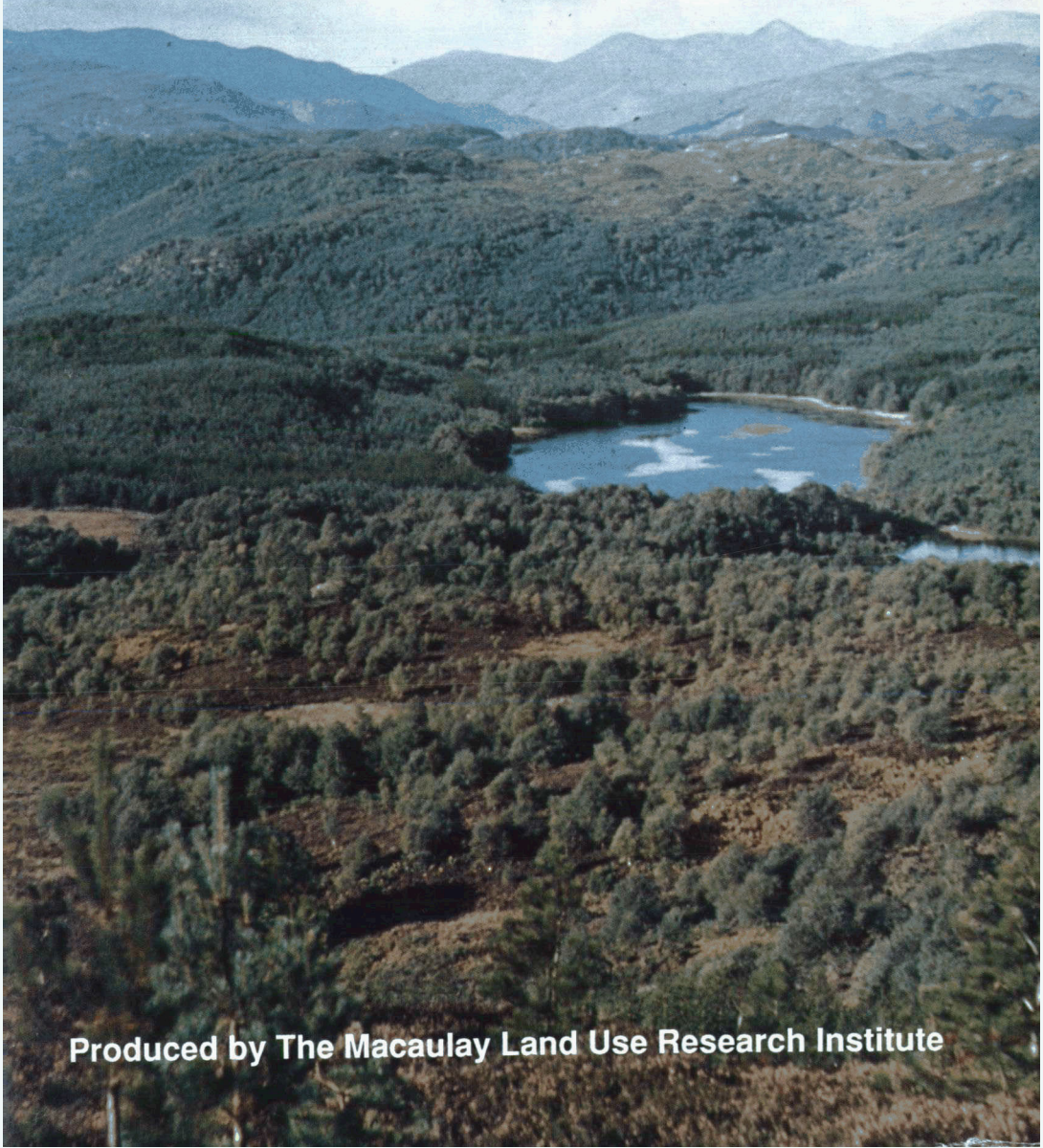




Forestry Commission

Field Book 3

Land Capability for Forestry Northern Scotland



Produced by The Macaulay Land Use Research Institute

Land Capability for Forestry in Northern Scotland

(including Orkney and Shetland)

by W. Towers and D.W. Futton

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FRONT COVER: *Torrachilty Forest, Strathpeffer (Forestry Commission photo)*

1. The land capability classification for forestry

The land capability classification for forestry is based on an assessment of the degree of limitation imposed by the physical factors of soil, topography and climate on the growth of trees and on silvicultural practices. The principal tree species considered are those broadleaves and conifers commonly grown in Britain, and the classification assumes a skilled management level that will include cultivation, drainage, fertiliser application and weed control where these are necessary.

