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ABSTRACT:

From the 1st of October 1989 to the 30th of September 1999, there was an average of:

- 20 avalanche accidents per year;
- 50 swept persons per year;
- 25 deaths per year.

The evolution of accidents and deaths is stable apart from the fact that figures of the five last years are more serious than figures of the five first years (89-94: 23 deaths and 18 accidents; 94-99: 27 deaths and 22 accidents). This slight increase has to be relativized with the frequenting of the mountains.

No surprise: accidents took place especially during the winter (80% of them between the 15th of December and the 30th of April). 50% of them took place during holidays. Almost 25% of them took place during weekdays and 20% during weekends.

Fatal avalanche accidents concerned especially backcountry activities and off piste activities. Between 1989 and 1999, 40% of the accidents concerned each activity. Though, backcountry activities killed more persons than off piste activities did (38% of the whole deaths with backcountry activity; 33% with off piste activities). Nevertheless, the evolution of accidents and deaths of backcountry activities was stable, while the evolution of accidents and deaths of off piste activities increased.

KEYWORDS: Avalanche, Accident, Evolution, Distribution.

ACKNOWLEDGMENT:

ANENA would like to thank the mountain rescue public services (CRS (State Security Police Group) and PGHM (High Mountain Gendarmerie Group)) which allowed us to collect data concerning fatal avalanche accidents as well as the National and Regional Development and Environment Ministry which financed this study.

Because of the lack of precise data on avalanche accidents as a whole, the study only focuses on fatal avalanche accidents. Data on those accidents are indeed exhaustive.

The study takes all fatal avalanche accidents that took place between the year 1989-90 and the year 1998-99 into account. According to the CISA-IKAR convention, every season begins on the 1st of October and ends on the 30th of September of the following year.

INTRODUCTION

The aim of the study carried out by ANENA is to obtain better knowledge on avalanche accidents. Such knowledge would allow us to diffuse better prevention messages suiting the reality.

1. GENERAL DATA

1.1. Global results

1.1.1. Results on 10 years

From the 1st of October 1989 to the 30th of September 1999, there were 209 mortal

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avalanche accidents. In these 209 accidents, 597 persons were swept and 316 died (53% of the persons swept by avalanches died, 18% were injured and 29% were unharmed). Globally, this gives a ratio of 3 swept persons per accident and 1,5 deaths per accident.

persons (that is 15%);
- 161 accidents caused the death of 1 person (that is 80%).

1.1.2. Exceptionnal avalanche accidents

Among the 209 fatal accidents, 9 accidents are "exceptionally important" (an "exceptional accident" is an accident that causes more than 3 deaths). Those 9 accidents caused 67 deaths (between 4 and 12 dead persons per accident), that is to say a ratio of 7,5 deaths per accident.

Thus, if not taking into account the 9 "exceptionnal" mortal accidents, there were 200 fatal accidents between 1989 and 1999. 479 persons were swept by avalanches (that is to say 2,4 person swept per avalanche) and 249 persons died (that is to say 52% of the persons swept by an avalanche died). So, the mortality rate (number of dead persons per accident) is 1,25.

date dd/mm/yy	activity	deaths
14/02/91	Backcountry skiing	9
21/11/92	downhill skiing	7
28/03/93	Backcountry skiing	5
29/01/94	off piste skiing	6
28/07/94	alpinism	9
05/09/96	alpinism	4
14/09/97	alpinism	4
23/01/98	Backcountry skiing	11
09/02/99	houses	12

Figure 1. Fatal avalanche accidents in France between 1989 and 1999 (10 years) that caused the death of 4 persons or more.

We can observe that the exceptional accidents concern more backcountry activities and alpinism activities than other activities.

1.1.3. Rest of the 200 fatal avalanche accidents

Among the 200 fatal avalanche accidents that caused less than 4 deaths:
- 10 accidents caused the death of 3 persons (that is 5%);
- 29 accidents caused the death of 2

Warning: When it is not specified, the rest of the present study does not take accidents that caused 4 deaths or more into account.

