

Development of Avalanche Education and Hazard
Forecasting in Hokkaido, Japan

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Avalanche fatalities in Hokkaido have been recorded for more than fifty years and Japan devotes considerable public funds to the academic study of avalanches yet operational forecasting is not conducted. While avalanche defenses protect highways and railroads throughout Hokkaido, hazard evaluation is not practiced at Hokkaido ski resorts and in-bounds avalanche terrain is neither controlled nor closed during periods of extreme hazard. Out of bounds avalanche paths are permanently closed, but the policy is not always effective in deterring many individuals from skiing in these paths.

On 15 January, 1990 two skiers were killed and several others caught in two avalanches on prominent avalanche paths between the Niseko Hirafu and Niseko Higashi-yama ski areas in western Hokkaido. These accidents occurred near the end of one of the most intense storm cycles of the season in Hokkaido. Two periods of very heavy snowfall accompanied by extremely high winds were punctuated by a day of warm sunny weather, followed by a cold, clear night. It is believed that a weak depth hoar layer formed near the snow surface during the night of 12 January that formed the sliding layer for both avalanches on 15 January (Akitaya and Fukuzawa, 1990). One of the victims was a thirteen-year old boy who was taken across a clearly flagged rope line by an uncle who had been involved in another fatal accident two years earlier outside Niseko Moiwa Ski area. The fact that avalanche fatalities at Japanese ski areas are not higher is probably due to the limited number of ski areas with large numbers of out of bounds skiers. With greater public awareness and more consistent enforcement of ski area boundaries these fatalities could be greatly reduced.

The mountaineering and backcountry skiing communities have little avalanche training beyond a cursory discussion in informal meteorology lectures given by local mountaineering clubs. The use of avalanche transceivers is unknown. Case studies of avalanche accidents (Naruse, 1989) and discussions with ski-mountaineers suggest that the general level of avalanche awareness is comparable to that of ski area patrons; surprisingly low for such a group.

With support from the Japanese Ministry of Education and the Institute of Low Temperature Science at Hokkaido University a project has been initiated to develop guidelines for the formation of an avalanche hazard warning system for Hokkaido. This project consists of two components: preliminary compilation

and analysis of requisite data sets and subsequent examination of the problems associated with the implementation of avalanche education and forecast systems where historical precedents are absent.

The first component, compilation of data sets, includes a detailed climatology of the winter climate of Hokkaido as it relates to patterns of avalanche activity. The island of Hokkaido is similar in size, latitude and climate to the state of Maine. Hokkaido's winter climate differs however, in the amount of snowfall, which can be prodigious. The western side of Hokkaido, facing the Japan Sea, receives the greatest amount of snowfall, with maximum snow depths often exceeding five meters in several mountain ranges. Near the Japan sea temperatures are moderately cold and precipitation is frequent. The climatological pattern, termed "winter monsoon" (Kume, 1960) is a dominant feature of the general circulation in winter, characterized by a strong Siberian high, coupled with a trough or closed low in the Pacific ocean, east of the Japanese archipelago. In eastern regions of Hokkaido snowfall is much lighter due to the shadowing effect of high mountain ranges (Yamada, 1982) and temperatures can be extremely cold (-40°C).

Vastly differing snow conditions can be found on opposite sides of a mountain range, leading to spatial variation in patterns of avalanche activity. The purpose of the data gathering component of this project is to create a climatology of avalanche activity to be used as an information base in the future establishment of an avalanche forecast and information center in Hokkaido. Data for this information base are being compiled from several sources. Large-scale climate data are archived on CD-ROM by the department of Atmospheric Sciences at the University of Washington. This CD-ROM includes the National Meteorological Center's (NMC) northern hemisphere grid point data set covering the years 1946 through 1988 at twice-daily intervals. Station data from airfields are also archived on CD-ROM by Weatherdisc Associates of Seattle, WA. Detailed meteorological data from automated weather stations in Japan are provided by the Automated Meteorological Data System (AMEDAS) of the Japanese Meteorology Service (Tsuboki et al., 1990). Naruse (1989) has compiled a historical record of avalanche accidents in Hokkaido from 1933 to 1989. The record includes information about weather conditions, general circumstances and type and size of avalanches encountered by mountaineers and skiers. This data set will be supplemented by Nakamura et al's (1987) historical avalanche data compiled from newspaper reports.

Problems in encouraging development of an avalanche forecast system often seem daunting. Beyond the obvious problem of the language barrier, the general knowledge base, outside of academia, is presently inadequate to build a network of observers. At present, ski patrols at Japanese ski resorts are not involved in avalanche hazard evaluation or mitigation. Public awareness about avalanches remains almost nil. Hence, any attempt to

create an avalanche information center must begin where the knowledge and experience exist. If the gap between the scientific community and the public at large is to be narrowed and if individuals outside the academy are to become an important part of the avalanche information process, the scientists involved in avalanche studies must reach out to educate the public.

At the institute of Low Temperature Science at Hokkaido University, members of the Snow Damage Section have initiated several projects aimed at increasing the public avalanche knowledge base. The video-cassette "Avalanche Awareness: A Question of Balance" has been translated into Japanese for use in introductory avalanche classes and it is hoped that a marketing agreement can be made to allow for its distribution in mountain shops and to Japan's abundant skiing and mountaineering clubs. A series of seminars for ski industry executives has been initiated and management is being encouraged to take a more active role in providing the opportunity for ski patrols to be trained in snow science and rescue procedures. A series of two-day avalanche seminars for backcountry skiers and winter mountaineers is being planned for the 1990-1991 season. An English language section is included in the plan to provide basic avalanche education also for Sapporo's large foreign community, which includes many mountain skiers.

The apparent inconsistency between academic achievements and the lack of public awareness seems most likely due to a combination of cultural and structural aspects of Japanese life. The Japanese legal system is not open to the kind of liability suits that have fueled an explosion in insurance costs for many industries, particularly in the United States. A typical lawsuit may take up to ten years to reach the docket. As a result, ski resort operators have not been compelled by insurance carriers to establish rigorous and detailed plans for dealing with avalanches.

In the aftermath of the avalanche deaths of 15 January, 1990 a seminar for management representatives of several ski areas from the Niseko region of Hokkaido was held at the Institute of Low Temperature Science. Seminar topics included a review of general avalanche mechanics, description of meteorological conditions for the week ending in 15 January, results of snow pit studies at the Niseko avalanche sites on 16 January and a lengthy appeal to adopt some more formalised strategies for dealing with avalanches. Discussion followed, concentrating mainly upon avalanche control methods, the activities of a professional ski patrol, and rescue procedures. Finally, the translated video-cassette, "Avalanche Awareness: A Question of Balance" was shown.

It is hoped that the activities initiated by the Snow Damage Section at the Institute of Low Temperature Science, and described in this paper, will begin to stimulate interest and

narrow the gap between the academic community and the skiing public. The process is likely to take several years because the public knowledge base is not yet broad enough to enable the rapid growth of an avalanche community such as exists in North America and Europe. As the public gains access to avalanche education and professional ski patrols become involved in hazard evaluation, avalanche control, and search and rescue the opportunity will exist to develop an avalanche forecast center that is suited to the particular needs of Hokkaido skiers.

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