Mountains in a Changing Climate

- a journey through time and space on Getryggen

Jämtland County
Administrative Board

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Photo: Lisa Öberg, 21 May 2010.

Getryggen.

Welcome to *Mountains in a Changing Climate - a journey through time and space on Getryggen* – in a constantly changing, but always beautiful and inspiring mountain landscape.

A century ago, the treeline was in a state of fast descent. Today, the situation is exactly the opposite. The trees are able to grow higher up on the mountains as the climate becomes increasingly warm. This means that many people are worried that the trees and forest will take over and the open mountainsides will disappear.

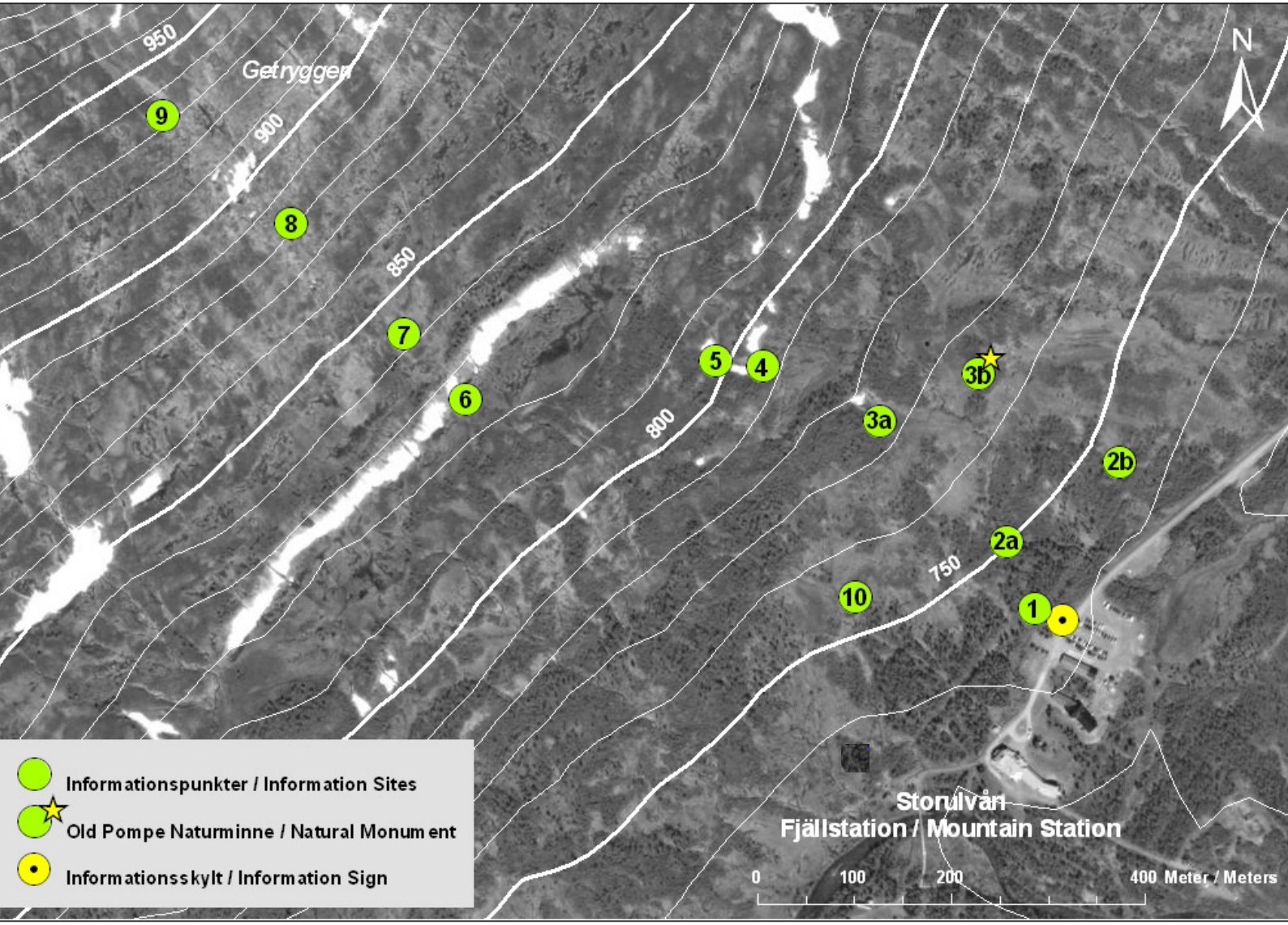
See it with your own eyes

The aim of this information project is that you can see for yourself and understand how the mountains and their vegetation change as the climate changes. This journey provides a dizzyingly long perspective through time and space and demonstrates what is happening around us right now. We trace the mountain vegetation development back to the time when the last ice sheet melted, more than 10,000 years ago.