These particular accidents are indeed very different from the others in regard to the gravity. They can not be taken into account in the same way as the other accidents without modification of the interpretation of the analysis results.

Their exceptional features (a great number of deaths and a low frequency) differentiate them from the other accidents, and place them aside.

Conclusions are not affected by this fact, as the aim of the study is to obtain better knowledge of fatal avalanche accidents in general. On the contrary, by excluding the exceptional accidents, the conclusions give a better picture of the accidents as a whole.

1.2. Evolution

From year to year, we observe a great variability in the number of deaths per season (from 12 to 39 deaths per season, that is to say a ratio of 1 to 3). For the 10 years (89-99), the average is 25 deaths by season. The same variability can be observed with the number of accidents per season (from 13 to 32 accidents per year). For the period 1989-99, the average is 20 accidents per season.

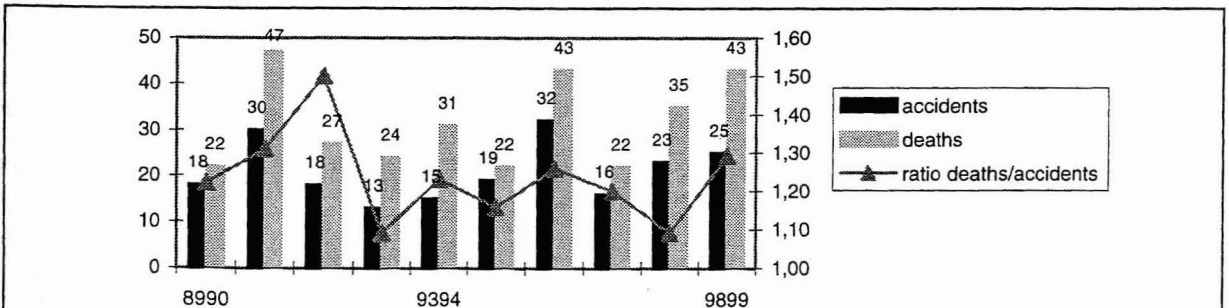


Figure 2. Annual evolution of the fatal avalanche accidents and deaths as a whole and of the ratio deaths/accident without exceptional accidents between 1989 and 1999 in France.

Nevertheless, if years are grouped together 3 by 3, we observe a stability between the years 90-93, 93-96 and 96-99 (that is to say an average of 25 deaths per season every 3 years).

However when comparing the five first years (89-94) with the five last years (94-99), one observes that there have been more accidents and deaths during the last seasons (23 to 27 deaths and 18 to 22 accidents).

This upward trend is confirmed with a calculation of a linear regression curve which gives a slope of 0,34 for the accidents and a slope of 0,15 for the deaths.

However, these gross results should be related to the number of people frequenting the mountains which has surely known a greater increase. So, globally, there has been less

accidents and deaths compared to the average of frequenting.

1.3. Annual distribution of accidents and deaths

1.3.1. Monthly distribution

Comment: The proportion of accidents and deaths are similar in pourcentage (only 1-2% difference)

For both accidents and deaths figure 3 shows that:

- 50% of the accidents (and deaths) took place in January and February;
- 80% between the 15th of December and the 30th of April.
- 90% between the 1st of December and the 15th of May.

