

Avalanche

REVIEW

VOLUME 31, NO. 1 • OCTOBER 2012

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Season Roundup 2011/12

in this issue

From the Executive Director	2
From the Editor	2
Metamorphism	3
What's New	3
Education	
Backcountry 101	6
Avalanche AWARE ³	8
Tragedy in Tajikistan	9
Level 2 for Snowmobilers	11
Snow Science	
SnowPilot Stability Test Usage Changes	10
Pushing the iButtons	12
Decision-Making	
Strategies for Dialing Back Risk	13
On in the Car, Off in the Bar	15
Crown Profiles	
Volcanic Ash Layers	14
Two Photo Sequences from Alaska	31
NAC 2011/12 Season Roundup	
National Avalanche Center	16
Crested Butte Avalanche Center	17
Bridger-Teton National Forest Avalanche Center	18
Wallowa Avalanche Center	19
Sawtooth National Forest Avalanche Center	19
Idaho Panhandle Avalanche Center	20
Northwest Weather and Avalanche Center	21
Chugach National Forest Avalanche Information Center	23
Mount Washington Avalanche Center	23
West Central Montana Avalanche Center	24
Kachina Peaks Avalanche Center	25
Eastern Sierra Avalanche Center	25
Kootenai-Flathead National Forests Avalanche Center	26
Utah Avalanche Center - Wasatch	26
Colorado Avalanche Information Center	26
Utah Avalanche Center - Moab	27
Gallatin National Forest Avalanche Center	28
Sierra Avalanche Center	29
Mt Shasta Avalanche Center	30
Payette Avalanche Center	30

December 2012, the south face of "Tincan Proper," an easily accessed backcountry run in Turnagain Pass.

This kind of big-mountain terrain in Turnagain Pass is seeing a huge increase in use in recent years. The young party in the picture is a great example of why we need more education in the community. Young, clueless riders are getting onto steep and high-consequence terrain on a regular basis, which will eventually result in tragedy. The day of this photo had a Low/Moderate danger rating, but we see people riding lines like this on Moderate/Considerable days with known persistent weak layers.

Kevin Wright, photographer, is the director of Chugach National Forest Avalanche Center

■ For more about 2011/12 avalanche conditions, see the NAC summaries starting page 16 ➡

The Avalanche Review
P.O. Box 2831
Pagosa Springs, CO 81147

We realized that these kids were not stupid, they were not lazy, and they were not really making bad decisions – rather they were letting the decisions make themselves.

—Brandon Dodge, *Backcountry 101*, pg 6



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The mission of the AAA is:

- A. To provide information about snow and avalanches;
- B. To represent the professional interests of the United States avalanche community;
- C. To contribute toward high standards of professional competence and ethics for persons engaged in avalanche activities;
- D. To exchange technical information and maintain communications among persons engaged in avalanche activities;
- E. To provide direction for, promote, and support avalanche education in the US;
- F. To promote research and development in avalanche safety.

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from the executive director

PLEASE READ THIS: Important News From Your Association

This summer AAA imported our membership database into Wild Apricot, an online database management provider. This is the long promised transition to all electronic database management. How will it affect you?

▶ Starting this fall, you will log into the new AAA Membership Web site to renew, make payment, and update your information. Log-in information will be emailed to you when the membership Web site goes live early this fall.

▶ You will be able to update any of your information at any time by logging into the Membership link.

▶ For those who have paid by check and snail mail, this will still be available, but we hope that you'll join the majority of members who renew online.

▶ This membership database will also become the source of the AAA Membership Directory to facilitate communication with other members. You determine what information you want other members to view.

For more than a year we've been sending renewal reminders and meeting announcements via email. This has been mostly successful, but we seem to have more lapsed members than ever before. This may be because we don't have their up-to-date member email address, or they have simply passed over the email renewal reminders among the numerous emails we all get. If you are reading this we have up-to-date information for you.

To make this transition work it is essential that we have an email address for you that is up-to-date and that you use.

You can rest assured that your contact information will not be shared or sold.

The December issue of *The Avalanche Review* will describe the complete process for logging in and managing your AAA membership or subscribership.

The purpose of going to online membership management is to simplify the administration of the



ED Mark Mueller seemed a little blue after two long days of AAA meetings this spring at Snoqualmie Pass.

Photo by John Stimberis

membership database. In the past decade, the membership has grown substantially and manual entry of membership information is no longer effective. Going online will allow us to direct your dues and staff activities to AAA programs that enhance membership benefits rather than administrative efforts. We've been preparing for this transition for some time and intend that it will go smoothly. We hope that any bumps in the road will be few and thank you in advance for helping us make this transition a success.

—Mark Mueller
AAA executive director ❄️

from the editor



Your editor, April in Alaska, in earn-your-turns mode on Python shoulder. Photo by Georgie Stanley

Considerable Considerations...

This issue of TAR comes to you earlier than usual, as our Alaskan friends are bringing us ISSW earlier in the autumn than usual. I've been covering from the sun and smoke indoors, trying to focus on stories of last winter's avalanche problems: Alaska and Washington had too much snow but La Niña was cruel to the rest of us, bestowing us with wedding cakes full of weak layers and the problems attendant. John McKinnon of the Crested Butte Avalanche Center poses a series of vital questions:

With so much Considerable danger present this season, we were often left attempting to answer the question, "What does today's Considerable danger mean?" in our snowpack discussions. Having Considerable danger on the rose almost every day mid-winter led to another issue: we would often have some form of Considerable danger before a storm, during a storm, and for days or weeks after a storm. This may have unintentionally diluted some of the specific hazards Considerable danger connotes.

We will attempt to address those quandaries in future issues of TAR, along with more responses to the Risk Tolerance issue (TAR 30-4), including perspectives from mentors Ron Perla and Tom Kimbrough, and younger practitioners such as Andrew Kiefer and Doug Krause. I hope that TAR readers understand that we are not trying to legislate a correct scheme for calculating what practices are appropriate, only offering a wide range of tools and approaches. Look for more on this topic in future issues of TAR, along with a number of stories that I had to bump due to the meaty mass of the season summaries. Thanks to Steve Conger and Reid Bahnsen for your patience and understanding; you'll see your stories and photos in the December TAR.

I have heard from many regular ISSW attendees that the combination of higher travel costs to Alaska plus tight budgets at the forecast centers or at home are keeping them from attending. With that in mind, TAR will bring you a complete report (minus the free beer). I'll sort through the richness of presentations and posters to bring you what's new and applicable, plus solicit perspectives from the geek and the practitioner as usual.

In addition to season summaries, this issue brings you stories of ash layers from a volcanic eruption in Argentina, another useful teaching acronym from John O'Dowd, and Brandon Dodge's story of how Brighton Ski Area is addressing sidecountry decision-making. We also have a ski area view on risk tolerance from Mike Buotte, an update via SnowPilot on what snowpack tests practitioners are using regularly, a look at the iButton for determining near-surface temperature gradients, and a variety of responses to a question I posed in TAR 30-4: how do you carry your beacon – harness or pocket?

See you in Anchorage.

—Lynne Wolfe ❄️



Hi there Lynne and TAR.

I walked in on my son Desmond enjoying some quality time with TAR and could not help but share.

Hope your summer is going well.

Brandon Dodge, Brighton Snow Safety

metamorphosis

Congratulations and thanks to our new AAA members as of spring 2012

Professional Members

John Bressette, Juneau, AK
 George D'Angelo, Challis, ID
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 Rick Gaukel, Estes Park, CO
 Lindsay Mann, Aspen, CO
 Dustin Kinnear, Crested Butte, CO
 Ben Weaver, Hood River, OR
 Stuart Slay, Tahoe City, CA

what's new**USAW Set for Saturday, November 3**

Providing an ongoing venue for professional development, the Utah Snow & Avalanche Workshop (USAW) is a region-wide event where snow and avalanche communities from Utah and neighboring states can share local events and history. This visionary seminar at an affordable price (around \$40 again this year, including a bitchin' swag bag, lunch, and an after-hours party with the Rolling Stones) taps into the vast amount of avalanche knowledge we have among our own local avalanche community. You'll hear about historic avalanche events and new innovations from avalanche forecasters, ski patrollers, snow scientists, DOT avalanche professionals, search & rescue personnel, mountain guides, backcountry skiers and snowboarders, snowmobilers, avalanche researchers, and more.

Peer-to-peer sharing of expertise and learning from the veterans are great ways

to hone your snow-safety skills while mingling with like-minded professionals and serious recreationists. This is the largest gathering of people who take avalanches seriously in the Intermountain West. The format will be like a mini ISSW with 15-minute presentations followed by five-minute Q & A sessions.

The one-day event will take place on Saturday, November 3, from 8am to 4:30pm at the South Towne Expo Center: 9575 S State Street, Sandy, Utah. The morning session is open to snow professionals and features an exchange of ideas and theories. The afternoon session once again features a host of intriguing guest speakers and will be open to the public. A social will follow the day's events.

If you'd like to present a topic, contact Craig Gordon: 801-231-2170, craig@utahavalanchecenter.org. ❄️

SAVE THE DATE: Regional Avalanche Workshops Supported by the AAA**NRASW Northern Rockies Avalanche Safety Workshop**

Saturday, October 13: Whitefish, MT • www.avalanchesafetyworkshop.com

CSAW Colorado Snow and Avalanche Workshop

Friday, October 19: National Mining Museum & Hall of Fame, Leadville, CO

USAW Utah Snow and Avalanche Workshop

Saturday, November 3: South Towne Expo Center, Sandy, Utah

ESAW Eastern Snow and Avalanche Workshop

Saturday, November 10: North Conway, NH • www.ESAW.org

NSAS Northwest Snow and Avalanche Seminar

Sunday, November 11 (pre-function November 10): Seattle, WA ❄️



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Photo: Josh Kling

Decision-Making and Psychology Professional Development Workshop

Story by John Barkhausen

As avalanche professionals, it's our job to make decisions. All that research, education, and knowledge can't help us do our jobs if we don't know how to decide what to do. In March 2012, the Friends of the Gallatin National Forest Avalanche Center (GNFAC) hosted a professional workshop for the region's ski patrollers, guides, avalanche forecasters, researchers, snow rangers, DOT employees, and other professionals in an attempt to improve their decision-making process and start a discussion about how to improve the way in which we make decisions while working in avalanche terrain.

Six speakers from a wide range of backgrounds spoke on this topic. Some brought lessons from outside the avalanche world, providing tools and research used by firefighters, military personnel, pilots, nurses, and workers in the exciting field of economic research and analysis. Others spoke about their avalanche forecasting and snow-safety experiences and about research they had done to learn about and improve their own decision-making. Around 50 participants attended the workshop at the Bozeman Public Library.

All the speakers gave pertinent and useful information, but some of the most interesting information came from outside the snowy realm. These topics ranged from using combat experience and training to help make quick decisions, applying the same analysis used

on large companies to ski patrollers and avalanche forecasters, and examining how pilots execute life-saving maneuvers in extremely stressful situations.

Christopher Robinson, a military contractor and former Navy SEAL, provided tools used by the LAPD and the military to help increase the speed and accuracy of decision-making. Rumsey Young, a retired military and commercial pilot, reinforced some of Robinson's ideas, saying that familiarity with a situation and pattern recognition are two key factors in decreasing the time it takes to make a decision. Although both speakers shared lessons learned from outside the world of avalanches, they continually related these lessons back to that topic. After explaining how pilots learn to quickly make decisions by recalling frequently seen patterns and predicting the actions to safely get them through those situations, Robinson said "that second or two when the snow starts to move can make all the difference for you."

Jerry Johnson, a political science professor at Montana State University, provided a perspective that distanced us from individual decisions and spoke more about how we might analyze how the whole field makes decisions. His background in research and analysis of how large businesses function provided him with the tools to look at the business of

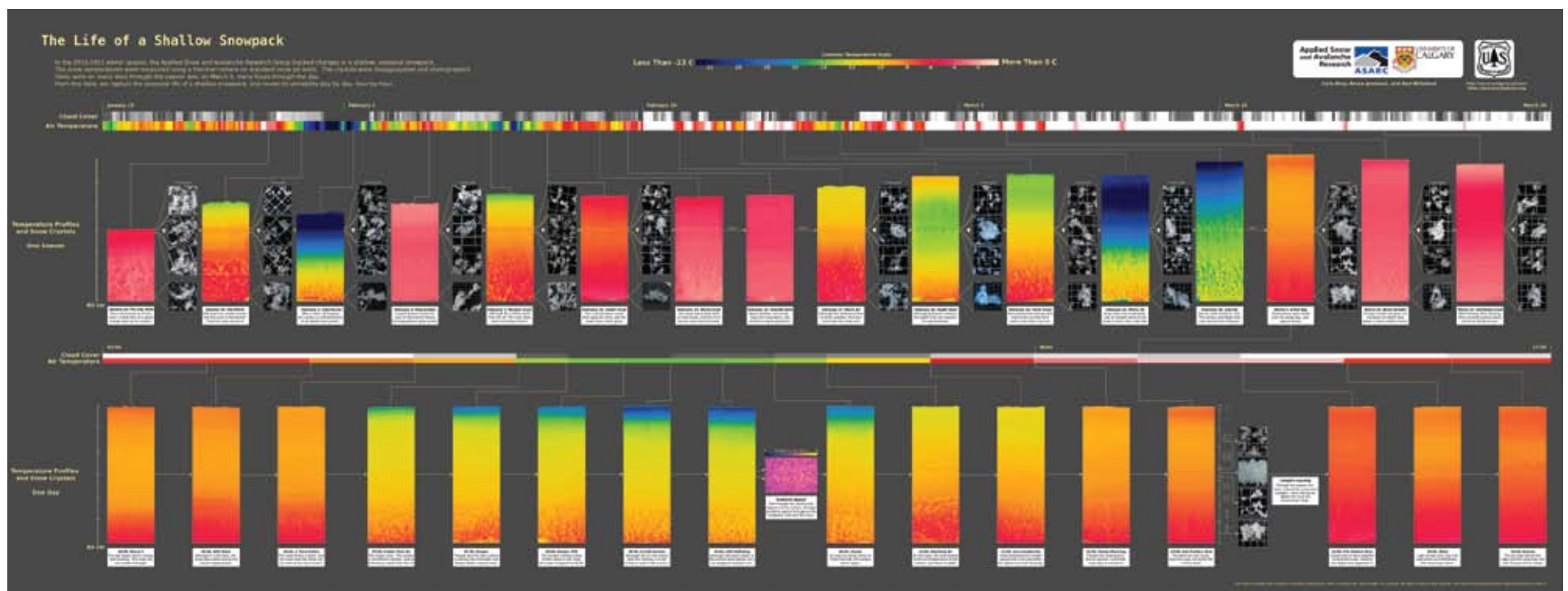
avalanche-hazard evaluation and mitigation as one functioning body.

Johnson began by saying that to accurately analyze this group, we first need to break down and define the problem, then focus our effort toward improving specific aspects of that problem. Johnson gave simple advice and examples that illustrated how we make decisions, how we can improve those decisions, and how we can teach people how to make better decisions.

Other speakers were from backgrounds more closely related to the world of avalanches. Scotty Savage, former snow safety director at Big Sky Resort, spoke about intuition and how avalanche professionals could use it to their advantage. Savage reviewed research from multiple psychologists and researchers to highlight theories on how people make decisions and how intuition plays into this process. He discussed recognition-primed decision-making, a process that utilizes past experiences to see patterns and subconsciously analyze a situation so we can make a decision.

Savage also compared reasoned and analytical decision-making to intuitive decision-making,

Continued on next page ➡



Cora Shea Leaves a Lasting Legacy

Story by Karl Birkeland, with help from Bruce Jamieson

Dr Cora Shea, a recent doctoral graduate of the University of Calgary and an extraordinary snow scientist, passed away in Calgary on June 30, 2012. She was 32 years old. In losing Cora, the snow science community lost a bright new star. During her short career she made a sizable contribution to our field that will undoubtedly be felt long after her passing.

Cora had a sharp and inquisitive mind to go with her awe-inspiring technical skills. In her publications and presentations she created incredible graphics that not only conveyed her science, but also increased the comprehension of all who saw them. One amazing example is her poster, *The Life of a Shallow Snowpack* (Shea et al., 2012). This poster (shown above) combines thermal images of the snowpack, crystal photos, a seasonal weather history, and a 24-hour snowpack investigation into a powerful and artistically beautiful presentation. Creating such a poster took remarkable technical skill, real scientific vision, and an incredible passion for the subject at hand. Cora also took justifiable pride in her writing and presentation skills. She could take complicated material, boil it down to its essence, and present it in an engaging manner to both technical and non-technical audiences. The breadth and depth of her work is too large to cover in this short article, but to get a sense of it, go to the ASARC publications page (www.ucalgary.ca/asarc/publications) and search on Shea.