The principles on which the classification is based and the guidelines for assessing each type of limitation are described in *Land Capability Classification for Forestry in Britain* (Bibby *et al.* 1988).

TYPES OF LIMITATION

The classification is based on seven types of limitation, these being climate, windthrow, nutrients, topography, droughtiness, wetness and soil.

Climate

Climate is probably the most important factor that affects afforestation in Britain and it provides the framework of the classification. The two principal elements are accumulated temperature, measured in day-degrees above 5.6°C (Birse and Dry 1970, Birse 1971) and exposure, measured in mean annual wind speeds (Birse and Robertson 1970). Rainfall is of less importance, since in Britain it is sufficient for tree growth provided the soil is capable of storing the moisture it receives. Seasonal frosts can affect tree growth and species choice, but their occurrences depend very much on the local topography.

Windthrow

The likelihood of windthrow in forests affects both forest management and timber production, since in areas of high risk, thinning is precluded and crop rotations shortened. Windthrow is likely to occur where soils with shallow rooting depths are found in combination with a high degree of exposure and high wind speeds. The assessment of risk, described by Miller (1985), is done on a point-scoring system which takes into account wind zone, elevation zone, topographic exposure and soil type. From the total score, the windthrow hazard class, of which there are six, is derived; low scores indicate a low hazard class and a low risk of windthrow.

Nutrients

Although the application of fertilisers, principally phosphorus and potassium, is part of regular forest practice, the natural availability of nutrients in the soil determines very largely the choice of species that can be grown. In organic soils, nutrient availability, related to the total content of nitrogen, phosphorus and potassium, is low except where considerable surface flushing has taken place. Mineral soils are usually more fertile, particularly those that have been used regularly for arable rotations. Their nutrient availability is related to the volume of soil available for rooting and the chemical composition of the soil parent material, those derived from acid rocks such as quartzites and granites being poorest. However, on soils developed on materials derived from basic igneous rocks, problems of poor phosphorus availability can arise, and on ultrabasic rocks, growth problems associated with high magnesium or nickel are likely.

Topography

Topography principally affects the mechanised operations necessary for the establishment and harvesting of the tree crop and the design and construction of forest roads. Slope is the major element. Two-way ploughing is generally only possible on slopes of less than 5° and trailed ploughs are mainly confined to slopes less than 18°. One-way ploughing with mounted plough reaches a limit at 35° on dry stable slopes but is less than this on wet slopes or where there is a danger of the soil layer parting

from the underlying rock and the tractor 'rafting' downhill. On irregular, rocky or bouldery topography these limits can be reduced considerably, and complete ploughing may be precluded.

Droughtiness

Droughtiness affects forestry capability in areas where soils with very low water-holding capacity, such as dune sands, occur under low rainfall. Where water is in short supply to the root, a number of problems can occur, particularly at establishment, which are partly physiological and partly nutritional. High soil moisture deficits can result in reduced yields and restrict the choice of species.

Wetness

Soil wetness is a physiological barrier to root growth and its implications for forestry are that it can lead to poor growth due to poor aeration, low soil temperatures and a restricted amount of soil exploitable for nutrients, as well as reducing tree stability and thus increasing windthrow risk, particularly in exposed upland areas. Seasonal saturation of the root zone occurs widely in surface-water gleys. Such soils, together with peats and peaty gleys, require drainage schemes. Sites which are subject to regular flooding are not suitable for afforestation.

Soil

Soil is an important factor in most of the types of limitation so far described, but in some circumstances it can be the dominant one affecting forestry capability. Shallow soils, for example, have restricted rooting depths and can be difficult to plough; trafficking on them can result in topsoil destruction. In areas where soil patterns are complex, site preparation and treatments appropriate to each soil type may not be easy and compromises will have to be reached.

THE CLASSES

Class F1. *Land with excellent flexibility for the growth and management of tree crops*

The soils are deep and well supplied with moisture, and neither climate nor site factors seriously restrict the growth of the main tree species used in Britain. A wide range of broadleaved and coniferous species can be planted.

Class F2. *Land with very good flexibility for the growth and management of tree crops*

The soils have no or only limited periods of seasonal waterlogging, but some mineral gleys may be included if, with drainage, the water-table can be controlled at depths which prevent serious waterlogging of the root system. Minor areas of shallower or wetter soils are acceptable but should not exceed 10% in total. Minor restrictions on cultivation and harvesting due to slopes or minor climatic restraints are also acceptable. Both broadleaved and coniferous species may be planted but choice is more restricted than in Class F1. In areas where available water is limited, those species with high water demand are unsuitable; in areas with water surplus soil drainage may be necessary.