Make the journey on foot at Mt. Getryggen, close to Storulvån Mountain Station, using GPS and the coordinates provided here. This publication (also available in Swedish) can be downloaded at oldtjikko.se.

Jämtland County Administrative Board

Photo front page: Lisa Öberg, 21 may, 2010.



Information sites

- Site 1: Spruce treeline in 1915 - 740 meters above sea level.
- Site 2a: Current overgrowth - 750 meters above sea level.
- Site 2b: Pine treeline 1975- - 750 meters above sea level.
- Site 3a: The small-white orchid (Pseudorchis albida) – 775 meters above sea level.
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- Site 4: The transformation from permanent snow patch to mountain birch forest – 790 meters above sea level.
- Site 5: Birch treeline in 1915 – 805 meters above sea level.
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- Site 8: The birch treeline in the 1970s and in 2010 – 880 meters above sea level.
- Site 9: The low-alpine zone – 940 meters above sea level.
- Site 10: Warmth demanding deciduous trees in the mountain birch forest – 760 meters above sea level.

Good to know before going into the field:

Path's total length: approx. 2.5 kilometres
Climb: 200 m (740 – 940 m)
Time: 3-4 hours
Difficulty: the path is relatively easy underfoot, but there are wet areas, so walking boots or wellies are recommended.

The walk …

…starts at the elevation at which the highest-growing Norway spruce, at least 2 m tall, was found around 100 years ago, i.e. at the spruce treeline in 1915. We then follow the trees and the various treelines up to a place just above the maximum elevation for mountain birch – the present-day treeline fringing the open mountainside. From there, you take the path back down again.

Photo: Leif Kullman.

The mountain birch treeline in 1915, 810 meters above sea level.

Why Getryggen?

Photo: Leif Kullman..

The mountain birch treeline in 2010, 905 meters above sea level.

This information is based on scientific surveys that have been continually performed since the early 1900s on the mountain Getryggen, in the western part of Jämtland. Getryggen has also been part of the County Administrative Board of Jämtland's environmental monitoring of the alpine treeline since 2007.

By visiting the different points along this information path, you will find out how the treelines of the most common tree species in this region - mountain birch, Norway spruce and Scots pine - has changed, as a response to climate change.

Climate change also affects the depth and duration of snow cover, the length of the growing season, soil frost, ground moisture and the availability of nutrients. Along this path, we demonstrate the importance of these matters and what the consequences might be for the mountain vegetation.

Photo: Leif Kullman.

Glacier buttercup

Foto: Leif Kullman.

The glacier buttercup grows alongside snow patches and on other sparsely vegetated, damp ground in the mountains. It is one of the species that can be found very high in the mountains. On Getryggen's summit plateau, it is found just below the highest peak (1380 meters above sea level), but it can also be found considerably lower down the slopes. Initially, the glacier buttercup's petals are white, but later they turn almost purple.

The temperature changes with the altitude

Many species here in the mountains exist on the edge of survival. Small changes in climate are often enough to have noticeable effects on the flora and fauna.

Most people know that it gets colder higher up a mountain. We know instinctively when it's time to turn around and go home again. This is sort of what it's like for the mountains' plants and animals. There is a limit to what they can cope with. Of course, most animals can move up and down the mountain as the weather changes, just as we can. For the plants it's the climate, the variations in the weather over a long period of time, that governs where and at what altitude they can grow and survive.

When the climate becomes warmer, it is possible for the plants to spread up the mountainsides. How wet or dry the ground is, and how long the snow lasts into the spring and early summer are also important factors.

When the last ice sheet began to melt

When the last ice sheet began to melt, just over 15,000 years ago, it was the highest mountain peaks that first appeared. Quite soon, the seeds of the first plants germinated.

It was considerably warmer then than today, and the emerging mountain landscape was quite different from how it is now. Wood remnants reveal that pine grew just below the top of Getryggen, 10,300 years ago.