Cora was fascinated by the subtleties of temperature gradients in snow and elsewhere, as shown by her fancy thermal imaging camera. Photo courtesy Bruce Jamieson & ASARC

For me, I'll remember Cora with a smile on her face exulting about snow physics being "totally rad." I'll remember how she celebrated the complexity of the mountain snowpack

and how she worked on her days off after graduation to continue to try to better understand some of those complexities. And, I'll remember how she enthusiastically jumped at the opportunity to spend 24 hours camped out in the snow looking at the snow temperatures day and night to better understand the complicated patterns she was observing.

Time will tell, but I believe we will look back in five or 10 years and see some of Cora's work, particularly her work on snowpack temperatures, as paradigm shifting. We can only imagine what she could have accomplished in a long career. We lost Cora much too soon.

To honor and sustain Cora's memory, the Canadian Avalanche Foundation and Cora's parents have established the Cora Shea Memorial Fund to support women pursuing snow science, avalanche education, or avalanche forecasting. Donations can be made online at www.avalanche.ca/caf/support/memoria-donations. For more information, please contact info@avalanchefoundation.ca or call 1-403-678-1235.

REFERENCES

Shea, C., B. Jamieson, and K.W. Birkeland. 2012. The life of a shallow snowpack. Poster showing the weekly and, for one day, the hourly thermal evolution of a thin Canadian snowpack during the 2010/11 winter (available on both the ASARC (webapps2.ucalgary.ca/~asarc/files/ShallowSnowPoster_Shea_Jan2012.png) and NAC (www.fsavalanche.org/NAC/techPages/articles/12_ShallowSnowpackTempsPoster_Shea_et_al.png) Web sites) ❄️

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explaining that an intuitive decision may come more quickly, but it is harder to learn to be intuitive because it comes from experience. Savage also cautioned that intuition can lead you astray, saying, "Intuition is a powerful tool, but you can't rely solely on it," and, "There is a time and a place for everything." Savage and others in the audience noted that inaccurate or unclear feedback (e.g., skiing a slope without triggering it while a party on the same slope an hour later sets off a sizable avalanche) from our avalanche-related decisions is a significant problem.

Mark Staples, an avalanche forecaster with the GNFA, spoke about how hindsight can damage foresight. We use our view of past events and decisions to predict the future. If our view of the past is flawed, then our predictions of the future will be too. He warned that after an event, we already know the outcome, and this changes our view of the incident – a hindsight bias. This bias can cause us to think we saw the incident coming, knew more than we actually did, were going to be safe anyway, and other traps created by trying to predict the outcome after the fact rather than analyze the situation that led to it. Staples also warned that heuristic traps, like the "expert-halo," can become more pronounced when looking back.

In some cases hindsight can provide clarity and simplicity to help us in a complicated world, but this can hurt us too. Staples gave tools and tips that can be used to limit the effects of hindsight bias. He recommended that to make a quality analysis of an event or incident, you need to discover the real outcome through research and by not jumping to conclusions. Ask yourself, "What if the opposite had happened?" Then reduce the time between the event and the analysis, keep good records, and try to make decisions that can withstand hindsight bias.

The final speaker was former Sawtooth National Forest Avalanche Center forecaster Janet Kellam. She gave a very personal talk detailing the events leading up to her full burial in an avalanche while working for the avalanche center. This case study gave

the audience a first-hand view of how being so immersed in the science and history of a snowpack won't ensure that you avoid trouble on every individual avalanche path. Janet's story provided a great lesson to the audience – when you're in avalanche terrain, don't lose focus on what's happening at that exact moment in time.

After concluding her case study, Janet led a group decision-making exercise. Janet gave the audience the opportunity to reflect on a poor decision they made and analyze how they came to that decision, how everything turned out, and how things could have turned out. The group was then asked to share these experiences and thoughts so that we could learn from each other and start a dialogue about decision-making in a professional realm. Many audience members shared some stories of close calls and scary moments, and quickly the group was discussing decision-making and their own thought processes. Janet ended her talk by summarizing her idea of judgment and experience, saying, "Good judgment comes from experience, and experience comes from poor judgment."

The event ended with a meet and greet, and a number of the participants headed across the street to the local brewhouse for some post-workshop discussions. Many people lagged behind to discuss different thoughts or to ask questions of the presenters, and it seemed that all attendees left in deep thought, brooding over some idea or another. This successful event demonstrated the power a local community has to improve their professional standards and knowledge through the simple means of sharing specific know-how and spreading it around.

These workshop lectures are all online at www.youtube.com/playlist?list=UUl_ocrmLbXbk2xrqNlcl5sQw&feature=plcp.

John Barkhausen interned at the Gallatin National Forest Avalanche Center through the Prescott College adventure education program during the winter of 2011/12. He is excited to be presenting a poster on beacon interference at ISSW 2012. ❄️

Snowpulse Avalanche Airbags Recall

This recall involves Snowpulse avalanche airbags with inflation-system 1.0 air cartridges, including model year 2008 to 2010. A leak in the Snowpulse airbag's cartridge can result in the airbag not deploying. The packs are between 15 and 45 liters and have the Snowpulse logo printed on them. The metal cartridge is inside the pack and unscrews from the airbag. Cartridges affected by this recall can be identified by the pin inside the threaded fitting on the side of the cartridge. If this gauge does *not* have an "A" or "B" on the dial, then it is included in the recall. Consumers should immediately stop using the recalled airbags and contact Snowpulse for a replacement cartridge: 800-451-5127 or visit the Snowpulse Web site at www.snowpulse.com.

Forest Service Staff Honored by Pacific Northwest Ski Areas Association

The Pacific Northwest Ski Areas Association recently broke tradition and presented three Forest Service Partner of the Year awards: one each to Garth Ferber, Kenny Kramer, and Mark Moore. The "Partner" honor is reserved for a Forest Service employee who significantly and decisively helps to improve the quality and safety of Pacific Northwest winter sports facilities. Ferber, Kramer, and Moore are meteorologists employed by the Northwest Weather and Avalanche Center, a unit of the Forest Service. Their careers span nearly 70 years of combined service at the Northwest Weather and Avalanche Center. Congratulations Garth, Kenny, and Mark on this award, and congratulations to Mark Moore on his retirement.

See future issues of TAR for more on Moore and his remarkable career. ❄️

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BACKCOUNTRY 101

Grassroots Education Informs Brighton Sidecountry Users

Story by Brandon Dodge

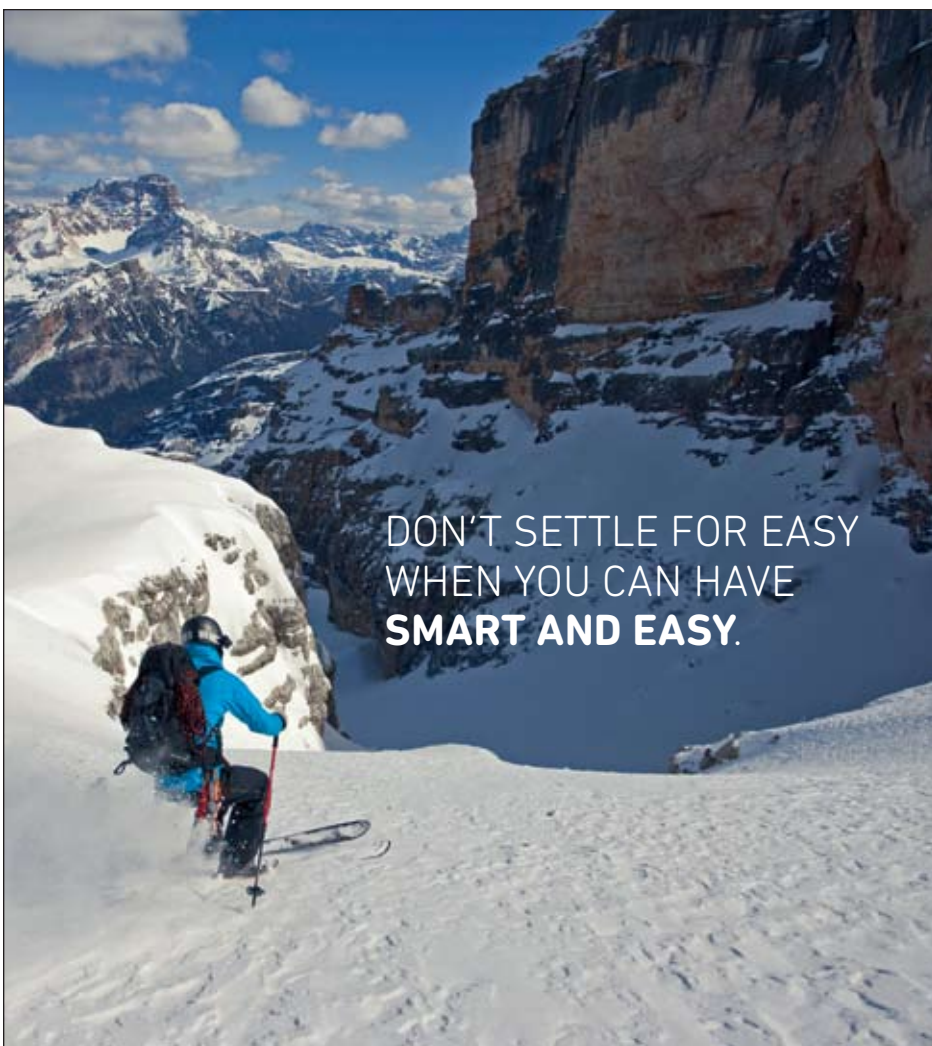


In Backcountry 101, participants gain valuable on-snow rescue practice.

Photo by Brandon Dodge

Here in the heart of the Utah's Wasatch Mountains, sidecountry use and avalanche issues have long been a topic of discussion and a point of concern for avalanche professionals, avalanche educators, and resort operators. The 2011/12 ski season brought increased media attention with incidents in Utah, Colorado, and Steven's Pass, Washington. Each season we see a growing influx of resort users egressing beyond the ski area boundaries and into the backcountry, often referenced to as "sidecountry" terrain. In the Wasatch Range since the year 2000 we have seen 12 incidents involving resort area users egressing into the backcountry and triggering avalanches that result in fatalities. In this same time period we have seen well over 100 incidents of sidecountry users needing assistance for medical, navigational, or other issues. With increasing demand, better gear, and a culture fueled by Red Bull, sidecountry use issues are on the rise.

First let's take a look at responsibility from the perspective of Forest Service policy. Resorts operating on Forest Service land are issued permits that specify an area of operations for the resort. The resort is responsible for the safety of the terrain within said permit area or area boundary. The resort is also responsible to post or mark the area boundary of the resort operations. Traveling beyond posted area boundary, where allowed*, is at the discretion of the user. Forest Service policy is stated plainly and posted at all access gates:



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When you pass beyond the Ski Area Boundary, you leave the area of ski patrol services including avalanche control. You are entering an area that has many natural hazards including avalanches. You are responsible for learning about and avoiding these natural hazards. You are responsible for your own actions, for your own rescue, for the cost of your rescue, and you waive all claims for injury.

This says it all: the choice is yours. Users determine how and when they choose to access backcountry or sidecountry terrain on public land. So how can avalanche educators influence the awareness and decision-making of the user? How can we change the attitude or culture of our resort users in regards to sidecountry danger?

"Sidecountry" was not a popular term at Brighton Resort in 2002. We witnessed a surge in unprepared, unequipped, and uneducated users egressing the ski area boundary into the backcountry. These were not your crusty leather-booted "bark eaters" of old. No – they were young, brightly dressed, usually carrying a snowboard and little else. On March 16, 2002, an avalanche in Forest Service terrain adjacent to the resort killed Richard Jones (19) and Allen Chatwin (18). We might not have been "hip to the lingo," but we knew we had a problem.

We also knew that we were not alone in this issue. The Canyons Resort, just over the ridge, had twice dealt with fatal sidecountry incidents. But this one hit close to home. This was in our backyard. This was a group of locals, pass-holders, just kids. We knew that they were very skilled snowboarders, even referred to as professional riders by friends. We knew that the Utah Avalanche Center (UAC) hazard for the day was rated considerable. The terrain was steep, wind-loaded, north-facing, and of course difficult to access. The group of 13 egressed at an access gate, ascended the ridge, and descended the slope all at once. They carried no gear essential for partner rescue: no beacons, probes, or shovels. And they followed no backcountry safety protocols. We learned that at least five members of the group had

taken a serious ride. Three ended up at or near the surface. Two others were not as lucky, their shattered young bodies located hours later with avalanche dogs and professional rescue teams.

This was unacceptable – not in our backyard. We knew that this was not the first accident of this type, nor would it be the last. History has proven us right eight more times, in the Wasatch Range alone.

After the incident I was approached by Craig Gordon, former Brighton patroller and heli ski guide and current avalanche forecaster and educator for the Utah Avalanche Center. Craig proposed a partnership with the Brighton ski patrol and the UAC with a focus on sidecountry avalanche education. We realized that these kids were not stupid, they were not lazy, and they were not really making bad decisions – rather they were letting the decisions make themselves. They just didn't know basic avalanche information or how to understand the information they had been given. These young athletes were progressing so fast at their sports that they lacked the skillsets you develop from a traditional mentored backcountry career. Traditional backcountry careers started using a bottom-up access approach, allowing the clues to present themselves well before venturing deep into avalanche terrain. The sidecountry user can egress into advanced challenging avalanche terrain in a matter of minutes, often missing the "obvious clues" and unaware of the hazards.

Brighton Backcountry 101 was created in partnership with UAC and Brighton patrol. The two-part course consists of a three-hour evening lecture and a five-hour field session. The lecture focuses on obtaining and understanding the UAC forecast, noting red flag clues of avalanche danger, making and using risk assessments, understanding contributory factors to avalanches, considering the human factor, and making conscious decisions. We focus on the obvious factors that can reduce fatalities right now: noting red flag clues, traveling one at a time, carrying rescue gear, making decisions as a group, and trusting that gut feeling of "maybe we should not be doing this today." Field sessions validate classroom lessons and focus on route finding, terrain management, and conscious decision-making.

Brighton pass holders can take the course for \$40; employees are half price, and we offer "patrol scholarships" for those who cannot afford to pay. To date, Brighton avalanche education has offered 21 BBC101 courses and taught over 400 students. Course instructors include patrollers, forecasters, pro riders, guides, and recreationists.

The biggest benefit we have seen is an increase in communication. Bringing "red coats," locals, "park rats," and pro riders together changes attitudes and promotes a more open dialogue. One of my favorite and most memorable courses included a long-time group of hard-core riders and local "problem children." The mutual respect gained through one eight-hour course opened my eyes to the power of powder. We all share the common bond of "lovin' some freshies" – we just need better communication. Other benefits include the education and mentorship of the instructor group; everyone learns a little more from each course we offer.

I am proud of our program, the bonds it has created and barriers it has broken. Several years ago the Friends of the Utah Avalanche Center, the education and fundraising arm of the UAC, adopted their own Backcountry 101 course. They offer this course several times a month to various user groups with great success. At Brighton we don't know the answers, but "we're workin' on it."

Lessons learned from increased sidecountry terrain demand

At Brighton Resort we have adopted a philosophy of ALERT, INFORM, EDUCATE, and ALLOW.

ALERT

We follow the USFS directions in alerting the public to the ski area boundary and the existence of hazards should they choose to leave the area boundary. Backcountry access gates are provided at most commonly used egress points. Area boundary is signed and often roped. Area boundary information is posted at access gates, on trail maps, and on the Brighton Web site.

INFORM

We inform the public at backcountry access gates that, "You are leaving the Ski Area Boundary. This is your decision point. The current UAC backcountry avalanche forecast is _____."

To receive more detailed information call 888-999-4019. Carry rescue gear, go with a partner, and be prepared for self-rescue."

We also participate in the "Are You Beeping" program with signs and beacon checkers at popular egress points.

EDUCATE

We offer affordable avalanche awareness education courses (Brighton Backcountry 101) and free awareness lectures (Know Before You Go) to pass-holders, local users, employees, and the public. Our patrol promotes an atmosphere of open communication between the patrol and the public.

ALLOW

We allow access to Forest Service lands adjacent to the resort. We close access gates only for operational concerns and not based on backcountry avalanche conditions. We encourage users to make decisions consciously, be aware of the hazards, get educated, and enjoy their public lands.