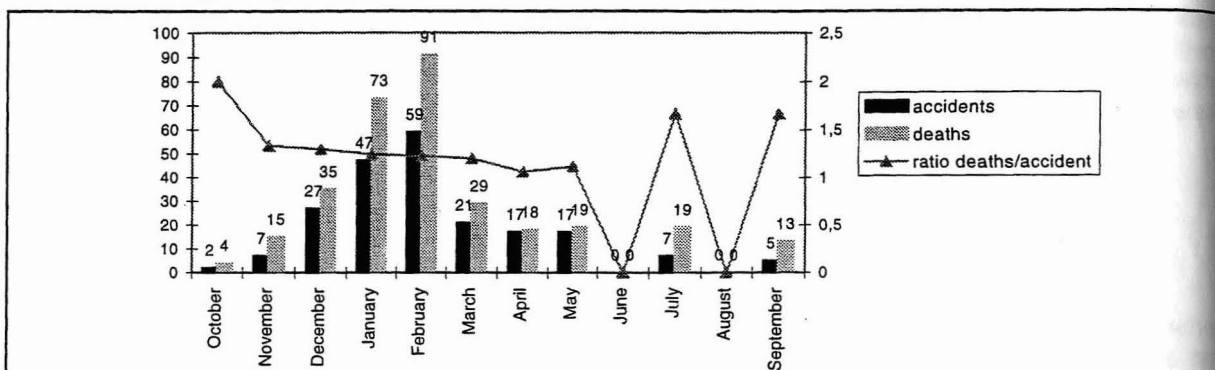


Figure 3. Monthly distribution of the fatal avalanche accidents and deaths as a whole and of the ratio deaths/accident without exceptional accidents between 1989 and 1999 in France.

1.3.2. Distribution during the holidays period

We observe in figure 4 that:

- 50% of the accidents and deaths took place during holidays (that is to say during 1/3 of one year);
- 20% of those accidents took place during the 4 weeks of February holidays and 15% during the 2 weeks of December holidays.

- 30% of the fatal avalanche accidents took place during weekdays:

 - 12% of those between December holidays and February holidays.

- 20% of the accidents took place during weekends:

 - 10% of those between December holidays and February holidays.

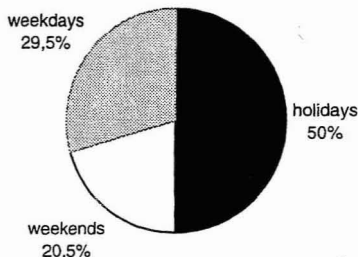


Figure 4. Distribution of the fatal avalanche accidents during the holidays period/weekend period/weekdays period between 1989 and 1999 in France.

2. DISTRIBUTION BY ACTIVITIES

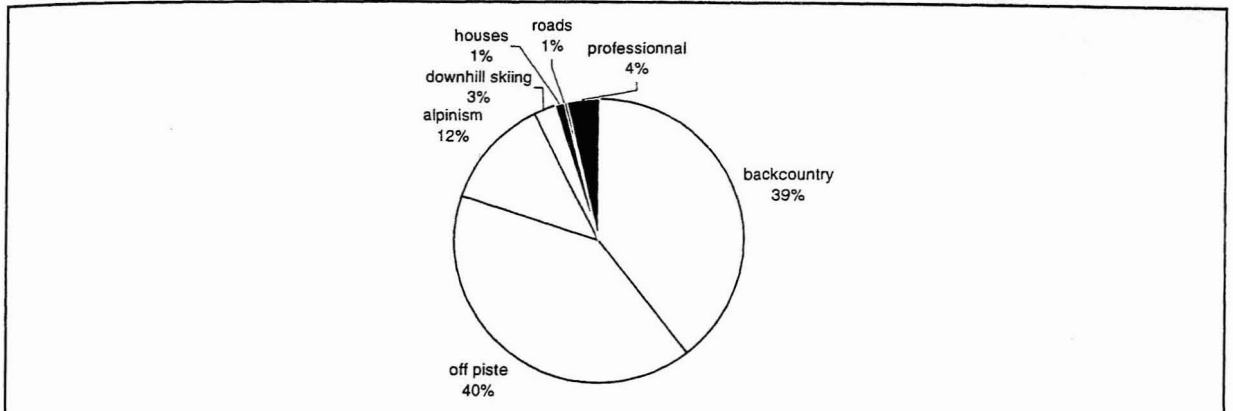


Figure 5. Distribution of the fatal avalanche accidents by activities without exceptional accidents between 1989 and 1999 in France.