As the ice melted and retreated, trees and other plants spread down slope the mountainsides. Some of them even spread further east.

Eventually, the climate cooled and the treelines gradually dropped. The treeline was at its lowest point ever about 100 years ago. At that point of time, we only had to walk up about 50 vertical metres to reach the mountain birch treeline – and the low alpine region. Nowadays, we have to go 165 vertical metres up to reach the open mountainside. During the 20th century, the climate changed – it began to get warmer again. The mountain plants could start spreading uphill again.

Reindeer – a natural part of Getryggen's fauna

Wild reindeer were among the first animals to arrive here after the ice sheet had retreated. Reindeer and other herbivores followed the plants as they appeared – and the animals were followed by people, who needed both meet and clothing.

An arrowhead that is about 1,000 years old has been found on Getryggen's summit plateau. It revelas that this mountain was used for hunting wild reindeer. Mount Getryggen has traditionally been called "The Wild Reindeer Peak" by the local Sami people.

The Reindeer's grazing and trampling help to keep the mountains open, just as we humans have recently become used to believing that the mountain "should" look.

Photo: Leif Kullman.

Reindeer husbandry

Getryggen is an important area of the state-owned reindeer grazing land on which reindeer husbandry may be conducted year-round by members of Handölsdalen Sami community. Small-scale reindeer husbandry has been carried out in the area for at least 1,000 years and was most intensive from the 1600s to the mid-1800s.

All visitors are requested to respect the reindeer found in the area. For more information about the special rules that apply in reindeer grazing areas, contact the County Administrative Board of Jämtland (see the contact information at the end of the document).

Photo: Lisa Öberg, 2009.

SITE 1: THE SPRUCE TREELINE IN 1915 – 740 METERS ABOVE SEA LEVEL.

A century ago, the spruce treeline was about here (730 meters above sea level). The Norway spruce tree in the pictures were the uppermost spruce on this part of Getryggen that had grown to at least 2 meters tall. This spruce, or spruce clone, is at least 5,200 years old. Its oldest living stem is around 400 years old. This spruce is growing a few kilometres northwards.

The spruces found around here at the beginning of the 1900s were scattered across the light and open mountain birch forest. Many of the spruces found here today are very old.

Please, continue to the new spruce treeline (Site 3b) – to the spruce Old Pompe, at least 5,700 years old.

Photo: Lisa Öberg, 2009.

Photo: Lisa Öberg.

SITE 2A: CURRENT OVERGROWTH - 750 METERS ABOVE SEA LEVEL.

The older, twisted birches around here have been compressed by snow, indicating that a permanent snow patch used to prevail here. Until the end of the 1980s, the snow remained for such long periods that only a few minor mountain birches was able to grow here. As the snow tends to melts earlier in the spring, the growing season now is long enough for mountain birches to thrive. This is why the mountain birch forest has become denser in places.

On your way to the next site, you will both see and feel (!) how the mountain birch forest closes in and makes use of the opening provided by the path.

SITE 2B: THE PINE TREELINE SINCE 1975 – 750 METERS ABOVE SEA LEVEL.

The pine treeline has remained at this altitude (750 meters above sea level) since the 1980s. This more than 8 meters tall Scots pine germinated in the warm 1930s. Since the early 1990s, the pine has grown about 4 meters. The pine is now surrounded by a number of young plants that are probably its own offspring.

Photo: Leif Kullman.

1991: 3.8 meters tall.

Photo: Lisa Öberg.

2009: 8 meters tall.

Unlike mountain birch and Norway spruce, Scots pine cannot reproduce vegetatively and must therefore produce cones and seeds. This means its reproduction is more climate- dependent than that of birch and spruce and needs some consecutive warm summers to produce viable seeds.

Photo: Leif Kullman, 2011.

One of the young pines that are growing close to the treeline forming pine today.

Photo: Lisa Öberg, 2009.

The highest pine treeline at mount Getryggen is found in the north-eastern slope. The uppermost tree sized pine grows there at 775 meters above sea level.

Photo: Leif Kullman, 2008.

Photo: Leif Kullman, 2010

This pine, found at Södra Tvärån, about 3 kilometers northwards (700 meters above sea level), constituted the pine treeline in this part of Handölsdalen around 1915. The pine fell over just a few years ago.

