SCOTLAND – NORWAY:
ECOLOGICAL COMPARISONS IN RELATION TO WOODLAND COVER

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Sub-alpine scrub at the treeline in Western Norway

CONTENTS

Introduction

It has been common in recent years for foresters and nature conservationists to come back from visits to Norway overwhelmed by the number of trees they have seen. They then spend the rest of their lives trying to make Scotland look more like Norway by persuading people to expand the woodland cover of the Highlands.

These people see Norway as what Scotland should be like if we had not destroyed our whole landscape by cutting down all the trees and overgrazing the land. But what is the evidence that the two countries should be the same?

Conservationists seem to have a belief that the presence of trees makes an area more natural: the mindset is that Scotland has few trees so humans must have got rid of them, whereas Norway has more and hence the landscape must be more natural!

However, if looked at from the perspective of grazing rather than that of trees, you could equally argue that it is the Scottish landscape which is the more natural, because, unlike Norway, it has managed to retain

The Scottish Highlands do not have an altitude-determined treeline or a high level scrub zone

significant populations of its large, indigenous herbivore (red deer) throughout the postglacial period.

Which viewpoint is correct? One of the problems with such simplistic comparisons is ensuring you are comparing like with like: are the environmental conditions of Norway and Scotland so similar that you would expect the vegetation cover to be the same? Or are the differences such that you would expect significant differences between the two countries?

When comparing it with Scotland you need to be sure you are comparing like with like. Here the focus is on comparing Scotland north of the Highland Boundary Fault with Southwestern Norway.

The physical environment

Mainland Norway is a much larger country than Scotland, stretching 900 miles from 58°N to way beyond the Arctic Circle. Mainland Scotland in contrast starts further south, from 53°N, and stretches for only 300 miles. Norwegian mountains also show a much greater altitudinal range, with the highest mountain at 2,400m, twice the height of Ben Nevis (1,344m). The greater scale of Norway gives rise to a wider range of environmental conditions and hence a wider range of habitats. The geology of the Scottish Highlands and Norway is countries is not too dissimilar, both consisting of ancient rocks which tend to breakdown into soils of low fertility (see the map on page 9).

Southwestern Norway, adjacent to the Atlantic Ocean, has the greatest similarities, with a humid, windy, climate, mild winters and cool summers. However, the temperature maps on page 8 below do indicate that its winters are slightly cooler and its summers slightly warmer. A significant difference is that in Scotland easterly winds, having passed over the North Sea, tend to be humid, whereas such winds in Norway are drier and colder. Thus Scotland tends to be humid whatever the wind direction, indicating a more oceanic climate.

Additionally, Norway has a more complex topography than Scotland, resulting in great variation in climate over short distances: a windswept coastal island will be very different to the head of a deep, sheltered inland fjord. In comparison, the heads of Scottish sea lochs often get strong winds. Additionally, the Norwegian fjords and mountains are steeper-sided, providing many more areas inaccessible to grazing, so favouring trees – ensuring there is always a significant seed source available.

In contrast to the extreme southwest, the east of the country has a gentler topography and, distant from the Atlantic Ocean, is drier with long, cold winters, and complete snow cover for many months every year: a boreal climate. The high winter snow cover both protects young trees and scrub from grazing and limits the number of over-wintering herbivores. This provides one explanation why Eastern Norway has high tree cover. The far north of Norway is different again, with fewer trees and Arctic tundra affinities.

Treeline & scrub zone

A distinct characteristic of many parts of Norway is a clearly visible climate-determined tree-line, the trees giving way to sub-alpine scrub, and then alpine heaths, meadows and fellfield. In these areas, grazing animals in summer can pass through the forest zone and graze the alpine meadows. In Scotland, a climatically determined tree-line would in many cases coincide with the tops of our hills: there are no significant areas of summer grazing above the putative tree-line, so

Farmland around a small settlement in a Norwegian fjord

when our grazing animals naturally move upwards, they are in direct competition with the trees. This makes a distinct tree-line is less likely.

Sub-alpine/arctic scrub of willow species, dwarf birch and juniper is abundant in Norway, but absent in Scotland. The climate of Scotland's hills is montane, *i.e.* mild winters and cool summers, in contrast to Norway's mountains where, at the treeline, the scrub is sub-alpine/arctic with consistent year-to-year winter snow cover. This snow protects the shrubs from grazing. In contrast, the montane climate of the Scottish Highlands means that herbivores can graze the hills all year, keeping scrub at bay (except on inaccessible cliffs). Indeed, it is difficult to conceive how the habitat of 'montane scrub' can ever exist in locations where large indigenous herbivores are present. The eminent Ecologist Duncan Poore in 1997 concluded for Scotland: "There is little evidence that there was extensive scrub on the mountains within the current climatic period." (1)

In contrast, in locations with a montane climate but without large herbivores, such as the Faeroe Islands and Iceland, then such scrub did once exist before the introduction of domestic livestock.

Vegetation

On its southwest coastal fringe, Norway does possess some vegetation which is similar to Scotland's, with oceanic plants which are found in both countries such as heather (*Calluna*), cross-leaved heath and bog asphodel (see the maps below). But a closer look will also show some significant differences. For example, in Norway the northern or bog blaeberry (*Vaccinium uliginosum*) and dwarf cornel are common throughout, whereas in Scotland they are much rarer and confined to higher altitudes; likewise bog rosemary and twinflower are abundant throughout Norway but both rare in Scotland. Conversely in Norway, bell heather, honeysuckle and ivy are confined to the coastal fringe in the southwest, whereas they are widely distributed in Scotland. Hence, although at first glance, much Norwegian vegetation looks very similar to Scotland's, there are significant differences between Scotland and Norway. A conclusion must be that the ecology and the ecological history is not identical across the two countries.

Grazing animals

One particular difference in Western Norway is the relative rarity of red deer (*Cervus elephas)*. Although red deer have been present for at least 4,000 years, they declined almost to extinction through the expansion of farming and hunting until, at the beginning of the 20th century, there were only seven isolated populations. Their population has since been increasing, with an estimated 20,000 in Norway in 1970, 130,000 by 2004, and 250,000 by 2024 (2). This has come about through a reduction in farming activity, including lower livestock numbers, and better regulation of hunting. Roe deer and elk populations have also been increasing for the same reasons.

The Scottish Highlands, in contrast, have retained a significant population of red deer throughout the

postglacial period. For example, Donald Monro, who visited the Hebrides in 1549, talked of “many deer” on the islands of Mull, Skye and Raasay, of Jura being “a fine forrest for deer” and of there being “abundant little deer” on the island of Rum (3). Martin Martin, who visited around 1695, talked of “some hundred of deer in the mountain” of Rum (4). And Taylor noted significant numbers of red deer in the Cairngorms in 1618, reporting that during deer hunts of several days “men bring in many herds of deer (200, 300, 400 to a herd) for the nobleman to kill” [paraphrased]; and he stated that wolves were also present (5). Later, the botanist James Robertson who toured the Highlands from 1767 to 1771 observed that there were numerous herds of red and roe deer in the Cairngorms (6).

A characteristic of red deer in Norway is that many populations, migrate relatively long distances from the low ground in the winter to the higher pastures in summer (2). This could take grazing pressure off the low ground in summer, allowing for some tree regeneration. In Scotland, in contrast, perhaps because of its montane climate (warm winters, cool summers) and gentler topography, deer populations, in particular female herds, are more static, although they can move from the high ground to the low ground and back in the course of a day. They spend much of the time on the hillslopes which tend to be more fertile than the peaty low ground. This is often at the putative climatic treeline, so it is not surprising that scrub and woodland are rare or absent on the hills.

Unlike Scotland, Norway does still have populations of wild reindeer, but these, once found throughout the country, have been reduced by hunting and are now largely confined to the Hardangarvidda area. However domesticated reindeer are present in the east and north of the country.

Modern ecological research highlights the role that large herbivores play in shaping ecosystems; at least they did, until we made most of them extinct over the millennia (7) (8). Hence there will be nothing natural about the grazing levels in areas of Western Norway where the numbers of domestic livestock have declined, but have not been matched by a concomitant increase in native herbivores.

Vegetation history

Between 4,000 and 2,000 years ago, coastal moorland and peat bogs in southwest Norway significantly increased in area at the expense of woodland, so that in many areas the landscape became largely open (9). The conversion of woodland to moorland in Western Norway over the centuries is traditionally seen as being caused by humans, particularly agricultural activity and the associated livestock.

But this vegetation change also took place during a climatic shift towards cooler, wetter conditions: the Boreal-Atlantic transition. A similar shift took place in Scotland over the 6,000-4,000 years ago, with the replacement of Scots pine woods by peat bogs, as demonstrated by the presence of bog wood at the base of peat bogs across much of the country. This change from woodland to moorland in Scotland is now thought to be largely natural, *i.e*. not caused by humans, and a characteristic of the oligocratic phase of postglacial succession (10). Modern palaeoenvironmental research indicates that the Scottish Highlands, in contrast to Norway, have been largely treeless for thousands of years, with indigenous woodland having declined naturally to about 5% of the land area by 1750 (11).

This means you have to question whether the similar loss of woodland in Norway was in fact caused by

A crofting settlement in Northwest Scotland

Red deer in a Scottish glen. It could be argued that the Scottish Highlands are more natural than Norway, having retained a relatively large population of red deer throughout the postglacial period

humans, or instead by climate change, or a combination of both. Research indicates a millennial-scale postglacial successional trend of woodland expansion (the mesocratic phase), followed by its decline (the oligocratic phase) (10). Indeed, in a few places in Norway, peatland can nowadays be seen expanding on gentle slopes at the expense of birch woodland (see photographs below on page 24).

Certainly, the creation of fields results in a direct loss of woodland, but elsewhere why would the introduction of livestock in Norway cause more deforestation than the red deer they replaced, particularly as deer tend to browse trees more than sheep or cattle? In other words, if humans had not colonised coastal Norway, introducing farming and killing-off the native deer, might not the landscape on the flatter ground not have remained as moorland and peatbog? Be more like Scotland today?

Land management

The land management history has been very different over the centuries between the two countries. Before the Battle of Culloden in 1746, much of the Highland landscape was "largely unused and uncared for during the era of the clans" (12); in other words, unmanaged – at least away from the vicinity of the settlements. Although largely unmanaged, there was summer-only grazing of cattle in many areas.

In contrast, except where altitude or topography made it impossible, most of Norway has been heavily managed (13). Wood has always been the main fuel, whereas in Scotland it was peat. Wood was also the dominant building material, whereas in Scotland it was turf and stone. Hence Norway's woods have a long history of management and herbivore control, and the coastal flats, inner fjords and major valleys have been used extensively for farming.

It is only following the Battle of the Culloden and the virtual end of the clan system, that the landscape of the Scottish Highlands began to be managed to any significant extent (away from the settlements, that is), and by this time the woods were long gone. During the period of the Clearances (following the Battle of Culloden), large numbers of sheep were introduced across the Highlands, there being plentiful hill grazing. Because of the montane climate, sheep spent the whole year on the hill; in any case they were too numerous to be wintered indoors, which is the traditional Norwegian practice. It is possible that as sheep numbers went up, then numbers of red deer went down, for there is only so much grazing available. Currently sheep numbers are going down, and deer numbers going up (where not heavily culled).