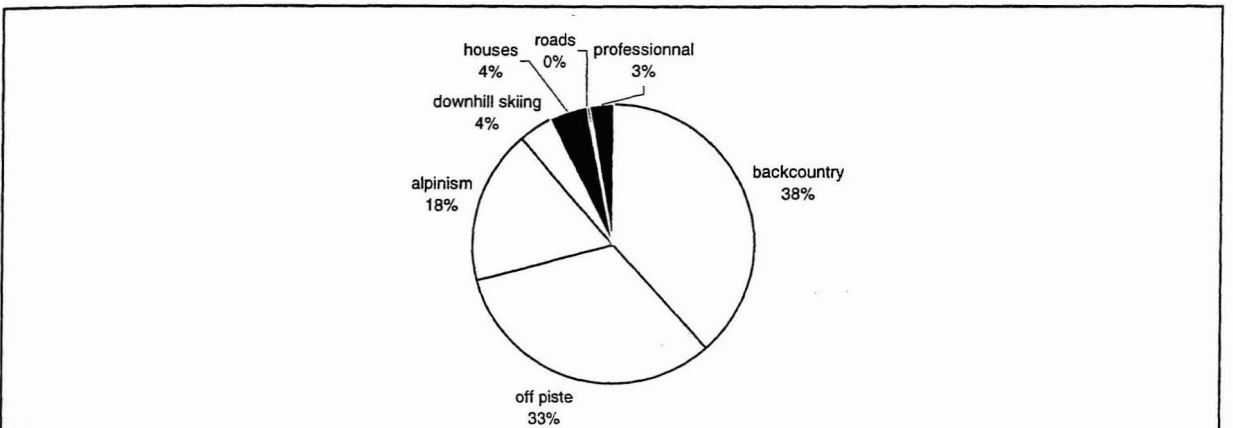


Figure 6. Distribution of the deaths by activities without exceptional accidents between 1989 and 1999 in France.

Almost all of the fatal avalanche accidents and deaths took place during recreational activities. Indeed, more than 90% of the accidents took place while people were doing backcountry activities, off piste activities or alpinism activities. Less than 5% of the accidents and deaths took place during non-recreational activities.

2.1. Distribution of non-recreational activities

The non-recreational activities are: professional activities (rescue operations, releasing avalanche operations, raming, ski lift maintenance), roads and houses.

Few accidents took place while people had non-recreational activities.

Activities	accidents	swept	deaths
houses	3	34	14
roads	1	5	1
professionnal	7	13	9

Figure 7. Details of non-recreational accidents (including the exceptional accident that concerned houses (12 deaths) of the 9th of February 1999).

2.2. Distribution of recreational activities

The recreational activities are: downhill skiing, backcountry activities (backcountry skiing, snowshoe walking), off piste activities (off piste skiing and snowboarding), alpinism activities (traditional alpinism and ice climbing).

2.2.1. Downhill skiing

Avalanche accidents for this activity are rare.

There were 6 fatal accidents between 1989 and 1999. 26 persons were swept and 12 died. One sole avalanche swept 10 persons and killed 7 of them (season 92-93).

2.2.2. Backcountry activities

2.2.2.1. Global results

There were 82 fatal avalanche accidents and 121 deaths for this activity (that is to say 39% of the total of accidents and 38% of the whole deaths). Among those 82 accidents there were 3 exceptional accidents that killed 25 persons (11+9+5).

2.2.2.2. Evolution

In figure 8 we observe that between 1989 and 1999, considering backcountry activities, there were an average of 8 fatal accidents per year, 20 swept persons per year and 10 deaths per year.