SITE 3A: THE SMALL-WHITE ORCHID (PSEUDORCHIS ALBIDA) – 775 METERS ABOVE SEA LEVEL.

Photo: Lisa Öberg, 2009.

The small-white orchids often grow in glades and, as in the picture, along paths in the mountain birch forest.

Photo: Lisa Öberg, 2010.

The small-white orchid (Pseudorchis albida).

Orkidén vityxne trivs i den öppna, ljusa fjällbjörkskogen. Den har blivit allt mer ovanlig i fjällnära områden. Det beror på att fjällbjörkskogen blivit tätare på senare år. Vityxne finns dock spridd här och var i den här delen av Getryggen, ofta i anslutning till gläntor och stigar. I likhet med alla andra orkidéer är vityxne fridlyst.

SITE 3B: THE SPRUCE OLD POMPE AND THE SPRUCE TREELINE SINCE 1975 - 770 METERS ABOVE SEA LEVEL.

Photo: Lisa Öberg, 2009.

The spruce Old Pompe.

This altitude (770 m) has been the maximum elevation for spruce since the 1970s. The uppermost spruce, called Old Pompe, is at least 5,700 years old. Old Pompe is the oldest known, living spruce on Getryggen.

Photo: Lisa Öberg, 2009.

Details of the spruce Old Pompe.

Mountain spruces have the ability of reproducing vegetatively by rooting of the lowermost branches. In this way, new shoots continually grow up around the “mother tree”. When the oldest trunks eventually die, new ones are ready to ”take over” if the climate is sufficiently favourable. Thereby, these spruces or spruce clones, can be virtually immortal.

Site 3b

1999: 2.1 meters. Photo: Leif Kullman.

2004: 2.8 meters. Photo: Leif Kullman.

2010: 3 meters. Photo: Lisa Öberg.

Just like other old mountain spruces, Old Pompe has survived long periods with a harsher climate as a low-growing bush, almost completely protected below the winter's snow cover. In the last few decades, the climate has been so favourable that some stems have rapidly attained tree size. The spruce Old Pompe has in 2012 awarded status as a natural monument.

The oldest known mountain spruces are at least 9,500 years old: Old Rasmus on Sonfjället in Härjedalen and Old Tjikko on Fulufjället in Dalarna. The two of them are the oldest known, still living trees, anywhere in the world.

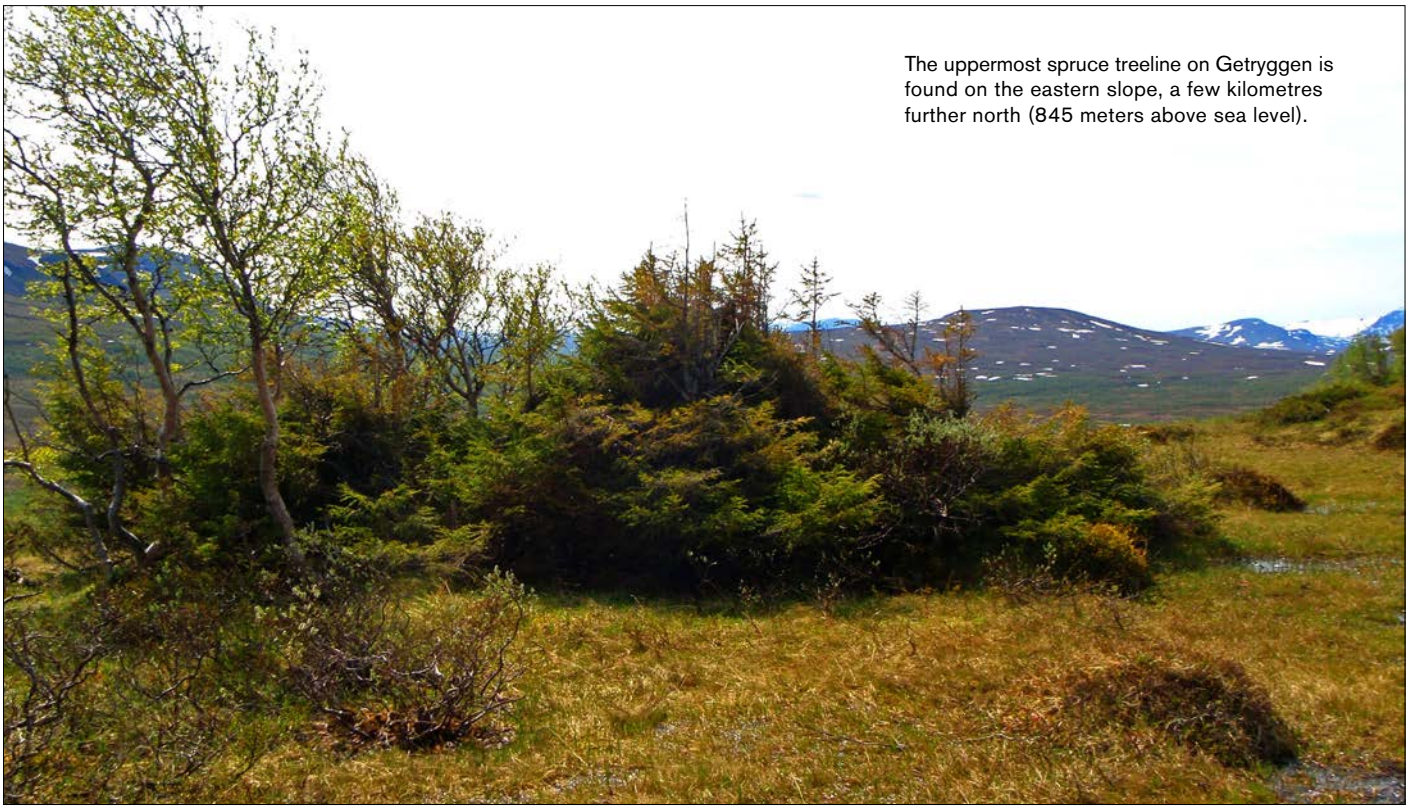
The spruce Old Pompe was named after the Golden retriever Pompe, who was present for many exciting scientific investigations and discoveries on Getryggen during his lifetime.

