at the seaward end of the larger straths [xx]. Relict raised bogs can still be seen in Strathcarron, Corpach (which is now being built over), North Connel, and Machrihanish.

B. BOG POOLS

In any place where a hollow in the peat is below the water table, there will be a pool. Generally blanket peat and raised bogs start off without pools but, over time, owing to the complex dynamics of peat growth, they become more common: they expand to form 'dubh lochs' (black lakes).

NATURAL HABITATS: MOORLAND
Coire Cerslie Hill, Inverness-shire

This shows a round-topped hill in winter with a summit altitude of 654 metres. The relatively flat summit ridge is covered in deep blanket peat (A) [xx]. Peat cannot form on steep ground both because steeper slopes are free-draining *i.e.* drier, and because and peat which did form would move downhill under gravity.

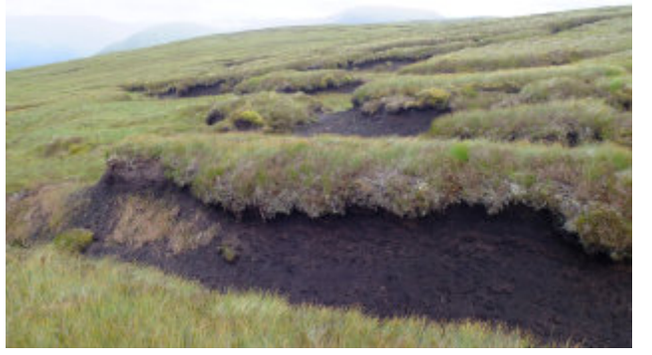
But even on gentle slopes, there is some downhill movement of the surface layers of the peat bog which, where the slope steepens, can result in vertical edges of exposed peat (B) owing to the the surface layer breaking off.

In this picture the steeper slopes below the blanket peat are covered in dry grassland (C) [xx], which provides the best grazing and will be where any red deer or sheep present will tend to congregate. In summer, these areas will be green. It is a common situation in the Highlands that the best grazing is on the steep well-drained hill slopes, with the low ground below (and sometimes the high ground, as here) of low grazing value because it is covered in blanket peat – and peatland vegetation is not very nutritious to grazing animals.

The very steep ground below, with some exposed rocks and cliffs, is dominated by heather (D), where it is largely out of reach of grazing animals.

A. BLANKET PEAT

This the summit of the same hill as on the left, in summer, when the vegetation is greener. Underneath the vegetation is a layer of peat [xx] one to two metres thick.



B. VERTICAL EDGE OF PEAT

This is taken near the site of the photograph above and illustrates the depth of peat. Vertical edges of exposed peat are present at the downhill-end of the blanket peat. The vegetation overhanging the edge shows it is moving downhill, and/or the vertical edge is eroding back.

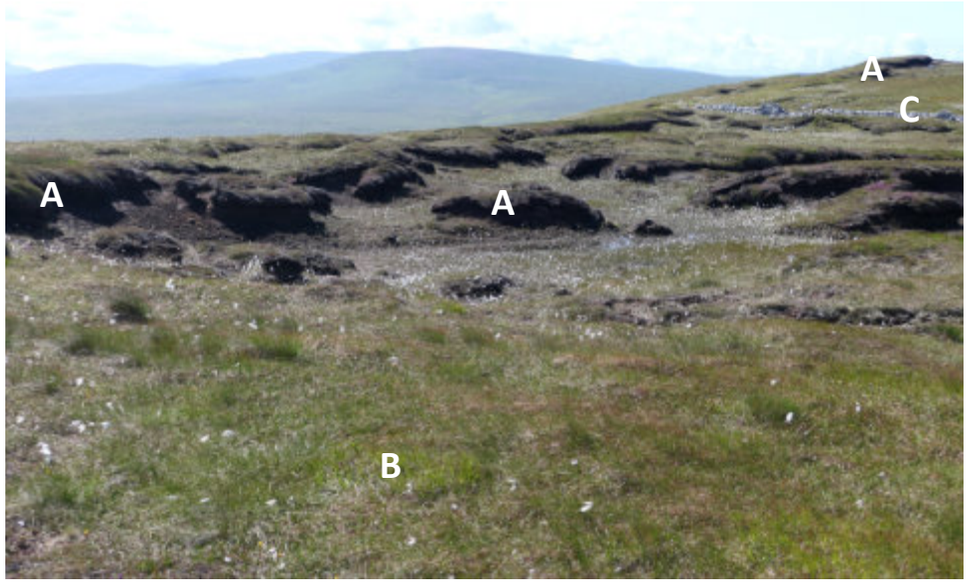
C. UPLAND GRASSLAND

Hillside dry grassland, the habitat favoured by sheep and deer on the open hill. The grass on these slopes is of higher nutritional value than the other moorland types (xx).

D. HEATHER

In areas where the soil is poor (acidic and nutrient deficient), heather can dominate the the moorland landscape, particularly in the eastern Highlands. Where the soils are richer, then heather is less likely to be dominant. Although it thrives on dry soils, it it also found at lower density on peat bogs and wet heath.

NATURAL HABITATS: PEATLAND EROSION
Cape Wrath, Sutherland



Peat is a soft material and subject to erosion (A), the chance of which increases as the peat thickens over time. The main causes of erosion are:

1) Water flow, with streams on the surface slowly eroding down into the peat.

2) Downhill creep of the surface layers of peat, even on gentle slopes, which results in vertical edges of exposed peat.

3) Trampling from animals or people, breaking through the surface vegetation.

4) Fires in extreme conditions, which can burn down into the peat.

Erosion exposes the peat under the surface layer of vegetation, which is then subject to further erosion from water flow, trampling, decomposition of the peat, and frost action (where the freezing and thawing of peat moves the peat around, preventing colonisation by plants). Erosion also occurs when pools on peat [xx] naturally drain, revealing the peat which was once underwater.

In many cases, once eroded peat is colonised by new peat-forming vegetation (B), so the long-term process of peat growth begins again.

A. ERODING PEAT

A gully through deep blanket peat caused by water flow. The bottom of the gully contains redistributed eroded peat, with some plant colonisation. An old peat bog may have a network of such gullies across the bog.

B. ERODED EDGE

A vertical edge of exposed peat. The surface vegetation, heather, has flowed down over the edge, the overhang now hiding the top. A stump of Scots pine is visible at the base of the peat, exposed by erosion. This indicates that the area was forest 1000s of years ago, before becoming swamped by peat.

C. PEAT BOG VEGETATION

Only certain plants cause peat formation. Visible here are Sphagnum moss (reddish) and bog cotton (the white tufts are its seed heads). Other plants on peat include cross-leaved heath, heather, bog myrtle, purple moor grass and deer grass.

D. RUINED DYKE

Visible in the main photograph is a ruined dyke (stone wall) [xx], built to enclose (or exclude) animals – dating from a time when livestock were present.

GEOLOGY: DRY STONE WALLS (DYKES)
Fair Isle

In the eras before fencing wire was invented in the 19th century, stone walls were built as means of either enclosing or excluding farm animals from certain areas, or as land-ownership boundaries. The picture here shows a 'dry stone dyke', that is one built without mortar (see lowest picture, right).

Many parts of the Highlands have plentiful stones available for building, hence the prevalence of this kind of field boundary. Most building occurred at the time of 'agricultural improvement', starting in the 1700s. Before then boundaries were built of turf, which do not persist long in the landscape once they fall into disuse. However, some dykes from the Stone Age (Neolithic), characterised by the use of very large stones, are still visible.

Some dykes were traditionally built with an unstable look (many air gaps), to discourage jumping over by sheep. Farms and croftland [xx] often had a dyke separating the cultivated land from the unmanaged hill land, called the 'head dyke' [xx].

Close observation of the building style gives a very indication of the geology of the landscape, because different geologies result in landscapes and rocks of different shapes. Old, hard rocks tend to produce rougher landscapes than younger, softer rocks. The above dyke has stones of many different shapes, from a hard metamorphosed mudstone.

GRANITE

In contrast to the main picture, this dyke on Iona is built of granite boulders, which are rounded in shape. Hence, if such a dyke is seen, then this means that there is granite in the vicinity.

SANDSTONE

In contrast, softer sandstones, here Old Red Sandstone on Orkney, result in thin, flat rocks – resulting in a different style of building. The eastern coastal fringe of the Highlands is underlain by such softer sedimentary rocks, making the landscape smoother and giving better agricultural soils.

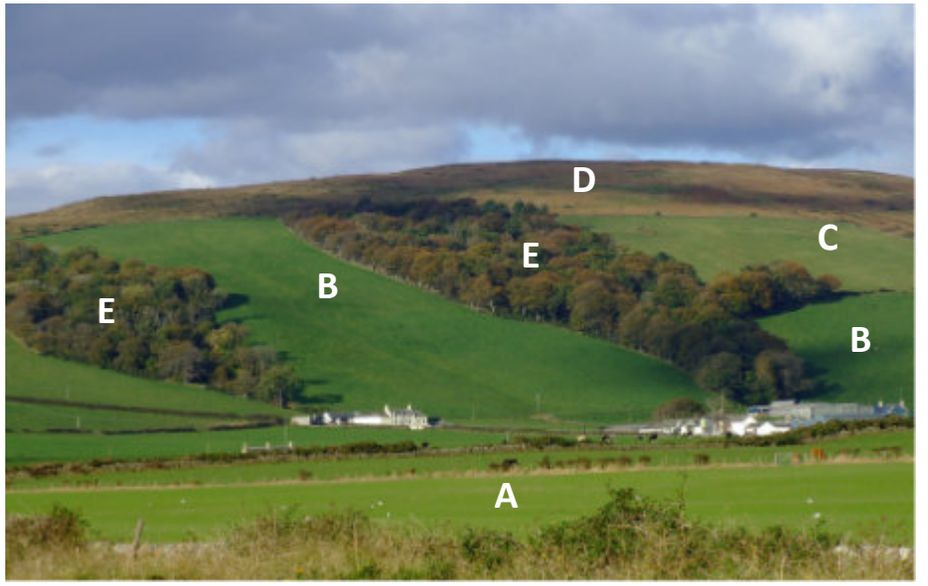
LICHENS

This dyke is built of a harder rock type which has broken up into rectangular stones. It is covered in orange lichens, which indicates a coastal location – where such lichens are common.

D. MORTARED DYKE

A 'dry stone dyke' is one built without mortar, unlike a mortared dyke as shown here. Perhaps counter-intuitively, a mortared dyke can be less robust than a dry stone. This is because, as stones settle down over time, the mortar can crack; in a dry stone one, they become packed.

GRAZING PASTURE
Isle of Bute



Except for the eastern coastal fringe [see Map xx], the climate of the Highlands is too wet for modern-day arable agriculture: on a year-to-year basis, it cannot be certain that crops such as barley or wheat will ripen to the required standard. The most robust cereal is oats which was traditionally grown in the Highlands because it can ripen in most summers. This is why porridge (made from oats) is traditionally associated with Scotland.

Additionally, much of the Highland landscape is too rough and stony for large arable fields. On the other hand, the mild, wet summers are ideally suited to growing grass –hence the prevalence of livestock farming, in particular sheep and cattle.

Before the introduction of sheep at the time of the Highland Clearances of the 1700-1800s, cattle were the mainstay of the economy of the Highlands and Islands. Calves born in the spring were grazed on grassland throughout the summer, and in the autumn were taken to markets in central Scotland and England along 'drove roads' – the droving trade.

Although the Highlands produce plenty of grass in the summer, it mostly dies off in winter. To support animals over the winter, in the past fields were cut for hay, nowadays it is mostly made into 'big bag silage'. This view also shows shelter belts of trees (E) [xx]..

A. PASTURE (IMPROVED)

There are several different types of grass pasture. Pasture is 'improved' agriculturally by adding fertilisers, and also by ploughing the land and seeding with better quality grasses than the original native species.

B. PASTURE (HAY, SILAGE)

The best fields on level ground are left ungrazed in the spring, and then cut for hay or silage in summer [xx,xx]. The aftergrowth is grazed in autumn and winter. improved pasture is more nutritious than unimproved, supporting more animals; it tends to be green all year round.

C. PASTURE (UNIMPROVED)

In contrast, 'unimproved' grassland has never been ploughed and still contains the original plant species, although, lime can be added to improve fertility [xx]. This, and the above two categories, are found within the head dyke [xx], *i.e.* comprise the inbye land [xx].

D. ROUGH GRAZING

There can be a lot of grazing on 'the hill land' beyond the head dyke consisting of unmanaged 'rough grazing' of native plant species. There are various types depending on the soil. The closely-grazed grass here indicates a good soil with high grazing, but with some rushes present [xx].

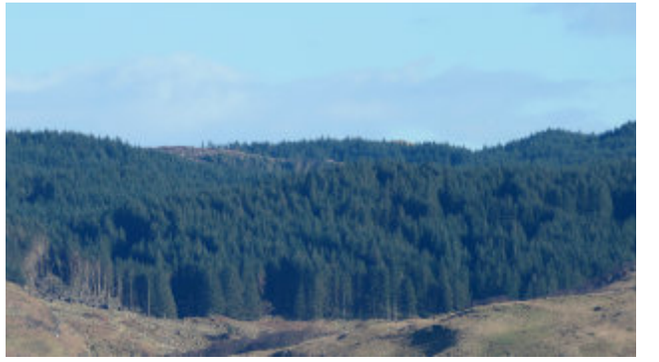
COMMERCIAL FORESTRY: PLANTATIONS
Loch Seil, Argyll

The Scottish Highlands had only about 5% woodland cover at the beginning of the 20th century [xx]. Following the end of the last Ice Age about 10,000 years ago, vegetation recolonised the land as the ice sheet retreated and the climate warmed. Trees colonised Scotland and reached a postglacial maximum extent, before a natural decline to the current low levels, which started 4,000 - 6,000 years ago.

Today, woodland cover has increased to about 17% of the land, largely through the planting of coniferous trees which are grown commercially to meet the needs of the UK timber industry. These commercial forests expanded rapidly following the creation of the UK-wide Forestry Commission in 1919. This was because the First World War brought attention to the fact that the country did not have its own strategic reserve of timber.

During a depression in sheep farming in the 1930s, whole farms were sold to the Forestry Commission, particularly in Argyll and Galloway, resulting in the landscape changing from open moorland to dense conifers. Where such forests cover a large tract of land, it is referred to as 'blanket forestry'. Today the Scottish Government has target of 25% of Scotland to be under trees.

(E) in the picture above is a track built to access the forests [xx].



A. OLD PLANTATION

The trees planted today are predominantly Sitka spruce, a species native not to Scotland but to western North America. Over the years it has been genetically improved to match the climate and soil of Scotland.

B. CLEARFELL SITE

Trees are planted close together so that they grow tall and straight, without side branches; this is what the timber industry requires. Scotland is a windy climate and if the trees are left to grow too tall they are liable to blow over. Hence they are felled after about 60 years, in large swathes known as 'clearfells'.

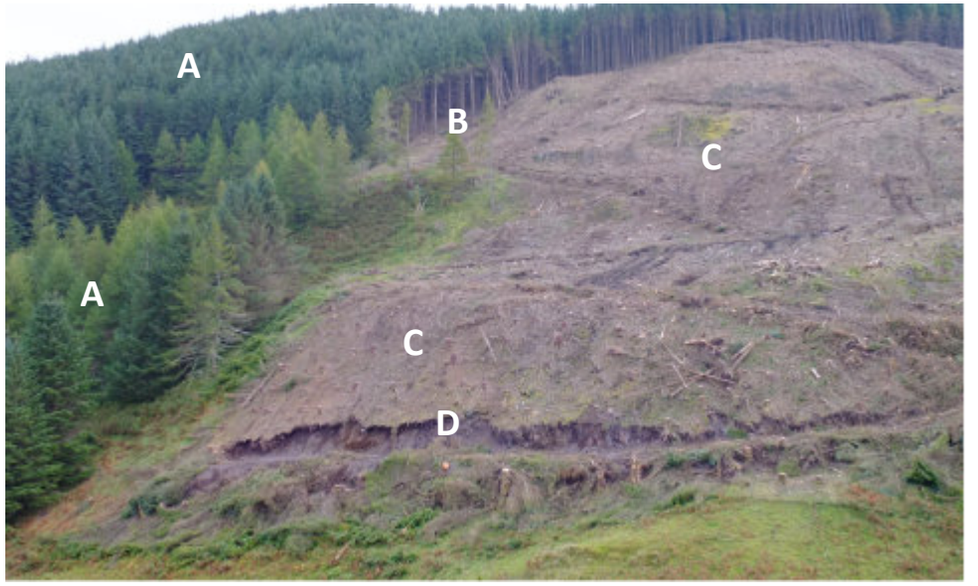
C. RECENT PLANTING

After felling, the site is replanted with seedlings of conifers grown in distant nurseries – and the growing cycle starts again. In this picture, a new plantation of young trees has been planted on what was once farmland, as indicated by the old dyke. An old plantation is visible in the background.

D. YOUNG TREES

Here, remains of old trees are visible in the foreground, indicating that this is a second rotation forest. When trees are first planted, there is open ground between the trees, visible in the picture above. But over time, the canopy closes and all vegetation is shaded out. The brown trees here are larch.

COMMERCIAL FORESTRY: TIMBER EXTRACTION
Loch Seil, Argyll



This shows a commercial plantation of conifers on the left (A) and a recent clearfell site on the right (C). The trees have only recently been felled as indicated by the fact that the ground is bare of vegetation. Dense plantations shade out all the light so that plants are unable to grow under the trees. Over time, the bare ground re-vegetates as shown in picture A.

At the very bottom of the picture the ground has not been planted with trees as shown by the presence of the original grassy vegetation. However, the planting of trees, the tree roots and the subsequent soil disturbance from timber extraction changes the soil structure, so that when a clearfell site re-vegetates, the plants which colonise are not the same as those on the original moorland [xx].

This means that planting forests irreversibly changes the nature of the landscape, and results in the loss of the natural vegetation of the Highlands.

Additionally, the vehicle tracks built to enable the timber to be harvested (D) means that the original wild nature of the landscape is also lost: with each new forest, the extent of wild land in the Highlands beyond the reach of cars and lorries declines.

A. CONIFER PLANTATION

Trees at the edge of a forest get buffeted by the wind and grow strong to withstand it. After felling, if trees once in the middle of are now at the edge, these weaker trees are liable to blow over ('windthrow').

B. TIMBER FELLING

Trees are nowadays harvested by machines which cut down the trees, remove the side branches ('snedding') and cut the trunk into lengths suitable for loading onto a timber lorry. One man can fell a large area in a singly day.

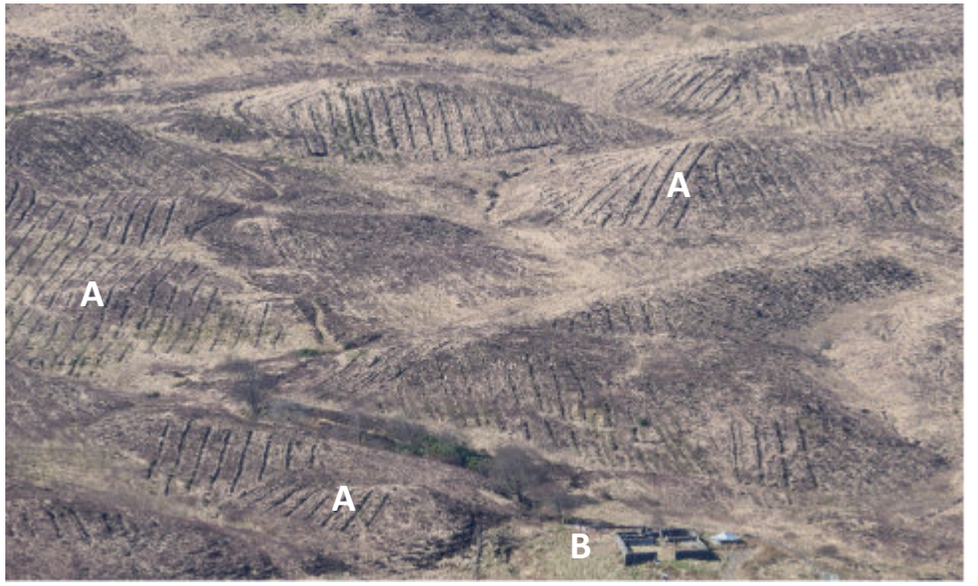
C. CLEARFELL SITE

A recently felled site before the planting of the next generation of trees, and before vegetation has colonised. A few dead tree trunks have been left standing. The cut branches on the ground have been moved into stripes by machine, leaving space for young trees to be planted in rows.

D. FOREST TRACK

Modern forestry cannot take place without the use of large machinery and 44-tonne timber lorries. To enable access for felling and timber removal, a network of large vehicles tracks are engineered throughout the forest.

COMMERCIAL FORESTRY: GROUND PREPARATION
Loch Awe, Argyll



The soils of the Highlands and Islands have developed over the 10,000 years since the last ice age. Over time, the high rainfall across the region has washed out the nutrients beneficial to plant growth ('leaching'), or washed them down to deeper levels of the soil. This has made the soil too acid for earthworms, so, apart from the best soils such as occur under dry grassy moorland [xx], there is no soil mixing by worms – with a resultant build-up of dead, acidic plant material at the surface.

Additionally, iron in the soil gets washed downwards where it precipitates out at depth into a solid lay impenetrable to water – the 'ironpan', or 'bog iron'. In the past it was quarried in the Roman and Viking eras as a source of iron.

The end result of all this is that many Highland soils are not very good for growing trees without changing the soil structure. For this reason, the double mould-board plough was invented which, when towed behind a powerful caterpillar tractor, breaks through the ironpan, brings the more nutrient-rich soil horizons to the surface and allows the soil to dry out. Trees are then be planted on the dry ridges created, where they grow much faster than if planted direct in unploughed ground.

A. PLOUGHED HILLSIDE

A hillside which has been forestry ploughed. The structure of the original vegetation can still be seen: the orange/brown areas were bracken [xx], the white areas grass, and dark areas, heather.

A. PLOUGHED HILLSIDE

A close-up of ploughed moorland, with planted young trees visible on the ridges of upturned soil. Such ploughing causes irreversible change to the naturalness of the landscape, and the ridge/furrow lines will remain for thousands of years. [see also 'lazybeds' xx]

A1. MOUNDING

In recent years, 'mounding' has taken over from ploughing in many places because it is seen to do less environmental damage. This is carried out by a digger with a bucket which scoops out a small section and places it upside down nearby as a small mound: trees are planted on this.

B. FANK FROM SHEEP-FARMING DAYS

Sheep 'fanks' are stone-walled enclosures used to hold sheep after they have been rounded-up from the hill land. Their presence here in an area now planted with trees illustrates this area was once a sheep farm.

COMMERCIAL FORESTRY: SEEDING-OUT OF PLANTATION TREES
Loch Avich, Argyll

Sitka spruce is a conifer which naturally grows in the Sitka area of the Pacific Northwest of America, It was chosen as a forestry tree in Scotland because it grows well on the poor soils and in the wet, cool climate of the Highlands. Over years it has been genetically improved to enhance its growth in Scotland.

However, an unforeseen side effect of this is that, as the original plantations reach maturity, they produce numerous seeds which are then blown beyond the confines of the plantation and thereafter germinate and grow.

The trees have spiky needles which are not very palatable to sheep or deer, so they survive browsing by these animals. The upshot is that, across the Highlands, these self-seeded Sitka spruce are beginning to take over the landscape.

If left unchecked, over hundreds of years the Highlands will begin to look like the conifer-dominated forests of North America. The spruce seem to grow equally well on moorland, on peat bogs and in native woods, and the end result will be a loss the natural vegetation of the Highlands.

It is an issue currently without any solution in sight because the forestry industry appears to wash its hands of the problem.

A. PLANTATION WITH DEER FENCE

Plantations are normally enclosed by a tall fence to keep out deer. Here young trees, seeded from the old ones behind, have 'leaped over the fence' to begin colonising the wider landscape.

B. SELF-SEEDED SITKA SPRUCE

An example of young self-seeded Sitka spruce growing on moorland distant from the source plantation. The seeds of spruce can blow a long distance in the wind before germinating.

B. SELF-SEEDED SITKA SPRUCE

An example of self-seeded Sitka spruce colonising heather moorland.

[see xx for a picture of spruce colonising a native woodland]

B. SELF-SEEDED SITKA SPRUCE

It is not only commercial plantations that can provide a source of self-seeded spruce. Spruce are often planted in private gardens across the Highlands because they grow fast and provide shelter [xx]. These trees have seeded-out from a garden below.

SPORTING ESTATES
Strathfarrar, Inverness-shire

The social structure of the Highland and Islands through most of history was that of a clan-based system: a patchwork of independent clans across the land, each with its own Clan Chief. Individuals in each clan took the name of the clan, such as McLeod, Mackenzie, Munro or Campbell.

But the system broke down after the Battle of Culloden, near Inverness, in 1746. There is a complex history here, but, following the battle, the previous Clan Chiefs metamorphosed into the more traditional type of landowner as found in the rest of Britain, but known as 'the laird' in Scotland. Land came to be seen to have monetary value, with the landowners now seeing the land as a source of income rather than a place where they and their clansmen lived.

From this evolved the concept of the 'sporting estate', where a shooting lodge and associated outbuildings were constructed (A), often in remote areas – which necessitated the construction of access tracks. The landowner and his rich friends stayed in the lodge for the duration of the shooting system, the principal game being red deer (B), red grouse and salmon [xx].

There are 'deer forests', where deer are the main game and, common in the east, 'grouse moors' for red grouse [xx]. Note that 'forest' is here used in the old usage of 'uncultivated land' rather than denoting the presence of trees.

A. ESTATE BUILDINGS

As well as the shooting lodge itself, there are normally buildings for the associated gamekeepers and ghillies, kennels, and a deer larder where the shot deer are kept.

B. RED DEER

Red deer are indigenous to the Scottish Highlands and have been present throughout postglacial times. They have been an important source of food. in previous centuries there were some 'Royal Forests', such as the Forest of Mar, where the Scottish aristocracy would go to hunt deer and other game.

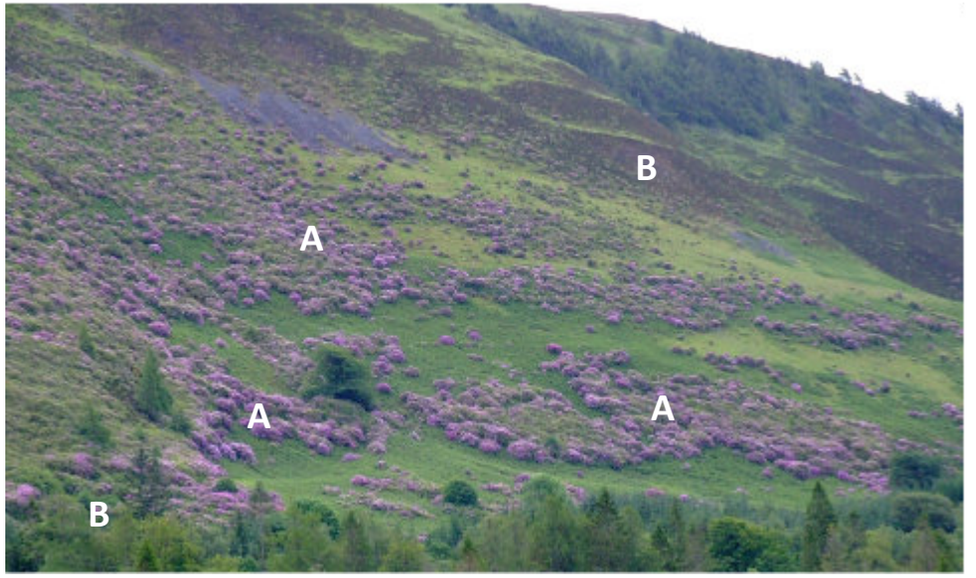
C. RHODODENDRON

The main residence of the laird ('the big house'), and some shooting lodges, had a garden. In Victorian times it was popular to plant rhododendrons in these. One species has proved highly invasive [xx], and the location of the big house can often be identified as the locus of a spread of rhododendron into the wider landscape.

D. MUIRBURN

The red grouse is a bird only found in the British Isles. It is associated with heather moorland [xx], which is more common in the east of the Highlands than the west. Today many heather moors are heavily managed for grouse, including regular burning ('muirburn') [xx], as visible here.

SPREAD OF RHODODENDRON
Great Glen



Rhododendrons were popular shrubs in Victorian gardens, particularly those around the big house of the Scottish laird [xx]. Species of rhododendron from all over the world were often grown, and nowadays they are a feature of many Highland gardens which are open to the public, such as the National Trust for Scotland's Inverewe [xx], Arduaine, Crarae and Brodick [xx] Gardens.

There is one species, not native to Scotland, which is particularly hardy, *Rhododendron ponticum*,which was used as a root-stock onto which stems of more colourful species were grafted. But if not managed, the *R. ponticum* can grow up from the root and takeover.

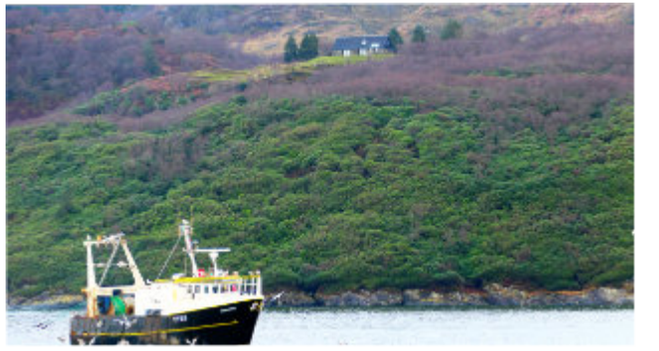
This species has proved highly invasive in the Highlands, particularly in the wetter west: it was, after all, chosen and bred by Victorian horticulturalists because it was hardy and well-suited to the Scottish climate. It readily spreads out from the garden in which it originated.

If not managed (it is expensive and difficult to control) it will take over much of the landscape as shown in this photograph. There are several other invasive garden escapes, but not on such a scale as rhododendron.

Both rhododendron and Sitka spruce [xx] have the potential to reshape the Highland landscape in coming centuries.

A. RHODODENDRON PONTICUM IN FLOWER

The plant has a light purple flower and comes into bloom in early summer. Each plant produces thousands of fertile seeds.

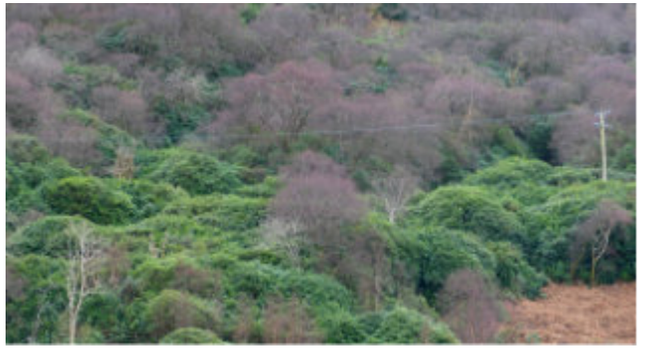


B. RHODODENDRON SPREAD

An example on the shores of Loch Fyne in Argyll showing how rhododendron has completely covered the coastal slopes. The leaves cast a dense shade, so that all other plants are shaded end, leaving bare ground underneath.

C. SPREAD ALONG ROADS

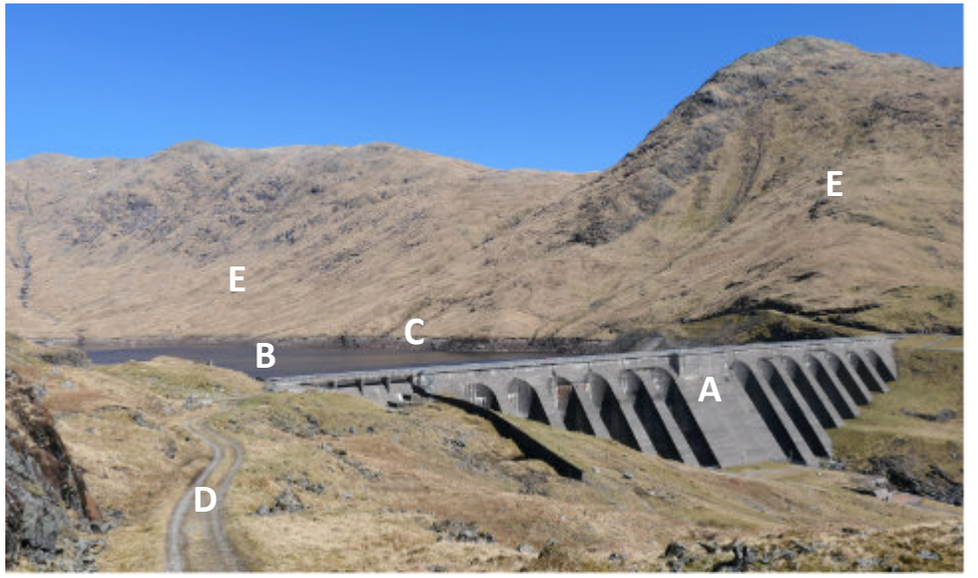
Rhododendron seeds well along roadsides, with roads sometimes providing a corridor for invasion of the species into a new area. Sometimes removal of a single plant in a new area would prevent costly and difficult control in future years -- but this rarely happens.



D. SPREAD IN WOODLAND

Like Sitka spruce [xx], the plant colonises a wide range of Highland vegetation types, including moorland, peat bogs and, as here on Arran, woodland. It swamps all other vegetation and shades out the ground flora, leaving bare ground beneath.

ENERGY GENERATION: HYDRO-ELECTRIC SCHEMES
Cruachan Dam, Argyll



Hydro-electric schemes produce electricity by creating a reservoir to store water (B), which is then piped downhill to a power station. In most cases, Highland reservoirs were created by increasing the depth of existing lochs with a dam across the outflow (A), although occasionally a totally new loch would be created such as Loch Glascarnoch in Wester Ross.

Construction of the first large-scale scheme in Britain began in 1895 at Foyers on the shores of Loch Ness to provide power for aluminium smelting. Two similar schemes followed at Kinlochleven and Fort William. Today, only the Fort William aluminium smelting is still functioning, but the other two schemes still produce electricity to feed into the National Grid.

The Tummel-Garry scheme in the Highlands was opened in the early 1930s to provide power for the Central Belt. Later, Tom Johnston, the Secretary of State for Scotland during the Second World War, had a vision of bringing ‘Power to the Glens’ to stimulate the Highland economy with cheap electricity. This vision was realised with the formation of the North of Scotland Hydro-Electric Board in 1943. Thereafter, the main era of dam building began, lasting into the 1960s. This resulted in about 50% of the river catchments in the Highlands being modified to feed water into reservoirs, producing about 10% of Scotland's electricity.

A. RESERVOIR DAM

Dams were built in remote areas of moorland (E) and were a huge engineering undertaking. Roads had to be constructed to allow materials to be brought in; large work camps were created; and streams diverted through pipes and tunnels to feed water into the reservoir.

B. RESERVOIR BEHIND DAM

Tunnels or pipes are used to take the water from the dam down to the power station. Some tunnels are many miles long. This reservoir below Ben Cruachan, is a pumped storage scheme: water is pumped up from Loch Awe when electricity demand is low, and released down when needed.

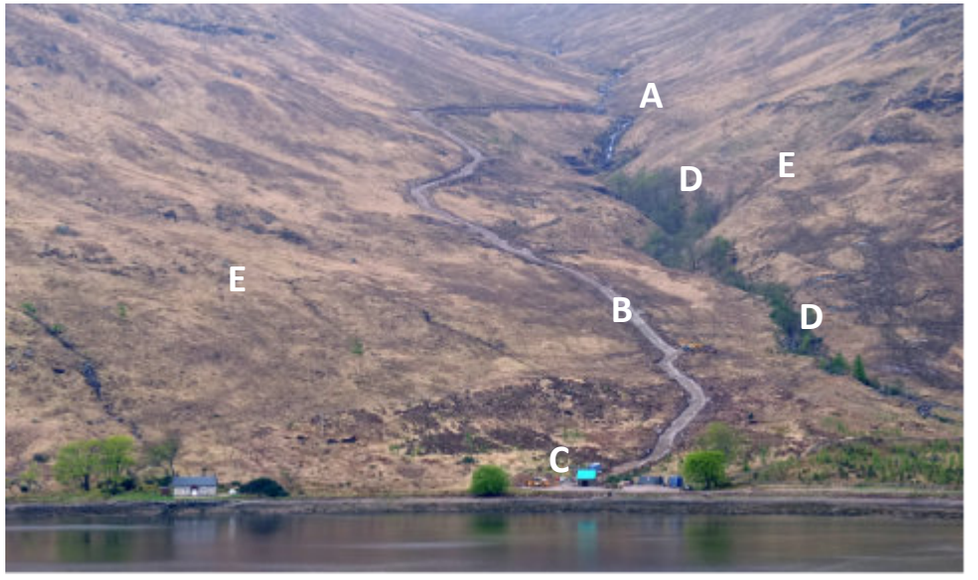
C. RESERVOIR DRAWDOWN ZONE

Reservoirs differ from natural lochs because, as well a dam at the end, they have a 'drawdown' zone around the shore. The water level goes up and down depending on rainfall and the demand for electricity; no plants can survive these variable conditions, so the shoreline is bare rock – here at Loch Cluanie.