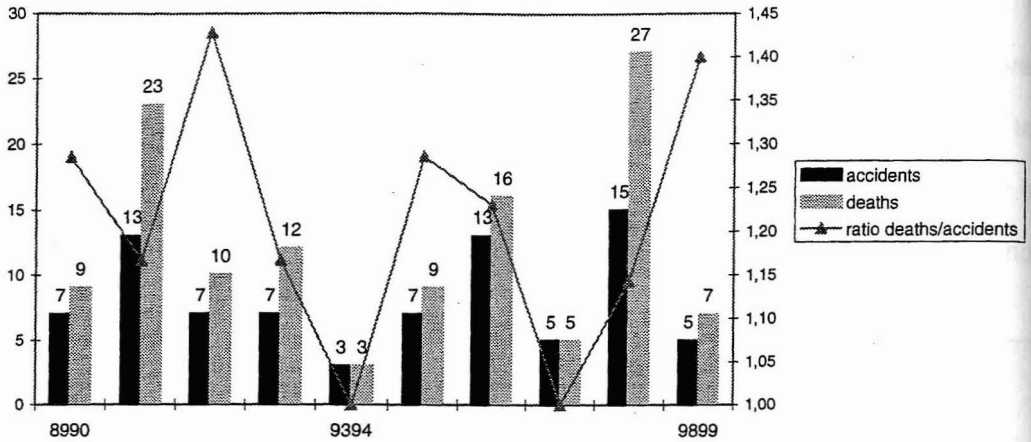


Figure 8. Backcountry activities: annual evolution of the fatal avalanche accidents and deaths as a whole and of the ratio deaths/accident without exceptional accidents between 1989 and 1999 in France.

If years are grouped 3 by 3, we remark a stability between the years 90-93, 93-96 and 96-99. If years are grouped 5 by 5, this trend is stable between the years 89-94 and 94-99. The calculation of a linear regression curve which gives a slope of 0,06 for the accidents (and 0,02 for the deaths) confirms the stability.

2.2.2.3. Distribution by periods

Figure 9. shows that:

- 91% of the accidents took place between the 1st of December and the 15th of May;
- 74% between the 15th of December and the 30th of April;
- 49% between the 15th of December and the end of February.

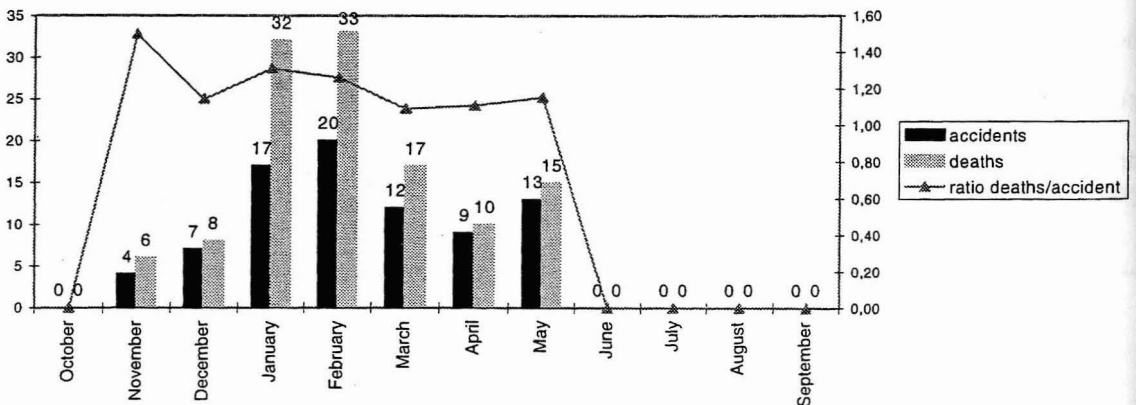


Figure 9. Backcountry activities: monthly distribution of the fatal accidents and deaths as a whole and of the ratio deaths/accident without exceptional accidents between 1989 and 1999 in France.

For backcountry activities, the distribution of accidents during holidays period, weekends period and weekdays period between 1989 and 1999 in France is:

- 46% of the accidents took place during holidays;
- 29% during weekends;
- 25% during weekdays.

2.2.3. Off piste activities

2.2.3.1. Global results

There were 82 fatal avalanche accidents and 103 deaths for this activity (that is to say 40% of the total of accidents and 33% of the whole deaths). Among those 82 accidents, there was 1 exceptional accident that killed 6 persons.

2.2.3.2. Evolution

In figure 10 we observe that between 1989 and 1999, considering off piste activities, there were an average of 8 fatal accidents per year, 16 swept persons per year and 10 deaths per year.