Photo: Leif Kullman.

Love and respect

Just like most other mountain spruces, Old Pompe has an amazing capacity for survival in the harsh mountain climate. However, they are not adapted to cope with man's interference. Spruce roots must have a protective layer of soil – with overgrowing plants – which means they are very sensitive to trampling and ground erosion, damage that can be caused by people walking.

So please, remember to show this many-thousand-year-old spruce the respect it deserves – observe it from a distance. This will give Old Pompe the chance to live on for thousands more years.



The uppermost spruce treeline on Getryggen is found on the eastern slope, a few kilometres further north (845 meters above sea level).

Photo: Lisa Öberg, 2010.

SITE 4: THE TRANSFORMATION OF A PERMANENT SNOW PATCH TO MOUNTAIN BIRCH FOREST – 790 METERS ABOVE SEA LEVEL.

Photo: Leif Kullman, 1980.

1980

This hollow used to host a permanent snow patch. The snow remained so far into the summer months that only some specially adapted vascular plants and mosses survived here. One reason for this is that it was too wet and the growing season was too short for many plants.

Photo: Leif Kullman.

2009

However, in recent decades, the snow has melted increasingly early in the spring. The ground has gradually dried out and become a suitable site for forest plant species. As an increasing number of birch seedlings are established in the hollow, the older birches on the surrounding exposed hilltops are fading away due to drought.

Are reindeer affected by the disappearing snow patches?
It is both good and bad for the reindeer that the hollows that previously held permanent snow patches are drying out. An increased availability of grass and herbaceous plants is good for the reindeers, but it also means that they have to go even higher up the mountains earlier in the summer to find the still remaining snow. The snow patches allow them to escape the worst irritation from insects as well as providing the needed coolness.

Photo: Leif Kullman, 2010.

Site 5

Photo: Lisa Öberg, 2009.

SITE 5: THE BIRCH TREELINE IN 1915 – 810 METERS ABOVE SEA LEVEL.

In about 1915, some of the birch trees in the picture were the uppermost trees that were at least 2 m tall on this part of the slope (about 810 meters above sea level). Today, you will find the uppermost birch trees 100 vertical metres further up, at 910 m.

SITE 6: 1930S MOUNTAIN BIRCH TREES 830 METERS ABOVE SEA LEVEL.

Photo: Lisa Öberg, 2009.

There are a number of visible terraces on the mountainsides that surround Handölsdalen, including on Getryggen. These are made from earth, gravel and stones that were deposited in the small lakes and pools that where formed between the melting ice sheet and the valley sides. The picture shows some of these terraces. Site 6 is located on one of them.

