

A Survey of Snow Avalanche Accidents in Norway

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ABSTRACT. Available historical data relating to snow avalanche accidents in Norway have been examined, ranging from the 17th century to present. A near continuous record of avalanche deaths from 1855 is documented. From 1946, the distribution according to activity categories for the fatalities is shown.

For the last 25 years the distribution of accidents by activity category and county is presented. Accidents during the last 14 winters have been compiled, including reported non-fatal avalanche involvements.

INTRODUCTION

Snow and slush avalanches remain an important natural hazard to society in large parts of Norway, and they cause damage to houses, roads, constructions and communications every winter. A number of lives are also lost in avalanche accidents every year. If preventive measures are to be implemented it is important to record what categories the victims belonged to and how this changes over time.

METHOD

Presented here are accidents caused by snow avalanches, or by avalanches consisting of a substantial part of snow, such as slush avalanches. Accidents caused by firn and glacier avalanches have also been included in the statistics, but not glacier front calvings.

Records exist of avalanche disasters dating back as far as to the 14th century. However, these records are intermittent and usually give little information about the number of people killed or the circumstances around the disaster; the sources typically include descriptions of whole farms that have been laid waste or churches that have been destroyed. Data has been gleaned from a number of historical records. For the 19th century up to around 1970 the most important ones are the records kept by Gunnar Ramsli, former avalanche consultant of the Department of Agriculture. Some of these records have been published by Statistisk Sentralbyrå and in the annual reports from the Swiss federal Institute of Snow and Avalanche Research in the 1950-ies and 1960-ies. Since 1972 the Norwegian Geotechnical Institute (NGI) have collected newspaper mentions of avalanche incidents and documented them in several NGI reports (Bakkehøi, 1979, Domaas et al., 1980, Kristensen, 1982, 1984, 1986, 1988 and Lied, 1987).

The victims for the period after World War II have been categorized according to activity and the activities have been grouped into 'recreational' and 'non-recreational' activity groups. The criterion for a 'non-recreational' activity is that it should be more or less directly required by society, while in the 'recreational' activities there is a voluntary acceptance of the risk involved.

AVALANCHES IN NORWAY THROUGH HISTORY

In the years since 1836 to present, 1510 are known to have lost their lives in avalanches. This is probably not the full number, since some of the years during World War II could not be accounted for. Available data indicate that until around the 1930-ies, those who lost their lives in avalanches, almost exclusively did so in inhabited areas.

The general environmental deterioration in Norway during the centuries before and after the culmination of the Little Ice Age around 1750, caused an increased incidence of landslides, avalanches and floods (Grove, 1972), and generally lowered food production. National demographic crises are known to have occurred in 1669, 1676, 1696, 1741-43 and 1809 as a result of widespread famine (Nagel, 1980).

Table I. Known winters with 20 or more fatalities

Winter	Dates	Area	Known deaths
1678-1679	6 February	Sunnmøre	130
1717-1718	17 March	Stryn, Lom	25
1754-1755	5-9 February	Sunnmøre, Nordfjord	>40
1810-1811	1 December	Sogn	43*
1845-1846	15 February	Møre	26
1857-1858	March-April	Møre	42
1867-1868	6-26 February	Stryn, Oppdal	161
1879-1880			20
1880-1881	February	Møre	60
1894-1895			24
1905-1906			29
1908-1909	March	Lofoten	20
1917-1918			29
1918-1919			31
1927-1928	8-9 February	Hordaland, Sogn	45*
1941-1942	February		22
1955-1956	Dec.- March	Lofoten	31
1985-1986	February	Nordland	22

* Mainly slush avalanches

The scarcity of farming land caused people to move into marginally inhabitable areas. One can assume that the people on these new settlements had little knowledge of earlier avalanche activity, so that all too often the settlers only found out