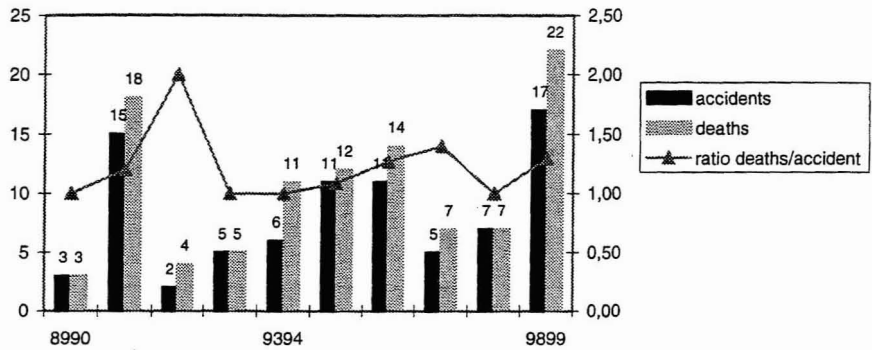


Figure 10. Off piste activities: annual evolution of the fatal avalanche accidents and deaths as a whole and of the ratio deaths/accident without exceptional accidents between 1989 and 99 in France.

If years are grouped 3 by 3, we remark a stability between the years 90-93, 93-96 and 96-99. Nevertheless, if years are grouped 5 by 5, there is a slight increase in the last years between the years 89-94 and 94-99.

This upward trend is confirmed with the calculation of a linear regression curve which gives a slope of 0,8 for the accidents (and 0,6 for the deaths).

2.2.3.3. Distribution by periods

Figure 11. shows that:

- 100% of the accidents took place between the 1st of December and the 15th of May;
- 96% between the 15th of December and the 30th of April;
- 77% between the 15th of December and the end of February.

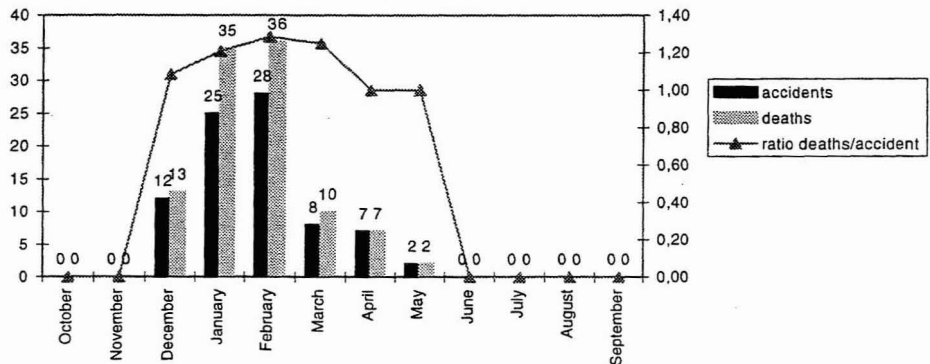


Figure 11. Off piste activities: monthly distribution of the fatal accidents and deaths as a whole and of the ratio deaths/accident without exceptional accidents between 1989 and 1999 in France.

For off piste activities, the distribution of accidents during holidays period, weekends period and weekdays period between 1989 and 1999 in France is:

- 54% of the accidents took place during holidays;

- 14% during weekends;
- 32% during weekdays.

2.2.4. Alpinism activities

2.2.4.1. Global results

There were 28 fatal avalanche accidents and 56 deaths for this activity (that is to say 12% of the total of accidents and 18% of the whole deaths). Among those 28 accidents there were 3 exceptional accidents that killed 17 persons (9+4+4).

2.2.4.2. Evolution

In figure 12 we observe that between 1989 and 1999, considering alpinism activities, there

were an average of 2,5 fatal accidents per year, 7 swept persons per year and 4 deaths per year. If years are grouped 3 by 3, we observe a fall between the years 90-93, 93-96 and 96-99. The same fall is observed when years are grouped 5 by 5 (89-94, 94-99).

This downward trend is confirmed with the calculation of a linear regression curve which gives a slope of -0,1 for the accidents (and -0,4 for the deaths).