Photo: Lisa Öberg, 2009.

Most of the birches on the edge of the terrace above here germinated in the 1930s, when it was about as warm as during the 1990s and 2000s. The mountain birches have found an optimal place to grow just here. They have not been able to grow further down the hollow because the snow has remained there for too long during the summers. However, just as with the large permanent snow patch at Site 4, the mountain birches have recently started to “creep” further down into the hollow. The climate has changed and so the ground conditions have also changed.

SITE 7: NEWLY ESTABLISHED NORWAY SPRUCE – 850 METERS ABOVE SEA LEVEL.

Photo: Lisa Öberg, 2009.

Most spruce trees on Getryggen are old and, like the Old Pompe spruce (Site 3b), they have carried out vegetative reproduction for hundreds, sometimes thousands, of years. However, there are some younger, newly established spruces. This little spruce (see the marks on the picture) is now about 0.6 meters tall and is one the few spruce to have germinated on Getryggen in the last 100 years.

Photo: Lisa Öberg, 2009.

Due to its minor size, this young spruce has so far enjoyed protection underneath the winter's snow cover. It will be considerably tougher if, or when, it protrudes above the snow cover. The impact of the wind (dehydration and abrasion) is greatest closest to the snow's surface. If it can just survive growing some extra inches, it has good chances of achieving tree height.

If the spruce continues to grow at about the same rate as it has done for the last few decades, it could be 2 metres tall in about 20 years' time. In that case, the spruce treeline would rise 80 vertical metres, to 850 meters above sea level. There are in fact mountain spruces that have recently grown as much as 0.4 meters per year.

Photo: Lisa Öberg, 2009.

A newly established spruce on the summit

Another, relatively newly established spruce is growing just below Getryggen's summit. It is about 20 cm tall. Who knows if it will survive? Much depends on the wind, wich has a great impact on the mountain flora. It chills and dehydrates plant tissues and it redistributes the snow, which causes an uneven snowcover and as a consequence widely different plant community types.

SITE 8: THE BIRCH TREELINE IN THE 1970s AND TODAY – 880 METERS ABOVE SEA LEVEL.

In the 1970s the birch treeline was positioned here, at 880 meters above sea level.

Today we will find the birch treeline 25 meters above here, at 905 meters above sea level. This young, fast growing birch is somewhat more than 2 meters tall.

Photo: Leif Kullman, 2009.

In this part of Getryggen, the birch treeline have risen by almost 100 meters since 1915. That means an average movement by 1 meter per year during the last century.

Photo: Lisa Öberg, 2009.

Photo: Leif Kullman, 2010.

The highest birch treeline on Getryggen is found on the south-facing slope of Getryggen, where the uppermost tree sized birch grows at 970 meters above sea level.

Photo: Leif Kullman, 2010.

The grey alder is another deciduous tree that grows high up on Getryggen. The grey alder reaches its highest point, 885 meters above sea level, on Getryggen's south slope. The grey alder treeline has risen by as much as the mountain birch treeline since the 1950s, by 95 meters. Finds of wood, leafs and cones in the soil show that this grey alder grew at about this level (895 m) 6,800 years ago.

SITE 9: PLANT'S ABILITY OF DISTRIBUTION – 940 METERS ABOVE SEA LEVEL.

The open mountainside is treeless, but small plants and low-growing bushes are spread over almost the entire mountain.

Photo: Leif Kullman, 2010.

1

2

3

4

Photo: Lisa Öberg

Not only the treeline shifts when the climate changes – the tree species lines and the upper latitudinal limits for understorey plants also changes. Up on Getryggen's summit plateau – the top 20 vertical metres – the changing climate has improved conditions for many plants. In the summer of 2009, there were around 70 different species (vascular plants) compared to about 50 species in the 1950s.

Among the "new" species that have become more common on the mountain, there are ones that we usually find further down in the forests, such as dwarf cornel (1) and small cow-wheat (2).

Two of Sweden's most common grasses, wavy hair-grass and tufted hair-grass (3) have also become more abundant in the mountains in recent years. Sweden's most common alpine plants also appear to thrive in the "new" climate – they have flowered unusually richly in recent years. Alpine lady's-mantle (4) is one of the species which, to judge by its amazingly rich flowering, is currently thriving.