I encourage you to start a Backcountry 101 program at your mountain. You will be surprised by the benefits both obvious and subtle. You cannot force education, but you can offer it in a way that encourages participation.

*Policies and regulations vary by resort and Forest Service region. Consult your local Forest Service and/or ski patrol for info regarding sidecountry and ski area boundaries.



Brandon Dodge is the snow safety manager and assistant patrol director for Brighton Resort. Dodge serves as assistant team leader for Salt Lake County Sheriff's SAR, is a WBR Rescue Dog Committee member and avalanche rescue dog handler. Dodge lives at Brighton Resort with his wife Jen and 3-year old "mini mountain man" Desmond (see photo, page 2). He can be reached at 801-803-3993, dodgerrow@hotmail.com, dodge@brightonresort.com. ❄️

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ISSW2012

We will be demonstrating our newest Snowpro Plus+ software this fall at the ISSW conference in Anchorage, Alaska. Drop by and see us! We also plan to demonstrate our new snow profile mobile app at the conference. We have also announced a Mac version of Snowpro that is in development which we hope to have ready later this winter.

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Avalanche AWARE³

An acronym for neophytes and know-it-alls to review, discuss and practice avalanche awareness, avoidance and survival skills

Story by Jim O'Dowd

One of the main difficulties of preaching avalanche awareness is that there are so many variables in play that even an expert cannot predict with certainty if and when a given mass of snow will slide. The AWARE³ acronym is a tool to help organize and memorize many of the critical factors for avoiding and surviving avalanches.

There are many examples of people having crossed or climbed a slope only to have it cut loose on a late comer. There are more cases where people cross slopes without incident that nobody with any degree of avalanche awareness would have touched with a hundred-foot pole. On average about 20 people die in avalanches each year in the US, and many more are injured. Don't count on luck to save your life; practice being **Avalanche AWARE³**.

A – Avalanche

While there is no foolproof predictor of avalanche potential, there is no better indication of probability than signs of recent or past slides: broken cornices, fracture lines, debris fields, slopes with only small and/or broken trees, branchless tree trunks, etc. If there are signs of recent slides nearby you can be sure the odds for more are high.

W – Wind Load

Winds can pile a few inches of new snow into large cornices, ridges, or pillows; make hard slabs; or deeply cover convex areas. These masses of snow are the most likely places for slides to start. They can move spontaneously if they break off from their own weight, did not bond to the surface below, or the weight collapses weak underlying layers. A trigger such as a human, animal, machine, falling object or explosives can start the movement.

A – Aspect

The aspect or angle and orientation of a slope have a lot to do with the stability of snow. Slope angles between 30 and 45 degrees are the most prone to slide. Gentler than that and the snow does not tend to get moving. Steeper than that and snow often does not build up enough to produce a big slide. There are exceptions. Do not get lazy and assume all is safe on gentler slopes, and be even more cautious around steeper slopes. Also watch out for "terrain traps" – steep-walled depressions, gullies, or chutes. They don't have to be big to be dangerous. Ten feet of snow can kill you just as dead as 100 feet if you cannot get out of the way or are buried.

Slope orientations of north, south, and points in between all hold or release snow differently. A north aspect might be stable one day while a nearby south face could be hair triggered. The reverse could be true by, or even before, the next day.

Hot sun can turn an east-, south- or west-facing snow field unstable in short order. Cold, shaded north slopes often have unstable, sugar-like depth hoar. Wind tends to affect the leeward (downwind) areas more than others. Think about the recent and current conditions as they relate to the different aspects of the slopes you are passing under, crossing, climbing up, or coming down.

R – Reconnaissance

Pay attention to where you are and where you are going. Look around. *Do not blindly follow others or their tracks and assume they know what they are doing.* They could be what are affectionately known as "sucker tracks." You are responsible for your own safety.

Are there other people or groups above or below you? They may or may not see you. Watch out for snow coming down from above – whether started by others or not. Slides can travel hundreds or thousands of feet, and you will not always see or hear it before it is too late. Once snow gets moving it can travel at speeds you cannot outrun. We lost the great mountaineer Alex Lowe in this way.

Climb near or up where you plan to come down to assess the conditions. If you would not climb up it, why would you be willing to come down it? Better yet, check it out in summer. In winter, major features can be hidden by deep snow making it difficult to know the true lay of the land. Smooth and/or grassy slopes lack anchor points to help hold snow in place.

E – Evaluation

People often rely on official (and unofficial) avalanche reports, which can be helpful but they are time and place specific. Conditions can change rapidly. Your real time and location specific evaluations are more relevant.

Think about the weather. New snow generally takes time to bond to the snow

below. A day or even hours can make a huge difference in stability. Sun, warm temperatures, and high humidity all can quickly increase the weight of surface snow, possibly causing it to slide or collapse underlying layers. Shallow surface snow slides, sometimes called "sluffs," are typically less dangerous than deeper slides, but you still don't want to be caught by one. They can push you over a cliff or into trees, or they may set off a bigger slide from the movement.

Snowpit analysis gets a lot of attention but few people take the time to dig them. You should dig a snowpit if you are in unfamiliar terrain or conditions. A snowpit cannot tell you with certainty if an avalanche will occur. It will give you detailed and useful information about the snowpack. However, don't forget that snowpit stability analysis will likely be somewhat different to very different only a short distance away depending on aspect, wind load, etc.

A quick evaluation technique is to probe the snow with a pole. Are there distinct layers? Is there a hard layer(s) covered by softer snow or the other way around? How thick are the layers? Can you feel a "rotten" layer where your pole sinks in easily? If these layers are not well bonded to one another the chance of a slide increases, sometimes dramatically. An even consistency to the snowpack from top to bottom is a sign of greater stability.

The infamous "whumphing" sound is a warning that the snow is unstable. It is usually caused by the collapse of a buried layer of loose or rotten snow from the weight of the snow above. If the area is relatively flat it may just collapse, but it still tends to get your heart racing and should be taken as a serious warning sign. If the area is steep it could easily start a downhill movement and become an avalanche. If hearing this distinctive sound does not raise "proceed-with-extreme-caution red flags," then nothing will.

Are those butterflies in your stomach from excitement and/or from fear? If the odds of a snow field avalanching were one in a five hundred, would you risk it? What about one in a hundred? People do survive avalanches, but will it be you? What is *your* risk tolerance?

Don't let others or your own excitement overrun your judgment. If no one else was around, would you risk it? When in doubt, turn aside while you can. Console yourself with images of enjoying many more tomorrows. At least be able to explain why you made the decisions you did instead of having

to admit you just did not think about it all that carefully.

E – Escape

When in an area that feels sketchy, identify nearby "safe zones" – such as heavy trees, overhanging rock bands, ridges, knolls – preferably downhill and to the side of the likely avalanche path. It does not mean you will make it if a slide starts, but at least you have admitted the potential. This heightens your awareness, giving you a better chance of getting out of the way or escaping.

If on skis, snowboard, or snowmobile and a snow field starts to move, make a bee line toward a safety zone. If you are on foot or snowshoes you will not have much, if any, chance of getting out of the way in time.

If you are caught in a slide, a swimming motion is thought to help keep you on top of the snow and not get buried. Good luck with that one. Grabbing a nearby object such as a tree has rarely been documented to save anyone – the force of the slide usually rips you away.

If caught and you are really lucky and come to a stop near the surface (and can still tell which way is up) you may be able to stick a hand or leg up above the snow for searchers to see.

If you are buried and still conscious, try to get a hand or arm in front of your face when things are slowing to a stop in order to create an air pocket that may give your companions time to get you out before you suffocate.

Spreading out and exposing only one person at a time while everyone else is in a safe zone is a protocol that seems to have gone out of style or been forgotten. Bunched up climbers, multiple people on the same slope at the same time, and big crowds at the bottom of a runout are common sights these days. Hopefully not everyone in your party is caught so someone is left unharmed to help dig out those who are.

Even if you think you are in a safe zone you should identify an escape route in case a slide becomes massive or unexpectedly comes your way.

E – Equipment

There is a reason equipment comes last on this list. It may save your life but its use generally means that bad luck or poor judgment let you or someone else down.

A rescue beacon should be worn close to your body. It should be turned on and checked *before* you set out. It will be real embarrassing if the news story states, "They had beacons but did not check

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to see if they were on or working," or, "Beacon found in pack; search still on for victim."

Read the instructions and practice with your beacon. If someone is buried, you do not want to be fumbling around. A few short minutes could mean the difference between life and death.

Probe poles speed up the search right at the end to help identify exact location, depth and, hopefully, the position of buried victims (head up, down, or sideways).

Without a good quality shovel you will not be able to extract a victim quickly unless they are only partially buried. *There is no excuse for not carrying a shovel!* You will feel guilty forever if you were unable to save someone because you could not dig them out.

Uncover the face first to be sure they can breathe or you can apply CPR. It can take quite a while to dig a big enough hole to safely get someone out.

The relatively new flotation packs and air packs have saved lives but have also not saved lives in some instances. Only a high-stakes gambler would be willing to bet his life on them. Think of them as catastrophe insurance. You never want to use it but hope like hell it comes through if you need it. Helmets fall in the same general category.

Do you know how to perform CPR, staunch bleeding, stabilize a traumatized patient? Do you carry pain medication? If not, what then? Only in videos do snowmobiles wait at the bottom of an avalanche to transport a shaken but uninjured victim back to civilization and drinks at the bar.

Be prepared to make a victim as comfortable as possible while waiting for evacuation by professionals. If you are capable of assessing that it is safe to move the victim, and you are equipped and able to do it yourselves then extra points to you for being self-reliant.

This is not everything you can or need to know about avalanches, but if you practice being **Avalanche AWARE³** you have a better chance of safely enjoying snow country.

Jim O'Dowd has called the Colorado I-70 corridor Front Range Mountains his home ski terrain for 27 of the last 30 years. Nineteen years ago, an error in his evaluation of avalanche potential nearly resulted in his demise. He is very thankful that the powers that be (including one very old and helpful tree) allowed him to continue looking for, and finding, sheer bliss in deep powder snow¹ and wants others to be able to do the same.

FOOTNOTES

¹Credit Dolores LaChapelle for phrasing this so well.

³This is not a footnote. It is a reminder that the E is used 3 times in the acronym. The author tried using a x3 superscript, AWARE³, and AWARE^{EEE} and did not like the look, so he opted to use the 3 superscript and risk the misunderstanding of footnote-philosophers and mathematicians. ❄️



Left: Newly built tunnels protect a main road from one of the most obvious avalanche paths in Dunshabe, Tajikistan.

Below: Doug Chabot works with an enthusiastic and involved group of locals through FOCUS Humanitarian.

Photos courtesy
Doug Chabot

Tragedy and Aftermath in Tajikistan

Story by Doug Chabot

The week of March 19, 2012, was a bad one for Central Asia. Heavy snow followed by a downpour of rain introduced their most widespread avalanche cycle in memory. Tajikistan, northern Pakistan, and northern Afghanistan had avalanches hit roads and villages, many in the dead of night. Most were climax slides that trapped and killed people, paralyzing an entire region. In southern Tajikistan near the border city of Khurog, 52 avalanches hit the valley floor, covering roads. Nineteen of these slammed into villages, many for the first time ever. Village growth in the last 20 years has spread buildings, residences and grazing into the runout zones of enormous avalanche paths with many paths running two to three thousand meters vertical.

FOCUS Humanitarian, the disaster relief arm of Aga Khan, a large non-governmental organization, is the lead agency providing relief in these remote zones since governments are ineffective outside of main cities. FOCUS typically deals with landslides, mudslides, floods, and earthquakes. Avalanches were now added to their list, and they were not prepared for it.

I was asked to help. In the last 12 years I've climbed and trekked through many of these areas. I understood, on a basic level, the geographic and cultural difficulties they faced. On June 8, I flew to Dushanbe, the capital of Tajikistan, and spent five days with 20 FOCUS field workers and management from Pakistan, Afghanistan, and Tajikistan. The Pakistan team almost didn't make it when the cargo door of their airplane flew open after takeoff from Islamabad. The sound of metal twisting and smoke pouring in the cabin with an odor of burning rubber had them white-knuckled during the wobbly landing. The disaster relief specialists almost succumbed to a disaster themselves.

The training had three objectives. The first was to give everyone some basic avalanche knowledge. The second was to come up with an avalanche incident form they could database for future reference and research. The third, and most important, was finding a way to convince the villagers to not rebuild in the same dangerous location.

The lectures were a mix of Level 1 and 2 curriculum with some extra time spent on mitigation, forecasting issues, and avalanche defensive structures. In this area of the world, opportunities or even a desire to winter recreate are close to zero. No one skis or snowshoes, and FOCUS's avalanche experience deals with the aftermath, exclusively in the runout zones. No one has ever seen a crown, heard a whumph, or dug a pit. Their videos of the March avalanche cycle show them walking across debris in loafers.

Some of the participants spoke only Russian so a translator echoed in the background as I lectured. I was constantly editing my talks since my usually funny pictures and jokes fell flat. Also, out of respect for Muslim culture, reference to alcohol or pictures of women in anything but full winter garb were removed. These were the most boring presentations I've ever given, but the students were the most serious I've ever taught, and they drilled me with pointed technical questions. Everyone had at least one university degree, could speak multiple languages, and had years of field experience. Most were either geologists or engineers. They grasped snow metamorphism quickly and challenged me with questions about impact pressures.

One of my favorite moments was when I described the destructive power of powder clouds. One of the Russian-speaking geologists said powder clouds are great because they save lives: the blast blows people out of the way of the debris! I told him this was crazy, but of course he had a story to back up his incredible claim. His cousin was blown across the Panj River, the size of the Yellowstone, from the Tajikistan side to the Afghanistan side. He was knocked out, came to, and realized he was in another country, without a visa! We had some good laughs on that one.

During one day we created a five-page avalanche accident form that addressed the unique situations in all three countries. The information gathered will be fed into a centralized database that FOCUS is committed to building. Unlike the forms we use in the

US for recreationists, this has fields for listing how many cattle and chickens died as well as detailed questions on the history of the avalanche path. These countries have no avalanche warning system, no mountain weather stations, and no snowpit data to record. And rescue is done by untrained neighbors with survival being a matter of luck.

We spent an entire afternoon tackling the thorny issue of how to convince locals to move out of the runout zone. We all had to take the long view: not rebuilding damaged residences in the same location as a first step. A second step is not building any new structures in the avalanche path. This sounds simple, but it's not. In all three countries the two main hurdles were the people's fatalistic approach to life; an "Inshallah, I'm powerless, and Allah is in charge" view, and the fact that their lands have ancestral significance. Relatives are buried there, and in some cases the land has been in the family for centuries. We role-played, wrote on butcher paper, and brainstormed ideas. Solutions all came down to basic education of the locals, especially among the village leadership. These small but significant steps will hopefully lead to measurable changes in the decades to come.

Doug Chabot is the director of the Gallatin National Forest Avalanche Center. ❄️

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snow science

Changes in Stability Test Usage by SnowPilot Users

Story by Karl Birkeland and Doug Chabot

Professionals and recreationists utilize stability tests as a primary tool for evaluating snow stability on suspect slopes. These tests aim to evaluate avalanche potential by testing small blocks of snow cut out of a snowpit. The development of different tests in recent years has added new tools to our toolbox. The goal of this paper is to determine whether or not people are changing the types of tests they conduct for their stability assessments.

To do this we utilized the dataset from SnowPilot, a free software program that allows many different users to enter, graph, and database their snow pits at www.snowpilot.org. These data have been used for several past studies [e.g., Birkeland and Chabot, 2006; Simenhois and Birkeland, 2009]. The advantage of SnowPilot is that it allows us to collect a great deal of data from diverse sources in all snow climates at a low cost. The data come from all over the US and from several different countries, including Canada, New Zealand, Norway, and Sweden. The disadvantage of SnowPilot is we cannot test whether or not our data are statistically representative of all people doing stability tests. Indeed, there is certainly a bias toward users from the United States, and certain groups or geographic areas within the US are likely over-represented. However, it is still interesting to see the trends that exist in these data. Our study uses over 3600 snowpits from nine winters, and

about 83% of these pits were dug by people who identified themselves as avalanche professionals.

There have been some fairly dramatic shifts in the tests preferred by SnowPilot users since 2004 (see chart, next page). In the following we summarize the trends for each of the tests:

Compression Tests (CTs)

Compression tests involve isolating a 30cm by 30cm block, placing a shovel on top of it, and tapping the shovel vertically with progressively stronger taps until the weak layer fails. By the time our data start in 2004, CTs were well established, having been used for over 30 years in some areas. The data clearly show their consistent popularity, with users conducting CTs in about 75% of all pits in 2004. Peak CT use occurred in 2007 (85% of pits), but they continue to be popular today, being used in over 65% of pits.

