

**AVALANCHE FORECASTING FOR A HELICOPTER SKIING OPERATION
IN THE UNITED STATES**

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ABSTRACT

Helicopter skiing is not a new sport in the United States, with a history spanning over 20 years, it has developed into a viable business in several locations throughout the West.

Although perceived as a "high risk" sport, the safety record of the Heli Ski operators in this country is incredibly good. Besides the obvious inherent dangers of flying in the mountains in a helicopter, in sometimes less than ideal weather conditions, it is the avalanche problem that must be dealt with once on the ground. This paper will address the daily operational forecasting routine of High Mountain Heli-Skiing in the Jackson Hole area.

The forecasting program for this operation, therefore, is somewhat complex and we will discuss the various methodologies and techniques employed throughout the season to evaluate and deal with the avalanche hazard. Including: Weather monitoring and forecasting system, snowpack evaluation and data logging, explosive uses, safe route finding, and terrain management.

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INTRODUCTION

High Mountain Heli-Skiing, Inc., (HMHS), has been in operation, and under permit with the Bridger Teton National Forest since 1976. Our permit allows us to ski in some of the most pristine and least trodden areas of the Forest, on the average we are over 10 air miles from the nearest road in our primary terrain, the Snake River Range. Our permit area covers 5 mountain ranges, including, in addition to the Snakes: The southern Tetons, the Hobacks, part of the Gros Ventres and the Palisades.

Essentially, therefore, we are forecasting for a backcountry ski area, i.e., an uncontrolled environment which gets very little skier impact through the course of the season. Naturally, this presents several problems which will be distinctly different from those normally found within the boundaries of a resort type ski area, i.e., a more controlled environment with high skier impact. By virtue of this lower impact, the avalanche forecasting problem in the backcountry is often more protracted. Of course, this also equates to significantly better powder skiing.

WEATHER MONITORING AND FORECASTING

During storm periods, when the weather is deemed "unflyable", it is not possible to be in our ski area monitoring the weather nor the avalanche activity. There are no remote weather stations in the vicinity and we must rely on data gathered, and extrapolated, from the Jackson Hole Ski Area, Grand Targhee Ski Area and from meteorological and hydrological data available via computer from the National Weather Service and The Soil Conservation Service. The closest remote weather instrument is on Teton Pass, (about 15 miles away), atop Glory Peak. This unit is associated with the Gas.EX system run by the Wyoming Highway Department. Unfortunately, the Highway Department has not made this data accessible to outside users.

Unique perhaps to this industry, HMHS has it's own meteorologist on staff, (Jim Woodmencey), who makes a specialized forecast of local weather for the operation. Prior to this more advanced forecast system, HMHS relied primarily on the operations manager's interpretation of the TV weatherman's forecast, or more commonly, an "OTW", (Out-the-Window), weather forecast was done in the morning to decide whether or not to fly.

The Forecast, in recent years, is much more complete and reliable. It contains information that is pertinent to both the

aviation aspect and the avalanche hazard evaluation aspect of the operation. It contains:

- ▶ A complete synopsis of the current and near-term weather situation. A Map and or Satellite photo with notable weather features is also included.
- ▶ Cloud ceiling and cover for the next 24-36 hours.
- ▶ QPF, (Quantitative Precipitation Forecast), for the mountains and the valley for the next 24 hours.
- ▶ Specific wind speed, direction, gusts, shear and variability information for both ridgetop level and canyon floor.
- ▶ Temperatures for the next 36 hours at 10,000 ft. and the valley floor, at 6500 ft. elevation.
- ▶ An Extended Outlook for the next 3 to 5 days, with regards to storms, new snow potential, and possible flying conditions to be expected, i.e. "work or no work!"

This forecast is faxed to the pilot early each morning, and both the pilot and the operations manager are briefed on the phone as well. The decision is then usually made by 7:15 AM whether to go ahead and launch the day or not. The forecast is also faxed to the HMHS registration desk for the planning of subsequent days of operation, and for the clientele to peruse.

During storm periods when we are not operating in our terrain, the weather forecaster is also logging critical information about wind, temperatures and precipitation and estimating their affects in our terrain. This information is then passed on to the operations manager and the other guides.

