Landscape history and land use in SW Norway

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NINA
Norsk institutt for naturforskning

The Norwegian Institute for Nature Research

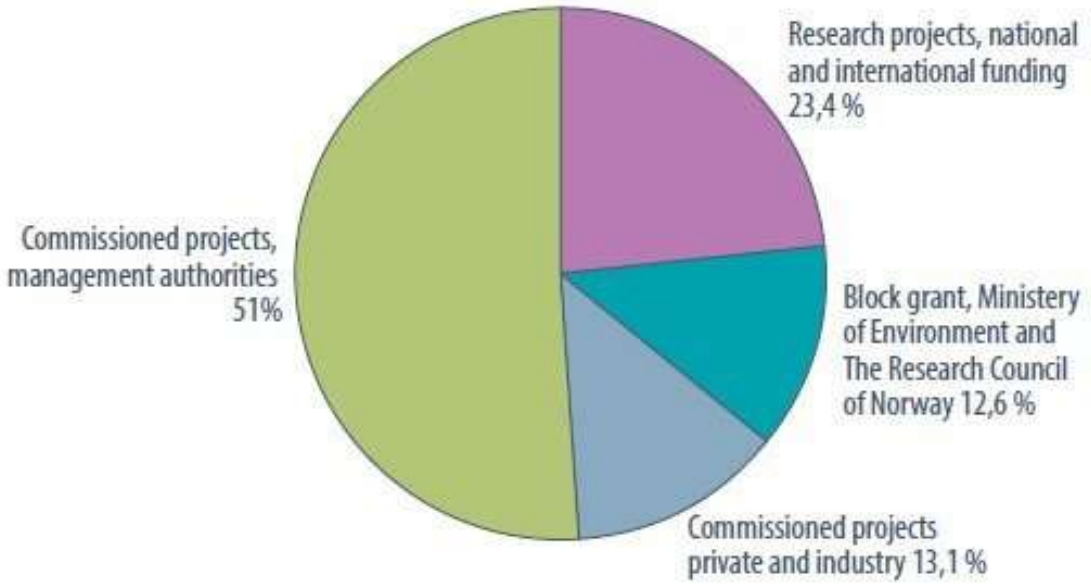
The Norwegian Institute for Nature Research (NINA) is an independent, not-for-profit institute working in the areas of fish and game management, monitoring, biodiversity, ecosystems services, sustainability, and community development of natural resource management.

NINA's key statistics for 2014

Number of publications	2014
Scientific papers	201
NINA reports	124
External lectures and presentations	600
Media coverage	2548
News stories published at nina.no	79
Unique visitors to nina.no website	90902

Number of employees (full-time equivalents)	2014
Total	216,5
- scientific staff	143,7

NINA´s turnover 2014



Total turnover: 36,7 mill. EUR

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Hjortevilt

Om Hjorteviltportalen Kontakt Høykontrast a A Sidekart

Portalen for alt om elg, hj

Hjem | Elg | Hjort | Rådyr | Villrein | Jakt | Forvaltning | Forskning | Vilt og trafikk | Arealbrukskonflikter | Hjortevilt

Hjortevilt Villrein 10. november 2015

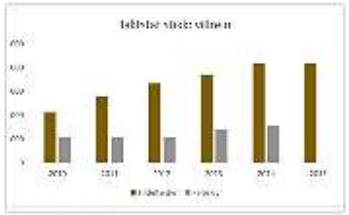
Ønsker velkommen til boklansering

I 50 000 år har mennesker og villrein levd i tett relasjon med hverandre. Nå har vi for første gang anledning til å ta en titt inn i villreinens personlige fotoalbum. Les saken...

Hjortevilt 09. november 2015

Hvilke etapper hadde en hjort vunnet i triatlon?

I forrige uke gikk Naturdatas viltkonferanse av stabelen. Der fikk tilhørerne nyte et variert program som tok for seg både utvidet jakttid på elg og hjortens ferdigheter i triatlon. Les saken...



Hjortevilt Villrein 27. oktober 2015

Dobling i fellingstillatelser på villrein på fem år

I 2015 ble det totalt tildelt en kvote 20 912 villrein fordelt på de 23 villreinområdene. Det er en dobling fra 2010, da tildelingen var på 10 521 dyr. Les saken...

http://hjortevilt.no/

Journal of Animal Ecology

Journal of Animal Ecology 2008, **77**, 958–965 doi: 10.1111/j.1365-2656.2008.01427.x

An efficient multivariate approach for estimating preference when individual observations are dependent

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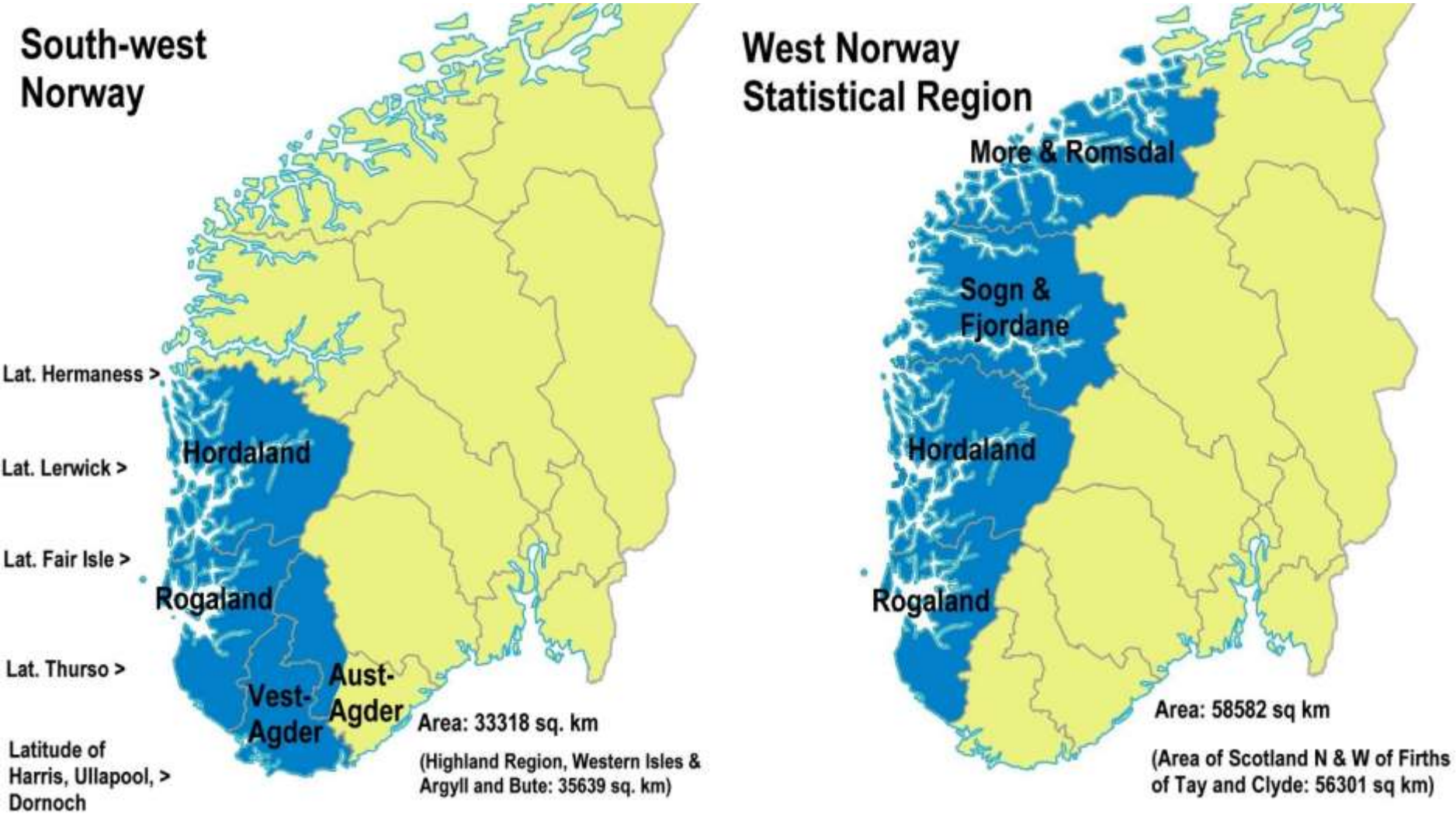
Summary

1. We discuss aspects of resource selection based on observing a given vector of resource variables for different individuals at discrete time steps. A new technique for estimating preference of habitat characteristics, applicable when there are multiple individual observations, is proposed.
2. We first show how to estimate preference on the population and individual level when only a single site- or resource component is observed. A variance component model based on normal scores in used to estimate mean preference for the population as well as the heterogeneity among individuals defined by the intra-class correlation.
3. Next, a general technique is proposed for time series of observations of a vector with several components, correcting for the effect of correlations between these. The preference of each single component is analyzed under the assumption of arbitrarily complex selection of the other components. This approach is based on the theory for conditional distributions in the multi-normal model.
4. The method is demonstrated using a data set of radio-tagged dispersing juvenile goshawks and their site characteristics, and can be used as a general tool in resource or habitat selection analysis.

Key-words: conditional expectations, correlation analysis, estimation, goshawk, intraclass correlation, multivariate normal distribution, preference

Geographical Definitions




West Norway, 1940s
ROMSDALSMUSEET

Oslibakken, Rogaland 1911

Foto: Ielstrup, Henrik Jacob

Norsk Skogmuseum

Old peat digging with pine roots, west Norway, 1917

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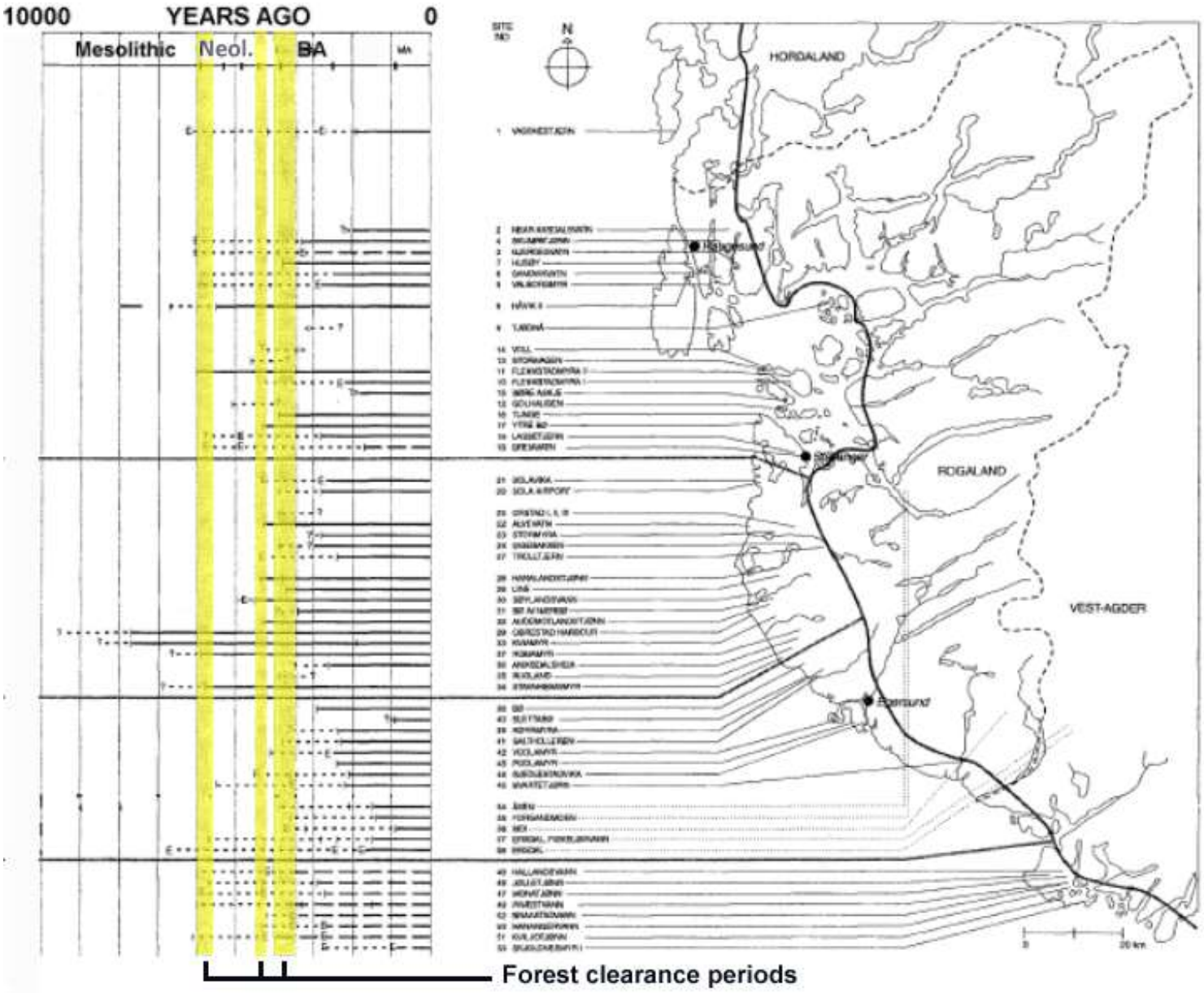
Industrial scale peat production on Fedje island near Bergen, 1903. The peat was transported to the quayside by train. This was the main source of domestic and industrial fuel in Bergen in the later 19th and early 20th centuries.



Age of final establishment of moorland, or grassland/ permanent infields, in coastal SW Norway

Yellow: Forest clearance periods. ***Dotted line,*** deforestation in progress; ***solid line,*** final moorland establishment; ***dashed line,*** grassland and permanent infields. Prøsch-Danielsen & Simonsen 2000. Veget. Hist. Archaeobot. 9:189-204.

Peat cuttings and drying stacks in Jæren (coastal plain near Stavanger). Kitty Kielland, oil on canvas, 1900

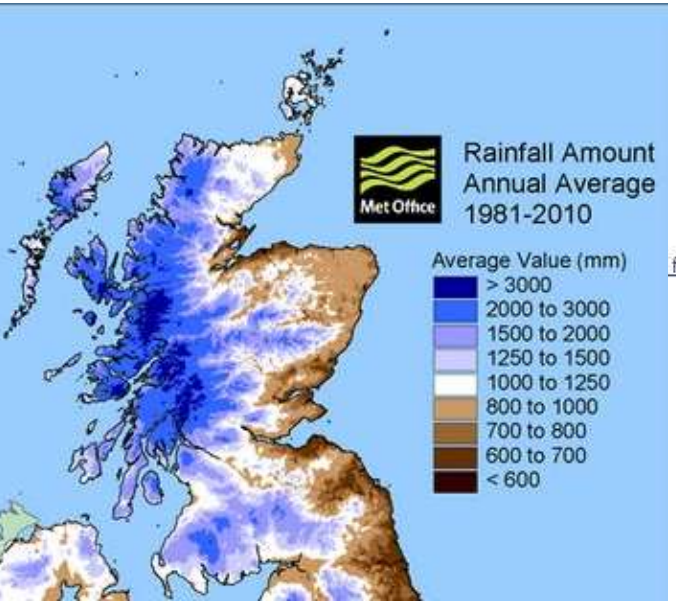
Peat was the main source of domestic fuel in coastal Norway for many centuries.

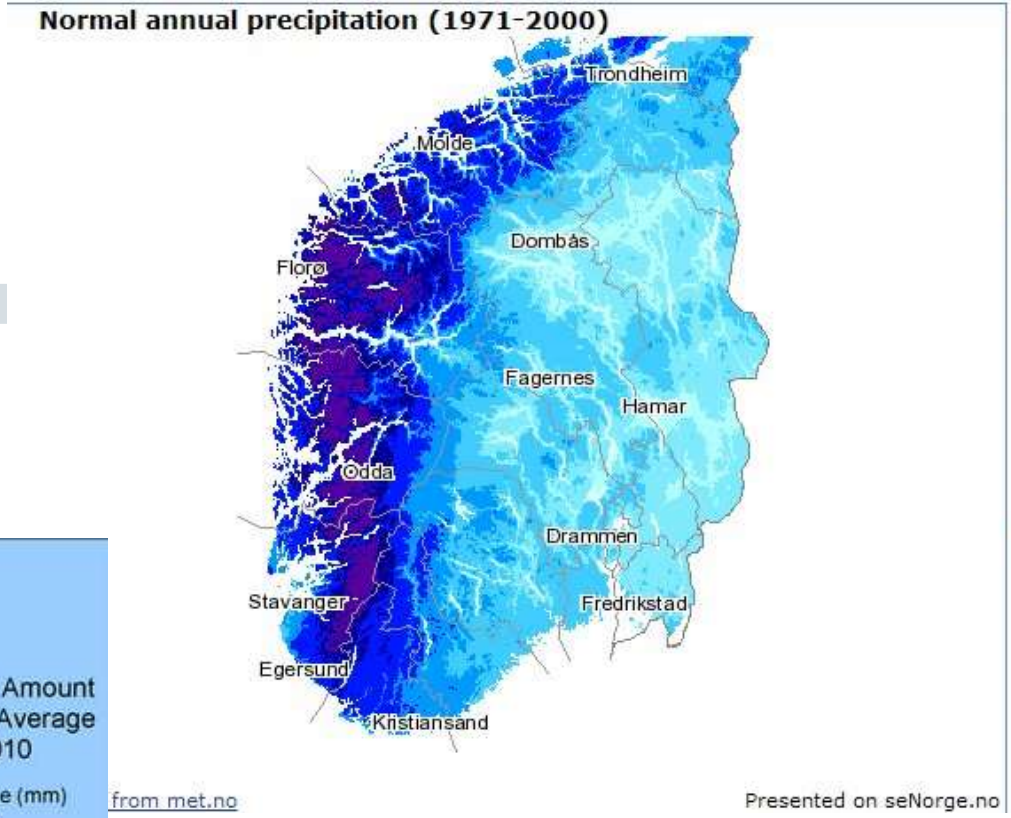
This was due to the lack of wood in the region; in coastal areas, **conversion to open moorland was «substantially complete by the Bronze Age»**.

Further deforestation and moorland establishment continued inland in SW Norway to the Viking era and beyond. Moorland reached its maximum extent in the 19th century.

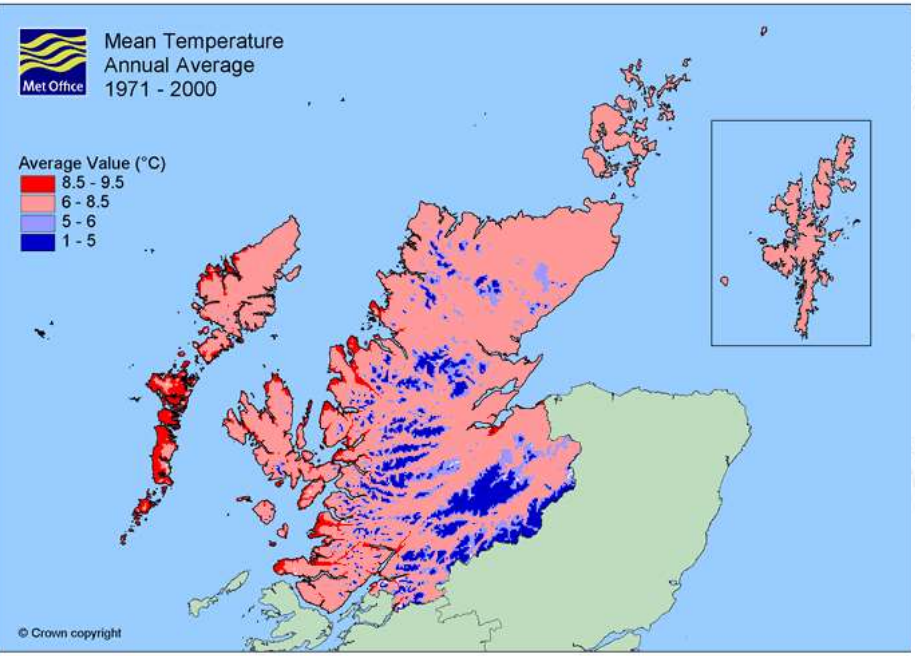
This open landscape was **«anthropogenic in origin»**, due primarily to the effects of grazing and associated activities such as muirburn and use for firewood (Prøsch-Danielsen & Simonsen 2000. Veget. Hist. Archaeobot. 9:189-204).