Rutschblock Tests (RBs)

Originally developed in Switzerland, Rutschblock tests involve isolating a 2m by 1.5m block and having a person on skis progressively load the block. Though the test of choice for some US avalanche professionals, RB usage peaked in 2005 when they were conducted in a little more than 40% of the SnowPilot pits. Since then RB usage has dropped steadily, and in 2011/12 they were used in less than 2% of the pits.

Shovel Shear Tests (STs)

Shovel shear tests have been around longer than most of us old grey hairs can remember; they were the test of choice in the US at least as far back as the 1970s and 1980s. STs involve isolating a 30cm by 30cm block, inserting your shovel behind, and pulling in a slope parallel direction until the block fails on a weak layer. In our data, ST usage peaked in 2006 when they were used in almost 30% of the pits. Since then their use has declined steadily to less than 10% this past season.

Stuffblock Tests (SBs)

Stuffblocks are a variation of the CT. The same 30cm by 30cm block is isolated, but instead of loading the block with taps, a stuff sack filled with snow is dropped from known heights until the weak layer fails. The idea is to better standardize the force being applied to the block. SBs gained popularity in some areas of the U.S. in the 1990s, but in our data we can see their steady decline in usage since their peak in 2005, when they were conducted in about 18% of SnowPilot pits. By 2011/12 they were used in less than 1% of the SnowPilot pits.

Extended Column Tests (ECTs)

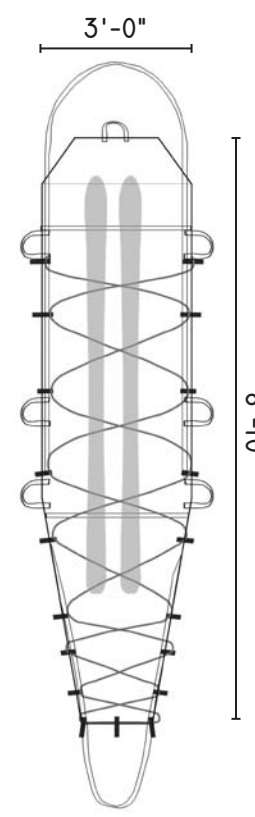
Extended Column Tests aim to test fracture initiation and fracture arrest by isolating a column that is 90cm wide and 30cm upslope and then tapping one side

of the block. Along with the Propagation Saw Test (see below) the ECT was the first to specifically try to index the propensity of a crack to propagate. The ECT was introduced to the avalanche community at the 2006 International Snow Science Workshop in Telluride, and has been extensively studied and tested in several countries since that time. The ECT was first implemented in SnowPilot in the 2006/07 season. The popularity of the ECT has risen steadily since its introduction, and it has become the most popular stability test choice in SnowPilot pits in the past two years, being conducted in almost 80% of the pits.

Propagation Saw Tests (PSTs)

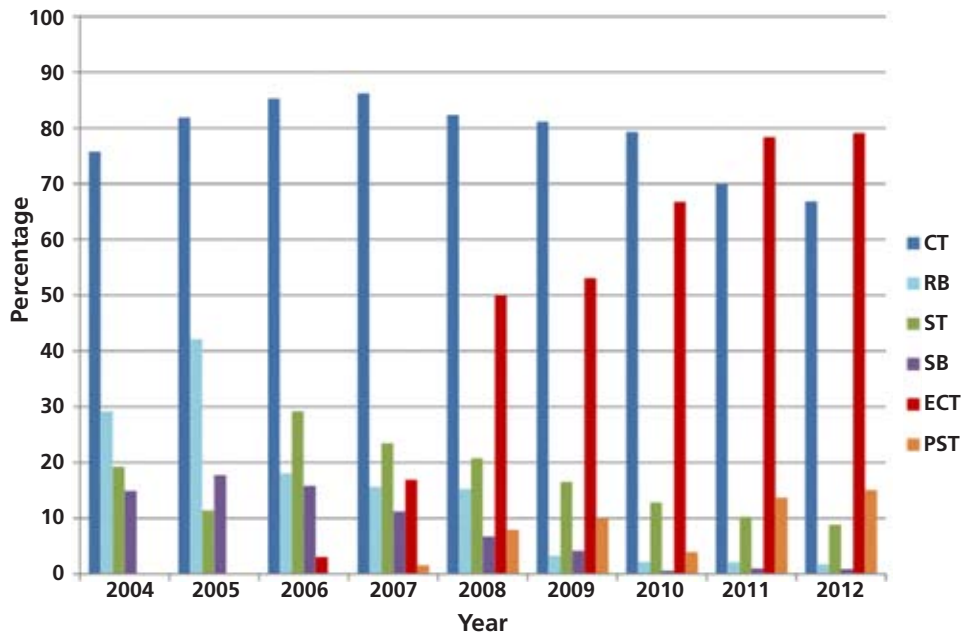
The propagation saw test involves isolating a block 30cm wide and varying length (but at least 100cm) upslope. Along with the ECT, the PST was the first to attempt to index crack propagation propensity, and it was also introduced to the broader avalanche community at the 2006 ISSW. It was first implemented in SnowPilot in the 2009/10 season, but prior to that people put it in the "Notes" section so we have data on it since the 2006/07 season. In general, the PST has seen steadily increasing usage, and this latest season it was used in 15% of SnowPilot pits, making it the third most popular test behind the ECT and the CT.

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SPECIFICATIONS

- NO ASSEMBLY REQUIRED
- BUILT FOR PERSON 5' TO 6.5' (135CM-200CM) TALL
- DURABLE WATERPROOF MATERIAL THAT MOVES EASILY THROUGH SNOW
- OCCUPANT AND SKIS FULLY SECURED INSIDE SLED FOR STABILITY AND SUPPORT
- NYLON SNOW GUARD PROTECTS OCCUPANT FROM MOISTURE AND ROPE ABRASION
- TOW STRAPS AT FEET AND HEAD
- MULTIPLE HANDLES TO AID IN PATIENT TRANSFER
- NYLON STUFF SACK
- DESIGNED AND BUILT IN BC



Change in usage of stability tests in the SnowPilot database. Percentages represent the percentage of time a test was used in all snowpits submitted to SnowPilot during the preceding winter (i.e., 2007 represents 2006/07 winter). CT = compression test, RB = rutschblock test, ST = shovel shear test, SB = stuffblock test, ECT = extended column test, PST = propagation saw test.

Conclusions

Although we cannot show that our data are statistically representative of the larger avalanche community, it is interesting to see trends in stability test usage over time. The last nine seasons have seen a dramatic shift in the tests we use to assess snowpack stability. We have moved away from RBs and SBs and moved more toward ECTs and PSTs, while still maintaining a large number of CTs. Not surprisingly, this shift toward ECTs and PSTs has coincided with an increasing emphasis on the importance of propagation potential in our stability assessments.

The reduced use of SBs makes sense given our broadened view of snow stability. When the SB was developed, the general consensus was that it was important to know just how much force was applied to get weak layer failure. Of course, this is still important. However, research continues to show that the force necessary for crack initiation varies dramatically across slopes. As such, an exact value has less meaning in stability evaluation, and the more approximate values of the CT are typically adequate.

The reduced use of RBs likely comes from the amount of time they take to prepare and conduct in relation to the other tests. They can be used to help determine crack propagation potential, especially when noting the amount of the block that slides (whole block, most of the block, or part of the block). However, with the introduction of faster tests that are more focused on propagation, such a use is not always necessary.

The increased use of tests developed to index propagation is a remarkable shift in the way we assess the snowpack, and a graphic reminder of the importance of propagation in most assessments. In particular, the ECT became the most commonly used test in the SnowPilot dataset only five seasons after it was introduced. Further, despite a more muted acceptance, the PST has become the 3rd most common stability test used. Our results mirror our own experience. We have found the ECT, which provides an index of both crack initiation and crack propagation, to be an excellent (though certainly not perfect!) test to provide information for our stability assessments. Further, the PST has proved useful for some situations, especially with deep slabs over the top of fragile weak layers. The results from both tests have been shown to be mostly independent of slope angle, an extremely valuable

characteristic for safely assessing unstable snowpacks. Finally, both the ECT and PST provide a much more graphic view of the current conditions, a quality that is especially important when attempting to communicate avalanche conditions to the public in videos.

We have undoubtedly not seen the last innovations in stability test development. As we learn more about snow and the way it fractures, newer and more effective tests might well be advanced. Our results from this paper demonstrate that when new tests are useful, and are scientifically validated, our community will quickly adopt them.

Acknowledgments

We owe a huge debt of gratitude to Mark Kahrl, the software developer for SnowPilot. Mark has spent countless hours working on and updating the program, and he extracted the data for this short paper. We'd like to thank Ron Simenhois for proofreading the paper. We are also grateful to all the users of SnowPilot, especially those who download their data into the database. If you are a SnowPilot user who does not download their data, please contact us (email Doug at dchabot@bresnan.net (summer) dchabot@fs.fed.us (winter)). We can keep your data private while still being able to use it for studies such as this one.

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Doug (left) and Karl (right) show off their new Grand Canyon hairstyles with hair stylist Kelsey Birkeland.

Karl Birkeland is the avalanche scientist for the Forest Service National Avalanche Center. When not doing avalanche work, Karl tries to spend as much time as possible on rivers and in the mountains with his wife and two daughters. Doug Chabot is the director of the Gallatin National Forest Avalanche Center and the developer of SnowPilot. In the summer, Doug does as much climbing as possible and works with his wife at Iqra Fund (www.iqrafund.org), a nonprofit organization they founded to help women and children in remote villages in Pakistan and Morocco improve their quality of life through education. Karl and Doug work in adjacent cubicles in their offices in Bozeman and they enjoy giving each other a hard time about whatever happens to be crossing their minds at the time. ❄️

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Level 2 for Snowmobilers

Story & photo by Doug Chabot



Snowmobilers can and do dig pits in the backcountry.

This winter, Friends of the Gallatin National Forest Avalanche Center taught a Level 2 avalanche class for snowmobilers, likely the first in the nation. Scott Schmidt, avalanche forecaster at the GNFA from 1999-2008, organized and ran the course. This was a pilot project for 17 snowmobile guides based in Big Sky and West Yellowstone. Half the attendees had Level 1 certification; the other half had attended our two-day Avalanche Awareness for Snowmobile Guides course at least four times, some as many as 10. We invited those who clearly demonstrated a basic understanding of snow, avalanches, and rescue. These were all expert riders and professional guides. Scott adapted the AAA Level 2 curriculum guidelines to the course and split up the lectures and field days over a one-month period in December and January so the course would not interfere with the guide's livelihood. This also allowed weeks between classes where the guides were able to dig snowpits, record them in SnowPilot, and read new material.

An unintended benefit to the GNFA was all the fantastic observations, pictures, videos and snowpit data we got on a regular basis, long after the course ended. Mid-season a guide told us a story how on an unstable day he would not allow his clients to highmark, much to their dissatisfaction. He then gathered them around, cut an ECT and broke the block clean with a few taps. The clients were stunned and never questioned him again.

The class ratio was 6:1 with me and Quint Gidley also instructing. Next year we hope to run another one for guides since the interest is incredibly strong.

Doug Chabot is the director of the Gallatin National Forest Avalanche Center. ❄️

Pushing the iButtons

Story & photo by Brett Kobernik

Ever wonder what is going on with the snow under the surface? Have you ever been curious how the temperature gradients fluctuate during the day and night in the near-surface layers (i.e., diurnal near-surface faceting)?

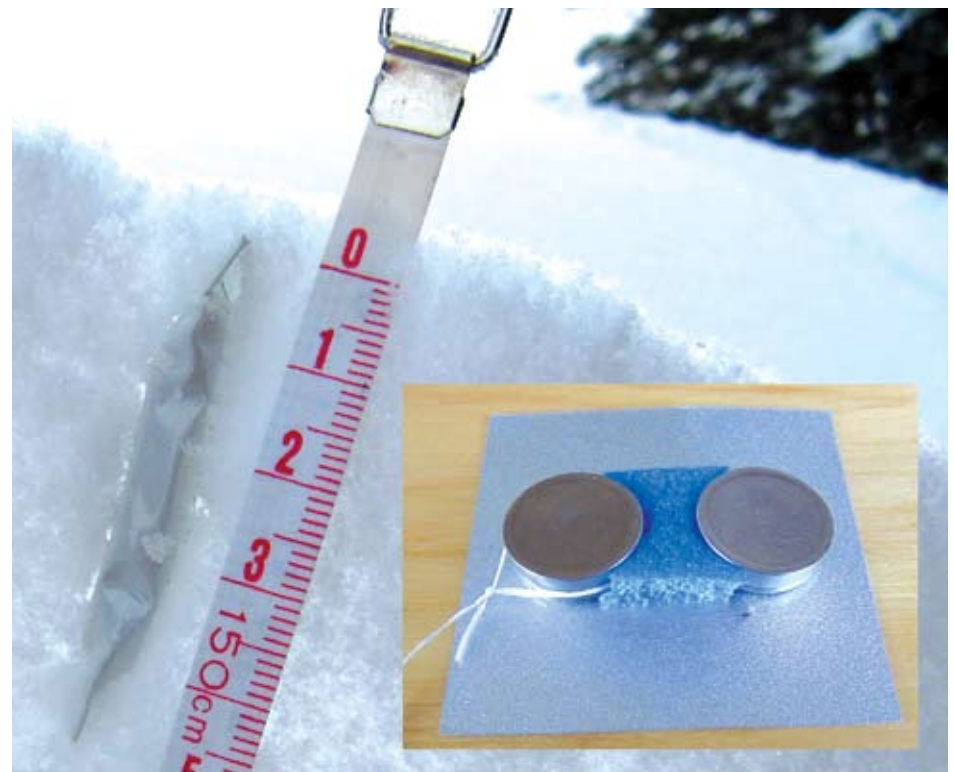
We've all been taught how to go out and measure temperature gradients within the seasonal snowpack. Avalanche forecasters do this routinely during fieldwork, which generally happens between 8am and 5pm and consists of a handful of measurements at different locations. However, these measurements are just snapshots of a particular place at a particular time and obviously rarely get recorded in the middle of the night. Of course, some information is gleaned from daytime measurements, but perhaps the steepest gradients were missed, occurring possibly six hours prior and wouldn't happen again for another 18 hours. To really paint the complete picture one would have to remain at one location and take regular temperature measurements 24 hours a day. Obviously, this is not a practical use of time for snow safety personnel.

Hence, I wanted to find an easy method to record temperature around the clock. Others have done this by inserting thermistors (temperature sensors) that are connected to a datalogger at a snow study plot into suspect layers of the snowpack. Like many practitioners, financial and technical constraints put this method out

of reach. Plus, I was not only interested in measuring temperature at a snow study plot (where a datalogger could live), I wanted to measure temperature in the hearts of the dragons themselves – avalanche starting zones.

I then stumbled onto Maxim Thermochron iButtons which looked like they might just work. The iButton is a self-contained temperature sensor, datalogger, and battery all concealed in a stainless steel can the size of about four dimes stacked up. They can be set to record temperature at any time interval desired. We set ours anywhere from once per minute to once per hour and would let them record for 3-6 days. They are configured through a USB connection to most any computer. And they're cheap!! The low-resolution model was only \$20 per unit. To get started, you need two iButtons and the USB connection, which only runs about \$70 total. Of course, a computer is needed also.

For some help on the project I recruited Wendy Wagner along with some of her girlfriends, all from the University of Utah Meteorology Department. Being a bit concerned with how well the iButtons would perform in field deployments, several field trial and error tests were performed. We were able to determine the iButtons are a satisfactory unit, and we were able to overcome issues with creep as well as minimizing absorption of solar radiation down to an acceptable level. Inadvertently, during initial



As the tools shrink in size, near-surface measurements can become more precise over distance and time.

testing in early December 2009, we recorded strong gradients leading to a near-surface facet layer which later produced numerous avalanche cycles involving fatalities. We have had further success in recording steep gradients that have produced deadly layers of near-surface facets.

The current preferred method of deploying iButtons for monitoring near-surface faceting:

1. Configure iButtons using a computer via USB interface.
2. Wrap iButtons in reflective tape (such as solas tape) spaced 2cm apart, measured from the middle of the iButtons. String or dental floss

can be used as a lanyard coming out of the tape.

