Part 4: Observe

Learning Outcomes:

- Gather morning observations and verify their relevance to conditions with field observations.
- Relate the importance of applying observed trends to field decisions.
- Describe “red flag” observations that relate to the immediate possibility of avalanches in the terrain.
- Compare one’s own field observations to expert opinion derived from the bulletin.
- Identify snowpack layers as described in the bulletin.
- Perform several informal snowpack tests.
- Explain the value and limitations of snow profiles, compression tests and Rutschblock tests.
- Use the Avalanches and Observations Reference table during planning and in the field.

4.1 – Field Observations

Field Observations - clues as to how weather and snowpack conditions are affecting the formation of avalanches in the terrain—play a vital role in contributing to the good decision, the appropriate terrain choice, and the appropriate travel technique. When discussing and completing the AIARE Trip Plan forecast and checklist, information is gathered about past and current avalanche activity, changes to snowpack strength and structure, and seasonal and recent influences of weather on both travel options and terrain choices. Both current *observations and trends* are noted and discussed by the group.

These are the components of the *Observe* side of the Decision Making Framework (DMF). The primary source for this information is generally the local public avalanche bulletin. Public avalanche bulletins contain valuable information that forms a local, expert opinion on “what is happening in your area.” The forecast center will summarize with a description of the “avalanche problem”, also termed the “avalanche issue” or “primary concern.” This refers to the avalanche type and characteristics and includes the forecast distribution and extent of the problem in the terrain. When the bulletin writers forecast for specific regions, their comments, while providing general insight, may not be *precisely* relevant to the specific location your tour may be planned. The same is true of information gathered from friends, local “experts,” books, and Internet or ski area avalanche forecasts. For this reason, backcountry travelers should make it a priority to gather site specific real time field observations during their field trip. It is important not to base terrain choices entirely on information obtained in the trip planning process but look with a trained eye for observable clues in the field.

Observations compare *actual* conditions observed in the terrain to the second-hand information gathered, analyzed and discussed at home or in the office. This comparison can be very powerful for improving one’s own comprehension of avalanche danger in terms of where, when, and why avalanches could be triggered. As understanding improves, backcountry travelers have the opportunity to re-evaluate terrain choices in light of newly gained information. Ability and willingness to observe and adjust is key to increasing the accuracy of your assessments.

Be observant - like a detective searching for clues. The trip plan will help target observable clues and avoid knowledge “gaps.” During the discussion the group develops a strategy when and where to make field observations. Note the usefulness of the information gathered depends on the quantity and quality (e.g. site selection, craftsmanship) of the observations and the observer’s experience interpreting the observation. Backcountry travelers often have limited opportunity to observe in the terrain. *Consider that conditions, hazards and weather may significantly limit where relevant observations can be obtained; and conclusions made from less relevant information can be dangerous!* Lastly, the trip plan checklist can help illustrate the unknown; managed by choosing terrain and travelling wisely.

OBSERVING AVALANCHE ACTIVITY

Current or recent avalanche observations are unequivocal evidence of snowpack instability—at the location of the observation—and extrapolation can be made to nearby terrain. When observing avalanches take careful note of the characteristics:

- **WHEN:** Current, recent or past? Was the occurrence associated with recent warming or snowfall or wind? Are the reports more than 48 hours old? Did you witness the avalanche?
- **WHERE:** Where in the terrain did it occur? What elevation range and aspect? What type of terrain feature(s)? How widespread is the activity? Is it isolated to specific terrain or is there activity in many different types of places? How does the terrain where it occurred compare to the terrain travel advisory discussion in the public bulletin?

- **SIZE, CHARACTER:** Slab or loose snow; or cornice fall? Dry or wet? Wind slab or a persistent slab? How wide does the slab propagate and what is the extent of the runout?
- Do you know the **weak layer?** Did the bulletin describe this concern? Can you relate this to nearby terrain?
- Does it appear to have been triggered by a human, or naturally? By a cornice?

A monocular or pair of binoculars is a useful tool for observing avalanches. Sometimes it works to use a digital camera and zoom in on the display to see closer than the naked eye. These are some of the most valuable observations you can make because they give you direct evidence of the potential for avalanches in specific locations. Take every opportunity to make sure the group observes and considers avalanche activity into terrain selection decisions.

Recording Avalanche Activity

Make notes about the characteristics of avalanches you observe on the **Field Observations Page** of your AIARE Field Book. Practice using the Avalanche observation abbreviation codes in the back of your AIARE Field Book.

OBSERVING THE SNOWPACK

Snow is an amazing and dynamic substance that continually changes from the moment it falls from the sky until it melts away in the late spring or summer. Observers attempt to look at avalanche activity and snowpack structure and answer the simple question “where in the terrain is the snow unstable?”

