AVALANCHE FORECASTING FOR SAFE TRAVEL IN THE BACKCOUNTRY: THE 5-STEP CHECKLIST

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Abstract: Operators and ski guides are in-field practitioners with a responsibility to provide a safe and enjoyable experience for clients and employees. As practitioners, our No. 1 goal is safety.

Within the mechanized ski industry, an effective risk management and loss prevention plan, including a rescue plan, needs to be in place to ensure safe travel within avalanche terrain.

Mike Wiegele Helicopter Skiing (MWHS) employs a proven 5 Step Checklist System for snow stability rating and avalanche danger forecasting. This focuses our decision making for safe terrain selection and guiding procedures. The ability to travel safely in avalanche terrain relies on early detection, forewarning and methodological gathering of information of avalanche danger prior to heading into the mountains and before descending down each ski run.

The purpose and goal of the 5-Step Checklist is to provide a systematic approach for safe travel in the mountains. It methodically provides information pertinent to analyses and interpretation of reasonable and accurate snow stability ratings and avalanche danger forecasting in a particular ski region and for specific slopes, where backcountry skiers are exposed to a potential avalanches during their climb to the high alpine terrain and their descent to the valley floor.

The information and procedures laid out in this paper can help shape a better international avalanche standard of safety and practices throughout the ski industry and the world.

1. INTRODUCTION

1.1 The Organization

The organization and the management team must consist of well structured formally trained, expert, experienced, certified ski guides with a track record for safety.

1.2 The Law and Legal Liability

As a practitioner, you must understand how The Canadian Court of Law and Worksafe BC perceive responsibility and legal liability. They state that any person, individual, organization, community or government who promotes and carries out a high risk activity where a person can get either injured or killed, which is foreseeable or preventable, has a duty of care and is responsible to provide the current highest standard of safety (Cloutier, M., 2000, pg 13). You must adhere to the law. Failure to do so is subject to legal scrutiny and potentially prosecution in the event of an accident or loss.

2. THE 5-STEP CHECKLIST FOR SNOW STA-BILITY EVALUATION RATINGS AND WEATHER FORECASTING SYSTEMS

The 5 Steps are:

Daily Weather Data
Graphs

- 3. Snowpack Profile
- 4. Field Observations
- 5. Stability Rating

Following the 5 Steps is a systematic and organized thought process. One must focus on each detail and the effect the main contributory factors may have on the snowpack and the mountain Range.

2.1. Daily Weather Data

The first Step is to collect the weather data to see how it has changed and how it may influence the snow quality in both strength and deterioration. All factors are interrelated and interact with each other. It is imperative to account for all areas.

Daily weather changes are important to record. The records are used for Step 2 – Graph with Tidal Times, with the main contributory factors and power players in snow stability and avalanche risk.

2.2 Graphs

The second step is to graph the weather data. The Graph illustrates by date and time on the Tidal Chart the factors of humidity, temperature, load, stability, rating, and correlated avalanche activity. The Graph also represents the historical background of the winter season. Heavy winds shape the snowpack of various depths and are included in the Load calculation.



Figure 1: Daily Weather Data form

From this we can begin to identify the major contributing factors to snow stability deterioration and avalanches. These are Temperature, Humidity and Cosmic Solar Radiation (CSR), making up the Major Contributing Factors Triangle. In order to interpret snow stability correctly, we have to recognize these three major components.



Figure 3: Major Contributing Factors Triangle

2.2.1 Analyzing and Interpreting the Major Contributing Factors Triangle

These Contributing Factors cause the major impact to snow stability deterioration. They can all work as a unit, but each one has the capability of overriding each other. CSR, in most cases, has the capability of overriding temperature and humidity. CSR has an impact that, if not considered as a major component on rating stability, can give misinformation and feeling towards stability. Consequently, if no consideration is given to CSR, we are missing out on a major link in the process of the stability rating.



Figure 2: Tidal chart

2.2.2 Cosmic Solar Radiation

Cosmic Radiation is made up from charged particles such as protons and helium that originate from the Sun and the wider universe. Numerous known contributory factors, such as in the triangle, have a major rapid impact on snowpack stability. Other elements have not been discovered yet.

Entering the Earth's atmosphere at relativistic speeds, these high-energy protons crash and interact with atoms and molecules -mainly oxygen and nitrogen- from gases in the atmosphere. This invisible yet powerful collision can happen many times. In a thousandth of a second, there may be thousands or millions of secondary radiation produced. This is called an "air shower" of cosmic rays. The "air shower" particles penetrate deep into the Earth's surface. It is through the process of penetration that the radiation weakens the snowpack. As observed, a snowpack may lift during the atmospheric pressure in high cycle. Essentially, radiation enters the snowpack, melting tiny particles of snow and emitting water vapor in the process. The water vapor then seeps back up to the snowpack surface, thus deteriorating the strength of the snowpack slab on top of the gliding layer and in the process creating a new gliding layer on the surface known as surface hoar. This increases the probability of snowpack failure and for natural or triggered avalanches to occur.