3. Insert iButtons into snowpack so the upper sensor is just below the surface. The second button will then be 2cm below the upper. Use an old probe or stick to mark the buttons so they don't get lost.
4. Allow them to record temperatures, then retrieve them and download the data.

At right is an example of results from a period in early December 2011 which produced a significant layer of deadly near surface facets.

There are a few things to note in the results. Colder overnight temperatures

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decision·making



Strategies for Dialing Back Risk

Story by Mike Buotte

This avalanche in The Wave was released with explosives on routine mitigation work the morning of February 24. The area had been subjected to moderate to heavy wind loading over the previous five days, along with 1.3" SWE new snow over the previous three days. The Wave was blasted thoroughly for the previous five days with no result beyond small new snow slides. We opted to dial back this terrain due to presence of basal depth hoar and cumulative loading. The Wave had been open for weeks and was skiing nicely, but it seemed to be reaching a potential breaking point. Any grumbling about our conservatism was mitigated by this result. HS-AE (simo. shots at 4 lbs each)-R3-D3. Crown 3-4'. Crown profile showed CT16, Q1/CT24, Q1. Initial failure may have been in upper pack but stepped down quickly.
Photo by Bart Mitchell

A previous edition of TAR requested that we think about and submit ideas for dialing back risk, both personal and professional. This piece focuses on some operational strategies that we use (lately) at Big Sky Resort to try and stay on the safe side. When the risk is a post-control slide, in the ski area context, the past five years have shown that we indeed do need to consider dialing things back a bit. In-bounds fatalities and close calls with post-control releases, including at Big Sky, have given me and our program pause.

At Big Sky our problems tend to be forecasting for persistent deep-slab instabilities and deciding when to close previously open terrain during periods of increasing loading and increasing avalanche hazard. I believe it is prudent to allow a few days of conservative openings around significant early season loading events, for a few reasons. An obvious one is giving the snowpack time to adjust to the load, although I wonder how much this actually helps in our cold, thin-snow environment. Another reason for keeping slopes closed after a round of explosives work is to allow subtle changes in loading to manifest themselves. There have been instances where we will shoot a path aggressively during periods of loading, thinking that the slope should fail deep slab, but it doesn't. Then, either some subtle change in snow distribution tips the balance, or we get the right shot placement for the big result. Either way, giving ourselves and the mountain some extra time can be of help. Generally, I feel a lot better as a forecaster if a slope was closed the day before a big avalanche.

The most important strategy for dialing back risk is to plan ahead and start the decision-making process early. When a storm shows up on the virtual horizon of the weather models and satellite loops, we plan for it, specifically. For ski area forecasters, a central question is, "Are we in a situation where we can trust the explosives to tell us what we need to know?" Is the snowpack so close to the tipping point that one slightly missed shot placement at 8:30am might mean a probe line at noon?

Another important question to answer before we go out is how a major result on one part of the mountain will affect our decisions on other parts of the mountain. It is better to consider these types of questions in the hypothetical instead of in the moment; say, while looking at a lift line full of eager skiers.

The structure of the decision-making process is important. By whom and how decisions are made needs to be clear, both to the "deciders" and to the crew in general. I see the lead forecaster role as mainly one of organization and planning, and secondarily as the "decider" if consensus cannot be achieved. It is the lead forecaster's job to assure that relevant questions are being asked of the snow and of staff; that information is gathered, heard, and processed; and that decisions are being made.

This structure is important for the well-being of the forecaster(s) as well. Decisions based on the appropriate

people getting together to make specific plans on openings diffuses the stress. It is easier to dial back risk when the decision is based on group input and made in a structured environment, rather than on the side of the hill, by one person with freezing feet and a whole lot of pressure.

This necessitates setting aside time to gather the appropriate people and talk through the decisions that need to be made: late afternoon, with a good forecast, seems to work well. If the following morning's plan can be achieved then, forecasters and supervisors can punch out, both literally and figuratively, and get some rest. (This does not imply that one stops thinking about the snow; that never really stops, does it?)

Experience has shown me that it is easy for a ski patrol to fall into a pattern of decision avoidance; there can be a lot of, "Well, let's see what it does out there and decide later." Sometimes this is the only logical thing to do, but I have observed a propensity to "wait and see" that looks suspiciously like decision avoidance.

If there is a big loading event in progress, and the decision has been made to keep some areas closed even if there is not a major avalanche occurrence, it is better for the patrol to know that before going out to work. It may affect their decisions on route, as well as minimize a feeling of wasted effort when they hear that the area they just worked so hard to mitigate will be kept closed. If there was an articulated plan going into the morning, the control teams may feel that they are part of the execution of the plan rather than a subject of the arbitrary decisions of a forecaster.

I feel that we all affect each other's tolerance of risk across the entire industry. It was very comforting to me as a professional when I heard that Jackson Hole shut down much of their hill a few years ago when it was obvious that the storm was too much. Bridger Bowl did the same this past season when their snowpack became highly unstable in the spring, and they put out media releases at 7:15am saying that the upper mountain would be closed until stability improved. These types of prudent decisions give all of us license to dial things back when we need to.

All this is said with the giant caveat that one must also remain flexible and willing to adapt to unplanned scenarios. Maybe the storm missed us. Maybe the wind did not blow. Maybe there was a surprise avalanche that went into deeper layers than forecast. Any of these possibilities, and many others, necessitate calling an audible – which will be less chaotic with some context (the original plan) for the adaptations. As well, there are plenty of days when it is not real complicated: get out the door, do the routes (well), and get the hill open...now.

Mike Buotte is the lead forecaster for Big Sky ski patrol. He grew up in Maine, where he began his ski industry career at the age of 16, in a ski school jacket, stretch pants, and a mullet. Buotte now lives and works in Big Sky with his wife Polly and kids Hazel and Linden. Their presence helps him manage risk in the mountains. He has been affiliated with the Big Sky pro patrol for 17 years. ❄️



12/5-12/6/11 TIME	SENSOR TEMPERATURES		Gradient (C per Meter)
	just below snow surface	2cm below snow surface	
6:00:01 PM	-17.746	-15.425	116
7:00:01 PM	-19.515	-16.948	128
8:00:01 PM	-20.211	-17.583	131
9:00:01 PM	-20.464	-17.964	125
10:00:01 PM	-19.768	-17.71	103
11:00:01 PM	-19.642	-17.519	106
12:00:01 AM	-19.389	-17.392	100
1:00:01 AM	-19.262	-17.329	97
2:00:01 AM	-16.924	-16.059	43
3:00:01 AM	-15.345	-14.473	44
4:00:01 AM	-15.093	-13.839	63
5:00:01 AM	-15.661	-14.473	59
6:00:01 AM	-17.114	-15.234	94
7:00:01 AM	-18.125	-16.059	103
8:00:01 AM	-17.683	-16.059	81
9:00:01 AM	-17.43	-15.869	78
10:00:01 AM	-14.525	-13.966	28
11:00:01 AM	-12.568	-12.127	22
12:00:01 PM	-11.495	-11.05	22
1:00:01 PM	-11.306	-10.797	25
2:00:01 PM	-10.801	-10.29	26
3:00:01 PM	-11.369	-10.48	44
4:00:01 PM	-12.883	-11.494	69
5:00:01 PM	-14.84	-13.015	91
6:00:01 PM	-15.345	-13.649	85

produce steeper gradients. However, notice the period from the 2am to 6am on the 6th where the temperatures warm during the night. This was caused by a period of clouds that rolled through, evident by viewing a satellite loop. Capturing this type of dataset is exactly what we hoped to accomplish with this project.

The iButtons are not the most precise scientific instrument due to their manufacturer claimed accuracy of +0.5C and their relatively large physical size. However, our calibration tests in the University of Utah cold lab resulted in an accuracy +0.2C, better than we anticipated, and thought to be adequate for showing general trends. With their large size, they are apt to absorb solar radiation from the sun so caution should be taken where to deploy them. We've found that more northerly facing slopes of at least 15 degrees in steepness produce more accurate results.

As for practical applications of the iButtons, they are a useful tool for the forecaster for gaining a more in-depth understanding of diurnal near-surface faceting trends in his/her region. Furthermore, they can be useful for anything you're concerned about involving temperature, springtime snowpack warming trends, depth hoar gradients, air temperatures at remote weather stations, etc. We've also found they could potentially serve as a valuable tool in teaching/learning about snow metamorphism. In fact, avalanche educators have expressed interest in incorporating them into their more advanced avalanche courses.

As for us, any time we're anticipating a cold dry spell, it's guaranteed that we'll be deploying iButtons throughout the mountains, getting a better understanding of what's going on under the snow.

For more information about the iButtons and how to use them, contact Brett or Wendy via email: brett@utahavalanchecenter.org, wendy@chugachavalanche.org ❄️

crowns profiles

A DIFFERENT TYPE OF LAYERING: Volcanic Ash in a Patagonia Snowpack

Story by Erik Sweet and SnowProject
 Photos by the author and Chapelco ski patrol

On June 4, 2011, just two weeks from the official opening date for the local ski resorts, an active volcano in the Cordón Caulle, just west of the Argentine/Chilean border in northern Patagonia, erupted with amazing vehemence.



Volcanic eruptions produced distinctive ash layers (see below), that surprisingly enough were not reactive.



Locals in the path of the onslaught,

in the mountain ski town of Villa la Angostura, sat in their homes in the early evening darkness listening to volcanic rock pelting the rooftops of their homes. The following morning some found 20cm disks of pumice-like stone that had fallen from the sky as molten volcanic rock spread into plate-like shapes as it impacted the ground. Over the next few weeks, over 30cm of grey ash would fall on the picturesque mountain town, bringing their winter season to a screeching halt before it even began.

In neighboring San Carlos de Bariloche, 60km to the south, the ski resort Catedral was spared any major fallout, but it became impossible for the hundreds of scheduled flights that would bring skiers throughout the winter to land. In San Martín de los Andes, 80km to the north of the volcano, we awoke to what seemed like snowfall – except it was grey, and it wasn't snow. Everyone's commercial ski season had just turned to crap.

The snow came a month late last year. Maybe it had something to do with the volcano, but personally I don't think so. Just before heading down to Tierra del Fuego in the middle of June to give a couple of avalanche courses in Ushuaia, we only had about 25cm of snow on the ground at 1600 masl. With my partner, Julian, we decided we should check out the snow/ash situation before leaving town for two weeks.

Upon our return, we found an undercurrent of hysteria around town. Everyone was saying the

“A word,” and suddenly they were all experts on slab avalanches and the cohesion of snow and volcanic ash. This was a situation no one had lived through before, and faced with the unknown, fear predominated.

As the “local experts,” we were asked by the town's tourism office if we could inform the general public as to the situation regarding the danger of an avalanche due to the ash layers in the snowpack. So

armed with our snow-study stuff, some sandwiches, and a video camera, we went up the mountain to check out what was going on.

By that time we had a 130cm snowpack with half a dozen layers of ash (some up to 10cm thick due to wind transport) alternating with layers of snow. Imagine how interesting THAT was! We were like pigs in a cornfield!

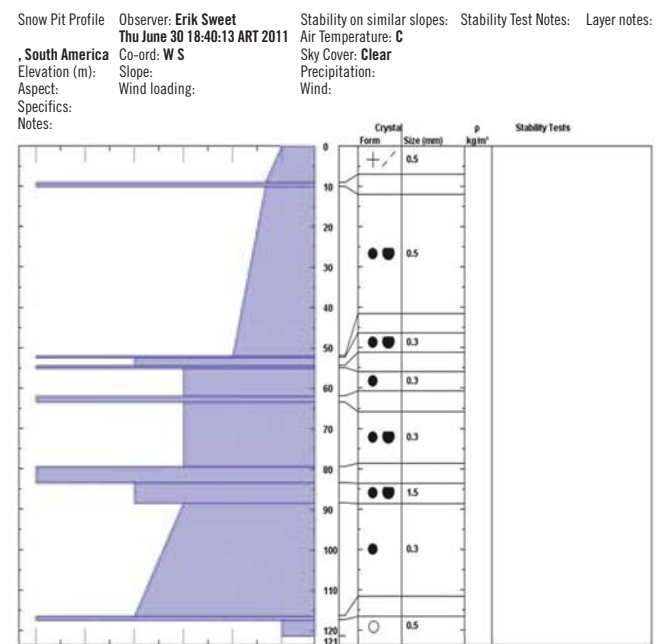
Eventually we ended up monitoring the snowpack throughout the entire winter without any signs of instability directly related to the ash layers, but throughout the season we did see some pretty interesting and unique stuff.

But going back to that “pre-season report.” We dug down to the ground, finding those original layers from the 25cm mid-June snowpack. On top of that lay what looked like an angel food cake with layers of frosting in-between. We performed several CTs and ECTs, snapping photos of the pits and columns, only because it was so cool, not because we had obtained any results worthy of note (although in this case, NO results were exactly what was noteworthy).

Since we knew that this information was going to be made public, we decided that the most graphic example we could provide would be a test where a skier was involved, so we begrudgingly dug a rutschblock on a very short 38° slope, filming the results. Even after RB7 we kept hammering at the snowpack and finally got a layer to slide, but it was not a layer in contact with the ash. To tell the truth, the only instability we found during the entire winter due exclusively to the ash was at a disperse, almost invisible layer, something akin to the dust storm layers



A snowpit converted into SnowPilot gives another set of evidence that although distinctive and abrasive, the ash layers were well-bonded to the rest of the pack.



we can get in Colorado when the wind blows in from the desert.

We discovered that volcanic ash is VERY abrasive. Though seemingly soft to the touch, looking at it through our 25x snow loupes, it is very jagged and sharp looking. Volcanic ash can differ depending on its mineral composition, and in this case the ash was mostly silica, the same mineral glass is made of. Eventually it would wreak havoc on the bases of our skis and the windows of our cars (as the ash would tend to accumulate in the little space where the windows roll down into the doors).

What we were surprised to find, however, is that the snow bonded well to the frozen layers of ash. An early season video of a rudimentary column test from Cerro Bayo ski resort in Villa la Angostura (www.youtube.com/watch?v=NZIWHHusnq0) revealed some possible concern with shear within the thickest layers of ash. But we found that once the ash froze solid, the bonding above and below the layer seemed good – an assessment that withstood the test of time as winter unfolded.

Our curiosity led us to take home some samples of the frozen ash layers, to see what would happen when it melted. The first thing I discovered was that it made a mess in the pocket of my pack as it lay on my dining room floor. The other interesting thing I found was that when I shook the plate that held the thawed ash, the sample turned into a glob with the consistency of heavy whipping cream that just oozed into a shapeless mass.

I instantly thought, “Springtime, we’re screwed.”

Once the water evaporated from my sample, I was left with a plate of ultra fine sand, like pumice stone used for polishing.

Eventually it began to snow, and it turned out to be an “okay” snow season at Chapelco ski resort in San Martín de los Andes. The ash continued to fall and, depending on which way the wind blew, it screwed up some of our ski days. Especially if we had ash fall right after a dump! As the season wound down and spring conditions prevailed, the ash layers began to settle, one by one, to the ground with nary a slide to be seen. And so ended our first (and hopefully only) experience with volcanic ash in a winter snowpack.



Erik Sweet is a long-time AAA pro member who splits his time between Aspen, Colorado, and Chapelco ski area in SW Argentina, where he works as an avalanche educator. ❄️

On in the Car, Off in the Bar

Anyone have an opinion about carrying your beacon in its harness or in your pocket?



Hard Fall Makes Case for Harness: Pants Shredded, Phone Crushed

I know this didn't meet your July 1 deadline, but it is summer, and it's taken me quite a while to actually get through the entire TAR...and the question was the last line on the last page. The attached picture shows the damage from a fall after landing on my side. My cell phone was in my pocket next to my thigh, and yes my pants were shredded at the point of impact. The phone was completely destroyed and you can see the bodily damage. Had this been a transceiver, I'm sure it would have suffered the same fate. Note: the fall was not caused by an avalanche, just inattention to my line.

—Joe Puchek,
La Grave, France, winter 2012

Harness Protects Beacon

I like it in my harness; it is more protected and closer to my airway. Batteries may stay warmer when buried? Plus it is not banging around my leg.

—Philip Edmonds,
Grand Targhee snow safety

Pocket = Dead Batteries

What I find is folks who don't use the beacon harness forget to turn off their beacon at the end of the day. These folks are the ones who show up to ski/board/take a course with dead batteries. :-)

—Halsted Morris, avalanche educator,
Hacksaw Publishing owner, and awards
committee chair on the AAA board

Avoid Rip Offs with Harness

I always use the beacon harness. It's under at least two layers of clothing. No chance of getting ripped off, falling out of a pocket, or forgetting to turn it off at the end of the day, so no dead batteries.