The bulletin usually summarizes the important snowpack factors that create the avalanche problem. This includes recent affects of weather on the snowpack **(recent snowfall, rising temperatures or rainfall, or increased wind** that is depositing a wind slab on steep lee slopes). Many of these important field clues can be observed without digging into the snow.

The most important observation when travelling through the terrain other than recent avalanche activity is observing shooting cracks called **cracking**, and below surface fracturing called **whumpfing** (or collapsing). Quick inspections of the layers near the snow surface include **ski pole probing, hand tests, and kick tests**. These can reveal shallow slabs over weak layers in the upper snowpack. While on your tour track these layers through varied terrain. Observers strive to make connections between field clues observed during travel, field tests performed at relevant locations and observations made by others in nearby terrain to piece together the evolving puzzle involving snowpack structure and *potential* instability. The AIARE Avalanches and Observations Reference guide found in the end of this chapter is a useful field tool. This reference guide is located near the front of the AIARE Field Book and helps to *forge a link* between the avalanche and snowpack concerns described in the bulletin and each person’s observations taken in the field.

The Snow Profile

The bulletin also refers to snowpack structure or layering—and will discuss weak layers and overlying slab formation. A proper inspection of these layers can only be done using a quality snow profile techniques and years of experienced interpretation. However, when the bulletin reveals weak layers of note, a non-expert can dig an **informal test snow profile** (in a safe site) to identify and verify the layer of concern. Then you can compare the depth and character from a given site to the public bulletin. To determine whether the layer you see is the layer of concern, one can compare the depth of the observed weak layer in the profile to the estimated depth of crown fractures on nearby terrain.

Key observations to consider in a snow profile include **depth, stiffness, and grain type of** layers.

- Can you identify the recent storm snow? How much new snow is there?
- Is there evidence of recent wind slab formation?
- Identify whether there is a stiffer layer over a less stiff layer (strong over weak; slab over weak layer)?
- With the naked eye, closely inspect the less stiff layers. Are the grains larger, square, sugar-like grains? These are likely buried persistent grains often present in weak layers.
- Is there a layer of wet grains?
- Is the slab over the weak layer deep enough to create an avalanche? Is it shallow enough that it can be potentially triggered?
- Does what I see in the profile relate to what I see in the terrain (cracking, whumpfing)? Would it help to also complete a few snowpack tests (Rutschblock or Compression Tests; see below) to better identify the layering?

Answers to these questions can provide very useful comparisons to the public bulletin discussion, or to your expectations during planning. The Trip Plan in your AIARE Field Book helps make the bulletin more relevant by targeting observations and comparing them to the observations and interpretations of the experts.

Snow Profile Procedures

Plan Ahead
Using the Trip Plan hazard forecast, the Avalanche and Observation Reference and other field notes from the day, determine what information will be investigated or verified in a snow profile. Consider which observations and tests will be most useful for answering relevant questions or addressing uncertainty. Use a map to plan possible site locations for snow profiles on the tour.


Photo: M. Wheeler

Site Selection
Select a site that is relevant:

- Not exposed; safe.
- Similar to the one you hope to cross or ski (aspect, elevation, terrain configuration).
- Has a nearby site given you useful information in the past?

If information cannot be gathered safely, then it may be best to choose safer terrain options. Remember the snowpack varies greatly over terrain and that it is impossible to broadly generalize about snowpack layering - let alone slope stability - especially from observations made in one snow profile. A truly slope representative profile site is elusive at best, and hazardous at worst.

Digging
Dig the profile so that there are at least two smooth perpendicular walls, where one of these walls is perpendicular to the fall line of the slope and one is parallel to it. If planning to complete snowpack tests afterward (RB, CT), it is recommended to dig the perpendicular wall approximately two meters wide and the parallel wall at least 1 meter long (measure or estimate this using your skis or poles). Column tests will be done on the perpendicular wall (“Test wall”). The parallel wall can be used to identify and mark layers of concern (“Observation wall”). Dig down to at least 10-20cm below any snow layers of concern. Digging more than 1.5 meters is often too difficult to manage. Dig at least enough of a floor out in the bottom of the pit to be able to squat down and look at deeper layers comfortably. Throw snow downhill and do not disturb the snow surface above or to the sides of the pit walls.

Layer Identification
Look at layers using a variety of layer identification techniques. Gently brush the wall with the back of a mitt or glove to see prominent layer interfaces. Poke or run a finger, or another thinner object vertically down the wall to feel differences in layer strength.

Hand Hardness
Using the layers identified and marked, use the hand hardness test to gauge the relative strength of each layer. Start at the top and press a fist into the pit wall at that layer. Push with around 2 lbs. of force (try pushing on your nose until it hurts). If the gloved fist penetrates to the wrist then the layer has a hardness of “F.” If it does not penetrate to the wrist then test the layer using the same amount of force, using four gloved fingers, seeing if it penetrates for the entire finger length. If not, continue the process according to the table below. Forecasters and competent observers will often use terms like “Fist,” “1 Finger,” “Pencil,” etc. to describe layer hardness (Greene et al, 2010).

