

THE ESTABLISHMENT OF THE FIRST PUBLIC AVALANCHE FORECASTING SERVICE IN SWEDEN

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ABSTRACT

Sweden started in 2015 the establishment of its first public avalanche forecasting service. The establishment of the service was initiated by the Swedish government and is a true milestone in the Government's public safety efforts. The first avalanche bulletins was published in January 2016 and daily bulletins has been issued for 3 separate areas. In the coming 3 years the forecasting service will try to cover up to 8 regions, which means most of the Swedish mountain area and its need.

In comparison to other European countries Sweden has chosen to establish the forecasting service following international standards using the North American danger scale and the Canadian Conceptual Model as the first country in Europe.

This is mainly because that Sweden during more than 15 years has adopted an avalanche education system with a strong relation and influence from the Canadian avalanche education standards. Due to the decision to adopt to the Canadian Conceptual model, Sweden has also decided to use the INFOEX Observation Exchange platform based on OGRS, as the first country in Europe.

Avalanche accidents has claimed 29 Swedish fatalities the past 10 years, both in Sweden as well as in other countries. The use of avalanche terrain is increasing as in most countries, which leads to more accidents.

The preliminary results and experiences from the first winter of forecasting and communication of the bulletins is that Sweden now has a very reliable forecasting service that works well and that has succeeded in reaching the main user groups.

KEYWORDS: Avalanche forecasting

1. INTRODUCTION

In February 2015, the Swedish government assigned the Swedish Environmental Protection Agency (SEPA) to establish an avalanche forecast service for the Swedish mountains. The assignment followed two previous test winters year 2011 – 2012. During the winter of 2016, the forecast service was operational and issued avalanche forecasts for three mountains areas. This paper describes the ongoing establishment of the public avalanche forecasting service in Sweden.

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2. BACKGROUND

Avalanche accidents in Sweden primarily involve winter recreationists. Winter recreation in the mountains is popular among Swedes and every winter the Swedish mountains have 1 million visitors. At varying degrees, many backcountry users like skiers and snowmobilers put themselves at risk for avalanches and the need for reliable public avalanche information in the Swedish mountains has been discussed for a long time. Basic conditions for a public avalanche service were investigated for the first time in the 1950's, and have been investigated several times since then, a forecasts service also been requested by Swedish skiers, snowmobilers and other stakeholders.

Two strong trends during the last decades have put light on the need for avalanche forecasts in Sweden:

One is changing terrain use in the mountains with a bigger group of recreationists travelling in steep terrain and thus exposing themselves to more avalanche risk.

The other is globalization of winter recreation, Swedish skiers are likely to not only ski in Sweden, but also abroad, and Swedish mountains are increasingly popular among visitors from other countries. Those trends highlight the need for avalanche information in Sweden that is comparable with international standards.

The main goals of the Swedish avalanche service are:

- To reduce the number and severity of avalanche incidents; and,
- To provide visitors with a good basis for decision, thus granting safer experiences while in the mountains.

Since the year 2001, 37 Swedish citizens has been killed in avalanches, a majority of those in other countries. There is disturbing evidence that Swedes have been overrepresented in avalanche fatalities abroad, and there is an assumption, or hope, that if Swedish skiers as a group get more accustomed to public avalanche information, they would be more likely to adapt to conditions and less inclined to risk-taking also when skiing abroad.

3. PRECONDITIONS

The Swedish mountain range stretches 1000 km along the Norwegian border in the northern half of the country. It spans from 61° to 69° north and part of the area is well above the Arctic Circle. Most of the area is sparsely populated and the roads are few.

Villages and tourism with ski resorts is concentrated around major roads. Both skiing and snowmobiling are both very popular in most areas. Small local populations, few roads and dark mid-winters means few visitors in essential major parts of the terrain during low season, and particularly in the northern part the low season extends well into February before daylight gets longer.

The mountain range is old and eroded, and in many areas a large portion of the terrain can be described as rather safe avalanche terrain. Avalanche accidents involve, with few exceptions, people who voluntarily seek steep terrain, either at their free time or at work. The network of automated weather stations is relatively sparse, specifically on higher altitudes

4. ASSIGNMENT

SEPA's mandate to provide an avalanche warning service includes three prerequisites:

1. *Begin the establishment of an avalanche forecast/warning service for the Swedish mountains, in cooperation with other relevant actors:*

SEPA has established a national avalanche forecasting service with managers and forecasters based from the city of Östersund, while area managers and field observers are based on the ground in the forecasting regions. Three regions have been established during the first winter of operations:

1. Åre/Bydalen/Storulvån
2. Hemavan/Tärnaby
3. Abisko/Björkliden/Riksgränsen

When choosing forecast areas, priority was given to areas that is popular among winter recreationists. Areas were the majority of historical avalanche accidents and the availability of local avalanche expertise were other factors. There is also an intention to spread the areas geographically, to make the forecast service relevant to more people already from the start.