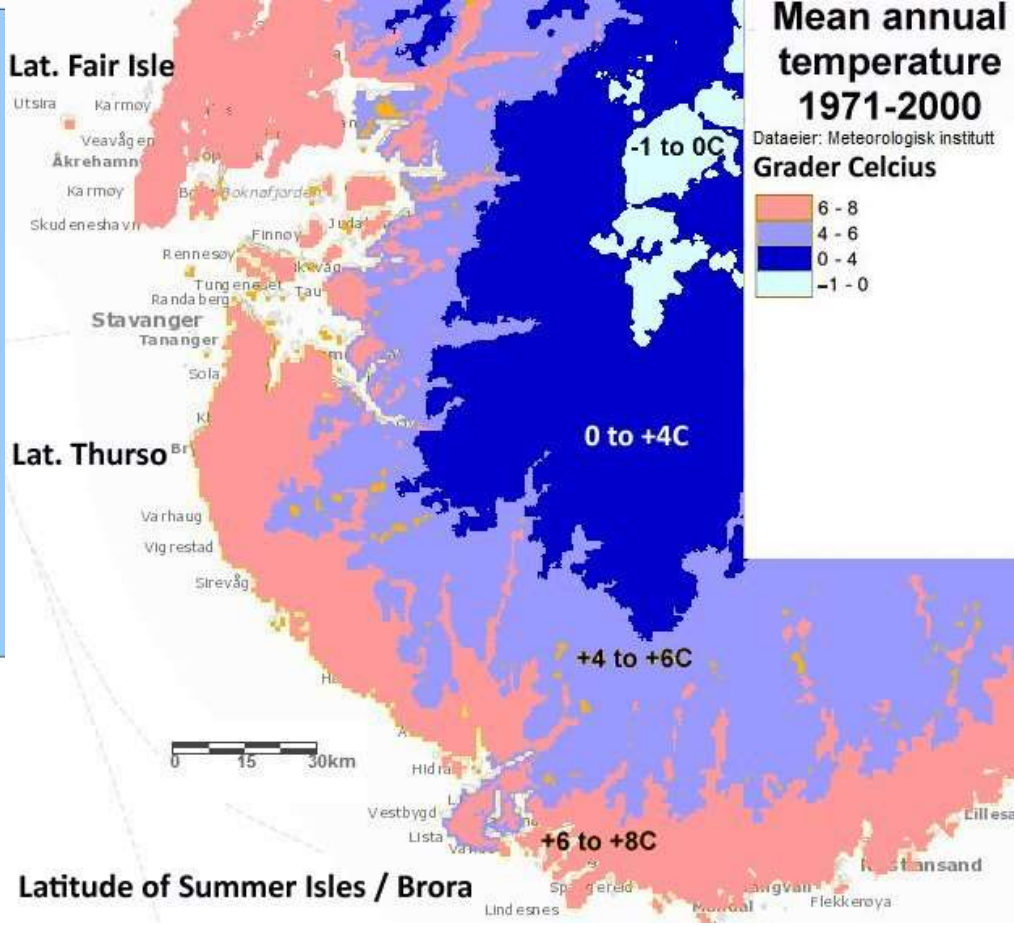
Climate comparisons

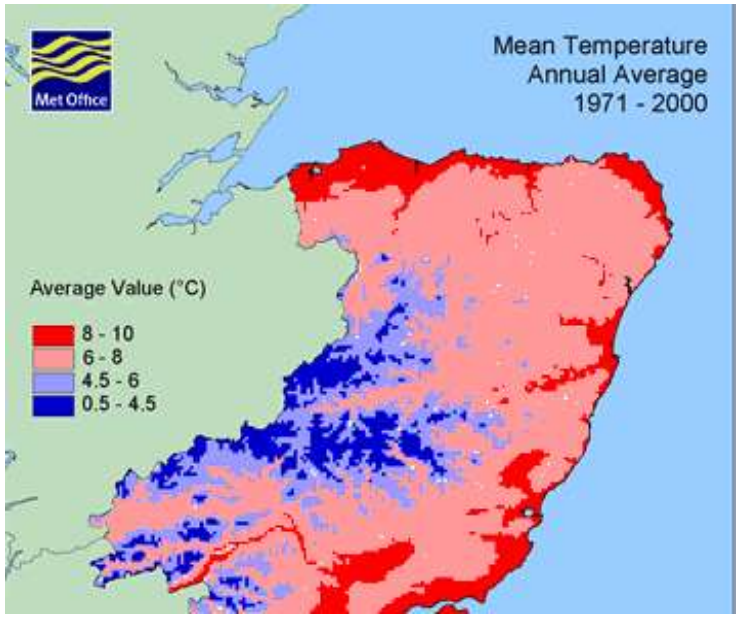


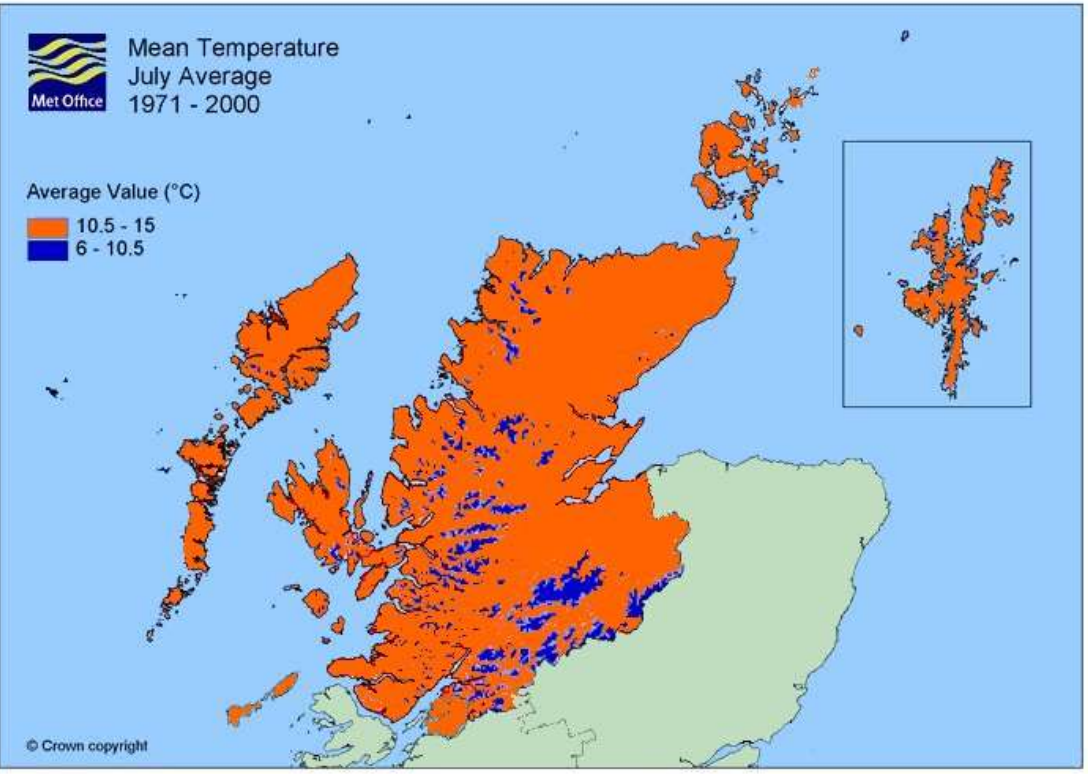


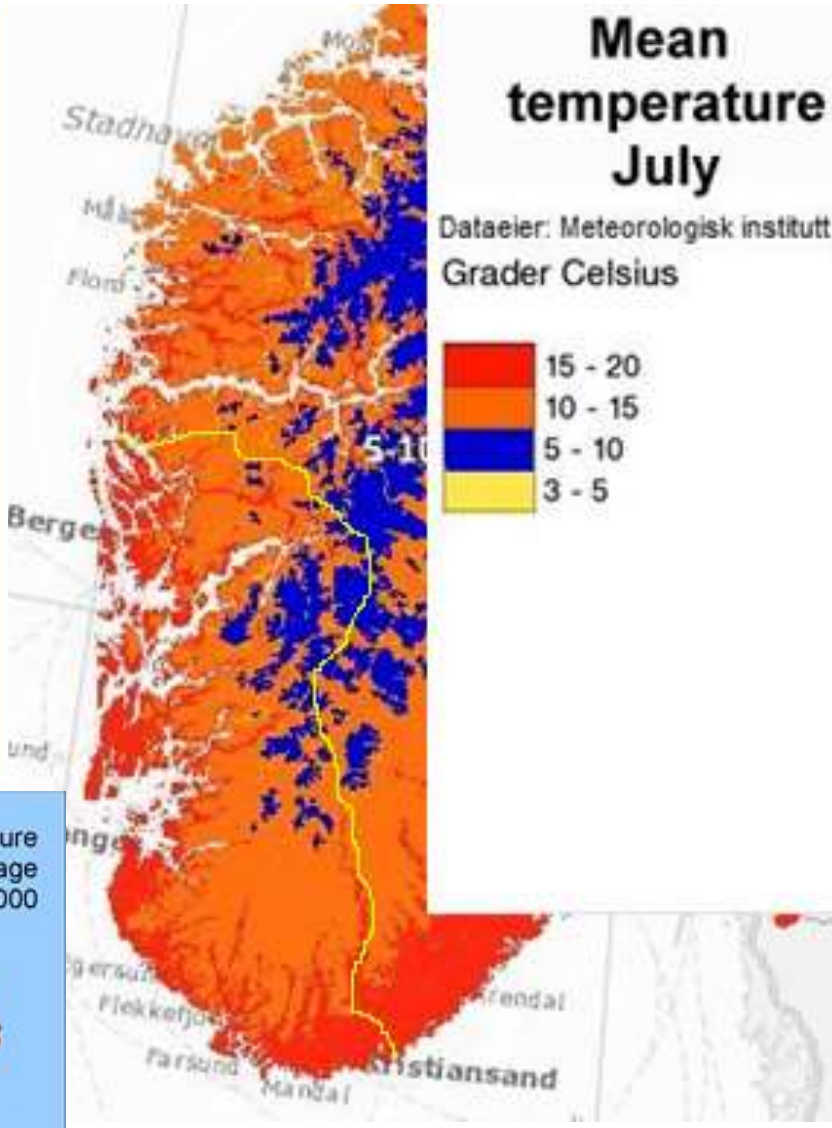
(maps to scale and in correct relative positions)

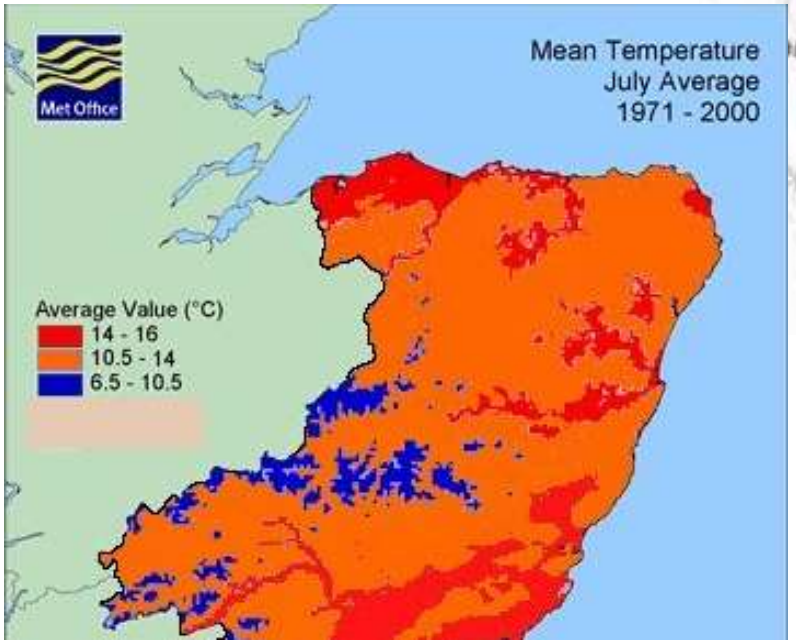

Mean Temperature
Annual Average
1971 - 2000
Average Value (°C)
8.5 - 9.5
6 - 8.5
5 - 6
1 - 5
© Crown copyright


Lat. Fair Isle
Lat. Thurso
Latitude of Summer Isles / Brora
Mean annual temperature 1971-2000
Dataeier: Meteorologisk institutt
Grader Celcius
6 - 8
4 - 6
0 - 4
-1 - 0
-1 to 0C
0 to +4C
+4 to +6C
+6 to +8C
0 15 30km
Stavanger
Tananger
Utsira
Karmøy
Åkrehamn
Skudeneshavn
Finnøy
Rennesøy
Tungenesset
Randaberg
Sola
Varhaug
Vigrestad
Sirevåg
Hidra
Vestbygd
Lista
Lindesnes
Flekkerøya


Mean Temperature
Annual Average
1971 - 2000
Average Value (°C)
8 - 10
6 - 8
4.5 - 6
0.5 - 4.5







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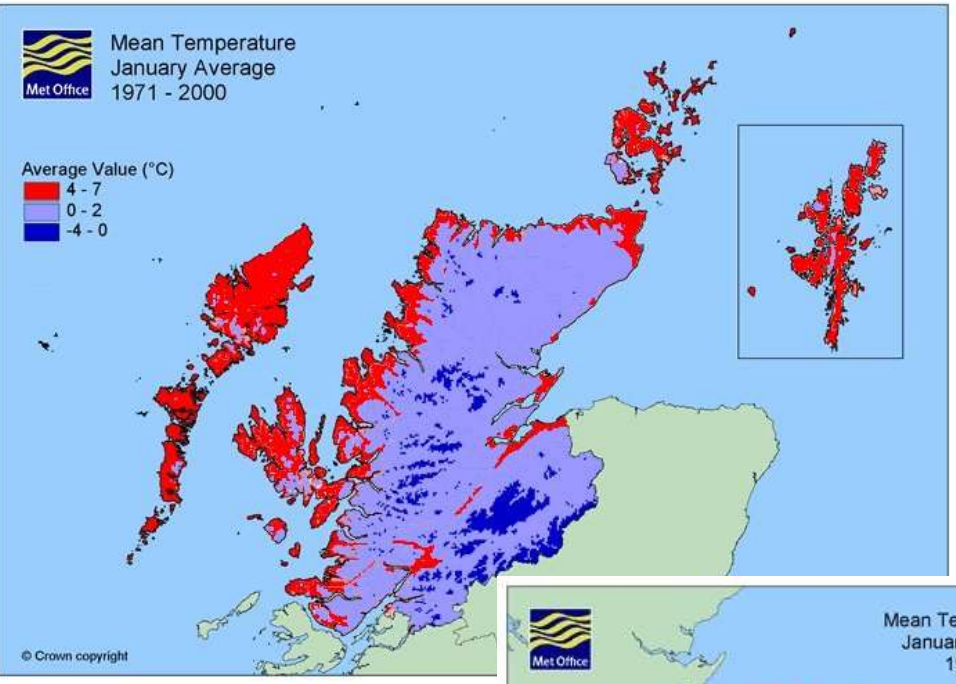
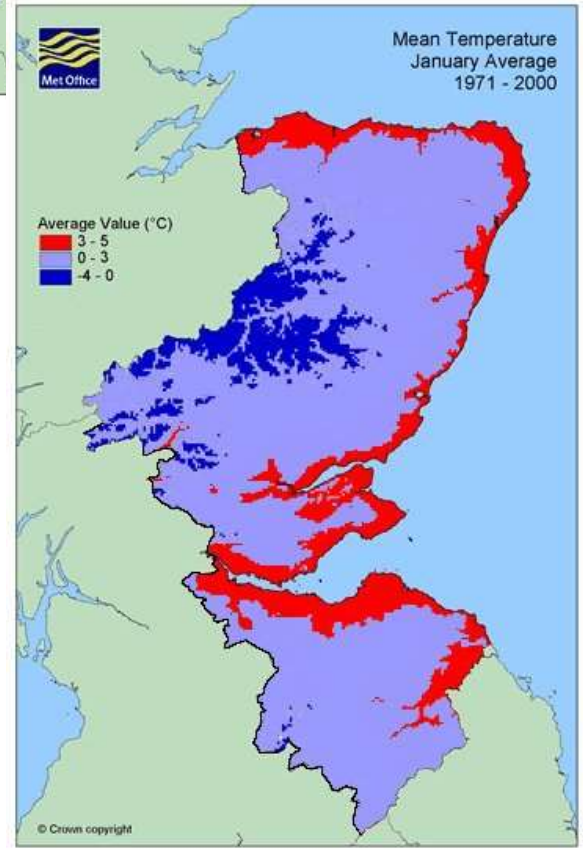
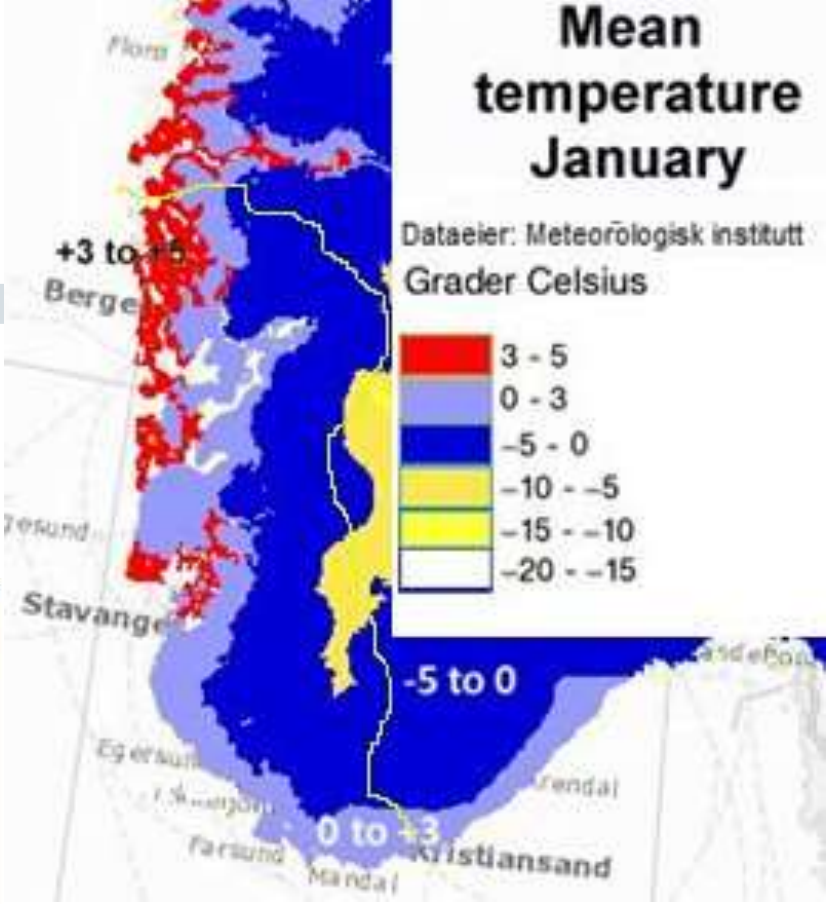

Mean Temperature
January Average
1971 - 2000
Average Value (°C)
4 - 7
0 - 2
-4 - 0
© Crown copyright


Mean Temperature
January Average
1971 - 2000
Average Value (°C)
3 - 5
0 - 3
-4 - 0
© Crown copyright


Mean temperature January
Dataeier: Meteorologisk institutt
Grader Celsius
3 - 5
0 - 3
-5 - 0
-10 - -5
-15 - -10
-20 - -15
+3 to +5
-5 to 0
0 to +3
Stavanger
Kristiansand