Symbol	Hand Test
F	Fist in glove
4F	Four fingers in glove
1F	One finger in glove
P	Sharp end of pencil
K	Knife blade
I	Too hard to insert knife


Photo: M. Wheeler

Snowpack Tests: The Compression Test (CT)

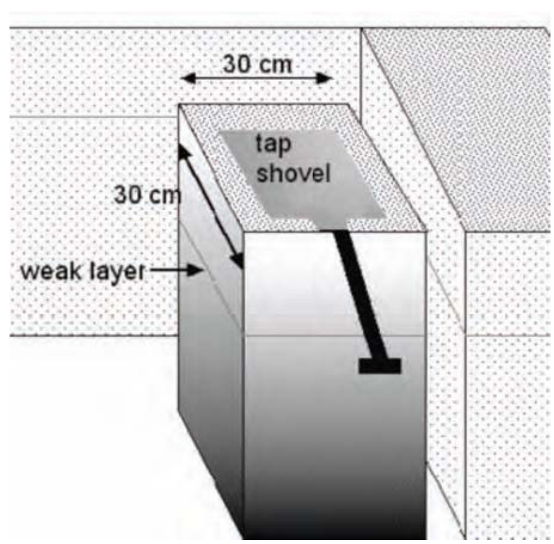
This is a good test to identify important layers, particularly thin weak layers hard to observe in a profile wall. The CT puts a controlled vertical force (downward taps) on an isolated column of snow to observe the effect and results.

Prepare the Column
Dimensions of the compression test are a column approximately 30 cm wide (across the fall line), 30 cm on each side (up the fall line), and somewhat deeper than the suspected failure layer (to a maximum of about 1.2 m / 4 ft). Dimensions should be measured to ensure continuity from one test to the next and from one observer to another.

1. Dig a pit with a wall of approximately 1.5 - 2 m across the fall line (Test wall). This wall should extend below the suspected failure layer if one has been identified or to a maximum of about 1.5-m deep. Clean the wall so it is plumb and very smooth.
2. Assess where failure planes may exist by examining the layers. Look for strong layers that overlie weak ones, significant changes in the look or feel of the grains, hard crusts, or other anomalies in the snowpack. These are areas to observe closely as the test proceeds.
3. Measure and gently mark a 30 x 30 cm square on the surface of the snow. Be careful not to disturb the snow that will become the upper part of the column.
4. Using a snow saw, cut one side of the column to the appropriate depth. Cut as plumb and square as possible.
5. Using a snow saw and/or shovel, excavate a chimney on the side of the column. This chimney should extend beyond the back of the column and should be wide enough so a snow saw can be used horizontally to cut the back of the column later. Take care not to pry on or damage the side of the column as you shovel.
6. Remove a wedge of snow on the side of the square opposite from the chimney. The wedge should reach the same depth as the chimney.

Conduct the Test

1. Place an observer in a position to watch the column for failure.
2. Carefully cut the back of the column with a snow saw to a depth that matches the side cuts.
3. Apply load to the column as described below.
   - Place the shovel: Carefully place the shovel so that it lies flat and flush on the top of the column.
   - Tap 10 times: Using the tips of the fingers and moving the hand only from the wrist to shovel blade.
   - Tap 10 more times: Using fingertips with moderate taps from elbow to shovel blade.
   - Tap 10 more times to complete the test: Using the palm or fist with whole arm to shovel blade.
4. If at any point during the taps the observer sees a fracture cross the block, stop, inspect the fracture and describe the fracture character. See the fracture character/shear quality comparison table below. Continue tapping until the test is complete.



5. Carry out at least two compression tests in the same pit to see if results are repeatable. The second column can be cut immediately adjacent to the first. The hole left by the first column can be used as the chimney for a second; otherwise use the same process for the second test as for the first one.
6. If results from the first two tests differ significantly, additional tests should be carried out to see if a consistent pattern develops. Observing similar fracture character when comparing tests is more significant than the specific number of taps, which can be generalized into easy, moderate or hard. Refer to the paragraph, “Interpreting Snowpack Observations” on pg. 57. Additional compression tests from other locations may also be useful if results and the danger rating over terrain vary significantly.

	Loading Steps and Compression Test Scores (Dimensions 30 x 30cm column, isolate to 100-120cm max depth from snow surface)
Term	**Description**
Very Easy	Fractures during cutting or insertion of shovel
Easy	Fractures within 10 light taps using fingertips only
Moderate	Fractures within 10 moderate taps from elbow using fingertips
Hard	Fractures within 10 firm taps from whole arm using palm or fist
No Fracture	Does not Fracture

In cases where a weak layer of concern is buried more than 1 meter deep, a variation of the Shovel Compression Test can be used (called the Deep Tap Test). With a shovel or snow saw, shorten the column so that the top of the column is 15cm above a suspect weak layer, measured vertically at the back of the column. Conduct the same series of taps to observe the characteristics of any fracture at the deeper layer of concern. This test requires targeting one weak layer at a time.

