

## PROSJEKT TUNSBERGDALS BREEN Tunsberg Glacier Project

### CONCEPT

To measure the annual changes in a large mass of glacier ice in a temperate climate zone, as it responds to accelerating climate change.

To continue monitoring the changes for a target period of 50 years, or until the results show a reversal in the current trend of rapid global warming.

To create an educational opportunity for successive groups of young people to explore an uninhabited wilderness and observe how human activity elsewhere is changing the natural world.

### LOCATION

The Tunsberg glacier is the largest outlet valley glacier of the Jostedalsgreen ice cap in southern Norway. The ice cap is the largest on the continent of Europe. Although it is less than 200 miles (300 km) from Oslo, and 800 miles (1200 km) from London, this glacier does not appear to have been monitored individually since 1972.

Access to the glacier is difficult, but its regular shape and behaviour had previously attracted glaciologists since 1868.

It was one of two glaciers in the area that were studied extensively 50 years ago, providing evidence of the melt rate at that time, due to natural climate change.

### MONITORING OF GLACIER FRONT POSITION, FLOW RATE, AND LOSS OF THICKNESS.

These 3 features of the glacier will be monitored at regular intervals, although it may not be possible to measure all 3 every year, dependant on weather conditions and resources available.

All 3 features will vary from year to year, but progressively the trend of the variations should begin to reflect the trend of climate change.

### FRONT POSITION

The annual advance or retreat in the front position of the glacier tongue will be measured against fixed markers.. If necessary this work can be done without the need for GPS survey equipment.

### FLOW RATE

To measure the rate of flow of the glacier, a line of numbered stones will be positioned across the central section of the glacier in 2 or 3 locations, in line with fixed markers. In subsequent years the distance the stones have advanced will be measured using a similar procedure. If necessary this work could be done without the use of GPS survey equipment, although using GPS would make it easier.

### LOSS OF THICKNESS

The upper part of the Tunsberg glacier, between elevations 800m and 1200m, is a reasonably uniform block of ice about 5 miles (8km) long, 1 mile (1.6km)) wide and several hundred metres

thick. Its top surface has a gradient of only about 1 in 20, and the average flow rate 50 years ago was about 100m per year.

We believe that annual measurements of the average loss of thickness of the upper glacier would be more consistent with the average annual temperature change in the area, than the total mass balance figures for the whole glacier catchment area, which may be more influenced by short term weather variations, affecting snowfall in the accumulation zone and melting at the glacier snout.

A full survey of the glacier surface will be done, from just below the firm line at about elevation 1200m, down to elevation 800m, just above the heavily crevassed area where the valley narrows. This survey will be done using GPS land surveying equipment. Readings of location and elevation will be taken at intervals of about 250m over the whole area, a total of about 200 readings.

The data will enable the changing shape and area of the glacier surface to be mapped as it melts. The total volume of ice lost since the previous survey will be calculated, to give the average loss of thickness.

## SURVEY TEAM

Portable land surveying instruments that use current GPS technology can record the position and elevation of locations as fast as the user can walk. Therefore, we believe that annual surveys will be technically simple to do, assuming that the data could be downloaded and interpreted by specialists.

Probably the upper glacier could be surveyed by a small team of perhaps 4 people in less than a week. However, because access to the Tunsberg glacier is difficult, we envisage the annual surveys being done by a team of perhaps 12 to 16 young people in total, with an age range of perhaps 17 to 21, under expert leadership and supervision.

Each member of the expedition will be given the chance to spend time on the glacier doing survey work, but would also be asked to spend some time carrying supplies and equipment from the nearest road at Snotun bridge, up Roykjedalen to a base camp located close to the glacier. This traditional method would allow the annual expeditions to be independent and self supporting, giving challenges and rewards to those involved.

The annual survey expeditions will probably take place during August and last for about 3 weeks.

## PARTNER ORGANISATIONS

The value of any glacier monitoring increases the longer it continues. For this project to have value in reflecting the future trend of global warming in a temperate climate zone, it will need to continue for as long as possible. Therefore we consider it essential for the annual monitoring to be done under the overall control and supervision of an appropriate organisation in Norway. The obvious choice is Norsk Bremuseum in Fjaerland, where the project will feature in the new Ulltveit - Moe climate centre. The results of the annual surveys will be displayed for public information and comparison with the future climate scenarios speculated in the centre for 2040 and 2100.

The Museum has appointed Karen Weichert as project co-ordinator.

On September 11<sup>th</sup> 2008, Norsk Bremuseum, the Field Studies Council and Brathay Exploration Group from the UK met at the Museum in Fjaerland to sign a Letter of Intent which sets out a proposal for the agreed operation of the project. These organizations will work together to promote the project and organize the annual survey expeditions. They will seek grant aid and other financial support in order to minimize the cost to individual members of the expeditions.

## TECHNICAL SUPPORT

For the survey results to have scientific value, the project will benefit from the technical support and involvement of glaciologists at the Norwegian Water Resources and Energy Directorate (NVE), who have already agreed in principle to give their support.

Our proposal involves monitoring the behavior of a large glacier in a temperate climate zone, in a way that non scientists would accept as a reasonable reflection of the way in which global warming is affecting that zone as the warming increases and then hopefully decreases later in the future.

Ours is a public information and education project. We are not seeking to do fundamental scientific research in either glaciology or climatology. Nor would the results extend to a mass balance assessment of the whole glacier catchment area.

However we believe that the results will have some intrinsic value to NVE in the context of the changing water resources of Jostedalbreen. Whether this would enable NVE to provide financial support remains to be seen, but NVE would be the preferred organisation to download the survey data, calculate the annual average loss of thickness and include the information in their routine glacier monitoring reports to CICERO, and WGMS in Zurich.

## 2008 SURVEYS

During the summer of 2008 several reconnaissance surveys were done by a small group of Norwegian and German volunteers, led by Trygve Snotun. They confirmed that access to the lower glacier via Tunsbergdalsvatnet is relatively easy, but access to the upper glacier, through the ice fall at elevation 800m, is difficult and may be unsuitable for inexperienced young people. The access route used 50 years ago, from Krundalen, may remain the preferred route to the upper glacier, with a Base Camp at either the Brathay site in Roykjedalen, or the higher Nottingham site overlooking the glacier.

The glacier front position was marked on September 1<sup>st</sup> 2008, and marker stones were placed at elevations 790m and 960m, for velocity measurements.

A full scale British led expedition will do the first complete annual survey in August 2009, including a surface level survey of the upper glacier. Future leaders of the 2010 -2014 youth expeditions will take part, gaining local knowledge and any extra training needed.

## SUMMARY

Climate change is a slow, almost imperceptible process. Ice, however is all or nothing stuff which exists at - 1 deg C, but does not exist at + 1 deg C. For this reason ice has recently become the standard bearer of climate change awareness, producing dramatic effects in the polar regions and appearing to concentrate scientific effort there.

In contrast, our aim is to promote a long term educational project that will use the progressive changes in a large mass of glacier ice in a temperate climate zone to indicate progress in reducing the rate of global warming in that zone.

We believe that this simple and practical monitoring regime will produce results which should become increasingly useful the longer they continue. Meanwhile, the challenge involved in doing the annual surveys will engage the minds of more young people each year, and provide an extra educational opportunity for the Ulltveit-Moe climate centre.

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October 2008.