2. *Have principle responsibility for the operations, although operational parts of the assignment may be outsourced to other relevant sectors*

SEPA has taken the principle responsibility for the operations of the avalanche warning service, important parts of the daily operational work have been outsourced.

3. *Be responsible for governance and Funding*

The forecast service for the year of 2016 has been funded with approximately 3,5 million SEK.

5. TARGET GROUPS

Forecasts are aimed towards people travelling in the mountains during winter like ski tourers, snowmobilers, recreational off-piste skier, but also professionals like guides, heliski-operations, reindeer herders, hut wardens, nature wardens, mountain rescuers and others. Besides exposing themselves to risk at work, many professionals also

have a key role as mountain visitors turn to them for advice and may be regarded as authorities.

In Sweden infrastructure rarely is affected by avalanches, such as railways, roads and communities which makes forecasts to mainly focus on active outdoor recreationalists rather than as a warning service for the community at large.

To learn more about how our main target groups are using avalanche terrain, we have conducted a series of targeted surveys, analyzed the responses and published a series of reports which have given us a good basis to better understand their needs of information and tools and how we can work to prevent future avalanche accidents.

6. PUBLIC AVALANCHE FORECASTS IN 2016

SEPA has published the avalanche forecasts on a standalone website, www.lavinprognoser.se. The priority in the design has been clarity and simplicity, but also to stay in line with international standards. The bulletins should be easily recognized by people who read avalanche bulletins from other countries. To make the message as clear as possible, we have deliberately rationed the amount of information on the page.

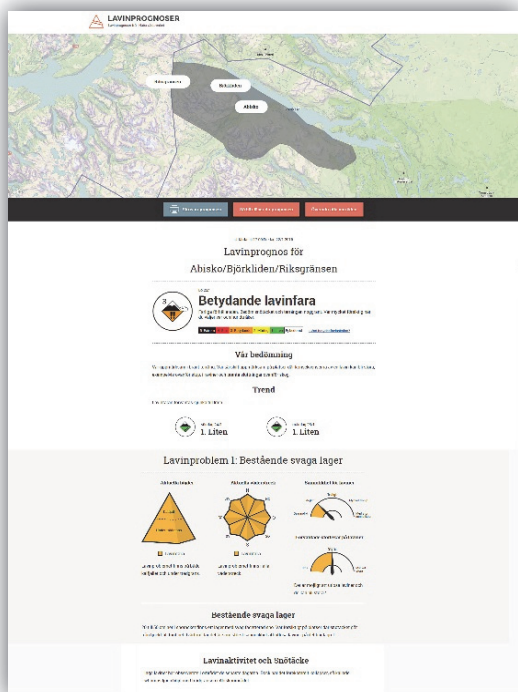


Figure 1 The regional forecast at www.lavinprognoser.se.
(Note that most forecasts would have longer texts)

The simplest information, gradation of avalanche danger 1 -5 and written advices comes first, and the more technical description of the avalanche danger further down. The main message is to be understood by people with limited knowledge of avalanches, but to fully understand all of the content most people would need both some learning and to get accustomed to reading avalanche forecasts.

7. FREQUENCY OF FORECASTS

Avalanche forecast have been issued daily for the three regions at 17 pm. There has been a time slot in the morning for updating the forecasts, which means frequency in one sense could be regarded as twice a day. Forecasts extends for the three following days.

8. PRODUCTION AND ORGANIZATION

The forecast service has been based on three principle sources of information:

- Contracted, local network
- Weather information, forecast and automated weather data from SMHI, Swedish meteorological agency, and also from and sources.
- Cooperation with local actors, like ski areas, tourist companies and the public.

Given the rather thin network of weather stations and the publics irregular use of terrain, and therefore also presumed irregular reporting, the conclusion was that a successful avalanche program in Sweden would need to compensate with organizing a professional network of observers to ensure a reliable flow of information.

The organization aims to balance central coordination with effective local management of the daily work. The service is based out of SEPA in the city of Östersund, where most, forecasts are issued. To make sure the flow of information from the field to the forecast office, each forecast area has a local "hub" for information, called area managers. The *area Managers* are responsible for coordinating the daily collection field observations, making twice daily hazard assessments, evaluating the forecast products and transferring all of this information to the *forecasters* in Östersund.