Comparison of Fracture Character & Shear Quality Scales		
Fracture Characteristics	Fracture Character (Data Code)	Typical Shear Quality
A thin planar fracture suddenly crosses column in one loading step AND block slides easily on the weak layer	Sudden Planar (SP)	Q1
Fracture crosses the column w/ a single loading step and is associated with a noticeable collapse of the weak layer	Sudden Collapse (SC)	Q1
Planar or mostly planar fracture that requires more than one loading step to cross column and/or the block does NOT slide easily on the weak layer	Resistant Planar (RP)	Q2
A fracture of noticeable thickness (non-planar fractures often >1cm), which usually crosses the column with a single loading step, followed by step-by-step compression of the layer with subsequent loading steps.	Progressive Compression (PC)	Q2 or Q3
Non-planar breaks	Break (BRK)	Q3

Snowpack Tests: The Rutschblock Test

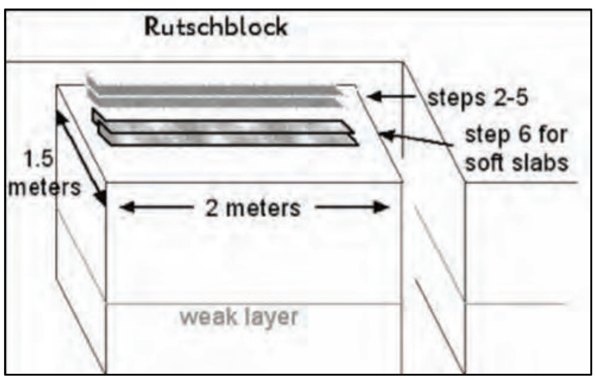
The Rutschblock Test is a much larger sample of snow (approx. 30x the sample area) than that observed in a compression test. The Rutschblock is a large column test that puts a skiers load on an isolated column of snow to identify potential weak layers. It is a good test to prioritize which of several identified layers is important. The slope for this test should be as close as possible to 30 degrees. It is used to test layers at a maximum depth of 100-120cm.

Clean off and expand existing snow profile walls to accommodate a 200cm wide column face. Dig trenches 150cm up the slope on the sides to isolate the sides of the column and clean all walls to make them plumb and smooth. Mark the back cut line with a probe and cut the column in the back, ideally using an extendable snow saw and/or a Rutschblock cord to complete the block isolation. Conduct the test as described below:

Rutschblock Test (Dimensions: 2.0 m wide x 1.5 m deep or 6.5 ft x 5ft)	
Loading Steps That Produce a Clean Fracture	**Score**
The block slides during digging or cutting.	RB1
The skier approaches the block from above and gently steps down on to the upper part of the block (within 35 cm of the upper wall).	RB2
Without lifting the heels, the skier drops once from straight leg to bent leg position (feet together), pushing downwards and compacting surface layers.	RB3
Skier jumps up and lands in the same compacted spot	RB4
Skier jumps again into same compacted spot	RB5
* For hard or deep slabs, remove skis and jump on the same spot. * For soft slabs or thin slabs where jumping without skis might penetrate through the slab, keep skis on, step down another 35 cm (almost to mid block) and push once, then jump three times.	RB6
None of the loading steps produces a smooth slope-parallel failure	RB7

Note specifically if any fractures observed were sudden, how they propagate across the column in a single step. Rate the release type using the terms in the table below:

Release Type: Portion of the block that did slide	
Whole block	90-100%
Part of the block (usually below skis)	50-80%
Edge of the block	10-40%



Interpreting Snowpack Observations

Current avalanche activity provides direct evidence of both snowpack instability and avalanche release. Shooting cracks, “whumpfing” and layers fracturing and displacing on small rolls provide direct evidence of unstable snow. However, relating these compelling clues to actual avalanche release on adjacent and distant avalanche paths takes experience interpreting and applying the information. Beyond that, interpreting snowpack observations, even for the experts, is challenging. In a recent paper presented at the 2010 ISSW experts Bellaire, Jamieson, and Schweizer stated backcountry “recreationists with basic knowledge should follow the advice given in the bulletin in absence of signs of instability” (selected quote below).

Snowpack layering may vary significantly over the terrain and often without any noticeable difference on the surface. The snow layers near the trailhead will generally be very different from the layers found near ridgetop. In the trees the layers will be different from open areas. North-facing slopes will have a completely different snowpack from south-facing slopes. The profile one digs within the sheltered treeline may not represent the avalanche path directly above that may have slid three times during the winter months. Even on a smaller scale, tests done in separate profiles within several meters of each other can yield different results. It would be foolish to think that just looking at the properties of the snowpack alone in a couple of profiles will lead to reliable avalanche predictions in the surrounding terrain.