D. ASSOCIATED VEHICLE TRACK

The presence of a drawdown zone makes reservoirs look artificial in comparison to natural lochs. Similarly, the constructed road or track up to a dam, and the dam itself, is a detractor to the wild character of the natural landscape. This track is to a run-of-river hydro-scheme [xx].

ENERGY GENERATION: RUN-OF-RIVER HYDRO SCHEMES
Kingairloch, Inverness-shire



The era of construction of large dams and reservoirs came to an end in the 1960s when most suitable river catchments had been tamed. A few proposed schemes were abandoned owing to their landscape sensitivity, including those planned for Lochan Fada/Loch Maree, Loch Affric itself (although there is a scheme immediately downstream), and a pumped storage scheme [xx] below Ben Lomond.

However in recent years, there are several pumped storage schemes being planned or built owing to their capacity to 'store electricity', *i.e.* as water, pumped up to the high level reservoir from the low level one. These new schemes need new reservoirs built high in the remote mountains [xx], with associated tracks, dams and pipes.

In recent years, aside from pumped storage schemes, these large-scale schemes have been superseded by 'run-of-river' schemes. These differ in not having an upstream reservoir. Instead, a dam is built across a burn or river and much of the flow diverted down a buried pipe to a small power station at the bottom. The characteristics of such a scheme is illustrated above: A. B. & C.

These schemes can introduce infrastructure into even remote glens [see also xx].

A. DAM

A dam for a run-of-river scheme. Above the dam there will be an intake for an underground pipe taking water down to the power station. Such dams interfere with the natural flows of water-courses, although operators always to have allow some flow.

B. ACCESS TRACK

An access track needs to be built for construction of the dam and buried pipe. The disturbed ground to the left of this track indicates where the pipe has been buried. The track needs to be retained after the dam is built to allow vehicle access: after heavy rainfall, the intake can become blocked by stones and sediment, and needs removal.

C. POWERHOUSE

Every scheme has a small power station at the bottom, and associated electricity cables to connect the supply to the National Grid.

D. BURNSIDE WOODLAND

Often the only trees in the landscape are those in gullies along the burns (xx). Elsewhere the vegetation comprises moorland habitats (E) [see xx].

ENERGY GENERATION: WINDFARMS
Caithness

'Renewable energy' is the term used for energy which uses the current natural flows of energy, whether plant growth (biomass), water (hydro-electric) [xx] or wind (windfarms) as here. These energy generation systems do not rely on the combustion of fossil fuels, that is fuels which depend on ancient organic matter buried underground in geological formations. It is the release of such fossil carbon into the air which is causing an increase the amount of carbon dioxide in the atmosphere – and carbon dioxide warms the surface of the earth by preventing long-wave radiation being radiated into space (the 'greenhouse effect').

With fossil fuels, a lot of energy can be obtained from a relatively small amount of fuel, hence the widespread use of coal, oil and gas. In contrast, the natural energy flows harvested by renewable energy systems are low density. A single power station burning fossil fuel can supply electricity to an order more homes than a windfarm whereas, if renewable energy is to be the main source of generation, a lot of land (or sea) needs to be covered in wind turbines.

Wind turbines need to be tall to maximise the harvest of energy, and the longer the blades the more they can harvest: as technology advances, they increase in size. The presence of windfarms, therefore, can transform the Highland landscape by the addition of a lot of visible infrastructure.

A. WIND TURBINES

For scale, three people can be seen at the bottom of the nearest wind turbine. Each windfarm necessitates the creation of a network of wide vehicle tracks, which, as with forestry [xx] and hydro-electric schemes [xx], is reducing the wildness of the Highlands.

B. ASSOCIATED ELECTRICITY PYLONS

Most electricity generated in the Highlands has to be exported to the main markets in the south, resulting in a network of high voltage transmission lines – which are highly visible within the landscape.

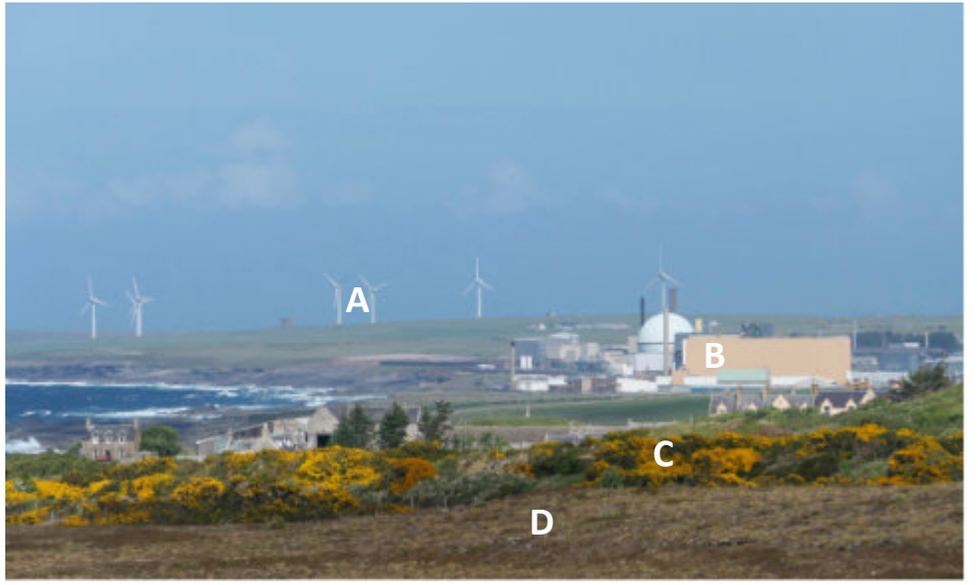
C. FLOW COUNTRY PEATLAND

The windfarm in the main picture on the left is in Caithness, a flat landscape of peatland [xx] as shown here. This means that even distant windfarms and pylons are highly visible.

D. CONIFER PLANTATION

In the 1980s many conifer plantations [xx] of Lodgepole pine were created on the peatlands of Caithness and Sutherland [xx]. This caused controversy because tree roots dry out the ground, causing a loss of the peat. Many of these plantations are now being removed.

ENERGY GENERATION: WINDFARMS AND NUCLEAR
Dounreay, Caithness



The windfarm in the distance (A) contrasts with Dounreay nuclear power station [B]. The latter was an experimental fast breeder nuclear reactor built in the 1950s, but it no longer produces electricity and is now being decommissioned.

But its presence has had an unexpected consequence: a power line was built up the east coast of the Highlands so that its electricity could be exported to the south. This meant that, when windfarms started being built in the 1990s, their electricity output could be connected through this power line direct to the National Grid, without the need for new pylon lines. This explains the large number of windfarms now built, or being planned, in the far northeast of Scotland.

A current constraint on the building of new windfarms in many areas of the Highlands is the lack of power lines to export the energy. Hence many new power lines [xx] are being planned across the Highlands.

The picture demonstrates how the one nuclear reactor at Dounreay occupies a relatively small land area compared to the numerous windfarms necessary to produce the same amount of electricity (it is the same with fossil fuel power stations, whether coal, gas or oil).

A. WINDFARM

A windfarm on farmland in the flat landscape of Caithness. Conifer plantations [xx] and grazing pasture [xx] are also visible

B. NUCLEAR POWER STATION

There is only one nuclear power station still operating in Scotland (at Torness in East Lothian). The Dounreay reactor here is being decommissioned. Nuclear power is controversial because the radioactive waste has to be stored safely for thousands of years.

C. GORSE

This prickly shrub forms large stands and has been expanding in extent in recent years. Although native to Scotland, it is not native to many areas the Highlands and Islands, but even in these places it is becoming common. In Scotland is known as 'whin', normally as the plural 'whins'.

D. PEATLAND

A close-up of peatland vegetation which here includes heather, purple moor grass and deer grass.

TELECOMMUNICATI0N MASTS
Invergarry, Inverness-shire

With the advent of the mobile phone network in the 1980s, telecommunication.masts began to be built across the Highlands. Previous to this there had been a few masts on coastal locations to for marine navigation, and some larger masts for broadcasting and for phone links to distant islands.

But mobile phone masts spread quickly, placed in locations accessible to the road network and settlements. In the mountainous landscape of the Highlands, more masts are needed to provide full coverage than in the relatively flat lowlands.

There may be two masts in the same location (A) because different telecommunication providers of do not always share masts.

There has to be access to the masts for maintenance (B), some of which have constructed tracks, and some where the vehicles just follow a given route over the vegetation (B).

A. HILLTOP MAST

Masts are often built on high ground in remote areas to provide signals to the road below, as here above Loch Cluanie. This is adding infrastructure to previously wild land.

A. HILLTOP MAST

A larger mast in a coastal location (Arisaig) providing microwave phone signals to the Small Isles (Rum, Eigg, Muck).

B. VEHICLE ACCESS TO MAST

Where no constructed track is built to the mast, then continual vehicle access across damp ground leaves obvious tracks in the vegetation, sometimes leading to erosion. The increasing vehicle access to remote areas of the Highlands, makes the land less wild.

C. MOORLAND (WET HEATH)

The vehicle wheel marks in the above picture (taken In Wester Ross), are over wet heath [xx] as shown here. This vegetation, together with peatland [xx] is particularly susceptible damage from vehicles and trampling.

FISH FARMS
Loch Craignish, Argyll

Fish used to be exclusively caught in the wild, but since the 1980s, as the technology has developed, numerous fish farms have been located in sheltered locations along the west coast and amongst the islands. These are for Atlantic salmon. The eggs are fertilised in onshore freshwater hatcheries, where they remain until big enough to be transferred to cages in the sea (as 'smolts'). This mirrors the cycle of wild salmon, which breed in freshwater rivers and burns, from which the young fish migrate down to the sea. Here they feed or a year or two until they are big enough to return to the freshwater spawning grounds to breed.

Fish farms consist of cages (A) which contain the fish, with netting both underwater and over the top to prevent predation of the farmed fish by seals or birds. The fish are fed from automated feeders (B) which deliver the food) through pipes into the cages. The food consists of fish-meal and fish-oil, normally harvested from smaller species of wild-caught fish.

Dedicated fish farm boats (C) bring in the feed and take away the salmon once they are ready to harvest – after one and a half to two years.

There are also trout farms present on some freshwater lochs.

The farm pictured here has a coastal birchwood on the shore behind (D) [xx]

A. FISH CAGES

A fish farm of ten cages in Argyll. After harvesting the salmon, the site is often left fallow, *i.e.* with no fish, for a year or two to allow the seabed to recover from the fish droppings and uneaten food has fallen to the bottom.

A. FISH CAGES

A fish farm on Loch Ainort on Skye. Ever since they started to appear in the sea in the 1980s, fish farms have had their detractors: from concerns about their landscape impact on wild coasts, and concerns about the environmental impact of the farming process itself.

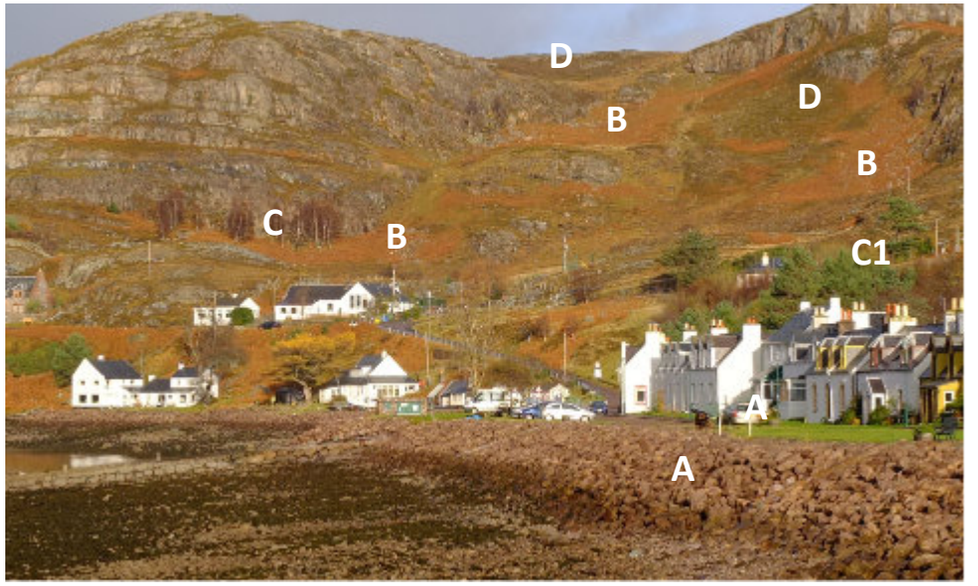
A1. FISH FARM SHORE BASE

Fish farms have a shore base to service them, here associated with a trout farm on Loch Awe. The base requires an access track, buildings, hardstandings, a slipway and pontoons. Sometimes these are located as new development in an otherwise remote area.

B. WELL-BOAT

'Well-boats' are nowadays a common sight on the west coast. These are used to transport the salmon, which are hoovered up from the cages in large pipes for delivery to the fish-processing factory. The industry as a whole is an important source of jobs and income to the Highland economy.

COASTAL DEFENCES
Shieldaig, Loch Torridon



Shorelines are susceptible to erosion by the sea during storms and such erosion is becoming more common as global warming both increases the intensity of storms and is also causing a rise in sea level.

Hence, roads and settlements near the sea are often protected from further erosion through the use of rock armouring [A]: that is, large rocks piled up along the shore to break the force of the waves.

This inevitably adds an increase of artificiality to the landscape in that the rock armouring rarely, if ever, matches any nearby rocky shore: the rocks are often brought in from elsewhere and so do not match the colour or shape of the native rock; also, they are generally all of the same size, whereas a natural shore will have bigger rocks at the bottom and smaller ones above.

The site in the picture at Shieldaig is an exception in that the rock armouring does appear to consist of native rock, although there has been no attempt to grade the rock up the shoreline – so it still looks artificial.

However, in most places, there rarely seems any attempt to mirror the natural landscape when rock armouring is added to the shore.

A. ROCK ARMOURING

Rock armouring on the Isle of Soil put in place to protect a new septic tank. The rocks used do not match the local rock, being of different colour and shape. Neither have they been graded small to large up the shore, so it all looks very artificial.

A1. GABION BASKETS

On more sheltered shores, gabions are sometimes used: wire baskets filled with rocks. They are also commonly used to reinforce track, road, stream- and river-sides. In the past such reinforcement would use mortared walls of local stone. Gabion baskets often break apart over time and come across as ugly, temporary structures.

B. BRACKEN (WINTER)

Bracken is a fern which covers large areas of land on fertile soils at low altitudes (below about 500 metres) [xx]. In winter, as here, it dies back and in summer, in optimal sites, can grow up to two metres tall. Some heather is also visible in the main picture (D).

C. BIRCH TREES

A stand of naturally regenerating birch trees, and also some conifers in a garden (C1). Birch trees in the west are the downy birch, whereas in the East Highlands the silver birch is more common, illustrated here: this latter species is identified by the way the upper twigs hang downwards.

TRANSPORT CORRIDORS
Dalwhinnie, Inverness-shire

Before the building of the first military roads by General Wade, which began in 1725, the mountainous areas of the Highlands were road-less, and, importantly, bridge-less, with many rivers impeding travel. Much of the land was rough and boggy, making any inland travel difficult. The sea was the main highway.

The Wade roads were not suited to civilian travel, and it was only possible for wheeled vehicles to traverse the Highlands after the completion of the road network overseen by the famous engineer Thomas Telford in the early 1800s. These were the 'Parliamentary Roads' (created by an Act of Parliament), which enabled the first regular coach services from the Scottish lowlands to Inverness to start in 1806.

Early roads tended to follow the landform and, if no longer used, have mostly merged back into the surrounding moorland landscape [E]. Modern roads (B), [XX], in contrast, are built with significant landform modification to ensure straight and level routes, and new roads are significantly wider than their predecessors [xx].

These modern transport routes all follow the main straths and glens, as do the modern-day power lines [D].

A. HIGHLAND RAILWAYS

The coming of the railways opened up the Highlands to mass visitation, with the Highland mainline though the Grampians from Perth to Inverness opening in 1863.

B. ROAD BRIDGES OLD AND NEW

The early roads followed the landform, without major cuttings and embankments. Bridges were stone-arched, most of which are still standing today. Modern roads cut through the landscape with straight lines, rather than meandering through the natural hills and hollows.

C. ROADSIDE TREES

The roadside trees visible in the main picture (C) were planted parallel to the main A9 trunk road to prevent snow blowing over the road. But many roadside trees, as here, are self-seeded from nearby plantations and woods, taking advantage of the better soil of the disturbed ground beside the road.

D. POWER LINES

With the increasing number of renewable energy schemes in the Highlands, particularly windfarms [xx], there is a need to upgrade the high voltage pylon lines, and to build new ones, to take the electricity to the main markets in the south – because the area generates more than it needs locally.

TRANSPORT: SEA AND LAND
Lismore

The sea had always been the main method of transport across the Highlands and Islands: it was the highway linking all the islands, and also linking coastal communities along the mainland. Inland, the land was rough, boggy and mountainous, with rivers which were impossible to cross in times of spate. Additionally, the highly indented coast meant long journeys by land to communities which might be only a few miles apart as the crow flies.

The development of the steamship in the late 1700s improved journey times around the coast, and made the Highlands more accessible to visitors from southern Scotland. Associated with the development of the tourist trade, harbours were improved, with jetties built, and some local villages developed into tourist hubs with hotels, such as Rothesay, Oban, Tobermory and Portree.

At the same time, harbours were built on the west coast for the fishing industry, and also to promote economic development, such as at Ullapool and Stornoway; and numerous harbours were built down the east coast. Until the 1800s, boats had to beach at high tide, or off-load into tenders.

The coastal steamer trade continued into the early 1960s, after which new roads and bridges made road travel more economic. But there is still a network of ferries In Shetland, Orkney and along the west coast to service islands (A).

A. ISLAND FERRY

The islands around the coast are serviced by ferries. Causeways have been built in the Western Isles and Orkney to replace some, and there is discussion on whether more islands could be linked by causeway, bridge (as Skye), or tunnel.

B. OLD ROAD – SINGLE TRACK

The traditional Highland road follows the landform and is single track with passing places, as shown here. There was a major road-improvement spree in the 1960s-1980s, so that most major routes are now two-lane, although many lesser routes remain as single track.

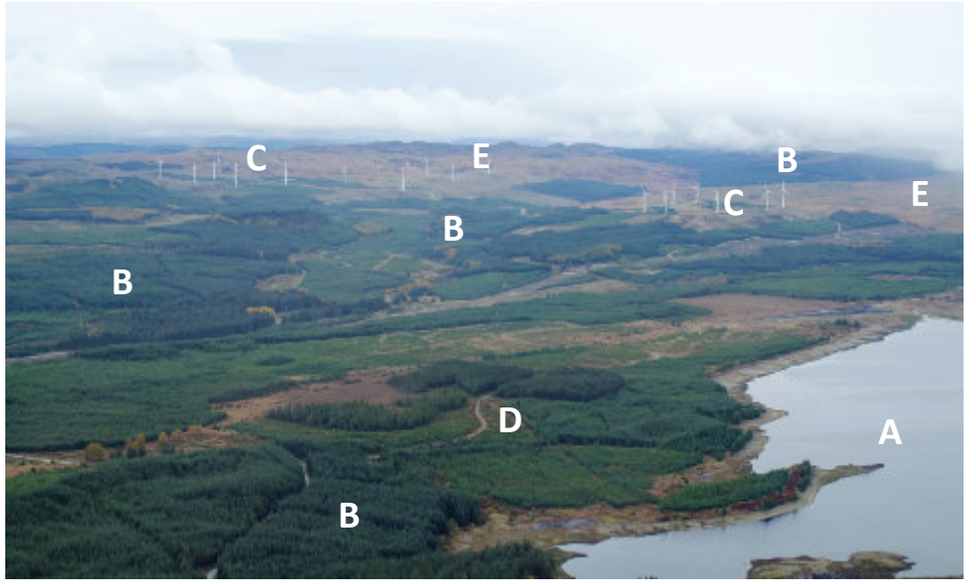
B. MODERN ROAD – TWO-LANE

Modern roads make no concession to the landscape, but are built as straight and level as possible as shown here – the main A9 trunk-road north [xx]. Currently this road has a few sections of dual carriageway, but is in the process of being converted to dual throughout.

B. CALEDONIAN CANAL

Two canals were built in the Highlands in the early 1800s. The Caledonian Canal (as here) which bisects the Highlands through the Great Glen, using both natural lochs and engineered sections; and the smaller Crinan Canal at the head of the Kintyre peninsula.

MODERN ECONOMIC LANDSCAPE
Asknish, Argyll



All the economic developments listed in the pages above are causing a change to the appearance of the Highland landscape over time, an issue discussed in my book *Landscape Change in the Scottish Highlands: Imagination and Reality*. In summary, economic development is resulting in an increasing imprint of human infrastructure in what was, until about 1750, largely wild and natural in appearance.

The above picture illustrates many of these economic trends:

A) A natural loch converted into a reservoir with a visible dam and drawdown zone [xx].

B) Commercial forestry plantations of Sitka spruce on a large scale. Here, both old and newly planted second-rotation forests are visible.

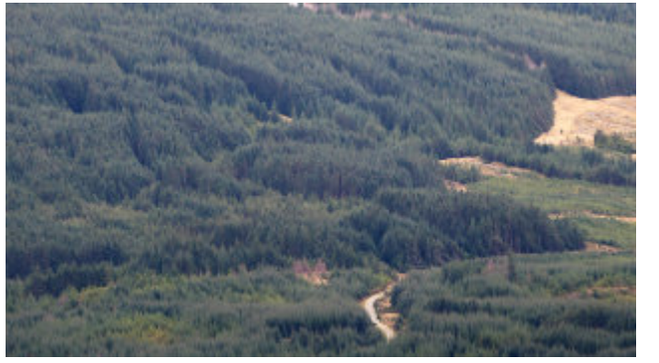
C) A windfarm of wind turbines and associated vehicle tracks.

D) A forest access track.

The original moorland vegetation (E) now only remains as small areas within a landscape of commercial forestry.

A. RESERVOIR

A hydro-electric reservoir [xx] with a water level which rises up and down depending on the amount of rain and the demand for electricity: this is demonstrated by the presence of the artificial-looking drawdown zone [xx].



B. COMMERCIAL FORESTRY

Mature spruce forest, a clearfell area (far right), new planting (middle right) and a forestry track illustrate the features of commercial forestry. This landscape differs markedly from the moorland on which it would have been planted.

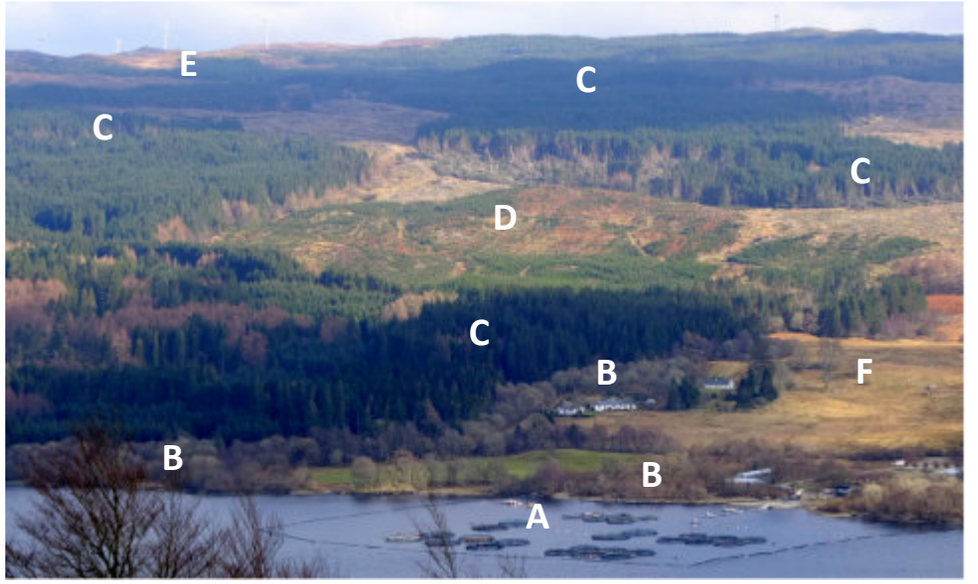
C. WINDFARM

Another view of the main picture, showing a windfarm built on moorland in the background; and a new windfarm being built within the plantation – demonstrated by the line of concrete bases visible here, on which the windfarm towers will be placed.

D. FOREST TRACK

Modern forestry needs to be able to deal with 44-tonne lorries for extracting the timber. Hence a network of roads such as these are built to deal with these heavy loads.

MODERN ECONOMIC LANDSCAPE
Loch Awe, Argyll



A view across Loch Awe in Argyll, again showing the features of a modern economic landscape:

A) A fish farm, in this case a freshwater trout farm. The shore base is just visible on the loch shore on right-hand end of the fish cages.

B) Relict native woodland along the loch shore and streamsides.

C) Most of the landscape is now commercial forestry, original planted on moorland and farmland, on which a small fragment still remains (F).

D) An area of young trees which have been planted on a clearfell site [xx] following felling of the original trees.

E) It is hard to see in this photograph, but there is also a small windfarm on moorland above the forestry plantation.

In the mid-1900s this whole area would have been a sheep farm, but is likely to have been planted with commercial conifers in a period when there was a depression in the sheep-farming industry. In other words, there was more money in trees than sheep.

Note: Much agricultural land can also be seen as 'a modern economic landscape': see, for example, [xx].

A. FISH FARM

Fish cages for a freshwater trout farm on Loch Awe. The non-native rainbow trout is the fish used, as opposed to the native brown trout. Rainbow trout cannot breed in Scottish waters, so if they escape, they will not be able to colonise.

B. RELICT NATIVE WOOD

The loch shore has woods comprised of alder [xx] and birch trees (as shown here) [xx]. The woods have survived in these places because they are in areas where it is difficult to plant and harvest trees; and there is now a policy not to plant conifers along water courses.

C. CONIFER PLANTATION

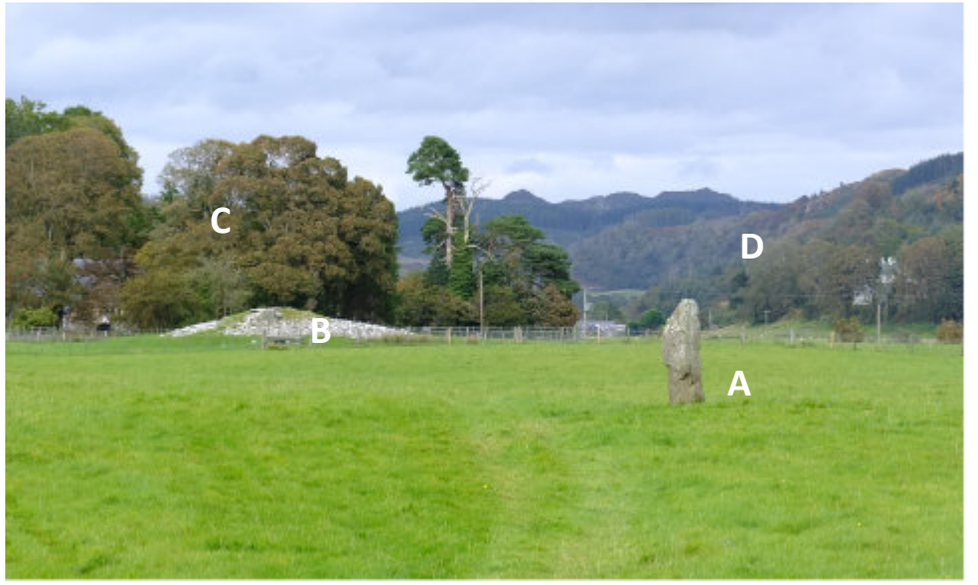
Planted conifers are liable to blow over during storms (windthrow) [xx]. Areas of windthrow are visible in the main picture, as well as here. It is uneconomic to harvest blown down trees, so trees are usually felled before they get big enough to easily blow over.

D. REPLANTED FOREST

Young trees are planted as soon as possible after felling [xx], before the ground vegetation has time to thicken up and compete with the trees.

HISTORIC ENVIRONMENT: ARCHAEOLOGICAL LANDSCAPES

Kilmartin Glen, Argyll



The Highlands and Islands have had a long history of human occupation, going back at least 10,000 years. The population was densest along the coast because in the past the sea was the main highway [xx], and much of the inland in the west was mountainous with soils and climate not particularly suited to agriculture.

These early settlers have left their mark on the landscape in many places, particularly in places which have not been heavily modified by modern agriculture [xx]. Archaeological remains include ancient standing stones (A), some of which form stone circles; burial cans from the Stone (Neolithic) and Bronze Ages (B); 'cup and ring marks', which are stones engraved with a range of patterns, but which are hard to date; remains of Neolithic stone walls; hut circles from the Bronze Age, which are the foundations of round houses; monastic beehive cells, small stone huts dating from around the 6th century which are found on west coast islands; remains of Viking longhouses; and the later Pictish brochs found in the west and far north [xx].

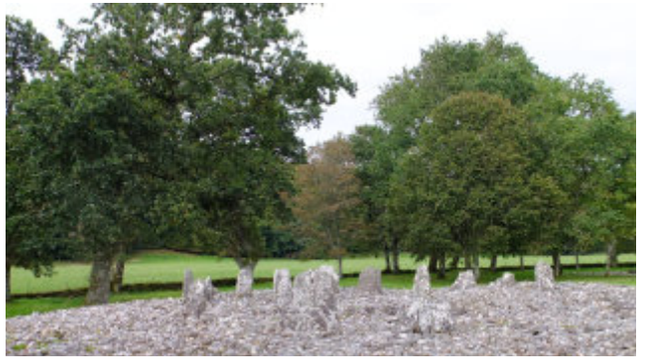
At Skara Brae in Orkney, there is even a whole Stone Age village, which was covered in sand for many centuries and only revealed after a big storm blew the sand away in 1850.

A.STANDING STONES

The Orkney Islands [xx] are particularly rich in archaeological remains owing to a long history of occupation because of their easy accessibility by sea and relatively rich soils. Pictured here is the ancient Ring of Brodgar.

B. ANCIENT CAIRN

One of the large burial cairns is in Kilmartin Glen in Argyll, a landscape rich in archaeological remains. Some cairns have burial chambers underneath, the most impressive of which is the 5,000 year old Maeshowe in Orkney. Smaller cairns are found across the Highlands and Islands.



C. PLANTED TREES

This cairn in Kilmartin Glen is unusual in that it has a circle of standing stones within the cairn. It is surrounded by planted broadleaved trees, giving a parkland feel [xx].

D. OAK WOODLAND

In the background of the main picture, there is woodland of sessile oak, with some birch trees. Oak woodland is common in some areas of the Western and Southern Highlands, comprising both native woodland and trees planted for industrial uses, such as charcoal and tanning.

HISTORIC ENVIRONMENT: CASTLES
Strome Castle, Inverness-shire

The Highlands are renowned for the castles which are found across the landscape, particularly in the west. These range from ruins in different states of disrepair (A) to castles which are still inhabited [xx]. Others consist of once-ruined castles which have been restored, such as the famous Eilean Donan castle on its island in Loch Duich on the main road to Skye, or Castle Stalker in Argyll.

The history of the Highlands is often one of battles and wars, both between warring clans, and against invaders – whether from elsewhere in Britain or the Norse invasions of Vikings in the 9th century. Several were destroyed during the Jacobite uprisings in the 1700s.

It is a complex history, but the upshot is that there was a need for fortified strongholds and, because stone is readily available, these are constructed of stone.

The picture here is of Strome Castle, which guards the approaches to Loch Carron. Its history mirrors the complexity characteristic of most castles. It was built by the MacKenzies in the 1400s. In 1549, the Scottish King, James V, handed it to the McDonnells but, in the 1602 Battle of Moray it was captured by the Mackenzies and blown up.

A. CASTLE RUIN

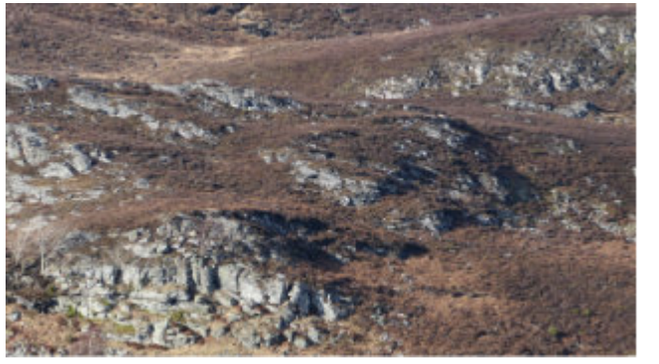
This is Carnasserie Castle, which is in a better state of repair than Strome Castle to the left. However, it was only occupied for a short time: built in the 1560s, it was burnt down in 1690, following the 'Argyll's Rising' against the monarch.

B. GRAZED GRASSLAND

Stome Castle is surrounded by sheep-grazed grassland [xx], which keeps the vegetation short and makes for easy access to the ruins.

C. NATIVE WOODLAND

On the hillslope behind the castle, pictured left, is some native birchwood on a coastal hillslope [xx].



D. ROCKY MOORLAND

Above the woodland is dry rocky moorland dominated by heather [xx].

HISTORIC ENVIRONMENT: DESIGNED LANDSCAPES
Brodick Castle, Arran

In the 1700s there was a movement to beautify the land around the houses and castles of landowners, a fashion that took root across the British Isles. Capability Brown was an English landscape architect who greatly influenced the design of such 'designed landscapes'.

The movement was also taken up in Scotland; for example, the extensive designed landscapes on the Atholl Estates at Dunkeld which included riverside walks, the planting of amenity trees such as the Douglas fir, the building of Ossian's Hall at the The Hermitage, which overlooks the Black Linn Falls on the River Braan – all in keeping with the Victorian romantic view of nature. The planted Douglas firs are now amongst the tallest trees in Britain.

Like Brodick Castle, pictured here, and The Hermitage at Dunkeld, the once exclusive designed landscapes are now open for public at large to enjoy through ownership by the National Trust for Scotland.

There has been a castle of some sort at Brodick from the 5th century, with the current castle dating from extensive reconstruction and expansion in 1844. As with many castles, the ownership has varied over the centuries. Surrounding the castle is parkland, a woodland garden and a walled garden – features of many designed landscapes.

A. NEW BIG HOUSE

The need for fortified houses disappeared as wars ended. Castles were replaced with more modern buildings in a designed landscape setting. Here, the Clan Maclean's Moy Castle on Mull (right) was replaced by the new Lochbuie House (left).

B. CASTLE GROUNDS

Aesthetics were important when designing the grounds around big houses and castles, with trees and shrubs imported from all over the world. This shows the land around Brodick Castle, pictured left, which includes both a woodland garden and a walled garden. Some castles also had a more formal garden.

B. WALLED GARDEN

Walled gardens, with an associated greenhouse, were a key feature of the laird's dwelling, providing fruit and vegetables throughout the year. Walls provided shelter and fruit trees were often planted against the south-facing walls. This shows the one at Inverewe Garden in Wester Ross.

B. PARKLAND

Around some castles, such as here at Inveraray Castle in Argyll, the seat of the Clan Campbell, there was extensive parkland with widely-spaced trees as shown here. There were also associated buildings built in a matching architectural style, such as the stables visible here.

TRADITIONAL CROFTING LANDSCAPES
Shawbost, Isle of Lewis

This photograph was taken in 1971 and shows a traditional crofting township on the northwest coast of the Isle of Lewis. A croft is a small area of land that is only worked part-time because it is not big enough for a full-time income and which also includes a croft-house. 'Crofters', *i.e.* those who live on crofts, also have a right to graze their animals on a wider area of land – known as the 'Common Grazings' because the land is shared by other crofters in the community.

Crofting, by law, is restricted to the islands of Shetland, Orkney, the Hebrides and the Western Highlands. Crofts are grouped into 'townships', with the houses centred on each croft rather than the houses being closely grouped together. This gives a spread-out feel to settlements rather than compact villages found elsewhere in Britain.

Any small towns or villages there are in the islands and Western Highlands, such as Stornoway or Ullapool, were planned towns around newly built fishing ports [xx] or, as Oban, grew up around tourist hubs [xx]. There were also planned towns built in the Central Highlands (*i.e.* not in the crofting counties), such as Grantown-on-Spey and Dunkeld; indeed, there is one being built today east of Inverness (Tornagrain).

The origin of crofting has a long history, as discussed below [xx].