There is two main channels for the flow of information in the service, daily conferences between

local networks and forecasters and technical information is exchanged through the software InfoEx.

In the daily work, the main staff has consisted of:

- A forecaster that issue daily forecasts for the three regions.
- One area manager in each region. The area manager evaluates the issued bulletin and make an avalanche hazard assessment twice a day. They also prioritize and coordinate observations in the region. Area managers communicate with forecasters in a daily video/tele – conference, (besides through InfoEx).
- A varying number of field observers.
- A meteorologist from SMHI has delivered detailed weather forecast and weather support during the day. The weather support is presented in a daily video conference.

Within the project a total of 25 people have been contracted as observers, area managers and forecasters. There is also a larger network of voluntary contributors, both public and professional like ski areas, guides and other actors in the tourism sector.

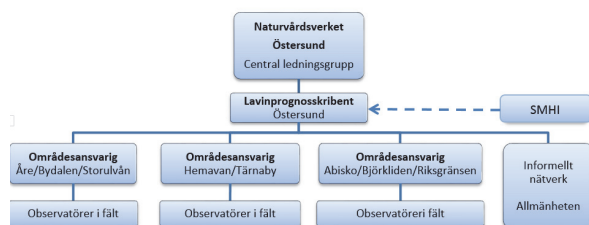


Figure 1. The avalanche forecasting organization

Decisions and assessments are often made in the local Organisation, while forecasters are responsible for all areas and shall make sure the service is kept together as one. Although the organization is slim, it is tailored to have more than one person involved in assessments.

Another effect of putting the duty to assess and evaluate avalanche hazard on the local network, is that area managers and observers will be engaged in building up a wider network of information locally.

9. THE SWEDISH USE OF INFOEX™

In 2016, SEPA purchased a license to use Canada's InfoEx™ software as the platform for technical information exchange between observers and forecasters. The InfoEx™ system is based upon the OGRS standards, uses the *Conceptual*

Model of Avalanche Hazard as the framework for avalanche hazard assessment, and communicates avalanche hazard ratings using a version of the *North American Avalanche Danger Scale*. These methods are consistent with the avalanche education Swedish forecasters receive, have recently been published in the CAA's *Technical Aspects of Snow Avalanche Risk Management* (2016).

10. OBSERVATIONS

The area managers and the observers has all been using OGRS as the standard used for all observations in the service. Area managers in each region made a hazard assessment twice a day during the season. During the first year observation collections has delivered approximately 300 avalanche observations, 400 avalanche summary's, 300 snow observations/snow profiles, 300 snowpack descriptions, 300 field summaries and 100 terrain descriptions. In addition to this close to 700 manual weather observations has been delivered, (in addition to SMHI's automatic weather observations).

11. TRAINING STANDARDS AND COMPETENCE REQUIREMENTS

To get an assignment as a forecast writer, an area manager or observer in the forecasting service, the requirement has been set to have taken proper avalanche training and in most roles, proofs of experience. Since 2001, Swedish avalanche professionals has taken their professional training in Canada from the Canadian Avalanche Association's Industry Training Program (ITP).

These programs offer a staged, apprenticeship style of training that is founded upon teaching consistent and standardized methods for avalanche forecasting. Forecasts and area managers must have accomplished at least Canadian Avalanche Association's Industry Training Program ITP L2. The observers must have taken a least CAA ITP L1 or similar. The training before the season focuses primarily on skills tasks that are specific to the task of making national avalanche forecasts.

12. EVALUATIONS OF THE FORECASTING SERVICE

The avalanche forecasting service has been evaluated by the users, the general public and professionals in the mountains using a web survey. An international evaluation has been made by Grant Statham from Canada and also by the 25 participating avalanche technicians.

The results from the evaluation process shows that the avalanche forecasting service of Sweden gets good grades from the evaluators and can be considered as a well-established avalanche forecasting service, also in comparison to other countries. The participating evaluators provide a number of constructive suggestions to refine work processes and the methodology, which is natural in a start and of course very valuable for the future. In the international evaluator's report, there is a number of recommendations, such as:

- Establishing an incident reporting system, to eventually be able to evaluate the effects of preventive work.
- Expanding the number of areas slowly and make sure there is local expertise in each new area.
- Continue work on Sweden's Avalanche Training program, education of both professionals and the skiers and snowmobilers are crucial for the future success of the avalanche forecasting service.
- Increased cooperation with the Norwegian avalanche forecast service in terms of communication of forecasts which should aim to be as equal as possible.