> “...Digging is only recommended for very experienced recreationists under specific conditions. In most cases digging is not required. Nevertheless, snow cover observations – performed and interpreted correctly – can contribute to informed decision making in avalanche terrain, especially if little or nothing is known about the snowpack conditions and stable conditions cannot be assumed.“ (Bellaire et al, 2010)

Factor in the time in the field to answer site-specific questions about the snowpack, but try to do so in a relevant site to where the group's questions can be addressed. These questions have been identified during the Trip Plan checklist. It is not always possible to safely access a relevant snow observation site. The less representative your site is of avalanche slopes of concern, the more uncertain an interpretation will be of what is observed. Even when the site seems representative, the variability of the snowpack across the slope can fool one into thinking the snowpack is more stable rather than less stable.

The best way to interpret snowpack observations is to always put them in the context of the avalanche advisoryand the Trip Plan. For example, "How does what we observe in the snowpack relate to the characteristics that contribute to avalanche danger as described in the bulletin?" Profiles may reveal a weak layer described as a less stiff layer under a stiffer layer; or compression tests may produce classic "pop or drop" sudden fractures. Before drawing conclusions regarding snow stability observers attempt to identify and date the layering to weather and snowpack changes over time. Verify with several tests over several locations. Determine whether this is the layer of concern, whether the layer is "persistent" or likely to change in the short term. The "pop and drop" fractures observed in Compression Tests may point to a larger, persistent and reactive grain type and may correlate to nearby whumpfing. Rutschblock "whole block release type" may be compared to observed cracking from ski tips in lower angled safer terrain and may also indicate a persistent grain type and weak layer. It is always important to remember that snowpack tests are a small sample as compared with large open start zones. While avalanches are evidence of an unstable slope, most of the other snowpack observations relate to a stronger or weaker parcel of snow and require experienced interpretation. Whumpfing and cracking are powerful warning signs but snow profile observations and snowpack tests should be referred to as clues used to piece together a complex puzzle. Local knowledge or the history of what has affected the slope of concern is as important as any other observations: past and current avalanches, wind redistribution of snow, cornice formation and fall, sun and past warming events, ski compaction etc. Observers don't trust a big decision in avalanche terrain on a snow profile or a few snowpack tests. And in the short term observers ask themselves, "given all of our observations over the past few days, can we identify an obvious pattern or trend, or do our observations leave us with a greater sense of uncertainty?"

Recording Snowpack Observations

Record field snowpack observations on the Field Observations Page in the AIARE Field Book. If you have the familiarity or experience to do so, fill out the Snow Profile Page—otherwise summarize the observations on the Field Observations Page as a daily journal, with notes, drawings and comments. Use the references in the back of the Field Book to help conduct and record column tests.

OBSERVING WEATHER

Weather factors are important because of their effects on the snowpack and the characteristics of its layers. The primary reason that snowpack varies over terrain is that weather effects vary over terrain. The weather factors that affect snow layering are:

- **Precipitation** – Type (snow/rain) and Rate.
- **Wind and Blowing Snow** – Speed, Duration, and Direction.
- **Solar Radiation** – Factor in cloud cover, timing, length of exposure.
- **Air Temperature**
- **Trends** (warming, cooling, rapid, slow).

Observations described as red flags are critical values known to cause avalanching. Red Flags when observing weather factors include:

- **Precipitation Type/Rate/Duration:**
  Snowfall > 1" (2-3cm) / hour for a period of 10 hours or more.
    - Snow accumulations of > 1 foot (30cm) in 10 hours.
- **Rainfall:**
    - Winter snowpack: Any amount, for any duration, at any time.
    - Spring snowpack: Conditions where the snowpack has gone through a lengthy melt freeze cycle can tolerate light to short duration moderate rainfall without avalanching.
- **Blowing Snow:**
    - Strong enough to transport snow (> 12mph or 20kph). Direction gives clues as to which slopes are becoming loaded. Visible plumes at ridgetop strong enough to transport snow consistently for 4 hours or more. Commonly, during storms blowning snow can deposit 3-5 times faster than snow falling in sheltered areas, therefore mod-heavy snowfall plus wind is even more of a red flag.

- **Solar Radiation Intensity/Duration:**
  - Strong radiation resulting in melt at the snow surface. Timing is critical for safe terrain choice. Beware of slopes subject to rapid temperature change or lengthy exposure to radiation. Travelers would feel significant warmth on the skin or face.
- **Air Temperature:**
  - Above 32ºF or 0ºC.
  - Rapid warming.