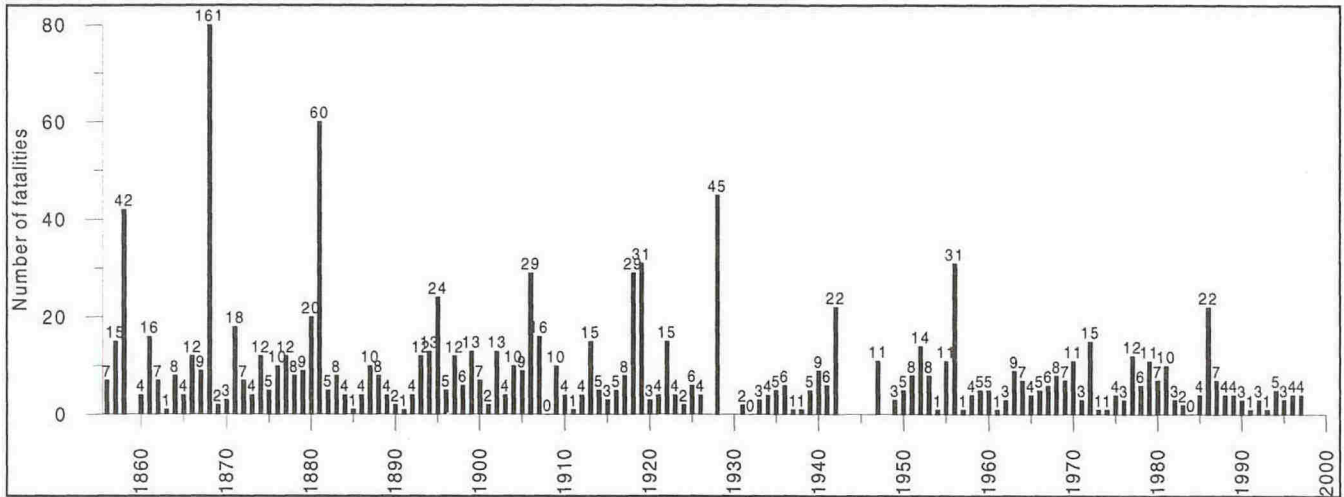


Figure 1. Known deaths from snow and slush avalanches from 1855 to 1997. The total number for this period is 1255, giving an average of 9.4 fatalities per year.

by direct experience. Previous knowledge about the avalanche conditions at many of these settlements would have been lost as a result from the aftermath of the Plague that came to Norway in 1349.

A few winters stand out as especially disastrous. On one single date, the 6th of February 1679, 20 farms in the Sunnmøre district of Western Norway were destroyed (Figure 2). In this area 130 were killed. A large number of deaths caused

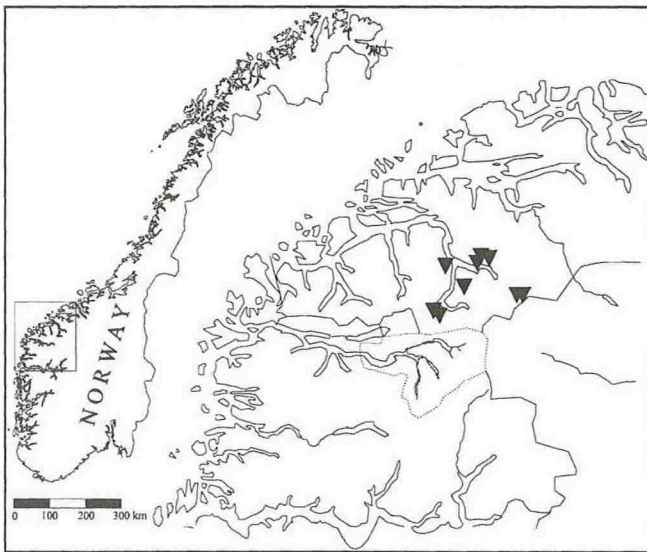


Figure 2. The avalanches of February 6, 1679 destroyed 20 farms and killed 130 in the fjord district of Sunnmøre in Western Norway.

by avalanches also occurred in the winters of 1656-1657, 1717-1718 and 1754-1755, but the exact numbers are not known (Table I). Grove and Battagel (1983) suggest that the avalanche activity was generally higher in the period from 1670 to 1770, than in the following century, with two winters with more fatalities than in 1868.

The most disastrous avalanche winter documented, occurred in 1868 when a total of 161 people were killed. Avalanches started running down into the inhabited areas of the north region of Western Norway on February the 6th, with disasters following on the 8th, 10th, 11th and the 16th. The communities that suffered the greatest losses were Stryn with

35 and Oppdal with 32 fatalities (Figure 3). All of the victims were caught inside buildings that were destroyed. There were also several avalanche deaths in Nordland during the same period.

Records of the annual number of deaths caused by avalanches are available from 1856, with the exception of some years during World War II (figure 1).

As can be seen from the graph in figure 1 in certain winters, the number of avalanche fatalities is much larger than average. A study by Fitzharris and Bakkehøi (1986) suggests a 'quasi-periodicity' of 12-13 years for major avalanche winters, i.e. winters with a large number of fatalities. These situations are found to be related to 'winter characteristics', i.e. unusual patterns of circulation through long periods of the winter, more than short-term climatic conditions.