Class F3. *Land with good flexibility for the growth and management of tree crops*

The soil range extends to include mineral gleys with sandy or loamy textures and flushed gleys with humose topsoils. Drainage is necessary on gley soils. Windthrow risk is not high and land management is primarily concerned with limitations imposed by drainage, sloping land or patterns of variable soils. The land is suitable for a wide range of conifers and for a restricted range of broadleaved species.

Class F4. *Land with moderate flexibility for the growth and management of tree crops*

The soils include the more fertile peaty soils and the problem mineral soils, e.g. gleys with clayey textures or soils with calcareous horizons.

Ploughing difficulty may be encountered due to stony or shallow soils but this should not be more than 20% of the area. There is a risk of small areas of windthrow which should not be sufficiently severe to reduce rotation lengths or influence management practices. The land is suitable for many coniferous species and in places for the less demanding broadleaves.

Class F5. *Land with limited flexibility for the growth and management of tree crops*

The soils are primarily podzols, peaty gleys and peat, but where limitations are sufficiently severe to limit species selection, other soils may be included. Ploughing is possible but may be more difficult than in the previous classes. Sites in which the risk of windthrow affects management by modifying the thinning practice fall within this class. In the uplands species choice is limited to conifers, such as spruces, larches and pines, and to birch, alder or other hardy broadleaves.

Class F6. *Land with very limited flexibility for the growth and management of tree crops*

The principal limitations are adverse climate and poor soil conditions. The soils include podzols, peaty gleys and peats, and soils affected by toxicities. Sites on which the risk of windthrow effectively prevents thinning and seriously curtails the rotation length, and sites with very severe surface terrain which imposes great difficulty in ploughing or extraction, fall within this class. Species choice is limited to lodgepole pine and Sitka spruce and to amenity broadleaves such as birch and alder.

Class F7. *Land unsuitable for producing tree crops*

Land is considered unplantable if its physical characteristics preclude the growth or establishment of tree crops by normal methods. These characters include extremes of climate (orohemiarctic and oroarctic climate zones over extremely exposed sites), wetness (flow-bog or flood sites), rockiness and extreme slopes.

2. The classes in Northern Scotland, Orkney and Shetland

This handbook describes the classes shown on the 1:250 000 scale land capability for forestry map Sheet 3 (Northern Scotland) and comments on Orkney and Shetland. The area covered amounts to 18 890 sq km.

Most of Northern Scotland lies in Highland Region, with the south-east corner forming a small part of Grampian Region. There are four main physiographic regions: the Moray Firth lowlands, the Northern Highlands to the north and west, the Caithness plain in the far north-east, and the Grampian Highlands to the south and east. The soils and land capability for agriculture have been described in publications dealing with Northern Scotland (Futty and Towers 1982) and Orkney and Shetland (Dry 1982).

All seven land capability for forestry classes are present. Classes F6 and F7 are overwhelmingly dominant, a reflection to a large extent of the unfavourable climatic conditions for tree growth which prevail over much of the area. Low temperatures and high wind speeds, often in combination, dominate much of the Northern Highlands, Grampian Highlands and Caithness plain. The highest classes, F1 and F2, are therefore found exclusively in the Moray Firth lowlands and in the low-lying sheltered straths. Classes F3 and F4 are also concentrated in the Moray Firth lowlands, on the foothills bordering them, and in the many straths. Occurrences on the west coast of the higher classes are not extensive and owe much to local topographic shelter.

Classes F5 and F6 form the bulk of the potential forestry land and largely reflect the vast extent of peat and peaty soils. Class F7, land unsuited for tree crops, covers large tracts of the Northern Highlands with smaller areas in the Grampian Highlands. In Orkney and Shetland, Class F7 land predominates, with Class F6 land, the highest class, occurring in locally less-exposed areas.

Forestry is well established in the Moray Firth lowlands, in the foothills adjoining them, in the major straths of the east, such as Strath Oykel, and in Strath Tirry to the north of Lairg. It is less extensive in the north and west.

Class F1. *Land with excellent flexibility for the growth and management of tree crops*

Area: 89 sq km

Class F1 land occurs at altitudes below 50 m and is restricted to gently sloping sheltered sites in the Moray Firth lowlands, principally around the Cromarty and Beauly Firths and in the valleys of the Rivers Nairn, Lossie and Spey.