Recording Weather Observations

Record observations on the Field Observations Page of the AIARE Field Book. Try to get information from multiple locations at different elevations, aspects, terrain types, and/or slope angles. Use the information compiled in the Trip Plan to focus on the most relevant observations and where to get them. Try to verify the weather forecast in the bulletin and relate it to forecasted avalanche danger.

FIELD OBSERVATIONS

NAMES: Joe J., Jane J., Jack J.

Location •Time •Elevation •Aspect	0800, Trail-head, 9,000' valley floor	0930, Gold Glade knob, 11,300' S	1015, Gold Glade ridge / Blue Bowl entrance, 12,200'	1130, Blue Bowl exit, 9,400', N
Sky •Cloud cover •Precipitation	◯ , NO	◯ , NO	◯ , NO	◯ , NO
Temperature •Air •Surface & 20cm↓	T_{Air} -6.0° T_{Surf} & T_{20} N/O	-3.5° N/O	-3.0° N/O	-2.0° N/O
Wind •Speed / direction •Blowing snow	Calm None	Calm None	Light N winds, None	Calm None
Snow •Surf form / size •New snow •Snow height •Pen boot / ski	est HST 20cm Stellars & D/F's Boot Pen ↓ crust	>10cm HST on ridge (normally windswept)	HST ≈30-40cm just below ridge Boot Pen 45cm	HST ≈25cm Boot Pen 35

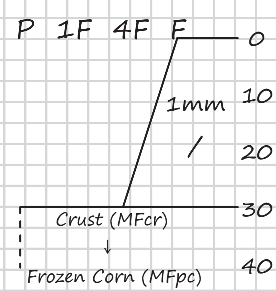
TERRAIN USE • SIGNS OF UNSTABLE SNOW • PATTERNS

Red Flags • Avalanches • Snowpack Tests • Other Observations • Comments

0800 – no fresh avalanches observed on the drive to trailhead. Recent cornice growth above treeline on SE-E aspects.

0930 – seen from Gold Glade knob: 3 wind slabs >12,000' on E and SE aspects below ridge crest (R1-D2) on Red Ridge, Purple Pk. and Maroon Mt. In general, less wind effect on south end of the range closer to town. Soft conditions with no cracks, whumpfs or fresh wind slabs seen so far on S-SW aspects.

1015 – Blue Bowl decision pt: No wind slabs in upper bowl. Dropped block of old hard cornice on N'ly slope @ 12,200' w/ no result. Fist hard snow still on ridge crest. Jane entered Blue Bowl and did two sets of tests, (see profile →) confirmed no slab on frozen old snow.



1200 – sunny slopes getting moist below treeline; crusts tomorrow.

CTM (PC,Q2) ↓30cm
on 1mm DF's
ECTN

REVIEW THE DAY: *"Were our choices in line w/ our forecast / plan?" "When were we most at risk?" "Where could we have triggered a slide?" "What would we do differently next time?"*

4.2 – Avalanches and Observations - making the link

The Avalanches and Observations Reference on the next page is a useful tool for relating the forecast avalanche problem to field observations. It also helps to identify the field observations and tests that most relate to the forecast problem in specific or general terrain features.

The table can be used during morning preparations to identify which field observations to take, and where. Located in the front of the AIARE Field Book the reference is used in the field to help summarize observations, note important patterns and link to decisions. In addition, at the end of the day the tool is used to supplement the daily debrief and analysis of observations.

Print copies of page 60 (Avalanches and Observations Reference). Circle the key factors during the discussion. Relate these factors to the other components in the DMF when discussing the Trip Plan the following morning.