On their own, each of the main contributory factors affects snowpack stability and deterioration. However, when all three factors are present, the risk of snowpack failure is at its highest, and the probability of large-scale avalanches increases.

We have observed worldwide over the past 40 years that most large-scale avalanches that run the width and length, those that create new paths in mature forests, ice falls, and fatalities, occur during high CSR cycle. Not giving full consideration to it may be the missing component in many snow stability assessments.



Figure 4: Snowpack profile chart

2.3 Snowpack Profile

The third step is to perform 3 to 5 profile tests of each gliding layer and assess each layer with the 1 to 7 Rating System (Step 5). This practice is to be carried out on all elevations and exposures on each new ski run chosen.

2.4 Field Observations

The fourth step is Field Observations. Consider Step 1 (Daily Weather Data) prior to going to the field. A thorough filed observation examination notes any natural avalanche activities and their trigger by noting:

- exposure
- elevation
- depth of crown fracture (load)
- gliding layer type(s) present
- shovel shear test stability rating
- distance of travel, and
- size of avalanches.

This alerts the practitioner of early warnings of danger of any other potential avalanche failure that may occur on similar slopes. A natural avalanche may be an isolated occurrence or a trend that practitioners should be aware of. All natural avalanches should be recorded, studied, and analyzed. If no snow profile tests are available, select a safe ski run with no large scale avalanche danger potential. Test sites should not produce an avalanche larger than C1 to C1.5 in an area with no terrain traps that could bury a person.

Look for natural avalanches in the past 24 hrs, 48 hrs or longer. Investigate the cause of failure by ice fall, cornice fall, rock fall, tree fall, mushrooms, elevation (exposure), foot penetration, ski penetration, snow surface (wind effected, snow drifts -pockets-, slab formations).

2.5 Stability Rating

The final step is stability rating. Ski tests are conducted on slopes to verify the snow stability forecast ratings. These must be carried out during the day. Tests are to be done on safe, short slopes that can produce an avalanche no larger than C1 to C1.5 in size while avoiding terrain traps.

	Very Easy	Easy	Easy Moderate	Moderate	Moderate Hard	Hard	Very Hard
Symbol	VE	Е	EM	M	MH	Н	VH
	1	2	3	4	5	6	7

Figure 5: Forecasted stability rating chart

3. TERRAIN SELECTION - GUIDING PROCE-DURE

3.1 Record for each elevation and exposure Terrain Evaluation and Descending Route Selection

1. Where Are the Weaknesses and Gliding Layers in Snowpack?

2. What type of Terrain, elevations, exposures, shape, steepness and unsupported slope and obvious avalanche slopes?

3. What impact or effect are the Contributory Factors having on snowpack deterioration, strengthening or prolonged present stage?

4. What is the potential outcome?

5. What is a Critical Load? 30 cm plus Overload? Wind transported snow? Variable depths?

3.2 Guiding Procedures and Considerations

1. Terrain selection is based on stability ratings of potential avalanches and consequent dangers

2. What are the Guiding Procedures and Practices during current Stability Ratings?

3. Safe favorable routes?

4. Are there any terrain traps cliffs, trees, and gullies near skiing route?

5. Be aware of skiers skiing beyond safe boundaries given, unaware or ignorant of backcountry mountain hazards and dangers.

6. Be aware of individual skiers unintentionally skiing beyond given boundaries influencing other skiers in the group and skiing out of boundaries is a constant threat.

7. Practice precise guiding procedures when a gliding layer is present in snowpack with critical load on steep terrain. Be sure to position yourself and your guests in a safe location.

8. Select descending slope with a low angle, avoid exposure of terrain traps, with no more than one person at a time. It is important to wait until the slope is clear before the next person can follow.

9. In summary, best practices need to be applied. These are subject to the stability rating. Your options are to avoid an avalanche slope, limit one person on a slope at a time, ski cut from the top down, or select less hazardous terrain.

10. In stability rating 1 to 4, ski-cut each 30°+ slope and proceed cautiously with precise guiding procedure avoiding burial traps. 11. Take into account unexpected and unusual avalanche mass travelling in flat terrain outside traditional boundaries.

4. CONCLUSION

Our operation has worked with this system on a daily basis, from December to April, every year for the past 36 years. Comparing results with other safety measurement procedures currently practiced, we have concluded that the 5 Step Checklist provides us with the best insight into backcountry snowpack. The resultant stability rating enables a high level of confidence that the consequent terrain selection and the applied guiding procedures will provide a safe outcome while offering all of the joy and excitement that the sport of skiing has to offer.

ACCREDITATION

The 5-Step Checklist approach is a joint venture between Peter Lev, ski guides, Ono Tanner, Howie Howlett, and Alta Ski Lifts Avalanche Forecasting Control. The checklist has been an ongoing system formulated and molded by a professional team of MWHS, the Canadian Ski Guided Association, the University of Calgary and industry experts, especially devised by Mike Wiegele. The purpose of the checklist is to provide a systematic approach for safe travel in a vast backcountry area.

REFERENCES

Cloutier, M., 2000, pg 13