A. PEAT CUTTING

The main picture shows a stack of peat outside a crofter's house. The peat would have been cut from a nearby peat bank in late spring, where each crofter had a right to cut it. Traditionally, the cutting was a community activity.

A. PEAT CUTTING

Once cut, the peat was piled in small heaps and left to dry for a few months, before being taken to the township where it was stacked up to provide enough fuel for a whole year. In the absence of woodland, peat was the main fuel in the Highlands across the centuries.See page [xx] for on more on peat.

B. CROFT HOUSE

The traditional house in the Highlands was the 'black house' xx [. From the 1700s this was slowly replaced by the type of two-roomed house shown here, all built to a standard pattern across the Highlands. This is traditionally known as a 'but 'n ben' [xx].

C. GRAZING PASTURE

Beyond the inbye land [xx] are the Common Grazings where sheep or cattle have free range. Each Common Grazings has its own committee which oversees the number of animals allowed to graze the land.

TRADITIONAL CROFTING LANDSCAPES
Vatersay and Mingulay

A traditional form of growing crops, common to Scotland and Ireland, was using 'lazybeds' (A). These comprise a series of ridges and furrows, with the crops planted on the top of the ridges, and rainfall draining down into the furrows. The origin of the term is obscure, but it seems like misnomer because it took a lot of manual labour to work the system.

In coastal sites, seaweed was applied to the ridges to act as a fertiliser, and crops such as potatoes grown on top. The lazybed system fell into disuse in the 1800s, but old lazybeds are visible in many landscapes.

The land suitable for growing crops (the arable land) was based on the 'runrig' system, whereby each family took it in turns to work the best land on a yearly rotational basis. This meant that no family lost out by always having the worst land. The use of lazybeds and the runrig system disappeared with the advent of the crofting system and the creation of formalised crofts [xx].

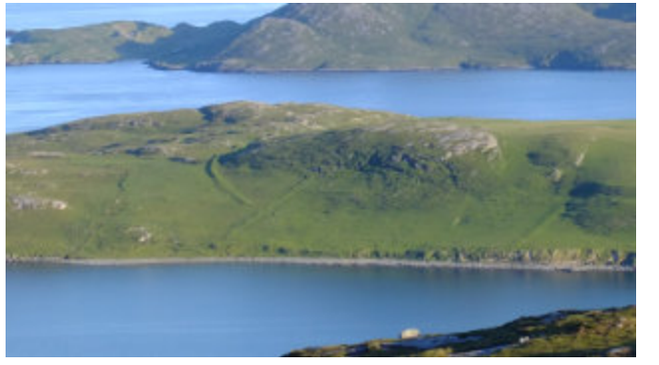
This arose following outcries about the way the landlords were treating their tenants, who had no secure tenancy, *i.e.* no guaranteed right to stay on the land – and were often cleared off their land during the preceding notorious Highland Clearances. The Napier Commission of 1883 looked into the issue, which resulted in the Crofters Holdings (Scotland) Act 1886, giving, amongst other things, security of tenure to crofters. Although most crofts are still tenanted, crofters nowadays have a right to buy their croft if they so wish.

A. LAZYBEDS

Old lazybeds covering much of the landscape on the Isle of Eigg. There are sea cliffs beyond, meaning that a long journey would have been need to carry the seaweed up to fertilise the ridges.

A. LAZYBEDS

A field of lazybeds nearer the sea at Reiff, a township in Wester Ross. In the past, a huge amount of human effort would have been put in to creating them and using them for growing crops. Now they remain as a reminder of the past.



C. PERMANENT PASTURE

The main picture shows the rocky nature of much of the landscape, making agriculture difficult. Areas of arable crops were confined to the small areas where there was sufficient soil. This shows an area of pasture, but the old field boundaries visible suggest it might once have been arable land.

D. ROCKY MOORLAND

Rocky moorland, with shallow peaty soils, is common over much of the Highlands. It is of low grazing value, so a given area cannot support as many grazing animals as is possible in the lowlands.

TRADITIONAL CROFTING LANDSCAPES
Shawbost, Isle of Lewis

This picture was taken in 1971 and illustrates crofting agriculture as it was then. Each croft had its own strip of land (A, C) where hay and other crops were grown, with wire fences between the strips. Hay was the traditional crop grown to feed sheep and cattle over the winter, although nowadays it has largely been replaced by silage [xx]. This has the advantage in that the grass does not have to dry out before being put into silage bags.

Hay cutting is more dependent on the weather because, once the grass is cut, it has to dry out before it can stored as hay. This means that, in wet summers, there is no guarantee that enough hay of good enough quality can be produced to feed the animals throughout the winter. Additionally, hay cutting has to take place in mid to late summer, whereas silage can be cut earlier. Traditional haystacks are visible here (B), but this is a sight not seen nowadays. Instead the silage bags are stored at the edge of fields [xx].

Other crops traditionally grown included: an old variety of barley called 'bere', grown for both cattle feed and for making whisky, which is still occasionally grown today; turnips for both livestock and people; oats, the main cereal grown because it can survive cool, wet summers; and potatoes, the staple crop for most of the crofters.

Nowadays, arable farming has nearly died out, the only crop grown being silage – the rest of the inbye land having become grazing pasture.

A. HAY FIELD

This picture taken in 1994 in the Uists shows hay which has been cut with a hand scythe. Today virtually all cutting, for hay or silage, is from a tractor-towed forage harvester.

B. STOOKS AND HAYSTACKS

Once cut, both hay and cereals such as oats, was piled up into small heaps called 'stooks'. Once dry the hay was stacked in haystacks (B in the main picture), and the oats threshed to extract the grain. This picture was taken in the 1960s, showing a sight no longer seen.

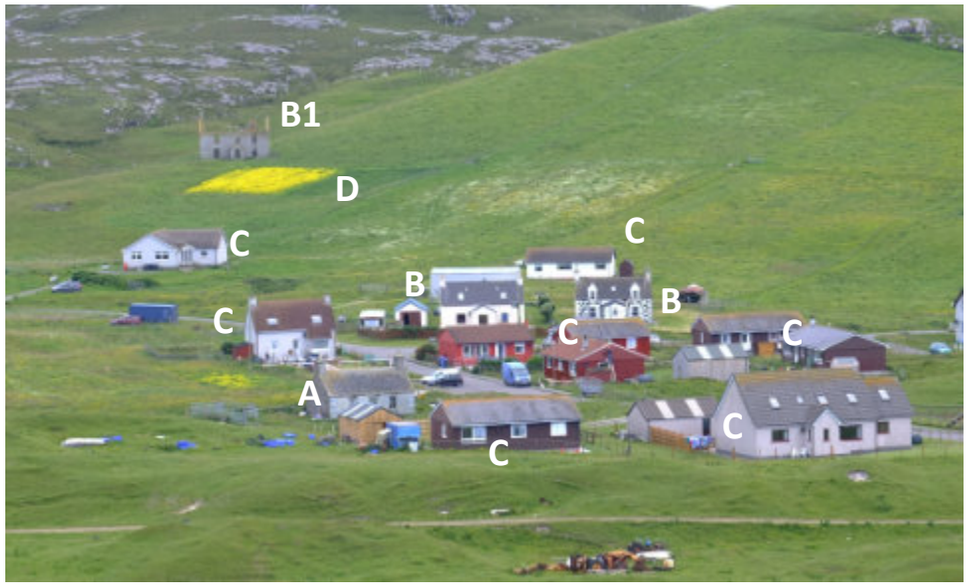
C. FENCED STRIPS

It is rare to see crops grown in the fenced strips of land associated with each croft. Much of this former arable land is now permanent pasture for sheep. However grass is still grown for silage, as shown here – the paler strip has been recently been cut. This is a modern picture from Calanais on the Isle of Lewis.

D. DYKE

In the past, livestock (sheep, cattle, goats) were kept out of the arable (inbye) land by shepherding. From the 1700s, dry stone dykes were built [xx], particularly to create a head dyke separating the inbye land from the Common Grazings on the hill land [xx].

MODERN CROFTING LANDSCAPES
Isle of Vatersay



This is a modern crofting settlement which has expanded considerably in recent years as can be seen by the presence of only four traditional stone-built houses (A) & (B), of which two are now derelict (A) & (B1). A small fenced area of arable ground is also present (D).

It differs from the traditional township with widely-separated croft-houses [xx]. In contrast to the the castles and big houses of the lairds [xx], the houses here are considerably smaller, reflecting how most people lived.

The typical dwelling in the Highlands and Islands before about 1750 was the 'black house'. Ruins of black houses are still visible today, particularly in the Western Isles, as shown in the top picture on the right. Black houses had thick walls with rounded corners and roofs of thatch. The had no, or very small, windows and no chimneys: the smoke from a peat fire in the middle of the house wafted up to the rafters to find its own way out through the thatch. The soot-filled thatch could later be put on fields to fertilise the soils.

The buildings, in modern terms, were energy efficient in that there were no windows or chimneys to lose heat, and all heat generated remained in the building. Hence they were ideally suited to the cool, damp and windy climate. From the 1700s the black houses were slowly replaced by 'white houses', the traditional 'but 'n ben' (A), although they proved to be draughty and needed more fuel to keep warm.

A. BLACK HOUSE

This is a ruin on South Uist. The presence of a chimney shows it has been 'improved' at some stage in the past. There are many such ruins in various stages of decay across the Western Isles – left behind as people moved into but 'n bens. .

A. BUT 'N BEN (But and Ben)

These were two-roomed houses, the 'but' being the kitchen and main living area, and the 'ben' the best room reserved for special occasions. Unlike modern housing, these houses were built to a standard pattern across the Highlands Islands.

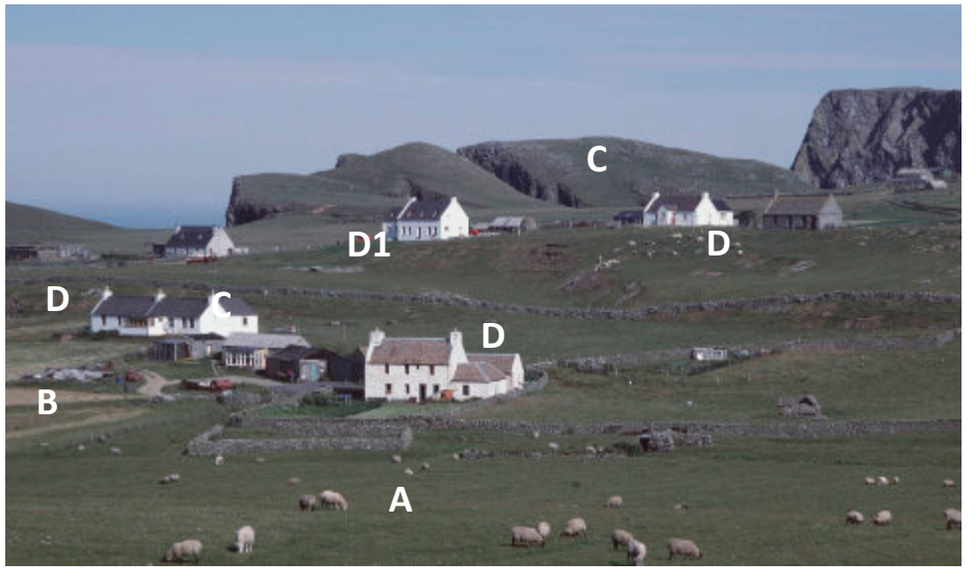
B. TRADITIONAL FARMHOUSE

Farmers and richer people built one-and-a-half storey houses, or occasionally 2-storey (B1). The top floor had sloping ceilings with characteristic 'dormer windows' coming out through the roof. The standardisation of house design in the past gave a coherence to the landscape which is missing today.

D. MODERN BUNGALOW

Modern bungalows came to be built on a large scale in the 1960s, replacing the but 'n bens. They come in different shapes and sizes and are not in keeping with the traditional vernacular style of building. Here the ruins of the original house are visible nearby.

MODERN CROFTING LANDSCAPES
Fair Isle



Fair Isle is a remote island over 20 miles from the nearest land, situated halfway between Shetland and Orkney. It is a crofting community and the islanders are keen to keep many of the crofting traditions. Hence it is not typical of the modern crofting settlement.

Although there is much permanent pasture on the inbye land [xx] used for sheep grazing (A), there is still arable agriculture in other areas (B). The island is three miles long, the southern half consisting of the inhabited area and the northern area the unenclosed Common Grazings (C).

The housing consists of a mix of traditional houses (D), some modernised and extended, and some modern houses (D1), as discussed on [xx]. Since the replacement of the black houses by the but' n ben [xx], new houses have had roofs of slate rather than thatch. This was because slate was becoming widely available from quarries opened at places such as Ballachulish, Easdale, Glen Almond and Dunkeld.

On Fair Isle there has been a policy of ensuring new housing is in keeping with the traditional style, assisted by the island being owned by the National Trust for Scotland – although with independent crofting tenants.

The island is good for observing migrating birds who stop off on the island on their journey north or south, or if blown off course. Because of this, there has long been a bird observatory at the north end of the island.

A. GRAZING PASTURE

Much of the once arable land is now used for sheep pasture, with wire fences replacing stone dykes as field boundaries.

B. ARABLE STRIPS

A fenced-off area used for growing hay, potatoes and perhaps other crops in strips of arable land, similar to the traditional pattern [xx]. Each crofter has their own area of land, but all share the Common Grazings.

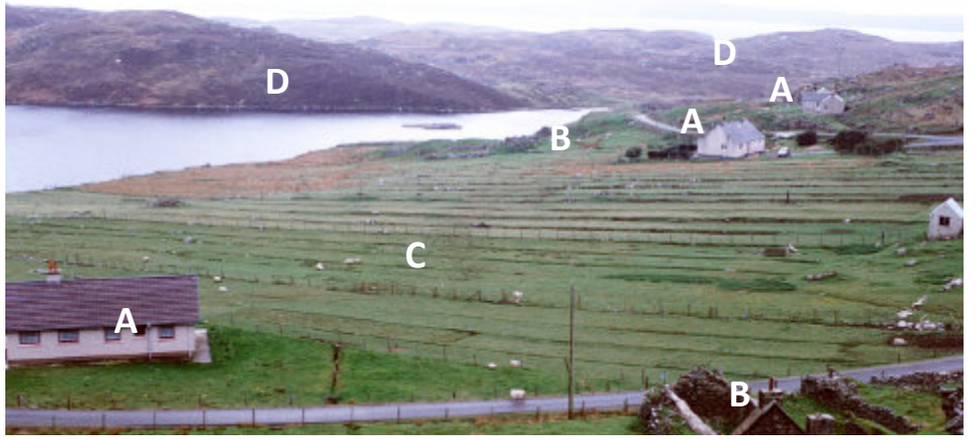
B. HAY CUTTING

A strip of land recently cut for hay, using a tractor-mounted cutter (visible in the picture above), as opposed to a hand scythe [xx]. A haystack is visible in the corner, a rare sight in the Highlands and Islands today [xx]. Grazing animals are excluded during the hay growing season, but after cutting will be let in to graze the aftergrowth.

C. MOORLAND

The dyke on the left is the head dyke [xx], with the inbye land to the left and the Common Grazings to the right – where everyone has the right to graze their animals. Although now heather moorland, much of the area was once blanket peat, stripped over the centuries to provide fuel. There is now only a small area of cuttable peat left.

MODERN CROFTING LANDSCAPES
Calanais (Callanish), Isle of Lewis



This modern crofting landscape on the Isle of Lewis in the Outer Hebrides contrasts strongly with views of a similar area in 1971 [xx,xx]. The modern (A) houses are not in the but 'n ben style [xx], but ruins of the houses which preceded them are still visible (B).

The original arable strips (C) are no longer used for cropping but, in this case, are devoted wholly to sheep grazing, as discussed on page [xx]. Common Grazings are visible in the distance (D), consisting of rocky moorland,

The absence of trees in the landscape meant that the traditional fuel for cooking and heating was peat [xx]. Over the centuries, the cutting of peat on the Common Grazings has markedly changed the landscape. Originally the hollows would have been filled with peat, and there may also have been blanket peat [xx] covering the gently sloping ground. In the vicinity of settlements, all this peat will have been removed over the centuries; as time goes on, then people had to travel further and further from the settlement to cut peat, or even to neighbouring islands.

On some small islands, the removal of all the peat resulted in depopulation because there was no other fuel for heating and cooking, such as at Papa Stour on Shetland. Nowadays peat cutting has virtually died out owing to the availability of modern fuels, although hand-cutting and cutting by machine can still be seen in some places [xx].

A. MODERN BUNGALOWS

Bungalows on the island of Yell in Shetland. Their design shows little relationship to the traditional style of stone house [xx], resulted in a marked discontinuity in the appearance of the landscape.

B. DERELICT BUT 'N BEN

it is now uneconomic to build with the traditional building material, *i.e.* stone; also the older houses, without expensive modification, are not suited to modern living standards. Hence, across the Highlands and Islands, they are abandoned, to be replaced with new homes.

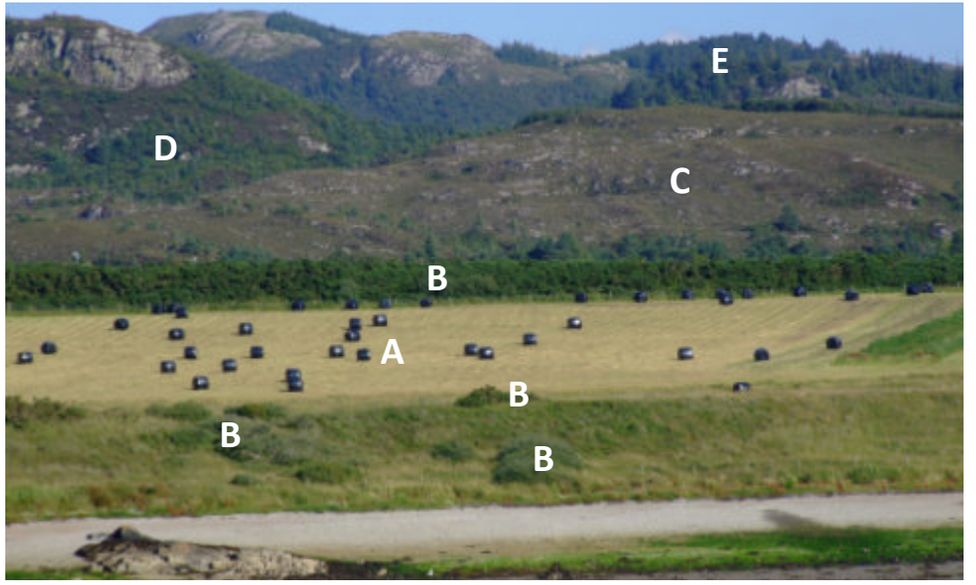
C. ARABLE STRIPS (FENCED)

This picture taken in 1971 shows strips of land growing crops at a crofting township on the north west coast of Lewis. It contrasts with the modern landscape, as in the main picture, where crop growing is rare, and sheep graze the once arable land.

D. ROCKY MOORLAND

This shows rocky moorland on the island of Eriskay. In such islands, population growth in the 1700 and 1800s created a great demand for peat as a fuel – so much so that in places turf was stripped off the landscape to burn as fuel. Hence, in this picture, much of the rocky moorland might once have been covered in peat.

MODERN CROFTING LANDSCAPES
Plockton, Wester Ross



This shows a modern crofting landscape, very different from the traditional one [xx]. A large field has been created from what would once have been narrow strips of arable land [xx], and hay [xx] has been replaced by silage.

However, silage production is not so dependent on the weather as hay: to contain enough nutritional value for livestock, hay has to be left to grow into late autumn or summer before being cut, and then left to dry out. This leaves a risk that a wet autumn can make hay cutting difficult or impossible. Silage, in contrast, can be cut earlier in the year, giving a greater range of days for cutting, and the grass is not dried out before being put into bags (A).

This explains why silage in most cases has supplanted hay as the main winter feed for animals. However, silage is generally grown on fertilised improved pasture [xx] which is dominated by the nutritious rye grass and nothing much else. This has caused the demise of the once flower-rich pastures [xx], and has also threatened the corncrake, a small grouse-like bird which used to live in hay fields but which cannot survive the early cutting characteristic of silage. After cutting, livestock while be allowed back into the field to graze the area until spring.

Visible also in this picture is a modern forestry plantation (E).

A. SILAGE BAGS

Silage bags on the Isle of Gigha to provide winter fodder for sheep and cattle. The bags have to be air-tight to maintain the nutritional value of the silage and to prevent mould growth. Bags can be black, white, green or pink.

B. GORSE

This prickly shrub with its yellow flowers is becoming increasingly common in the Highlands and Islands, colonising large swathes of land [xx]. This makes the land inaccessible to both grazing animals and people. Gorse is sensitive to late frosts so that, with a warming climate, the spread is likely to continue [xx]

C. HEATHER MOORLAND

The area too rough for agriculture comprises heather moorland. Heather dominates on dry ground on acidic, infertile soils.

D. NATIVE BIRCHWOOD

Birchwoods are the commonest woodland type in the West Highlands. At coastal locations, if the grazing is reduced through, for example, the removal of sheep or the culling of deer, the woodland can regenerate at its edges, expanding in area over time [xx].

MODERN CROFTING LANDSCAPES
Inverasdale, Wester Ross

A croft [xx] on the Inverasdale Peninsula on the wet shore of Loch Ewe. Much of the peninsula is relatively flat and hence covered in blanket peat [xx] up to two metres thick [xx]. The foreground here (A) shows smooth blanket peat indicating that this peat is still growing. However, adjacent to the settlements, much of the peat has been cut to provide fuel [xx], with some peat cuttings just visible below (D) on this photograph.

Nearby are the Inverasdale Peatlands, a large area of intact peat bogs which have been designated for their international importance.

The green area beyond (B) is improved pasture [xx] for sheep and cattle grazing, which is perhaps also used to grow silage [xx]. The ground has been levelled, with any rocks which would have originally been present removed to enable the area to be ploughed, enabling the area to be seeded with rye grass – which provides the best grazing.

The croft house (C) is a modern bungalow [xx], with an older house visible behind.

The building (D) is a modern farm shed. Over the years, these sheds have replaced the traditional stone barns (or 'byres' in Scotland) and are used for over-wintering cattle and for storing equipment. In earlier years cattle were over-wintered in byres attached to the dwelling house, and the heat from their bodies helped keep the house warm.

A. PEAT BOG

A nearby peat bog, with a vertical edge created by past peat cutting [xx]. The area to the right of the edge would, therefore, have been deeper peat. The site is no longer used, with peat-forming vegetation regrowing below the old cut.

B. PASTURE RECLAIMED FROM MOORLAND

The green field here is an example of how fertile pasture has been created within an area of brown, heather-dominated moorland. This process, particularly in the East Highlands, has over time led to the loss of heather moorland.

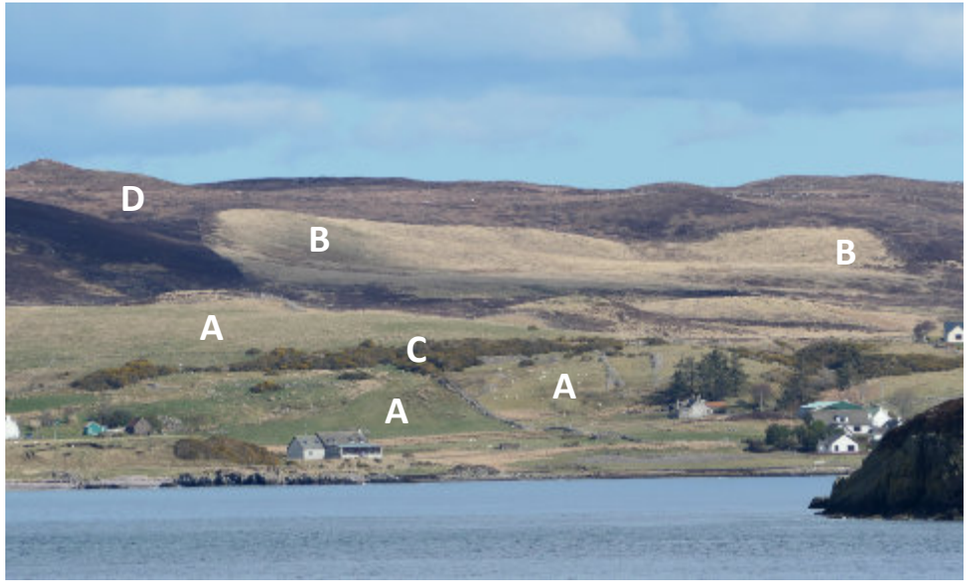
C. CROFT HOUSE

This shows the area around a typical agricultural croft house, with sheds and agricultural implements, old and new. The field at the bottom left shows signs of trampling by cattle: if cattle are wintered outside in the wet climate of the Highlands, their trampling can churn up the ground.

D. MODERN FARM SHED

A modern farm shed on Islay with walls of corrugated metal. In the foreground is a cattle feeding ring: silage is put inside which the cattle can reach through the bars on the side. There is normally extensive trampling damage around such rings.h

MODERN CROFTING LANDSCAPES (winter)
Mellon Charles, Wester Ross

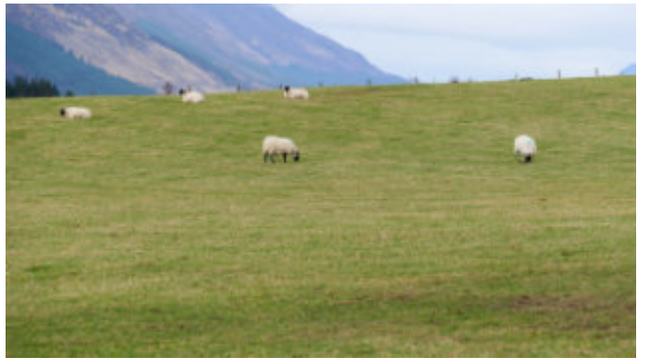


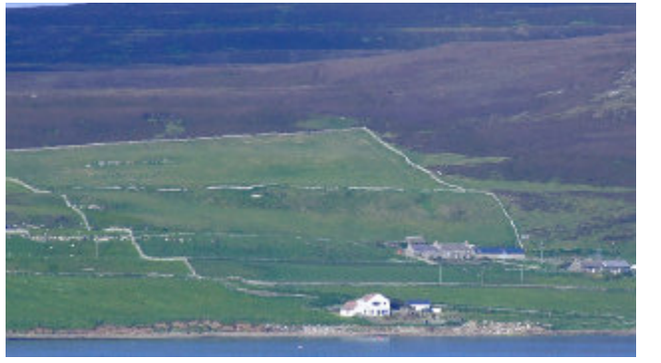
A winter view of a crofting township [xx] on the east shore of Loch Ewe; at this time of of year, only the best grassland contains a hint of green (A).

It can be seen that, unlike crofting landscapes of the past, there is no arable agriculture here, only pasture for sheep. This simplification of the landscape and land use has arisen for several reasons: in the past, crofting was a subsistence economy, with everything grown used on the croft itself rather than sold to markets (although a portion went to the laird for rent). Growing crops takes time and commitment and it is much easier to buy food from local shops and supermarkets than grow your own. With a large amount productive agricultural land in other parts of Scotland, it is not economic to grow crops for sale in the poor climate and on the small scale possible in the Highlands and Islands.

Ruins of old dykes are visible [xx] and sheep have a free rein to graze across the inbye land [xx]. It can be seen that a lot of the moorland (D) has been converted to pasture some time previously (B), increasing the area of better quality grazing land for sheep.

There is a stand of whins (gorse) in the middle of the picture (C), a thorny shrub which has been spreading throughout the Highlands and Islands in recent years. Although native to southern Scotland, it has been introduced to much of the Highlands and Islands, including Orkney, Shetland, the Outer Hebrides, Islay, Jura, Sutherland and Wester Ross.





A. GRAZING PASTURE (IMPROVED)

The greenest areas indicate improved pasture [xx], kept green through better soils and the addition of fertilisers. These are the areas most favoured by sheep.

B. PASTURE RECLAIMED FROM MOORLAND

This shows pasture on the island of Hoy in the Orkney Islands which has been created out of the surrounding heather moorland. It is surrounded by stone dykes which are now in ruins, allowing sheep to graze throughout the landscape

C. GORSE

Gorse growing beside a road. In fact roads provide corridors for the shrub to move into new localities because the disturbed ground beside the road, often created by road improvements in the 1960s and 1970s, provides ideal soil conditions for the plant; and seeds are spread by the slipstream of vehicles.

D. MOORLAND (WET HEATH)

Much of the moorland in the West Highlands is dominated by heath heath [xx], consisting of shallow, damp, humus-rich soils. Although heather is present, it is not dominant as in dry moorland: instead the dominant plants are cross-leaved heath and deer grass.

MODERN CROFTING LANDSCAPES
Poolewe, Wester Ross

A village in the West Highlands that sits within a crofting landscape. Nowadays most of the villagers will not be crofters but a mixed community typical of the Highlands: crofters, other local residents and incomers.

The croft here, comprises unfenced Common Grazings (A), inbye pasture for sheep and cattle (B), a croft house (C) native birchwood (D) and garden trees (E). Crofting [xx] was never designed to provide full-time employment. Hence nowadays crofters are likely be in full-time employment elsewhere – in fish farms [xx], forestry [xx], local government, tourism and many other occupations, with tourism often the mainstay. Originally 'bed and breakfast' was the main offering, but nowadays it is more often self-catering in houses or, increasingly, glamping pods. Campervans and motorhomes have also become popular.

In Wester Ross tourism in fact peaked in the late 1960/early 1970s before the advent of cheap overseas holidays and the 1970s oil crisis, both of which discouraged tourists coming on to the distant Highlands and Islands.

In recent years, tourism has picked up again, with people more willing to come and see the scenery and not so worried by the variable climate. The tourist route 'NC 500' (North Coast 500) circles the North Highlands and has been widely marketed as one of the best drives in the Britain. But its popularity in places overwhelms the infrastructure of narrow roads and parking.

A. MOORLAND (WET HEATH)

The Common Grazings in the main picture consist mainly of rocky wet heath [xx]. The foreground (A1) is not croft land, and is ungrazed by livestock, and hence shows less trampling damage [xx].

B. GRAZING PASTURE (IMPROVED)

The highest quality pasture which has been 'improved' for agriculture, including the use of chemical fertilisers [xx]. Traditionally pasture would have fertilised with the manure which built up from the wintering animals – sometimes with the addition of seaweed and lime.

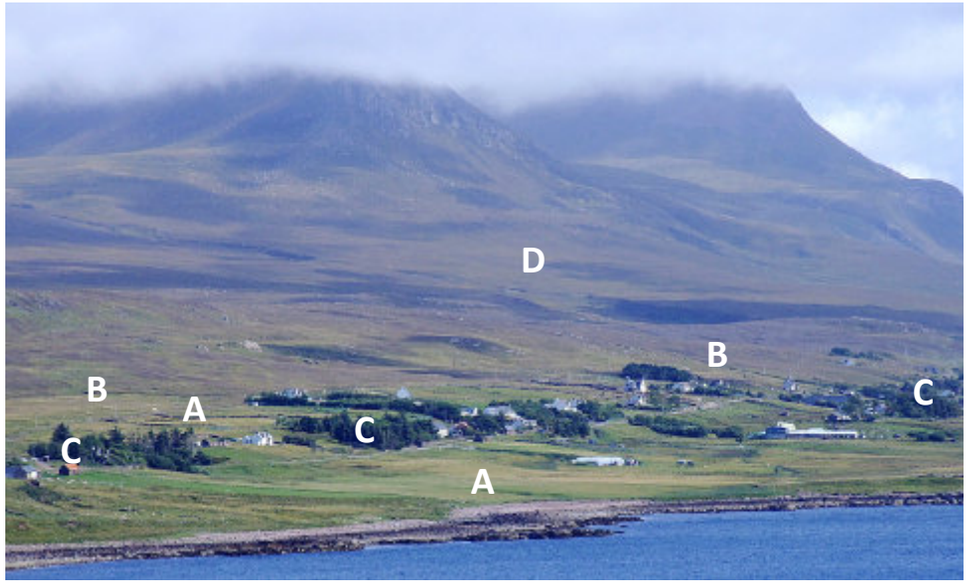
C. CROFT HOUSE

The croft house [xx] is normally situated adjacent to the inbye land which, in this case, consists of improved pasture [xx] grazed by sheep and cattle.

D. NATIVE WOOD

Native birchwood is visible in the main picture both in the foreground and on distant coastal slopes. The woods here are expanding through regeneration of young trees at the edge, in spite of sheep grazing [xx].

WESTERN HIGHLANDS: LANDSCAPE VIEW
Achiltibuie, Wester Ross



This picture demonstrates the main characteristics of a West Highlands' landscape where most settlement is near the coast because conditions are milder and there is also easy access to the sea for fishing. In some locations, settlement is coastal because the population was settled here after removal from inland areas to provide land for sheep farming – during the period of the Highland Clearances in the eighteenth and nineteenth centuries.

It shows a crofting township, the houses widely spaced in a linear pattern along the road. An important factor in coastal locations is that there is often flat land near the sea owing to the presence of raised beaches [xx], formed when the sea level was higher. The fields visible here [A] are on such a raised beach.

Just visible is the 'head dyke' (B), a wall which separates the inbye land where crops are grown [xx] from the open hill land beyond which comprises the Common Grazings [xx].

Woodland has been rare over most of the Highlands for thousands of years, so that all the trees visible here (C) have been planted in gardens.

The open hill above the head dyke consists of natural moorland vegetation: there will be blanket peat [xx] on the gently-sloping ground below the steeper hill-slopes; and the steeper slopes will be better drained with upland grassland and heathland.

A.INBYE LAND

An example of inbye land on Skye, with most of it being grazing pasture. There are also polytunnels visible – for growing vegetables out of the wind. Immediately above them is a vegetable garden for the more hardy plants.

B. HEAD DYKE

An example of a head dyke, above the church glebe in Gairloch. In summer, sheep and cattle would be kept above the dyke to protect the crops in the arable inbye land from grazing animals.

C. GARDEN TREES

Trees are planted extensively in Highland gardens to provide shelter from the wind. It is common to plant conifers such as Sitka and Norway spruce because they grow quickly. However, when tall, they are liable to easily blow over, and also to seed-out into the wider landscape [xx].

D. WILD LAND

Most of the Highland landscape consists of natural moorland of various types [xx]. In the foreground are two heaths: bell heather (dark purple) and cross-leaved heath (pale purple). The commonest heather (ling, *Calluna*) [xx] flowers later in the year. It is termed 'wild land' because there is little sign of human interference.

WESTERN HIGHLANDS: SEA LOCH
Loch Eriboll, Sutherland

A view of a sea loch on the north coast of the Scottish mainland. It shows a 'tombolo' (A), which is an island connected to the mainland by a narrow spit of sand or gravel, with beaches on both sides.

This island also contains large lime kilns (C) dating from 1870. These kilns were used to heat limestone to a high temperature to make lime, which was an important fertiliser. Most soils in the Highlands are acidic in nature and deficient in calcium, so adding lime increased the soil fertility.

The kiln is situated here because it is in an area of Durness limestone. There is a geological fault which runs down the far northwest of the Scottish mainland, the Moine Thrust, and parallel to this is a belt of Durness limestone, an ancient rock dating from the Cambrian geological era. This is unusual because limestone is a rock type generally rare in the Highlands.

It takes a lot of heat to create lime, so kilns only became common when coal become widely available from about the end of the 18th century. Behind these kilns is a large limestone quarry, from which the rock was taken from to feed the kilns.

A. TOMBOLO

This tombolo, Ard Neakie, is a fine example. But the largest in Britain is St Ninian's Isle on the west side of mainland Shetland. This is full of archaeological remains, and is famous for the hoard of Viking silverware found in 1958.

B. SAND DUNES

Sand dunes form from windblown sand off a beach, where the presence of vegetation, particularly marram grass, traps the sand and allows the a dune to build up.

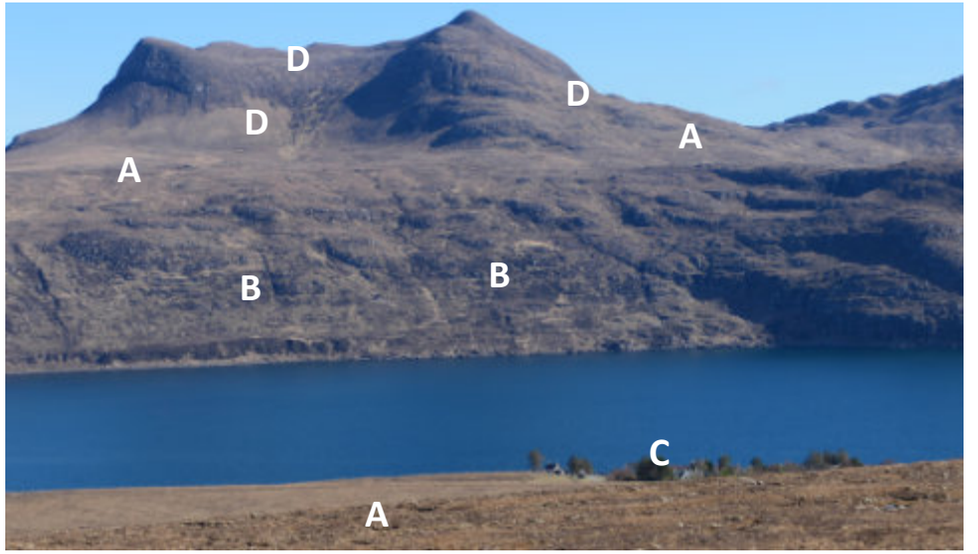
C. LIME KILN

Another small kiln on the shores of Seil Sound in Argyll. Here the rock used to make lime was not limestone as such, but a calcium-rich metamorphic rock. Being near the sea, made it easy to transport the lime to where it was needed.