The combination of favourable climate, soil and topography allows a wide range of coniferous and broadleaved species to be grown. The climate is warm (accumulated temperatures generally greater than 1400 day °C) and sheltered (wind speed less than 2.6 m/s). The presence of numerous very tall trees of a range of species in this area serves as a useful indicator of the climatic potential for tree growth; for example, at Conon House near Conon Bridge, Beaufort Castle near Kiltarlity, and Gordon Castle near Fochabers.

The soils are mainly freely drained, with sandy or loamy textures, on gently sloping river terraces and, less frequently, raised beach terraces. The area at Udale Bay comprises cultivated podzols with deep topsoils. Rooting is unrestricted, and as present land use is moderately intensive arable agriculture, nutrient levels should be high. There is little or no risk of windthrow (hazard classes 1 and 2) and few restrictions on mechanised forestry operations.

Class F2. *Land with very good flexibility for the growth and management of tree crops*

Area: 474 sq km

Class F2 land occurs extensively throughout the Moray Firth lowlands at altitudes of up to 100 m, and locally in the more sheltered valleys such as Strathconon, Strath Glass and Strathspey, and at Lael and Attadale in the west. Climate is the main limiting factor. Much of the class has a similar



Plate 1. Class F2 near Avoch. A wide range of opportunities is available for the growth and management of broadleaves and conifers on the lower ground of the Black Isle. (Photo: MLURI)

Plate 2. Highland glens can encompass a whole range of capability classes. Here, at Strath More, near Ullapool, the valley floor is Class F2, the valley sides Class F4, and the higher ground Classes F6 and F7. (Photo: MLURI)



temperature range to that of Class F1 land, but exposure is greater, with wind speeds between 2.6 and 4.4 m/s; the exceptions are the sheltered valleys and west coast locations where the temperatures are lower. Land limited to Class F2 only by climate is similar in most other respects to Class F1 land; level or gently sloping, with freely drained soils developed on a range of parent materials including alluvium, raised beach deposits, fluvioglacial sands and gravels, and till. Some of the soils, however, are imperfectly drained. Like Class F1 this land has had a long history of cultivation and nutrient status should be high. Windthrow risk is low, hazard class 2.

Some shallower soils occur locally, particularly the cultivated podzols of the Black Isle and a few sloping areas, for example near Avoch and Munlochy, have minor topographic limitations.

Class F2 also includes some land with wetness limitation. This land, comprising some of the most productive cereal land in Northern Scotland, occurs on alluvial or raised beach soils with sandy, fine sandy, loamy and occasionally silty textures. Natural drainage is imperfect or poor. The water-table has been controlled to a large extent by artificial drainage, but root systems may still suffer from short periods of seasonal waterlogging. Most other factors are very favourable - deep, fertile, mainly stone-free soils on level terrain at low altitudes. Windthrow hazard class is 2, locally 3. Land of this type is found at Arabella, Invergordon, Dingwall, the head of the Beauly Firth and near Elgin.

Although conditions for tree growth are not quite as favourable as in Class F1, there are some fine stands of both coniferous and broadleaved woodland; Lael, Darnaway near Forres, Castle Leod near Strathpeffer, Brahan and Calrossie near Fearn are examples.

Class F3. *Land with good flexibility for the growth and management of tree crops*

Area: 875 sq km

Class F3 land occurs mainly throughout the Moray Firth lowlands, on the lower slopes of the adjoining foothills, and in the adjacent straths. Climate and droughtiness are the main limitations.

Land with climatic limitations, forming an almost continuous strip fringing the Moray Firth lowlands and in Strathspey, mainly comprises cultivated podzols with restricted areas of noncalcareous gleys. Alluvial soils are present in most of the straths. The bulk of Class F3 land has accumulated temperatures of between 1200 and 1350 day °C and is moderately exposed (wind speeds between 2.6 and 4.4 m/s); the main exceptions include warmer, but more exposed, coastal parts of the Moray Firth lowlands. In the most favoured circumstances, for example around Inverness and in Strathspey, Class F3 occurs at altitudes up to 180 m, but only up to 50 m in east Sutherland and on the west coast.

The land is non-rocky and gently sloping, although locally there are steep slopes, for example in the Findhorn valley. Induration can locally restrict rooting depth in the podzols and may lead to minor problems of crop stability, although the windthrow hazard class is generally only 2 or 3.

Class F3 land with droughtiness limitation is associated with the cultivated podzols developed on gravels and, less commonly, sands. It is most extensive to the east of Inverness, but is of local significance in the Alness, Dornoch and Muir of Ord areas. The climate is warm and moderately exposed and the mean annual rainfall is low (600-800 mm); the topography is gently moundy. The soils, which are coarse textured, stony and have low nutrient- and moisture-retaining capacities, are moderately droughty. Traditional forestry on these soils comprises almost entirely Scots pine.