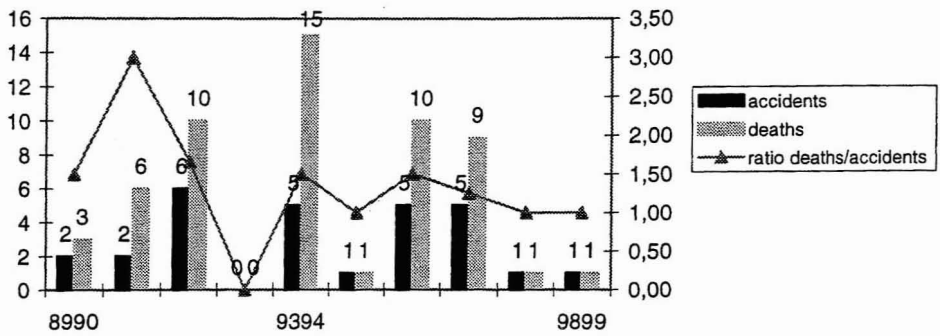


Figure 12. Alpinism activities: annual evolution of the fatal avalanche accidents and deaths as a whole and of the ratio deaths/accident without exceptional accidents between 1989 and 99 in France.

2.2.4.3. Distribution by periods

Figure 13. shows that:

- 52% of the accidents took place between the 15th of May and the 30th of November.

For alpinism activities the distribution of accidents during the holidays period, weekends

period/ and weekdays period between 1989 and 1999 in France is:

- 48% of the accidents took place during holidays;
- 24% during weekends;
- 28% during weekdays.

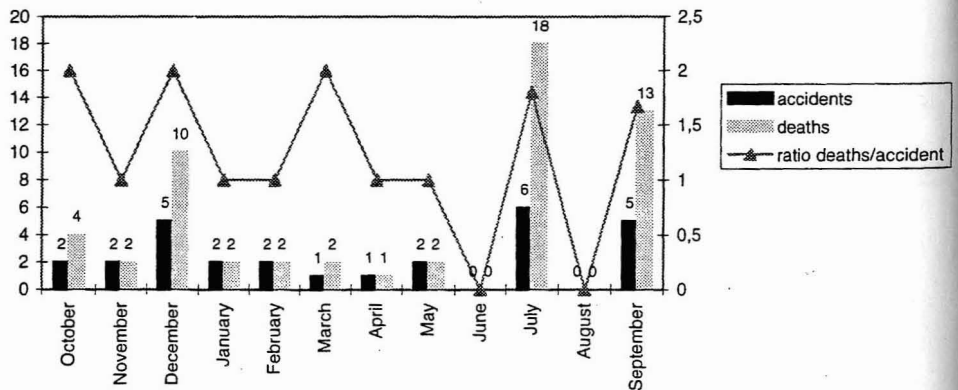


Figure 13. Alpinism activities: monthly distribution of the fatal accidents and deaths as a whole and of the ratio deaths/accident without exceptional accidents between 1989 and 1999 in France.

CONCLUSIONS

From the 1st of October 1989 to the 30th of September 1999, there was an average of:

- 20 avalanche accidents per year;
- 50 swept persons per year;
- 25 deaths per year.

The evolution of accidents and deaths is stable apart from the fact that figures of the five last years are greater than figures of the five first years (89-94: 23 deaths and 18 accidents; 94-99: 27 deaths and 22 accidents).

This slight increase has to be relativized with the frequenting of the mountains.

Accidents took place especially during the winter. 50% of them took place during holidays. Almost 25% of them took place during weekdays and 20% during weekends.

Fatal avalanche accidents concerned especially backcountry activities and off piste activities. Between 1989 and 1999, 40% of the accidents concerned each activity.

Though, backcountry activities killed more persons than off piste activities did (38% of the whole deaths with backcountry activity; 33% with off piste activities).

Nevertheless, the evolution of accidents and deaths of backcountry activities was stable, while the evolution of accidents and deaths of off piste activities increased.