Summary: Norway – the wrong model for Scotland

Over the past hundred years most of the previously open coastal moorland of southwest Norway has become tree-covered. This has happened because of the abandonment of farming, significant woodland planting (for example in the area around Bergen) and the natural regeneration of trees. For reasons which are unclear, observations indicate that trees regenerate more freely in Norwegian moorland vegetation than Scottish moorland, perhaps related to a difference in soil conditions or vegetation type (see the picture on page 22). However this regeneration has taken place during a period when deer numbers have

not recovered to more natural levels. Therefore, as mentioned above, it must be questioned whether the recent tree-covered landscape of the coastal lowlands actually reflects how a natural landscape would look with its full complement of herbivores.

Although Norway has a much higher woodland cover than Scotland, all its woodlands, apart from those on the steepest slopes or in the remotest areas, have been managed or influenced by humans (13), and in many areas they are recent secondary woods. This factor, together with the major reduction in native large herbivores over the centuries through hunting, means the landscape of Southwest Norway cannot be said to be more natural than Scotland's. Indeed, it could be argued that Scotland, having retained a significant number of its main large herbivore (red deer) throughout the postglacial period, represents a more natural landscape than Southwest Norway (14) (15).

Taking Norway as a whole, for the reasons mentioned above, you would always expect more woodland in Norway than Scotland. Adding trees to the Scottish landscape to make it look like Norway is both ecologically unsound, and also leads to the loss of the distinctive Scottish landscape: that is, globally-rare oceanic moorland, with woodland only in favourable locations. The occurrence of indigenous woodland as isolated fragments is, in fact, a natural biodiversity characteristic of the area.

Trying to make Scotland look more like Norway is contributing to global landscape homogenisation: the trend for humans to make everywhere look the same, which goes against the spirit of the European Landscape Convention (16). We should be wary of simplistic comparisons with Norway, and instead value the open moorland which characterises Scotland and which makes us distinctive within Europe.

Note

This paper has been written as an alternative viewpoint to that presented by Duncan Halley at the 2017 Scottish Native Woodland History Conference. His conclusion is that the landscape of Southwestern Norway is more natural than that of the Scottish Highlands, the opposite of the conclusion here. See his paper '[Woodland History in South West Norway – Comparative insights from a parallel universe]'. It is for the reader to decide which viewpoint best accords with ecology and ecological history of the two regions.

References

(1) *Quoted in:* 'The Ecology and Restoration of Montane and Subalpine Scrub Habitats in Scotland' (1997). Scottish Natural Heritage Review 83: 115–116. https://www.nature.scot/doc/naturescot-review-83-ecology-and-restoration-montane-and-subalpine-scrub-habitats-scotland

(2) *Extract from:* 'Red Deer: Møre og Romsdal, Norway' (2024). Global Initiative on Ungulate Migration: FACT SHEET.

> Red deer populations in Norway have increased rapidly over the past 30 to 40 years. The annual harvest peaked above 50,000 red deer in 2021-2022, and the population size is more than 250,000 individuals. Red deer distribution spans the whole southern part of the country, but the species is most abundant along the southwest coast.
>
> Populations in this region are partially migratory, which means they consist of both migratory and resident individuals. Red deer typically migrate from lower elevation winter ranges toward higher elevation summer ranges. Migration is more common for red deer living in the central mountains where steep environmental gradients occur, compared to populations near the coast. In Møre og Romsdal, red deer migrate up in elevation to follow the green-up of spring vegetation, and they return in the fall with the onset of hunting, snowfall, or cold temperatures. Winter ranges are mainly restricted to lower elevation valleys, or near the coastline. Red deer frequently feed on agricultural grasslands during the spring and fall and typically migrate alone or in small family groups.
>
> Their migratory routes can stretch across large parts of the landscape. Red deer are able to migrate in most of their range in Norway, contending with natural barriers like fjords and mountains which limit connectivity to some degree. Red deer are generally able to adapt to human disturbance, and they frequently cross roads during their seasonal migrations…
>
> Climate change is leading to more rapid and variable snowmelt across the landscape, which in turn leads to a shortened period where deer can access nutritious early plant growth. Because temperate ungulates like red deer migrate to take advantage of spring green up, warming is therefore anticipated to lead to a higher proportion of resident individuals in the future.

(3) *From* 'Description of the Occidental Islands of Scotland', by Donald Monro, c.1549. Published together with Martin Martin's book of 1695 [see below]

(4) *From* 'A Description of the Western Islands of Scotland' by Martin Martin, c.1695. Published in 1999 by Birlinn.

(5) *From* 'Taylor, The Water Poet' in 'Early Travellers in Scotland', edited by Peter Hume Brown. Facsimile of 1891 edition, published by James Thin, Edinburgh in 1973.

(6) *In* 'A Naturalist in the Highlands 1767–1771', by James Robertson, edited by D.M. Henderson and J.H. Dickson. Published in 1994 by Scottish Academic Press.

(7) *See for example:* 'Megafauna and ecosystem function from the Pleistocene to the Anthropocene' (2016), by Malhia, Doughtya, Galettib, Smith, Svenning, & Terborghe. PNAS, vol. 113 (4), pages 838–846. www.pnas.org/cgi/doi/10.1073/pnas.1502540113

(8) *and:* 'Late-Quaternary megafauna extinctions have strongly reduced mammalian vegetation consumption' (2023), by Pedersen, Faurby & Svenning. Global Ecology and Biogeography. https://onlinelibrary.wiley.com/doi/10.1111/geb.13723

(9) *In:* 'Flora Nordica: General Volume', page 110 (2004). Published by the Royal Swedish Academy of Sciences.

(10) *See for example:* 'The Rise and Fall of Forests' (2004) by J. Birks and H. Birks. In Science, Volume 305, Issue 5, 683, pp. 484–5.

(11) The extent of woodland in the Scottish Highlands was mapped by General Roy and his surveyors 1747-52. These maps are available to view on the National Library of Scotland website under 'georeferenced maps': https://maps.nls.uk/geo/explore/

(12) *A quote from*: 'The Drove Roads of Scotland', by A.R.B. Haldane, p. 210. First published in 1952 by Thomas Nelson and Sons.

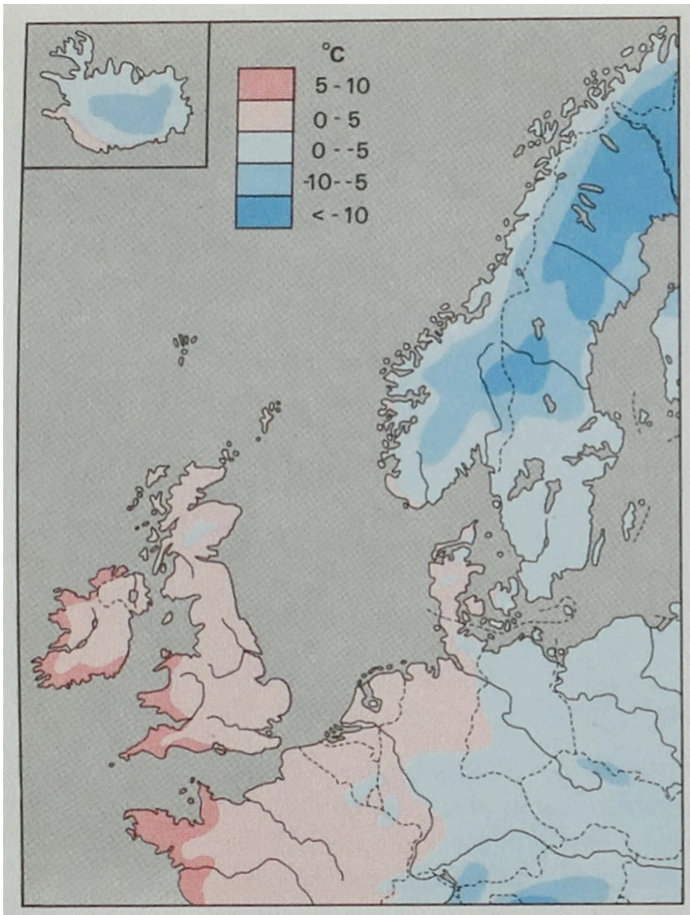
(13) *See:* 'Biodiversity in Norway: A country study' (1992), published by the Directorate for Nature Management as report as DN-report 1992 – 5b.

(14) Explanations of why the landscape of the Scottish Highlands could be dominated by moorland rather than woodland can be found in 'A postulated natural origin for the open landscape of upland Scotland' (2008) by James Fenton. 'Plant Ecology and Diversity', Volume 1, pp. 115–127.

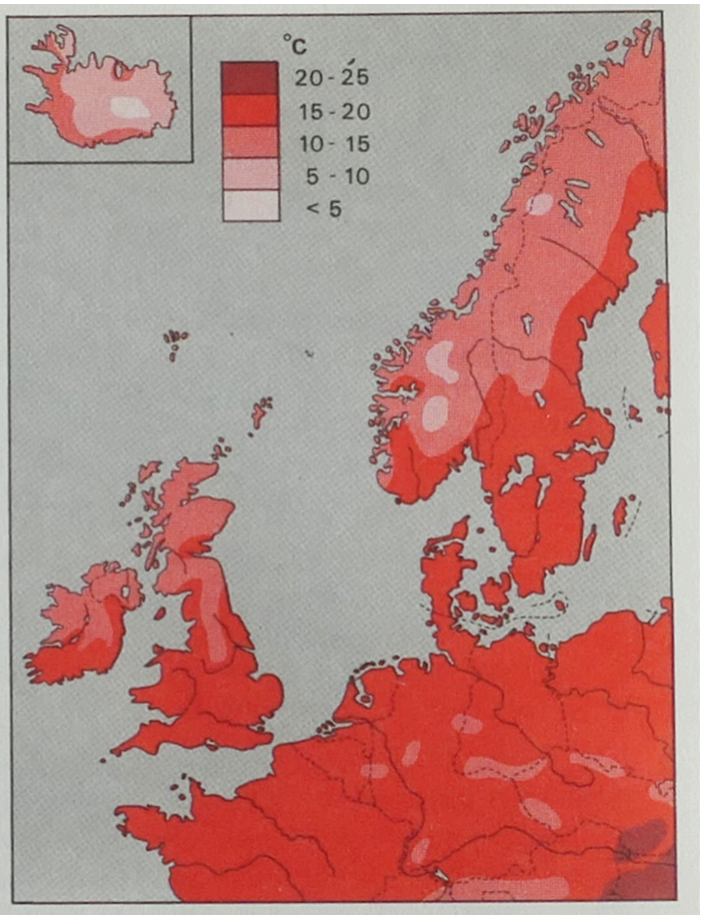
(15) *See also:* 'The role of grazing in maintain open landscapes in temperate regions' (2023), by James Fenton, published in 'The International Journal of Environmental Sciences & Natural Resources' Volume 31(3) DOI: 10.19080/IJESNR.2022.31.556320