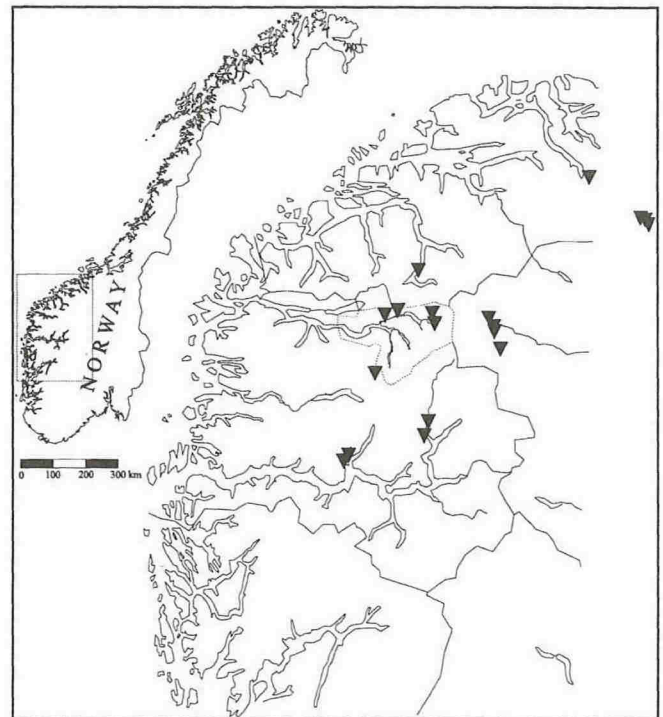


Figure 3. The avalanches in February 1868 that cost 161 lives mainly affected the north-west part of Western Norway.

It is also evident that there has been an overall decline in the number of avalanche fatalities from the 19th to the 20th century. This may be attributed to a number of different factors since the frequency of accidents will depend on exposure as well as avalanche activity. Some of the most exposed settlements have been abandoned the last century, although the population distribution in the mountainous areas have largely been maintained in Norway. In addition, better land use planning have reduced the number of buildings damaged. Less deforestation and overgrazing in the mountain slopes have probably also reduced the number of mass movements in general.

Tax records and other written sources indicate that the climate during the Little Ice Age caused a marked increase in the number of major mass movements and floods which started in the late 17th century and continued into the 19th century [Grove, 1972]. This seems to be the case with snow avalanches as well, although the connection between the climatic change and the frequency of snow avalanche damage and fatalities is not well understood.

AVALANCHE ACCIDENTS AFTER WORLD WAR II.

Recreational activities in the mountains started to increase in the 1930-ies. From 1947 to present, the skiers (almost exclusively with cross country or telemark equipment) constitute the single largest category of avalanche victims with 101 fatalities, or 33% (figure 4). The recreational group, consisting of individuals engaged in voluntary activities, as a whole constitute 45% of the total number of 311 fatalities. The non-recreational group constitute 55%.

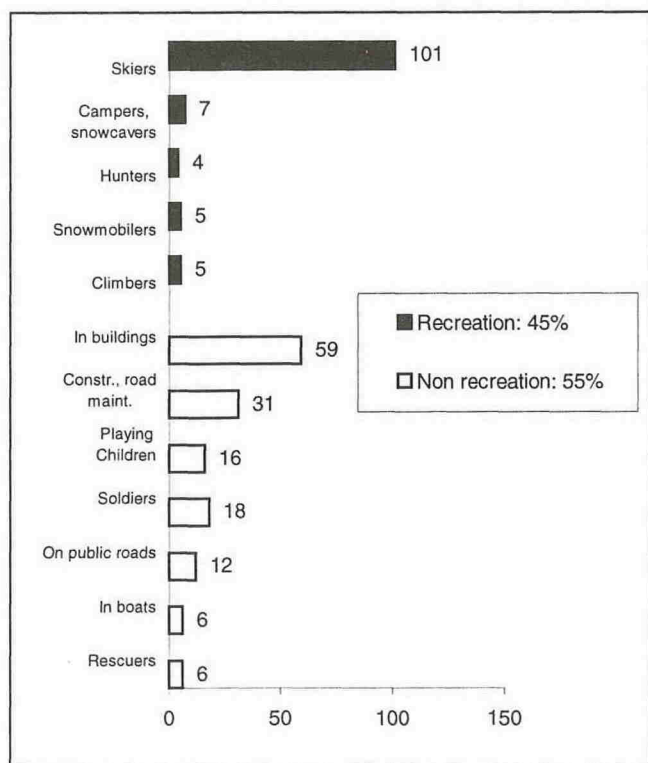


Figure 4. Avalanche fatalities by activity category from 1946/47 to 1996/97.