D. MOORLAND

Most of the landscape around Loch Eriboll consists of acidic moorland of various types [xx]. Where the bedrock is limestone, then the soils are richer resulting in greener vegetation and richer a flora – as shown here around the village of Durness.

WESTERN HIGHLANDS: SEA LOCH
Little Loch Broom, Wester Ross



The landscape west of the Moine Thrust in the northwest of mainland Scotland [xx] is underlain by ancient, hard rocks. These has eroded over millions of years to produce the distinctive mountains of Sutherland and Wester Ross with narrow ridges and steep cliffs. The hill here is Beinn Ghobhlach which lies between Loch Broom and Little Loch Broom, with the latter in the foreground.

The landscape here is underlain by Torridonian sandstone, a hard rock which is about a thousand million years old. Apart from the Durness limestone adjacent to the Moine Thrust itself [xx], these rocks west of the thrust weather slowly and result in infertile soils and a landscape dominated by acidic moorland of dry heath, wet heath and peat bog. There is generally a lot of exposed bedrock.

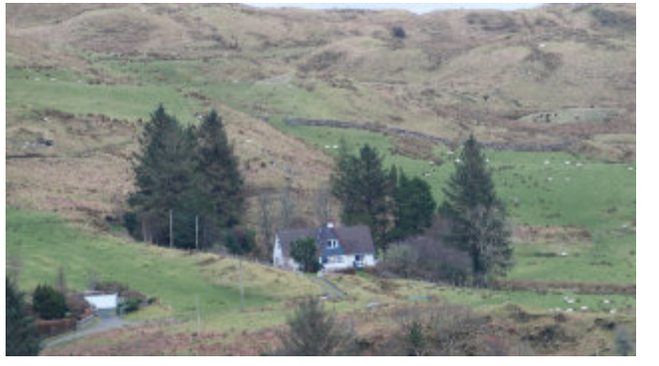
The picture is taken in winter when all the moorland is brown. But even in summer, unlike fertile landscapes, there is always a brown tinge to the vegetation.

A. MOORLAND (PEAT & WET HEATH)

Level and gently-sloping ground is dominated by wet heath [xx] and blanket bog [xx].

B. MOORLAND (DRY HEATH)

The steeper, drier slopes are dominated by heather.



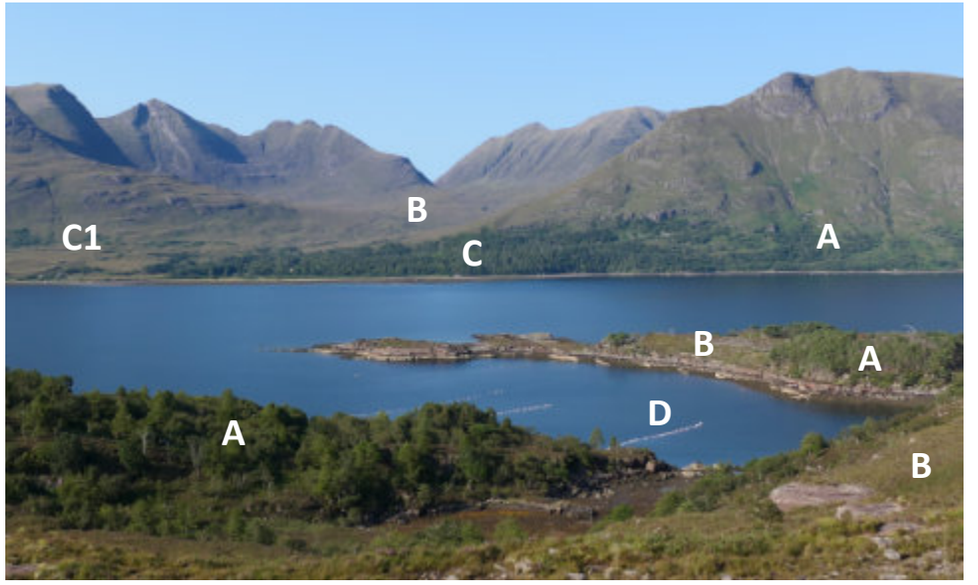
C. GARDEN TREES

The trees visible in the main picture have been planted around gardens to provide shelter. There is no other woodland present in the main picture.

D. MOUNTAIN GRASSLANDS

At higher elevations, mountain grasslands are found, with plants able to tolerate the extreme weather found on the hilltops: strong winds much of the time, and cool, cloudy summers giving only a short growing season.

WESTERN HIGHLANDS: SEA LOCH
Loch Torridon, Wester Ross



The Torridon area of Wester Ross is renowned for its dramatic mountain landscapes. The mountain rise straight up from sea level with steep cliffs and narrow mountain ridges. Visible her across Loch Torridon is Ben Alligin (left), Beinn Dearg (middle), and the western end of Liathach (right). The mountains are built of 1,000 year old Torridonian sandstone, and have given the rock its type name. The rocks are too old to contain fossils, meaning the sandstone was laid down before multi-cellular animals became common.

During the peak of the Ice Age, which only finished about 10,000 years ago, the whole area was under a thick sheet of ice, with perhaps just the mountain tops sticking through. Movement of the ice has created the deep glens between the mountains.

Below the second peak from the left of Beinn Alligin, a gash can be seen, caused by a massive landslide after the ice had retreated. Such landslides were common across the Highlands at the end of the Ice Age, because glacial movement scoured the side of the mountains and when the ice melted, the sides had nothing to support them and collapsed into the glen below.

Most of the landscape here is open moorland without the trees (B), which research shows has been the case for the last 4,000 years. However there is some native birchwood present (A) and also plantations of Scots pine (C), including a young planting on the extreme left of the photograph (C1).

A. NATIVE WOOD

Native birchwood as present on the lower, western slopes of Liathach and along the shore. These woods have been expanding naturally in recent years.

B. MOORLAND (VARIOUS TYPES)

Wet heath [xx] dominates the level and gently sloping ground, with mountain grasslands at higher altitudes. The north slopes of Liathach, cool and shaded from the sun, are a good habitat for rare liverworts.

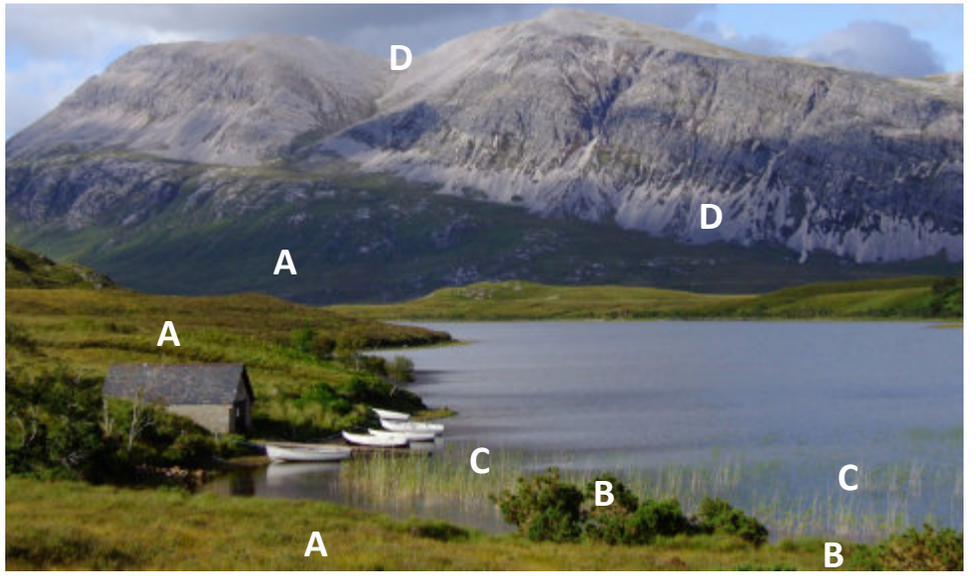
C. SCOTS PINE PLANTATION

The woods around Torridon House are plantations which date from the early 19th century. The new plantation on the lower slopes of Ben Alligin (C1) were created as part of a Scotland-wide tree-planting project: the Millennium Forest for Scotland.

D. MUSSEL FARM

Mussels are grown on ropes hanging down from buoys. Unlike fish farms [xx], although they have a visual impact, they do not create any environmental damage because the growing mussels merely filter-feed the water around them – rather then being fed with any food.

WESTERN HIGHLANDS: MOUNTAIN VIEW
Loch Stack, Sutherland



The boats indicate that Loch Stack shown here is popular with fishermen. The main fish caught will be brown trout, although in the past sea trout would have been an important catch. Numbers of sea trout have declined markedly in recent years, which some people blame on the presence of fish farms at sea [xx], but problems at their feeding grounds at sea may also be an issue.

Salmon are fished on rivers when the adults return from the sea to the rivers and burns where they hatched and spent early months of their life. However, as with sea trout, there has a been a major decline in numbers returning to spawn.

The mountain beyond is Arkle, composed of white quartzite. This is a hard and brittle rock which breaks down easily: when water enters cracks in cliffs, it expands when it freezes, causing the rock to break-up and fall onto the scree slopes below ('frost weathering') (D). The white quartzite with its scree slopes is here overlying the much older Lewisian gneiss, identified here by its smoother and more rounded landform, and without scree slopes.

The mountain is near the boundary of the Moine Thrust, a thrust caused caused by younger rocks to the east being pushed up over the older ones underneath, which is why the bedding-planes of the quartzite visible here slope down to the right (towards the thrust).

A. MOORLAND

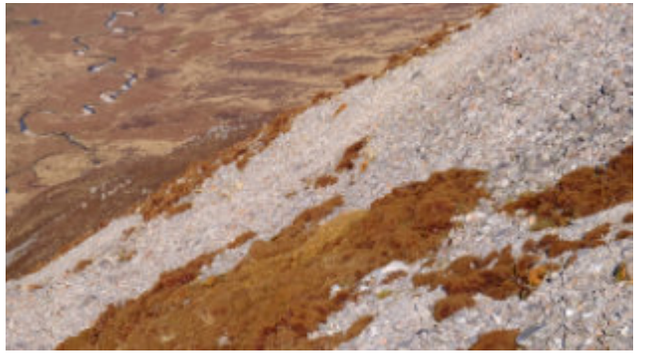
Arkle rises out of treeless moorland comprised of wet heath and dry heath [xx].

B. GORSE

Gorse is not native to Sutherland, but has been spreading rapidly across the landscape in recent years. As discussed on page [xx], roads have acted as corridors which the plants follow, and thereafter move into the wider landscape.

C. REEDS

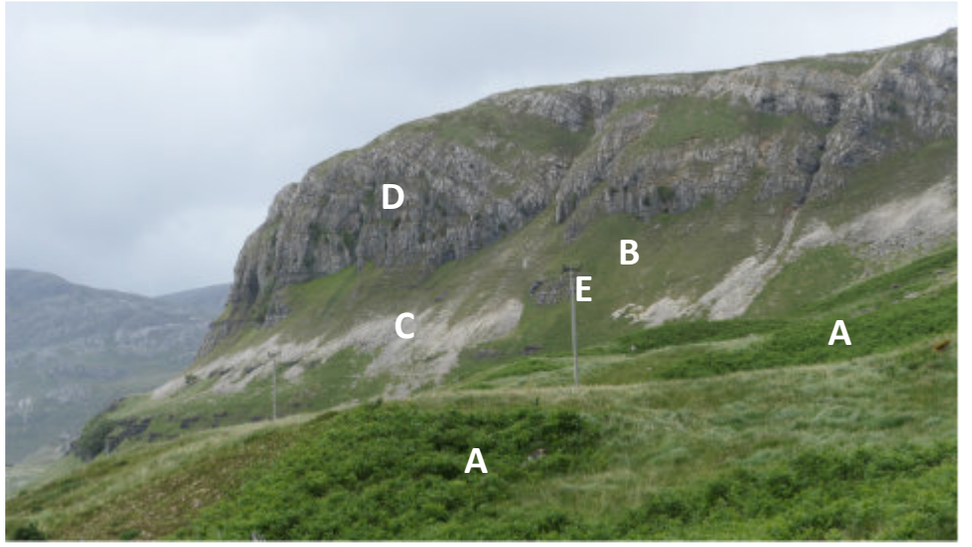
Reeds grow in the shallow edges around lochs, lochans and slow moving rivers. They are grasses, and not be confused with rushes which are common in the Highlands where they colonise grass pastures [xx]. There is only one species in the world, so it is the same one here as, say, along the Nile in Egypt.



D. SCREE SLOPES

Scree slopes are common below most cliffs as a result of weathering of the cliffs above, forming characteristic fan-shaped deposits. This a scree of quartzite on the island of Islay.

WESTERN HIGHLANDS: MOUNTAIN VIEW
Inchnadamph, Sutherland



The Inchnadamph area of Sutherland contains the most extensive areas of Durness limestone along the Moine Thrust [xx]. This picture shows cliffs of limestone (D), a rare phenomenon in Scotland.

The richer soils which occur over limestone give the landscape a greener appearance than most of the landscape because it results in soils of higher fertility. Bracken can be seen invading the dry grassland (A). Bracken is a fern which thrives on the more fertile and well-drained soils across the Highlands and Islands, but is less common west of the Moine Thrust where the soils tend to be poorer – because the ancient rocks are hard, poor in nutrients, do not weather into fine particles to create soil, and provide an impermeable bedrock which results in waterlogging.

The importance of the area in geological terms has been recognised by its designation as a UNESCO Geopark – sites deemed as important for their geological structure.

A study of the Moine Thrust by Victorian geologists was important in the history of geology: the presence in some places of younger rocks actually underneath some older rocks proved that horizontal movement of rocks on a large scale can occur.

A. BRACKEN

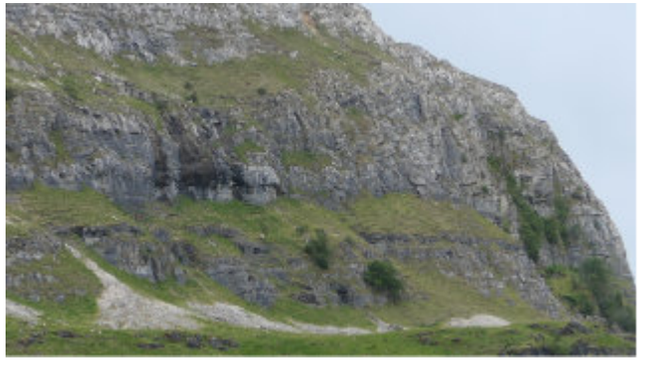
Fronds of bracken, a fern which can take over grassland. It is poisonous to livestock so as it spreads, it reduces the grazing value of the grassland. In the past.it was cut to provide bedding for cattle overwintered indoors, and dried for fuel.

B. GRAZED GRASS

Limestone grasslands provide some of the best grazing in the Highlands. The greener area here overlies a belt of Durness limestone and shows how the richer soil results in greener vegetation more nutritious to animals. This site is located on a small outcrop of limestone further south at Kishorn.

C. SCREE SLOPES

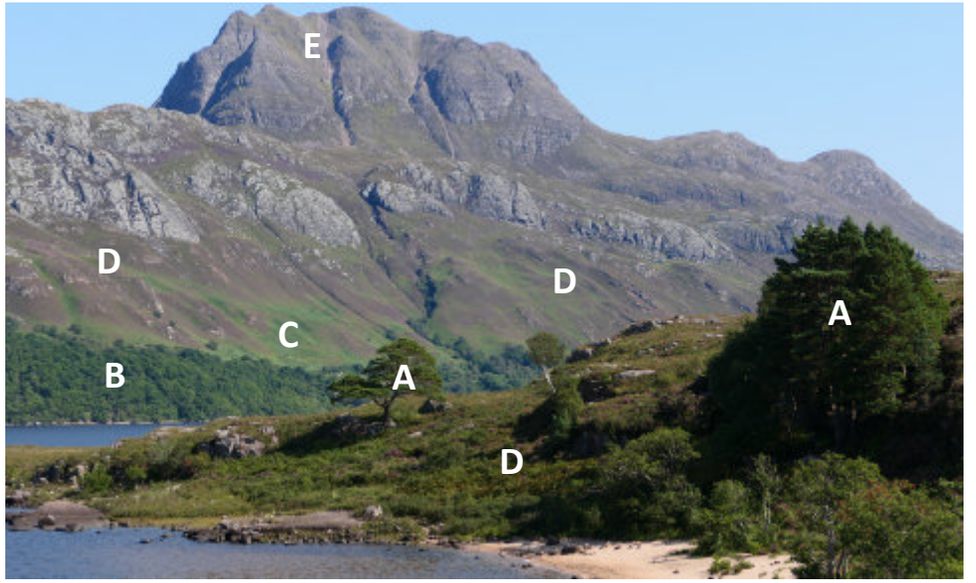
Large scree created by rocks falling off the cliffs above. In this case, the rock is not limestone.



D. LIMESTONE CLIFFS

A close-up of the Inchnadamph cliffs. Being limestone, they contain caves caused by burns dissolving the rock over the millennia. They are famous for containing the remains of Stone Age (Neolithic) artefacts and of animals which are no longer found in Scotland such as lynx, reindeer, arctic fox and bear.

WESTERN HIGHLANDS: MOUNTAIN VIEW
Loch Maree & Slioch, Wester Ross



The mountain here is the dramatic Slioch which towers above Loch Maree in Wester Ross. Slioch is Gaelic for 'spear'. This area is famed for its natural beauty and was one for the five areas in Scotland identified as being worthy of National Park status by the Ramsay Committee in 1945. This committee met while the Second World War was still in progress, and providing National Parks which would have had open public access (rare in Scotland at the time) was seen as a way of rewarding people for the war effort.

In the event, it took another fifty years before the first National Parks were created in Scotland: Loch Lomond and the Trossachs in 2002, and The Cairngorms in 2003. However the finest landscapes in Scotland were identified in the 1978 report by the then Countryside Commission for Scotland called Scotland's Scenic Heritage. 40 locations were identified, which have since been designated 'National Scenic Areas', most, but not all, of which are in the Highlands and Islands. They include the five areas identified by the Ramsay Committee. National Scenic Areas are planning designations, meaning that there are certain planning restrictions designed to protect their landscape quality. Perhaps surprisingly, most people of Scotland have not heard of them!

There was a hydro-electric [xx] scheme proposed in the 1960s connecting Lochan Fada to Loch Maree below, but this was never built owing to concerns about the effect on the landscape of such an iconic area.

A. SCOTS PINE

Above Loch Maree is the Glas Leitire Pinewood, a relict from the era thousands of years ago when Scots pine wood was once common across the Highlands [xx]. The two pine in the main picture are outliers from the main wood which is about three miles to the southeast.

B. NATIVE OAKWOOD

The east shore of Loch Maree is famous for its woods of sessile oak, once used to provide charcoal for an iron furnace at the south end of the loch. This was built in 1610, and was one of the first in the Highlands. However, in spite of the past harvesting of the trees, the oakwoods are still there.

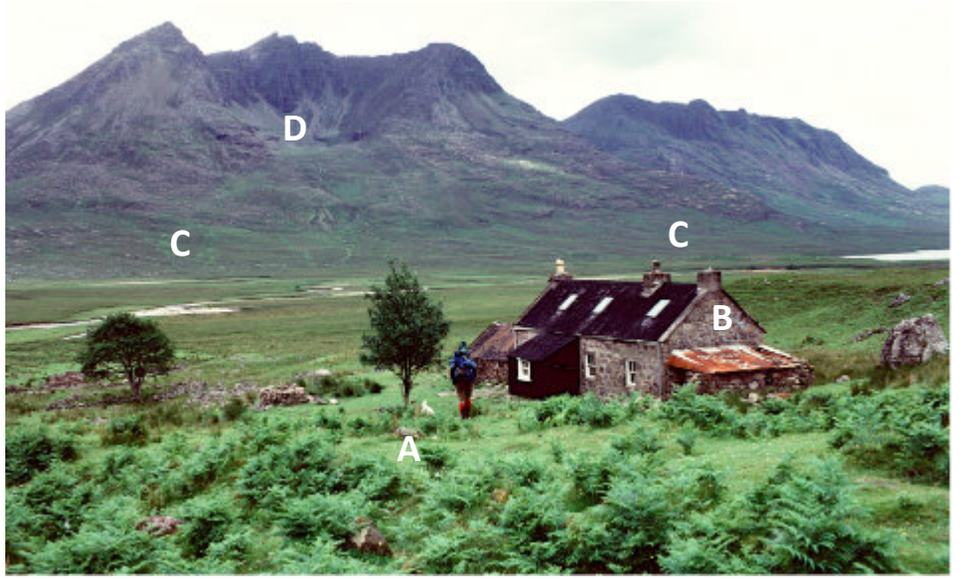
C. BRACKEN SLOPES

The lower slopes of Slioch have stands of bracken, a fern which can take over the landscape on drier soils [xx]. It is an unusual fern in that the stem is underground, giving rise to widely-spaced shoots; most ferns have a central rosette of leaves. It dies down completely in winter [xx].

D. MOORLAND (DRY HEATH)

Above the bracken on Slioch are slopes of dry heath, composed mainly of heather (ling) [xx], but also with some bell heather [xx]. Although heather is visible in the foreground of the main picture, it is here growing on wet heath as opposed to dry heath [xx].

WESTERN HIGHLANDS: MOUNTAIN VIEW
Strath na Sealga, Wester Ross



This picture is taken in a remote area of Wester Ross far from any road in an area which has been called 'The Last Great Wilderness, encompassing the land between Loch Maree and Little Loch Broom. This is because it contains minimal signs of human infrastructure: only some footpaths and a couple of bothies. There is only one small forestry plantation of (at Kernsary), and no dams, pylons, windfarms or fences.

The Scottish Government's nature conservation agency, Scottish Natural Heritage, conducted a survey of such wild areas across Scotland which resulted in a map of what were called 'Wild Land Areas', published in 2014. There are 42 such areas which, apart from two in southern Scotland, are all in the Highlands and Islands. Five criteria were used to identify them:

1) Perceived naturalness
2) Rugged or challenging terrain
3) Remoteness from public mechanised access
4) Lack of built modern artefacts
5) Relative wildness

However, these Wild Land Areas have no legislation to back them up and, to date, have proved unpopular with government and developers because it is felt that, keeping them wild, is a constraint on development. Therefore, the extent of wild land in the Highlands and Islands continues to decline through the types of development discussed in this book.

A. BRACKEN

Bracken is growing on the grassland around the bothy because the soils here are dry and relatively fertile [xx].

B. BOTHY

A bothy is a hut used by walkers and climbers for overnight accommodation. The conditions inside are basic, without electricity and often without running water. Most bothies were originally built as croft houses [xx] or shepherds' houses dating from the sheep farming days)

C. MOORLAND (WET HEATH)

Trees are absent over most of the landscape, which is dominated by wet heath [xx] on the at lower altitudes and mountain grasslands higher-up [xx]. This is natural vegetation with an unbroken link back to the last Ice Age, a rare situation to find in Europe today.

D. MOUNTAIN CORRIE

The northern and northeastern sides of the higher mountains in Scotland have large bowl-shaped hollows below the summit ridge, with steep cliffs at the uphill end, and often a loch at the bottom. These are called corries (or cirques, or cwms in Wales, or coire in Gaelic), were formed by small glaciers during ice ages.

WESTERN HIGHLANDS: MOUNTAIN VIEW
Stac Pollaidh, Sutherland

The hill pictured here is Stac Polly (Stac Pollaidh in Gaelic). At 612 m it is not high enough to be a Munro, but its spectacular mountain ridge makes it popular with hillwalkers. A 'Munro' is a hill over 3,000 ft (914 m), so-called because they were first listed by a mountaineer named Sir Hugh Munro in 1891. There are 282 across the Highlands and Islands. People who like to climb them are called 'Munro-baggers'. Most hills in Scotland never had paths to the top because they were rarely climbed. In the 19th century and the first half of the 20th century, the hills were in sporting estates [xx]. Access was the preserve of the landowner and his friends, and public access was not allowed.

However, as hillwalking became more popular in the second half of the 20th century, conflicts arose between the owners and those wishing to climb the hills. This was resolved to some extent by the National Trust for Scotland buying some estates in popular hillwalking areas, such as Glencoe, Ben Lawers, Kintail and Torridon, which were open to the public all year. The situation was only fully resolved by the Scottish Government passing the Land Reform (Scotland) Act in 2003, giving the public the 'right to roam' everywhere, apart from the vicinity of buildings and a few places.

An upshot of the popularity of hillwalking has been the proliferation of footpaths to the summits of hills (A). Previously, what paths there were, were built as paths for deer stalkers in Victorian times – and they went to the corries, where the deer were, rather than to the summits.

A. FOOTPATHS

An example of how mountain paths have developed with the popularity of hillwalking. This shows paths in the Cairngorms. The main picture shows a path with erosion at (B), but which has been repaired at (A).

B. ERODING PATH

Because the paths were not constructed, but followed the easiest route to the summit, the passage of feet has eroded the vegetation down to the soil or peat beneath. In the wet climate of Scotland, water causes additional erosion (see also [xx]). There are now footpath teams dedicated to path repair.

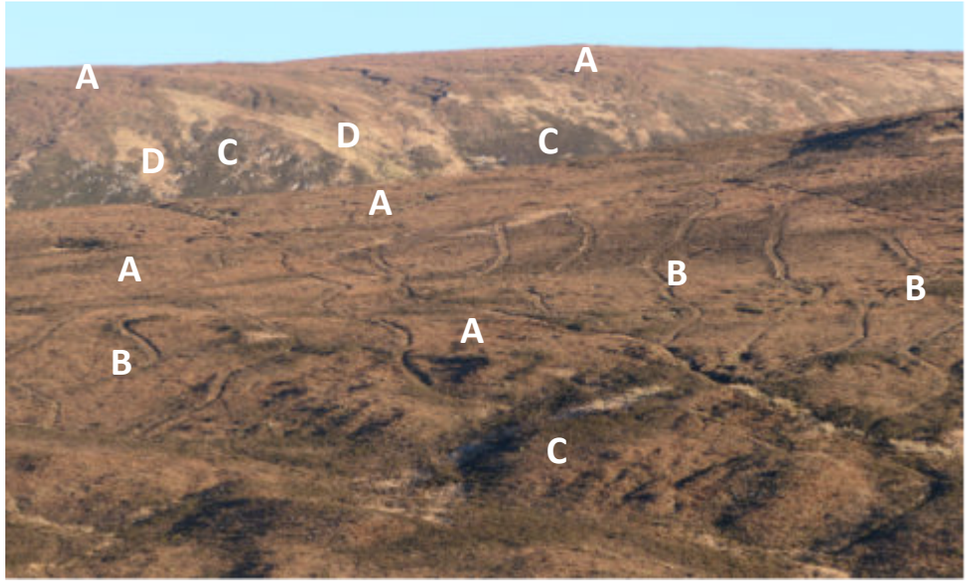
C. MOORLAND (DRY & WET HEATH)

The vegetation around the base of the hill is wet heath [xx]

D. BRACKEN (WINTER)

The steeper, drier slopes are bracken covered [xx]. Bracken dies down in the winter, leaving brown dead stems. Bracken occurs at lower elevations and does not occur above 500-600 m.

WESTERN HIGHLANDS: MOORLAND VIEW
Applecross, Wester Ross



This is a moorland landscape covered in blanket peat (A) [xx], similar to the one shown on page [xx]. However, it differs in that at some time in the past a series of drains were cut through the peat (B), leaving their mark on the landscape. These were dug by a plough behind a tractor with the aim of draining the peat so that the drier ground produced more productive vegetation for sheep to graze; and also, on some sporting estates [xx], to encourage heather growth for the benefit of red grouse. The practice took place mainly in the 1950s and 1960s and was grant-aided by the government in support of farming.

The ditches are known as 'moor grips' and can be seen even in remote areas. But they proved ineffective in draining the land: this is because the peat they were cut through is not permeable to water – so water does not drain out of it into the ditch. In fact, the reason blanket peat forms in the first place is because the half-decayed vegetation below becomes compressed by the weight of the plants above – so much so that it holds water tightly by capillary action. This means it is permanently saturated with water, which results in anaerobic conditions (i.e. without oxygen) which prevents further decomposition.

Hence blanket peat can grow upwards above the landscape, taking the water with it, resulting in what is called a 'perched water table', because capillary action is a stronger force than gravitational drainage.

A. BLANKET PEAT

An example of undisturbed blanket peat, is actively accumulating peat underneath, so that, over time, it rises above the landscape. Peat growth is of the order of 1 mm *per* year, *i.e.* it gets thicker by this amount every year.

B. MOOR GRIP (DITCH)

Water does not drain out the peat into the ditch, although, after rain surface water will run into it. This can cause the ditch to deepen, resulting in erosion of the peat. This erosion releases carbon to the air, so many such ditches are now being dammed to stop this.

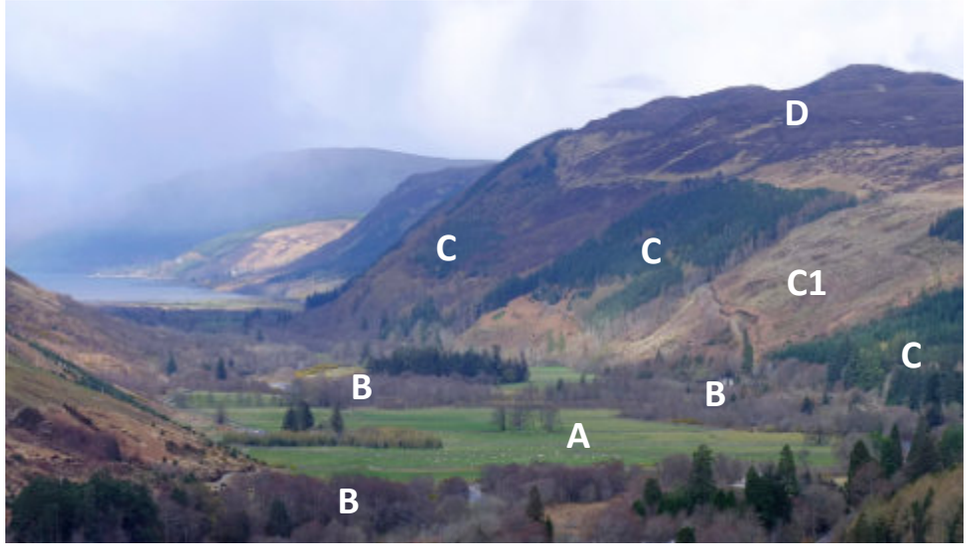
C. MOORLAND (DRY HEATH)

The steeper slopes in the main picture are better-drained, resulted dominance of heather in some places rather than peatland vegetation [xx].

D. MOORLAND (DAMP GRASSLAND)

The steeper slopes also contain areas of damp grassland dominated by purple moor grass. They photographs here were taken in winter. when the dead leaves make the grasslands look white. In summer, with new growth, they turn green.

WESTERN HIGHLANDS: GLEN VIEW
Strathmore, Wester Ross



This a wide, flat bottomed strath leading down to the sea at the head of Loch Broom. It originally would have been carved out by ice flowing down into the sea from a large inland icesheet.

The flat bast of the strath, composed of sediment washing down by the river and perhaps also by raised beach deposits [xx], is well-suited to agriculture: it is near sea level and sheltered, giving mild growing conditions, and the level ground is ideal for the creation of fields (A). Such flat ground is rare in the Highlands. The side of the River Broom has alder trees growing along its length (B) and the hillslopes have commercial conifer plantations (C), with a clearfell site [xx[visible (C1). Above the plantations is heather moorland (D).

The sheltered nature of the strath in this far north location has long been recognised, and resulted, in the 1870s, in the creation of Lael Arboretum – a woodland garden with about 200 species of tree from all over the world, including the giant Wellingtonia from North America. This is now managed by the government's forest body, Forest and Land Scotland.

The strath ends suddenly with a steep slope leading up the moorland to the south. Cutting through this slope is the famous Corrieshalloch Gorge, where water from melting glaciers at the end of the Ice Age has cut down 60 metres into the rock, leaving a narrow and spectacular gorge. It is owned by the National Trust for Scotland.

A. PASTURE (IMPROVED)

The fields at the base of the strath are well-suited to cattle production. Over time they have been 'improved' for agriculture [xx], that is, made more fertile with drainage, fertilisers and reseeding with better grasses.

B. RIVERSIDE ALDER WOODS

Across the Highlands, alder trees are characteristic of riversides and also other wet areas at low altitudes.

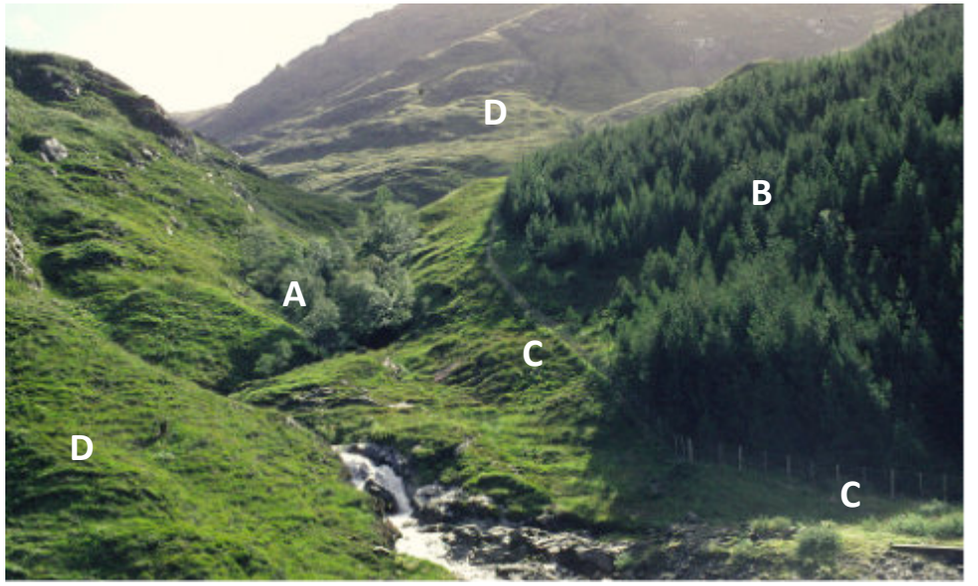
C. CONIFER PLANTATION

This shows a mature plantation with clearfell site in the foreground [xx]. The purple flower is foxglove, which would not have been found on the original moorland on which the trees were planted. This shows how tree planting permanently changes the soil structure.

D. HEATHER MOORLAND

The natural vegetation over much of the Highlands, particularly on drier, less fertile soils – which is determined by the type of bedrock present.

WESTERN HIGHLANDS: GLEN VIEW
Glen Shiel, Wester Ross



This picture shows the difference between the natural woodland of the Highlands (A) and the commercial conifer plantations (B) which have become common over much of the area over the past decades.

Natural woods are irregular, with trees of different sizes and shapes, and irregular edges: straight lines are rare. In contrast, commercial plantations have regular patterns with straight lines: trees are planted in parallel rows to match the forest plough-lines [xx] and also close together: this ensures straight growth without side branches, as required by the timber industry. Edges of plantations are often straight, with surrounded by straight fences (C), although in recent years, greater effort has been put into the design of forests, so that the edges blend more into the landscape.

Additionally, plantation trees are not native to Scotland. In the early years of forestry, the native Scots pine – the only conifer native to Scotland – was used: for example, there are still several Scots pine plantations in Moray. But the tree is nowadays rarely grown commercially because it does not grow as fast as, for example, Sitka spruce – the main tree grown today.

However, in the last few decade, new Scots pine plantations have been planted, not for commercial reasons, but as an attempt to recreate the original native pine forests which, thousands of years ago, once covered much of the Highlands [xx]. Fragments of these woods, called Caledonian Pinewoods, still occur in scattered locations across the Highlands.

A. GULLY WOOD

Trees in the Highlands are often restricted to steep burnside gullies [xx], here birch trees growing in such a gully near Bridge of Orchy.

B. CONIFER PLANTATION

A mature plantation of Sitka spruce, of an age when felling is imminent. Because large trees are more likely to blow over in the windy climate, and because growth slows as the trees age, the trees are harvested when they are 50-60 years old.