(16) Details of the European Landscape Convention can be found on the Council of Europe website: https://coe.int/en/web/landscape

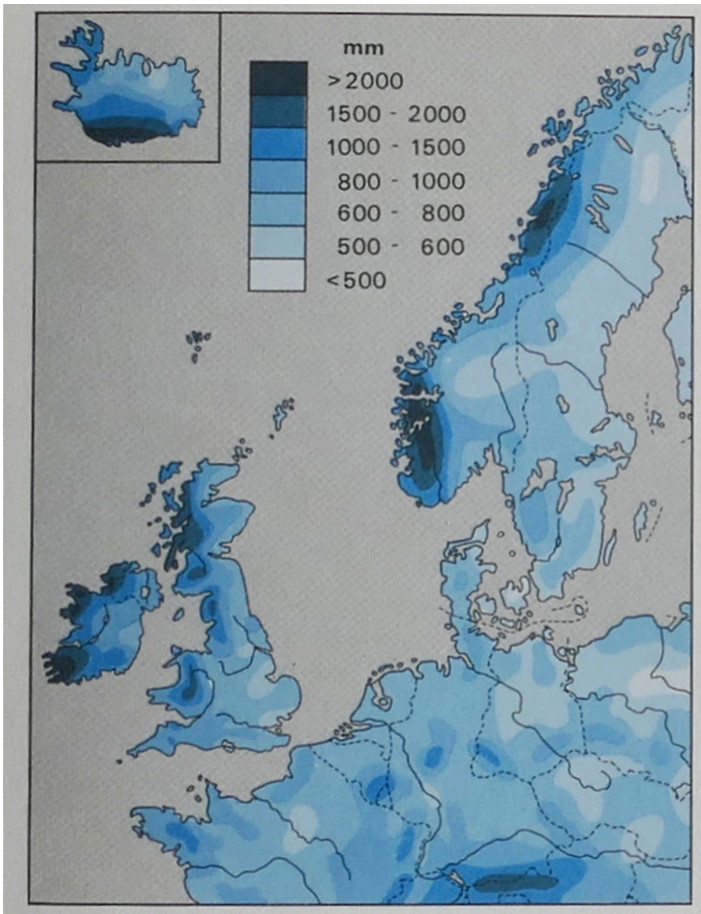
COMPARISON OF ENVIRONMENTAL CONDITION
BETWEEN THE SCOTTISH HIGHLANDS AND WESTERN NORWAY



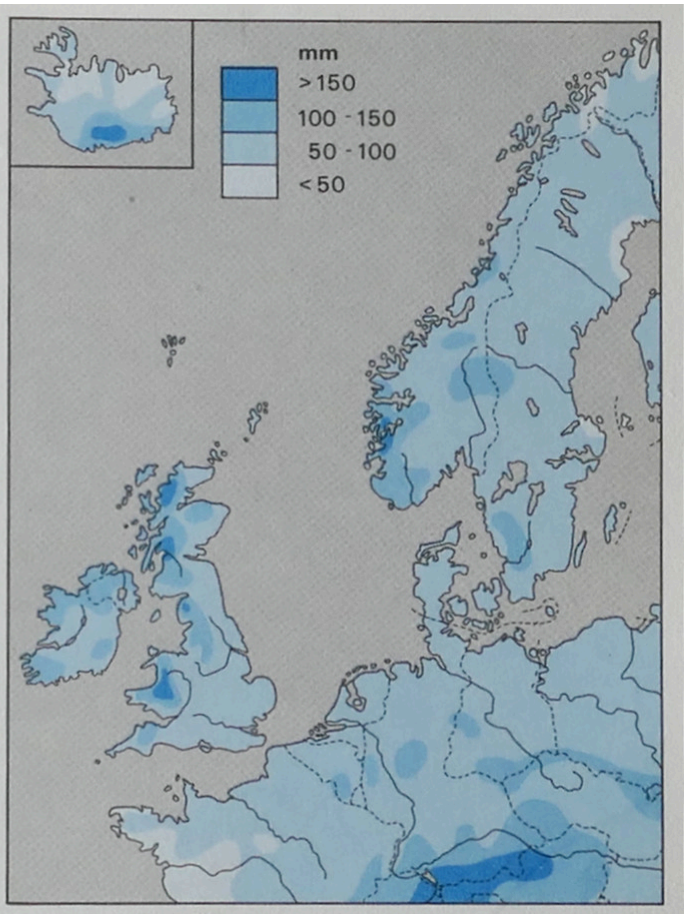
January mean temperature



July mean temperature

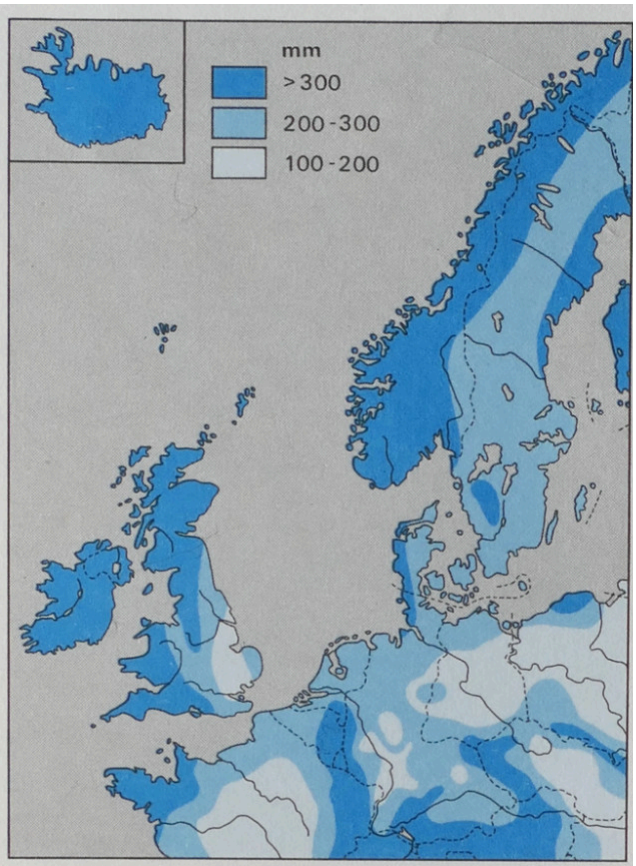


Annual precipitation

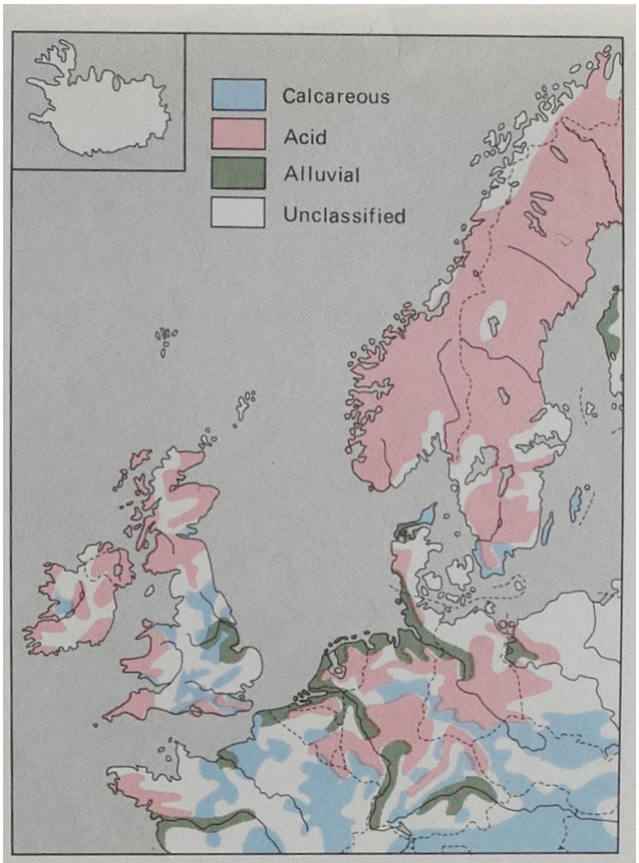


July rainfall

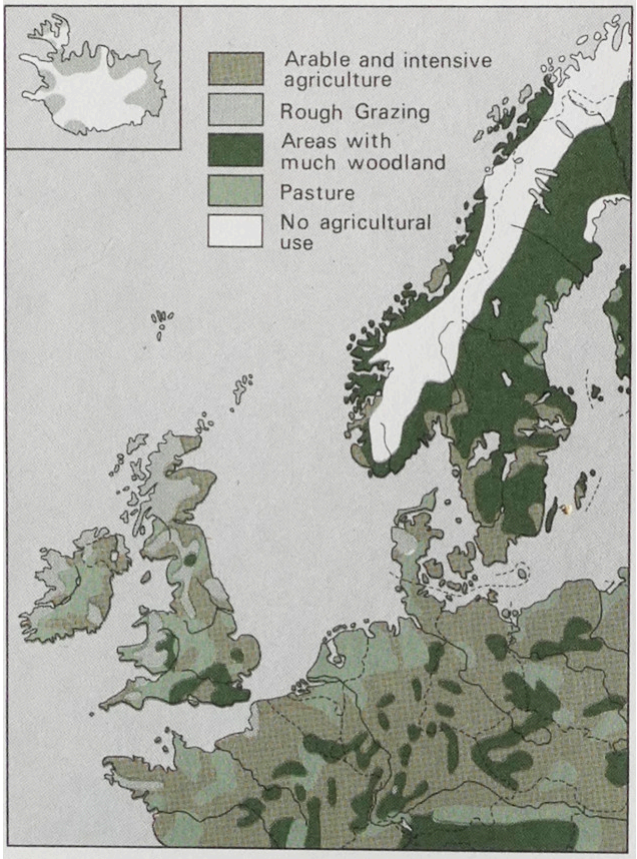
COMPARISON OF ENVIRONMENTAL CONDITIONS BETWEEN THE SCOTTISH HIGHLANDS AND WESTERN NORWAY



Annual excess of precipitation over evaporation



Soil types



Major land use

COMPARISON OF ENVIRONMENTAL CONDITIONS BETWEEN THE SCOTTISH HIGLANDS AND SW NORWAY

Temperature:
– Highlands have a milder January
– Similar summer temperature, except warmer in the far south of Norway

Precipitation
– Similar total precipitation, but balance between rain & snow not clear