Topography poses few forest management problems throughout Class F3 land, although on some alluvial soils, for example in Strath Glass and the Strath of Kildonan, there are wet patches associated with meander channels.

Class F4. *Land with moderate flexibility for the growth and management of tree crops*

Area: 862 sq km

Class F4 land occurs mainly in the foothills around the Moray Firth lowlands, in Strathspey and in the Keith area. Occurrences to the north and west are associated with sheltered valleys and inlets. Climate is the



Plate 3. Class F3 in the foreground and Class F5 on the partially afforested steep slopes, Strathconon. (Photo: MLURI)

Plate 4. Class F5 on the heather-covered slopes and Class F6 on the more exposed higher ground, eastern Grampians near Cawdor. (Photo: MLURI)





Plate 5. Class F5 near Thurso. Exposure to strong winds and high risk of windthrow determine the class in the arable lands of Caithness. (Photo: MLURI)

Plate 6. Rock outcrops can affect site preparation and harvesting or render land unsuitable for planting. Class F5, afforested, in the foreground, and F7 beyond, at Loch Meig, Strathconon. (Photo: MLURI)



main limiting factor, with soil, topographic and wetness limitations much more site-specific.

The distribution of Class F4 land with climatic limitations broadly follows that for Class F3, but occurs at higher altitudes as well as having a wider geographic spread. The differentiation from Class F3 is mainly due to lower accumulated temperatures, generally in the range 1100-1200 day °C; wind speeds are in the moderately exposed range (2.6-4.4 m/s). Only on the west coast at sites such as Gairloch and Applecross, and exposed parts of the Moray Firth coast (Tarbert Ness, Roseisle) is the exposure element dominant. Class F4 land occurs at altitudes up to 240 m in Strathspey and the Moray Firth foothills, but this limit drops rapidly towards the north; in east Sutherland the upper limit is at 100 m and in the far north, 50 m. A similar although less severe decrease occurs moving east into Banffshire where the regional wind speeds increase and the landscape becomes more open.

In most other respects land with climatic limitations is similar to that in Class F3; humus-iron podzols, mainly cultivated, and alluvial soils predominate, although noncalcareous gleys are found in the Archiestown and Bellehiglash districts of Strathspey and to the east of Keith. There are no rooting restrictions in the alluvial soils, and although the podzols generally have an indurated horizon, there is usually sufficient depth above it to allow adequate rooting. Despite high regional wind speeds in the northern straths, deep rooting, topographic shelter and the low altitude provide compensatory benefits; windthrow hazard class 3 is general, but 4 on the gleys.

This land is capable of growing a wide range of coniferous species and there are few topographic difficulties for forest management. Conditions are more limiting for broadleaves, but the hardier species will grow successfully.

Although class allocation is largely due to climate, other factors are also limiting. The uncultivated humus-iron podzols are nutrient-deficient, acidic, and often have a vegetation dominated by *Calluna vulgaris*. Even at low altitudes, as in Easter Ross and near Forres, where climate is better, soil conditions are not suitable for many broadleaved species. Where the soils are developed on sands and gravels, as near Forres and to the east

of Elgin, conifers with a high moisture requirement are not particularly suited, except in localised receiving sites.

Areas with topographic limitations are rare, but occur on non- or slightly rocky steep slopes with brown forest soils at Novar, Loch Garve, Strath Fleet and Strath Oykel, and on podzols at the southern end of the Black Isle. Wetness limitations are not common, but are found on the fine-textured alluvium in Strath Fleet, on the poorly drained lacustrine clays near Duffus, and on the alluvium near Marybank where there is a flood risk and numerous wet meander channels.

Class F5. *Land with limited flexibility for the growth and management of tree crops*

Area: 1631 sq km

Class F5 land is found predominantly in the eastern areas of Northern Scotland and it includes the widest range of soil and landform types of any class. Because of climatic constraints it does not occur above 330 m; this upper limit falls rapidly towards the north and west.

The most extensive limitation type is low nutrient status associated with peaty podzols and flushed peaty gleys. Except for some moderately rocky ground on the south side of Loch Carron, the land is non-rocky, slopes are less than 15°, and complete ploughing can normally be carried out. The peaty podzols have a strong eastern distributional bias and examples include the Drynachan area in Nairnshire, to the east of Dallas in Morayshire and in the Strath of Kildonan. Considerable areas of this site-type are already afforested, most notably the Wood of Ordiequish between Fochabers and Keith and the Strath Rory area of Easter Ross. Areas of gently moundy moraine where the peat component is subordinate, for example near Spinningdale in Sutherland and at Gorstan in Ross-shire, are similar, in forestry capability terms. Most problems associated with these soils are concerned with *Calluna vulgaris*, which is usually dominant, causing growth check in spruce. An iron pan, induration or both, may restrict rooting depth but can be ruptured by deep tining.