—Susan Sweetra, via Facebook

Pocket Better for Variable Weather

In the pocket, tethered to a loop on my pants, pocket sealed with a small clip. I live in Alaska; temperature changes can be huge where I am shedding/adding layers throughout the day. I see more people with transceivers in a harness on the outside as they shed layers. Begging to get ripped off? I don't know.

Jaime Andersen, Anchorage, AK

Harness Provides Routine

I prefer the harness because it becomes part of my routine in the AM and at the end of the day. In a pocket would be too random for me to remember it every day. The time to get it out and go to search mode is not long, but may seem like it. Efficiency with whatever you do is key.

—Pat Hinz, via Facebook

Harness Keeps Beacon on the Body

While it's certainly becoming more popular (likely for no reason other than it's easy/easier) to carry beacons in a pocket, and the move toward the “Euro-style” harnesses show we also want that as an option; we teach our new patrollers to always use the harness and locate your beacon on your body away from radio/cell/electronics. The easy rationale we use when explaining this policy is a story about a patroller in the early years of our resort who was caught in a slide that was violent enough to rip his jacket off.

—Liam Bailey, Kirkwood pro patrol

Response from a Rep

A couple different things play into this decision. Going directly from the mechanical standpoint, a beacon should always be worn in a harness as close to the body as possible. This does two things. First, it will keep the device at an ideal working temperature for battery life and general electronics. Second, this is a life-saving device – you want to protect it as much as it will protect you. A broken beacon cannot save lives, yours or your partner's. So in it's padded harness under your outermost layers will add additional padding.

Another advancement in technology can play into this decision as well. The Pieps iProbe gives you a series of tones depending on how close the probe tip is to a buried beacon. Further than 2m it gives off a tone every three seconds. At 2m it will give a tone every second letting you know that you are close. At 50cm it goes to a solid tone so you know you are within 50cm of the beacon. This 50cm is huge because with a beacon worn on the chest (as designed), 50cm will hit at your average waist and top of the head. In other words, you'll never dig out a foot first because your probe only hit the victim's big toe. You'll always dig out the upper body. In a pocket you may not get the same results.

The other side of this argument – your pocket: it seems easier to access. It may be more comfortable. No extra harness to mess with. Maybe the harness is not comfortable when worn with a pack.

The flip side: Keeping it in a pocket, you take the chance of that outer layer of clothing being torn, possibly losing the device. An avalanche is a horrifyingly brutal and tremendously violent experience. Torn layers are very common in larger slides especially when trees and other debris are involved.

The device will be cold, yes people can argue this (insulated pants). A cold beacon will have lowered battery life.

The device can be damaged. I have a beacon sitting on my desk right now that was broken and still working. The outer casing was completely shattered on one side. It was hit by a probe when in a jacket pocket. Not to say this will always happen, but it can.

These are just my opinions, so take them as just that. But my personal stance is that I used to ski with my beacon in my pants pocket. After taking this job and learning all that I have learned, I will be keeping it in a case on my chest under at least one layer!

—Ryan Guess, US Pieps specialist

In the story, *Close Call on Petes North*, in TAR 30-4, one of the people involved in the avalanche brought up this question about beacons, and we asked our readers for their opinions. Over the summer TAR received the following replies via email and Facebook.

No Right or Wrong: Choose a System

First of all a small disclaimer: I know Cody quite well and have even discussed this issue with him prior to the incident. He brings up some valid points that warrant discussion, but I think ultimately it comes down to personal preference and having a system that is the same every time you venture into avalanche country.

I choose to wear my beacon in the thigh pocket of my pants for a number of reasons. The first is access: every second counts in a partner rescue scenario and having to unzip multiple layers and deal with whatever harness system your beacon uses just to get it into search mode seems a waste of those precious seconds. From personal experience I proceeded to tear my zipper pull off my jacket, then had to wrestle and dig under my clothes to get to my beacon, ultimately having to cut a strap to extract it from my base layer where it comfortably rested as more than one mentor had taught me.

Additionally I am far less likely to blow off a beacon check on a cold day, because I don't have to unzip anything to get there.

What about security and protection? I secure my beacon with 3mm cord to my belt – it's staying with me unless I lose my pants. If an avalanche tears my pants off, I think I will be beyond the help a beacon would provide.

I have toured and worked with a number of people who have removed their beacon at lunch, while changing layers or answering the call of nature, and have forgotten to put it back on. I don't recall myself or a partner ever forgetting to put our pants back on before proceeding.

And what about impact damage? I truly believe if you strike an object hard enough to damage your beacon, it won't matter where it is on your body, you will suffer some level of traumatic injury. I don't think my fleece or puffy jackets really provide any more protection than my Gore-tex pants do.

As far as getting to the airway quickly, for argument's sake, let's say the lowest reading you get on your beacon is 1.5 meters in a real life search. Depending on orientation of the buried unit you could be directly above it that distance or directly horizontal or any combination of the above. This is why pinpoint probing is so important. Probing is faster than shoveling – probe as many times as necessary, but dig just once. In my experience beacon location on the victim's body has never really been a factor in the time to access the airway; the real challenge is figuring out which part of the body you have first uncovered and which direction the head is from there.

I don't think there is a right or wrong answer, but I do believe the system you choose, and maintaining consistency with it, is extremely important. The less you have to think and the more you can act, the faster you will be. Remember no matter where you wear it, “On in the car, off in the bar.”

—Jake Hutchinson,
American Avalanche Institute ❄️

2011/12 Avalanche Center Season Summaries



This huge wet slide at Bridger Bowl on March 27, 2012, took out Bridger Gully wall-to-wall when one shot stepped down and went further than Bridger snow safety has ever seen. With 1.5" of SWE plus two non-freezing nights, it didn't take much of a trigger. For more on this avalanche, see page 28.

Photo by Doug Chabot

■ Forest Service National Avalanche Center

This transitional year for the National Avalanche Center (NAC) was marked by the retirement of Doug Abromeit. Doug founded the NAC and served as its director since its inception back in 1989. He oversaw the transition of the NAC to a truly national operation in 2000 (with a doubling of NAC staff – to a total of two individuals!) and also assisted in the establishment of many of the avalanche center programs around the country. Though small in stature, Doug left some big shoes to fill! With his departure, Karl Birkeland was named the acting director, and he did his best to juggle two jobs. Luckily for Karl, Doug was able to help out part time with the military artillery program, providing much-needed expertise, mentoring, and institutional knowledge. This past June, Karl was selected as the new NAC director.

The NAC again congratulates the avalanche centers for another stellar season of saving lives. This season was particularly challenging for many of our operations. Alaska was the exception, where the season started strong, kept going, and finished strong. The rest of us were not so fortunate, with most areas of the country starting with a thin snowpack that created a layer of weak basal facets that plagued our snowpacks for the entire season, including right into full-depth spring avalanches. The avalanche center summaries and photos that follow tell the tale of the winter and the challenging conditions faced by many of the avalanche centers.

As of this writing the US avalanche toll recently rose to 34 after four fatalities on Denali in Alaska. Snowmobilers accounted for about 30% of the total, which has dropped from the 50% level we were seeing for several years. Last year just 16% of the US avalanche victims were snowmobilers. It's too early to make any firm conclusions, but we hope that some of this drop is due to an increased focus by our avalanche centers on educating and informing this user group. Most avalanche



Doug Abromeit shows off his retirement quiver of skis in Alaska a few years ago.

Photo by Karl Birkeland

centers have strong partnerships with local dealers, riders, and manufacturers. This past season all the avalanche centers partnered with the International Snowmobiler Manufacturers Association (ISMA) to increase and improve avalanche awareness through an ISMA grant, and this summer Mark Staples worked with the NAC and the ISMA to update an avalanche safety brochure for snowmobilers.

Sidecountry skiers and snowboarders continue to make up a sizable percentage of our avalanche fatalities, comprising 21% of the total for this past season. All of these accidents happened over the course of about a month, from mid-January to mid-February, and included several high-profile accidents, including one in Washington that killed three prominent ski industry folks. Many avalanche professionals continue to be amazed at the unstable conditions that sidecountry riders are willing to risk – and that they sometimes get away with it. The ski industry and the avalanche centers continue to work together closely to get the best possible avalanche information to sidecountry users, but ultimately the decision of whether or not to go will be up to the individual.

There are numerous projects afoot this summer, including establishing consistent avalanche warning criteria, updating Web sites, creating new trailhead signs, databasing information from the avalanche centers, and creating a national map of avalanche warnings from all the avalanche centers. Many of these have been cooperative projects between the NAC and the various avalanche centers, which have strengthened ties (and increased consistency) between the centers.

I hope you enjoy reading through the avalanche center highlights that follow as much as I do. It always amazes me how much work gets done with such limited resources. The avalanche center personnel, as well as all the avalanche professionals in our industry, deserve a huge congrats for their work to improve public safety. Thanks again also to Mark Staples for his work tracking down avalanche center folks and hounding them for their season summaries. I hope to see many of you in Anchorage at the ISSW, and here's to a great and safe 2012/13 season!

—Karl Birkeland

■ Crested Butte Avalanche Center

Frustrating. Challenging. Confusing. Educational. Dangerous. These are some words that come to mind when describing the 2011/12 winter in our corner of the Elk Mountains. A combination of long dry periods punctuated by modest storms, severe wind events, and unseasonably warm temperatures led to a complex, dangerous, and unpredictable snowpack. Snow totals were between 40-50% of the historical average for our forecast area. The town of Crested Butte reported 96.5" of snow from October through the end of March. This was the fourth driest winter on record in town since 1962. Crested Butte Mountain Resort and CS Irwin reported 145" and 271" during their respective operating seasons. It was an unmemorable winter with regards to snow quantity and quality, but the backcountry snowpack offered endless challenges, debates and head-scratching for the Crested Butte Avalanche Center's staff.

The 2011/12 winter was the Crested Butte Avalanche Center's eleventh operational year. The CBAC is a 501(c)(3) nonprofit organization registered with the Federal Government and the State of Colorado. Our local ski and ride community stands behind us and graciously donates their time, resources, and energy toward keeping us afloat. The CBAC also received several grants this year, most notably from the Jean Thomas Lambert Foundation and the Town of Crested Butte. The CBAC forecast team consists of local snow and avalanche professionals who work as ski guides, ski patrollers, and avalanche educators. A board of seven volunteers also helps with fundraising and events.

The CBAC officially opened November 19 and operated through April 8. We did put out two early season advisories in mid-November. In total we issued 143 daily avalanche bulletins. We had High danger a total of seven times on the danger rose, and we met Avalanche Warning criteria three times. However, Considerable danger was present on the danger rose a grand total of 45 days this season. To give a better idea of the mid-winter snowpack, we issued some form of Considerable danger every day from January 16 to February 3 and every day from February 9 to March 7 (with the exception of February 25). We did not forecast any High or Considerable danger for the entire month of December or after March 7.

A major forecasting challenge we dealt with this season was relaying the various definitions and quantifiers of Moderate, Considerable, and High danger to the public. A very tricky mid-winter snowpack with a daily persistent slab/deep-slab problem forced a strict interpretation of the danger scale. As forecasters, we read and re-read the 2010/2011 North American Danger Scale each morning. Although we became very intimate with the "Likelihood of Avalanches" and "Avalanche Size and Distribution" columns, conveying the subtleties of the danger scale to the public became one of the season's greatest challenges.

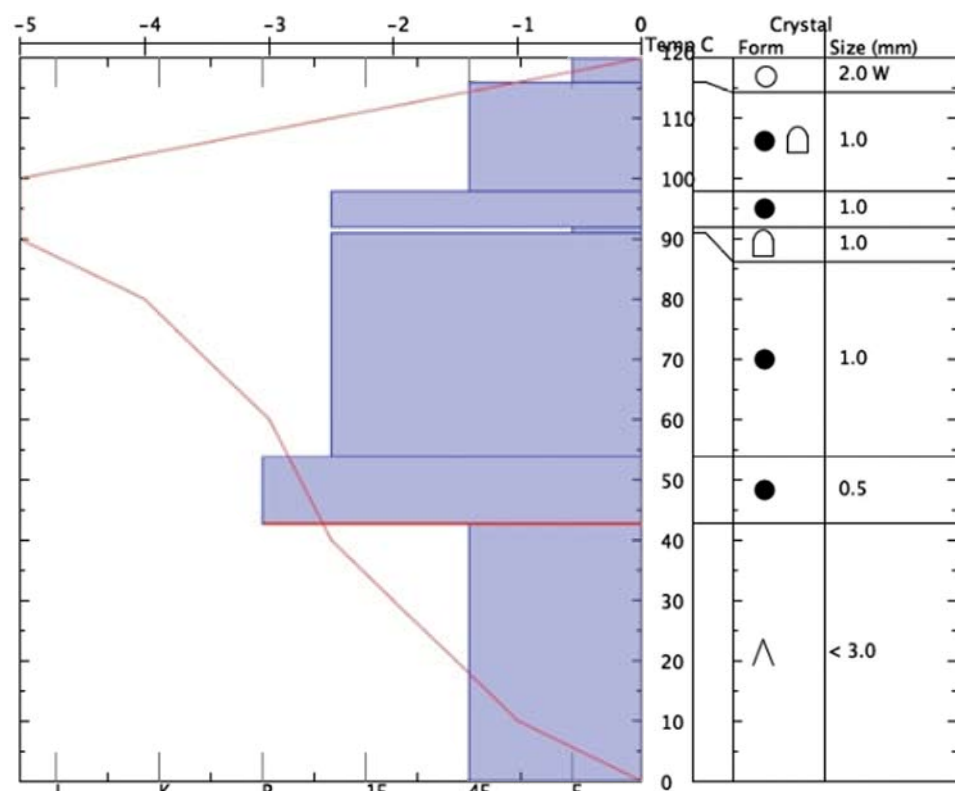
With so much Considerable danger present this season, we were often left attempting to answer the question, "What does today's Considerable danger mean?" in our snowpack discussions. Is it a "Scary Considerable" day, a "small in many or large in specific" day? Are "natural avalanches possible," or has the natural cycle stopped but triggers are still "likely" – as they were most of mid-January through early March.

Having Considerable danger on the rose almost every day mid-winter led to another issue: we would often have some form of Considerable danger before a storm, during a storm, and for days or weeks after a storm. This may have unintentionally diluted some of the specific hazards Considerable danger connotes. With Considerable danger present for 40 days in mid-winter, many of our users probably got fairly accustomed to riding regularly in Considerable danger.

A final crux this season was reporting on persistent slab/deep-slab instability; this avalanche concern was the main reason for a season chock-full of Considerable danger. And once the probability of triggering a persistent slab or deep slab



SS-N-R2-D2.5-I from 3/2/12 off the north side of Scarp Ridge. The end of February and the first couple days of March brought the final avalanche cycle to the Elk Mountains. The total accumulations for that week was 2.5" H2O and close to three feet of snow. We reached Avalanche Warning criteria 3/1-3/2. Photo by Tom Kelly



CBAC snowpit profile from Snodgrass Study Plot, east aspect at 10,200'. 3/12/12: Depth hoar continued to make up the bottom third of the snowpack through March despite mild daytime temperatures. This profile pretty much tells the snowpack structure story of the 2011/12 winter in the Crested Butte forecast area.

tapered off from "likely" to "possible," we were left with some very scary moderate danger.

A dry December left the mountain snowpack faceting from the bottom up and from the top down. A series of storms and mild temperatures in mid- to late January left a dense slab resting on a weak base. As storm systems stacked up through mid-February, the persistent slab problem became a deep-slab problem. It was hard not sounding like a broken record reporting on basal weak layers and the "lingering threat of deep slab avalanches" from February through the end of March. However, while riders did trigger deep-slab avalanches around the state last winter, we did not have a single deep-slab avalanche in the Crested Butte backcountry.

The lack of deep-slab avalanches here does leave us with some open-ended questions: How real was the threat of triggering a deep-slab avalanche in the Crested Butte backcountry? Did fewer riders commit to serious terrain? Do we need a better understanding of deep-slab instability? Or, did we just get lucky? Whichever way, we are VERY thankful to have finished up the 2011/12 season here with no serious injuries and no full burials in our forecast area.

This winter was a transitional year for the CBAC. Steve Banks stepped up into the executive director position and we hired Josh Hirshberg (formerly of the Roaring Fork Avalanche Center) to work as a forecaster. We also had several new additions to our Web site including a new media section with videos and a blog, as well as a snow-profile page where local professionals can post profiles. Monday Stability Meetings, open to the public and conducted by CBAC staff, were a new part of the CBAC schedule as well. These meetings proved extremely useful during a tricky snow year and served as a forum for local professional and recreational riders to swap observations. Our core staff is returning next year, and the forecast team is excited about working together again and dedicated to putting out a professional product.