Evaporation over precipitation
– Both with excess precipitation

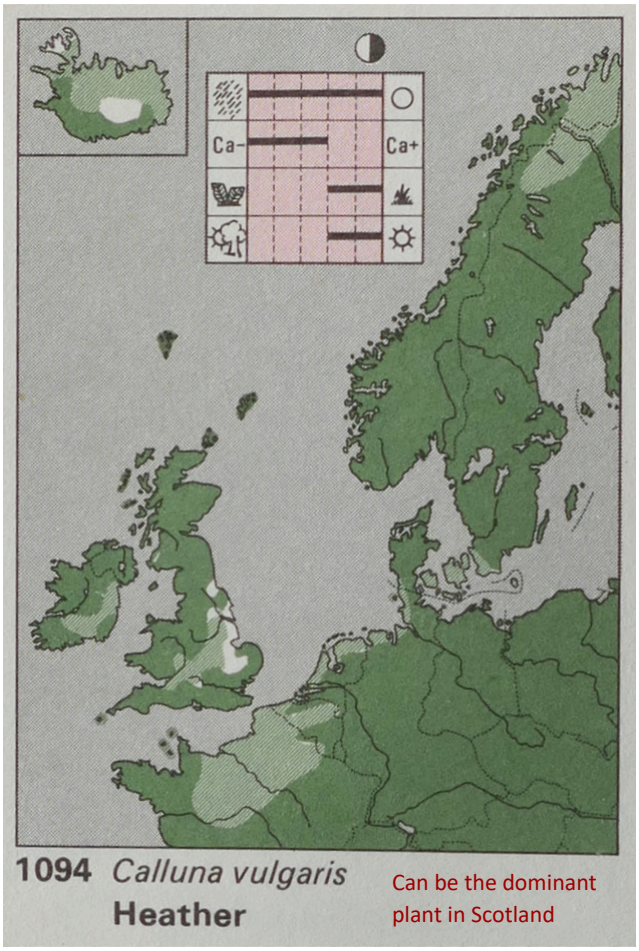
Soil types (based on bedrock)
– Similar

Land cover
– Considerably more tree cover in Norway
– Considerably more rough grazing in Scotland

EXAMPLES OF PLANTS WITH A SIMILAR DISTRIBUTION IN THE HIGHLANDS AND WESTERN NORWAY

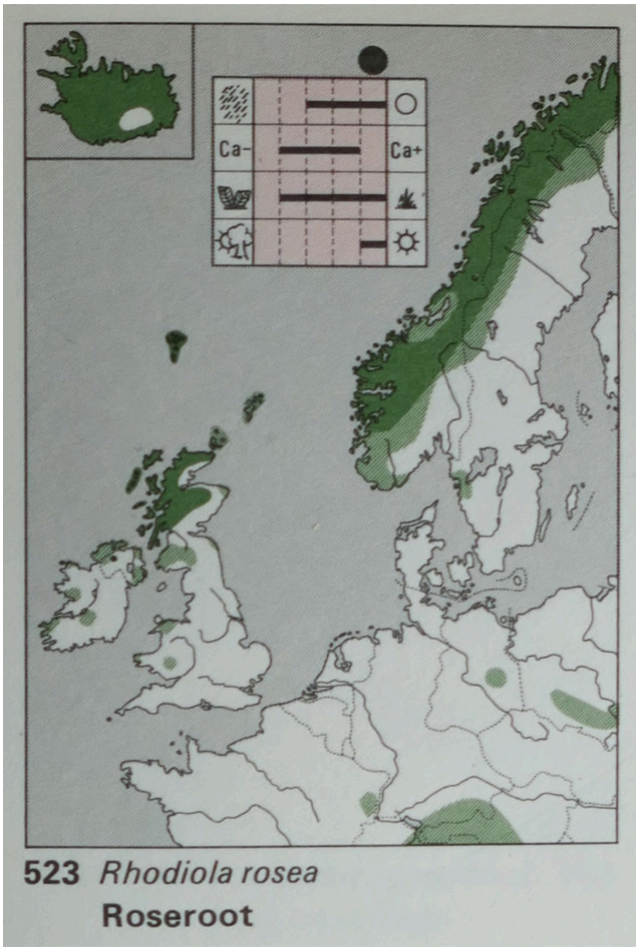
Dark green = core of range

Pale green = plants more sporadic

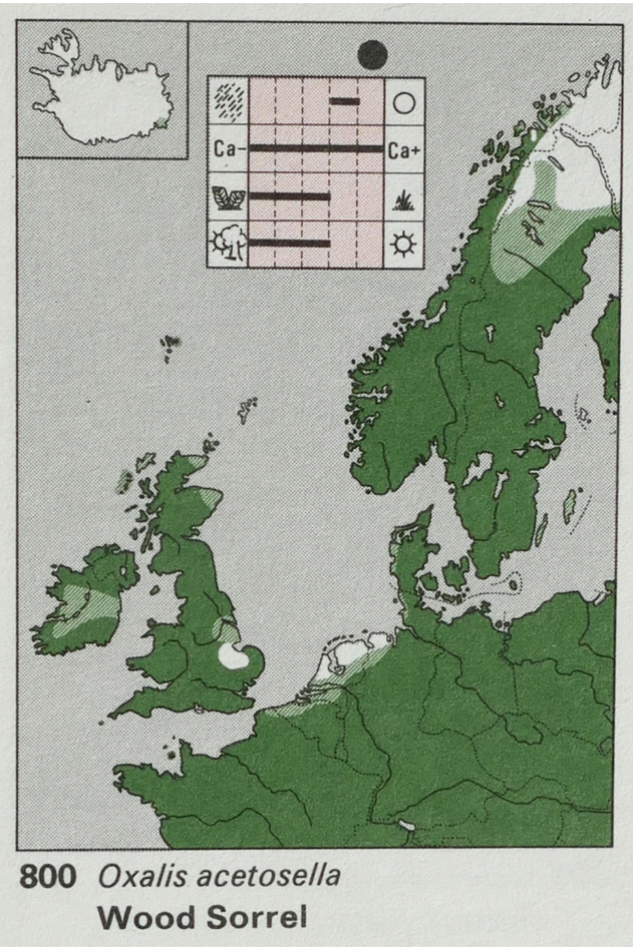


1094 *Calluna vulgaris*
Heather

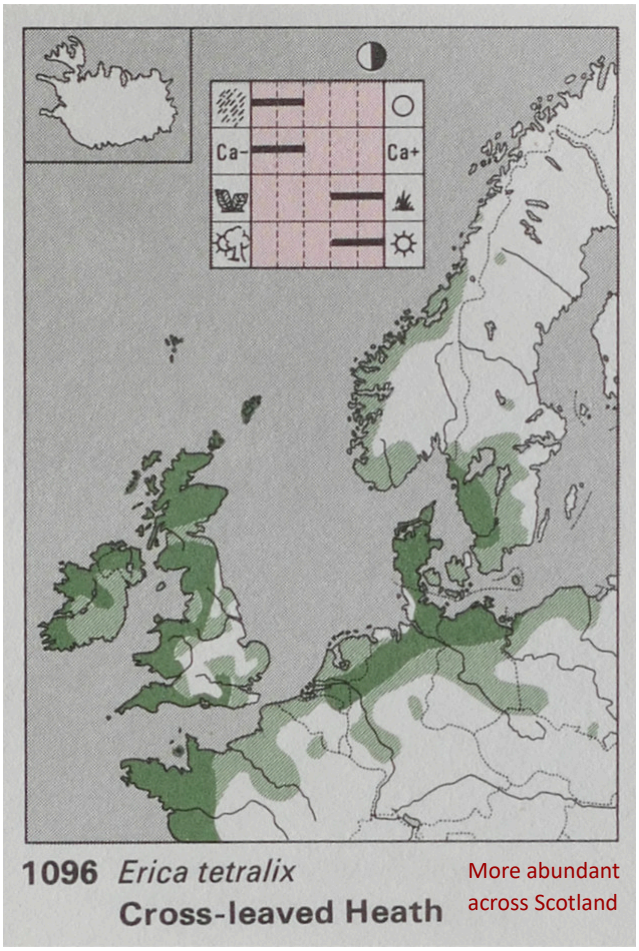
Can be the dominant plant in Scotland



523 *Rhodiola rosea*
Roseroot



800 *Oxalis acetosella*
Wood Sorrel



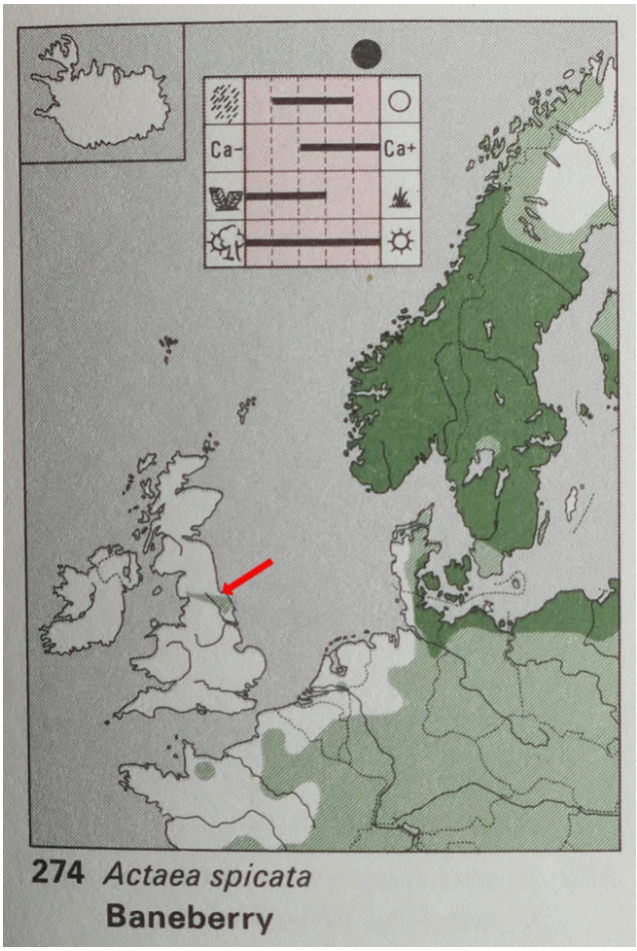
1096 *Erica tetralix*
Cross-leaved Heath

More abundant across Scotland

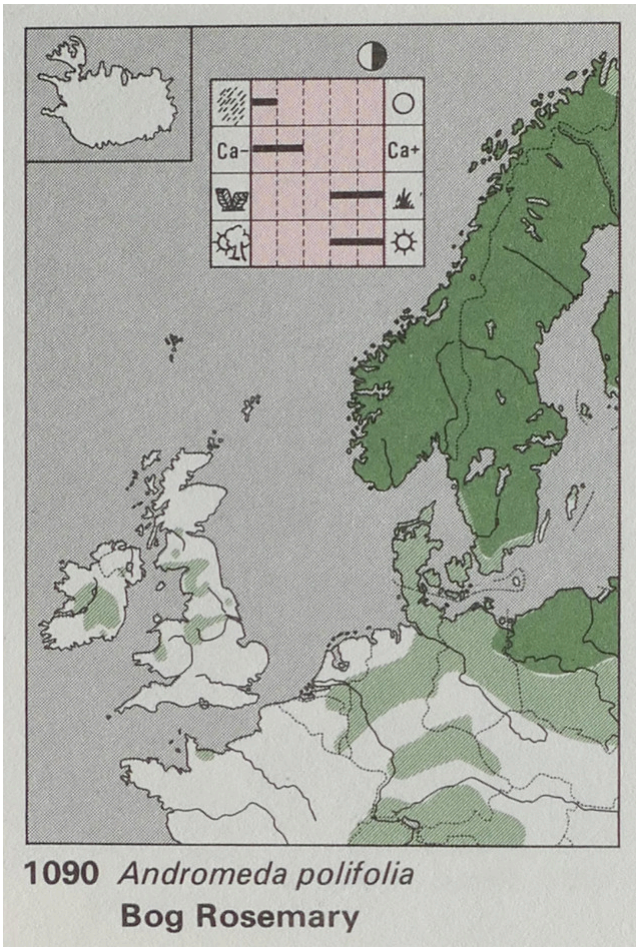
EXAMPLES OF PLANTS RARE OR ABSENT THE HIGHLANDS BUT ABUNDANT IN SOUTHWESTERN NORWAY