THE LAST 25 WINTERS; 1972-1973 TO 1996-1997

The last 25 winters the Norwegian Geotechnical Institute has compiled avalanche accidents and material damage caused by snow and slush avalanches (Bakkehøi, 1979, Kristensen 1982, 1894, 1986, 1988). In this period a total of 131 have died in avalanches

Activity category

The distribution of avalanche fatalities in this period are nearly shifted more towards the recreation group with 71 fatalities, or 55%, while the non-recreation group constitute 45%, or 58 victims. Contributing to the non-recreation group was the single most serious accident in this period, the Vassdalen disaster the 5th of March 1986, when a troop of 31 soldiers participating in the NATO exercise 'Anchor Express' in Nordland, were caught in an avalanche. 16 of the soldiers lost their lives (Lied, 1987).

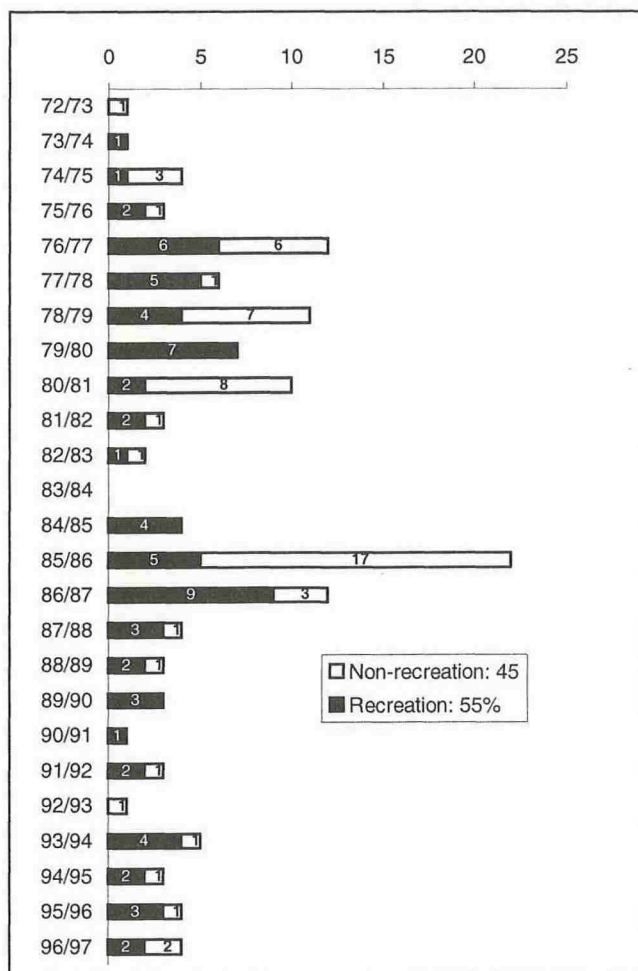


Figure 5. Avalanche fatalities from 1972/73 to 1996/97.

Geographical distribution

Nordland stands out as the county with highest number of fatalities in this period. This is partly due to the Vassdalen accident in 1986. When this accident is not included, it is Oppland that has the highest number of fatalities. This is due to the fact that Oppland is the most popular county for winter

tourism in Southern Norway, and most of the fatalities here belong to the skier category.

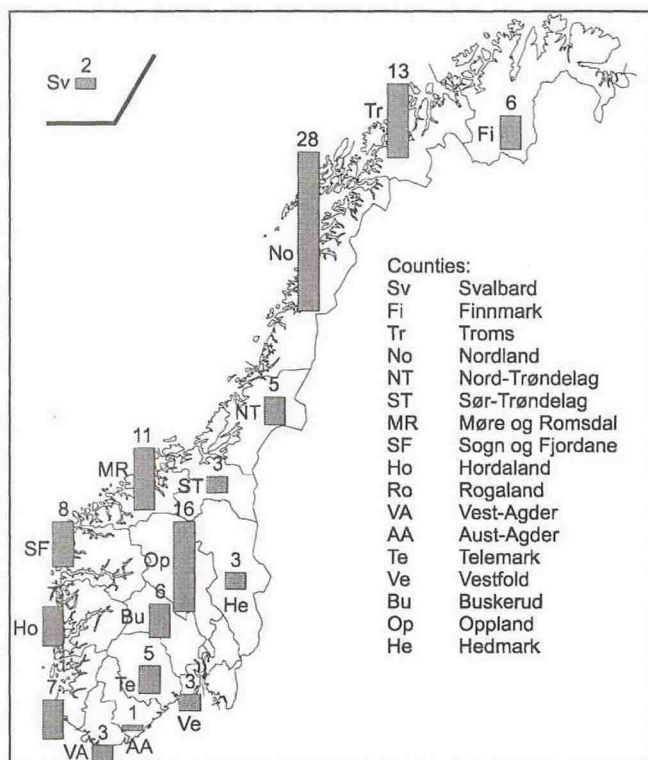


Figure 6. Avalanche fatalities by county from 1972/73 to 1996/97.

