THE CUMULATION OF AVALANCHE ACCIDENTS IN CERTAIN PERIODS– AN ANALYSIS OF BACKCOUNTRY EVENTS IN AUSTRIA

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ABSTRACT: This paper deals with an analysis of backcountry avalanche events in Austria. In particular the cumulation of accidents in certain periods will be investigated.
During the last 50 years an average of 30 persons per year were killed by avalanches in Austria; about two third of all fatalities occurred as a result of `tourist avalanches´.
The most fatal event in the backcountry was in January 1982 when 13 skiers (mainly students) were killed by an avalanche near to Werfenweng (Salzburg).
The majority of `tourist avalanches´ occurs in a few (short) periods; generally one to four periods per winter can be identified. In many cases the cumulation of accidents is correlated with new snow and drift snow.

KEYWORDS: backcountry avalanches, avalanche accidents, avalanche statistics

1. INTRODUCTION

Since 1950 more than 1600 persons were killed by avalanches in Austria which is in average approximately 30 fatalities per year.
According to de Quervain (1972) two categories of avalanches can be distinguished: `catastrophic avalanches´ and `tourist avalanches´. `Catastrophic avalanches´ are caused by specific strom periods and affect settlements and developed areas; `tourist avalanches´ primarily are triggered by skiers and generally occur in the backcountry and off-piste.
About two third of all fatalities in Austria belong to the category `tourist avalanches´. Table 1 gives an overview on the most severe `tourist avalanches´ in Austria.

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`Catastrophic avalanches´ in many cases are associated with heavy snowfall caused by certain meteorological situations (Höller, 2007; Höller, 2009) and regularly concentrate on a few days; as indicated by several authors (Föhn, 1975; Höller, 2009) such catastrophic avalanche situations can be identified at intervals of about six to seven years.
On the other hand `tourist avalanches´ occur every year and they spread over the whole winter.
However, the evaluation of accidents in the backcountry indicates that the majority of `tourist avalanches´ occurs in only a few (short) periods.
Aim of this paper is to analyse the cumulation of backcountry accidents and to find out the (meteorological) conditions which are responsible for the release of `tourist avalanches´.

2. DATA

As a base for this study the records of Fliri (1998) and the data of the `Kuratorium für Alpine Sicherheit´, were used. The weather data were

provided by the Central Institute of Meteorology and Geodynamics.

year	date	federal state/location/ type of accident	fatalities
1963	31.03	Tyrol / Kemater Alm / backcountry	9
1973	04.02	Tyrol / Arbiskogel / backcountry	10
1974	21.12	Tyrol / Steinbergkogel / piste	9
1974	31.12	Vorarlberg / Silvretta Nova / piste	12
1977	31.12	Salzburg / Loferer Steinberge / backcountry	8
1982	31.01	Salzburg/ Wenfenweng / backcountry	13
1987	05.04	Tyrol / Ischgl Idalpe /off-piste	6
1988	28.03	Tyrol / Jamtal / backcountry	6
1999	28.12	Tyrol / Jamtal / backcountry	9
2000	28.03	Salzburg / Schmiedinger / backcountry - off piste	12
2009	02.05	Tyrol / Schalfkogel / backcountry	6

Tab 1.: The most severe `tourist avalanches´ (avalanches with more than 5 fatalities) in Austria in the last 50 years. (Gayl, 1975; Bauer, 1982; Hörmann, 1982; Merwald, 1985; Fliri, 1998; Schaffhauser, 1988; Mayr, 1992; Mayr, 2000; Höller and Bilek, 2009).

3. RESULTS

The investigations indicate one to four periods with an increasing number of accidents in almost every winter.
Some characteristic examples in the recent past are shown in the following paragraph:
In 2006/2007 the period from 03.01. to 08.01. 2007 stands out with 21 accidents (even 15 accidents from Jan. 5th to Jan. 6th) which was about one fourth of all accidents in that winter. The reason for the strong increase of accidents may have been a heavy snowfall from 02.01. to 03.01.
Between 13.02. and 18.02. the data base shows 23 accidents (even 9 accidents from 17.02. to 18.02).
A heavy snowfall around Feb. 27th and March 1st was responsible for a considerable increase of accidents between 02.03. and 04.03. (in total 15 accidents).
Almost two third of all avalanche accidents in 2006/2007 occurred in only 15 days.
The winter 2007/ 2008 was characterised by an accumulation of accidents in the first week of January (03.01. to 09.01.); in particular the 3rd, 4th and 5th of January were influenced by a heavy storm from the south which caused a significant transport of snow to the opposite aspects (NW to NE).
Within these 7 days 20 accidents and 9 fatalities (which was about one third of all fatalities in 2007/2008) can be identified.