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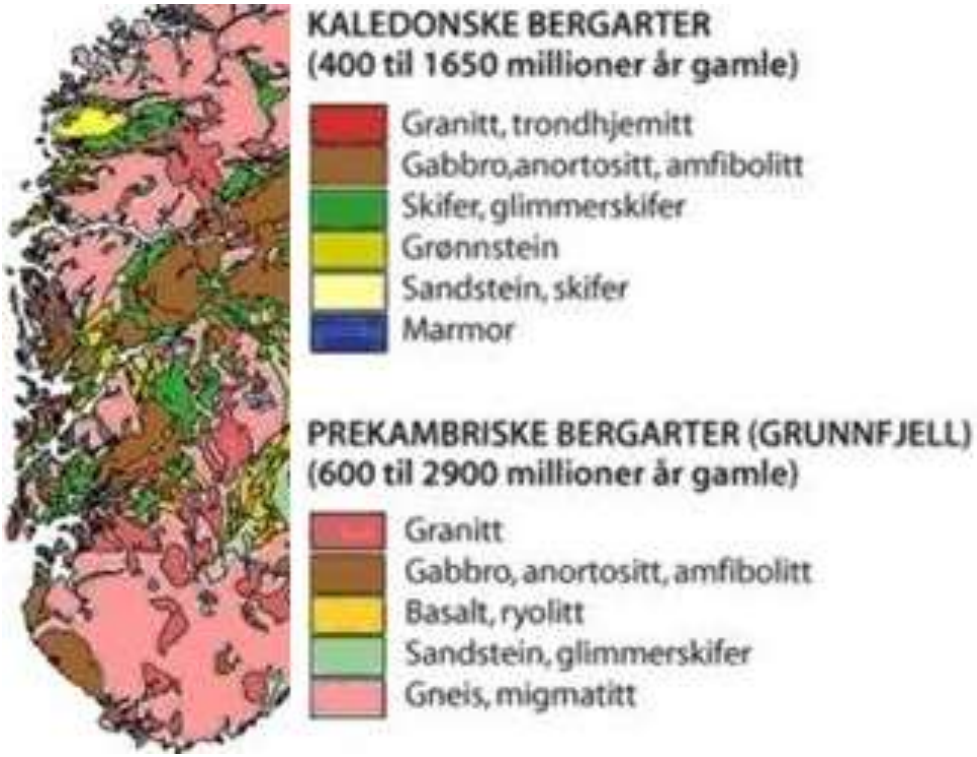
Baltasound 6.9m/s >
Hellisø 7.6 m/s >
Lerwick (S. Screen) 7.5m/s >
Fair Isle 7.4m/s >
Røvær 6.8 m/s >
Utsire 8.2 m/s >
Kvitsøy 6.5 m/s >
Kirkwall 6.9m/s >
Eigerøya 8.0 m/s >
Stornoway 5.1m/s >
Lindenes 7.8 m/s >
S. Uist (Range) 7.1m/s >
Barra airport 7.5m/s >
Tiree 7.3 m/s >
Mean Annual Windspeeds
Islay airport 6.4 m/s >
Campbeltown airport 6.2 m/s >
Sources : Meteorological Office
Meterorologisk institutt

Geology



Source: Norges geologiske undersøkelse

Land cover history, climate, and geology: Summary

- SW Norway has (as Scotland) been largely deforested for centuries; in coastal districts, for millennia.
- Research indicates this was caused by the cumulative effects of livestock grazing and associated land uses, such as muirburn and felling for timber and fuel.
- Data on climate is comprehensive, standardised, publically available, and consists of precisely quantifiable physical measurements collected by the respective Met Offices.
- It indicates that the climates of SW Norway and Highland Scotland are very similar: highly oceanic, mild, and wet; precipitation varying strongly depending on topography and rain shadow effects; and with similar seasonal temperature ranges.
- Winds as measured at the west coast are overall slightly stronger in SW Norway. Some parts of SW Norway are wetter than anywhere in Scotland.
- The geology of the two areas is also very similar. Hard, volcanic or metamorphic rocks, largely from the same mountain building episodes, predominate. Soils are generally infertile.

Fidjadalen 1927

Fidjadalen 2007

http://jarenfri.no/no/steder/friluftsgarden-man/

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Note woodland regrowth (1960, 2004) on bare rock slope, upper right of 1885 image

Geiranger
(west Norway)

www.tilbakeblikk.no

Kvenadhøla sawmill, inland Rogaland

Ca. 1890

Kvenadhøla was one of many sawmills in inland SW Norway that sawed lumber using water power for the 'skottehandel', or 'Scottish Trade' – ie for export - in the later 17th to 19th centuries.

2004

The trade took its name from the dominance of Scotland as a destination for the timber, and lead to further substantial declines in the remaining forests of inland SW Norway

www.tilbakeblikk.no

Oslibakken near Stavanger, 1911

Oslibakken near Stavanger, 2015

X=approximate point of shot 1911 photograph


Fonnes, Hordaland 1971
Pines planted 1907 >


Fonnes, Hordaland 2005
Grazing pressure reduced from 1975

Future trends in land cover

Adapted from: *

Anders Bryn , Pablo Dourojeanni , Lars Østbye Hemsing & Sejal O'Donnell (2013) A high-resolution GIStnull model of potential forest expansion following land use changes in Norway, Scandinavian Journal of Forest Research,28:1, 81-98

Forest defined as trees >2.5m high. "Other land cover types" mainly infield farmland and urban.

Input baseline maps: cover as mapped in 2007.

Potential natural forest regeneration

Actual forest cover (2007)

Jæren (mainly arable and infield pasture)

Montane scrub and alpine

Other land cover types

0 100km

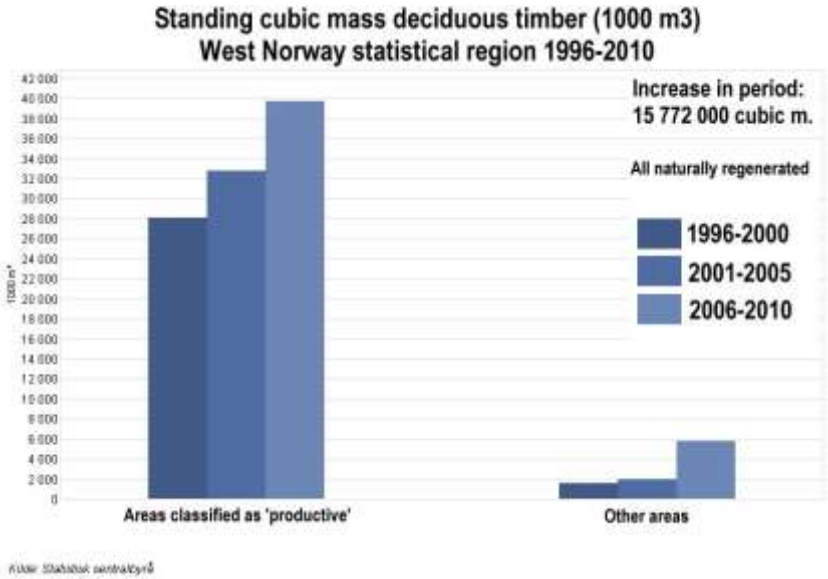
* Montane scrub/alpine and Jæren split from "other land cover" category

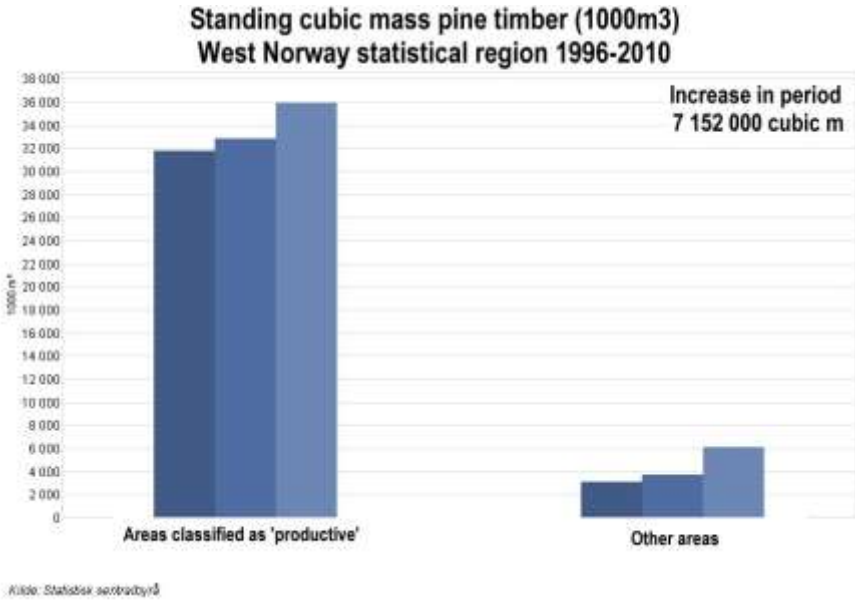
NB Assuming current land use patterns and trends do not change significantly. Much of the 'potential natural forest regeneration' mapped is occurring now, but has not reached the >2.5m height threshold. Regeneration is due to reductions in grazing pressure and associated land uses (muirburn, firewood collection). In recent years climate change may be marginally affecting the altitude limits of zones, but if so is subordinate to browsing effects (Bryn (2008) *Norw. J. Geog*. 62:251-270; Hofgaard et al (2010) *Plant Ecol. & Diversity* 3:19–27).

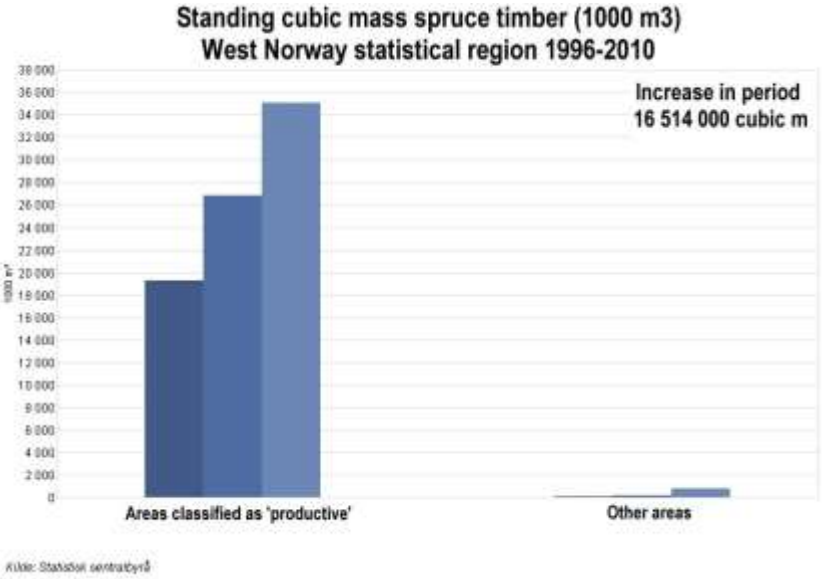
Woodland expansion: area

- **The total area of forest classified as 'productive' increased in SW Norway by 55% 1963-93** (Source: Norwegian Forest & Landscape Institute).
- 'Productive' is a forestry statistics term. It means potential increase in harvestable timber volume of >1m^3/ha/year, whether or not harvested for timber.
- **Between forest inventory periods 2005-09 and 2010-14 the annualised increase in area of woodland in West Norway was 305 sq. km/year**, or **2.6% of the land area over 5 years**. (Data: Statistisk sentralbyrå)
- Almost all of the expansion in area in the period 2005-2014 has been through natural regeneration.
- Scottish Forestry Strategy (2006) for increased forest area: 17% to 25% of land cover (+8% increase) by 2030; 1000 km^2 increase by 2022.

Woodland expansion: standing mass of timber and carbon sequestration







- Annualised increase in standing timber volume 1996-2010: **3 943 800 cubic metres / year**
- Using volume increase ratio 1996-2010 spruce:pine:deciduous (mainly birch) and Forestry Commision conversion factors this represents an **annual sequestration of 0.99MtC**
- Notional value, EU CO2 emissions auction price 16/11/15 (€8.46/tonne CO2): €26.6 million/year
- Does not include bark, branches, leaves, root system, or soil carbon.
- Scottish Forest Strategy sequestration target:sequester 1.0MtC annually by 2020 through woodland expansion.

Recent regeneration on wet peat

<Old peat digging in regenerating birch, cleared for archaeological investigation

Erklia, W. Norway

Bjåen

Bjåen

6% of Norway is blanket bog. Tree growth on drier areas is ubiquitous.

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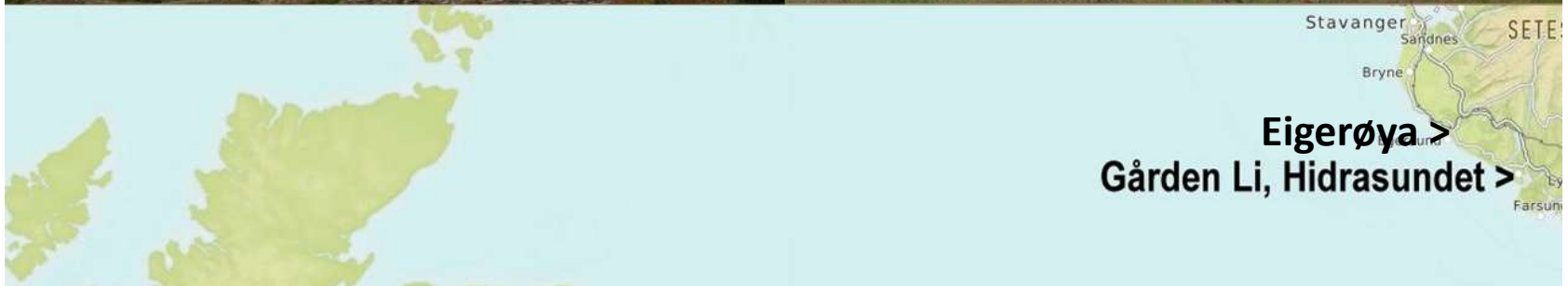
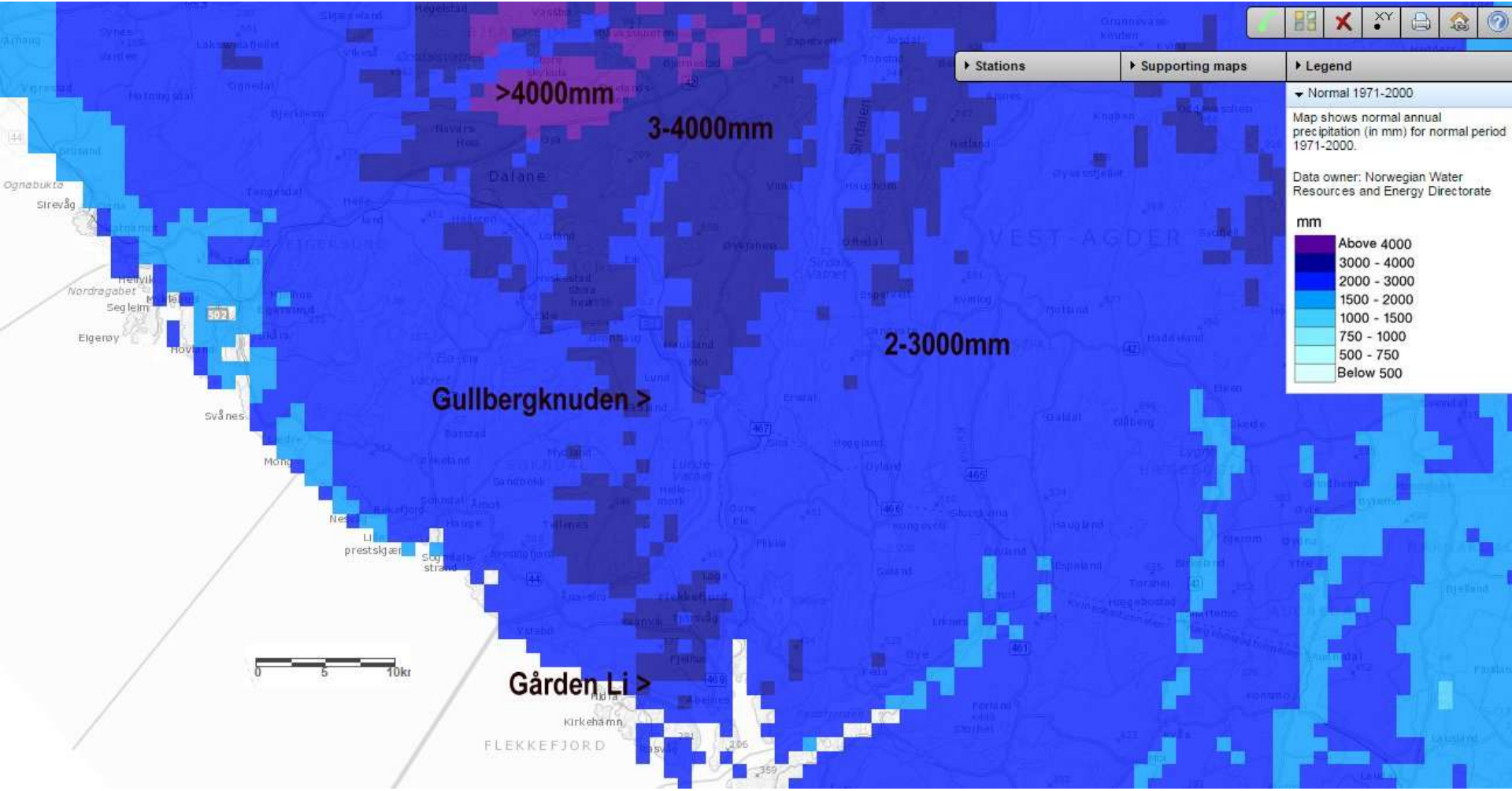
Summary: Recent landscape history

- Landscape history in SW Norway was similar to Scotland from the arrival of agriculture (Neolithic period) until the end of the period when land use was dominated by subsistence pastoralism and associated land uses (Norway: late 19th century; Scotland 17th-18th century).
- Since when landscape histories have diverged sharply.
- SW Norway has been reforesting, in part through forestry practices but mainly through natural regeneration, from the later 19th century and especially since the 1950s. In recent decades reforestation by natural means has been very rapid.
- Research* has determined that this widepread natural regeneration has been due to reductions in grazing pressures and associated landuses such as muirburn and fuelwood collection.
- This was caused by mass (voluntary) emigration to N. America in the period 1862-1914; and by changes in social and economic conditions from the 1950s.
- 90% of the coastal region moorland of the 19th century is now either reclaimed arable/improved pasture or (mainly) woodland (Source: Norwegian Environment Agency).
- Much of the natural regeneration has occurred on wet peat soils.
- Most new woodland is of an open structure with an understory remaining suitable for purposes such as livestock grazing at moderate densities. Most is so used.

*e.g. Ålmås et al (2004) *Norwegian agricultural history (Tapir, Trondheim);* Bryn (2008) *Norw. J. Geog*. 62:251-270; Hofgaard (1997) *Glob. Ecol. and Biogeog. Lett.* 6:419–429; Hofgaard et al (2010) *Plant Ecol. & Diversity* 3:19–27; Olsson et al (2000) *Landscape Ecol.* 15: 155–170; Rössler et al (2008) *Erdkunde* 62:117-128.