Long-term stability is a greater problem on flushed peaty gleys than on the peaty podzols. Drainage is necessary on these soils. Windthrow hazard class is generally 4 in the east, and increases westwards as regional



Plate 7. Class F6, Dalchork, near Lairg. Unflushed blanket peat, extensive in northern Scotland, is suitable only for the less demanding conifers such as lodgepole pine and Sitka spruce. (Photo: MLURI)

Plate 8. Class F7, Glen Torridon. Extremely rocky and bouldery land is not suitable for the production of tree crops. (Photo: MLURI)



wind speeds increase. Low nutrient status is also a limitation on the low-lying basin peats of the Moray Firth lowlands and on scattered areas of peaty alluvium such as in Strath Bran and at the head of Loch Kishorn.

Topographic, in addition to nutrient, limitations occur on the moderately rocky ground with humus-iron podzols and peaty podzols which is common in the south-eastern part of the Northern Highlands. Slopes are generally less than 15° with steeper ground on the valley sides. Similar topographic limitations occur on moderately rocky ground with brown forest soils. Distribution is scattered, the larger areas occurring in Strath Glass, Glencarron and at Loch Maree on steep terrain, and at Rogart in Sutherland and Lochcarron in Ross-shire where the slopes are less than 15°. Although these moderately rocky landforms all pose management problems, some of these areas are quite sheltered, for example Strathconon, Glen Strathfarrar and Strath Glass.

Climate is the limiting factor in non-rocky areas of humus-iron podzols, many of which are cultivated. The largest is in the south-east, for example in Glen Rinnes and the Glass area to the south of Keith. The soils have a higher natural level of fertility than over much of Northern Scotland, being derived from mica-schists and slates. There are no or few topographic limitations and trafficability is high. Similar ground occurs around Lairg and Loch Moy where alluvial soils are also present. In these central and eastern areas accumulated temperatures, generally in the range 950-1100 day °C, are the dominant climatic factor in class allocation. Only on small areas of Class F5 which occur on some of the crofting land of the north and west coasts, and on the exposed Hill of Nigg in Easter Ross, does the exposure rather than temperature element of the climate become dominant.

Class F5 land dominates the arable land of Caithness below about 50 m. The soils are noncalcareous gleys and cultivated humus-iron podzols on non-rocky, gently sloping land. Although the climate is moderately warm, it is also exposed and combined with the shallow rooting depths of both soil types and the open nature of the landscape, there is a high risk of windthrow (hazard class 5). Many trees in the landscape show strong evidence of wind-clipping.

Class F5 land also includes the gently undulating links and sandy

raised beach soils at Golspie, Dornoch, Morrich More, Delnies near Nairn, Culbin and Roseisle, limiting factors being droughtiness and low nutrient status. Detailed soil survey in Culbin Forest (Gauld 1981) has identified areas where buried former cultivated horizons, silt or peat, increase the nutrient and moisture availability.

On the open landscape of Drummossie Muir, there is an intricate pattern of soil types with humus-iron podzols and some peaty podzols on low parallel rock-cored ridges and flushed peat and peaty gleys in the hollows and basins between. Both podzolic types are shallow, either on rock or induration, and all the soils require nutrient inputs. The concomitant effect of climatic, nutrient and soil factors are moderately severe and limit the land to Class F5. There are already extensive coniferous plantations on this plateau.

Class F6. Land with very limited flexibility for the growth and management of tree crops

Area: 6573 sq km

The distribution of Class F6 land is overwhelmingly correlated with both the vast extent of peaty moorland and the cool exposed climate zone. The main difference from Class F5, in climatic terms, is greater exposure (wind speeds between 4.4 and 6.2 m/s) although there is also a wider temperature range (accumulated temperatures 875-1100 day °C). Much of the land has more than one limitation type. Land with severe nutrient deficiencies and climatic limitations are frequently co-incident, particularly in Caithness and Sutherland, the Grampian Highlands and central Ross-shire and north Inverness-shire. Blanket peat, often extensive, peaty gleys and, less commonly, peaty podzols, cover an undulating non-rocky landscape. The soils are nutrient-deficient, particularly the blanket peats and those derived from Moinian and Torridonian rocks. Dalradian and Lewisian rocks are slightly richer. Little flushing is present and the vegetation is dominated by *Trichophorum cespitosum*, *Eriophorum angustifolium*, *E. vaginatum*, *Calluna vulgaris*, *Erica tetralix*, *Narthecium ossifragum* and *Sphagnum* spp; in places, particularly in the exposed north and west, the ground surface is only partially vegetated.