Dark green = core of range

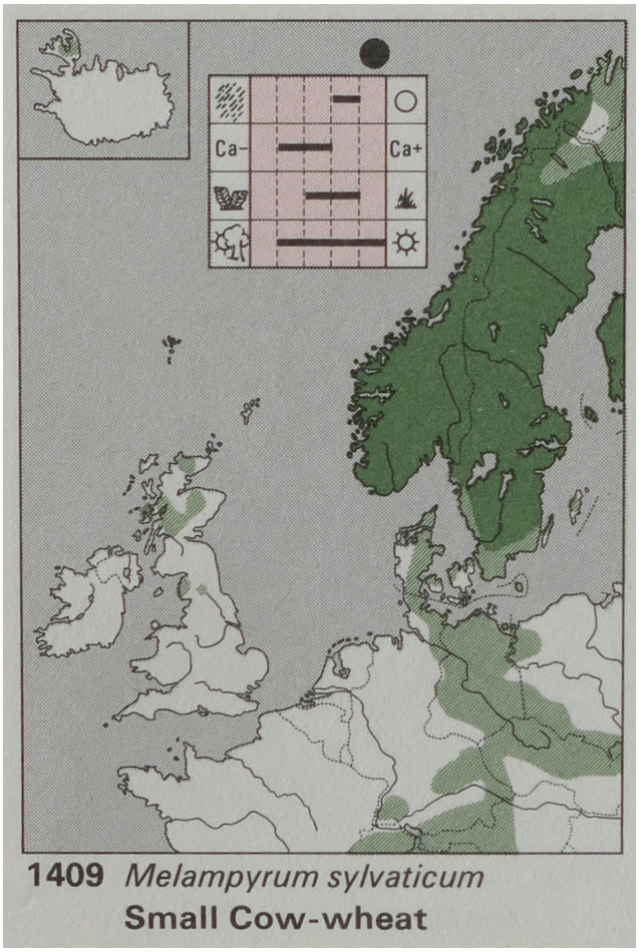
Pale green = plants more sporadic



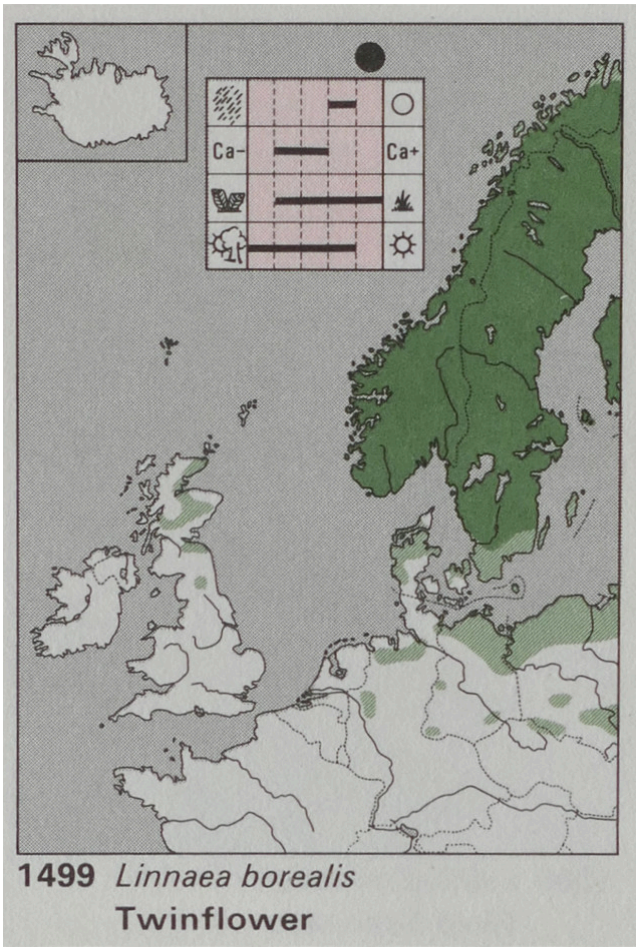
274 *Actaea spicata*
Baneberry



1090 *Andromeda polifolia*
Bog Rosemary



1409 *Melampyrum sylvaticum*
Small Cow-wheat

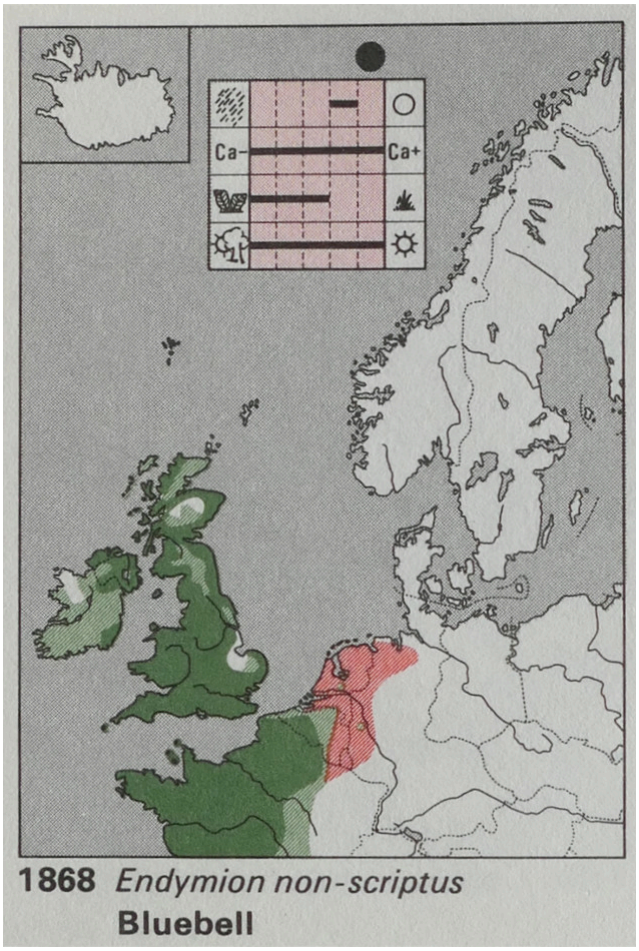


1499 *Linnaea borealis*
Twinflower

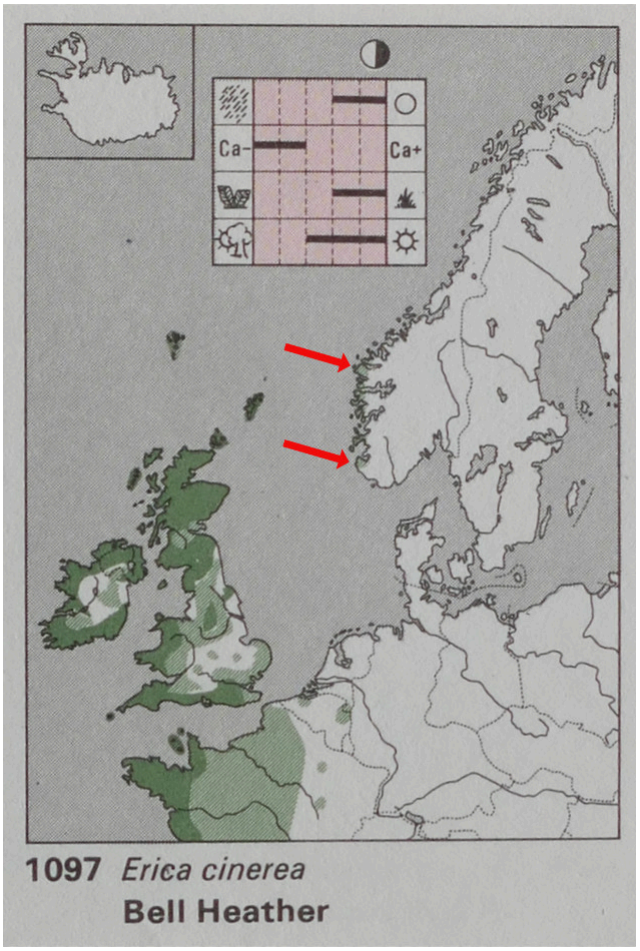
EXAMPLES OF PLANTS ABUNDANT THE HIGHLANDS BUT RARE OR ABSENT IN SOUTHWESTERN NORWAY