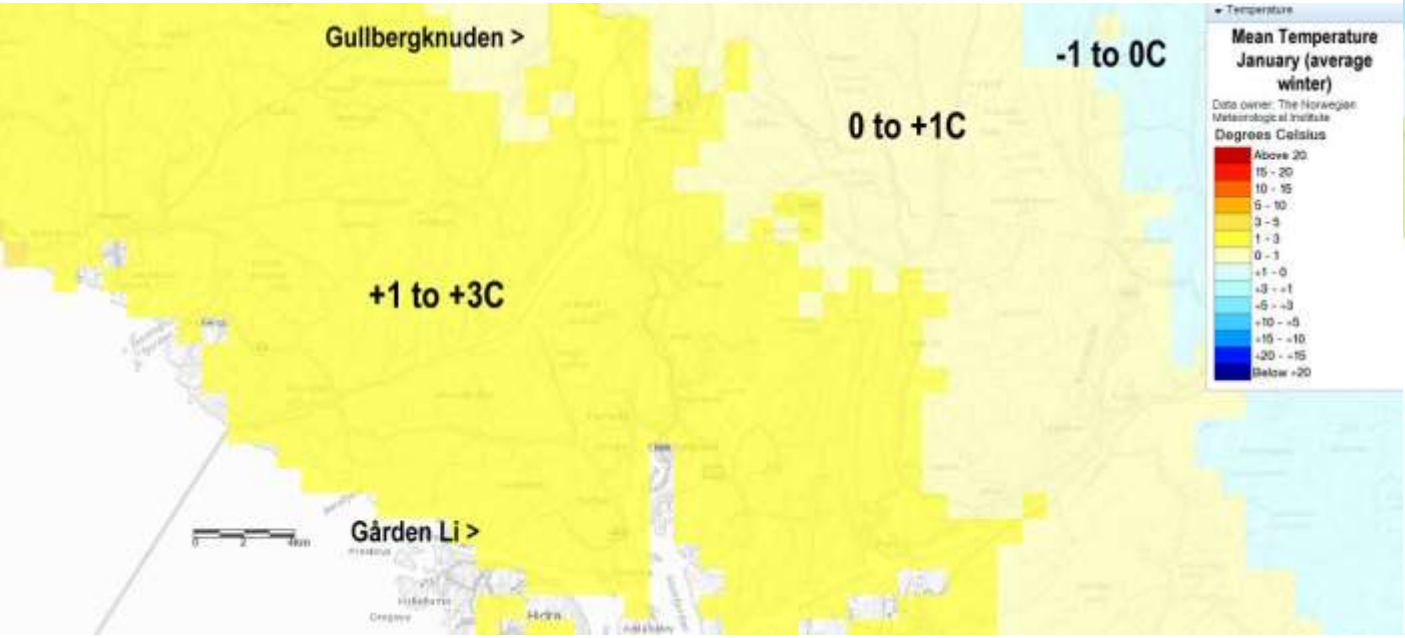
1. Gården Li & Hidrasundet



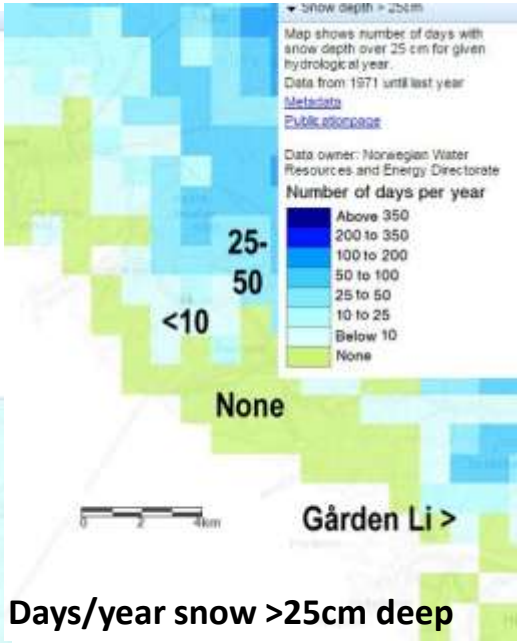


Annual precipitation

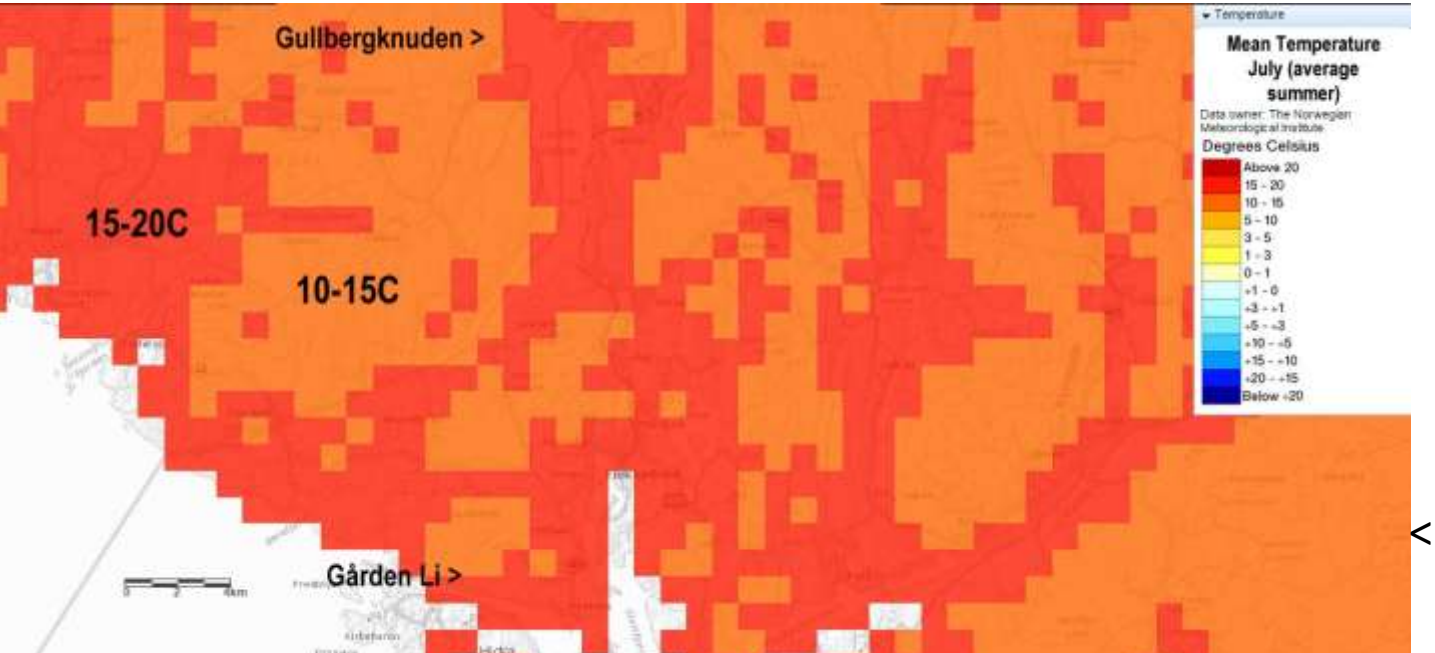
Weather data from www.senorge.no



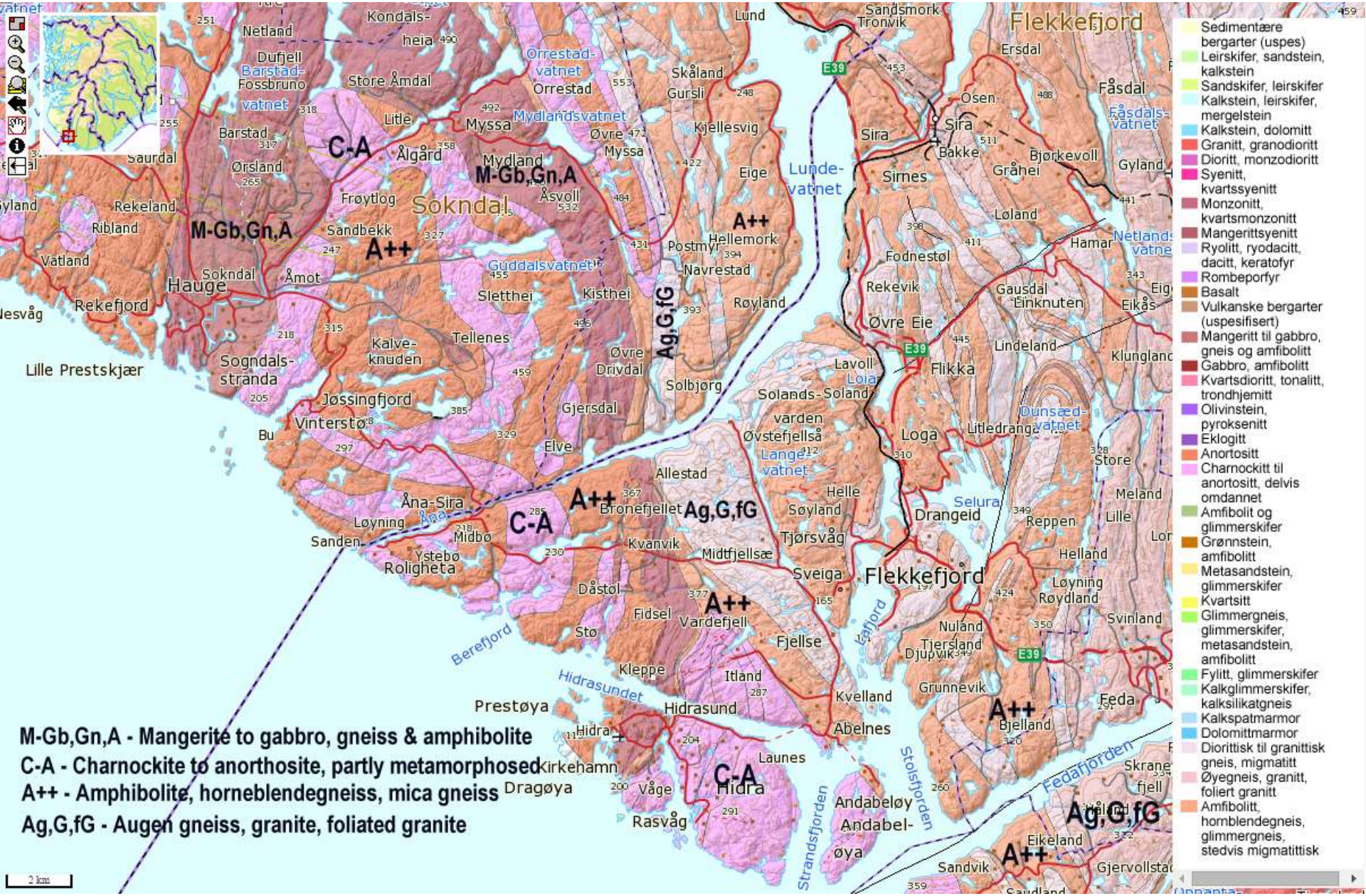
Mean January temperatures



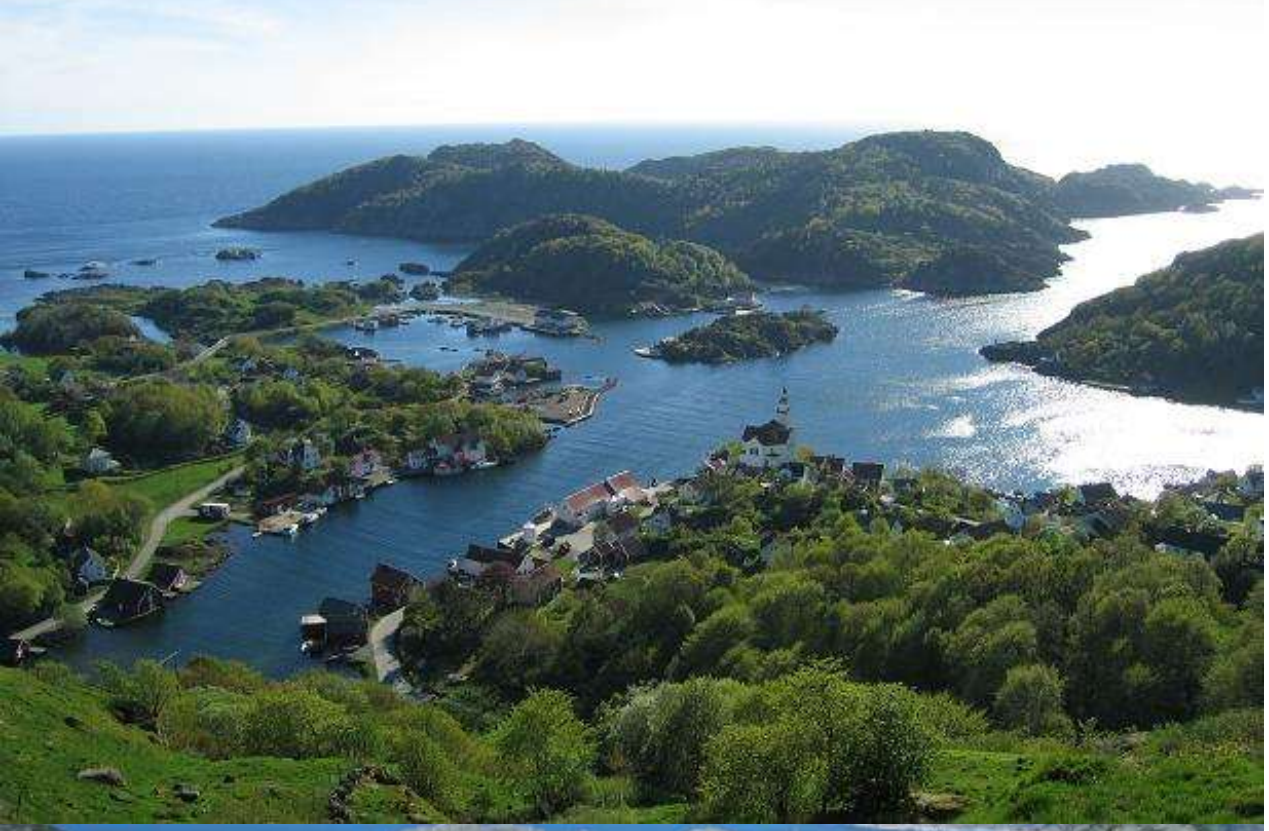
Days/year snow >25cm deep



<Mean July temperatures


M-Gb,Gn,A - Mangerite to gabbro, gneiss & amphibolite
C-A - Charnockite to anorthosite, partly metamorphosed
A++ - Amphibolite, horneblendegneiss, mica gneiss
Ag,G,fG - Augen gneiss, granite, foliated granite
Sedimentære bergarter (uspes)
Leirskifer, sandstein, kalkstein
Sandskifer, leirskifer
Kalkstein, leirskifer, mergelstein
Kalkstein, dolomitt
Granitt, granodioritt
Dioritt, monzodioritt
Syenitt, kvartssyenitt
Monzonitt, kvartsmonzonitt
Mangerittsyenitt
Ryolitt, ryodacitt, dacitt, keratofyr
Rombeporfyr
Basalt
Vulkanske bergarter (uspesifisert)
Mangeritt til gabbro, gneis og amfibolitt
Gabbro, amfibolitt
Kvartsdioritt, tonalitt, trondhjemitt
Olivinstein, pyroksenitt
Eklogitt
Anortositt
Charnockitt til anortositt, delvis omdannet
Amfibolit og glimmerskifer
Grønnstein, amfibolitt
Metasandstein, glimmerskifer
Kvartsitt
Glimmergneis, glimmerskifer, metasandstein, amfibolitt
Fylitt, glimmerskifer
Kalkglimmerskifer, kalksilikatgneis
Kalkspatmarmor
Dolomittmarmor
Diorittisk til granittisk gneis, migmatitt
Øyegneis, granitt, foliert granitt
Amfibolitt, hornblendegneis, glimmergneis, stedvis migmatittisk
Flekkefjord
Sokndal
Hauge
Rekefjord
Lille Prestskjær
Hidra
Prestøya
Dragøya
Kirkehamn
Rasvåg
Andabeløy
Andabel-øya
Fedafjorden
Lundevatnet
Mydlandsvatnet
Orrestad-vatnet
Guddalsvatnet
Dunsæd-vatnet
Lange-vatnet
Berefjord
Hidrasundet
Strandsfjorden
Stolsfjorden
Lafjord
2 km

Geology



Kirkehavn, west entrance to Hidrasund

Extreme wind events at Eigerøya weather station, 30km NW, 1994-2015 (Force 10, 25-28m/s, is annual):