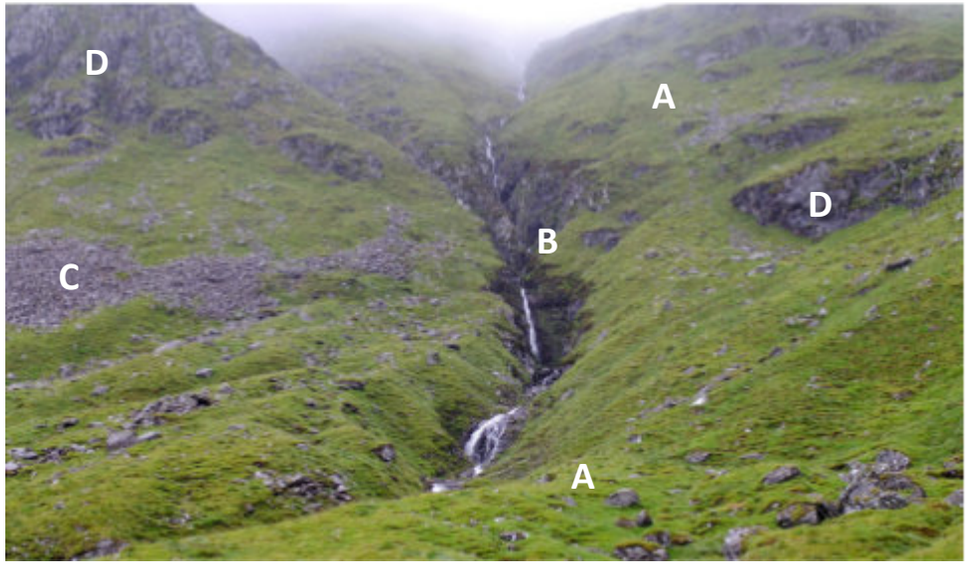
C. DEER FENCE

Standard fences around agricultural fields [xx] are low enough that deer can easily jump over them. Tree plantations are fenced with higher 'deer fence' to keep out red and roe deer which might otherwise browse the young trees.

D. MOORLAND (WET HEATH)

Wet heath [xx], the type of vegetation on which the trees in the main photograph were planted. As the trees grow, they eventually shade out all the plants underneath, leaving largely bare ground.

WESTERN HIGHLANDS: GLEN VIEW
Ben Doran, Perthshire



This shows a mountain view at a location further south than the other pictures of the Western Highlands above. Generally, the hills in the southwest of the Highlands are less heather-covered and more grassy (A), giving them a greener appearance in summer. This probably arises because the bedrock is of a type that weathers to produce richer soils – and heather is more susceptible to grazing on richer soils, whether by sheep or red deer.

The tops of the Scottish hills are often, as here, wreathed in cloud. This keeps them cool and damp which, combined with the windy nature of the climate, makes the hilltop an extreme climate for plants to grow. The Scottish hills have what is called a 'montane climate' which is one characterised by mild winters and cool summers. These are 'oceanic climates', i.e. near the sea: the relative warmth of the sea prevents the cold winters found in the interior of continents, and ocean dampness mean the summers are rarely hot.

A montane climate, therefore, contrasts with that of an 'alpine climate' such as that of the European Alps, with warmer summers and colder winters. One feature of places with colder winters is that snow protects trees and shrubs from grazing. The absence of guaranteed winter snow cover in the Scottish hills means that trees are rare because deer can easily graze the whole landscape – the hills being low enough for the native red deer to easily go up and down in a day.

A. MOUNTAIN GRASSLAND

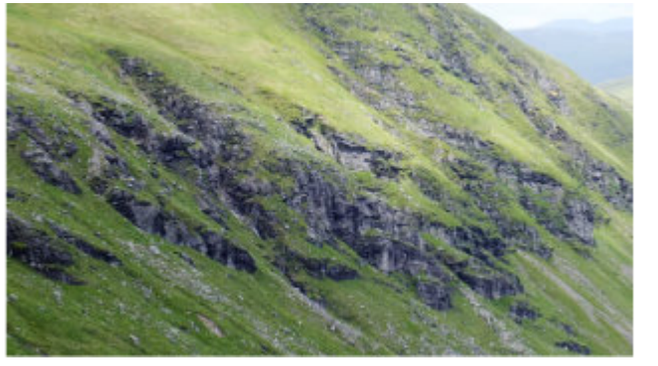
Here a footpath is visible through the mountain grassland to the summit of Ben Doran, a popular hill because it is a Munro [xx]. Such ridges exposed to the strong winds only have low-growing vegetation.

B. WATERFALLS & GULLY

The waterfalls of the Scottish Highlands are popular tourist attractions, such as the Falls of Falloch and Kilt Rock. The highest in Scotland, indeed in Britain, is the Eas a' Chùiall Aluinn in Sutherland with a drop of 200 metres.

C. SCREE

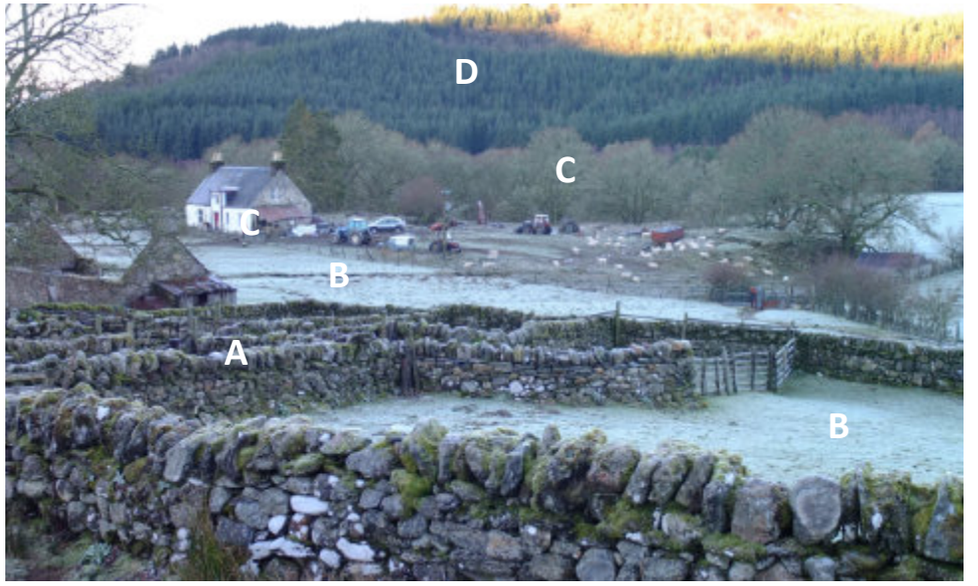
Scree slopes form beneath cliffs from rocks breaking off and rolling down the hill [xx]. The bigger stones are at the bottom and the smaller ones at the top.



D. CLIFFS

Cliffs are inaccessible to grazing animals and, particularly where the bedrock is rich in calcium, can host plants absent from elsewhere in the landscape. These can include plants once common at the end of the Ice Age 10,000 years ago, but now rare in the warmer climate. See also 'cliff woodland' [xx].

WESTERN HIGHLANDS: SHEEP FARM
Glen Spean, Inverness-shire



This is a traditional Highland sheep farm, as opposed to a croft [xx]. The number of sheep farms in the Highlands is declining for a variety of reasons. Many sheep farmers are near retirement age and have no-one to take over the farm; sheep farming is a hard, outdoor life and is a career the younger generation are not interested in. There is not much money in the business and the annual income is barely enough to support a living; indeed, without annual grants from government, the farms would make a loss.

The Scottish Government has a policy to cover a quarter of Scotland with trees. There are government grants for tree planting and many landowners are taking advantage of this, closing down their sheep farms at the same time. In this picture, the plantation (D) was likely once to have been a sheep farm about forty years ago.

Another contributing factor is that sheep farming has a bad press in many environmental circles: sheep are accused of making the landscape barren by eating young trees and so preventing what natural woods are present from regenerating. Sheep are also accused of destroying the original native woodland following the introduction of large-scale sheep farming at the time of the Highland Clearances [xx], made possible by the extinction of the wolf at the end of the 17th century. This is an unfair accusation because woodland had declined to a low level centuries before sheep were introduced. Finally, eating meat is seen as unethical by the increasing vegetarian movement.

A. SHEEP FANK

Stone fanks were used for holding sheep at times of sheep-shearing, dosing for parasites and end of seasons sales. This one is abandoned, with forestry plough lines [xx] at the top indicating that forestry is replacing farming.

B. PASTURE

Sheep, unfairly, have a bad press, with their grazing said to damage landscapes. But grazing animals maintain the fertility of landscapes through their dung and urine, and also maintain the species-richness of many habitats. But because they eat young trees, they are seen as bad for the environment.

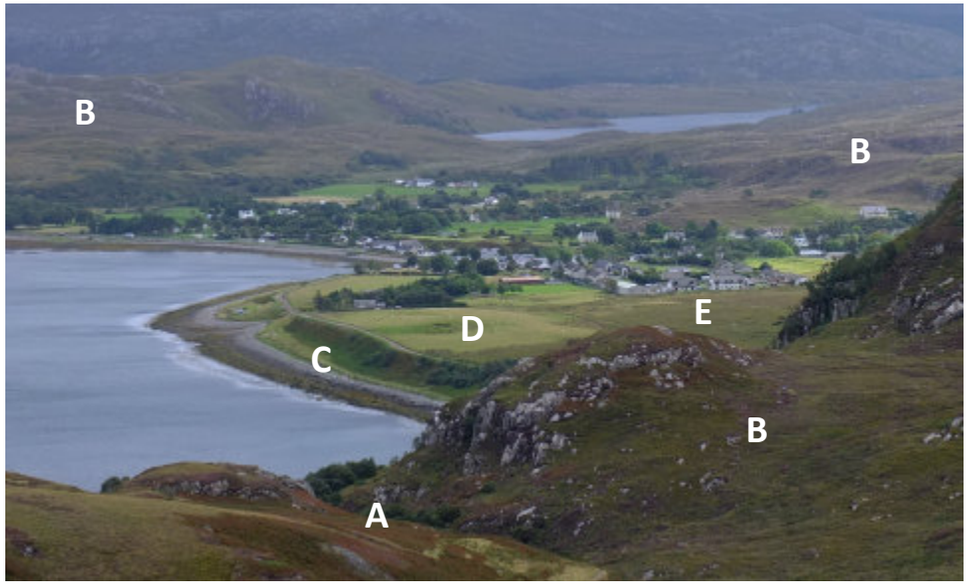
C. OAKWOODS

There are extensive oakwoods along the River Spean. There are two species of oak in Britain, the sessile oak and the pedunculate oak, of which the sessile is the commonest in the Highlands. There are both natural woods and woods planted in the past for the charcoal and tannin industries.

D. CONIFER PLANTATION

The plantation in the main picture has not quite reached maturity so there are no clearfell sites present [xx]. The picture here shows a clearfell in the foreground, which indicates that harvesting is in progress and the trees beyond will be the next to be felled.

WESTERN HIGHLANDS: VILLAGE
Poolewe, Wester Ross



It can be seen here that the village of Poolewe resides in a smooth and level area within a more undulating and rocky landscape. This is because it is sited on a 'raised beach' (D). These are beaches which were once underwater when the sea level was higher, the action of waves and currents smoothing the land

The weight of ice on the land during the Ice Age pushed the whole landmass down, in effect making the sea level higher. When the ice melted and the weight taken off, the whole land rose up again in a process called 'isostatic rebound'. The situation is complicated because all the ice on the land in icesheets and glaciers during the Ice Age caused lower sea levels because the ice was, in effect, water taken out of the sea and put on the land. When it melted, then sea levels rose.

Hence the actual sea level was a complex interplay between isostatic rebound and melting glaciers. This is shown in the above picture because there are two raised beaches visible: a lower one (C) and a higher one (D). Raised beaches are visible all along the coast of the west Highlands (see also [xx]) and it is their presence which largely makes the coastal regions habitable by providing level and rock-free areas for farming. There are also areas where seacliffs and caves are now present parallel to the coast but away from the sea, created thousands of years ago when the sea was higher.

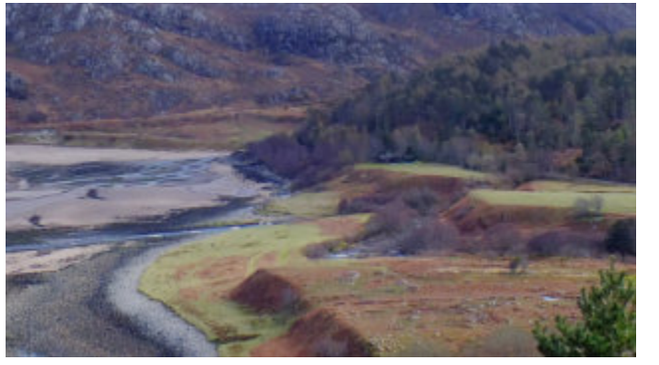
See [xx] for more information on Highland villages.

A. GULLY WOOD & BRACKEN SLOPE

There is wood in the foreground of the main picture along a gully beside a burn, with a bracken slope above. This picture is taken upstream of the same burn, with the vegetation described at [xx].

B. MOORLAND (DRY & WET HEATH)

The moorland visible is a mosaic of dry heath [xx] on the steeper rocky slopes, wet heath [xx] beneath, with better drained grassland [xx] in the foreground. The grassland will provide the best grazing for sheep and deer.



C. RAISED BEACH

Another raised beach in Wester Ross at Gruinard, showing both the lower beach not far above the high tide line, and the higher one above it. The vegetation on them is either dry grassland [xx] or bracken [xx]. It can be seen why they make good fields in an otherwise rocky landscape.h

D. PASTURE (IMPROVED)

Where nearest the sea, the vegetation on the raised beach is dry grassland which has been improved for agriculture [xx]. The darker vegetation inland (E) is peat bog, with the picture here showing a similar situation: peat in the foreground, grass behind. The grassland has been created out of peatland.

WESTERN HIGHLANDS: NATIVE WOODLAND EXPANSION
Loch Broom, Wester Ross

Natural woodland has been rare in the Highlands for the last few millennia [xx], but has always been commonest along the coast [xx]. The amount of grazing in the landscape, whether from sheep, cattle or red deer, influences the cover of woodland because the animals eat the young trees, preventing regeneration. If the number of animals is reduced, whether through reduction or removal of livestock, or disease, harsh weather or culling of deer, then woodland can expand from its core areas of gullies and cliffs [xx]. This is happening here with birch trees colonising heather-covered slopes above Loch Broom, opposite Ullapool.

The dominance of heather here indicates drier soil, more suited to trees than wet heath [xx] or peat bog [xx]. This, combined with its coastal location and milder climate, means that if grazing is reduced, as presumably has happened here, then birch woodland can expand.

Expansion of woodland such as this, without any tree planting, is called 'natural regeneration'. This is the method of new woodland creation preferred by environmentalists because it results in a more natural pattern of trees than in a planted wood [xx]. It can questioned if it actually is 'natural' regenerationwhen it is brought about by a level of grazing lower than would be expected naturally. Modern research highlights the importance of grazing animals in shaping the ecosystems of natural landscapes. Hence the desire for more trees in the Highlands may be based on human preferences.

A. GULLY WOODS

Gully woods such as these can be seen as 'core woods' which are always present, which trees can expand outwards if conditions change, or retreat back if conditions revert.

B. CLIFF WOODS

Cliff woods, as here in Glencoe, can also be seen as core woods, always present in the landscape. See also [xx]

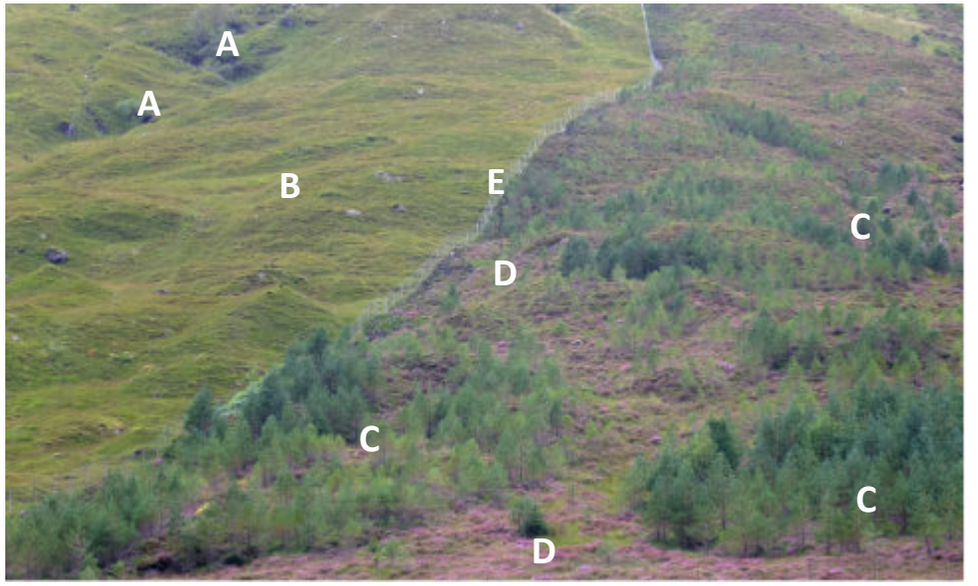
C. REGENERATING BIRCH TREES

This is on the island of Rona where grazing has reduced significantly in recent years owing to the removal of sheep. This has resulted in extensive regeneration of birch as visible here. Over time, if sheep numbers drop, the number of red deer increases; this makes it to be difficult to determine what is the 'natural' grazing level.

D. DRY HEATH

Well-drained heather moorland at lower altitude can be a suitable habitat for Scots pine, birch and oak to colonise if grazing levels are reduced. In these situations, trees regenerate best if there are some animals present whose trampling damage provides seed beds for young trees.

WESTERN HIGHLANDS: NEW NATIVE WOOD
Glen Shiel, Inverness-shire



The previous page showed woodland expansion by natural regeneration, i.e. self-seeded trees without human planting. Although favoured by environmentalists, the approach does not guarantee woodland, or at least enough trees quickly to satisfy people in these impatient times.

Therefore many woodland schemes in the name of conservation (and all commercial schemes) go down the planting avenue, as illustrated here where native Scots pine have been planted (C). Unlike commercial schemes, though, the trees are not planted in straight lines and the woodland managers would have used the 'mounding' method of planting [xx]. There are also some open space left unplanted, both to ensure habitat diversity in the forest and for aesthetic appeal. Such schemes are grant-aided by government and, for the landowner to get the grant, there have to be a minimum number of trees planted. This constraint means that the new wood is unlikely to mirror its natural counterpart.

The increasing number of such schemes has come about both from environmentalists wanting to 'restore' the landscape to a more wooded state (as it was thousands of years ago); and more recently from the justification that trees store carbon to the benefit of the climate. The latter is dubious because tree roots dry out the soil which increases the rate of organic matter decomposition in the soil, *i.e.* releases carbon. On balance, the loss of soil carbon is probably greater than that gained in the trees.

A. GULLY WOOD

The only existing natural woodland in this upper area of Glen Shiel is in gullies and on cliffs as shown on page [xx]. Additionally, native Scots pine, is absent in the glen, although this is the main tree planted.

B. MOORLAND (WET HEATH)

This is the typical type of vegetation on which the trees have been planted – wet heath [xx]. A woodland in the same location would absorb more solar radiation because less is reflected back to space: this reduced reflectivity (albedo), warms the local climate.

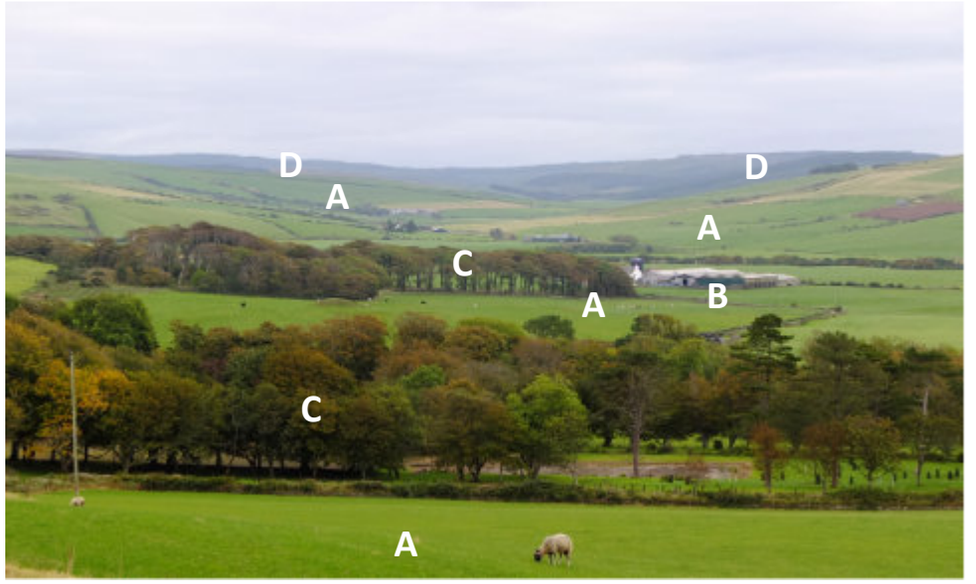
C. PLANTED NATIVE WOOD

This is another planted wood of native trees, further south near Kingairloch. It is a mixture of birch and Scots pine, and is typical of the many new tree-planting schemes across the Highlands.

D. HEATHER

All woodland planting schemes have a deer fence around them (E} [xx] to keep out animals so they do not eat the trees. The absence of grazing within the fence has caused the heather to flourish. It was always present, but suppressed by grazing. This illustrates the effect of grazing animals on the landscape.

WESTERN HIGHLANDS: KINTYRE PENINSULA
Southend



The Kintyre Peninsula is the southern extremity of the Highlands, a landscape not of rugged mountains, but of moorland, forestry plantations and farmland. The peninsula, in fact, extends much further south than Edinburgh or Glasgow to the east. The climate is mild, albeit windswept.

The farmland pictured here comprises large, smooth fields, in contrast to the small pockets of farmland further north. The eastern fringe of the Highlands [xx] is in the rain shadow., i.e. is drier than the west because all the rain has fallen in the mountains, and suitable for growing a wide range of crops, including wheat and barley. The west coast, in contrast, is only good for growing grass, which thrives in the damp climate.

Hence the south end of the Kintyre Peninsula is suited to dairy farming and produces good quality milk and cheese, although it suffers from being a long way from the main markets in the Central Belt of Scotland: although a long way south, in practice it is a remote area, reached by long road journeys.

Although in the past, every farm and croft would have its own dairy cow, dairy farming is now mostly absent from the Highlands. It is much easier to buy in milk than have your own cow, and the much larger farms in the lowlands can produce milk more economically. The dairy industry is also struggling because margins are low and the public are moving away from dairy products.

A. PASTURE (IMPROVED)

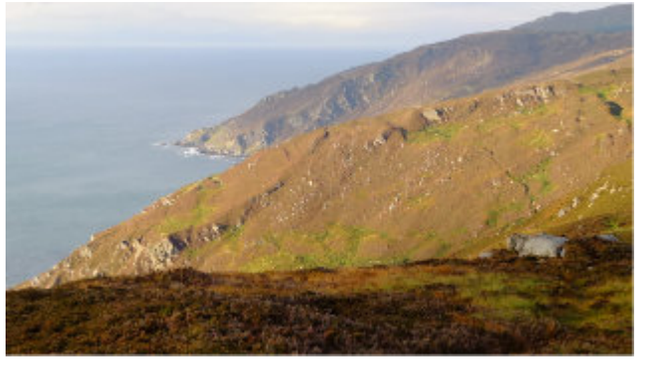
The improved pasture [xx] in Kintyre provides ideal grazing for dairy cattle, owing to the mild climate with a long growing season for grass.

B. CATTLE SHED

Dairy and other cows are normally overwintered in large sheds. The manure (slurry) produced over the winter is later spread over the fields as fertiliser. The slurry is stored in large tanks adjacent to the shed.

C. SHELTER BELTS

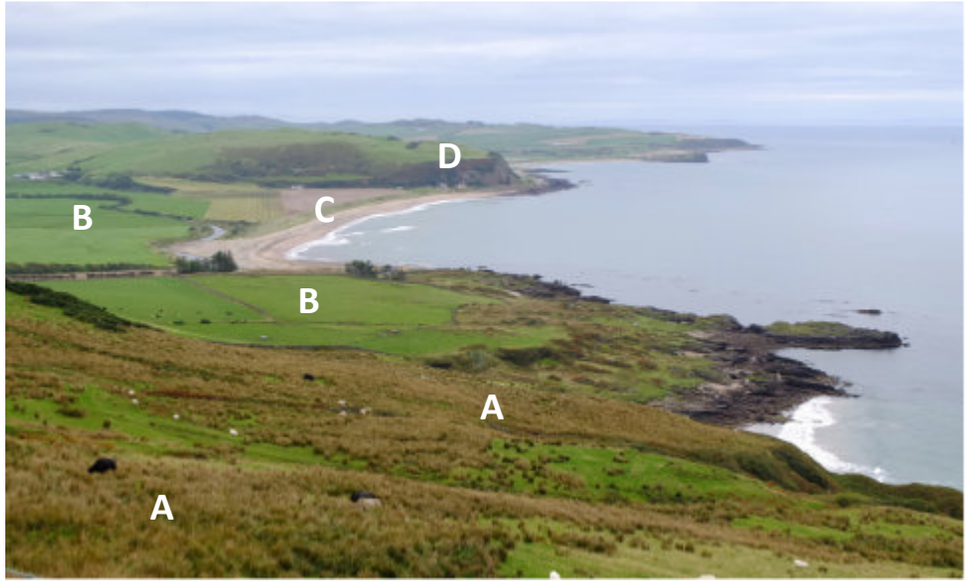
The Highlands have a windy climate. Hence strips of woodland are planted to shelter the fields. This shows a shelter belt of conifers, and the main picture shows belts of broadleaved trees.



D. MOORLAND

What is now farmland would once have been moorland. But over the centuries it has been converted to farmland. Moorland still exists at higher elevations in Kintyre (where not planted with conifers). This picture shows natural moorland north of the Mull of Kintyre, a location too exposed, steep and rugged for farming.

WESTERN HIGHLANDS: KINTYRE PENINSULA
Southend



Another view of the south end of the Kintyre Peninsula. The foreground shows permanent pasture [xx]. A common feature of pasture in the Highlands is that it is subject to colonisation by rushes, so much so that at times it is called 'rush pasture' (A).

During the era of agricultural improvement starting in the second half of the 18th century, a lot of field drains were laid down. These were pottery pipes buried underground to drain off the water; the drier soils which resulted were better for grass growth. Many of these drains are now becoming blocked and, without new ones, the fields are getting wetter – and this encourages the rushes. But even drained fields succumb to rushes eventually. Modern drains are flexible plastic pipes with small holes along their length to enable water to enter the pipe; the original field drains had small gaps between the pipes for this to happen

Rushes are not nutritious to animals, and so are not grazed – except occasionally at the end of winter when there is not much else to eat. Farming and crofting in the west, therefore, is often a constant battle against rushes. Even if a field is ploughed and reseeded with grasses (B), over time the rushes will return and spread throughout the grassland.

Although rarely eaten, rushes do provide some shelter from the wind for sheep.

A. PASTURE (RUSHES)

There are several species of rush, but the one which invades pastures is the 'soft rush'. Rushes have round, shiny leaves and are not to be confused with reeds, which is a tall grass [xx].

B. PASTURE (IMPROVED)

improved pasture [xx] is used to produce silage to feed the livestock over the winter. This shows large silage bags [xx].

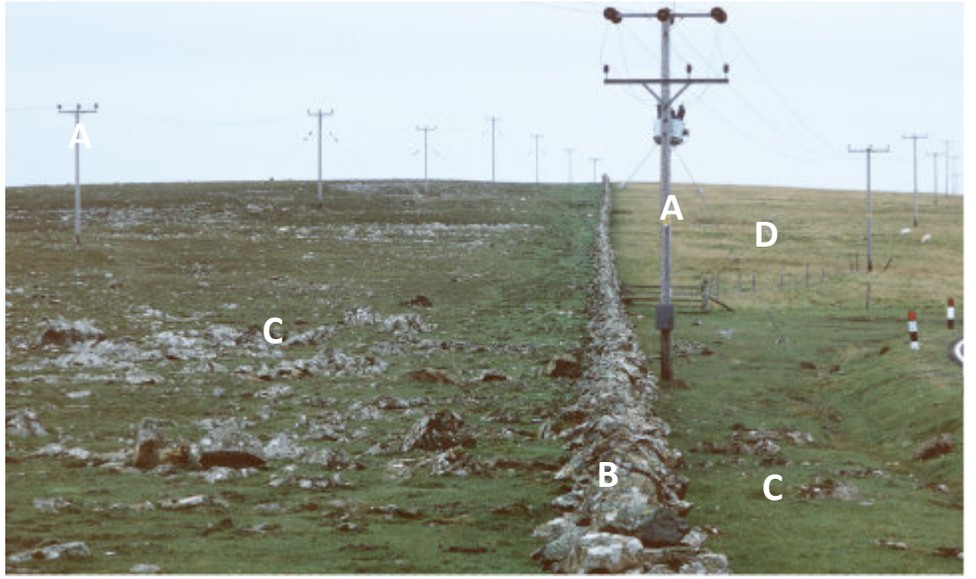
C. SAND DUNES

The beach here has vegetated dunes comprised of sand which has blown inland from beach, to be colonised by maritime grasses. The commonest such grass is marram grass, which is resistant to wind and salt spray, and has deep roots to reach water at the base of the free-draining sand.

D. COASTAL SCRUB

This is wind-blown scrub on a steep coastal in winter [xx]. The green plant on the left is ivy, a plant sensitive to frost and hence commonest on cliffs in the southwest Highlands.

ISLAND LANDSCAPES
Shetland: Unst



Unst is the most northerly of the Shetland Islands, so making it the most northerly inhabited land mass in the British Isles. The island has a complex geology, including outcrops of serpentine (a rare phenomenon in Britain) at the Keen of Hamar Nature Reserve. This is largely unvegetated because of the toxicity of the soil to plants owing to the presence of heavy metals. However, the extreme conditions have resulted in the evolution of a plant found nowhere else in the world: Edmonston's chickweed.

This picture shows natural rocky grassland to the left of the dyke (C) on rock which was once part of the ocean floor and, to the right, improved pasture (D) [xx]. This latter has had the rocks removed and thereafter been seeded with better quality agricultural grasses.

One consequence of creating such pastures is that, in addition to providing better grazing for sheep, they become attractive to wild geese. Some species of geese are migratory, coming south to spend the winter in Scotland, such as barnacle and pink-footed geese. But increasingly there are two species which spend the whole year in Scotland: the native greylag goose and the non-native Canada goose.

The increasing numbers, particularly of greylag, are a problem for farmers and crofters because the geese consume a significant amount of grass. There are currently government schemes in place to help farmers manage the problem.

A. POWER LINES

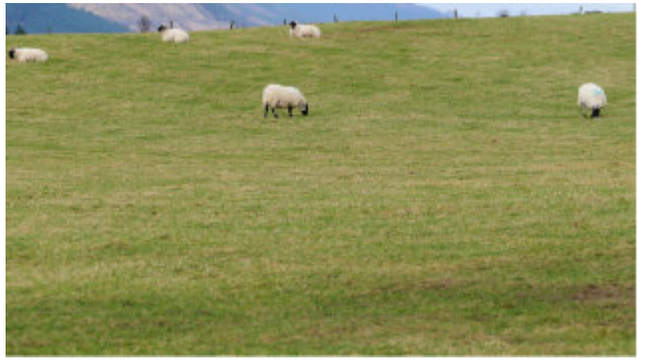
In such an open landscape as this part of Unst, power lines are highly visible and detract from the landscape quality.

B. DYKE

There is plenty of rock available for building dry-stone dykes (xx). Many are falling into ruins as they are replaced by wire fences as visible on the right of the main picture. Fence are cheaper and easier to build and maintain.

C. ROCKY GRASS MOOR

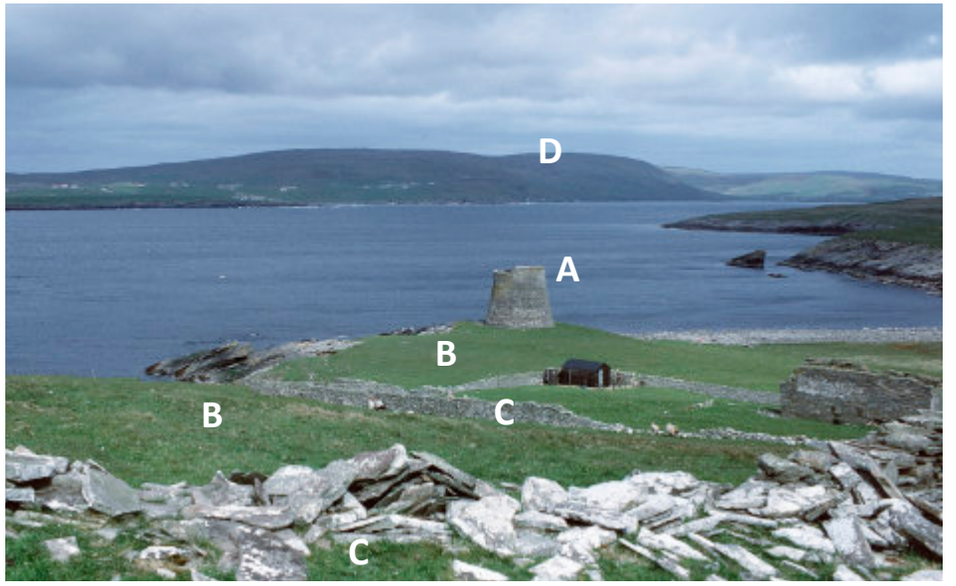
This is unimproved land [xx], meaning it consists of the original native grasses, unlike the improved grassland to the right (D). It will be relatively high in plant species.



D. PASTURE (IMPROVED)

Improved pasture [xx] contains few plant species, sometimes only two: rye grass and clover. This is both because it will have been ploughed and reseeded, and also because there are few plants which can tolerate soils high in phosphate and nitrate (from fertilisers).

ISLAND LANDSCAPES
Shetland: Mainland & Mousa



is a picture of the small island of Mousa, now uninhabited but still used for grazing sheep. The island is rich in archaeology and contains the most complete broch in Scotland. Brochs were built about 2,000 years ago, but their origin and use remains obscure. Most are found in the far north – Shetland, Orkney, Caithness, Sutherland – but they are found scattered across Scotland. Another famous broch is that at Carloway on the Isle of Lewis. It is estimated there are 120 in Shetland, although most now appear as circular piles of stones. Brochs have a staircase within their thick walls which circles round the building until you emerge at the top.

In the distance is the largest of the Shetland Islands, Mainland. On the left, the inbye land [xx] appears green with white houses above. Above this is darker vegetation, most of which is blanket peat [xx]. In fact, a large proportion of Shetland's landscape is peat-covered, which has provided plentiful fuel for the islanders over the centuries. But on some of the smaller islands, all the peat was removed, resulting in depopulation such as at Papa Stour.

Shetland is a windy climate and currently a large windfarm [xx] is being built along the spine of Mainland – the Viking Wind Farm. Fishing has been the mainstay of the economy although the islands have benefited significantly from the boom years of the oil industry, starting in the 1960s; mainly through the large Sullom Voe oil terminal.

A. BROCH

This broch is an impressive structure, of the order of 2,000 years old. It is open to the public and it is possible to climb to the top. It is also interesting in that storm petrels nest within its walls; if visited at night, they can be heard chattering away.

B. PASTURE

The island provides good grazing pasture for sheep. However, although there is a long tradition of grazing sheep and cattle on offshore islands, the tradition is dying out owing to the cost and hassle of taking animals on and off islands.

C. DYKE

The island has a network of old dykes [xx] acting as field boundaries, but most are now falling into disrepair.

D. PEAT-COVERED HILLS

An example of blanket peat on a Shetland hill, showing extensive past and present peat cuttings. The use of peat as a fuel has become rare in recent years: it is much simpler to buy-in a modern fuel.

ISLAND LANDSCAPES
Orkney

The Orkney Islands are very different from Shetland. This is because it is underlain by the sedimentary rock Old Red Sandstone, which weathers to smooth landscapes and fertile soils. This also the case in Caithness and around the Moray Firth [xx].

Orkney is therefore suitable for agriculture on a relatively large scale, and, as with the Kintyre Peninsula at the other end of the Highlands and Islands, is particularly suited to raising cattle, both dairy cattle and beef cattle. This is because the mild climate, albeit windswept, is good for growing grass. Orkney cheese is renowned.

This shows land north of Finstown on Mainland. Most of the pasture is improved (A) [xx], and therefore not species-rich, sometimes only containing rye grass. However, marshy areas are good for wading birds.