Site drainage will usually be required, but complete ploughing

should be possible, apart from a few local areas of dubh lochans in the blanket peat. In addition to low nutrient status, windthrow risk is high (hazard class 4 or greater) in most areas of Class F6, but particularly so in the open landscapes of the north and in exposed areas of the west. Some Class F6 land with soils similar to those described above, but a moderately rocky landscape, has a topographic limitation in addition to those of climate, low nutrient status and windthrow; rock outcrops, steep slopes and boulders can affect mechanised forestry operations.

Other types of Class F6 land are not so extensive. Most common is land with mineral soils restricted by climate alone. The best example is in Caithness, where land with noncalcareous gleys on fine loamy till, together with some podzols, occurs above 50 m. Small areas occur in the most sheltered parts of Orkney and Shetland. Windthrow risk is high (hazard class 5), a result of the combination of a high degree of exposure and the shallow rooting depths, due either to soil wetness in the gleys or underlying induration in the podzols. Other areas of Class F6 land on mineral soils include the crofting lands along the north and west coasts, such as at Bettyhill, Melvich, Aultbea and Gairloch. Climate is also limiting on the sandy soils of Keiss and Dunnet Links in Caithness. Peaty podzols in the south-eastern part of the Northern Highlands and in the Grampian Highlands are also restricted to Class F6 by climatic limitations.

The steep, undulating dunes at Culbin, with raw, nutrient-deficient soils, are included within Class F6. Land with topographic limitations alone is uncommon, but does occur on the moderately rocky or rocky ground with mineral soils associated with the Durness Limestone and on some steep valley slopes. Distribution is very scattered, the largest areas occurring at Durness and Inchnadamph.

Class F7. Land unsuitable for producing tree crops

Area: 8294 sq km

Class F7 covers vast tracts of the Northern Highlands and most of Orkney and Shetland. Climate and topography are the principal limitations.

In the hill and upland areas, low accumulated temperatures (less than 875 day °C) and high mean annual wind speeds (more than 6.2 m/s) result in large areas being too cold, or too exposed, or both, for forestry.

The effective planting limit, which decreases from south to north and from east to west, a trend that correlates broadly with the regional wind zonation of Miller (1985), is around 450 m in the more sheltered south-eastern parts of the Northern Highlands and in the Grampian Highlands, falling to 350 m in Strath Bran, 300 m in the Strath Oykel and Shin areas and 150 m in the far north-west. Planting is also precluded on the very exposed coastal headlands of the north and west, from Gairloch round to Wick.

Land limited to this class only by climate comprises mainly the peaty ground above the planting limit, common more in the east and central districts than in the west, and the crofting land with mineral soils on the very exposed areas of the west and north coasts, for example the Stoer peninsula. Much of Orkney and Shetland, including arable, crofting and hill land, also falls into this category.

In much of the Class F7 land above the planting limit the limitations are topographic as well as climatic. Very rocky and bouldery land with peaty soils occurs in places and, at higher altitudes, in the zone of subalpine and alpine soils, bare bouldery ground and very steep craggy or scree slopes are common. Other types of Class F7 land include areas of hagged peat on high-level plateaux which are extensive in central Sutherland and on the Sutherland/Caithness border above 250 m, and on either side of the Findhorn valley. Hagged peat is also extensive in Shetland.

Class F7 land below the planting limit comprises particularly the very rocky land, largely with peaty soils, that occurs in the west of the area on Lewisian, Torridonian and Cambrian rocks. Such areas may provide locally suitable patches for afforestation. Small, isolated areas also occur in the east, particularly in the Loch Luichart area and in Glen Strathfarrar. Planting is also precluded on very bouldery terrain, often comprising moraines, with few rock outcrops - for example in Glen Torridon. In the Alders at Loch Fleet in east Sutherland, severe wetness determines the class.