AVALANCHE HAZARD EVALUATION AND REDUCTION

Once he is briefed on the weather, the operations manager begins preparing for the day in the mountains,. With knowledge of the season's snow history and an array of maps on the wall encompassing our permit area, we ask the question, can we ski safely today? In the lab, the most sophisticated equipment can only forecast a perceived hazard. The forecast hazard is not necessarily the same as the actual hazard.

With the knowledge that we have, we must then go into the field

to prove the forecast and discover what the actual hazard is on a given slope, at a given moment. We want to know, can we ski this slope now?

Data Logging. Data is taken from the Jackson Hole Ski Area study plot and from SNOTEL sites around the area, we utilize these two sources for our baseline data each season. We must correlate this data to our terrain based on storm direction and our knowledge of the history of the area. Once in the field, any discrepancies are noted and data is adjusted if necessary. Snow history is also plotted on a calendar which provides a large visual account of all the data. This calendar was adapted from the MSU/ Bridger Bowl Snow History Calendar, circa 1965.

Field Evaluation Methods

After major precipitation periods, based on the data we've obtained, a decision must be made on how to approach the terrain. The following options are available:

- 1 Full Guide Recon. If deemed necessary a group of guides will be deployed to perform evaluation. The objective is to do a more thorough evaluation of the hazard, which usually includes explosives. In this scenario the group of guides is opening terrain ahead of the clientele.
- 2 Partial Recon with clients. The operations manager may at his discretion choose to take a backup guide in the lead group. This guide is used to assist in establishing landing zones, digging snow pits and evaluating terrain. Speed in evaluation can be critical to a smooth operation, but safety always takes priority.
- 3 Evaluate and Ski. Used primarily on subsequent days after other methods of evaluation have been utilized.
- 4 Stay Home. This is not a popular option!

Visual Observations: From the helicopter much can be learned visually of the effects of wind and snow in a very short time. Natural activity, cornice development, drifting, loading and wind effected snow, as it relates to "skiability", all must be quickly evaluated and incorporated into the initial decision of where to ski first.

Ski Cutting: On the way to the first pit site, and throughout the

day, ski checking and probing of indicator slopes is used to test how the snow feels. Is the snow hollow underneath, is there any cracking or settling going on?

Snow Profiles. Snow pits are the best and most proven method of evaluating snow stability. Throughout the season, particularly after precipitation periods, many pits are dug, giving a wide sampling of as many slopes and aspects as is feasible. Layers are identified and standard tests are performed and recorded. Pits are left open for all guides to conduct shear tests and make an evaluation. A rating system was developed by the guides to assign an overall stability number, 1 to 10, (10 being the most stable, 1 being the least stable), to the pit, based on each individual's instincts. Pits are compared and any discrepancies are addressed.

Explosives. Primarily, explosives are used during reconns as an additional stability test, not a control method. We employ several methods for delivering the explosive to the snow. We have one bomb tram that was constructed in an exposed, high use area. Whenever possible, explosives are placed on a stick, to elevate it off the snow, or if that is not possible a hand charge is thrown with several pine boughs attached to it, to keep the bomb from sinking too deeply into light density snow. On occasion we have aerial bombed from the helicopter to hit a broad area with a variety of aspects in a short time period. Again, bombing is not used to control the snow or to stabilize it, except in the case of a persistent hazard in a high use or heavily travelled entrance area to safe skiing below. If we bomb and get positive results, we obviously had a weakness. If we bomb and have a negative result, we cannot assume that a slope is stable. We have observed that post control release is a very real thing!

Routefinding. Guide experience and technique are essential in moving a group of skiers through the mountains safely. During periods of high hazard, it is possible to ski, with good routefinding, and have a safe day. On a low hazard day, disaster may result from poor techniques and routefinding. Knowledge of terrain and terrain/snow history are invaluable, as is knowing when you can increase the degree of exposure and when it is time to back off.

Guides must always be thinking and adjusting throughout the day to the changes that may be occurring. They must be sensitive to and heed Nature's warning signals. At the end of the day we will have experienced, and only then will we know, what the actual hazard that day really was.