Dark green = core of range

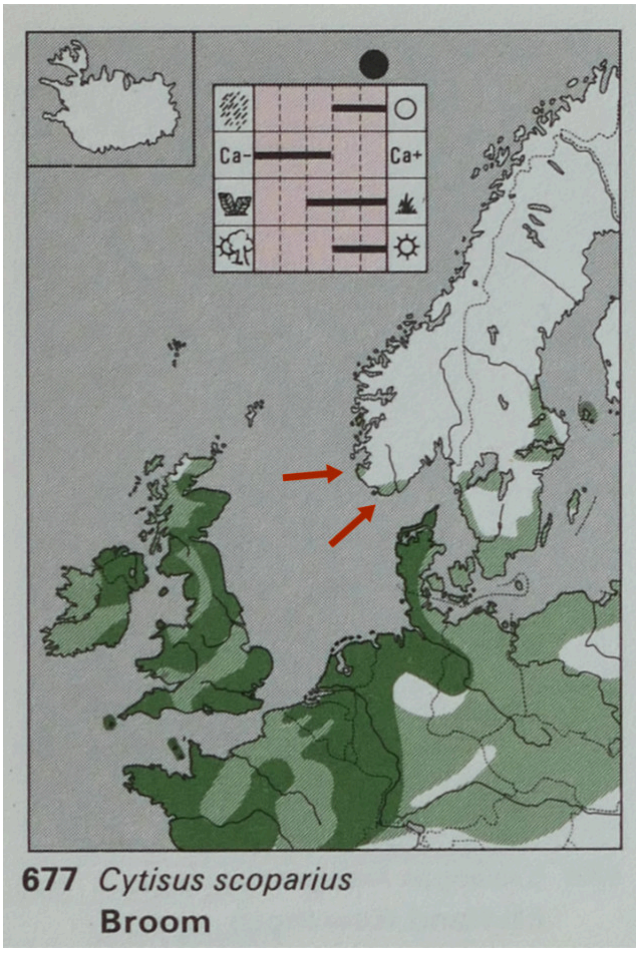
Pale green = plants more sporadic



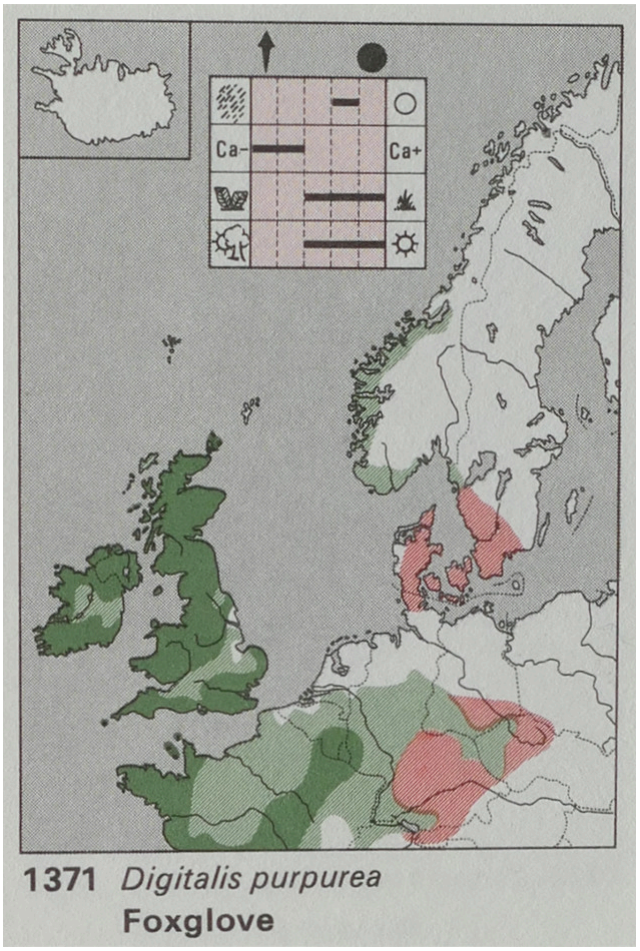
1868 *Endymion non-scriptus*
Bluebell



1097 *Erica cinerea*
Bell Heather



677 *Cytisus scoparius*
Broom

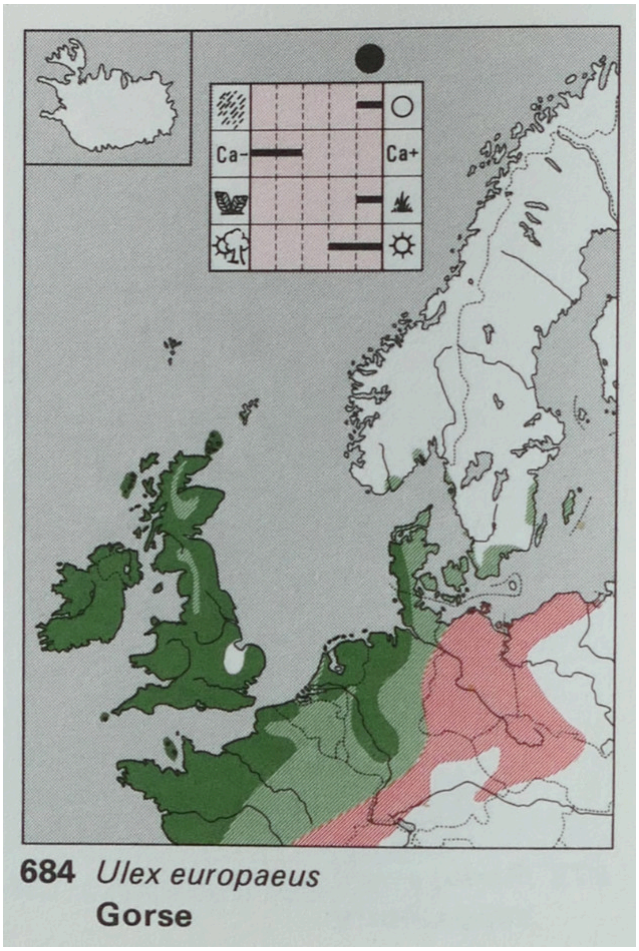


1371 *Digitalis purpurea*
Foxglove

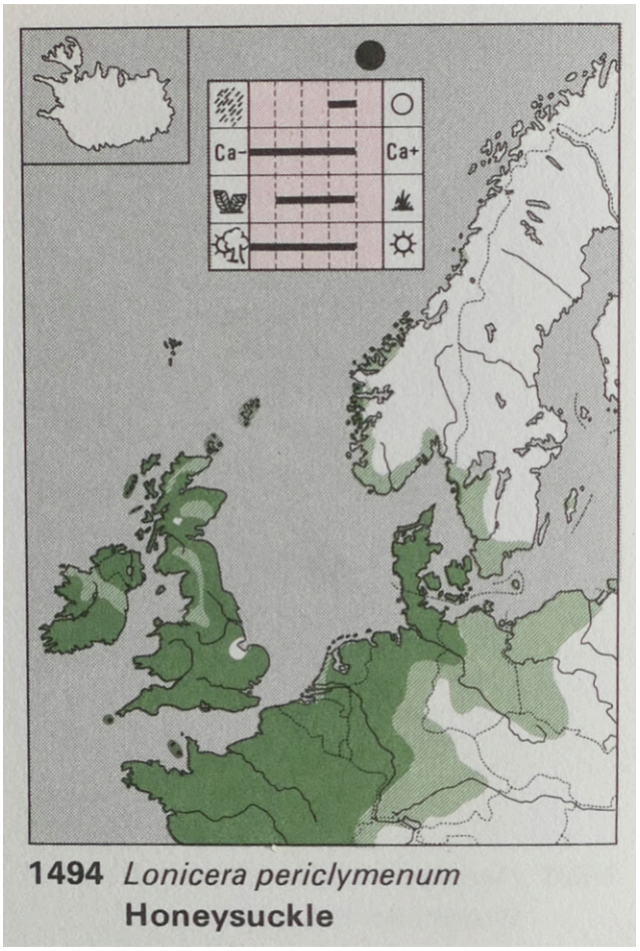
EXAMPLES OF PLANTS ABUNDANT THE HIGHLANDS BUT RARE OR ABSENT IN SOUTHWESTERN NORWAY