Another example comes from the winter 2008/2009. The majority of all accidents occurred in only four short periods (25.01., 13.02 to 16.02, 21.02 to 01.03 and 07.03 to 08.03).
As shown in Fig. 1 the period from 21.02 to 01.03 stands out with 40 accidents (about 25 % of all accidents).
However, in only 13 days (13.02 to 16.02 and 21.02 to 01.03 10 people have been killed, which was about one third of all fatalities in that winter.
The period from middle of February to end of February was characterised by several snowfall events which caused a considerable load on the old snowpack.

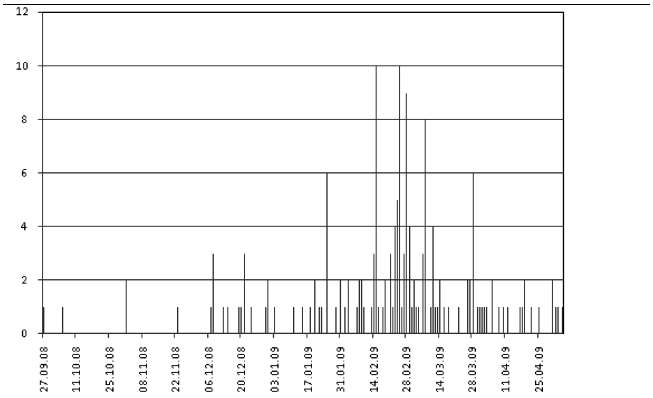

Fig. 1: Distribution of avalanche accidents (`tourist avalanches´) in the period 2008/2009 in Austria (Höller and Bilek, 2009).

In the following winter (2009/2010) a significant increase of avalanche accidents can be found in the first week of February 2010 (Fig. 2). Between Feb. 2nd and Feb. 8th 48 accidents (about 25% of all accidents) and 15 fatalities (about 50% of the averaged number of casualities) can be identified.

In only three days (02.02 to 04.02) 9 people have been killed (even 6 fatalities on the 4th of Februray). The period was characterised by several storms which caused different layers of wind-deposited snow; the result was a poor bonding of the snow drift masses with the old snowpack.
An increasing number of accidents was also found between 26.02 and 28.02 (15 accidents, 3 fatalities) and between 11.03 and 17.03 (19 accidents, 6 fatalities).

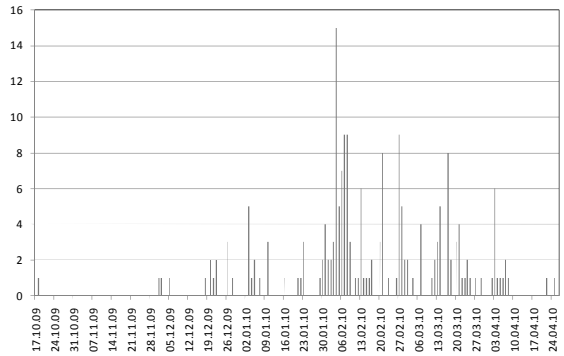

Fig. 2: Distribution of avalanche accidents (`tourist avalanches´) in the period 2009/2010 in Austria (Höller and Bilek, 2010).

In 2011/2012 (Fig. 3) a considerable increase of accidents is evident in the middle of February (16.02 to 18.02). 34 accidents in only three days represent more than one fourth of all accidents in that winter.
Responsible for the strong increase of accidents was an intensive snowfall between 15.02. und 16.02. The new snow caused a heavy load on the weak (old) snowpack, which developed prior to the snowfall (a cold period in the first two weeks of February favoured the formation of faceted crystals and depth hoar).

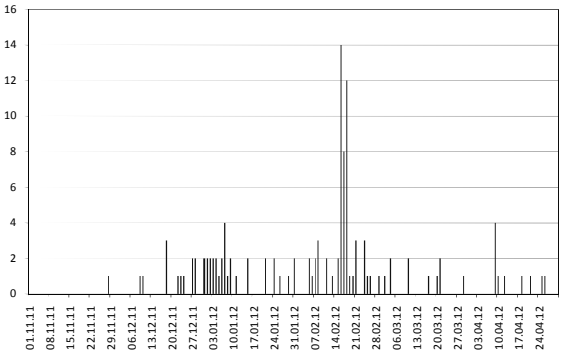

Fig. 3: Distribution of avalanche accidents (`tourist avalanches´) in the period 2011/2012 in Austria (Höller and Bilek, 2012).