The original vegetation would have been moorland, which is still present on the hills (C) and which covers most of the island of Hoy. But the picture here shows how much of the moorland has been converted to pasture (D), although in recent years this practice has ceased, partly because of its impact on moorland birds such as hen harriers.

A. PASTURE (IMPROVED)

Cattle grazing, the mainstay of the Orcadian agricultural economy. In winter, they are fed silage [xx] harvested earlier in the year from the best fields.

B. GORSE

This prickly shrub is not native to the Orkney Islands, having been introduced by humans sometime in the past. As in the rest of the Highlands and Islands, it is expanding its range.

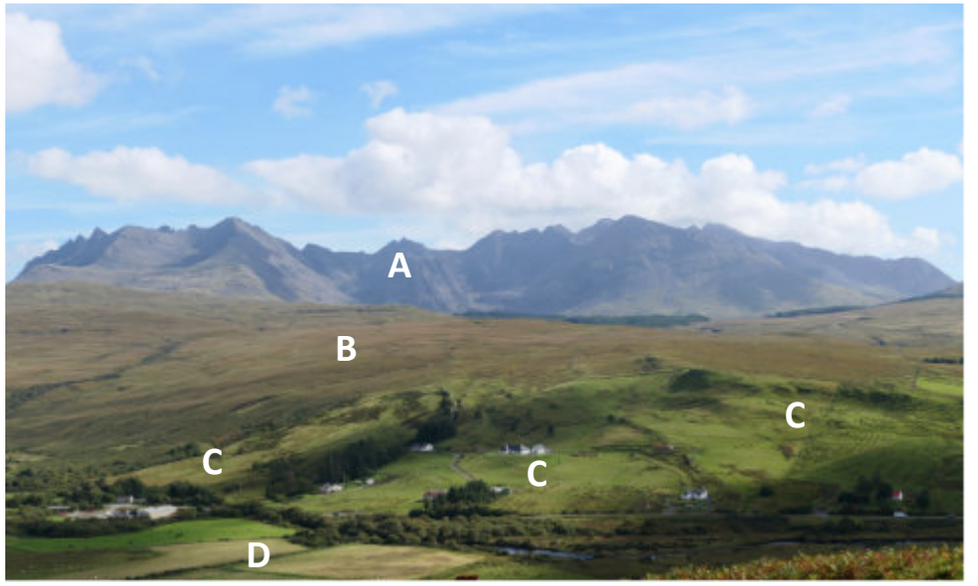
C. HEATHER MOORLAND

Orkney is famous for its wealth of archaeological remains. This is the Ring of Brodgar which is surrounded by agricultural pasture as in (A). But because the land around the stone circle is not used for agriculture, it has retained its original moorland vegetation

D. PASTURE RECLAIMED FROM MOORLAND

This shows a similar situation of pasture reclaimed from moorland as in the main picture, but on the island of Hoy. This must have happened a long time ago because the fields are bordered by stone walls rather than modern fences.

ISLAND LANDSCAPES
Skye



The Island of Skye has a complex geology and landscape. The Black Cuillin is a spectacular mountain range in the centre of the island (A), renowned for its narrow rocky ridges and steep cliffs. The mountains are composed of gabbro, a hard, dark rock derived from an ancient volcano, which is popular with mountaineers because it is not friable. The Cuillin provides the most challenging hill climbing in the British Isles, and is extremely popular.

To the south of the Black Cuillin are the Red Cuillin, mountains composed of pink granite, a more friable rock resulting in rounded hills and more scree slopes [xx].

The landscape surrounding the hills is unwooded moorland (B) which gives a wild foreground to the stark mountains.

Since 1995, the island has been linked to the mainland by bridge which has made it easily accessible. The island is increasingly popular with tourists, which creates problems because the roads, many single track [xx], and parking areas were not designed for the large increase in traffic.

There is a wide variety of popular tourist attractions which, in addition to the Cuillin. include Dunvegan Castle, seat of the Clan MacLeod, the Fairy Pools, Kilt Rock Waterfall, the coral beach (actually made from calcified red algae, not coral), the Old Man of Storr, the Quiraing and the Talisker Distillery.

A. THE CUILLIN MOUNTAINS

This is one of the famous views in Scotland: Sgurr nan Gillean from the Sligachan Hotel. A dramatic mountain rising out wild moorland, unhindered by any human infrastructure.

B. MOORLAND

The surrounding moorland is largely wet heath [xx] with peat [xx] in the hollows.

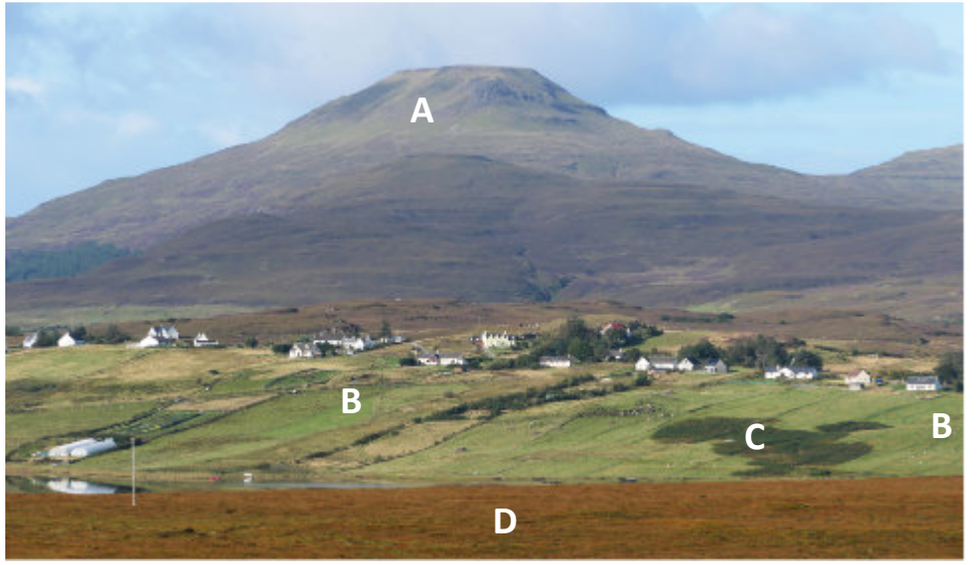
C. PASTURE

North of The Cuillin, the landscape changes and the soil becomes more suitable for agriculture. It is largely croft land [xx], most of which is permanent pasture or rough grazings [xx]. A common feature of the pasture is invasion of the grassland by rushes, as here [xx].

D. IMPROVED PASTURE (FOR SILAGE)

The better land is used to make big bag silage [xx] for feeding to the cattle or sheep over the winter.

ISLAND LANDSCAPES
Skye



The landscape north of the Cuillin mountains [xx] is very different because the geology is different. The rock is formed from a series of massive horizontal flows of basalt from eruptions millions of years ago; these are visible at (A). This gives a more horizontal feel to the landscape compared to the southern half of Skye.

The rock, although hard, weathers down to provide richer soil than most of the Highlands and Islands which, together with flatter ground. supports a significant crofting population in northern Skye.

This view is of Healabhal Bheag, one of the two MacLeod's Tables near Dunvegan: a pair of hills of similar shape and height, both with horizontal tops. The story goes that a rich aristocratic from the south was boasting about his huge dining hall with chandeliers in the ceiling. The chief of Clan MacLeod said he could do better than that: he laid out a table on the top of one of the two hills, and invited his visitor up – boasting that you could not have a grander hall than this, with the endless sky above and stars as chandeliers.

A. HORIZONTAL BASALT STRATA

Basalt landscapes have horizontal platforms and vertical cliffs, as visible here at Burg on Mull; this is famous for a fossil tree from the Devonian area. Nearby Fingal's Cave on the island of Staffa is famous for its vertical basalt columns.

B. CROFTING AGRICULTURE

The strips of land below the croft houses are now mainly used for sheep grazing, when they once would have been used for growing crops [xx]. However, there are two polytunnels and a vegetable garden visible, showing that some food is still grown

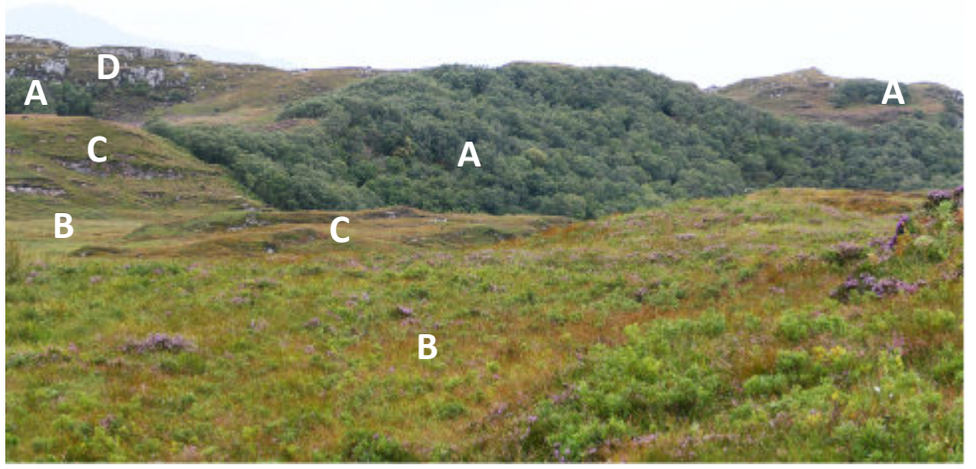
C. BRACKEN

The dark vegetation in the pasture is a stand of bracken [xx], a plant that can spread rapidly across good grazing land.

D. PEAT BOG

The foreground of the main picture shows a peat bog – a location used in the past for cutting the peat as an essential fuel for cooking and heating [xx]. The small picture here shows an intact peat bog which has never been cut, and which will be actively accumulating peat.

ISLAND LANDSCAPES
Raasay



Raasay is a long, thin rocky island off the coast of Skye. It has a varied geology, including deposits of iron ore at the south end which were once mined. The remains of the mine can still be seen, including the route of a railway from the deposits down to the processing plant at the jetty. The mine only ran a few years during the First World War (1914-1918), when there was a high demand for iron. It closed down when the war ended and never re-opened, partly because the ore was low grade.

There is a single track road [xx] running the length of the island, mostly through moorland, the north end of which is famous as 'Calum's Road'. Calum MacLeod was a crofter who, when the local authority, Inverness County Council, in the 1960s, refused to build a road to the remote settlement of Arnish, himself built the two-mile stretch by hand. It is now tarred and part of the local road network.

The main population resides in the southwest of the island, with the east coast consisting of steep cliffs with coastal woodland [xx].

A. WOODLAND ON STEEPER SLOPES

Birchwoods occupy the steeper ground with its better-drained soil. Pictured here is such a wood as it appears in winter, when birch trees can be identified by their purple tinge.

B. PEAT BOG

A close up of the peat bog vegetation [xx] characteristic of the West Highlands. The larger green plant visible here (and in the main picture) is bog myrtle, a dwarf shrub with aromatic leaves. Sphagnum moss and deer grass are the other main plans present.

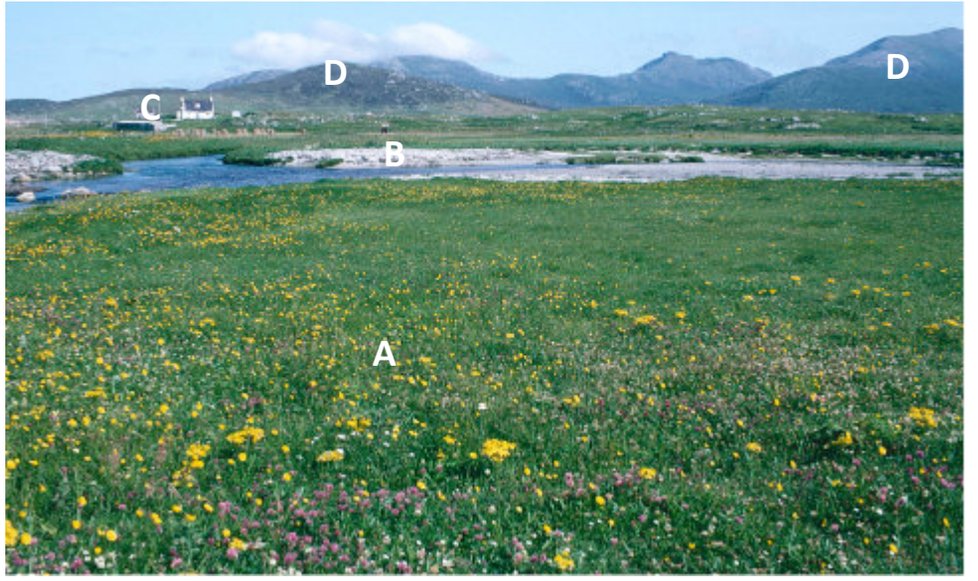
C. WET HEATH

Wet heath [xx[is similar to peatland, but not underlain by deep peat. The soil is all humus, often sitting direction on the bedrock. The orange plant here is deer grass.

D. ROCKY MOORLAND

The north end of Raasay has much exposed rock. This is a landscape characteristic of Lewisian gneiss, with rocky rounded hills,often with lochans in the hollows (called a 'cnoc and lochan' landscape). The rock is only found west of the Moine Thrust [xx], and is 1.5 to 3 billion years old – one of the oldest rocks in the world.

ISLAND LANSCAPES
South Uist



The islands of North Uist, Benbecula and South Uist in the Outer Hebrides, which are linked by causeways, are renowned for their machair.

The west coast of these islands is gently sloping and open to the full force of the Atlantic ocean. The waves have ground-up sea shells into a white, fine sand, rich in calcium carbonate (which the shells are made of). Hence there are long white beaches along much of the coast .

The sand is blown inland by the strong winds from the west and covers the black, peaty soils. The calcium carbonate acts as fertiliser to the calcium-deficient peat soils, resulting in flower-rich grasslands, or 'machair' (A). The machair is also used by many ground nesting wading birds, because there are no native predators in the Outer Hebrides such a hedgehogs or foxes, which would otherwise eat the eggs. Hedgehogs were introduced a few years ago, but have now been eradicated in North Uist through a successful control programme – with control now centred on Benbecula and South Uist.

The fertile and well-drained sandy soils are used to grow crops, supporting a large crofting population in this windswept landscape. Inland, between the machair and the hills (D) are the 'blacklands' of blanket peat, providing an essential source of fuel in this treeless land.

A. FLOWER-RICH MACHAIR

Here bluebells (harebells), meadow buttercups, lady's bedstraw and kidney vetch are visible, an example of the rich flora of the machair grasslands.

B. SHELL-SAND BEACH

Behind the white, shell-sand beaches are sand dunes covered in marram grass [xx], a plant which traps the sand and allows the dunes to stabilise. The dunes also provide shelter to the machair beyond.

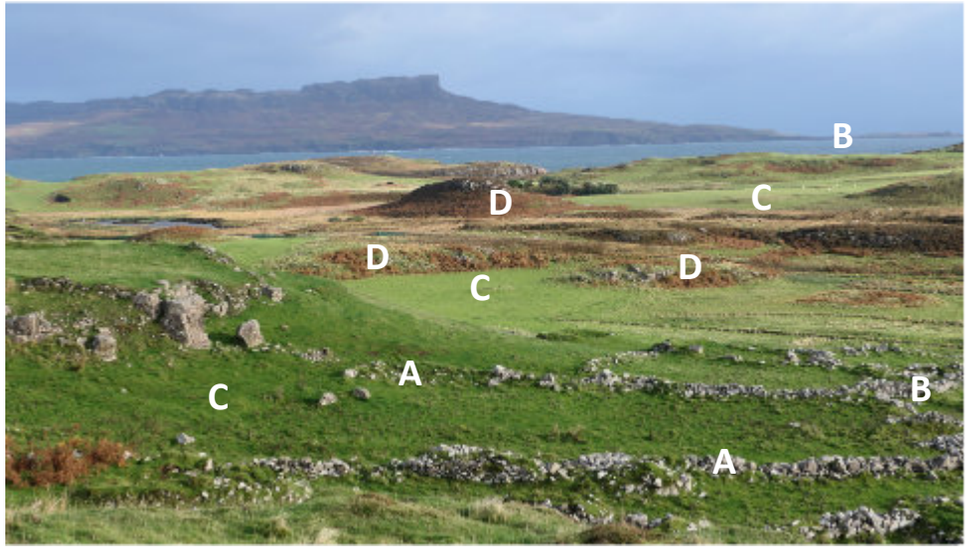
C. CROFT HOUSE (BUT 'N BEN)

A traditional but 'n ben [xx]. These houses replaced the black house; the ruins of many of these can still be seen across the Outer Hebrides [xx]. This is a photograph taken by the author on Fair isle [xx] in the 1960s.

D. BACKDROP OF HILLS

In contrast to the west coast of the Uists, there is a line of mountains along the rocky, uninhabited east coast. These are composed of Lewisian gneiss, named after the Isle of Lewis to the north. Between the mountains and the machair lie peatlands.

ISLAND LANDSCAPES
Muck



The Small Isles are a group four islands in the Inner Hebrides. The largest is Rum, a mountainous island which is now a nature reserve. To the west of Rum is Canna, a more fertile island with a less rugged landscape composed of horizontal basaltic larva flows [xx]. In the distance in this picture is the Isle of Eigg with its distinctive ridge, well-known as it was the first place in Scotland where the local community bought the land from the landowner.

Muck is a low-lying island, the smallest and furthest south of the four. It is not croftland, but comprises a single farm. Like many islands, it once had a larger population as shown by the remains of old settlements (B).

It is reported that there were 160 inhabitants in the late 1700s, but most were cleared off the land in the earlier 1800s by the then landowner who was heavily in debt. This is an example of the notorious Highland Clearances [xx]. The island was a sheep farm for a while, before the new owner replaced them with cattle.

The island is now managed for both sheep and cattle, together with sport shooting and tourist accommodation.

A. RUINED DYKES

Ruined dykes [xx] illustrate old field boundaries built when the population was higher. Over time, they slowly collapse, remaining as linear features in the landscape

B. RUINS OF A SETTLEMENT

The original houses would have been black houses with thick stone walls and thatched roofs [xx], or houses built of turf. Turf houses are easier to build than stone houses but, when abandoned, their remains become invisible in the landscape.

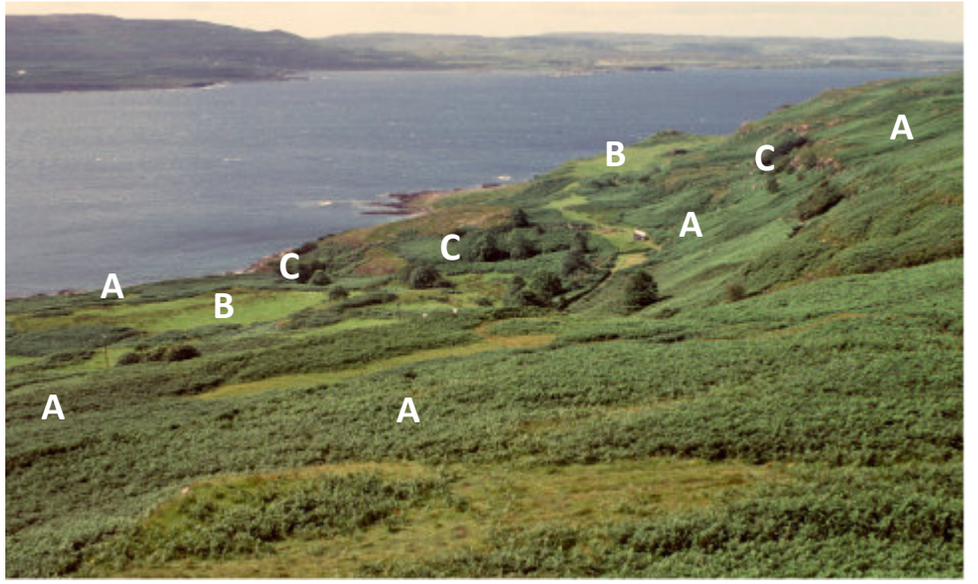
C. PASTURE

The grazing pasture on Muck is a mixture of improved and unimproved pasture [xx], used for both cattle and sheep. With the exceptions of the Kintyre Arran, Islay, Bute and Gigha, cattle in the Western Highlands and Islands are beef rather than dairy cattle.

D. BRACKEN (WINTER)

Stands of bracken [xx] are visible on sloping ground in the main picture, a plant that, if not controlled, can take over the pastures – reducing their grazing value.

ISLAND LANDSCAPES
Mull



Like many of the Scottish islands, Mull has a varied landscape owing to the range of different rock types present. There are rugged mountains in the centre, and more horizontal landscapes underlain by basalt in the north and west [xx]. There are numerous forestry plantations on the island [xx]. Off the west coast are two famous islands: Iona with its abbey where, a thousand years ago, the Irish monk St Columba brought Christianity to Scotland; and Staffa with its impressive caves of basalt columns, linked geologically to the Giants Causeway in Ireland.

This picture shows the area of Burg on the south side of the Ardmeanach Peninsula. In the 1930s it was a farm, but suffered challenging conditions because of the amount of bracken present (A). Without control through cutting, it spreads rapidly across pastures. The farm was donated to the National Trust for Scotland, who wished to make it into a demonstration farm. But, with the advent of the Second World War, the farmhands went to war and never returned.

Although the land is nowadays leased for cattle and sheep grazing, bracken remains a problem and continues to invade the pastures (B). However, the grasslands below the coastal basalt cliffs to the west host a rich plant and insect fauna.

A. BRACKEN

Although bracken has always been present, its current rapid rate of spread on better soils may be down to the onset of milder winters. The plant is frost-sensitive and, because late frosts are now rare, there is no climatic control of the species.

A. BRACKEN

The same area in winter, when bracken dies down to dead shoots. Dense stands of bracken, dead or alive, shade out all the plants underneath so that the species can be a monoculture. If it colonises grassland rich in flowers, the flowers are all lost. For more on bracken, see [xx].

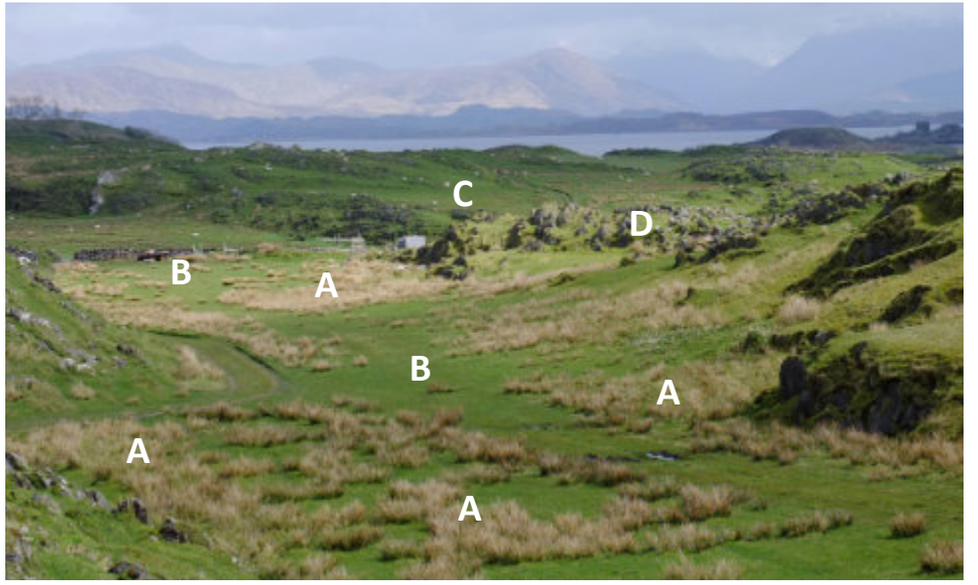
B. PASTURE

Bracken can invade new pasture at the rate of two metres advance a year. Control is by cutting, but has to continue for many years to eradicate the plant. Chemical control is successful, but the chemical used has recently been banned in Scotland.

C. GULLY AND CLIFF WOODS

Natural woods on Mull are restricted to cliffs and burnside gullies. This picture is of such a gully above Loch na Keal on the west of Mull. The dominant vegetation on the Mull hills, as here, is damp grassland dominated by purple moor grass [xx].

ISLAND LANDSCAPES
Lismore



Lismore is a long, thin low-lying island in Loch Linnhe, east of Mull. Its main characteristic is that, unlike the surrounding area, it is underlain by limestone, making the island grassy and standing out as a green oasis. The limestone gives the island fertile soils, so the island has always been well populated, indicated by the presence of ancient Bronze Age cairns. At one time the population was about 1,000, but is now reduced to 200.

It has been a centre of Christianity since the 7th century and was the seat of the Bishop of Argyll from the 13th to 16th century, based at the mediaeval St Moluag's Cathedral. In the 18th century the cathedral was reduced in size to become the current parish church.

At one time, there were kilns on the island to produce lime, created by heating limestone [xx]. Lime was exported as it was used as a fertiliser, necessary on the generally acidic soils of the Highlands.

Those taking the ferry from Oban to Mull cannot help noticing the prominent Lismore Lighthouse at the south end of the island. This was built in 1833 by Robert Stevenson, during the period when lighthouses were being built all round the coast of the British Isles.

A. RUSHES

Most of the island consists of grassy pastures but, as in elsewhere on the west coast, it is a constant battle to keep rushes at bay [xx]. If not controlled, they will take over the grassland

B. PASTURE (UNIMPROVED WITH RUSHES)

This shows the early colonisation of pasture by rushes. The tall green plant is yellow flag iris, which also invades damp pasture, but at a much slower rate than rushes. Its underground stems are poisonous to cattle.

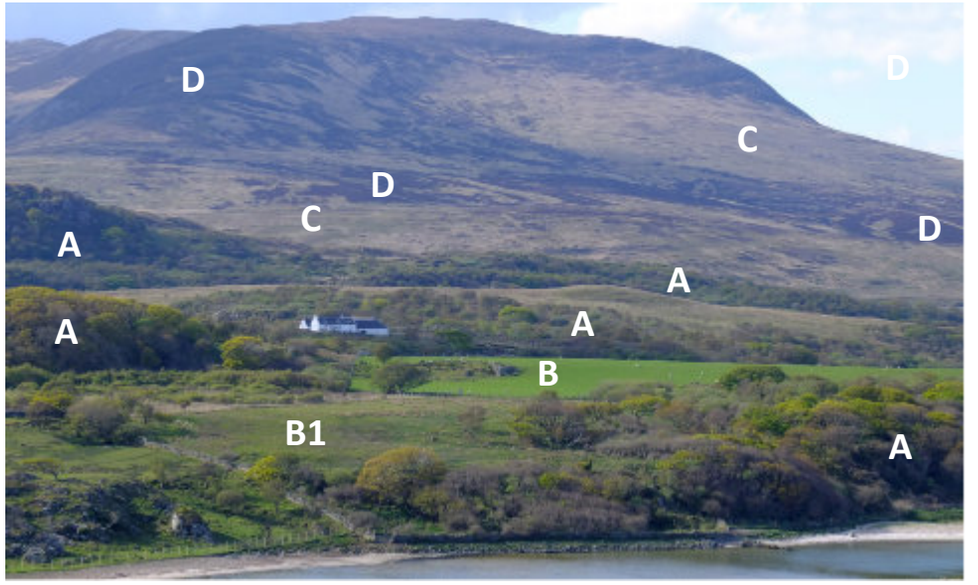
C. PASTURE (IMPROVED)

Xxxx

C. LIMESTONE OUTCROPS

The pastures on Lismore have outcrops of limestone, sometimes forming an irregular 'limestone pavement', as here on the Garvellach Islands. These are rare in Scotland, but common on the Carboniferous limestone in northern England.

ISLAND LANDSCAPES
Islay



Islay and Jura are two large islands off the coast of Argyll. Jura is mostly moorland and rock, with only a small population. In contrast, Islay is a mix of good quality farmland (B) and upland moors (A). Pictured here is a view of the southeastern area of the island.

The farmland is used both to grow grass for livestock and also barley for the whisky industry. There are several distilleries on Islay, with well-known names such a Laphroaig, Lagavulin, Bowmore and Ardbeg. Although some local barley is still grown, most is imported from Northeast Scotland [xx]. To make whisky, barley first is germinated in water to extract the sugars and then distilled.

By law, Scotch whisky has to be left to mature in barrels for at least three years, and around distilleries can be seen large warehouses to store the barrels. The walls of these warehouses are normally stained black; this colour arises from fungus growing on the walls which survive by metabolising whisky fumes leaking out of the barrels.

A. NATIVE WOODS

Particularly in the southeast of the island, there are stands of natural woodland, often dominated by sessile oak. In spring, its new shoots and leaves have a slight orange tinge, as here. Although whisky is often matured in oak barrels, the oak is all imported.

B. PASTURE (IMPROVED)

An area of improved pasture [xx], which has been reseeded, fertilised, with buried field drains installed in the past. A stand of rushes is visible on the left. Unlike most of the Highlands and Islands, there are some h farms on the island, used to make local cheese.

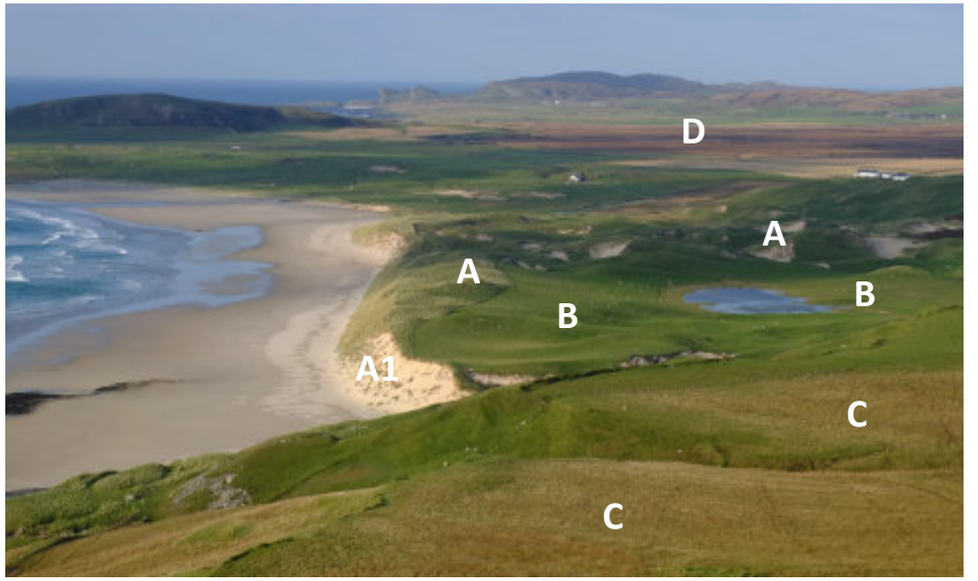
C. MOORLAND (DAMP GRASS)

The whitish area on the hills is damp grassland dominated by purple moor grass [xx]. This grass dies down in the winter, leaving the white dead leaves visible. Because these leaves can blow around in the wind, in Southern Scotland it is called 'flying bent' by farmers

D. HEATHER MOORLAND

The darker areas on the hill are heather, which grows on the drier slopes.

ISLAND LANDSCAPES
Islay



Machir Bay on the west of Islay. The sand of the beach has is derived from the local rock, not from shells as in the Western Isles [xx] where the beaches are white. Beyond the sand dunes (A) is a large raised bog [xx]. There are several such large deposits of peat on the island, from which the peat is cut, dried, and then burned to provide smoke to flavour the whisky. In the past, peat would also have been used to heat the whisky stills.

The extent of grassland on Islay, both improved and unimproved, has resulted in Islay being a major wintering ground for geese. The island hosts 70% of the world's barnacle geese, which breed in Greenland, comprising about 40,000 birds. It also holds 40% of the Greenland white-fronted goose population, comprising of the order of 10,000 birds. The RSPB has an important bird reserve at Loch Gruinart.

Choughs are a black crow-like bird with red beaks and legs. It is a rare in the British Isles and there are only two small populations in the Highlands and Islands: on Islay and the neighbouring island of Colonsay. They feed on insects, particularly those in the dung of grazing cattle, on the type of short grassland visible here (B,C). They are highly social birds and the populations in Scotland are fragile, being highly dependent on how the land is managed.

A. SAND DUNES

The dunes here are covered in marram grass as shown here [xx]. An area of actively eroding sand dune is visible (A1). Dunes can be mobile features, eroding in some areas, and being stabilised by colonisation of marram grass on others.

B. MACHAIR

The greener areas of grassland here overlie sand which does contain some shell sand, so it is similar to machair with a rich array of flowers [xx]. But that visible in the main picture is grazed short by sheep all year round, so the plants rarely have a chance to flower.

C. PASTURE (UNIMPROVED)

A flock of barnacle geese on pasture. The geese are not popular with farmers because of the amount of grass they eat. Being protected species, they cannot be killed; hence there are government schemes available to help farmers deal with the problem.

D. PEAT BOG

A small raised bog [xx] on Islay, a habitat common at low altitudes. Unlike this one, most have had peat cut from them, either for domestic fuel or for the whisky industry. They are also grazed by geese, although, with modern agricultural improvement, the geese prefer the green fields.

ISLAND LANDSCAPES
Arran

Like many of the Scottish Islands, the geology of Arran is complex. Indeed, it is the variety of different rock types in the relatively small country of Scotland which results in such a diversity of landscapes. Arran is an island in two halves: the northern half has high, rugged granite mountains, whereas the southern has a variety of rock types and less-rugged hills.

This is a view eastwards through the southern half to Holy Island in the distance. Much of the area is covered by commercial conifer plantations of Sitka spruce (A) planted on moorland (D). There are a few pockets of native woodland (A) on hillsides.

In several areas, invasion of woodland and moorland by rhododendron is a serious problem [xx], with the picture [xx] taken at Lamlash at the north end of Arran. It has also spread out into the surrounding woods from the garden at Brodick Castle [xx]. The plant is hard to control: if cut, then new shoots readily grow up again, as do numerous seedlings. Injection of weedkiller is the best solution for, if sprayed, it runs off the waxy leavings without being absorbed. Many rhododendron control schemes fail because control needs to be continued for many years following the initial cutting – and it does not continue long enough, particularly if all the available money has been used up.

A. NATIVE BIRCHWOOD

A natural birchwood in winter, similar to the one visible in the main picture.

B. CONIFER PLANTATION

Plantations cover a large percentage of the island, planted on land which was once sheep farms [xx]. The trees are planted close together and the woods host little wildlife, except along the edges of forest tracks ('rides').

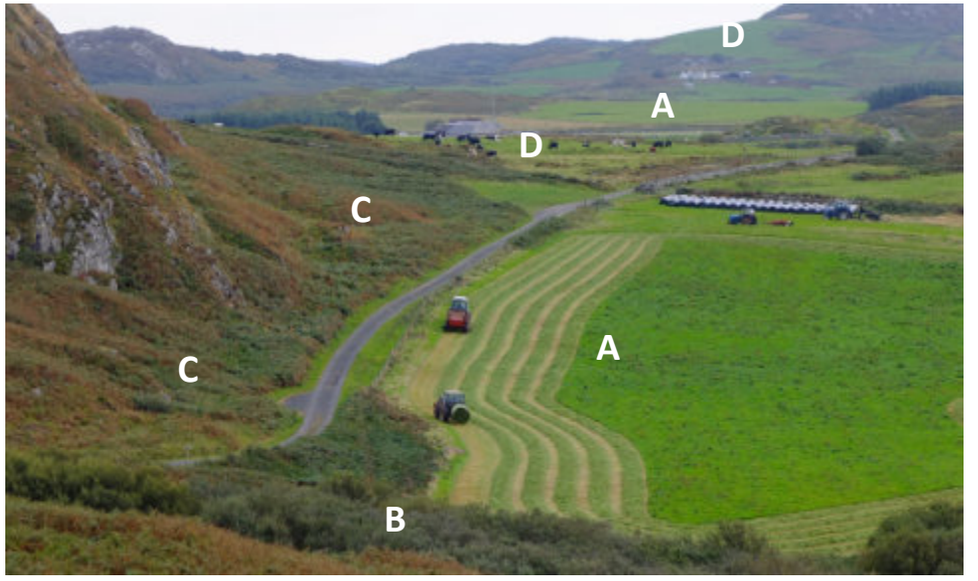
C. NATIVE WOOD WITH SELF-SEEDING CONIFERS

Self-seeded commercial conifers are becoming an increasing problem across the Highland landscape, as discussed previously [xx]. In this location, Sitka spruce are colonising native woods.

D. BRACKEN SLOPES

Bracken is common on the slopes with richer soils – the browner areas in the main picture, taken in winter when the bracken has died down.

ISLAND LANDSCAPES
Gigha



Arran lies in the Firth of Clyde on the east side of the KIntyre Peninsula [xx], whereas Gigha is a small island to the west. The island of Eigg was bought by the local community in 1997, followed by Gigha in 2002. Thus both islands are owned and managed by the inhabitants rather than a largely-absent landowner.