Dark green = core of range

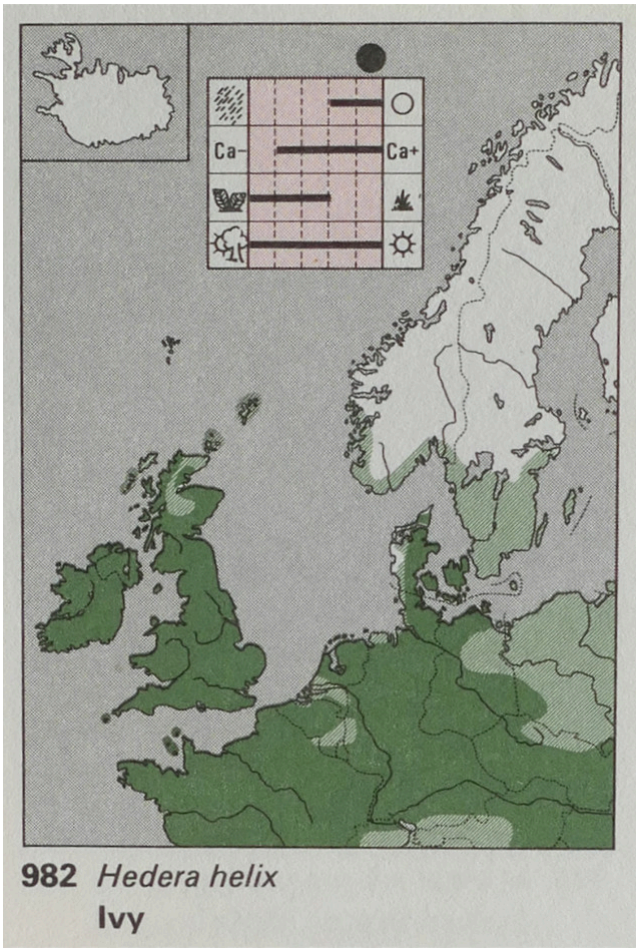
Pale green = plants more sporadic



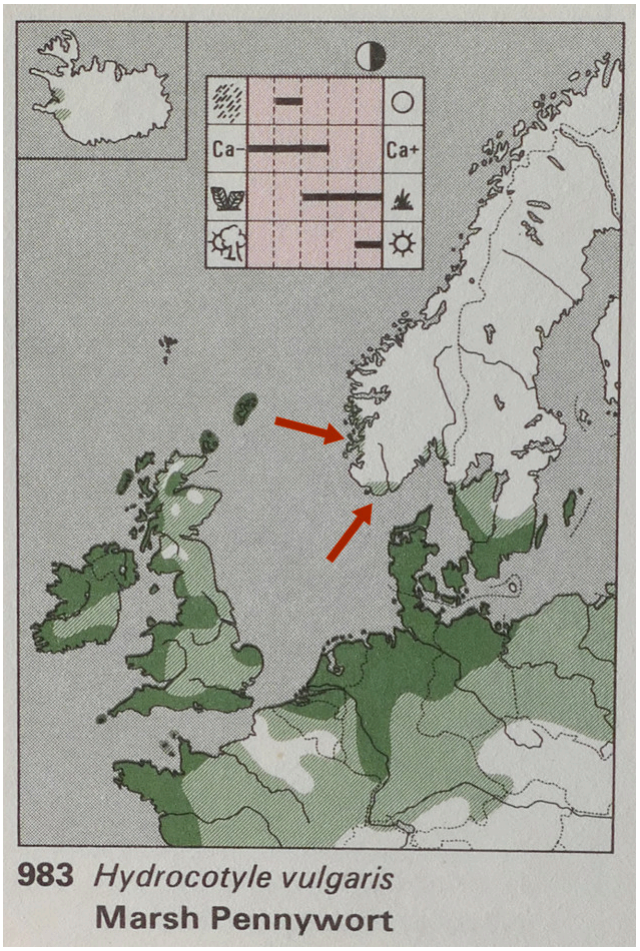
684 *Ulex europaeus*
Gorse



1494 *Lonicera periclymenum*
Honeysuckle



982 *Hedera helix*
Ivy

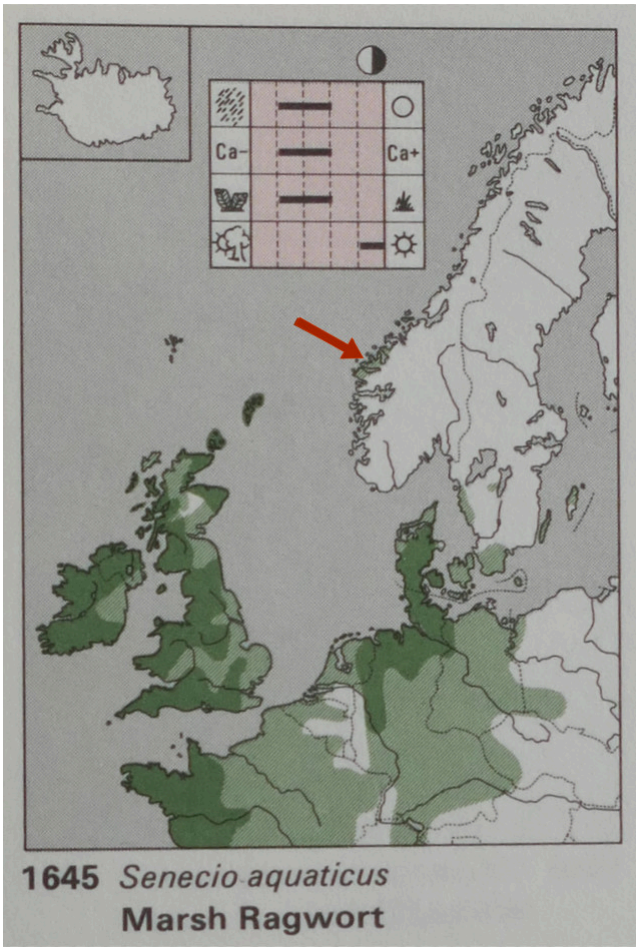


983 *Hydrocotyle vulgaris*
Marsh Pennywort

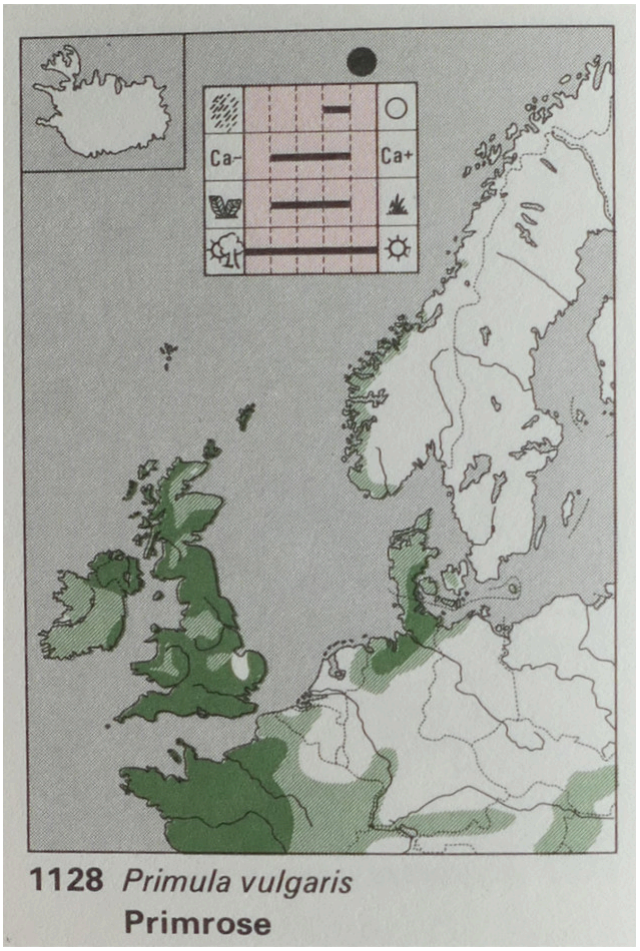
EXAMPLES OF PLANTS ABUNDANT THE HIGHLANDS BUT RARE OR ABSENT IN SOUTHWESTERN NORWAY

Dark green = core of range

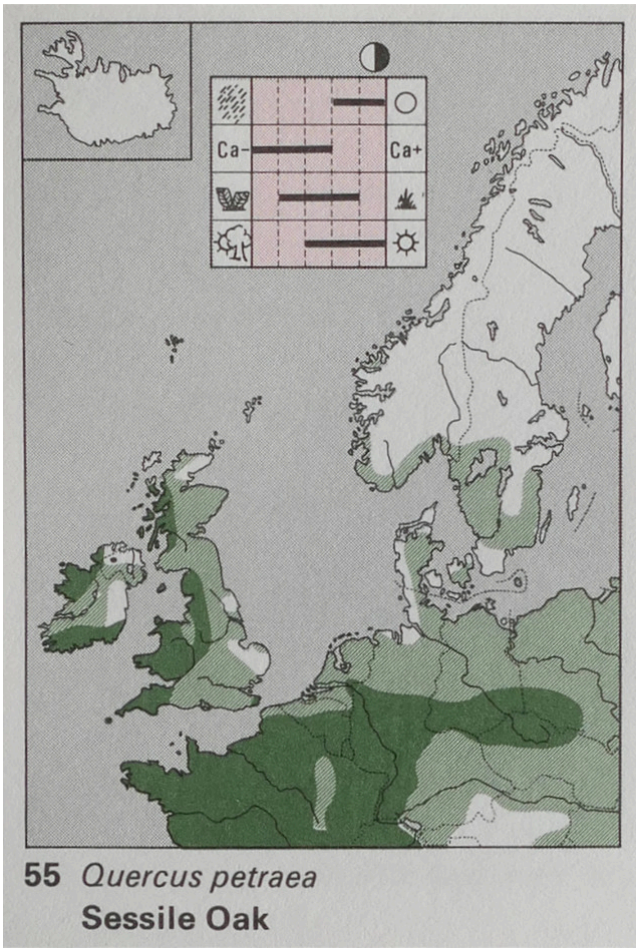
Pale green = plants more sporadic



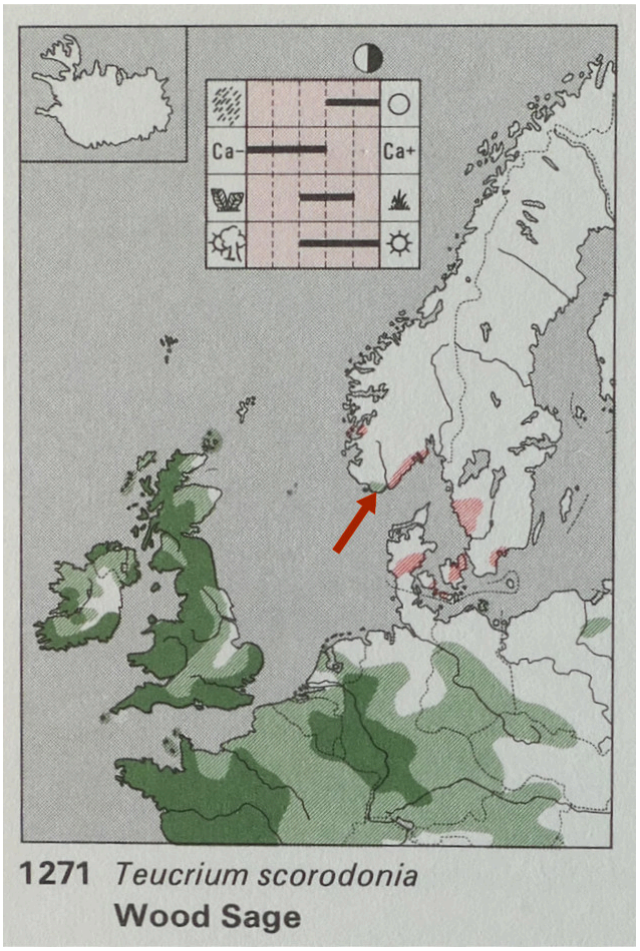
1645 *Senecio aquaticus*
Marsh Ragwort



1128 *Primula vulgaris*
Primrose



55 *Quercus petraea*
Sessile Oak

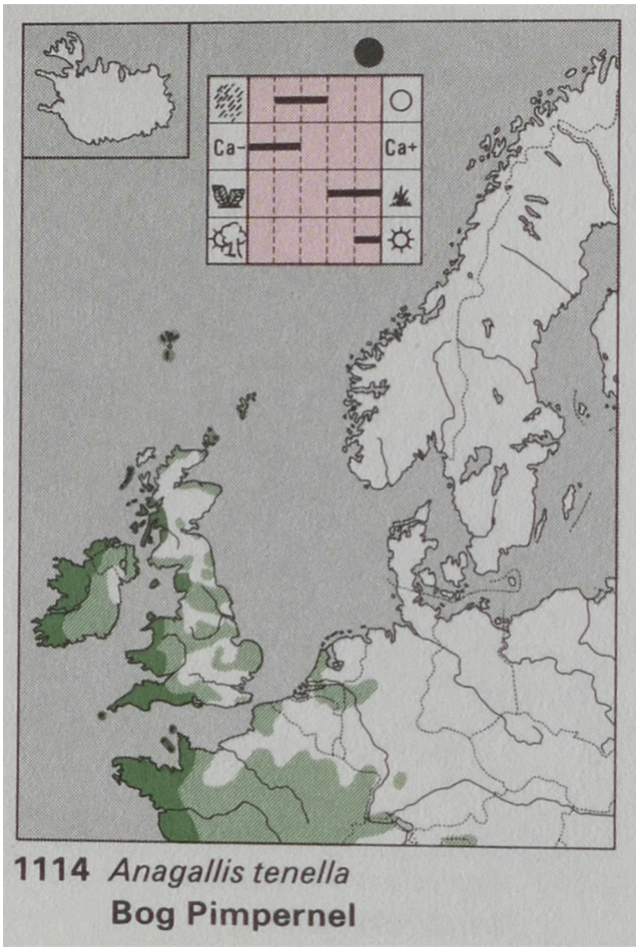


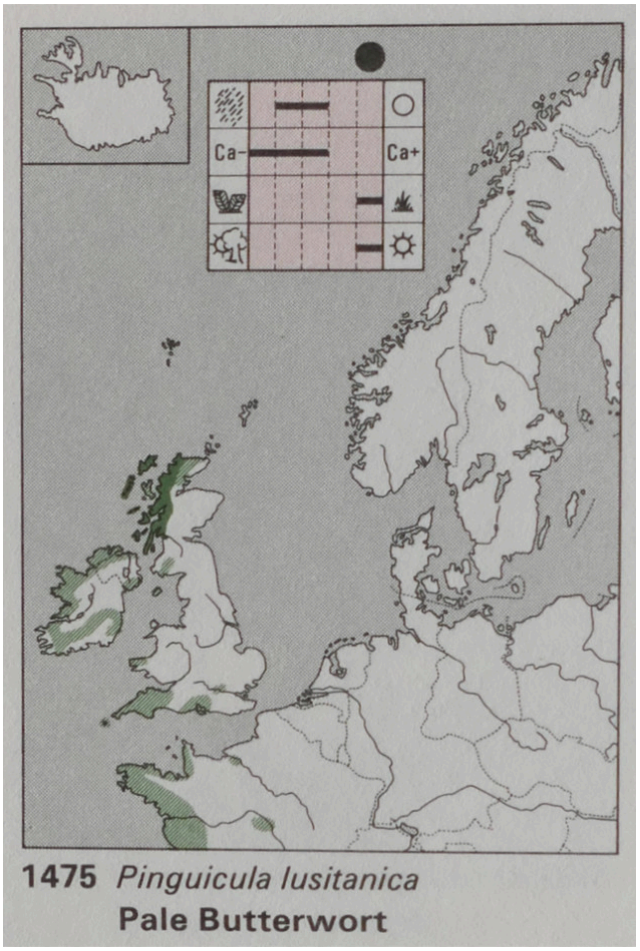
1271 *Teucrium scorodonia*
Wood Sage

EXAMPLES OF OCEANIC PLANTS ABSENT FROM NORWAY

Dark green = core of range

Pale green = plants more sporadic





Summary

Plants with a boreal distribution are abundant in Norway. In the Highlands, some of these are common, some rare and some absent.