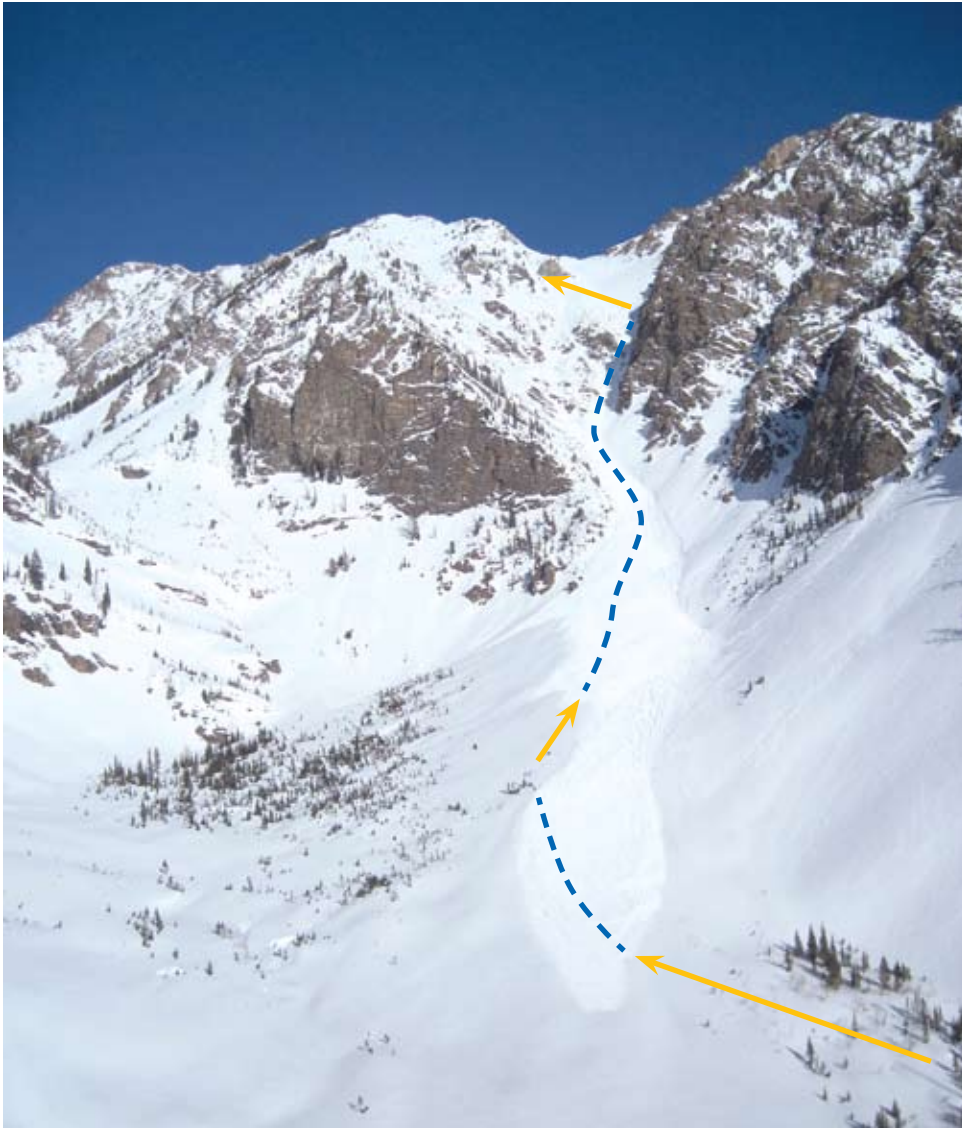
For more detailed information about the 2011/12 winter in Crested Butte, visit our Web site and check out our Annual Report and Seasonal Snowpack Summary.

—John MacKinnon, forecaster

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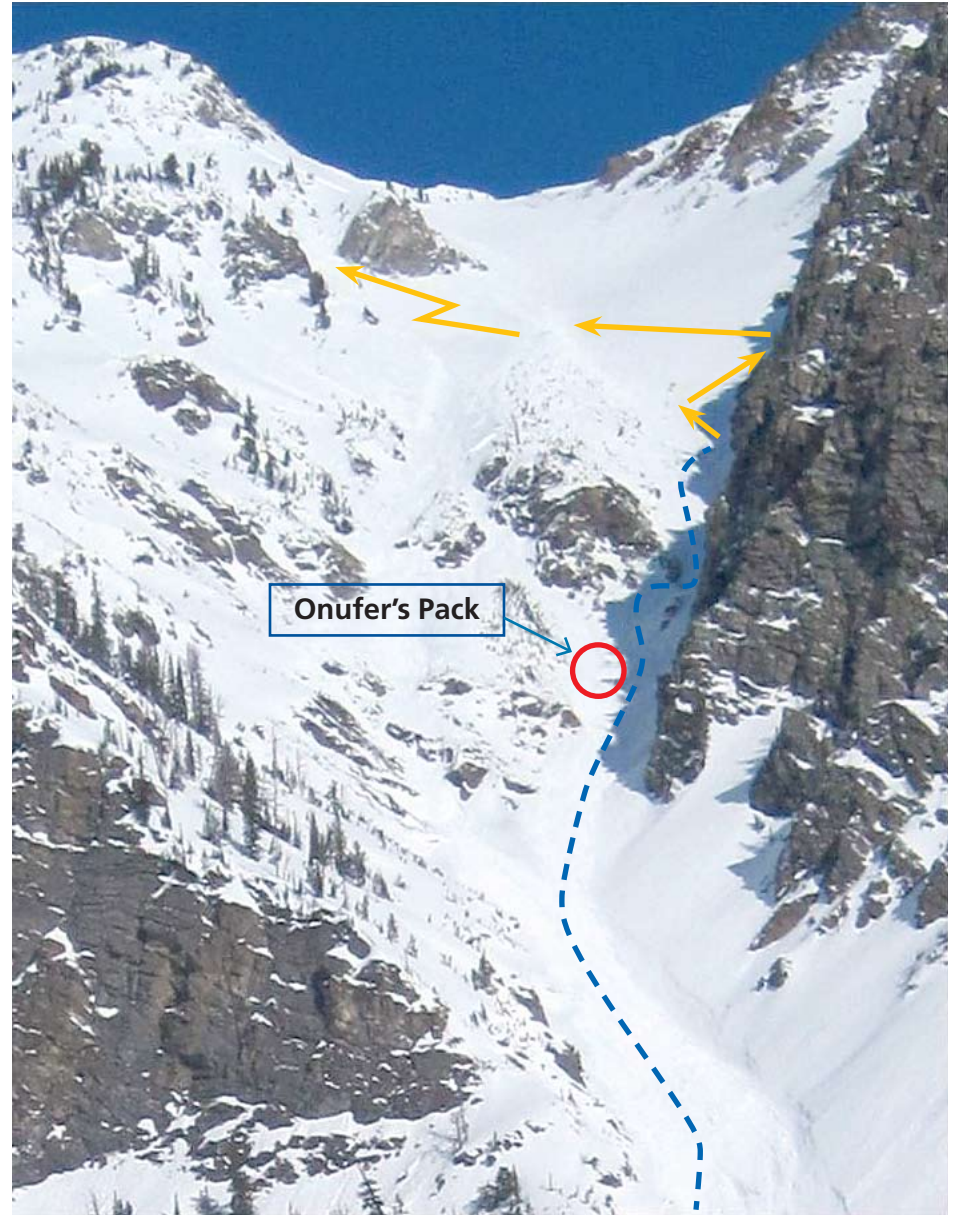
Sastrugi and "scree loading" from the New Year's Eve wind event. The wind storm brought 100+mph winds throughout the state. This created a layer of pencil- to knife-hard slabs and wind crusts in the Crested Butte backcountry. Localized blowing gravel was also reported from the Paradise Divide area. Photo by Jayson Simons-Jones



Ranger Peak, northern Tetons, March 7, 2012. In this large avalanche, two local and well-known ski mountaineers, Steve Romeo of TetonAT.com and Chris Onufer, were killed as they ascended this path. Their skin track is still visible after the avalanche where it traverses the path. The dashed blue line denotes the pair's route, while the gold line indicates the visible skin track.

In a tragic note, they were discovered missing when Chris's father flew into the Jackson airport but was never met by his son; he then alerted authorities who began the search and recovery operation.

Photos by Rich Baerwald



SEASON SUMMARIES 2011/12

continued from previous page

■ Bridger-Teton National Forest Avalanche Center

This winter season began with residual snow from the previous winter's prolific snowfall. It was characterized by a shallow early season snowpack, extended dry periods with interspersed storm cycles and a dry and mild spring.

The season began with some snow in October and November that was followed by a long dry period in December. December snow depths were shallow but remained deeper than most other areas in the Rockies. In late December a three-day storm cycle triggered widespread natural avalanche activity. Drought conditions returned during the first half of January. By January 18 our snow depths were near record lows. An eight-day storm cycle in late January once again triggered widespread avalanche activity on a shallow "continental" snowpack.

Dry conditions returned during the first eight days of February. Then it snowed some every day from February 9 to March 3. At the beginning of March our settled snow depths were at our 40-year average. The February storm cycle favored the western ranges in our forecast region. The new snow buried the persistent weak layers with enough strength to mitigate the deep-slab instability in these areas. In outlying areas that received significantly less snowfall the continental type instabilities persisted into early March.

Conditions transitioned from winter to spring in a matter of hours in early March. Although we experienced above-average precipitation at the higher elevations, sustained periods with temperatures above freezing and multiple rain events rapidly melted the snow at the lower elevations. April was warm and dry. Record high temperatures for the month were recorded in both March and April. Aside from some shallow, wet-loose avalanche activity associated with new snow events there was little avalanche activity in March or April.

End of the season snowfall totals exceeded 400" in the Teton Range, approached 300" in the Greys River forecast area and were as little as 200" on the east slope of the Continental Divide.

The Bridger-Teton Avalanche Center issued weekly snowpack summaries from the beginning of October until mid-May and issued evening regional avalanche hazard forecasts and morning area-specific nowcasts on a daily basis from November 11, 2011 to April 22, 2012.

Numerous close calls occurred during the December, January, and February storm cycles. Some involved well-trained individuals with many years of backcountry experience. There were four fatalities in Wyoming. Human factors played a role in these fatalities and many of the close calls.

The first fatality involved backcountry skiers and occurred just south of the Wyoming border near Cooke City, Montana, during the late December storm cycle (see TAR 30-3 for full write-up of this event). At the time of this incident, avalanche warnings issued by the Bridger-Teton and the Gallatin Avalanche Centers extended continuously to the terrain where this event occurred. The second fatality was in the Togwotee Pass area and involved a snowmobiler in a guided party and with over 20 years of experience in the area. The last incident occurred in the Teton Range and involved two well-known local ski mountaineers (see photos).



A total of 17 incidents involving humans who were caught in avalanches were reported to the center. Aside from the four fatalities there were four injuries. In two of these instances there were full burials, one with injuries and one without injuries. There were also two partial burials without injuries.

The center engaged in several exciting new projects and made some powerful improvements to our Web site during the 2011/12 season. A Recreational Trails Program Grant obtained in partnership with the Wyoming State Trails Program funded the purchase and installation of a new automated weather station that was placed on Commissary Ridge on the south end of the Salt River Range. This station became operational in December and exceeded our expectations in filling a data gap regarding snowfall in a portion of our Grey's River Forecast Area that is heavily used by the snowmobile community.

Funding provided by Outdoor Research obtained in partnership with Outerlocal.com enabled the center to purchase and install "Are You Beeping?" transceiver checking stations at 14 backcountry access points throughout the forecast areas. Other partners in this project were Grand Targhee Resort, Jackson Hole Mountain Resort, Caribou-Targhee National Forest, Bridger-Teton National Forest, Grand Teton National Park, and Backcountry Access. Thanks to Craig Gordon from the Utah Avalanche Center for his help with this project.

The center experienced over 1.35 million contacts during the 2011/12 season. Web site visits were up 34%, and page views were up 65%. About 20% of the visits were new users, and 80% of the site visits were from repeat users. Visits to all of our advisories were up substantially. There were increases by users in the number of pages visited and the duration of time spent on the site during visits.

The Web site has become a year-round resource that users visit multiple times per day to get the latest information on changing conditions. The most visited site features, aside from our daily avalanche advisories, are the various data displays from our network of automated weather stations, links to weather forecast products, weekly snowpack summaries, a new field observation section, a new snowpit profile section, and our Google map display of avalanche events. Other areas of our site that received frequent visits are the historical data section and the fatality section. Our Google map display of avalanche events was upgraded during the previous summer to include layers which display the location and provide links to our historic database of avalanche fatalities (1912 to present), snowpit profiles, and data from our automated weather stations. This season's large increase in page views occurred as a result of these site improvements. As a result of these improvements we experienced a decrease in calls to our telephone hotline.

—Bob Comey, director



"My Mercedes is underneath, but fortunately my other car gets better gas mileage in this costly fuel climate." Slide ran 2/3 mile, dropped 2000', snaking down the confines of a narrow, steep-walled gully in the Hurricane Creek drainage. At the road it was 25' high covering 125' of road surface. N-HS-R1-D3. Photo by Keith Stebbings

■ Wallowa Avalanche Center

My late December 2011 bulletin discussed the thin snowpack start to the season, not unusual in the Wallowas, with the basal facet factory in full production. We had 20" on the ground in the high country. Nearly all that snow fell in October and November. Please Santa, bring us a White Christmas. He delivered beginning December 29. By the end of January our average depth was 59", and we were on our way to what turned out to be only a slightly below-average season of snowfall. We had our share of deeper slab releases on that depth hoar layer, but warm temps and quickly increasing snow depths began arresting activity on that sensitive layer.

With a grant from the Wildhorse Foundation in Pendleton, Oregon, we got busy in summer 2011 developing our own flashy new avalanche awareness program. With help from the Utah Avalanche Center and a local avalanche educator we wowed our audiences. We gave nine free presentations and reached 235 participants. Track A specifically addressed backcountry law enforcement, USFS personnel, and Search and Rescue units. Track B catered to the general public, children, and university students. We built a model avalanche board, including scale terrain features, trees, people, and complete with a loading of flour and sugar that was a big hit during our presentation intermission.

As part of an overall strategic initiative to increase our footprint through more of the Forest economic area, we developed a new relationship with Eastern Oregon University. Through a combined effort with the university, the region saw two additional awareness programs and a Level 1 class.

In other efforts to reach more people, we doubled our mountaintop weather station installations by adding a second station at Anthony Lakes ski area, the largest alpine hill in the region with a permitted backcountry cat-skiing operation. Sidecountry use has increased significantly in recent years, and the nonprofit ski area supports our efforts by providing facilities for the weather station and financial support to cover the operation of the station.

In the Wallowa Mountains we facilitated the siting of a new ham radio repeater as a backcountry safety tool, filling a communications void and generating infrastructure for a future third weather station at a strategic location near a popular SnoPark launch point.

We issued 21 weekly bulletins beginning in late November and ending in mid-April. The bulletins include a snowpack analysis, stability problem summary, and weather discussion. For a third year the National Weather Service in Pendleton developed specialized products at our request. Our continuing partnership with the Forest Service provided office and meeting facilities. Fundraising efforts provided for our general operations through a mix of private donations, corporate sponsorships, and raffle proceeds. We concluded the season soliciting feedback from our users in return for entry into a drawing for a BCA-donated snow study kit.

Web site traffic was up over 40% for the season, despite a somewhat slow start. Our Web site saw some new features this season, including a front page map and separate regional pages, making links to weather and backcountry information easily accessible. User input to the site was up considerably as well, with backcountry condition reports submitted from throughout the region.

We look forward to another season bringing the avalanche safety message to the northeast corner of Oregon and a solid administrative agreement with a governmental agency.

—Keith Stebbings, director



In the biggest avalanche cycle of the season in the Boulder Range, in the Sawtooth forecast area, this path on Galena Peak ran a mile and a half long. Photo courtesy SNFAC

■ Sawtooth National Forest Avalanche Center

The 2011/12 winter in central Idaho was memorable for dramatic storms and uncommon loading patterns. We saw two-week to four-week droughts capped by extended wet storm cycles rather than our typical incremental loading. This pattern led to several cycles of widespread and sometimes destructive natural avalanches interspersed with periods of good stability and great skiing and riding conditions. Our northern and western zones ended the season with near-normal snowpack, but our southern and eastern zones remained well below average through the winter. Indeed, it seemed that Galena Summit marked the line between the above-average snowfall of the Pacific Northwest and the dismally dry conditions of regions further south.