This gives the islanders an ability to decide how the land is managed, to set up income-raising businesses, and to prioritise new housing. An ongoing problem in the Highlands and Islands is that there are not enough houses available at a cost affordable to local people. Incomes in rural areas are generally low, especially in the tourism and hospitality sectors, and what houses do come on the market are often expensive and bought by outsiders as a holiday home – or for retirement. This can cause young people to leave and also prevents new people of working age coming to the area, whether to run essential services, or create new businesses. It is perhaps there are not enough houses in a land with so much space!

There is a three-turbine community-owned windfarm on Gigha, which provides the island with an income. There was also an experimental halibut farm, but this has closed as the fish proved difficult to keep in tanks.

A. SILAGE FIELD

There are several farms on the island, and the main picture shows grass being cut for silage [xx]. The silage already made can be seen in the pile of black silage bags visible in the middle of the main photograph.

B. LOW SCRUB

The agricultural fields have been carved out of a rocky landscape of scrub, bracken and moorland. The main shrub found on these southern islands is the eared sallow [xx], which can form dense, impenetrable scrub – especially if prickly sloe bushes are present. The berries of sloe (blackthorn) are used to make sloe gin.

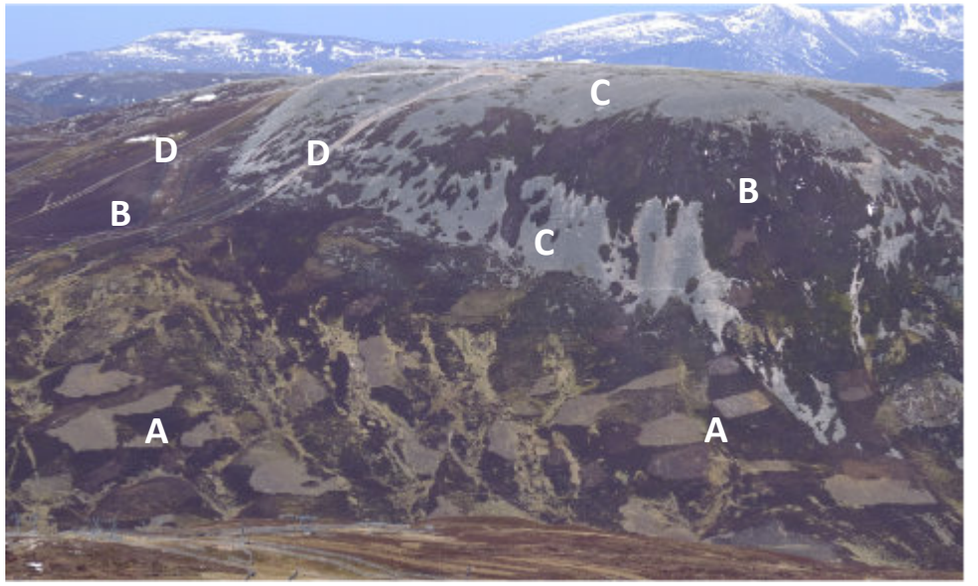
C. BRACKEN

Bracken is common on the island [xx], with young shoots visible in this picture. In spring, before the bracken grows, the area can be a carpet of wild hyacinth (bluebells). They also occur in many native woods, giving rise to a carpet of blue in the spring.

D. PASTURE

Most pastures on Gigha have been improved [xx] to provide increase the grass growth. Where not cut annually for silage (A), the grassland is used as permanent pasture. As well as beef cattle production, there is one small dairy farm on the island, which exports milk and ice-cream to the mainland.

CENTRAL HIGHLANDS: MOUNTAIN VIEW
Upper Glen Clunie, Aberdeenshire

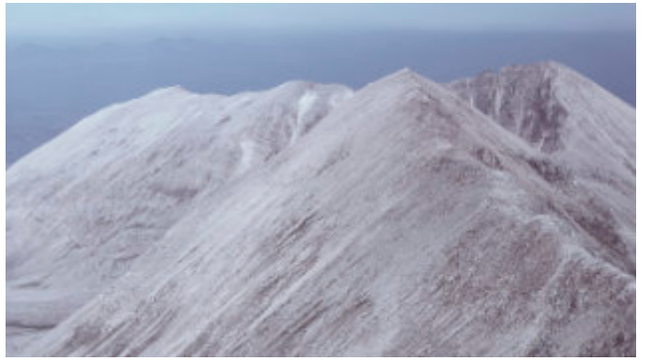


The Central and Eastern Highlands present a different landscape to that of the west. The mountains are less rugged and more rounded, although they can have steep-walled corries [xx] on their northern and northeastern sides.

With the prevailing wind in Scotland from the west, much of the rain has already fallen by the time it has crossed the Western Highlands, so the eastern half is drier. One result of this is that wet heath [xx] is less common in the east and heather moorland [xx] more common.

The picture here shows such a moorland landscape within the Cairngorms National Park, adjacent to the Glenshee ski centre. The main Cairngorm mountain range is visible in the top right, notable for its high altitude mountain plateau, with several hills above 4,000 feet (1,200 metres), although the highest hill in Scotland is in the Western Highlands above the town of Fort William – Ben Nevis at 4,413 feet (1,344 metres).

Heather moorland has been the dominant vegetation in this area for thousands of years and is the habitat for the ground-nesting red grouse. There are still pockets of native Scots pine woodland within Strathspey [xx] to the west and Deeside to the east. The are relicts of the so-called Caledonian Pine Forest which was significantly more common thousands of years ago.



A. MUIRBURN

A major land use in the area is grouse shooting on sporting estates [xx]. The red grouse eats heather shoots and benefits from heather with a range of different ages. This is brought about by rotational burning – 'muirburn' by land managers.

B. UNBURNT HEATHER

Older, taller heather provides shelter and concealment from predators such as hen harriers and foxes, but short, newly burnt heather provides the most nutritious shoots to eat. Hence rotational burning, on a cycle of 7-8 years is ideal. This gives the moors their mosaic appearance.

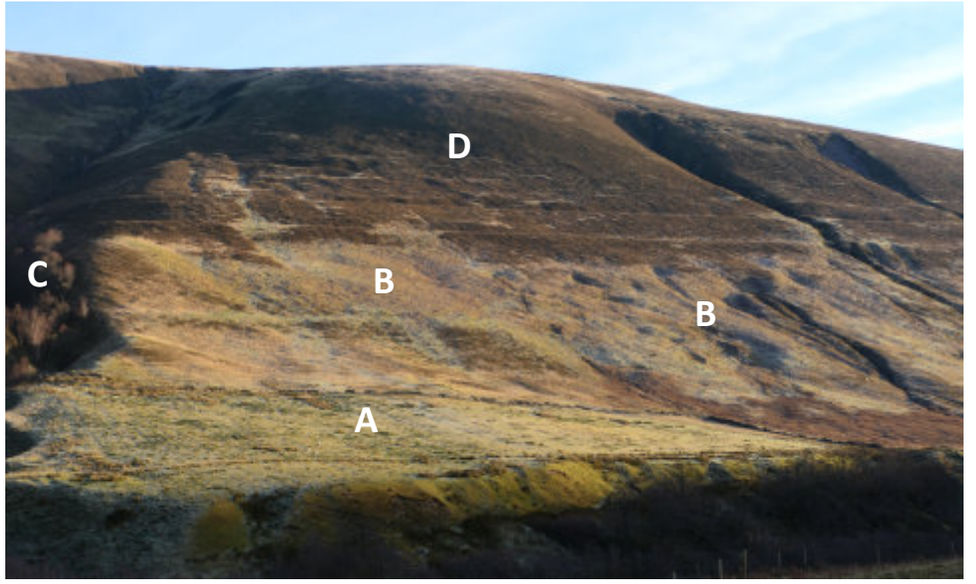
C. SCREE

Both scree [xx] and fellfield is visible in the main picture. 'Fellfield is similar to scree, but is found on flat hilltops rather than slopes. The amount of scree depends on the rock type. The picture here shows a whole mountain covered in scree derived from quartzite [xx] – Beinn Eighe in Wester Ross.

D. SKI SLOPES

There are five ski centres in Scotland, and two linear ski runs at the Glenshee centre are visible in the main picture. Runs consist of fences built to trap snow and ski tows as illustrated in this picture at Cairngorm. Ski centres produce significant infrastructure into the mountains, albeit localised.

CENTRAL HIGHLANDS: GLEN VIEW
Glen Roy, Inverness-shire



A glen further west than the Cairngorms – Glen Roy. This is famous for its 'parallel roads', visible here as horizontal lines across the hillside. Their origins perplexed people for many years, including theories that they were built by earlier populations. In fact they represent shore lines of a large lake which was present at the end of the Ice Age.

Glen Roy feeds into the larger Glen Spean to the south, which is at right angles to the glen. At one time there was a large glacier flowing down Glen Spean, which acted as a dam to any water flowing out of Glen Roy, causing a large lake to form in the glen. The water level in this slowly dropped as the glacier melted, resulting in shore lines at progressively lower levels.

Glen Roy is sparsely populated: there is a shooting lodge [xx] at the north end, and a sheep farm to the south. This picture from the centre of the glen shows that it once had a higher population because the remains of an old field is visible (A), surrounded by a ruined dyke [xx]. This has long since been abandoned, but does provide an area of better grazing on the heather-covered hillside (D), although the old field is now being invaded by bracken (B).

A. OLD FIELD

An old field, now permanent pasture, with a ruined dyke visible [xx]. This provides the best grazing in an otherwise infertile landscape.

B. BRACKEN (WINTER)

Bracken is colonising the more fertile land of the original farm.

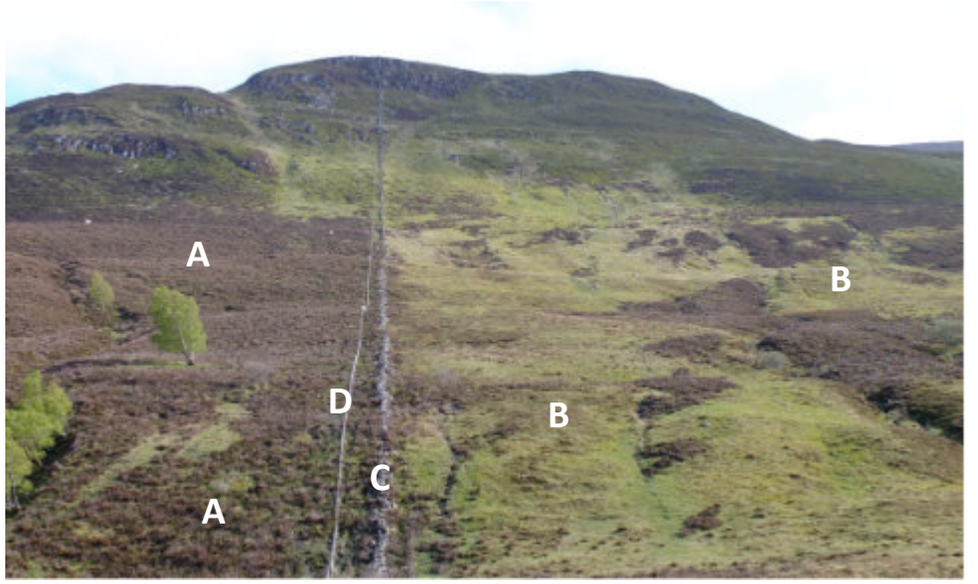
C. GULLY WOOD

Upper Glen Roy is treeless apart trees along deep, burnside gullies [xx], a very common situation in the Highlands. However, there are oakwoods along the River Roy in the lower half of the glen, and along the River Spean below [xx].

D. HEATHER MOORLAND

The well-drained slopes of the hillsides are largely heather covered. The glen is used for sheep grazing in its lower half and deer stalking in its upper half.

CENTRAL HIGHLANDS: GLEN VIEW
Glen Keltney, Perthshire



This picture illustrates the impact of grazing animals on the vegetation of the landscape. To the left of the old dyke (C) there is moorland of tall heather (A) and to the right is grassland (B).

There will still be heather present in the grazed grassland, although kept short and prostrate by grazing. If the number of grazing animals, sheep or red deer, is reduced, heather will grow tall and, in time, come to dominate the vegetation – as is the case on the right where grazing is low or absent.

Much of this glen has now been planted with trees: not commercial conifers but native trees such as birch, so that over time the heather moorland will become woodland. There are grant schemes to encourage this owing to the policy of the Scottish Government to increase the woodland cover of Scotland: for climate reason, because trees store carbon, and for biodiversity reasons as woodland is seen as the natural vegetation if it were not for human deforestation in the past. Both these claims are dubious scientifically [xx].

The main for increasing tree cover in the past was to create a commercial timber resource [xx], and this is still policy today: as well as new woods of native trees being created, so are new commercial plantations.

A. MOORLAND TO WOODLAND

A nearby area of Glen Keltney showing stripes visible across the heather. This is where a machine has gone across the landscape creating rows of mounds for tree planting [xx]. A common situation nowadays.

B. GRAZED GRASSLAND

Although heather is not the preferred diet of sheep, they will eat the shoots, particularly in late winter/spring when the grass is not growing. But even in grassland such as this, they may short heather shoots amongst the grass.

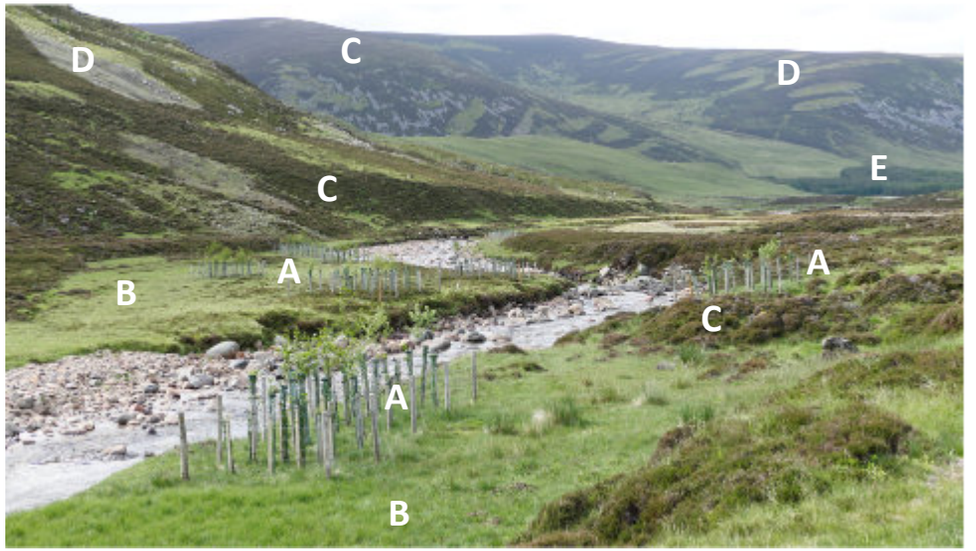
C. OLD DYKE

Before the advent of fencing wire in the mid-1800s, stone dykes were the main field boundaries. Ruins can be seen across the Highland landscape, even to the hilltops to divide landownership boundaries. Maintaining dykes needs skilled dykers and is expensive. Hence most fall into ruin.

D. NEW FENCE

Wire fences are much cheaper to build and maintain than dykes. The main picture, and the one above, show a fence has been built parallel to the dyke to be the new stock-proof boundary. These are stock fences, which deer, but not sheep, can jump – in contrast to the taller deer fences [xx].

CENTRAL HIGHLANDS: GLEN VIEW
Glen Clunie, Aberdeenshire



The picture on page [xx] is taken at the upper end of Glen Cluanie, which runs from Glenshee into the River Spey at Braemar. This one is taken further down the glen and illustrates an increasingly common development: the planting of riverside trees, more commonly called 'riparian planting'.

The upper reaches of most rivers in the Highland have no trees along their banks, a situation explained by many (but without evidence) that this is because 'overgrazing' by sheep and deer has prevented tree regeneration.

With the climate warming up, and with the increasing probability of ever-hotter summers, the water in the rivers can heat-up in the summer. The upper-reaches of Scottish rivers, together with their smaller tributary burns, are the main spawning ground of Atlantic salmon [xx], which cannot survive hot water – partly because the hotter the water, the less oxygen it contains.

Hence there has been a big push to plant trees along watercourses to help keep the water cool in summer (A). Over time, this will transform the appearance of the land.

All the changes taking place in the landscape discussed here – forestry, hydro-schemes, windfarms, riparian woodland, *etc.* – are taking place in isolation: there is no consideration or discussion of the cumulative impact of them all in transforming the whole appearance of the Highland landscape.

A. RIPARIAN TREE PLANTING

Trees are either planted along fenced-riversides, or in plastic tree shelters as here. These protect young trees from grazing by voles, and also provide extra warmth and shelter.

B. GRAZED GRASSLAND

River floods bring down sediment which acts as a fertiliser along the edge of the river; alluvial gravels are also free-draining. This means that some of the best grazing is on the alluvial flats, which are attractive to animals – giving trees little chance to grow.

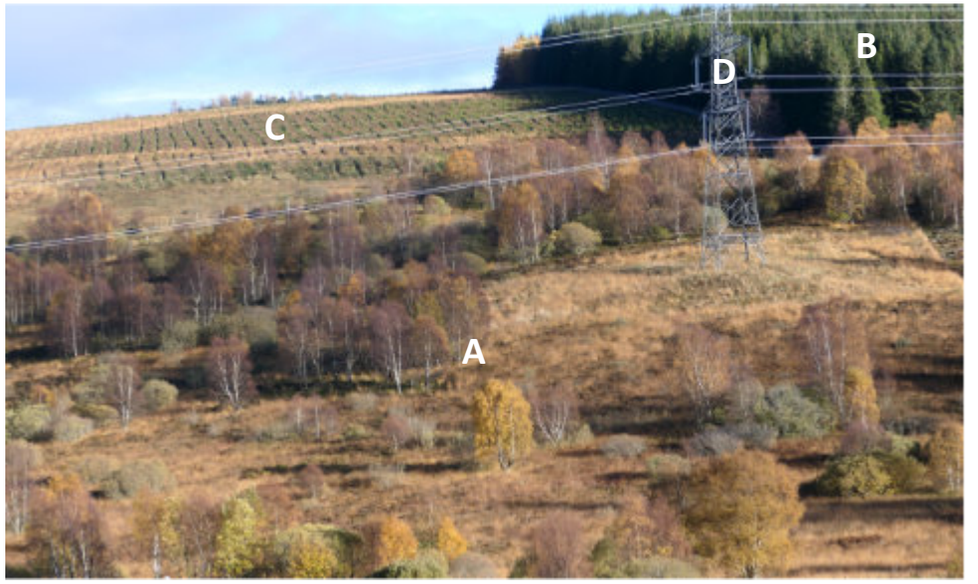
C. HEATHER MOORLAND

Where the soil is less rich, then heather dominates, both on the floor of the glen and on the hillslopes. Unburnt heather, as here, provides tall shoots where red grouse and their chicks can shelter from the wind, and also provide concealment from predators.

D. MUIRBURN

Patches of burnt heather, to provide nutritious new heather shoots for grouse. This landscape is also the habitat for mountain hares, which are rare in the wetter West Highlands; they turn white in winter as camouflage in the snow. Wading birds also use the high moors for breeding.

CENTRAL HIGHLANDS: GLEN VIEW
Trinafor, PerThshire

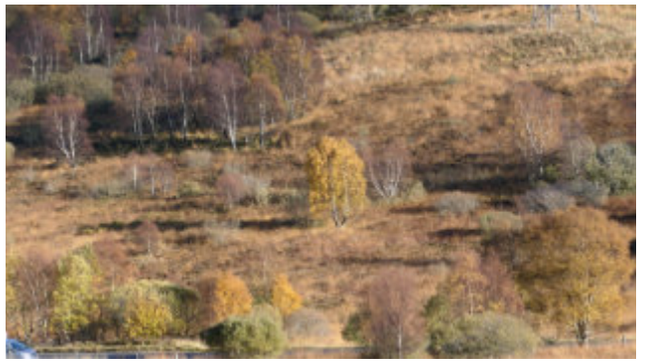


This photograph illustrates many of the changes taking place in the Highland landscape: it is no longer the open moors and hills of the imagination!

The lack of grazing from both sheep and red deer, has caused the vegetation to thicken-up (A). Although this encouraged trees and scrub willow to grow, it will resulted in the loss of diversity of other plants – shaded out by the taller vegetation. This is increasingly the case as the number of sheep farms continues to decline and environmentalists are demanding a reduction in grazing levels.

There is a modern commercial plantation of Sitka spruce (B), with forestry ploughing adjacent to it (C) indicating that the area of plantation is being increased.

There is a modern pylon line (D) to transfer energy from windfarms and hydro-schemes in the north the main markets in the south.



A. ROUGH GRASSLAND WITH REGENERATING TREES

Birch trees and willow scrub colonising what was once sheep-grazed grassland. This grassland has thickened up and become tussocky.

B. CONIFER PLANTATION

A typical commercial plantation with an area of clearfell in the foreground [xx]; and with some windblown trees at the edge of the clearfell. These trees would once have been sheltered in the middle of the forest but, now that they are exposed, they are not resistant to wind.

C. FORESTRY PLOUGHING

Ploughing for tree-planting, a practice, although good for trees, destroys everything in its path and adds an artificial look to the landscape.

D. ELECTRICITY PYLONS

With the increasing number of on- and off-shore windfarms [xx], and with new pumped-storage hydro-electric schemes, there is a need to take this energy south. This is done by enlarging existing pylon lines and building new ones – a sometimes controversial process.

CENTRAL HIGHLANDS: STRATH
Kingussie, Strathspey

The River Spey is the largest river flow through the Highlands. It occupies a wide strath, providing level ground and alluvial soils suitable for agriculture. Additionally, thee have long been native pinewoods in Strathspey [xx], which have been managed over the centuries to provide the main source of timber in Scotland. Once cut, logs were floated down the Spey to the sea at Kingston on the Moray Firth, where there was once a ship-building industry. Before the roads were built in the Highlands from the beginning of the 19th century [xx], this was the only means of exporting timber out of the Central Highlands.

The above, taken with the drier climate than the west, has resulted in Strathspey always having been well-populated.

The picture here, taken near Kingussie, shows the level alluvial plain with improved fields for grazing livestock [xx], the best of which are used to produce silage (A) [xx]; there is a pile of silage bags visible on the left.

In addition to the original natural woodland of Scots pine, there are also planted woods of pine (C), although nowadays many are planted with Sitka spruce. The moors above (D) are used for deer stalking and grouse shooting.

A. PASTURE (IMPROVED)

Improved pasture [xx], typical of the type of grassland on the flat land adjacent to the River Spey.

B. NATIVE WOODS

Stands of birch are typical rougher ground not so suitable for agricultural improvement. Here birch is growing on hummocky glacial moraine in a location near where the main picture was taken. The ground flora here is mainly blaeberry (bilberry, blue berry)

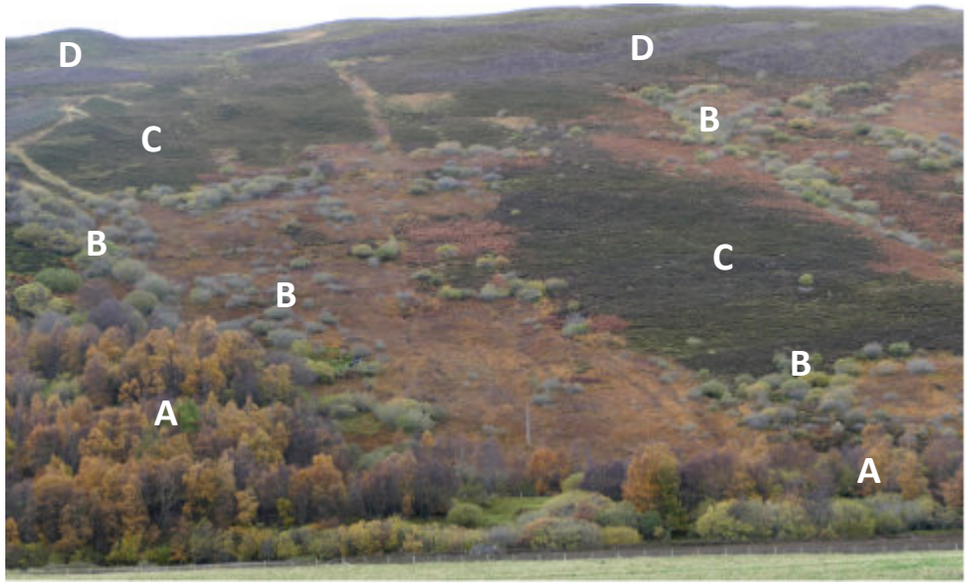
C. CONIFER PLANTATION

A plantation of closely-spaced Scots pine in Strathspey. The tall, straight trees are very different from the widely spaced trees of the native pine forests - see [xx]. Because pine grows slower than Sitka spruce, the latter is normally planted nowadays in commercial plantations.

D. MOORLAND

A peat-filled hollow amongst heather moorland above Kingussie, with bog pools present [xx]. In the distance, smoke from muirburn [xx] can be seen.

CENTRAL HIGHLANDS: UNGRAZED HILLSIDE
Glen Truim, Inverness-shire



This is a hillside north of Dalwhinnie showing what happens if grazing animals, sheep or deer, are removed from moorland (B).

The most obvious sign is in the increase in willow shrubs, visible as the rounded clumps (B). The commonest species involved is the eared sallow. particularly the eared sallow. This will have been growing amongst the heather but kept low by grazing: once grazing is removed, these suppressed shrubs can now grow up above the heather.

This is normally the case with trees as well. In the vicinity of woodland (A), there can be a lot of young trees present, but none getting above the height of the surrounding vegetation. When grazing is taken away, there is an immediate growth of regenerating trees because they can now grow to their full height.

But after a year a two, once all the suppressed trees have got away, then tree regeneration slows. This is because the vegetation thickens-up and, without trampling breaking up the plant litter (from dead leaves), tree seeds cannot reach through to the soil to germinate.

It is obvious, really, but without grazing the vegetation gets taller. An upshot of this is that naturally low-growing plants are shaded out and the number of different plants in the sward decreases.

A. NATIVE WOODLAND

Birch woodland, which can expand in area if grazing is reduced; see also [xx].

B. SCRUB ENCROACHMENT

Eared sallow growing in moorland vegetation and now just beginning to grow above the height of the surrounding heather, indicating low grazing in the area.

C. UNBURNT HEATHER

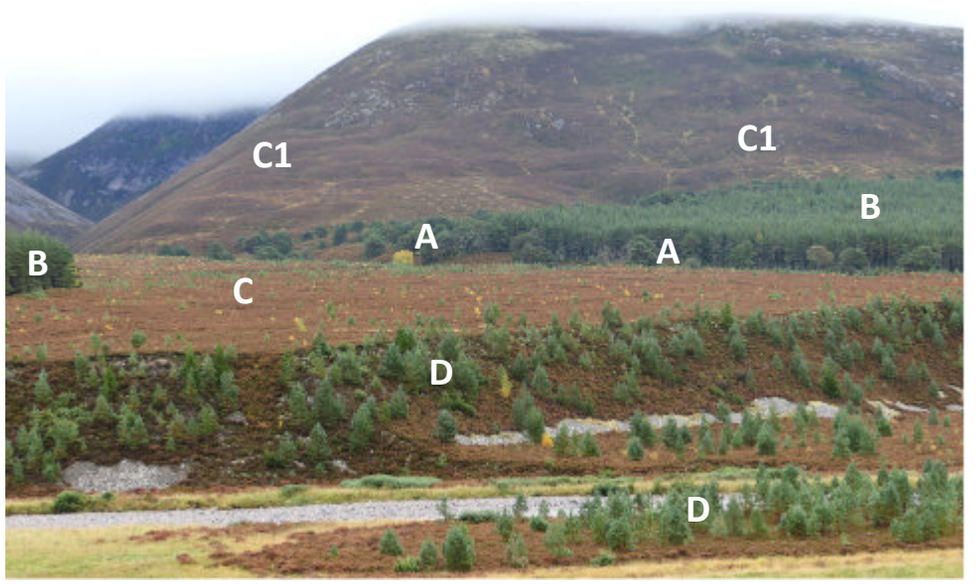
Burning keeps the heather short – without burning it can grow tall and leggy. It also becomes increasingly woody, so that unburnt moorland is a fire risk: with warmer and drier summers becoming more common, this increases the risk of catastrophic wildfires, whether from lightning strikes or human carelessness.

D. MUIRBURN

Muirburn carried out to benefit red grouse [xx]. Most of the landscape would still be heather moorland without burning: it just changes its structure. Regular burning for grouse started in Victorian times, but burning has long been carried out by farmers and crofters to improve the grazing.

CENTRAL HIGHLANDS: NATIVE WOODLAND EXPANSION

Glen Feshie, Inverness-shire



Scattered across the Highlands are woods of Scots pine (A), remnants from a time when it was once abundant – where it has been called The Caledonian Forest (named in Roman times). The oldest remaining trees can be up to 500 years old. The previous wide extent of pine woodland can be deduced from the remains of old pine stumps visible at the base of peat bogs [xx]. However, after reaching a maximum extent, pine woodland has been naturally declining for the past few thousand years to the low coverage of today. Dating of the pine stumps in peat shows they are of the order of four to six thousand years old.

The reasons for the decline of the pinewoods is not always clear, but probably relates to a change to a cooler and wetter climate, combined with the impact of grazing by deer. Felling and extraction of timber has played some part in modern times, which will have impacted the structure of the wood locally, but cannot be blamed for the general demise.

However, there is a strong movement in Scotland to 'restore the Caledonian Forest', mainly by reducing the numbers of red deer to levels low enough for the trees to regenerate – as here in Glen Feshie (C,D). This approach is now generally known as 'rewilding', but it is a moot point if this is the case when the mainly treeless moorland landscape of today is in fact the natural 'wild state', and if grazing has to be reduced to way below the assumed natural level: grazing animals are intrinsic features of natural ecosystems.

A. NATIVE SCOTS PINE WOOD

An example of a relict native pinewood, here at Glas Leitire in Wester Ross. The trees are often widely spaced, with long side branches, as here – indicating trees have always been regenerating at low density.

B. SCOTS PINE PLANTATION

There are considerably more areas of planted Scots pine in Strathspey than original native woodland. This is an example of a more widely-spaced plantation pine compared to those in [xx]; the plantations in the main picture are densely planted, more akin to the latter.

C. YOUNG PINE IN HEATHER

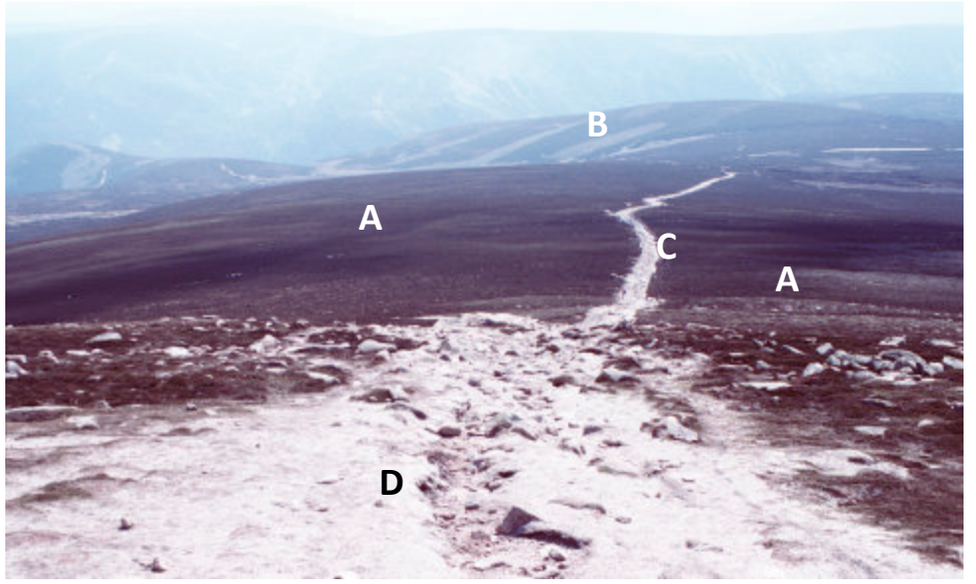
If there is a major reduction in the number of grazing animals, then young Scots pine trees can colonise heather moorland, as here at the Mar Lodge Estate, east of Glen Feshie. To some extent heather inhibits trees, but if there is a large seed rain, then some seedlings establish.

D. REGENERATING SCOTS PINE

In the main picture, there is considerably more pine regeneration on the drier soil along the river. But, near existing trees with a high seed rain, there can also be a considerable number of young trees if grazing is reduced. Old pine with rounded crowns are known as 'Granny Pines'.

EASTERN HIGHLANDS: HEATHER MOORLAND

Mount Keen, Angus



Mount Keen is the easternmost Munro in the Highlands, that is a hill over 3,000 feet (914 metres) high [xx]. As with all Munros, it is popular with hillwalkers, which is why there is a wide path to the summit (C) – although the route is also used by vehicles on this sporting estate [xx].

In recent years, many sporting estates have bulldozed new vehicle tracks into the hills in order to take their shooting clients up to the grouse moors. Indeed, most modern forms of land use in the hills involve the creation of new tracks: sporting and agricultural use, forestry plantations, windfarms, hydro-schemes, masts, new pylons lines. Intrusion of vehicles and vehicle tracks into the hills is an issue of concern to those wishing to keep the hills wild: nowadays, there are very parts of the Highlands more than a mile or two from a road or track.

The hills of the east are rounded with wide ridges and summits, in contrast to the more spectacular mountains of the West Highlands; many, as here, are covered in heather moorland (A) and managed for grouse shooting [xx]. As with the Cairngorm Mountains [xx], Mt Keen is underlain by granite which gives rounded boulders [xx], and infertile soils that erode easily if the surface vegetation is damaged. This has happened here: once trampling or vehicle use breaks through the vegetation, the gravelly soil beneath easily erodes when it rains (D). The small gravel particles of eroded granite are known as 'growan'.

A. HEATHER MOORLAND

In late summer, the hills of the East Highlands turn purple when the heather comes into bloom. It is popular with bees, and heather honey has its own unique flavour. The Highlands are the world centre for heather.

B. MUIRBURN

Burning is carried on dry days in late winter and early spring, when the surface vegetation and dead leaves are dry, but the soil underneath is still wet. This stops the fires burning too hot and deep. It is also before the breeding season of ground nesting birds, such red grouse and waders.

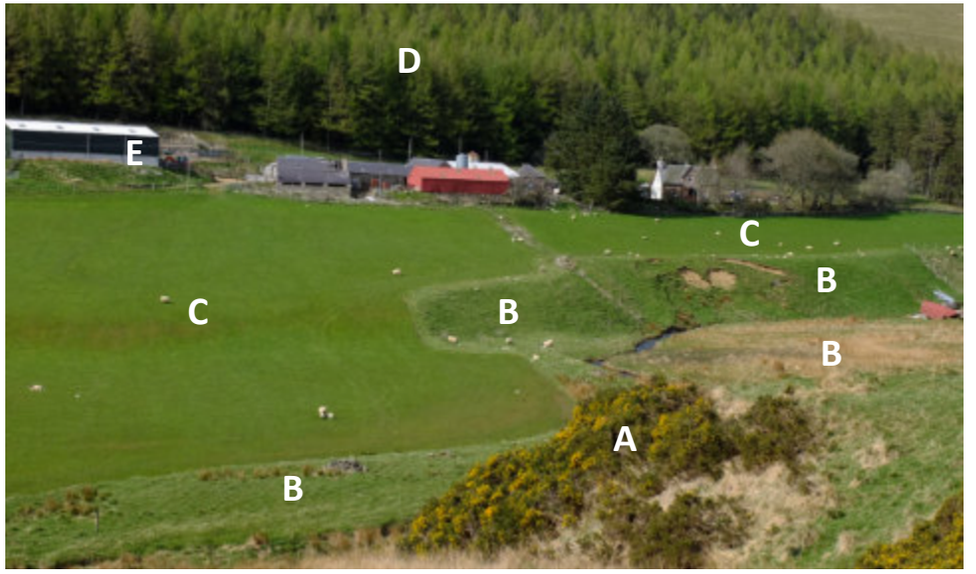
C. FOOTPATH

Another view of the path to the top of Mount Keen, showing the complete removal of vegetation, with gully erosion beginning to set in, visible on the right of the path.

D. ERODING PATH

Further down, water flowing down the path has deepened the gullies, with erosion set-in. This causes the path to widen over time as walkers move to the edge to avoid the rough ground. Eroding mountain paths such as this are repaired by dedicated footpath repair teams [xx].