13. DISCUSSION – THE CHOICE OF FORECASTING MODEL

In the absence of a national avalanche service in Sweden, avalanche risk has been managed and avalanches has been forecasted professionally on the local scale in ski areas, in guiding, in transportation and by the Swedish armed forces. This means avalanche forecast are introduced in a context where it already exists certain established industrial standards. Those standards are primarily learnt in professional avalanche courses, and national Swedish avalanche courses have since 15 years been based on Canadians avalanche associations ITP course system.

Since then, a Swedish version of the North American version of the avalanche danger scale has been used, and Sweden has also adopted the use of Canada's Observation Guidelines and Recording Standards for Weather, Snowpack and Avalanches (OGRS) as a national standard.

More than 150 people have been taken the "Avalanche technician" course, similar to CAA's Industry Training Program ITP L1 and close to 3000 persons have taken shorter avalanche courses.

Although we consider avalanche forecast as a very important part of the preventive work, it is not

the only part, and Sweden has been implementing a Canadian approach to structuring its avalanche industry for 15 years. As most readers probably know, there are two variations of the international avalanche danger scale, the European- and the North American avalanche danger scale, (used not only in I Norths America though).

In SEPAS assessment, the difference between the scales has very small effects for the public that use the forecast to manage risk, especially considering the well-known pedagogic challenges with the danger scale. However, the differences in the underlying structure have certain practical implications in the professional setting.

Although geography is a strong argument for Sweden to convert to the European scale, we need to take a broader look at the avalanche industry as a whole. Education is a key, and we are convinced that our decision to base our course system on the CAA's Industrial training program is right.

From that follows the choice to keep using OGRS as professional observation standards, using the conceptual model and the Swedish version of the North American avalanche danger scale. That said, we encourage the work to bring the two existing standards together to make just one international avalanche danger scale in a close future.

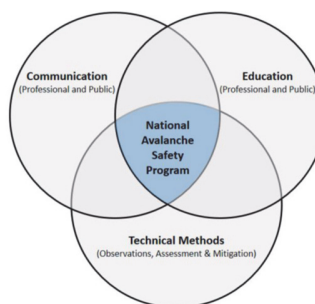


Figure 3: The three strategic components of avalanche safety programs, and how harmonization between them can intersect for national level prevention programs

14. FUTURE DEVELOPMENT

Some of the more important parts of the future development are:

14.1 Expansion the service to additional forecast areas

SEPA intends to expand the forecasts to more areas gradually. In the forecast model as it stands, the local network has a key role, and when adding new areas to the service a local network with ava-

lanche competence has to be built. Long term, expansion to 8-9 areas is planned for within this forecasting model. That would not cover the whole mountain area, but all of the most visited parts of the mountains.

14.2 Improving communication with users

Development of the website will continue, adding map services and open up for easier/better interaction between the public and forecasters. Adding very easy channels for public users to report observations is also a priority.

14.3 Avalanche terrain exposure scale

Exposure to avalanche risk is very unevenly distributed among the mountain visitors, with a smaller percentage of the visitors taking much more risk, deliberately or not. Forecasts are written primarily with the people in mind that seek avalanche terrain because of the nature of their activity, like freeriders on skis or snowmobiles. But there is also a big group of mountain visitors that prefer gentle terrain that also wants avalanche advice for a safe travel. To really get through with the message that risk is individual and dependent on personal choices of terrain is challenging. SEPA believes one way to clarify this is through the *Avalanche Terrain Exposure Scale*. The most visited parts of the Swedish mountains are rated using the ATES technical model and the intention is to make the ratings an integral part of the forecasts.

14.4 Collaboration with stakeholders

Contribution from stakeholders like ski areas, nature wardens and guides could add much value to the service as it expands to new areas.

14.5 Avalanche courses

SEPA recognize that professional and recreational training is an integral part of the national avalanche prevention program. The Swedish avalanche course system SVELAV should contribute directly to the program objectives, and SEPA will continue to promote the development and implementation of the SVELAV training model.

14.6 International collaboration

Since Sweden is a relatively small country, we have always seen a need to establish and maintain good relations with other countries with established avalanche safety programs. Since 2012, Sweden leads a working group of ICAR in order to develop mountain safety related issues where we

have good support from the member countries' representatives around to prepare for our ongoing establishment of a national avalanche forecasting service. We have also participated in EAWS for several years, which conducts cooperation, primarily with countries within Central Europe.

Sweden sees it as quite natural for the further development of avalanche safety issues, that all nations of the world which conducts an avalanche forecast service, would benefit around to meet regularly, exchange experiences, share new knowledge and current research in order to be able to reach even further and together develop new tools with the aim of preventing even more avalanche accidents in the future.

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