SITE 9: MELTING GLACIERS AND WIND EROSION REVEAL ANCIENT TREELINES - 940 METERS ABOVE SEA LEVEL.

The view towards Sylarna in the south.

Photo: Leif Kullman, 2009.

The warming climate has also resulted in shrinking glaciers. The glacier *Storsylglaciären* has retreated upwards about 150 vertical metres in the last 100 years.

Radiocarbon dating of wood remnants that were recently revealed by wind erosion show that tree-formed pines grew at 1250 meters above sea level on Getryggen about 10,300 years ago. At that time, there were probably remnants of the ice sheet in the valleys below.

The pine treeline then gradually moved down the mountainsides until about 100 years ago, when it started rising again.

The oldest remnants of birch wood here on Getryggen are 9,700 years old. They have been found at an altitude of about 1000 meters above sea level. Around 9,000 years ago, tree-sized birches grew even higher up, just below the Getryggen summit (1,375 meters above sea level.

Photo: Leif Kullman, 2009.

As the glaciers have melted and decreased in size, a lot of wood remnants have been uncovered. These originate from trees that grew here before it once again became so cold that glaciers formed. Radiocarbon dating of this wood shows that trees grew there about 8,000 years ago. The piece of wood in the picture is about 7,800 years old.

SITE 10: WARMTH DEMANDING DECIDUOUS TREES IN THE MOUNTAIN BIRCH FOREST – 760 METERS ABOVE SEA LEVEL.

Photo: Leif Kullman.

Getryggen.

Around 9,000-7,500 years ago, that is shortly after the deglaciation, warmth demanding deciduous trees such as oak, elm, alder, hazel and silver birch grew in the lower slopes of Getryggen. They prevailed alongside mountain birch, spruce, pine and Siberian larch at elevations currently supporting forest of mountain birch. Wood, leaves, nuts and cones from these tree species have been found in the marshes below.

At the beginning of this period, summers were a few degrees warmer than currently, Subsequently, the temperature decreased slightly, and the warmth demanding deciduous trees perished. Biodiversity has declined as the climate cooled.

Photo: Leif Kullman.

Photo: Leif Kullman.

The pictures show some of the macrofossils that have been unearthed in the mire at the base of the slope; leaves from hazel, oak and alder trees (left) and hazelnuts (right).

Photo: Leif Kullman.

Photo: Leif Kullman.

Photo: Lisa Öberg.

Warmth demanding deciduous trees are now beginning to return to the mountains around here. An elm plant (left) on Mettjeburret-jakke, to the east of Handölan (995 meters above sea level). On the mountain of Predikstolen in the Helags massif, there is an oak plant growing just below an altitude of 1,000 meters above sea level (middle). On Storsnasen, a few kilometres north of Getryggen, a small black alder has recently become established (right).

SUMMARY

For plants, climate warming over the past 100 years or so has enhanced the growth of many species and maximum elevations have increas:

- The treelines have shifted upslope: birch 95 meters, spruce 40 meters, and pine 50 meters, in this area of Getryggen. The largest change to the birch treeline is demonstrated by birch on the southern slope where it has advanced by 140 meters since 1915.
- The tree species lines (plants, bushes and trees that are less than 2 meters tall) for birch and spruce have risen by 460 and 485 meters respectively on Getryggen since the 1950s.
- The species lines for small cow-wheat and rosebay willow-herb have moved up by 350 and 260 meters respectively since the 1950s.
- Since the 1950s, the number of vascular plant species has increased on Getryggen's summit plateau, but none of the "original" alpine plants have disappeared.
- The alpine flowering of alpine plants has been particularly rich in recent years in response to climate warming.
- Young individuals of warmth demanding deciduous trees are now found growing in several places close to Getryggen.
- The structure and composition of many alpine plant communities are changing as the snow patches are melting earlier in the summer and the ground is drying up.
- In places where the melt water dries up early in the summer, large tree birches are affected by drought. In places where too much snow previously precluded, new birch seedlings are currently becoming established in response to earlier and more complete snow melt.
- For the reindeer, the increased growth in many plant species means that access to grass and herbaceous plants has improved in the summer. The fact that the snow disappears earlier in the summer also means that the reindeer must move higher up the mountainsides more often and earlier in the summer, in order to find places where the snow remains and to avoid harassment by insects.

Will trees grow up on Getryggen's summit?