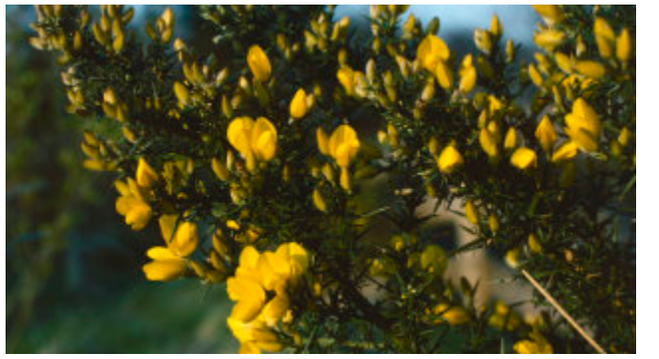
EASTERN HIGHLANDS: UPLAND FARM
Glenhead, Angus



Many flat-bottomed glens thread their way into the Eastern Highlands, including what are known as the Angus Glens. This is a farm on the side of the glen north of Alyth, which holds the Backwater Reservoir. This reservoir, opened in 1969, was created to provide drinking water for the towns and villages of Angus, and also for the large city of Dundee.

The picture shows a typical upland farm with improved pasture (C) for grazing and silage production [xx]. There are areas of rough grassland in locations too rough or wet to be improved (B), some of which is being colonised by gorse (A). There is a large modern shed for housing cattle in winter (E).

Above the farm is a commercial forestry plantation. This will not be managed as part the farm because forestry and farming are not integrated in the Highlands: modern farming and modern forestry necessitate different skills. Additionally, many forests are owned by companies seeing forests as a financial investment, rather then being interested in growing trees – this is left to the specialist forest management companies. In contrast, farms are managed to provide an income for those living in the farm, whether owner or tenant. However, there is little money to be made in upland farming.



A. GORSE

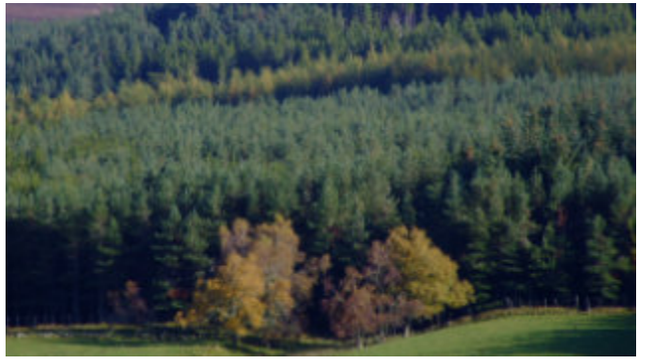
As elsewhere in Scotland, gorse easily colonises rough ground. However, gorse is a legume, which means it fixes nitrogen from the air – making the leaves nutritious to livestock. In the past, there were gorse-grinders to make the leaves palatable.

B ROUGH GRASSLAND

Areas of the farm which are not suitable for improvement (fertilising, re-seeding, drainage) may be the only places where wildflowers can still be found. Although, if close to a field, can suffer from herbicides landing on them, reducing the diversity of plants

C. PASTURE (IMPROVED)

A view up the glen from the main picture. Apart from the relict moorland in the far distance, the only vegetation is improved pasture with few, if any wildflowers, and commercial forests similarly deficient in wildlife. A modern upland scene of little conservation interest.

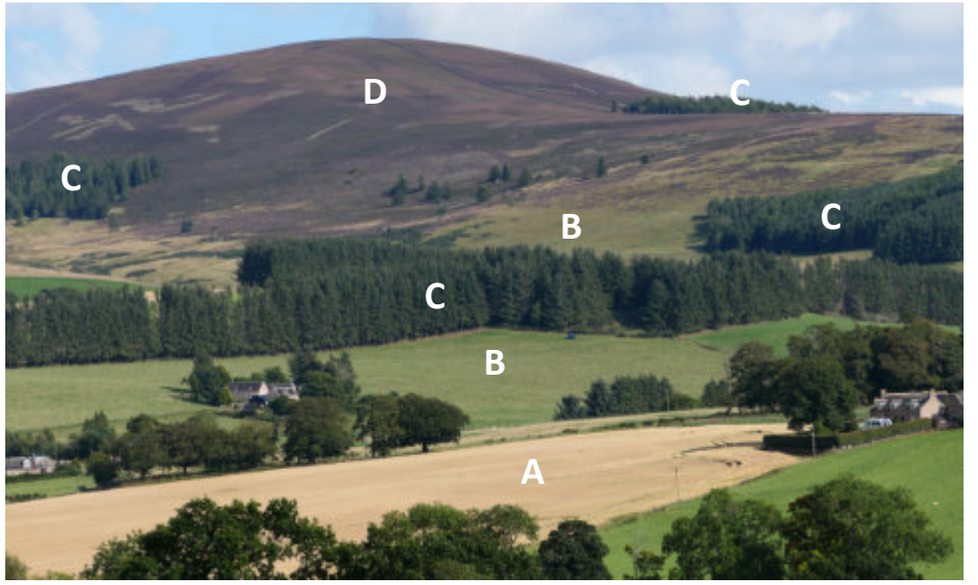


D. CONIFER PLANTATION

A dense plantation of Sitka spruce, holding little wildlife interest

EASTERN HIGHLANDS: MOUNTAIN – FARMLAND TRANSITION

Kintocher, Aberdeenshire



The mountains of the Eastern Highlands in Aberdeenshire do not end suddenly. There is farmland spreading west up the glens and, in the east, isolated hills surrounded by farmland (D). It is, therefore, a mixture of upland and lowland.

The fields, as well as growing grass for silage, also contain barley (A), and occasionally oats. Barley is grown for the beer and whisky industries, which use malted barely, with the lower quality grain going to animal feed.

As with Islay [xx], the Eastern Highlands are a major centre of the whisky industry, centred around Dufftown, which includes famous brands such as Glenlivet. To make whisky, barley is allowed to germinate in water and once the resulting sugar is extracted, the leftover barley is used as animal feed and the liquid is piped into the sea on the Moray coast. Hence a common sight on Highland roads is tankers, both taking the liquid waste away and transporting the whisky south to the bottling plants; and also trucks bringing in grain.h

These eastern hills are increasingly being chosen for the siting of windfarms [xx],being easily accessible and near the main power line of the National Grid which runs down the east coast.

A. ARABLE FIELD

A recently harvested field of barley in Aberdeenshire. The remaining straw is rolled up into bales, visible here, which are sold as bedding for livestock.

B. PASTURE (IMPROVED)

Aberdeenshire is the centre of the beef industry in Scotland, the cattle grazing on improved pasture [xx].

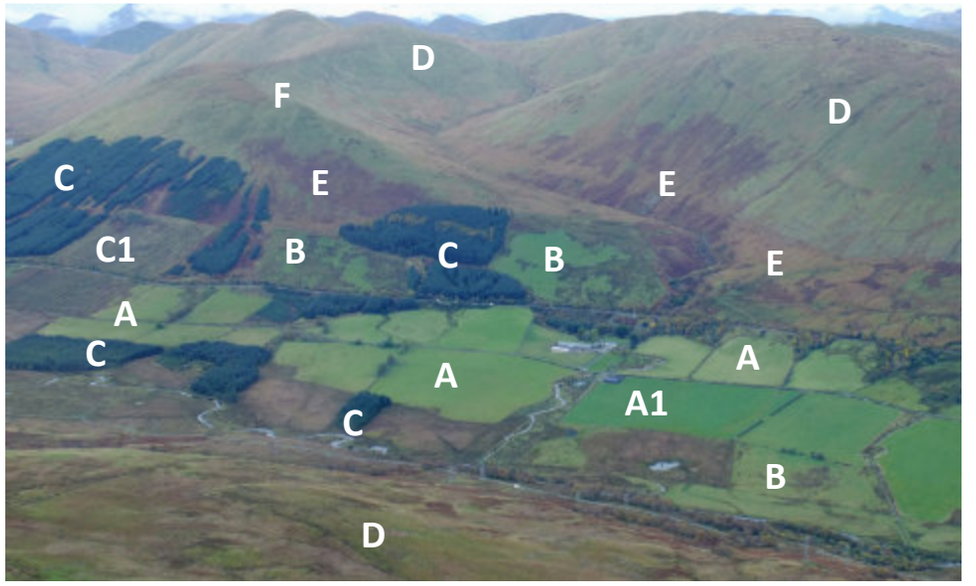
C. CONIFER PLANTATION

There are many commercial forestry plantations [xx] on the hills of the Eastern Highlands. The gently-sloping hills, the less windy climate and nearness to centres of population makes it an economic place to grow trees (although most forestry would be uneconomic without grants),

D. HEATHER MOORLAND

There are many outliers of heather moorland in the east: some managed for grouse or grazing, some unused, and some being colonised by trees. Heather, here with a red admiral, makes flavoursome honey.

SOUTHERN HIGHLANDS: MOUNTAIN VIEW
Glen Luss



The hills of the Southern Highlands are often grass-covered (D), as here in Glen Luss to the west of Loch Lomond, The hills are generally treeless, although the hillslopes around Loch Lomond and Glen Falloch to the north are well-wooded with birch and oak. This is partly explained by the planting of oak woodland in the past for charcoal making and for the extract of tannin (in the bark), used in the leather industry: tannin softens the leather

However, there are many commercial forests of planted trees (C) in the area, many created in the 1930s to replace sheep farms when farming was in recession [xx]. Although sheep farms are still present nowadays, as in the above picture, many are now disappearing because they are being converted to woodland; for example, around Loch Katrine in the Trossachs. This is because woodland is seen as a more environmentally-friendly use of the land than sheep grazing, although this is open to debate [xx].

The lower slopes of the hills are often covered in bracken (E), with the flatter hill-slopes peat-covered: blanket peat [xx] is just visible on the hill ridge at (F).

A. PASTURE

Land along the bottom of the glens is generally permanent pasture for sheep and cattle grazing. This may be unimproved pasture (A) or improved pasture [xx] identifiable in the main picture (A1) because the grass is greener.

B. PASTURE WITH RUSHES

As in most of the Highlands, all types of pasture tend to be colonised by rushes [xx] if not controlled by chemicals, cutting or ploughing. In the past, the central pith of the round rush leaves was used as wicks in candles of animal fat.

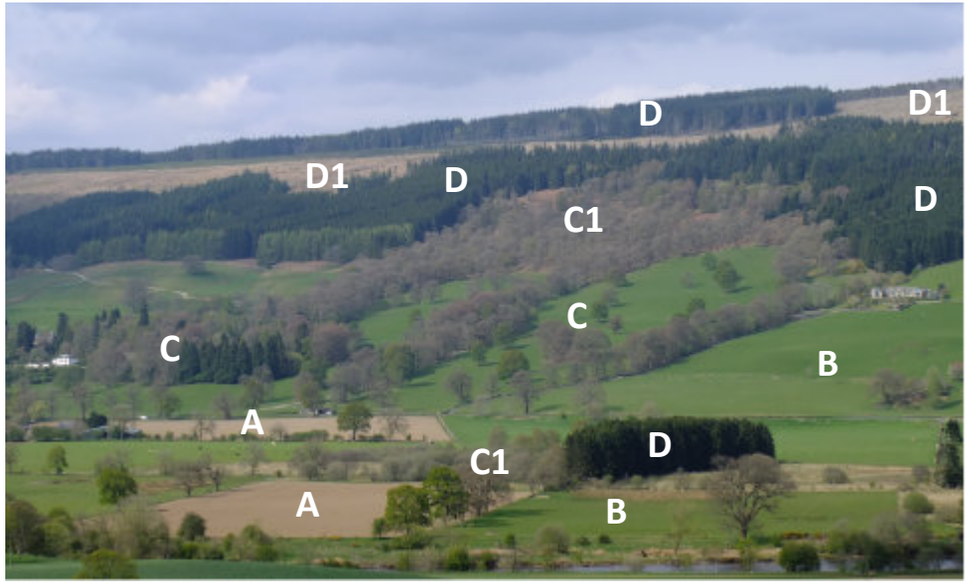
C. FORESTRY PLANTATION

The main picture shows both mature plantations of Sitka spruce (C) and recent clearfell sites (C1), as does this picture [xx].

D. GRASSY MOORLAND

The hills are grassy because the rock type means the soils are relatively fertile and, where this is the case, grazing by sheep (or red deer) favours grasses over heather. There will be both damp grassland dominated by purple moor grass and dry bent-fescue grasslands [xx].

SOUTHERN HIGHLANDS: STRATH VIEW
Strathtay, Perthshire



Perthshire has less extreme climate than many other areas of the Highlands, with wide straths with fertile flood plains. This means that the landscape is well-inhabited, with farmland extending north into the hills. The River Tay is Scotland's largest and longest river, with the city of Perth at its mouth; this is a picture of its middle reaches.

Cereal growing (wheat, barley, oats) is possible on the level ground (A), with grazing pasture elsewhere (B). Native woodland of birch and oak is more common in Perthshire than other parts of the Highlands (C1) and commercial plantations are also common (D). The county is noted for the autumn colours trees bring to the landscape.

The rivers often have alder trees growing along their banks [xx], and are renowned for their salmon fishing [xx]. In recent years, beavers have been introduced into the area and their presence can be noted by their gnawing and felling of trees. Beavers become extinct in Scotland in the 1500s because their fur was sought-after, and there are now re-introduction schemes across the Highlands – indeed, across Britain. However, they are not always popular with farmers because they can burrow into the banks which protect the farmland from floods.

A. ARABLE FIELD

Ploughing of a field in autumn prior to the planting of barley. The gulls follow the plough to catch worms and insects brought to the surface.

B. PASTURE (IMPROVED)

The flatter ground will be used to grow silage [xx], with the hillsides retained as permanent pasture [xx].

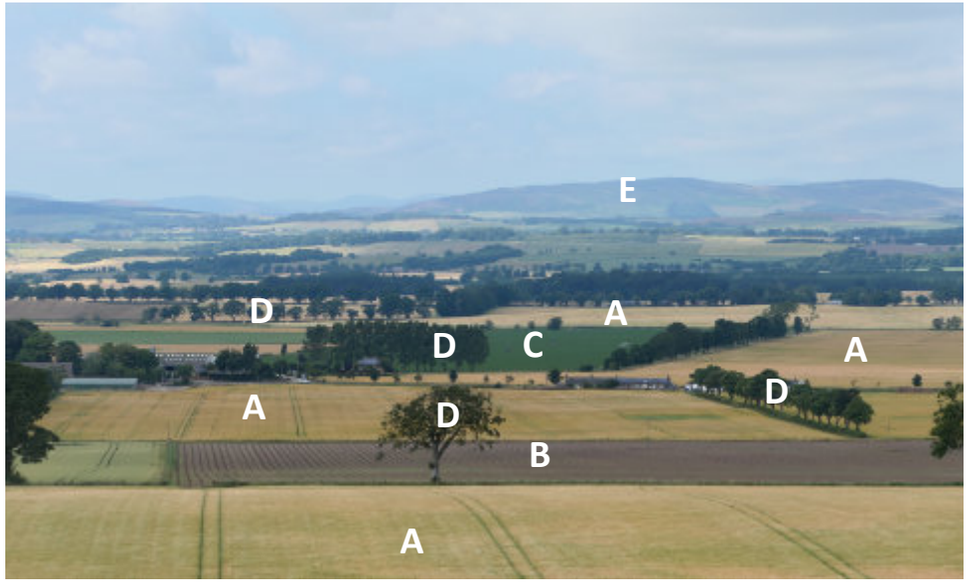
C. DESIGNED LANDSCAPE

The widely-spaced trees indicate that is a designed landscape [xx], with parkland trees planted around the main house for aesthetic reason. Such widely-spaced trees, unlike plantation trees [xx], have long branches and wide crowns.

D. CONIFER PLANTATION

Both mature plantations and clearfell sites [xx] are visible in this and the main picture. These have been planted on the higher ground less suited to agriculture.

SOUTHERN HIGHLANDS: MOUNTAIN – FARMLAND TRANSITION
Strathmore



This is an example of the fertile landscape immediately south of the Highlands in the drier, east side of the county – here the wide Strathmore between Perth and Forfar.

The rounded, moorland-covered hills of the Eastern Highlands are visible in the distance (E). The fertile soils of the strath are suitable for growing crops, in this case wheat (A) and potatoes (B).

Wheat needs a relatively warm and dry climate to ripen. In contrast, potatoes grow well across the Highlands and, after their introduction from North America, became the mainstay of the Highland population. However, disaster struck when potato blight killed the potatoes in the mid-1800s, causing, as in Ireland, widespread starvation. Some landowners provided the population with paid work to see them through; for example, the road between Dundonnel and Braemore in Wester Ross is known as 'Destitution Road' because it was built by destitute people during the famine.

Strathmore is a major potato-growing region, with potatoes exported across the country. Further north, seed potatoes are grown, that is potatoes grown for planting new crops rather than eating. This is because the cooler climate means the crops are relatively disease-free. They are exported over the world.

A. ARABLE CROP

Modern cereal crops, here wheat, need fertilisers, herbicides (for killing weeds) and pesticides (for killing invertebrate pests). Hence they are monocultures of little wildlife interest.

B. FIELD PLOUGHED FOR POTATOES

Potatoes are planted in fields ploughed into parallel ridges, as here in Moray, and harvested by machine in autumn. Previously they were planted by hand, when schools had 'tattie holidays', allowing the children to join their parents in 'tattie howking' (harvesting).

C. PASTURE (IMPROVED)

Although Strathmore is largely devoted to growing crops, there are still some fields of improved pasture [xx] for livestock or horse grazing. Before tractors started becoming common in the 1930s, a large amount of farmland had to be set aside to proved grazing for work horses.

D. BOUNDARY TREES

Although the landscape appears well-wooded, most of it is open field. The trees are either planted shelter belts [xx] or planted in hedges which were once field boundaries – but now have largely disappeared. If the trees are not replaced, then the landscape will become treeless over time.

SOUTHERN HIGHLANDS: MOUNTAIN – FARMLAND TRANSITION

Duncryne Hill, Loch Lomond

On the west side of the country, the transition to the Highlands is not through arable fields to the hills as at Strathmore [xx], but through grassland. The west is too wet to guarantee the ripening of cereal crops, so most of the farmland is devoted to growing grass for sheep and cattle (B,C): the mild, wet climate is ideal for grass.

This picture, taken from Duncryne Hill above the south end of Loch Lomond, shows a view immediately south of the Highland Boundary Fault, a landscape of rolling hills. The gentle hills originated as glacial moraine, deposits of rock and sediment brought down from the north when the whole of the Highlands was covered by ice during the Ice Age over 10,000 years ago. When the ice melted, the material it had carried down from the interior was left behind as these hills.

The smooth topography makes it ideal for farming, and the land has been divided up into fields of both better quality improved pasture (C), and lower quality, but more species-rich, unimproved pasture (B) [xx].

The fields are separated by both dykes [xx] and shelter belts [xx].

A. BRACKEN

There is bracken [xx] in the foreground, growing on the sides of the hill in a location which is left unmanaged (*i.e*. not used for farming). In the past, bracken was cut and collected for animal bedding or, when dried, made into bundles of fuel.

B. PASTURE (UNIMPROVED)

These grassland are akin to the original natural grasslands in that they have not been drained, fertilised or re-seeded – or, at least, not on a significant scale. Hence they host more plants and insects than improved pasture.

C. PASTURE (IMPROVED)

Improved pasture being cut for silage [xx]. The more fertile conditions encourage fast grass growth.

D. BOUNDARY TREES

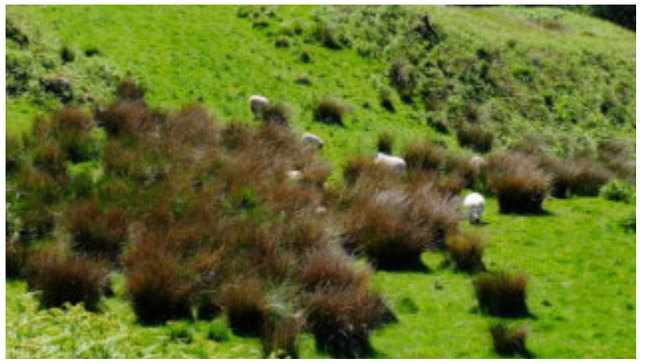
Boundary trees can be planted as shelter belts [xx], planted along hedge lines or, as in this picture, can grow up from old hedges which are no longer cut. Hedges are more a characteristic of lowland Scotland, rather than the Highlands where abundant stone was used to build dykes [xx].

EASTERN COASTAL FRINGE
Near Helmsdale, Sutherland

The definition of 'The Highlands' used in this book, that is the land north of the Highland Boundary Fault, does not mean it is all 'high land'. It is more of a general geographical distinction separating the northern half of Scotland from the South. The land down the east coast is low-lying compared to the rugged and infertile mountains to the west, and is underlain by younger, sedimentary rocks which weather to give fertile soils.

There is only one place where the hills actually reach the sea: at the border between Sutherland and Caithness – the Berriedale Braes. Caithness is a flat landscape bounded by vertical cliffs along the coast and hills to the west and south. To some extent, it has the feeling of an island. There are pictures of Caithness here [xx].

The land bordering the Moray Firth is one of the driest parts of the British Isles, being in the rain shadow of the western hills [xx]. This, combined with the fertile soils, makes it well-suited to growing crops. As you head south into Sutherland from Caithness, the strip of arable land starts off narrow (B), as in the above picture, with the heather-covered hills close to the sea (E); but the strip slowly widens, reaching its widest in what was once Banffshire (now Aberdeenshire).



A. RUSHES

Rushes [xx] have colonised a damp hollow within the improved grassland. If not controlled, they are likely to slowly invade the whole field.

B. PASTURE (IMPROVED)

The fields have been drained an fertilised to produce silage for winter feeding of the animals [xx]. This shows silage production in action, with tightly-rolled bales of grass before being put into large plastic bags [xx].

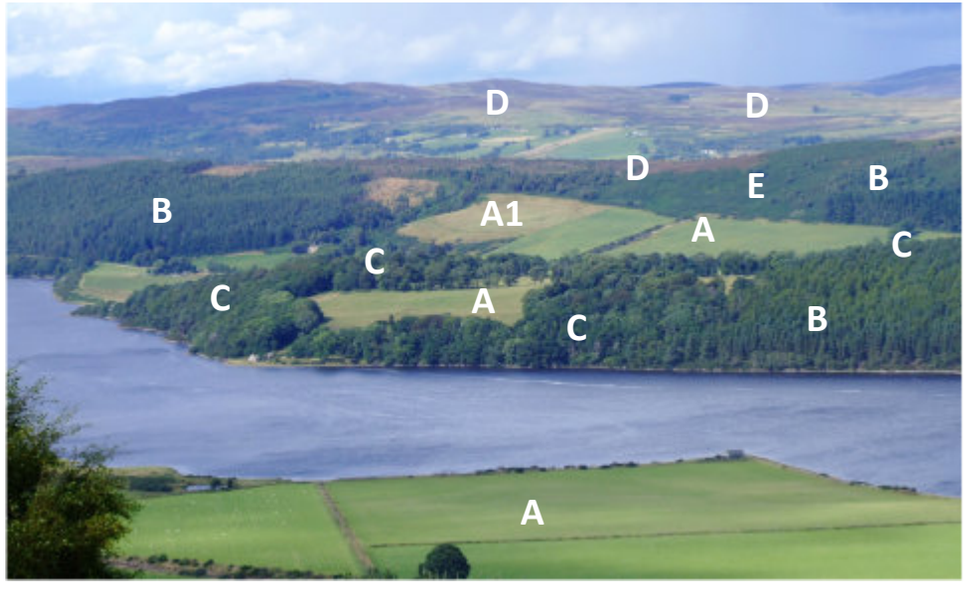
C. GORSE

Gorse is spreading throughout the Highlands [xx] and can grow into large stands to the exclusion of other plants – as here on the Common Grazings [xx] of Gairloch on the west coast.

D. BRACKEN (WINTER)

There are large stands of bracken [xx] on the well-drained slopes at the bottom of the hill slope.

EASTERN COASTAL FRINGE
Dornoch Firth, Sutherland



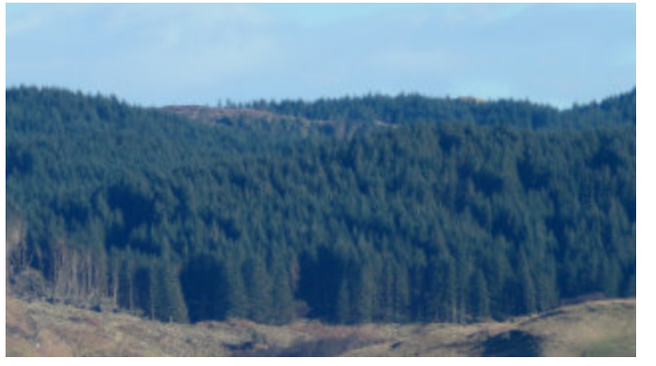
The Dornoch Firth between Dornoch and Tain extends deep into the hills, but has gently-sloping sides in comparison to the steep-sided sea lochs on the north and west coasts. It is perhaps the only such estuary in Britain with an absence of industrial development or large towns along its shores.

At its eastern end are large expanses of sand which dries out at low tide, backed by extensive sand dune vegetation. Indeed, the Morrich More on south side is one of the largest expanses of natural, undisturbed sand dune vegetation in Britain – perhaps protected by being a military firing range.

The strath has a lowland feel, with its smooth agricultural fields (A) and with broadleaved woodland along its shores (C). But there are commercial plantations (C) with moorland beyond (D). A large expanse of gorse is also visible (E).

A. PASTURE (IMPROVED)

The fields around the Firth are mainly used for growing grass for silage [xx], which is stored in large plastic bags, as here. There is a field of unimproved pasture visible (A1), identified by its browner colour.



B. CONIFER PLANTATION

There are extensive commercial plantations [xx] in the area, planted on land which was once heather moorland.

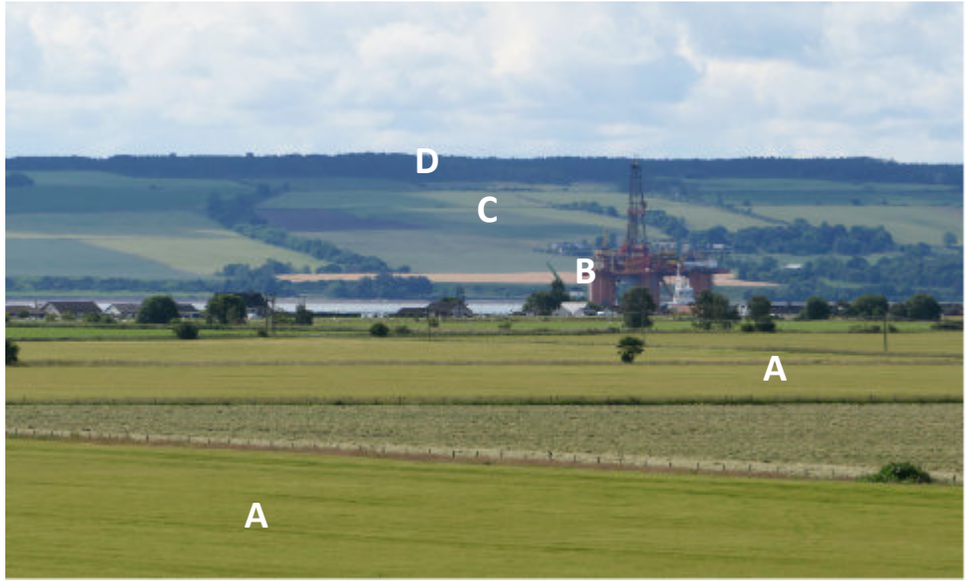
C. BROADLEAVED WOODLAND PLANTATION

There are stands of mature, broadleaved trees, mostly likely planted in Victorian times to improve the landscape.

D. MOORLAND

Moorland vegetation is now distant from the Firth owing to agricultural improvement and forestry plantations.

EASTERN COASTAL FRINGE
Cromarty Firth, Easter Ross



The wide Moray Firth splits into two smaller Firths: the Cromarty Firth to the north and the Beauly Firth to the south. Inverness, the 'capital of the Highlands', is on the shores of the Beauly Firth, a city whose population has expanded rapidly in recent years.

The sheltered waters of the Cromarty Firth provide one of the best harbours in Britain for sheltering large fleets. It was the base of the main fleet of the Royal Navy during the First World War before Scapa Flow on Orkney was developed. Invergordon, near which this photograph was taken, has always been an important naval base, before being superseded as a base for servicing the North Sea oil sector and, recently, as the main cruise ship terminal for the Highlands. The oil industry, starting in the 1960s, has been a major provider of jobs in the Highlands.

An aluminium smelter was built at Invergordon to help provide jobs to the Highlands, with thousands of people moving to the area as a result. But it only lasted ten years, closing in 1982 with 900 jobs lost – because it was unable to secure the necessary cheap electricity. Invergordon, and the nearby Alness, have never fully recovered. Today there jobs being provided in servicing the windfarm sector at Nigg at the north end of the Firth, at a site which once built oilrigs. The Firth has recently been designated a freeport.

Ardersier to the south on the outer Beauly Firth, where oilrigs were also once built, is now being developed to build blades for wind turbines [xx].

A. ARABLE CROP

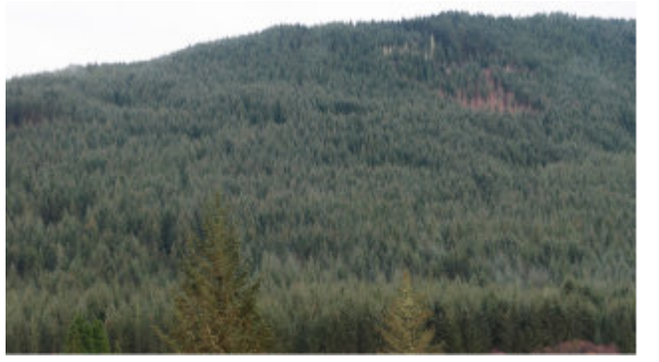
The farms of Easter Ross, sheltered from the mountains to the west, have some of the best grain-growing areas in Scotland. Pictured here is a field of barley.

B. OIL RIG

In recent years, oilrigs have been a common sight in the Cromarty. The deep water allows them to brought close inshore, where they are brought in between contracts, or to await decommissioning. Extraction of oil from the North Sea started in the 1960s, but is now past its peak – so rigs will become less in future years.

C. THE BLACK ISLE

The peninsula between the Cromarty and Beauly Firths is called the Black Isle. Perhaps so-called because it was once covered in black peat. Today it comprises intensive farmland around the edge forestry plantations in the middle. There is still one relict peat bog [xx] – the Monadh Mòr.



D. FORESTRY PLANTATION

The landscape of the Black Isle has been transformed by the planting of commercial conifers along the spine of the peninsula.

EASTERN COASTAL FRINGE
Laich of Moray

The ancient province of Moray, between Inverness and Aberdeen, has always been a rich area owing to its benign climate. Its county town of Elgin once had a grand cathedral, dating from 1224 and the second largest in Scotland (after St Andrews). It was the seat of the bishops of Moray, but following the Scottish Reformation in the 1560s, it fell into disrepair and is now a ruin. The Reformation resulted in the abolition of bishops, and the rise of Presbyterianism as the main religion in most of Scotland.

This view is over the Laich of Moray, a low-lying area which was once a loch until it was drained in the 1800s. However, there is a still a small loch remaining, Loch Spynie, which is now a nature reserve. Nearby are the ruins of Spynie Palace, the past residence of the bishops of Moray.

The fact that the area has been long-inhabited is shown by the presence of a Pictish fort at Burghead and Sueno's Stone at Forres, dating from the ninth or tenth centuries – the same era in which the brochs were built [xx]. Sueno's stone is the largest example of a carved Pictish stone in Scotland.

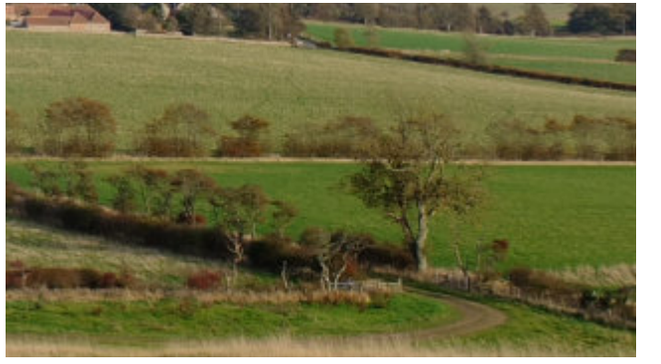
On the coast of Moray at Kinloss and Lossiemouth are two military bases. Fog is very rare in the region and the landscape flat, making it an ideal area for military airfields which were first built in the Second World War. Today the military provides a major source of employment to the region.

A. ARABLE CROP (WHEAT)

A field of wheat before harvesting. Wheat can only be grown in the drier and warmer areas of Scotland, because otherwise it does not ripen.

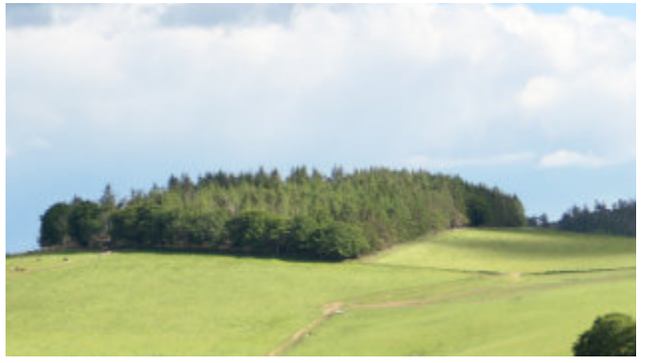
B. ROUGH GRASSLAND

Locations where cultivation is not possible comprise rough grassland. Because these areas are subject to drift of herbicides and pesticides sprayed on crops, and also to run-off of fertilisers, they tend to be species-poor, dominated by only one to species of grass or nettles.



C. HEDGEROW TREES

Hedges were once planted in this area as field boundaries, but in recent years they have been removed, or abandoned. When no longer cut, the woody plants which once comprised the hedge, can now grow to their full height



D. FARM WOODLAND

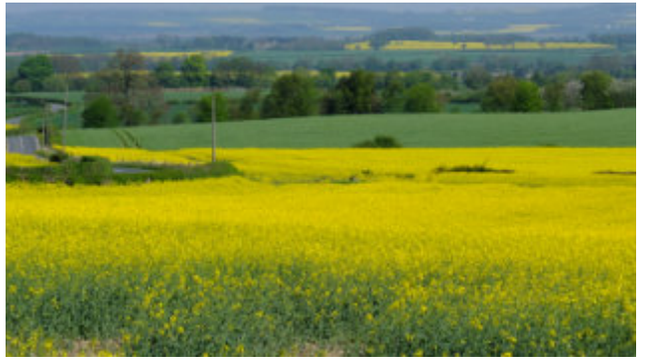
Areas not so suitable for agriculture, are often planted to provide farm woodlands. These differ from the larger-scale commercial forestry plantations because they are designed to provide an income to the farm rather than distant owners. They are also planted to provide habitat for game species such as pheasants

EASTERN COASTAL FRINGE
Rothiernorman, Aberdeenshire

North of the city of Aberdeen is a large tract of intensively-managed farmland. It used to be largely cattle country, but over the past decades it has changed to cereal growing, with barley (A) for the brewing and whisky industries [xx] being the commonest crop.

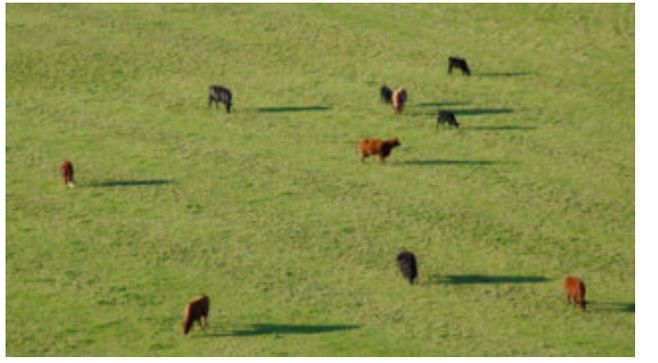
Compared to most of the Highlands, there is little natural vegetation left, and what there is confined to the hilltops or steep ground (D). This is because the whole landscape is devoted to growing crops, leaving no space for most wild plants and animals.

Where there is grassland for sheep or cattle, it is improved grassland [xx] containing few species other than the agricultural rye grass and clover. There will be some birds such as rooks which can find enough food in the fields, and in winter there may well be flocks of geese. But birds which used to thrive on farmland, such as corn bunting and partridge, cannot survive modern intensive management.



A. ARABLE CROPS

A crop widely grown along the east coast, but not present in the main picture, is oilseed rape. The fields full of yellow flowers stand out from a long distance away. Its seeds are oil-rich, from which vegetable oil is extracted.



B. PASTURE

Grazed pasture is present on hillslopes, normally species-poo improved pasture rather than natural grasslands.

C. SHELTER BELT

Winds can be strong across the gently rolling countryside of Aberdeenshire, so planted shelter belts of trees benefit both crops and livestock. However trees are not also popular with farmers because their leaves can shade the neighbouring crop, and their roots can both dry out the soil and make ploughing difficult.

D. GORSE

Often the hillsides which are not used for cropping become dominated by gorse [xx].