In contrast, there are many plants common in Scotland with an oceanic distribution which are rare or absent in SW Norway. For plants absent from Norway, it could be that these plants have been unable to reach the country, rather than the climate *per se*.

The maps indicate significant differences between the two areas.

Maps from:

An Atlas of the Wild Flowers of Britain and Northern Europe

Alastair Fitter
Published by William Collins in 1978

EXAMPLES OF VASCULAR PLANT DIFFERENCES
Pictures from Western Norway

Bog rosemary *Andromeda polifolia i*s abundant on open heathland in Western Norway, but has a very localised distribution in the UK, being restricted to raised bogs (see map on page 11). It is not found in Scotland north of the Highland Boundary Fault.

Northern blaeberry *Vaccinium uliginosum* visible on the left with blue-tinged leaves . Abundant at all altitudes in Western Norway, but restricted to higher altitudes in the Highlands (although at sea level in Shetland).

Twinflower *Linnaea borealis* is visible in the centre (white flowers), restricted to native pinewoods in the eastern Highlands, but very common in woods and heaths in Western Norway (see map on page 11). Crowberry *Empetrum* and blaeberry *Vaccinium myrtillus are* also visible, both abundant in the Highlands and Norway.

Dwarf cornel *Cornus suecica* is abundant throughout Western Norway, including at sea level. In the Highlands it is restricted to the higher altitudes and rarely abundant.

Cloudberry is visible here at the bottom left. It is abundant across Norway, but less common in Scotland where it tends to occur on mid-high level peatbogs.

Dwarf birch *Betula nana* is abundant throughout Scandinavia, including Iceland, and occurs on all soil types. It has a sporadic distribution in Scotland, where it is mainly restricted to peatland in the East Central Highlands.

EXAMPLES OF VASCULAR PLANT DIFFERENCES *(continued)*
Pictures from Western Norway

This moorland vegetation in Western Norway may look similar to Scottish moorland, but this picture includes the Northern blaeberry *Vaccinium uliginosum* and dwarf cornel, both restricted to higher altitudes in Scotland. In Scotland, cross-leaved heath *Erica tetralix* and heather *Calluna vulgaris* are more dominant on damp moorland.

Bog vegetation in Norway with bog asphodel *Narthecium ossifragum* and common butterwort *Pinguicula vulgaris*, sphagnum and leafy liverworts. But it also contains a shrub willow species (pale blue leaves) rare in Scotland.

LANDUSE IN WESTERN NORWAY AND WESTERN SCOTLAND

A coastal scene from Western Norway at about 68° North.

A coastal scene from Western Scotland at about 58° North.

EXAMPLES OF LIVESTOCK IN NORWAY
Pictures from Western Norway

Traditional Norwegian cattle at a coastal location in Western Norway.

Transhumance, *i.e* the movement of livestock from the low ground to high level pastures (saeter) in summer, is a traditional practice in Norway, although it is now dying out. See also the bottom left picture of page 19.

In Scotland, cattle were moved to the shielings in summer, which tended to be on the glen floors and lower slopes, rather than at high altitude.

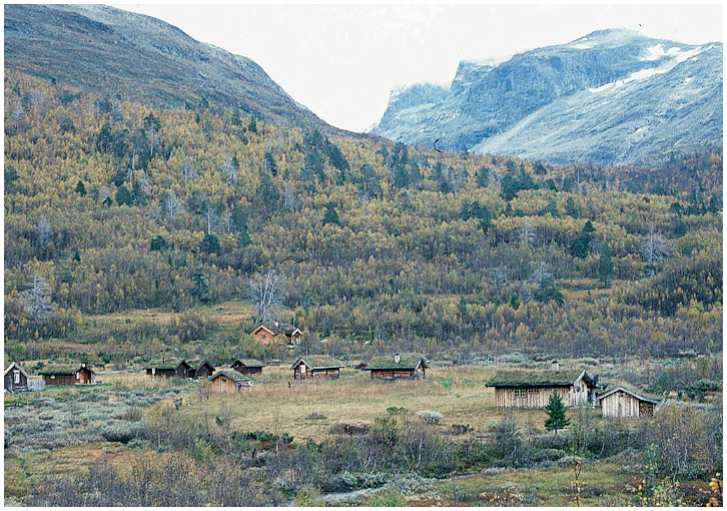
Sheep in summer, grazing the pastures above the treeline in Western Norway. Numbers are generally low, and traditionally wintered indoors.

The keeping of domestic reindeer is a traditional activity in Northern Norway and in certain mountainous areas in the central and south of the country. In 1992 there were estimated to be 250,000 domestic reindeer. Wild reindeer herds exist in the mountainous areas of Southern Norway, where they can interbreed with the domestic animals.

EXAMPLES OF LANDUSE IN NORWAY
Pictures from western Norway

Domestic animals are traditionally wintered indoors owing to winter snow cover, in the kind of barn illustrated in the centre of this picture (the red building). Sheep in Scotland are wintered outdoors, being too numerous to winter indoors.

Modern landuse in Western Central Norway, illustrating the pastures around the farmhouse being managed for silage. During the grass-growing season, the livestock would be moved to pastures away from the farm, brought back after the silage has been cut to graze the aftergrowth – before being wintered indoors. The forest surrounding the building would be managed to produce timber and firewood.



A traditional settlement of saeter (summer dwellings), where livestock would have been brought to graze during the summer, leaving the low ground available for growing crops and grass. The practice (transhumance) is dying out, with this settlement no longer being used for grazing – as can be seen by the extensive development of scrub. This location is now a tourist site.

An example of an abandoned coastal farm in Western Noway. For many years, the Norwegian government has been supporting farmers in order to maintain rural communities in remote locations.

EXAMPLES OF LANDUSE IN NORWAY *(continued)*
Pictures from western Norway

A small settlement along the side of a deep fjord, surrounded by woodland on the steep sides of the fjord. Much of this woodland would always have been inaccessible to grazing.

The inner fjord areas can be sheltered, with a more benign climate than the coast – as can be shown here by the presence of an orchard.

A farming settlement on the floor of a valley in Western Norway, a location more sheltered than the coast. Note the woodland on the steep slopes, much of which would always have been inaccessible to grazing.

There has always been a strong tradition of hunting in Norway, here showing elk. In the past this resulted in a decline of the native large herbivores. With stronger regulation, populations are now increasing.

THE TREELINE IN WESTERN NORWAY

Winter snow cover at the altitude of the treeline in SW Norway, east of Bergen. Such consistent snow cover from year to year protects trees and shrubs from grazing.

Sub-alpine scrub is abundant at the treeline in Western Norway.

A view of Western Norway at about 63°N showing woodland extending from sea-level to the treeline, with glaciers above.

A view further north in the latitude of Tromsø (69^{0}N), showing blanket peat on the lower ground with bog cotton and sphagnum; and woodland on the better-drained slopes, extending up to the treeline. Although much further north than Scotland, it does give an indication of the kind of locations (better-drained steep slopes) where woodland might have persisted longest in inland areas of the Highlands.

SUB-ALPINE SCRUB IN NORWAY

Sub-alpine scrub of willows growing in a sheltered hollow above the treeline in Eastern Norway.

Sub-alpine scrub of willows and birch at the treeline in Western Norway. This is the kind of landscape with those promoting 'montane scrub' in Scotland are trying to create. See page 25 below.

COASTAL HEATHLAND IN WESTERN NORWAY

Coastal heathland surrounding a settlement in Western Norway. The origin of such heathland has traditionally been ascribed to woodland clearance by farming, but its expansion, starting 4,000 years ago, also correlated with a deterioration of the climate. See page 4 above.

Coastal heathland in Western Norway, for reasons which are unclear, is particularly susceptible to invasion by regenerating trees. Maybe it is that in Scotland, where heather (*Calluna*) is more dominant, the heather, as foresters have long known, keeps trees in check?

EXAMPLES OF WOODLAND TYPES IN WESTERN NORWAY

A boreal Scots pine wood of the type found in Eastern Norway. These forests have affinities with the relict native pinewoods of Scotland, although in Scotland heather (*Calluna*) tends to be more dominant.

The woods of Western Norway are still evolving, with Norway spruce a relatively recent arrival, having colonised from the east. It is still expanding its range.

A species-rich birchwood from Western Norway of the kind found on the richer soils.

A more typical birchwood of Western Norway, of the kind found on poorer soils, and similar in many respects to the native birchwoods of the Scottish Highlands. Some are relatively species-rich, and some species-poor.

BLANKET PEAT IN WESTERN NORWAY

Blanket peat with heather (*Calluna*) expanding into birch woodland at a mid-altitude site in Western Norway.

Blanket peat with Sphagnum expanding into birch woodland at a mid-altitude site in Western Norway. Scotland, with its montane climate, has had a longer period for blanket peat to develop than much of Norway. Hence it is more common.

Blanket peat at a coastal site in Southwestern Norway, showing an old peat cutting. Bog myrtle, common in both the southwest of Norway and the lower altitudes of the Scottish Highlands, is visible in the foreground, with heather and bog cotton dominating in the background.
With the climatic deterioration of the Boreal-Atlantic transition staring about 4,000 years ago, woodland declined in coastal areas, with peatland and heathland expanding.
See the text on page 4 above.

Another view of coastal Norway showing blanket peat in the hollows together with large bog pools. The moss *Racomitrium*, common in both countries, is visible in rocky areas.

It is still debatable how much the open moorland habitats of Western Norway are natural or anthropogenic in origin – see the text above.

Transhumance in Norway, where dairy cows were taken up to the summer pastures, has now largely died-out. This has resulted in the pastures reverting to sub-alpine scrub of juniper, dwarf birch and willows. This shows Norwegian conservationists using a scrub-cutting machine to recreate the lost grasslands.

In contrast, this shows people planting out shrubs on grassland in order to convert it to montane scrub. This is on the hypothesis that montane scrub (as opposed to sub-alpine scrub in Norway) has died out in Scotland due to livestock grazing. However, although there would have been sub-alpine/arctic scrub in the past when the climate was much colder, there is little evidence that montane scrub as such ever existed. See pages 2-3 above.

A picture taken in 1993 on Ben Lawers showing a landscape dominated by mat grass, with a richer flora along the burnside.

A picture of the same area taken in 2021 showing how it has changed as a result of tree and shrub planting combined with the exclusion of grazing animals. The aim has been to recreate the treeline landscapes found in Norway, as shown in the top right picture of page 22.

But how such landscapes could have existed in Scotland, which, unlike Norway, has retained significant populations of red deer (later replaced by sheep) throughout the postglacial period, is a moot point.