08.12.1994 Force 11 (29-32m/s)

19.01.1995 Force 11

30.01.1995 Force 11

17.02.1997 Force 11

28.11.1999 Force 11

11.01.2005 Force 12 (>33m/s)

13.01.2007 Force 11

10.08.2014 Force 11

10.01.2015 Force 12 (>33m/s; max gust 45.6m/s)

Drystane farm ruin, Hidrasundet

Photo: Thomas MacDonell

<Våskeland: Old hill farm

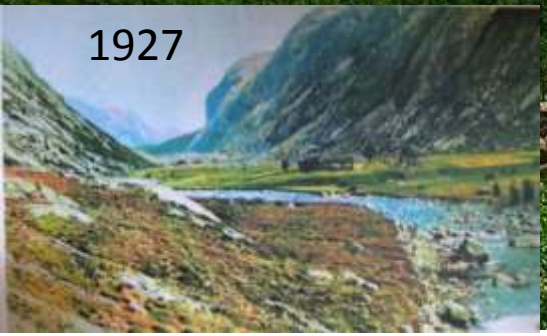
Røynes: Old hill farm

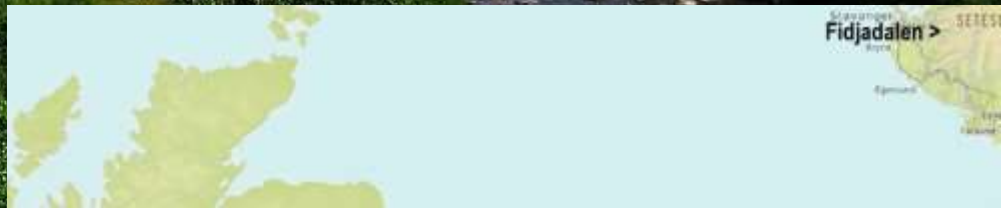
Tjellås: Old hill farm

http://www.kvinesdal.no/farmregister/

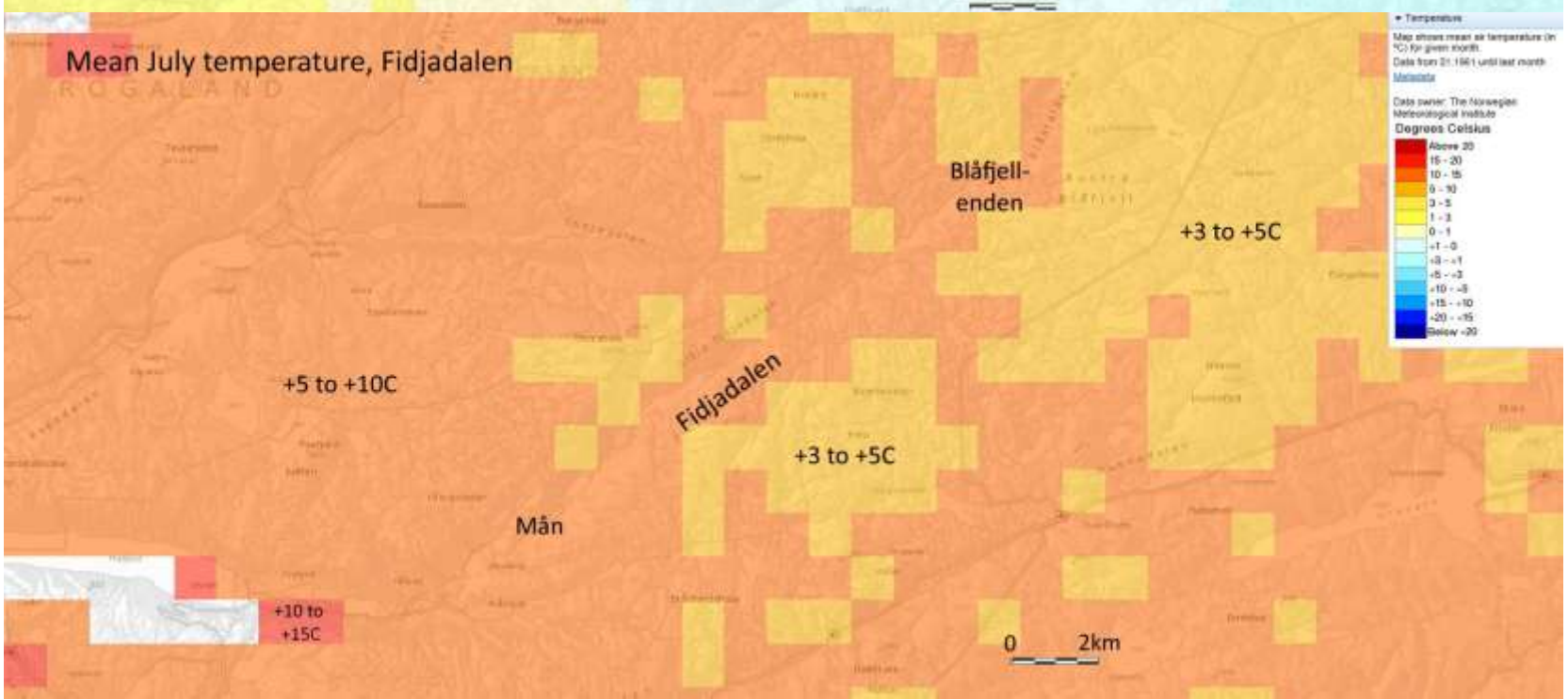
Elevation 352m asl

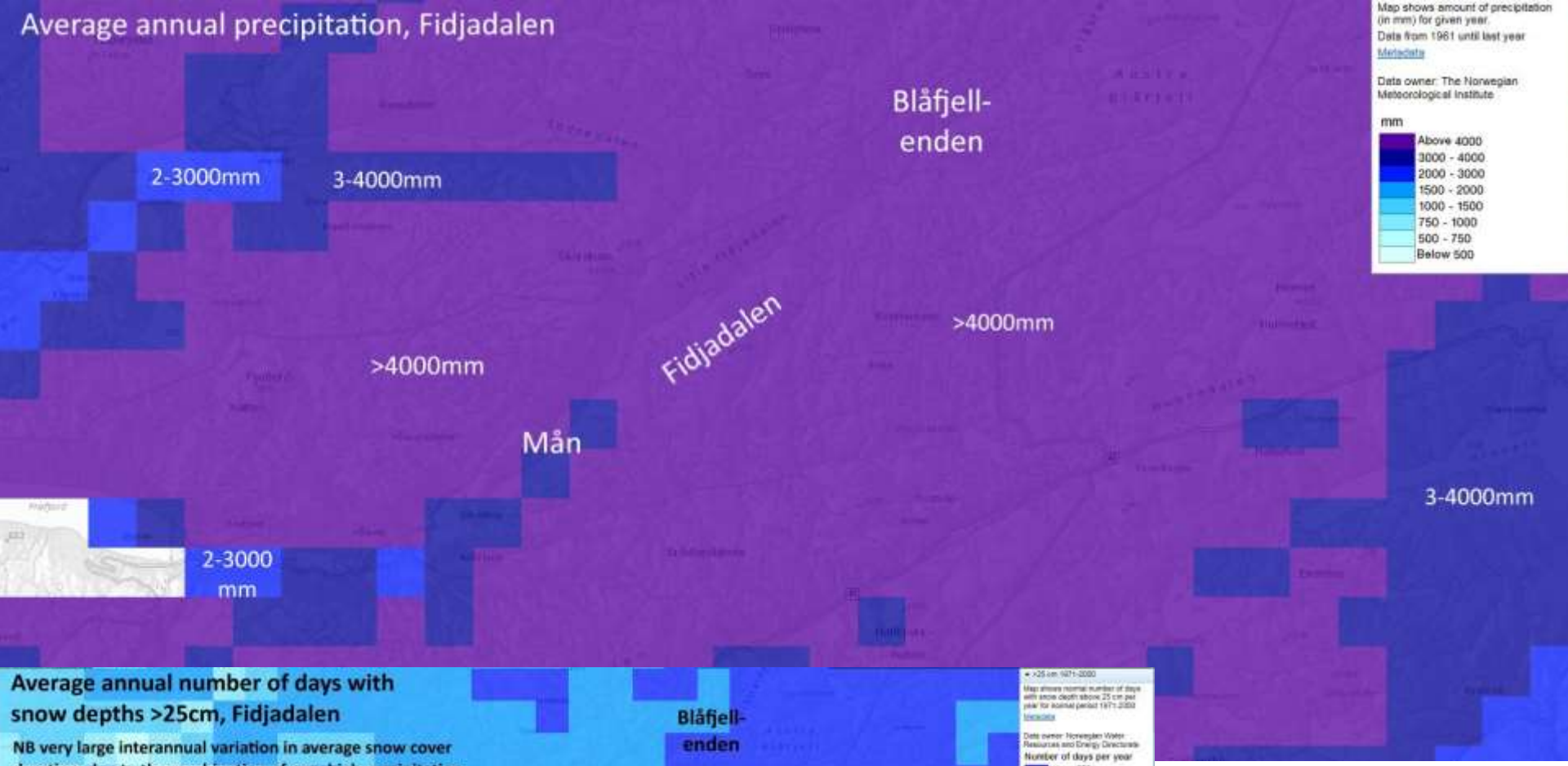
2. Mån & Fidjadalen

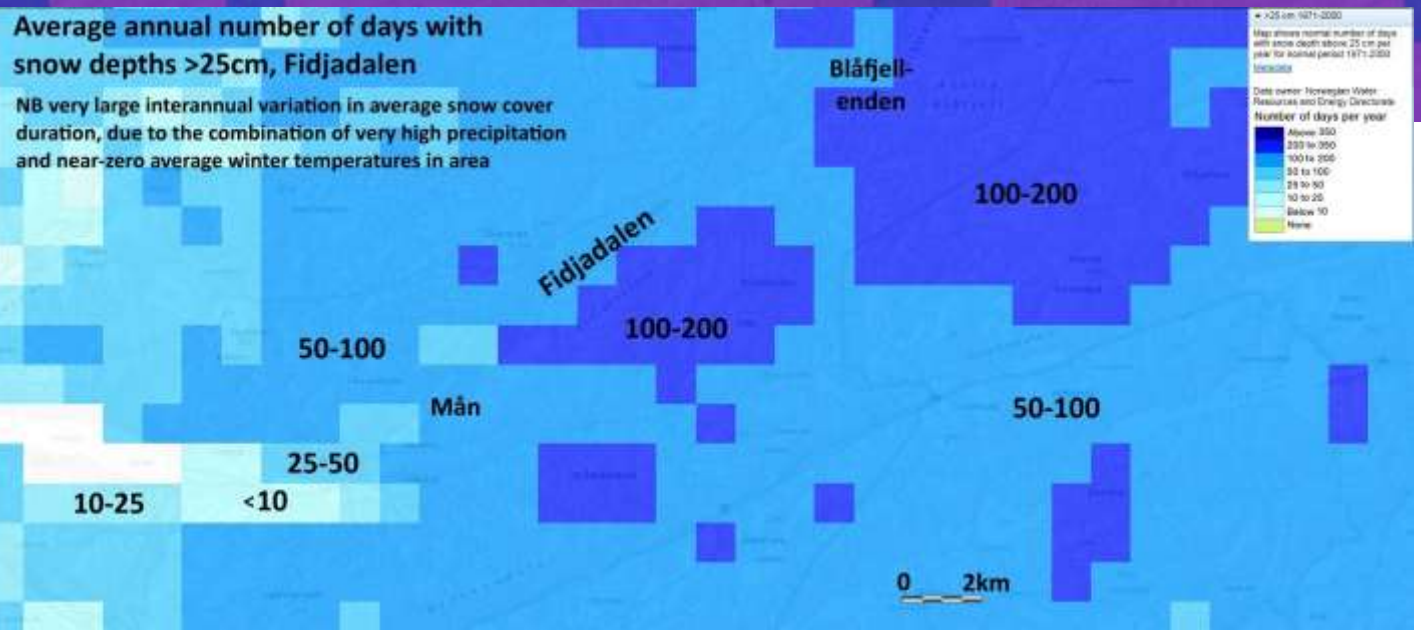




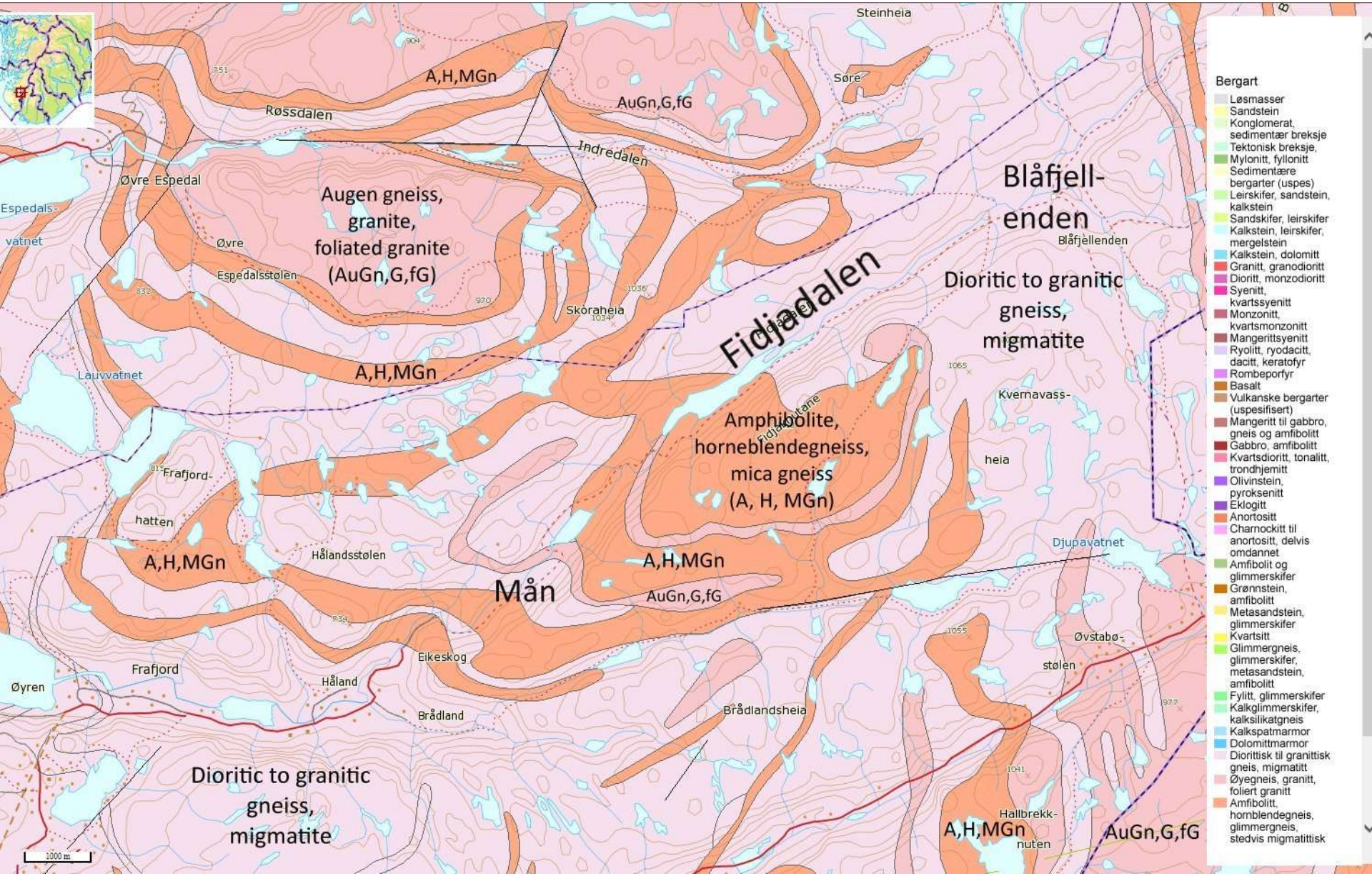

Mean January temperature, Fidjadalen
Blåfjell-
enden
+1 to +3C
0 to +1C
Fidjadalen
-1 to 0C
Mån
0 2km


Mean July temperature, Fidjadalen
Blåfjell-
enden
+3 to +5C
+5 to +10C
Fidjadalen
+3 to +5C
Mån
+10 to
+15C
0 2km


Average annual precipitation, Fidjadalen
Blåfjell-
enden
2-3000mm
3-4000mm
>4000mm
Fidjadalen
>4000mm
Mån
3-4000mm
2-3000
mm
Map shows amount of precipitation (in mm) for given year.
Data from 1961 until last year
Metadata
Data owner: The Norwegian Meteorological Institute
mm
Above 4000
3000 - 4000
2000 - 3000
1500 - 2000
1000 - 1500
750 - 1000
500 - 750
Below 500


Average annual number of days with snow depths >25cm, Fidjadalen
NB very large interannual variation in average snow cover duration, due to the combination of very high precipitation and near-zero average winter temperatures in area
Blåfjell-
enden
100-200
Fidjadalen
100-200
50-100
Mån
50-100
25-50
10-25
<10
0 2km
Number of days per year

NINA


Steinheia
A,H,MGn
AuGn,G,fG
Søre
Røssdalen
Indredalen
Øvre Espedal
Augen gneiss,
granite,
foliated granite
(AuGn,G,fG)
Espedals-
vatnet
Øvre
Espedalsstølen
Skoraheia
Fidjadalen
Blåfjell-
enden
Blåfjellenden
Dioritic to granitic
gneiss,
migmatite
A,H,MGn
Lauvvatnet
Kvernavass-
heia
Amphibolite,
hornblendegneiss,
mica gneiss
(A, H, MGn)
Frafjord-
hatten
A,H,MGn
Hålandsstølen
Djupavatnet
A,H,MGn
Mån
AuGn,G,fG
Øvstabø-
stølen
Eikeskog
Frafjord
Øyren
Håland
Brådland
Brådlandsheia
Dioritic to granitic
gneiss,
migmatite
Hallbrekk-
nuten
A,H,MGn
AuGn,G,fG
1000 m
Bergart
Løsmasser
Sandstein
Konglomerat, sedimentær breksje
Tektonisk breksje,
Mylonitt, fyllonitt
Sedimentære bergarter (uspes)
Leirskifer, sandstein, kalkstein
Sandskifer, leirskifer
Kalkstein, leirskifer, mergelstein
Kalkstein, dolomitt
Granitt, granodioritt
Dioritt, monzodioritt
Syenitt, kvartssyenitt
Monzonitt, kvartsmonzonitt
Mangerittsyenitt
Ryolitt, ryodacitt, dacitt, keratofyr
Rombeporfyr
Basalt
Vulkanske bergarter (uspesifisert)
Mangeritt til gabbro, gneis og amfibolitt
Gabbro, amfibolitt
Kvartsdioritt, tonalitt, trondhjemitt
Olivinstein, pyroksenitt
Eklogitt
Anortositt
Charnockitt til anortositt, delvis omdannet
Amfibolit og glimmerskifer
Grønnstein, amfibolitt
Metasandstein, glimmerskifer
Kvartsitt
Glimmergneis, glimmerskifer, metasandstein, amfibolitt
Fylitt, glimmerskifer
Kalkglimmerskifer, kalksilikatgneis
Kalkspatmarmor
Dolomittmarmor
Diorittisk til granittisk gneis, migmatitt
Øyegneis, granitt, foliert granitt
Amfibolitt, hornblendegneis, glimmergneis, stedvis migmatittisk

Mån
300m

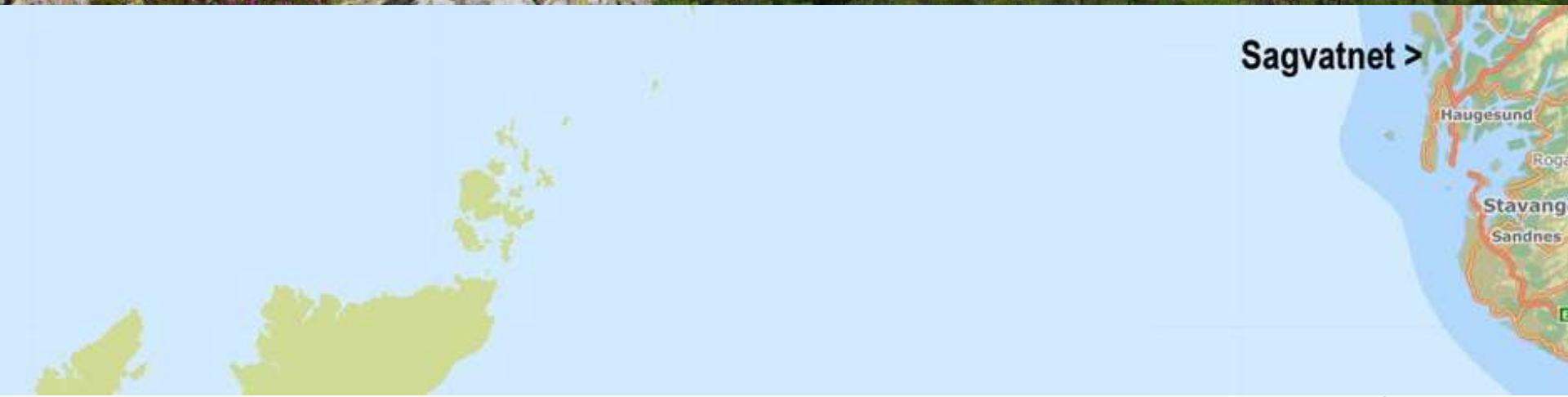
Månemyra
(Mån's bog)
580m

"Peat they took among other places from Månemyra. Peder relates that they found the roots of large trees up there"
-1987 oral history account by Peder Østebø, who lived at Mån until 1914.

‘Almost exactly 1000’ sheep are turned out to graze in Fidjadalen each summer. They graze in the glen itself and in the surrounding hills.
(Source: farmer at Eikeskogen below Fidjadalen, in conversation with the author)


Birch and aspen
colonising open scree

3. Sagvatnet, Bømlo



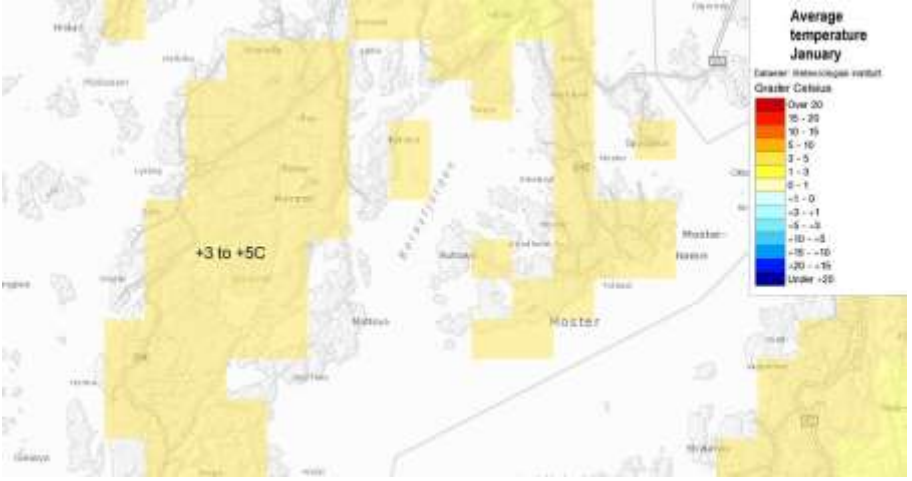
Sagvatnet

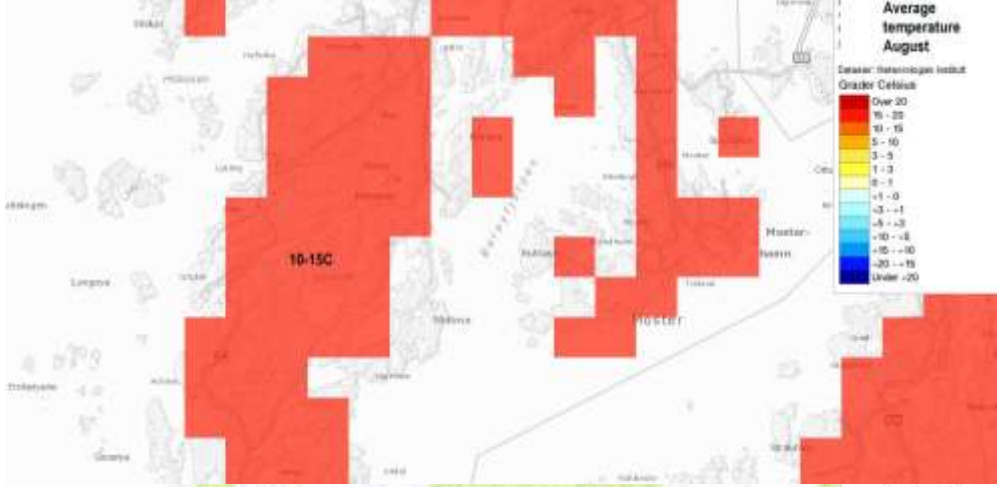
59.67421° N 5.31348° Ø

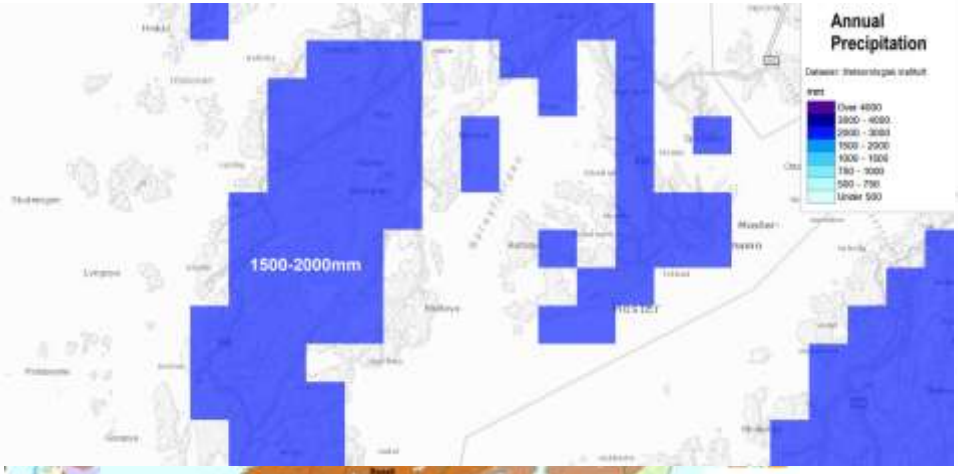
500 m

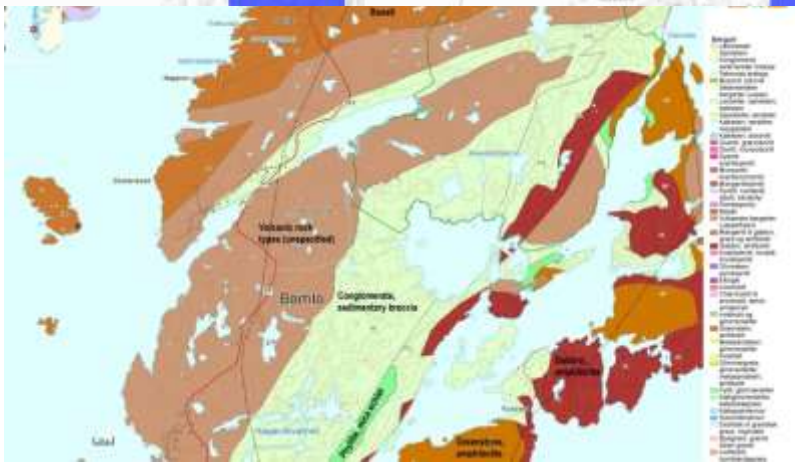
Woodland at Sagvatnet is predominantly Scots Pine.