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4. Areas of land capability for forestry classes in Scotland by district and region (sq km)

	F1	F2	F3	F4	F5	F6	F7	built -up	total land	water
Shetland Islands	0	0	0	0	0	76	1352	5	1433	37
Orkney Islands	0	0	0	0	0	101	868	7	976	34
Western Isles	0	0	0	0	0	451	2444	3	2898	189
ISLANDS	0	0	0	0	0	628	4664	15	5307	260
Caithness	0	0	0	3	215	1303	247	8	1776	30
Sutherland	0	0	79	149	219	2923	2491	4	5865	212
Ross & Cromarty	34	242	250	206	298	1208	2724	14	4976	197
Skye & Lochalsh	0	7	7	96	426	1026	1127	2	2691	39
Lochaber	4	31	23	155	980	1110	2149	16	4468	180
Inverness	21	94	138	126	474	727	1194	15	2789	122
Badenoch & Strathspey	0	0	6	150	383	647	1131	0	2317	49
Nairn	11	28	88	60	73	120	38	4	422	3
HIGHLAND	70	402	591	945	3068	9064	11101	63	25304	832
Moray	24	123	337	365	491	519	336	36	2231	13
Banff & Buchan	0	0	12	817	572	105	8	14	1528	5
Gordon	0	0	48	1087	609	318	148	4	2214	7
City of Aberdeen	0	0	15	81	20	4	0	64	184	2
Kincardine & Deeside	3	24	168	606	435	469	840	5	2550	17
GRAMPIAN	27	147	580	2956	2127	1415	1332	123	8707	44
Angus	38	184	657	174	229	321	403	25	2031	14
City of Dundee	0	22	112	34	12	6	0	49	235	1
Perth & Kinross	264	480	685	591	622	1120	1447	27	5236	126
TAYSIDE	302	686	1454	799	863	1447	1850	101	7502	141
Kirkcaldy	0	101	79	21	1	0	0	46	248	3
North East Fife	21	212	329	129	38	17	1	11	758	3
Dunfermline	2	138	73	44	2	8	0	35	302	5
FIFE	23	451	481	194	41	25	1	92	1308	11
West Lothian	0	71	83	114	70	19	1	65	423	5
City of Edinburgh	0	80	21	19	17	8	1	115	261	3
Midlothian	7	18	81	74	81	57	11	29	358	3
East Lothian	29	258	125	96	105	67	7	27	714	3
LOTHIAN	36	427	310	303	273	151	20	236	1756	14

NORTHERN SCOTLAND

	F1	F2	F3	F4	F5	F6	F7	built -up	total land	water
Tweeddale	0	6	16	118	278	348	128	5	899	5
Ettrick & Lauderdale	0	42	171	212	322	469	128	11	1355	11
Roxburgh	60	116	236	286	445	345	41	11	1540	8
Berwickshire	129	190	208	155	141	49	3	1	876	4
BORDERS	189	354	631	771	1186	1211	300	28	4670	28
Clackmannan	17	37	12	31	4	27	25	7	160	1
Stirling	13	273	192	363	315	535	464	21	2176	69
Falkirk	2	93	27	95	14	1	0	59	291	3
CENTRAL	32	403	231	489	333	563	489	87	2627	73
Argyll & Bute	2	97	204	733	2137	1989	1306	30	6498	116
Dumbarton	4	60	42	47	145	80	57	37	472	54
City of Glasgow	3	23	2	5	0	0	0	165	198	3
Clydebank	0	0	2	3	10	4	0	16	35	1
Bearsden & Milngavie	0	1	5	7	2	0	0	21	36	1
Strathkelvin	0	73	12	21	6	8	21	23	164	2
Cumbernauld & Kilsyth	0	18	14	32	11	10	5	13	103	2
Monklands	0	22	8	81	25	0	0	28	164	4
Motherwell	2	17	19	49	25	0	0	60	172	3
Hamilton	8	14	39	26	2	0	0	42	131	2
East Kilbride	0	14	30	111	21	85	0	24	285	1
Eastwood	0	14	18	23	26	18	0	16	115	3
Renfrew	0	58	43	67	26	16	9	89	308	6
Inverclyde	0	14	16	35	33	22	8	30	158	4
Clydesdale	4	21	124	265	420	403	66	19	1322	10
Cunninghame	0	27	114	202	192	116	163	64	878	7
Kilmarnock & Loudoun	4	45	96	115	24	66	0	23	373	2
Cumnock & Doon Valley	1	19	86	224	116	311	25	18	800	5
Kyle & Carrick	10	128	183	243	378	288	39	48	1317	21
STRATHCLYDE	38	665	1057	2289	3599	3416	1699	766	13529	245
Wigtown	0	89	227	403	712	219	52	11	1713	17
Stewartry	3	84	199	419	617	283	61	5	1671	20
Nithsdale	12	210	181	311	320	326	52	21	1433	9
Annandale & Eskdale	15	151	265	338	397	313	57	17	1553	9
DUMFRIES & GALLOWAY	30	534	872	1471	2046	1141	222	54	6370	55
SCOTLAND	747	4069	6207	10217	13536	19061	21678	1565	77080	1703

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