THE LAST 14 WINTERS; 1983-1984 TO 1996-1997

For the last 14 years an attempt to record fatal, as well as non-fatal, involvements with avalanches has been done. To record the non-fatal involvements is obviously a very difficult task, as many involvements are, for different reasons, never reported. The number of reports about avalanche involvements that reach the media should however give a general idea of the frequency of non-fatal avalanche involvements.

The number of fatalities during this period is 69, but the total number of people directly involved in avalanche incidents that caught the attention of the media, is no less than 780. Not included in this number are the presumably several hundred that have had to evacuate their homes during periods of avalanche danger.

A large share of the involved belong to the non-recreational group. This may be a reflection of a more consistent reporting of such incidents. However, a closer examination of the data reveals that a fairly large number, 374 persons of the non-recreational group have been affected by avalanches during outings and activities in the mountain terrain. These activities include ski-trips, camping, climbing and sight-seeing, and they have been organized by organizations like schools, the military, rescue and professional organizations.

Especially noteworthy is the fact that 184 became involved in fatal and non-fatal avalanche incidents during activities where education and exercise in mountain winter

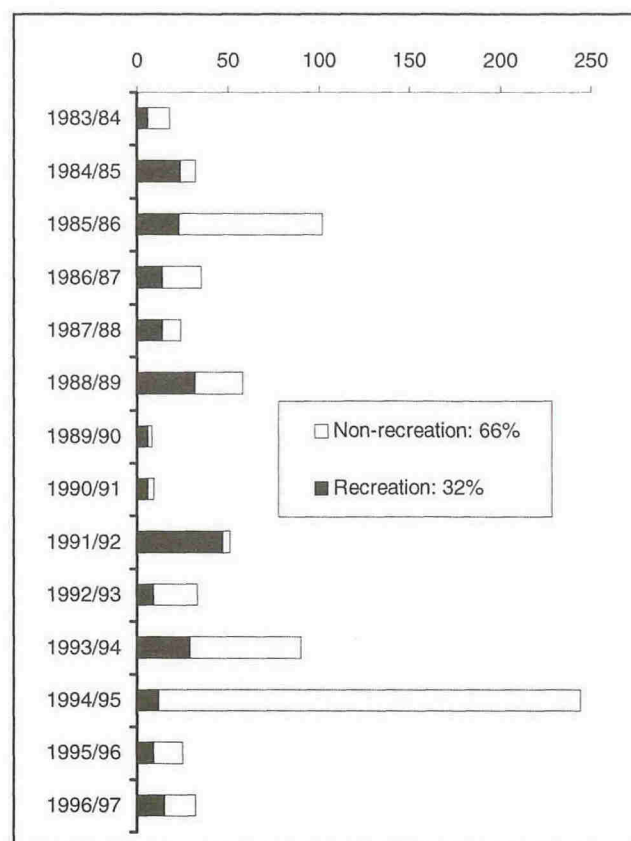


Figure 7. Fatal and non-fatal involvements in snow avalanches from 1983/84 to 1996/96

conditions was the main purpose. This is a remarkably high number for activities where the responsible leaders presumably should have a high competence in avalanche hazard evaluation.

CONCLUDING REMARKS

The average fatality rate per year has nearly halved from about 13 in the period from 1836 to 1899 to 7 in the years from 1900 to present. This is a reflection of depopulation of the most avalanche exposed areas and a greater awareness of avalanche hazard, and also possibly a result of a large scale climatic change. The Little Ice Age caused an increased incidence in mass movements in mountain regions in general, but it is uncertain whether this applies to the snow avalanche activity which often depend on snowpack stratigraphy developing through the winter and short term weather conditions.

In the years from 1947 to present, the recreational category and the skiers in particular, constitute a significant percentage of the total number of avalanche victims. From the relatively small numbers it is not possible to see any clear tendency towards a higher share of skier accidents, as can be seen in the Alps (Valla, 1987), although reports the last few years indicate that snow boarders, telemark and alpine skiers outside designated areas increasingly get involved in avalanches.

The high number of involvements during educational activities and exercises in mountainous terrain calls for an evaluation of the training of the leaders that are responsible for the safety of such activities.

ACKNOWLEDGMENTS

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