Satellite images: www.norgeskart.no





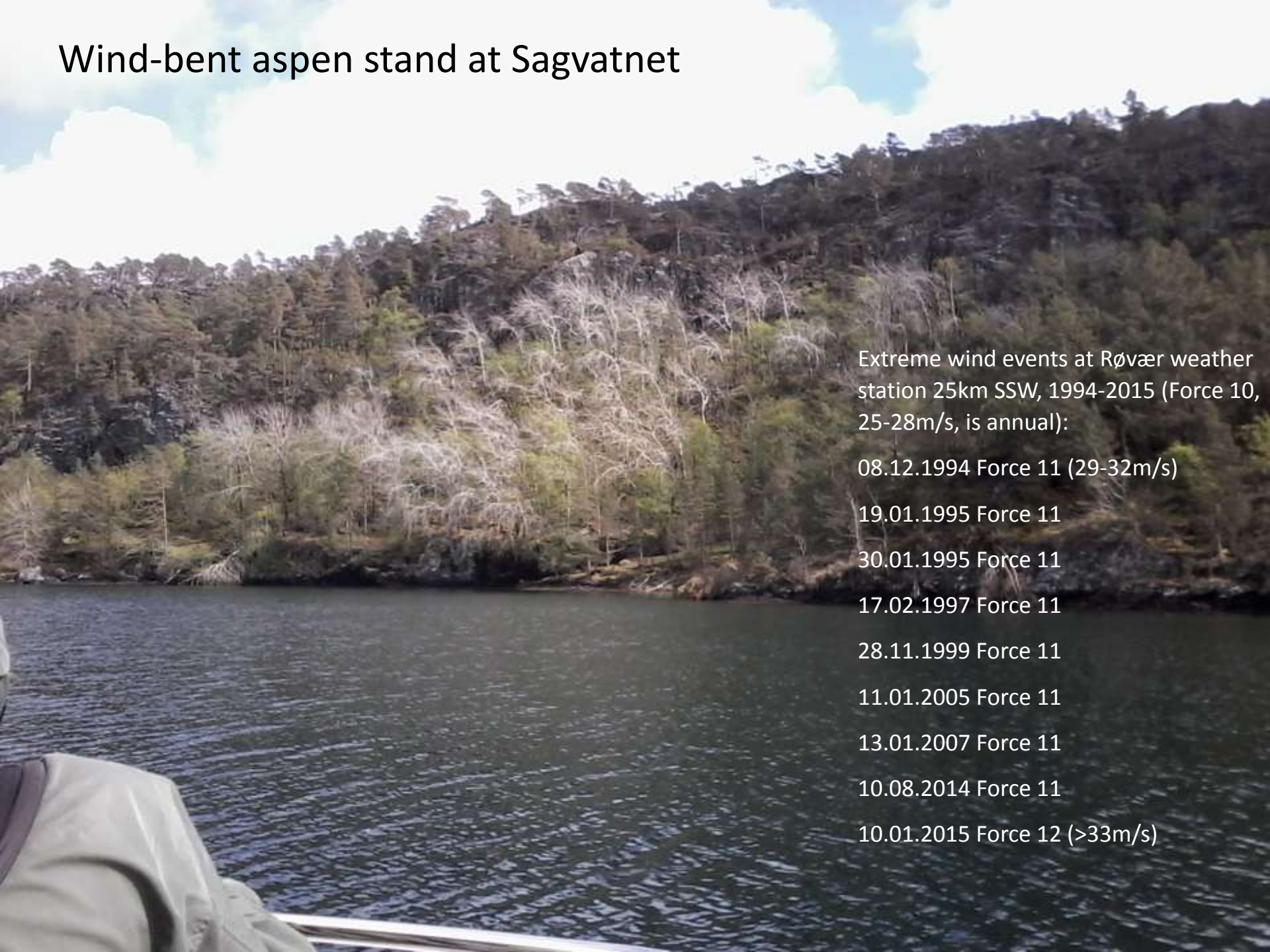




All trees at Sagvatnet are less than 150 years old. Most are under 100 years old. All are naturally regenerated. Previously coastal moor from Bronze Age until decline in grazing pressure associated with mass (voluntary) emigration in the later 19th and early 20th centuries.

(Steinsvåg, M.J. 2013. Forvaltingsplan for Sagvatnet naturreservat: Naturkvalitetar, bevaringsmål og forvaltingstiltak – Fylkesmannen i Hordaland, Mva-rapport 8/2013.)

Wind-bent aspen stand at Sagvatnet



Extreme wind events at Røvær weather station 25km SSW, 1994-2015 (Force 10, 25-28m/s, is annual):

08.12.1994 Force 11 (29-32m/s)

19.01.1995 Force 11

30.01.1995 Force 11

17.02.1997 Force 11

28.11.1999 Force 11

11.01.2005 Force 11

13.01.2007 Force 11

10.08.2014 Force 11

10.01.2015 Force 12 (>33m/s)

4. Natural treeline zonation: an example from Byklehaiene

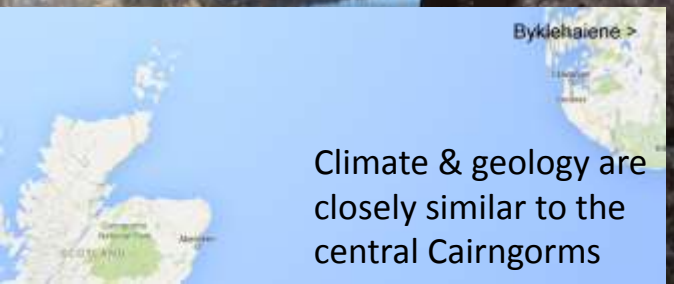
Alpine zone

Willow Region

Birch Belt

Pine woodland

- Heights of zone transitions are sensitive to climate. They decline towards the coast and tend to be lower on north facing slopes
- Nearer the coast there is little willow in the 'willow region', due to less protection from snow cover
- But there is always a zone of increasingly dwarfed open woodland above the timberline and below the alpine zone



Climate & geology are closely similar to the central Cairngorms

Pine-birch belt transition, Bykleheiane


Birch belt on Hovdenut
Hartevatnet 759m

On ridges, etc. where snow normally blows off in winter, dwarfed birches usually predominate. Willow is typically found in more sheltered locations with snow lie.

Willow zone c. 950m

(Typical ‘willow zone’ vegetation. The term means the zone where montane willows are common; not that the zone is all willow, or even dominated by willows. Birch, rowan, juniper and aspen are typically common as well; with krummhölz pine in some places.

This area was open moor 50 years ago; regeneration has followed decline in grazing pressures. Cows and sheep are still grazed at this site in summer at moderate densities; wild browsers include moose and reindeer)

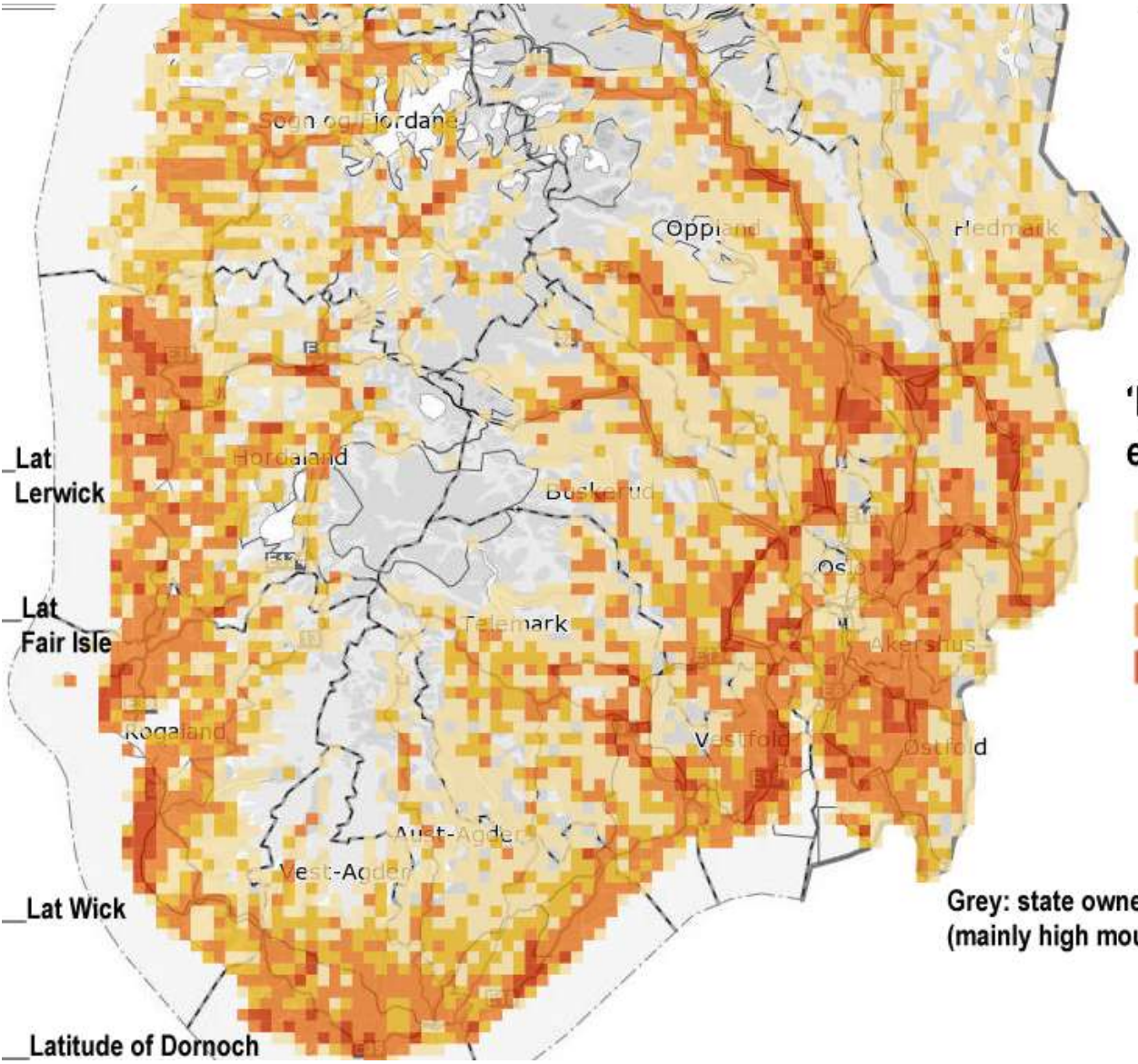
NINA


Hovatn 1100m

Hovden, Bykle

‘Landbruk’ – Land use

- ‘Landbruk’ (*pron. ‘landbrook’*) is a central concept in understanding how land is used in Norway.
- ‘Landbruk’ literally translates as ‘Land Use’
- But is usually translated into English as ‘farming’ or ‘agriculture’. This can be misleading.
- ‘Landbruk’ is a wider concept. It means making a living from the land, most usually from diverse sources.
- Usually several income generating activities are carried out on any given piece of land, by the same owner/occupier landowner. Monocultural use is rare, except on arable fields.



'Land Use' (farming, forestry, hunting etc) properties per 5km grid square

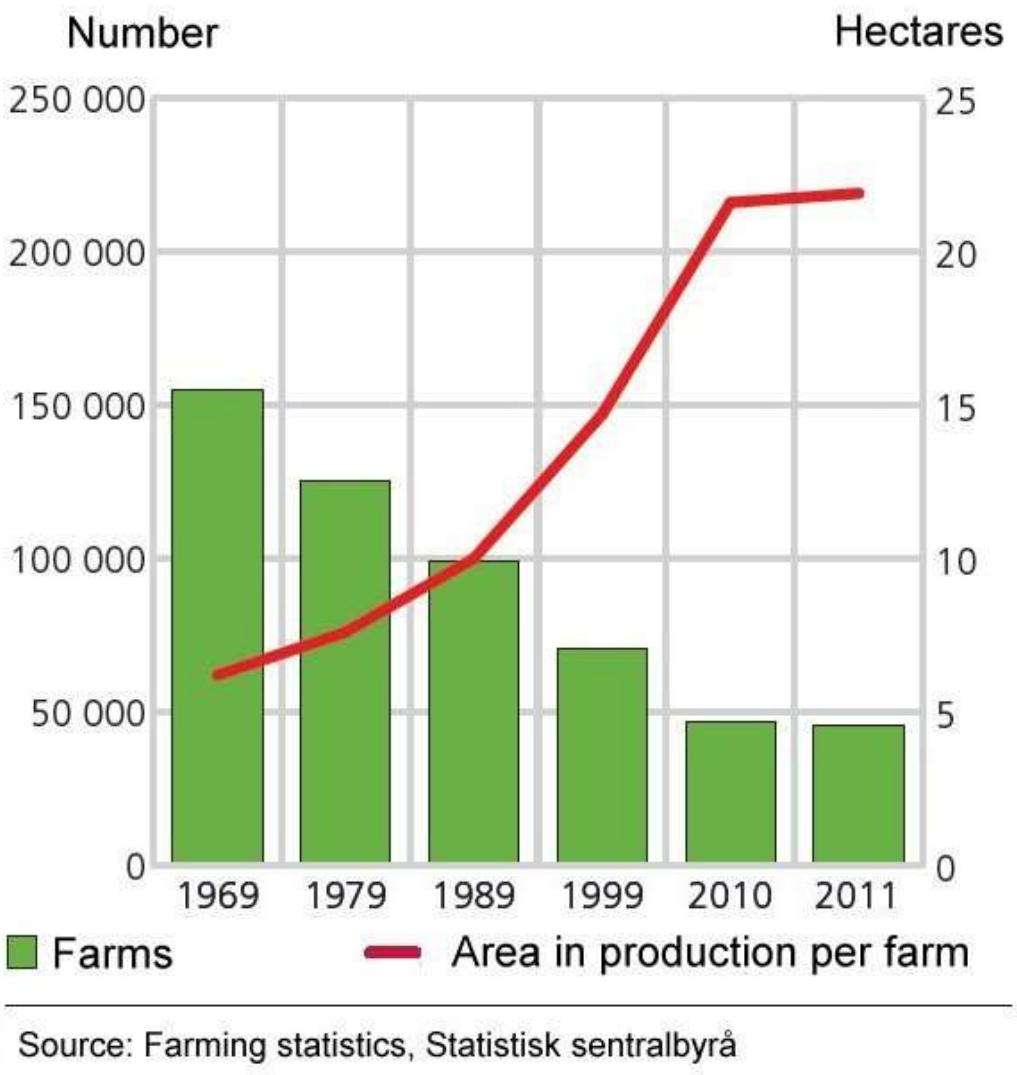
- 12 or fewer (<0.5/sq km)
- 13-25 (0.5-1/sq km)
- 26-75 (1-3/sq km)
- 76 or more (>3/sq km)

Grey: state owned, state common lands ('Statsallmenning'), etc. (mainly high mountain plateaus above the natural treeline)

Source: Statistics Norway (www.ssb.no)

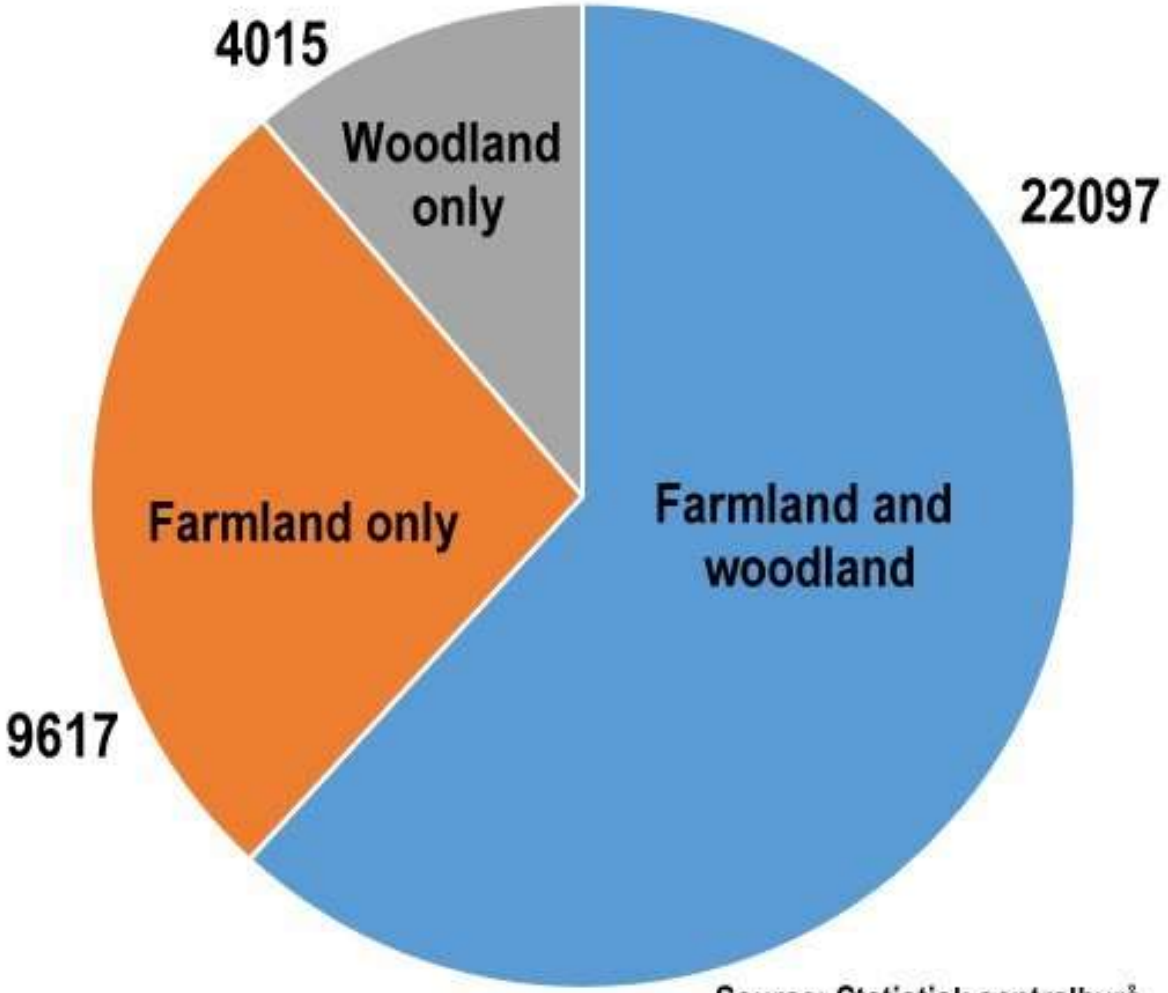
NINA

Number of farms practising agriculture, and average area of arable and improved pasture per farm, Norway, 1969-2011