Photo: T. Murphy

Mt. Crested Butte, Colorado

AVALANCHES & OBSERVATIONS REFERENCE			
"The Problem"	**Critical/Red Flag Observations**	**Field Tests & Relevant Observations**	**Important Considerations**
Loose Dry Snow	- Recent fan-shaped avalanches on steep slopes: debris fine - Loose surface snow ≥12" (30 cm) deep	- Boot/ski penetration ≥12" (30 cm) - Slope tests/cuts result in sluffs - Loose snow surface texture (as opposed to wind-affected, refrozen, or other stiff snow textures)	- Can be triggered by falling snow, cornice fall, rock fall, a brief period of sun, wind, or rider - Sluffs can run fast and far - Small slides dangerous with terrain traps/cliffs - Sluffs can trigger slabs in certain conditions
Loose Wet Snow	- Rain &/or rapid warming - Air temp > 0ºC for longer than 24 hours; cloud cover may prevent nighttime cooling - Pinwheels or roller balls on steep slopes - Fan shaped avalanches: debris lumpy & chunky	- Observed & forecast temp trend - Air, Surf, T20 and freezing level indicate near surface snow temps at 0ºC - Note slopes receiving/will receive intense radiation - Wet snow surface: water is visible between the grains w/ a loupe, may be able to squeeze water out with hands	- Timing is critical - danger can increase quickly (minutes to hours) - No freeze for multiple nights worsens condition - however, nighttime freeze can stabilize - Gullies & cirques receive more radiation and retain more heat than open slopes - Shallow snow areas become unstable first - may slide to ground in terrain with shallower, less dense snowpack - May initiate from rocks or vegetation - Can occur on all aspects on cloudy days/nights - Conditions may also include cornice fall, rockfall or increased icefall hazards
Wet Slab	- Rain on snow, especially dry snow - Current or recent wet slab avalanches: debris has channels / ridges, high water content, at times entrains rocks & vegetation - Prolonged warming trend, especially the first melt on dry snow	- Consider Loose Wet Snow observations - Observed melting snow surface (rain or strong radiation) of a slab over weak layer - Tests show change in strength of weak layer due to water &/or water lubrication above crust or ground layer - Identify the depth at which the snow is 0ºC - Monitor liquid water content & deteriorating snow strength using hardness & penetration tests - Nearby glide cracks may be widening during rapid warming	- Snow temp of slab at or near 0ºC - Loose wet snow slides can occur just prior to wet slab activity - Possible lag between melt event & wet slab activity
Storm Slab	- Natural avalanches in steep terrain with little or no wind - ≥12" (30cm) snowfall in last 24 hrs or less with warmer heavier snow - Poor bond to old snow: slab cracks or avalanches under a rider's weight	- Observe storm snow depth, accumulation rate & water equivalent - Observe settlement trend: settlement cones, boot/ski pen, measured change in storm snow (>25% in 24 hrs is rapid) - Tests illustrate poor bond with underlying layer; ID weak layer character - Denser storm snow over less dense snow (boot/ski pen; hand test: profiles)	- Rapid settlement may strengthen the snowpack, or create an avalanche condition if the strengthening snow lies over a weaker snow - When storm slabs exist in sheltered areas, wind slabs may be also present in exposed terrain - May strengthen and stabilize in hours or days depending on weak layer character - Potential for slab fracturing across terrain can be underestimated
Wind Slab	- Recent slab avalanches below ridge top and/or on cross-loaded features - Blowing snow at ridgetop combined with significant snow available for transport - Blowing snow combined with snowfall: note this can deposit into start zones 3 to 5x the snowfall accumulating in sheltered areas below tree line	- Evidence of wind-transported snow (drifts, plumes, new cornice growth, snow surface penetration) - Evidence of recent wind (dense surface snow or crust, snow blown off trees) - ≥ Moderate wind speeds observed for significant duration (reports, weather stations and field observations)	- Often, it is hard to determine where the slab lies & how unstable & dangerous the situation remains - Slope-specific observations, including watching wind slabs form, are often the best tool - Strong winds may result in deposition lower on slopes - Often trigged from thin areas (edges) of slab - Wind transport and subsequent avalanching can occur without snowfall or days after a snowfall
Persistent Slab	- Bulletins/experts warn of persistent weak layer (surface hoar, facet/crust, depth hoar) - Cracking, whumping	- Profiles reveal a slab over a persistent weak layer - Make quick tests that will verify the location of this condition in terrain - Small column tests (CT, DT) indicate sudden (Q1) results; large column tests (ECT, PST, RB) show tendency for propagating cracks	- Instability may be localized to specific slopes - often more common on cooler N and NE aspect - and hard to forecast - Despite no natural occurrences, slopes may trigger with small loads - more likely when the weak layer is 8-36" deep (20-85cm) - Human triggered avalanches are still possible long after the slab was formed
Deep Slab	- Remotely triggered slabs - Recent and possibly large isolated avalanches observed with deep, clean crown face	- Profiles indicate a well preserved but deep (≥1m), persistent weak layer - Column tests may not indicate propagating cracks; DT and PST can provide more consistent results - Large load (cornice drop or explosives test) tests may be needed to release the slope - avalanches tend to be large and destructive	- May be aspect/elevation specific - very important to track weak layer over terrain - Slight changes, including mod. snowfall, and warming can re-activate deeper layers - May be dangerous after nearby activity has ceased - Tests with no results are not conclusive - May be remotely triggered from shallower, weaker areas - Difficult to forecast & to manage terrain choices
Cornices	- Recent cornice growth - Recent cornice fall - Warming (solar, rain at ridge tops)	- Note rate, extent, location & pattern of cornice growth & erosion - Photos tracking change over time	- Cornices often break further back onto ridge top than expected - Can underestimate sun's effect on the back of cornice when traveling on cool, shaded aspects

4.3 – Human Factors and Observations

A conclusion to this chapter on observing and recording in the field would be incomplete without a discussion of the effects of human factors on making high-quality observations. Part 5 and the Epilogue discuss the human factors that affect decisions in avalanche terrain. Many of these traps apply to our tendency to inadequately observe and interpret conditions. It is important to be willing to maintain open eyes and an objective mindset when gathering and interpreting observations. When drawing conclusions from field tests and observations, ask:

- Were my observations consistent with the bulletin and what others are seeing?
- Do I have the experience to correctly assess and relate the field conditions to terrain choices?
- Are my conclusions based on assumptions or fact?
- Would I have done anything differently if I hadn't looked in the snowpack?