The wind's effect on the plants increases with altitude. It counteracts a great deal of the beneficial effects that the higher temperatures may otherwise have on tree growth. However, in areas protected from the wind, such as in hollows and ravines (see Site 4), trees will grow, at least periodically, as long as the climate conditions are right – i.e. warm enough, but not too dry.

In a longer perspective, the mountain landscape that we see today is only a momentary picture – a picture that can probably never be reproduced. It can be regarded as the last frame of a film, where the first one was recorded more than 10,000 years ago. We cannot now say with any certainty what the upcoming frames of the film will look like.

The information on the project's website: **www.foranderligafjall.se** will be continually updated with new changes and new research results. We will be following the development of the vegetation on Getryggen – you are welcome to return and follow it with us!

Information site positions
Given as coordinates in WGS84

SITE	N	E	ALTITUDE (meters above sea level)	DESCRIPTION
1	63°10.231	012°21.771	740	Spruce treeline 1915
2a	63°10.268	012°21.722	750	Current overgrowth
2b	63°10.318	012°21.831	750	Pine treeline since 1975
3a	63°10.335	012°21.535	775	The small-white orchid vityxne (Pseudorchis albida)
3b	63°10.361	012°21.658	770	The spruce Old Pompe and the spruce treeline since 1975
4	63°10.366	012°21.373	790	From late laying snow-patch to mountain birch forest
5	63°10.380	012°21.294	805	Birch treeline 1915
6	63°10.393	012°21.229	830	Mountain birches from the 1930s
7	63°10.373	012°20.947	850	Young Norway spruce
8	63°10.425	012°20.838	880	Birch treeline 1975 and today
9	63°10.488	012°20.636	940	Open mountain side - the alpine area
10	63°10.304	012°21.225	800	Warmth demanding decidious trees in the mountain birch forest

www.foranderligafjall.se

For more information about this project, please contact the County Administrative Board of Jämtland, tel: +46 (0)63 146 000 (switchboard) or e-mail: jamtland@lansstyrelsen.se. Contact information is also available on the project's website where this document is also available for download.

Terms and definitions

Climate The weather's variations over a long period of time.
Mountain birch *(Betula pubescens ssp. czerepanovii)* A subspecies of the common downy birch (Betula pubescens). In general, the mountain birch is more low-growing and twisted than the downy birch and often has darker stems and thicker leaves.
Natural monuments Distinctive natural objects that require protection or special care. Most of these are ancient trees. There are provisions relating to natural monuments in the Swedish Environmental Code. Natural monuments can be designated by the county administrative board or the municipality.
Radiocarbon dating A method used to determine the age of once-living material, such as wood remnants. Simply expressed, it uses the measurement of how much there is of a certain type of carbon (14C) remaining in the wood. Because decomposition takes place at a known rate, it is thus possible to determine the wood's age.
Spruce clone In the mountains, spruce often reproduces vegetatively when its lower branches take root. New stems can grow upwards and eventually replace the old ones when they eventually die. This means that single and multi-stemmed spruce clones can form.
Snow patch A hollow in the terrain in which the snow remains long into the summer. Species line: the upper altitude at which a species is found – regardless of size. Expressed as meters above sea level.
The alpine zone The lower alpine zone begins above the treeline. The middle alpine zone starts above the lower alpine zone. The upper occurrence of blueberries is considered to constitute the border between these zones. The high alpine zone is found above the middle alpine zone. It is characterised as having no continuous vegetative cover.
Treeline The highest altitude, expressed as meters above sea level, at which at least 2 meters tall trees are capable of growing. The treeline is often higher on southern slopes and lowest on slopes that are north-facing.
Vegetative reproduction Is used by many alpine plants because the climate is rarely sufficiently beneficial for sexual reproduction using flowers and pollination.

Financing and execution
This project has primarily been financed by the County Administrative Board of Jämtland and with funding from Miljömålsmiljonen 2008. Co-financiers were the Mid Sweden University, Swedish Tourist Association (STF), Skogsstyrelsen (Swedish Forest Agency) and Åre Municipality. The project's initiator and manager is Lisa Öberg, Mid Sweden University and the County Administrative Board of Jämtland. Professor Leif Kullman, Umeå University, has contributed advice, data and photographic documentation. The project is owned and administered by the County Administrative Board of Jämtland.

Contact
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Mittuniversitetet MID SWEDEN UNIVERSITY

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