Source: Farming statistics, Statistisk sentralbyrå

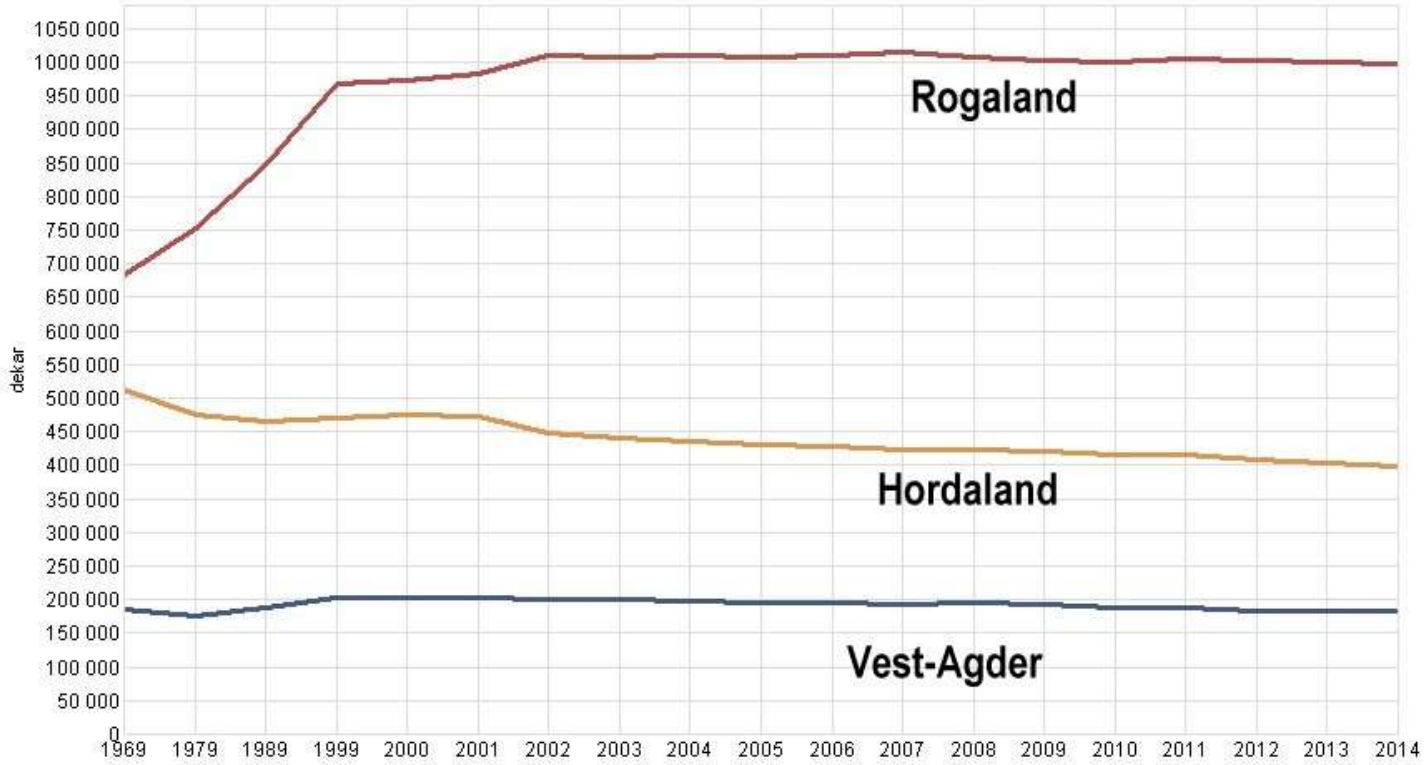
Land use properties with different combinations of farmland and woodland, SW Norway (Vest Agder, Rogaland, Hordaland), 2010



Source: Statistisk sentralbyrå

NINA

Area of enclosed fields in production by province, SW Norway, 1969-2014



10 decares (dekar) = 1 hectare

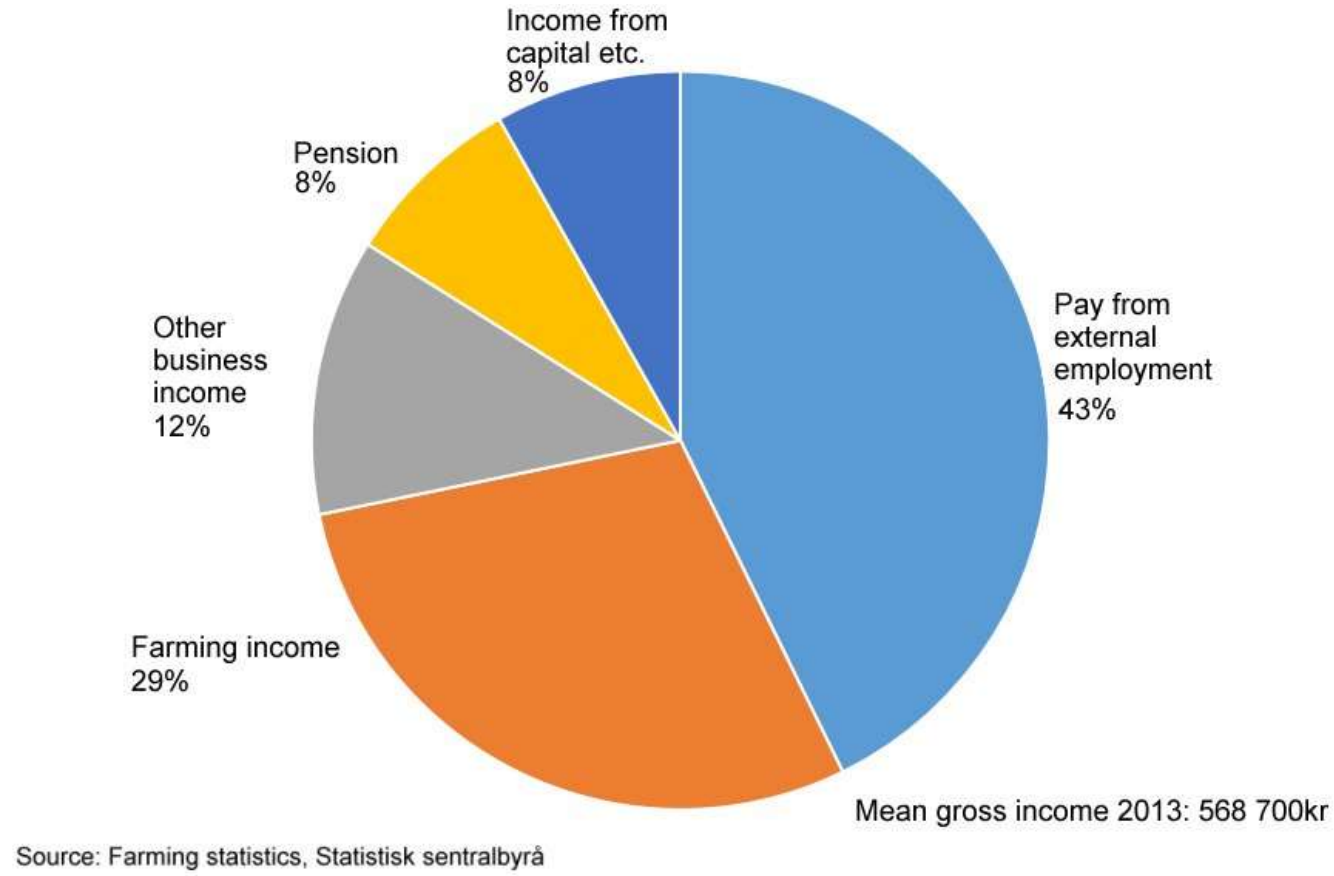
Kilde: Statistisk sentralbyrå

The increase in Rogaland (300km^2) is due to conversion of moorland to arable and improved pasture.

Slow declines in Hordaland and Vest-Agder largely due to small outlying fields going out of production.

NINA

Average % farm owner's income by source, Norway, 2013



Source: Farming statistics, Statistisk sentralbyrå

6.4% of the population of SW Norway are resident on Landbruk properties.

While ownership is individual, properties are typically worked by families.

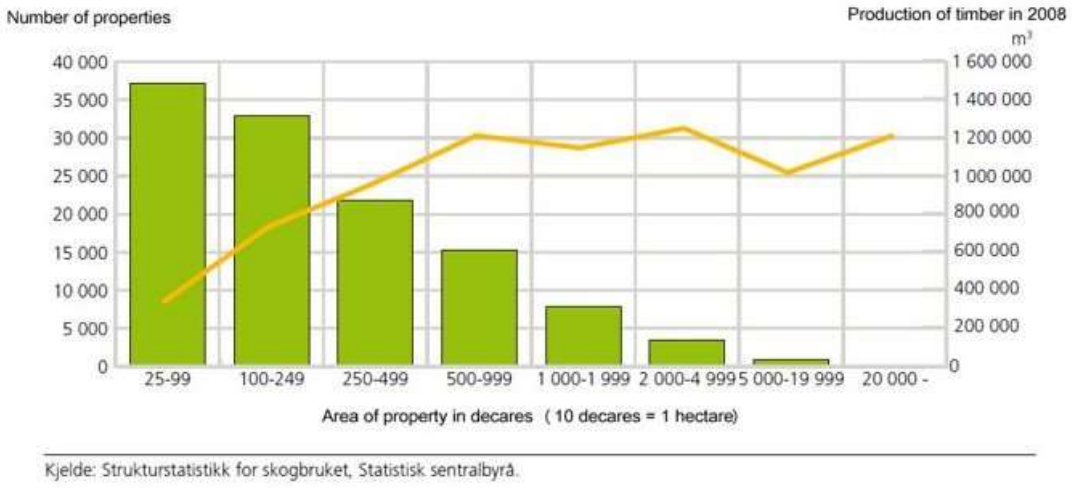
Photo: http://www.landbruk.no/

Woodland

http://www.nordicforestry.org/facts/Norway.asp

Ownership structure

- 119600 woodland proprietors in 2008 (Total population: 4.9 million)
- Average property 58 hectares 'productive woodland'*
- 97% of owners private individuals
- 80% of area owned by private individuals
- 20% of area owned by forestry companies, state, etc.
- Forestry employs 3900 full time equivalents in direct timber harvesting
- The wider industry (processing etc) employs 22000 full time equivalents



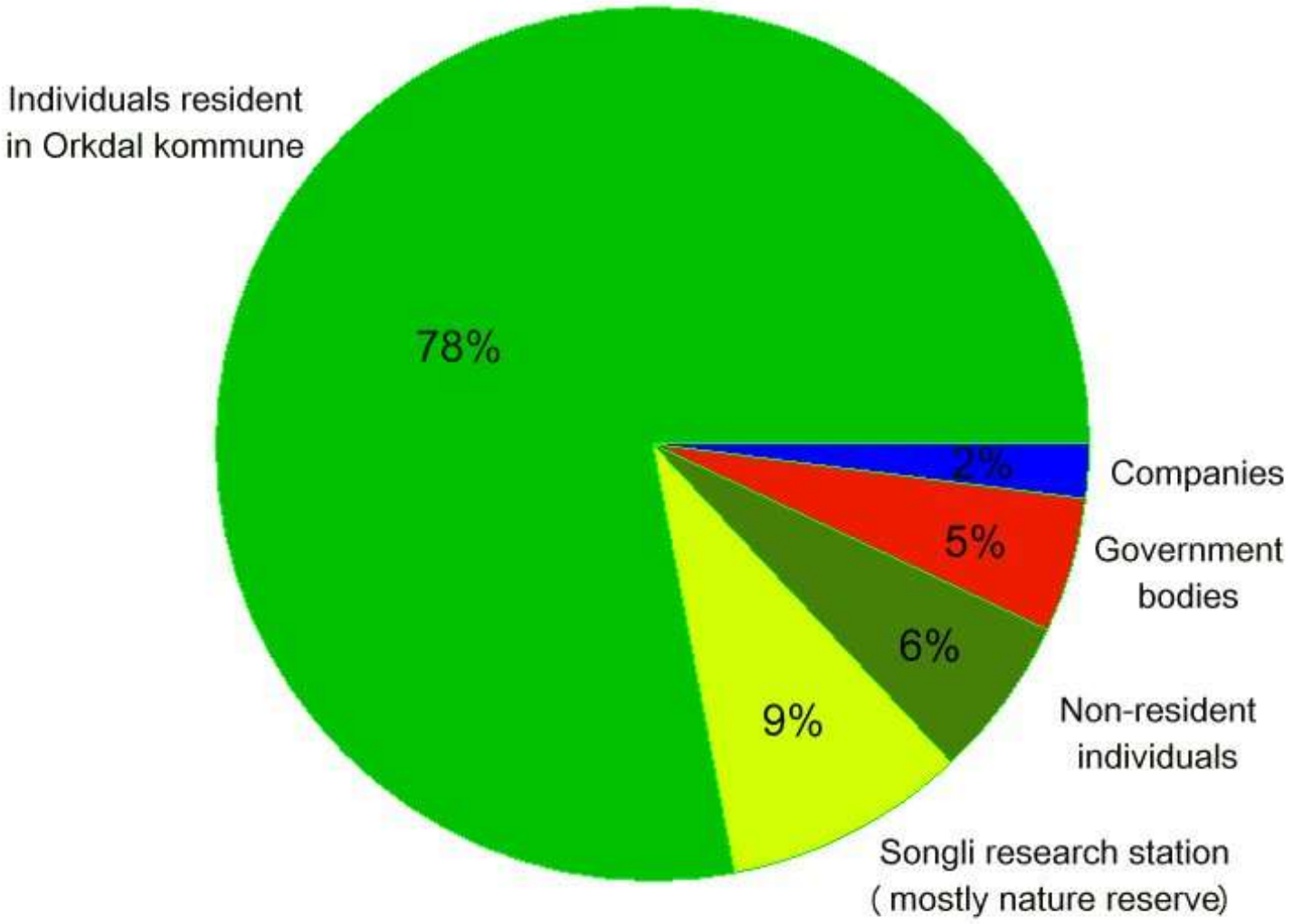
Kjelde: Strukturstatistikk for skogbruket, Statistisk sentralbyrå.

(all Norway)

*definition: area with annual growth of woody mass >1m³/ha

NINA

Forest ownership in Orkdal kommune, Norway



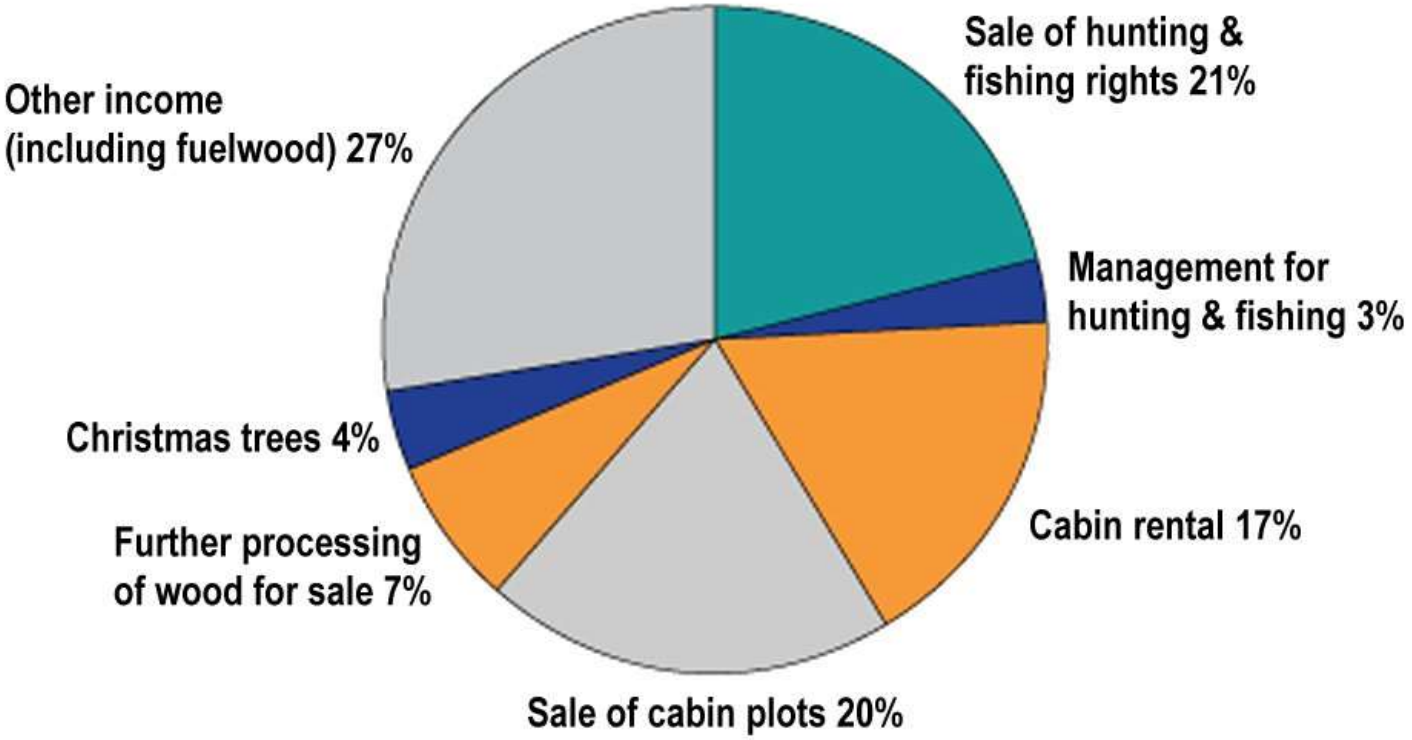
Data by area.
Source: Orkdal kommune

NINA

Forestry cooperatives

- Most forest owners belong to regionally-based forestry cooperatives
- These do the bulk of timber management, harvesting and sales
- This allows for investment in modern machinery and other economies of scale
- Woodland is exploited for other purposes (hunting, grazing, recreational sales, etc.) by the landowner individually

Non-timber sources of income from woodland, Norway, 2007



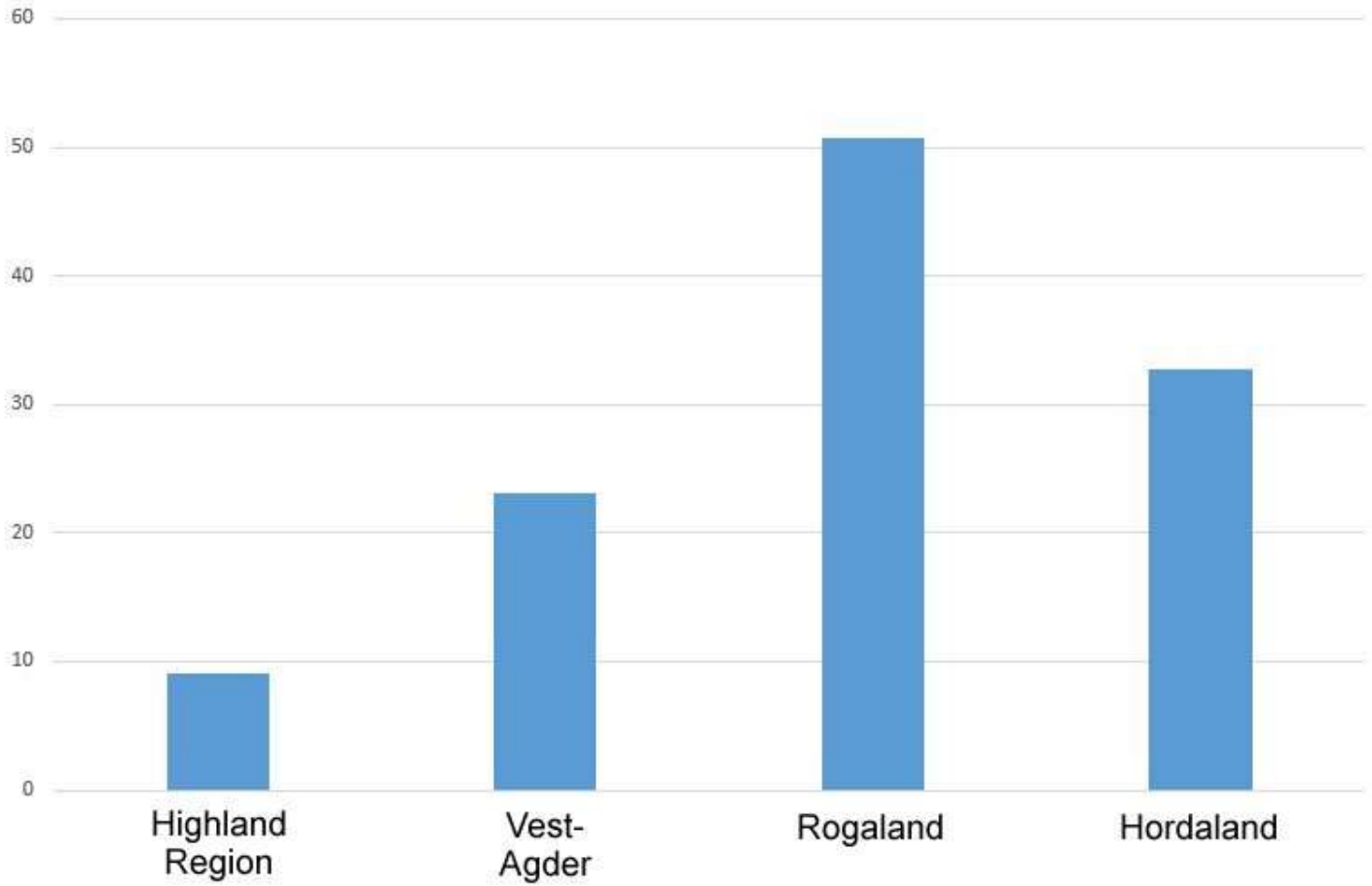
Source: Statistisk sentralbyrå

Data for all Norway.