REALITY CHECK! OBSERVE...AND MANAGE RISKS

AVALANCHE INVOLVEMENT REPORT, CANADIAN AVALANCHE CENTRE
Date/Time: 2007-12-08 13:30
Description: NE of Tent Ridge-Kananaskis Country-2 Fatalities
Mtn Range: Rocky Mountains Province: AB
Type: Activity: Backcountry Skiing

AVALANCHE INFORMATION
Number: 1 Size: Size class 3 Type: slab avalanche
Trigger: Skier accidental (While digging profile)
Dimension: 250m wide; ran for 750m; average slab depth of 100cm.
F**ailure Plane:** Old snow; Weak layer: Facets
Starting Zone: Alpine, at approx. 2450m.
Character: NE; 35 degrees; Lee Slope(s); Planar Slope.
Comment: Trauma a factor.
Another party of 3 came to the rescue

INVOLVEMENT INFORMATION
Number of people involved: 2 completely buried.
Number of people injured: 2 deceased.

"The two backcountry skiers were in the middle of a bowl in Spray Valley Provincial Park on Saturday, checking the avalanche conditions (digging a snow profile) when they likely triggered one themselves, say officials."

"In hindsight, when looking at the terrain, it (the location where the two skiers gathered information) was not the best choice," said search and rescue official George Field.

"Several people snowshoeing and skiing nearby helped dig the men out in about 20 minutes, but the avalanche knocked them into some trees and they likely died from the trauma, said Field." (CBC NEWS Dec. 10th, 2007)

"Another group of skiers, which had stopped for lunch about 100 metres behind the pair, were the first on the scene. The three skiers quickly homed in on transmitters the two men were wearing and had dug them up within 25 minutes. "Their efforts were heroic," said George Field, public safety specialist with Kananaskis Emergency Rescue. "They did everything they could."

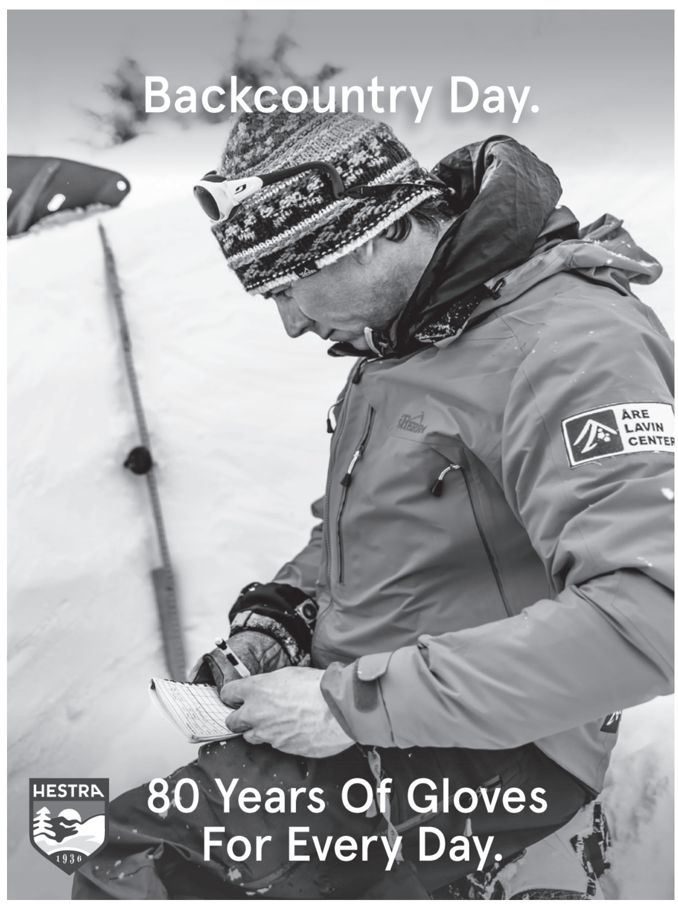
"The avalanche danger was rated as considerable at treeline and alpine elevations and moderate below the treeline on Saturday." (Calgary Herald, Dec. 10th, 2007)

QUESTIONS TO TEST UNDERSTANDING:

1. What is a “red flag” observation?

2. If it is difficult to ensure relevant site selection and interpret snow profiles or column tests for a recreational backcountry traveler, what is the value in completing these tests?

3. What is the compelling, obvious evidence of unstable snow? How does this compare to cracking and whumping?

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