4. DISCUSSION AND CONCLUSIONS

Depending on the weather conditions and the structure of the snowpack one to four critical periods [with a cumulation of backcountry and off-piste accidents (`tourist avalanches´)] can be identified per winter.
Hoi (2012) indicates that critical periods due to certain weather conditions occur from year to year and called those periods as `Lawinenzeiten´.
However, the time when `tourist avalanches´ accumulate does not correlate with the time of catastrophic avalanche situations documented by Höller (2009); these avalanche cycles are regularly caused by storm periods with an extraordinary amount of new snow and do not occur in every winter.
Taking into account the four designated avalanche patterns from Harvey (2008) and Harvey et al. (2012) [(i) new snow, (ii) drift snow, (iii) wet snow and (iv) weak snowpack] it can be concluded that the accumulation of backcountry and off-piste accidents (`tourist avalanches´) is mainly correlated with new snow and drift snow [pattern (i) and (ii)]; wet snow and a weak snowpack [pattern (iii) and (iv)] are in the minority.
The pattern which can be identified most simple (new snow) seems to be responsible for the majority of avalanche accidents.
If mountaineers would avoid such new snow periods (generally those periods continue only over a few days per winter) the number of avalanche accidents would clearly decrease.

5. REFERENCES

Bauer, H. 1982 Lawinenunfälle im Winter 1981/82 in den österreichischen Alpenländern Sicherheit im Bergland. Österreichisches Kuratorium für alpine Sicherheit, 197 – 214.

de Quervain M. 1972. Lawinenbildung. In: Lawinenschutz in der Schweiz, Bd. 9 der Reihe Bündnerwald, Beiheft, pp 15–32

Fliri, F. 1998. *Naturchronik von Tirol*, Universitätsverlag Wagner, Innsbruck, 369 pp.

Föhn P. 1975. Analyse der Beziehungen zwischen Witterung, Schneedeckenaufbau und Großlawinen am Beispiel der Katastrophenlawinen vom April 1975, Winterbericht. Eidg Inst. Schnee- u. Lawinenforschung 39:209–218.

Gayl, A. 1975. Lawinenunfälle im Winter 1974/75 in den österreichischen Alpenländern. Für die Sicherheit im Bergland. Österreichisches Kuratorium für alpine Sicherheit, 53 – 72.

Harvey, S. 2008. Mustererkennung in der Lawinenkunde. Sicherheit im Bergland. Österreichisches Kuratorium für alpine Sicherheit, 88 -94.

Harvey, S., Rhyner, H., and Schweizer, J. 2012. *Lawinenkunde*. Bruckmann, München 192 pp.

Hoi, K. 2012. Lawinenzeit. bergundsteigen, Heft 1/12,

Höller, P. 2007. Avalanche hazards and mitigation in Austria: a review. *Natural Hazards* 43, 81–101.

Höller, P. 2009. Avalanche cycles in Austria: an analysis of the major events in the last 50 years. *Natural Hazards*, 48, 399–424.

Höller, P., Bilek, H. 2009. Lawinenunfälle in Österreich – Winter 2008/2009. Sicherheit im Bergland. Österreichisches Kuratorium für alpine Sicherheit, 220-254.

Höller, P., Bilek, H. 2010. Lawinenunfälle in Österreich – Winter 2009/2010. Sicherheit im Bergland. Österreichisches Kuratorium für alpine Sicherheit, 160- 198.

Höller, P., Bilek, H. 2012. Lawinenunfälle in Österreich – Winter 2011/2012. Sicherheit im Bergland. Österreichisches Kuratorium für alpine Sicherheit, in press.

Hörmann, H. 1982 Das Lawinenunglück in Werfenweng vom 31.1.1982. Sicherheit im Bergland. Österreichisches Kuratorium für alpine Sicherheit, 79 – 90.

Mayr, R. 1992. Lawinenunfall Jamtal-Silvretta am 28. März 1988. In: Lawinenereignisse und Witterungsablauf in Österreich, Winter 1987/88, 1988/89, 1989/90 und 1990/91, FBVA-Berichte 68, 133 – 142.

Mayr, R. 2000. Lawinenereignisse in Österreich im Winter 1999/2000. Sicherheit im Bergland. Österreichisches Kuratorium für alpine Sicherheit, 89 – 121.

Merwald, I. 1985. Lawinenereignisse und Witterungsablauf in Österreich, Winter 1974/75, 1975/76 und 1976/77. FBVA-Berichte 10, 76pp.

Schaffhauser, H. 1988. Lawinenereignisse und Witterungsablauf in Österreich, Winter 1986/87. FBVA-Berichte 35, 138pp.