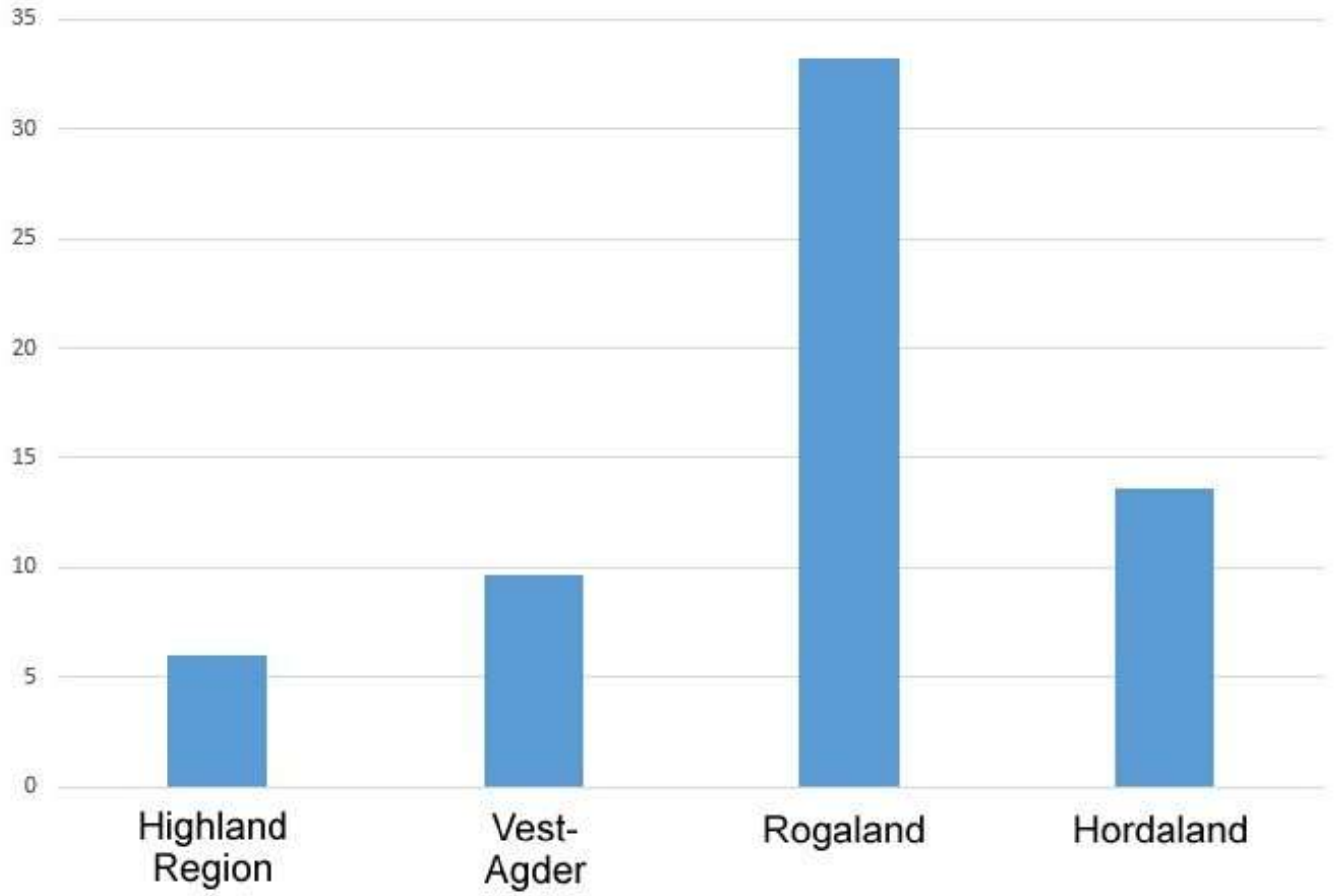
Does not include grazing of domestic stock.

NINA

Population densities (residents/km^2), Highland Region and SW Norway



Population densities (residents/km^2) Highland Region and SW Norway, excluding main urban settlements



Inverness, Kristiansand, Stavanger (including Sola kommune), Bergen excluded

View from Hovdenuten (1119m)

- SW Norway is closely similar in the basic conditions of life (climate, landforms, geology) to Highland Scotland, as comprehensive data demonstrates.
- It was formerly strongly deforested; in coastal regions almost completely so since at least the Bronze Age.
- It has reforested, largely through natural regeneration, since the late 19th century, and especially since the 1950s.
- Research demonstrates that this been a result of reductions in grazing intensities and associated land uses (e.g. muirburn, fuelwood).
- Natural reforestation is continuing at a rapid rate.
- Much of this regeneration is occurring on wet peat soils formed during the deforested period.
- Including on hard, infertile rock types in very wet, mild, and windy ocean-edge locations.
- It was and is a working cultural landscape.
- Land use is diversified, typically with multiple income streams from the same property; including agriculture, grazing, forestry, hunting and fishing sales, fuelwood production, cabin sales and rental.
- Most land is privately owned; owner-occupation is typical and strongly encouraged by government policy.
- Landbruk properties are much smaller than the typical holding in Scotland.
- Most are an element in a wider family income
- The overall population density on the land is higher than in Highland Scotland


Photo: Erlend Tøssebro

Forestry

Much woodland is in clear-fell rotation for timber (as primary use)


Much is in mixed-use for timber, firewood,
grazing, hunting, and forest products


Trees in this form of management are felled in
small cuts, or selected individually (”plukkehøgst”).
This results in a more varied woodland structure.

Grazing

Population of sheep, SW Norway (summer): c. 450 000 Source: Statistisk sentralbyrå

Hunting

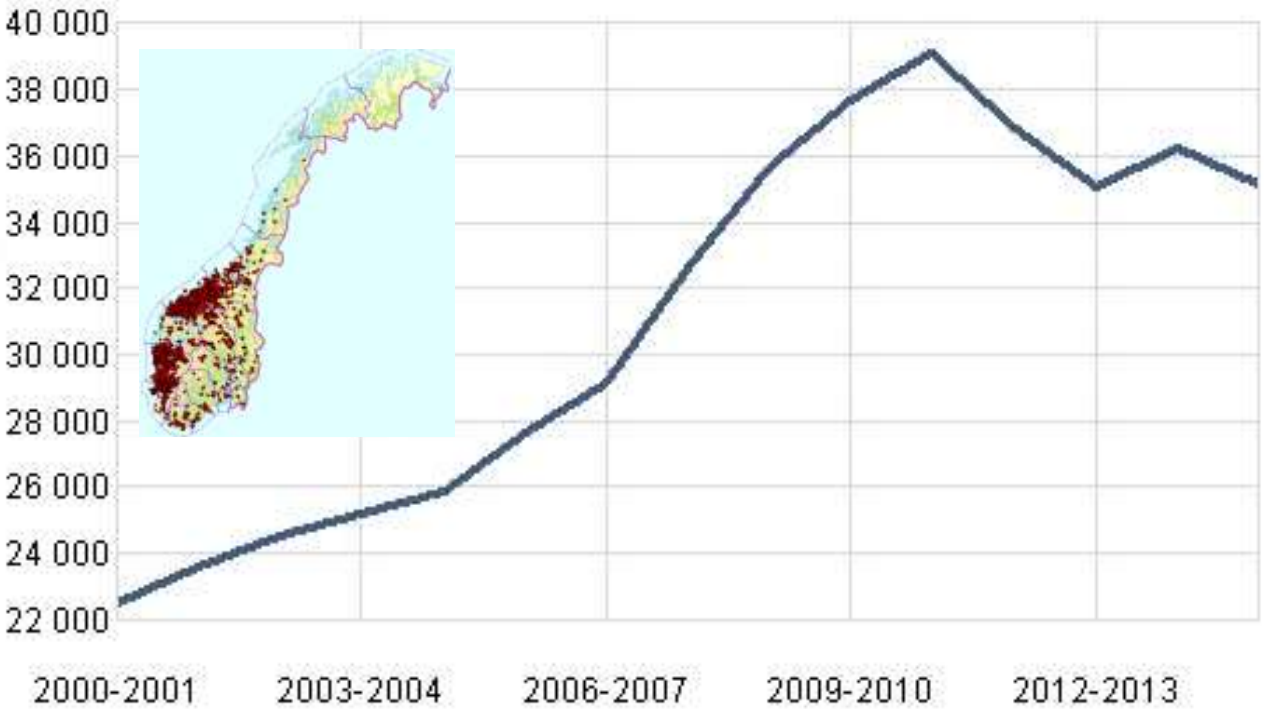
NINA

A hunting culture

- There were 473 100 registered hunters in Norway in 2014; 9.5% of the total population.
- 201 400 people paid the annual hunting licence fee (which pays for the game management system).
- Of whom 199 300 were Norwegian; 9% of adult males paid the fee.
- The game resource is a public asset (as in Scotland).
- Hunting rights are owned by the landowner (as in Scotland).
- Management is through a publically accountable system, in which government, communities, landowners, and hunters have clearly defined roles.
- Red and roe deer, and grouse, are the main game species in SW Norway



Red deer harvest, Norway 2000-2014



Source: Statistics Norway

Decline from 2010-11 hunting season is due to managed population reduction.

Source: Solberg, E. J., Strand, O., Veiberg, V., Andersen, R., Heim, M., Rolandsen, C. R., Solem, M. I Holmstrøm, F., Jordhøy, P., Nilsen, E. B., Granhus, A. & Eriksen, R. 2015. Moose, red deer and reindeer: Results from the monitoring program for wild cervids, 2012-2014. NINA Report 1177. 58 pp.

Reasons for managed reductions

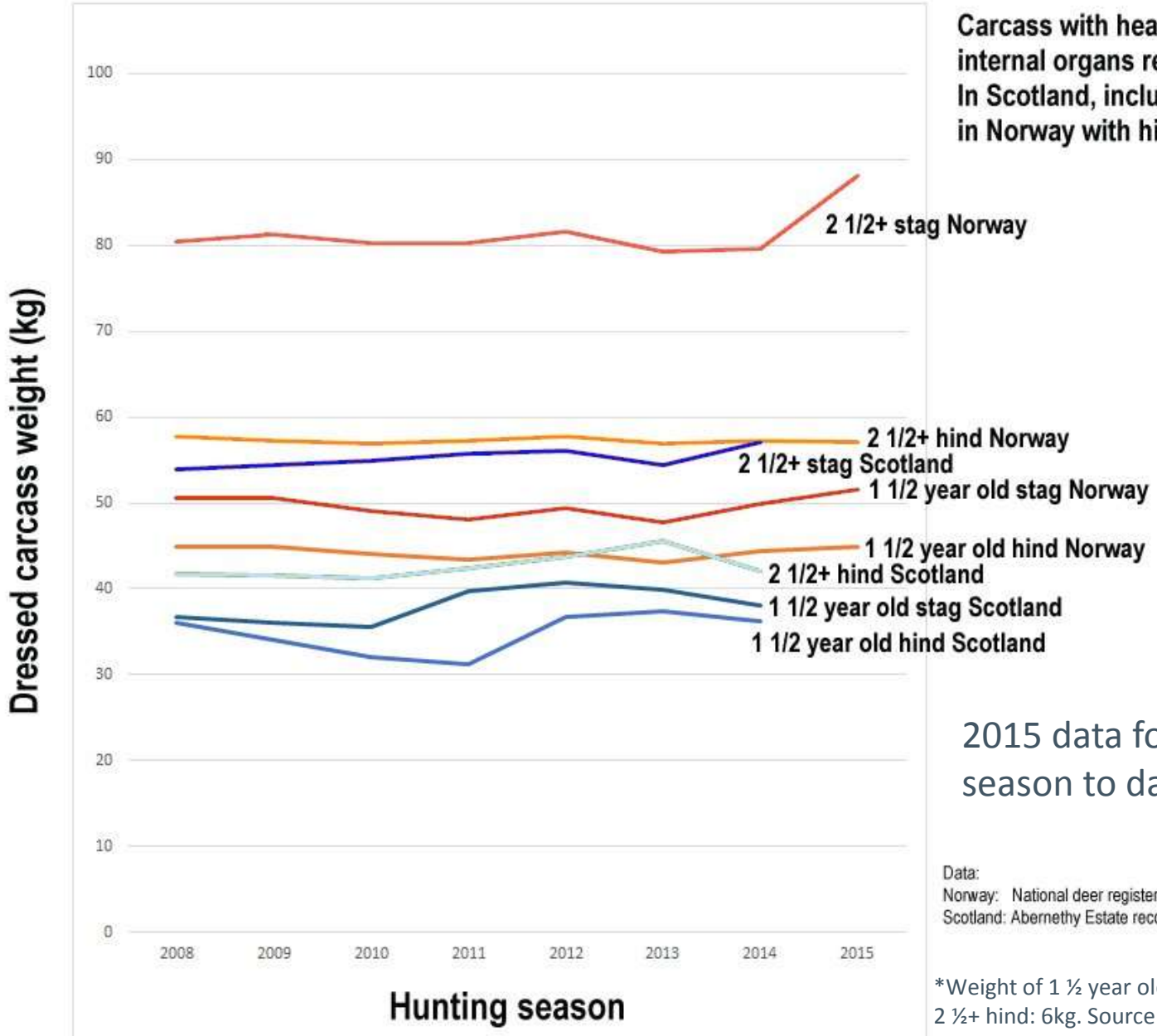
- Carcass weights, body condition, and calving % all started to decline in recent years, due to incipient competition for food.

This indicated populations had risen to a point beyond the optimal for harvest purposes, and an animal welfare issue

- Reducing road accident risks.

- Reducing negative impacts on forestry and agriculture.

Dressed carcass weights of red deer in Norway and Scotland, 2008-15



Carcass with head, lower limbs, internal organs removed.
In Scotland, including hide;*
in Norway with hide removed

2015 data for Norway is for season to date

Data:
Norway: National deer register (www.hjorteviltregisteret.no)
Scotland: Abernethy Estate records

*Weight of 1 ½ year old Scottish hind hide, 2015: 5kg
2 ½+ hind: 6kg. Source: Deer Consultancy Services

Gathering

Berries, fungi and common flowers may be picked by anyone as part of ’Allemannsretten’ (’Everyman’s right’)



Fuelwood

2009 household fuelwood consumption: 1 600 000 tonnes (9% up on 2008); or 816kg per household*

2008 declared income from fuelwood sales: 323 million kroner (£37 million)*

*Source: Statistisk sentralbyrå


Education


Most Norwegian children go to kindergarten
All kindergartens often go on excursions into the woods
About a third of kindergartens are ”nature kindergartens”, outdoors all day in most weathers

<Photos: Niall Benvie

Excursions and longer stays (’camp school’) in the outdoors are a required part of the curriculum throughout the period of compulsory education

Hytter (cabins)

Number of cabins, summer houses, etc, Norway, 2009: 398 884
(1 per 12 inhabitants)
Source: Statistisk sentralbyrå











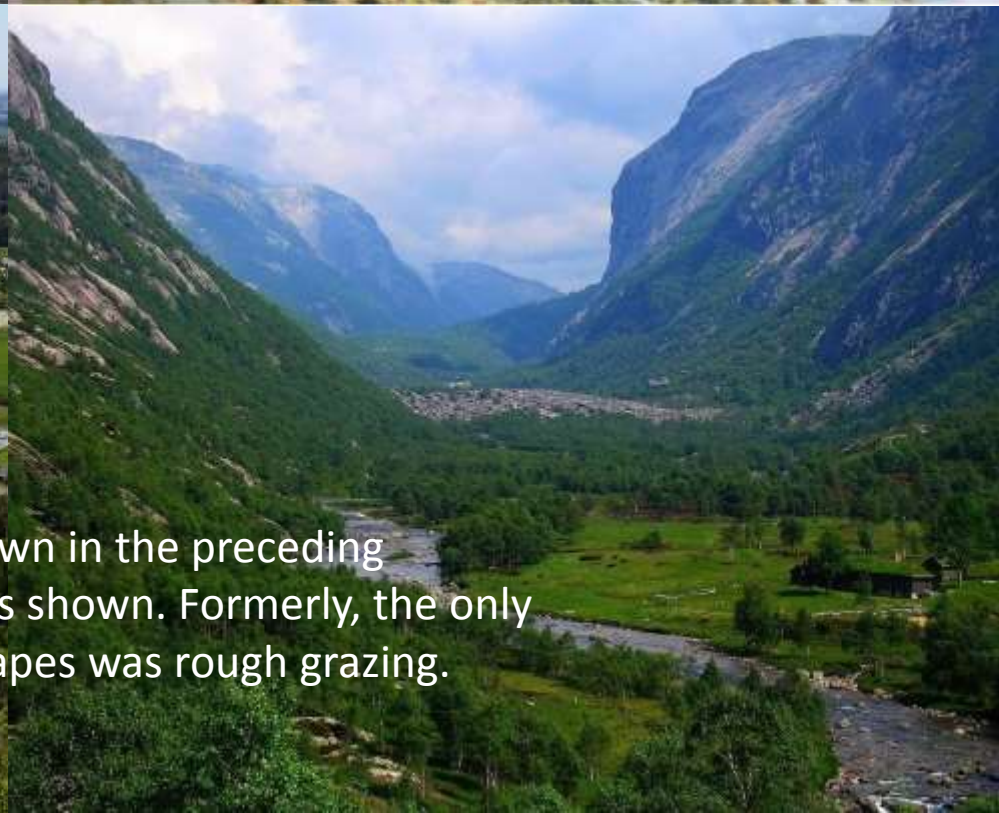

www.ut.no

Hiking and rambling (etc.)

Det norske turistforening (Hiker's Association) membership: 258 000 (5% of population)

”Oot on tour – never soor!”

(392 000 hits for exact phrase, Google)



All of the economic and social activities shown in the preceding sequence take place today in the landscapes shown. Formerly, the only significant economic activity in both landscapes was rough grazing.
See also HD video of Tysnes island

Photo: Erlend Tøssebro


N59°
Dyce-Stavanger: 470km
W 10°
W 5°
N57°
Hovedmeridian
E 5°
N55°
Dyce-Gatwick: 695km
N53°
(Turnhouse-Stavanger: 3hrs50min via Copenhagen)
N51°

[Frafjord cabins](). Sleeps 6, 750kr/night or £9.56/person/night

[Bjåen Turisthytte](), Bykleheiane. Sleeps up to 22, £15/person/night

Example of costs

- September 2015: 5-night study tour from Scotland, 15 people, to SW Norway (Stavanger- Hidrasund-Frafjord- Bykle-Stavanger) ex Aberdeen, all flights, car rental, fuel, accommodation, food (self-catering) included: £560/person.