After a Thanksgiving storm, backcountry recreation started with high hopes of a big La Niña winter, but four weeks of astonishingly dry weather left us with 48% of average snowpack at Christmas. A well-advertised change to a zonal flow had us expecting a storm but not the forecasted precipitation totals – 3.5" of SWE. In one storm? Hah! We got that, and then some, over the holiday week, along with a widespread cycle of natural and remotely triggered avalanches running on facets formed during the December dry spell.

The pattern repeated – two weeks of drought, another well-advertised pattern change to zonal flow, an extended storm with surprising snowfall totals, and a widespread avalanche cycle. The instability tapered off, and by mid-February cold temperatures and a lack of wind had produced beautiful skiing and riding conditions even at upper elevations. They also left a fine-grained layer of facets at the snow surface.

Snowfall started again on February 17, with 50cm or so of light-density snow accumulating in each of the next two weeks. It's not clear whether it was some characteristic of the facets buried that day or the incremental loading, but this layer proved the most troublesome of the season. It was variably distributed and produced inconsistent results in stability tests and few natural avalanches, yet several parties had close calls with unintentionally triggered slides. By mid-March, it seemed as if the 2/17 weak layer had strengthened enough to pose only an isolated danger.

The largest storm cycle in years proved that assumption untrue. Between March 12-18, weather stations in our advisory area recorded an average of 4.7" of SWE and/or rain, with several in the southern Sawtooths recording over 6" and those in the central Wood River Valley gaining 25-50% of their seasonal snowfall. The rapid loading led to avalanche warnings and a destructive avalanche cycle; many slides ran to valley bottoms, and two on Galena Peak ran over a mile and half. Most of these avalanches failed on the month-old 2/17 weak layer. Heating and sun triggered several more natural slides on this layer a few days later.

The last storm of the forecasting season blew in March 28 and ended March 31 with more than 2" of SWE at most sites but rain to over 9500'. Despite the load and the rain, this storm did not produce widespread avalanches. A freeze-thaw cycle dominated the last few weeks of the season, and we issued our final advisories with low avalanche danger and generally stable conditions.

Although persistent weak layers formed during the dry spells between the season's storms, they were buried and loaded more abruptly than is usual in our area and did not seem to result in the elevated instability or lingering danger that we typically experience. We had fewer avalanche incidents this season, perhaps because the storms limited travel or made for obvious danger. One party of snowmobilers was nearly caught several times by slides during the New Year's Eve storm, but the 2/17 weak layer was present for most unintentionally triggered slides, including the season's only reported incident with partial burials. Fortunately, no one was hurt in any of the incidents, and we ended our second consecutive accident-free season with a sigh of relief.

SNFAC notable season highlights:

- We issued 119 Daily Advisories between December 27 and April 15, 19 fewer than last season due to the winter's late start.
- Our advisories averaged 1095 views each – a 15% jump over last season – for a total of over 130,000 views via the Web, email subscription, and recorded hotline. We also issued 76 morning avalanche condition summaries at 7:45am on KECH radio, which reached thousands of people during their morning commute.
- We expanded our education programs, teaching classes to new audiences like the Blaine County Road & Bridge Department and the National

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SEASON SUMMARIES 2011/12

continued from previous page

Brotherhood of Skiers, and developed a new sidecountry program. All told we taught nearly 600 skiers, snowboarders, snowmachiners, and snow professionals – kids and adults alike!

- Public outreach through the local newspaper, radio, and social media continues to be very successful. Our “Likes” on Facebook increased from 960 to 1150, and we have 99 followers on Twitter.
- Thanks to a Resource Advisory Committee grant, we installed an automated weather station in the Soldier Mountains that provides invaluable snowfall data for that forecast zone.
- We made significant improvements to our Web site backend that are invisible to the public but help ensure advisories are issued on time.
- The Friends of the SNFAC added new board members and had several successful fundraisers. The “Skin It 2 Win It” uphill-downhill race on Dollar Mountain was a huge hit and promises to be even more popular next winter. They continue to pursue their own 501(c)(3) status, independent of the current American Avalanche Association umbrella.



Past, present, and future members of the Sawtooth forecasting team (l-r): previous director Janet Kellam, newest director Simon Trautman with daughter Cora, current forecaster Blase Reardon, and most recent ex-officio director Chris Lundy.
Photo by alpinfoto.com

We had a fully returning staff: Chris Lundy as director, Blase Reardon for his fourth winter, and Simon Trautman for his sophomore season. Between these three snow nerds, there are more master’s degrees and years of avalanche experience than is healthy. However, Chris stepped down at the end of the season – his eighth at SNFAC – to pursue other goals closer to his home in Stanley. He’s made remarkable contributions over that time, and we’ll miss his extraordinary work ethic, programming skills, and analytical talents. Thanks, Chris! You’re not off the hook for obs or ski days, though!

—Blase Reardon, forecaster



The new head of the SNFAC demonstrates the gravitas required for his new role.

Photo courtesy Simon Trautman

Scouting Roman Nose Lakes area for places to conduct the Idaho Parks and Rec/IPAC snowmobile avalanche class the following day.
Photo courtesy IPAC

Idaho Panhandle Avalanche Center

Snow began falling mid-November, and many valley locations had a couple of feet of snow by Thanksgiving. It was looking like winter was going to hit hard. The start certainly was in line with the predictions for La Niña. After the initial surge of snow it tapered off to an unseasonable December with high pressure and very little snowfall. This set up our first concern of several feet of faceting snow on the ground. January gave us just enough to produce some climax avalanches witnessed along the Idaho/Montana border. The weather in February embellished on faceted snow between ice crusts, sprinkled with surface hoar. It seemed that every week a new layer of surface hoar was buried. One nasty layer, which became known as the mid-February PWL, was a cake of two surface hoar layers separated by about 2". Both showed weakness while becoming buried 6-8' in one month. One avalanche witnessed in the Cabinets south of Bonners Ferry fractured 1000' and 5' deep. March then hit with a vengeance. Strong Pacific storms plowed through north Idaho bringing feet upon feet of snow. Listen to these SWE numbers from March: Lost Lake – 16", Lookout Pass – 14", Schweitzer – 22", Hidden Lake – 16", Bear Mountain – 25". Silver Mountain Patrol Director Dave Alley said that the ski area received 6.5' of snow in March. In the high country, as of April 12, we’re about 25% above average peak snowpack.

It’s great to have Friends and this was our first year of collaboration. One of our first objectives was to create a new Web site since the Forest Service one has continued to be temperamental at best. To make a long story short, we successfully posted weekly advisories to a new site, but it is still “under construction” and far from the interactive site we were hoping for. We’ll have it fully functional by next year. On a positive note, the Friends held the first fundraiser with a raffle and silent auction, and local mountaineer Karl Deidrich finished the evening at the Laughing Dog Brewery with a slide show of his adventures in the Coast Mountains and Canadian Rockies.

We have strong Forest Service support for our program from recreation and Claire Pitner, a recent recruit as a rec planner, expressed interest in participating and helped to spread the word this year. Lisa Portune, formerly of the Chugach AC, helped greatly with education and was instrumental on the board of the Friends. It was a very busy year with education and outreach, and we conducted 39 classes with almost 1000 participants. We began the season on a day of information sharing with the National Weather Service in Spokane. IPAC lectured on weather influences on snowpack, and the NWS forecasters educated us on useful weather models and reviewed their weather forecasting operations. NWS/IPAC conducted a free-to-the-public class on La Niña weather trends and what to expect for winter 2011/12. NWS/IPAC created a podcast about avalanche safety and an avalanche safety link aired on their Web site.

We added a little twist at our Sandpoint High School presentation on avalanche safety with Caleb Mullan, a local freeride competitor, to help strengthen the message. This was also the first year IPAC assisted with Winterfest at 49° North Mountain Resort in northeastern



With several vendors in the Idaho Panhandle area, snowbikes are becoming popular.

Photo courtesy IPAC



Dave Alley, Silver Mountain patrol director, explains avalanche safety control on the mountain during Forecaster Field Day. *Photo courtesy IPAC*

Washington. You may remember Keith Wakefield, the host, who has created quite the winter playground up there. Carole Johnson is going strong, providing pit data and education for both IPAC and West Central AC. With the help of Dan Frigard they reach S&R, snowmobile clubs, local schools, and chambers of commerce. Carole is a stalwart of avalanche education and I dread the day she decides to retire.

Forecaster Field Day at Schweitzer and Silver Mountain resort was a success this year. Dave Alley, Silver ski patrol director, and Tom Eddy, Schweitzer snow safety patroller, were gracious hosts, and the collaboration of IPAC forecasters, Lisa Portune, ski patrol, and public participants made for great information sharing. As a result, IPAC has received more consistent and quality observations and got people hooked on SnowPilot.

Our partnership with Idaho Parks and Recreation continued with collaboration on snowmobile classes in Coeur d'Alene and Sandpoint. I was able to host the north Idaho trails specialists, Marc and Scott Hildesheim, along with the ISSA safety coordinator Lauren Frei the day before the Sandpoint class. We had a great day showing them popular areas for riding and how to conduct pit tests and assess avalanche hazard. Saw a lot more snowmobiles at our classes this year. It's amazing where you can ride those things. I'd like to thank everyone who helped IPAC this season. We accomplished a lot and I see great potential for the program to continue to grow and improve.

—Kevin Davis, director

Northwest Weather and Avalanche Center

Given the La Niña winter of 2010/11 that stretched into June for the forecasters of NWAC, the expected back-to-back La Niña season for 2011/12 was met with trepidation to say the least! We were given periodic reprieves along the way however and managed to see our way through into a spring that is very welcomed and surprisingly feeling like spring. Following are some highlights as well as some tragic lowlights of this past winter season in the Pacific Northwest.

The winter season really began to take shape in November with NWAC starting daily forecasting on November 17 as a strong storm cycle was upon us. Mt Baker Ski Area received over 40" of snow in two days thus began another long winter forecasting season. By Thanksgiving snow depths had grown to 3-5' with 69" on the ground at the base of Mt Baker providing a promising start to the season.

As strong as the beginning of the season was, the period from Thanksgiving to Christmas proved as weak with most areas only receiving 6-12" of snow. High freezing levels dominated, with two periods exceeding 10,000' in early December producing a strong crust. A cold snap in mid-December allowed for faceting above and below that crust layer creating a weak layer involved in many future avalanches. The crust-facet combination would be evident in the snowpack for months to come.

The storms returned near Christmas with most areas receiving 2-4' of new snow from Christmas to New Year's. However, the on-again, off-again nature of the season persisted into the New Year, with generally less than one foot of snow falling during the first half of January 2012.

The second two weeks in January were definitely of the on-again nature. Over 10' of snow fell during this period over most of the forecast region, from Mt Hood in the south to over 11' at Mt Baker in the north and even over 8' at the low pass of Snoqualmie. Following an extended storm cycle, warming periods with heavy precipitation produced a significant avalanche cycle as evidenced by the photo of a large natural avalanche that released January 20th at Mt Hood Meadows failing on the late December crust (*see photo next page*). This period also included the first of the three episodes during the season which raised the avalanche danger level to extreme.

The storm hose once again shut off after February 1 as high pressure dominated, producing high freezing levels climbing over 10,000' during the first week of February. The mid-season drought lasted from February 2-16 with most NWAC weather stations in Washington receiving only 3-6" of snow. As is the nature of the avalanche beast though, it is not only during the stormy periods when the dragon is active, but often when it's thought asleep as well.

In this case the weather patterns in early February conspired to form a buried surface hoar layer that would be evident for much of the rest of the season, especially in the north Cascades. The warm weather in early February formed the strong crust, while the clear weather allowed for significant surface hoar growth. The return to light snowfall

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SEASON SUMMARIES 2011/12

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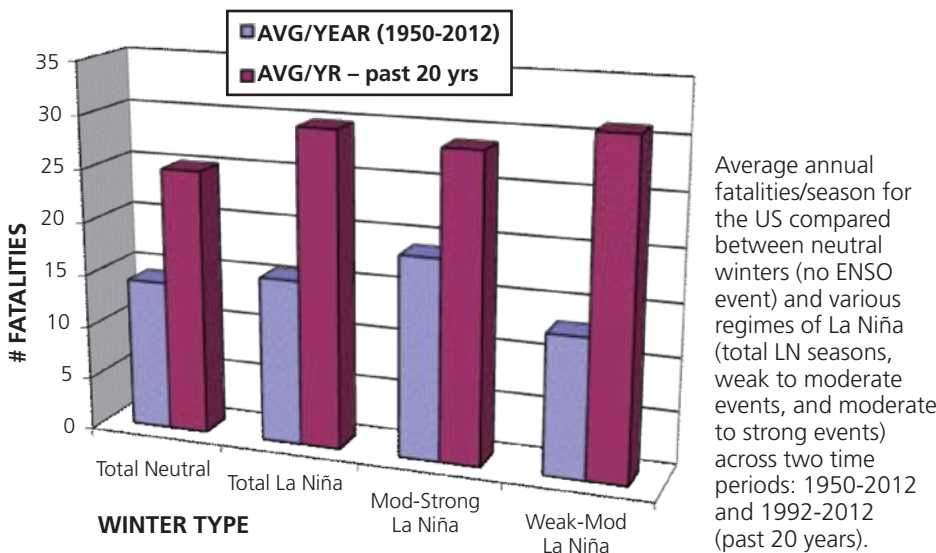
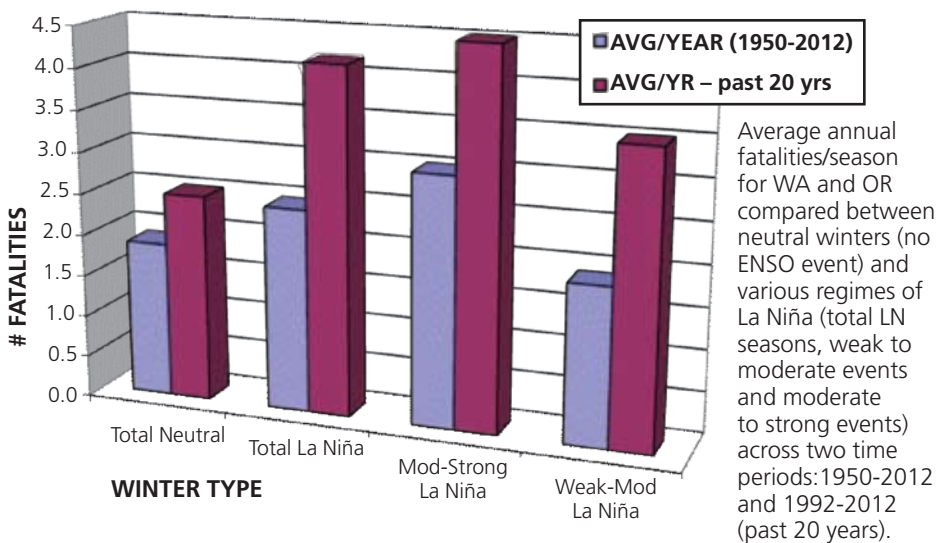
Mt Hood Meadows, January 20, 2012. Absolute magnitude path, SS-N-R3.5-4-D3-O, failure on facets below old crust. Photo by Tighe Stoyanoff

on about February 8 arrived with gentle winds, thus just covering and protecting the hoar layer over a widespread region. The weakness lay dormant until stronger storms would build larger slab layers over one of the more notorious of weak layers.

By mid-February backcountry enthusiasts were anxiously awaiting a return to real Northwest winter conditions. Those conditions arrived alright; unfortunately they came at the dear cost of four lives that were swept away in two separate avalanches on February 19. By the morning of February 19 the two-day storm had amassed snowfall totals over 30" at most west-slope areas. That snow, with very strong winds in combination with the lurking weak layers described earlier, led to the fatal avalanche conditions. The accidents included a party of snowboarders accessing a very steep slope outside the Alpental ski area, rarely attempted in the best of conditions, which led to one of the members being caught and carried over steep cliffs and killed. The other fatal accident occurred in the backcountry outside the Stevens Pass resort boundary, where a large 2-3' slab was triggered by the seventh skier of a large party entering a steep open slope just below the top of Cowboy Mt to the southwest of the resort. The ensuing slide caught four members of the group and swept them down a twisting tree-lined chute over 2400 vertical feet to the valley floor of the Tunnel Creek drainage. One person who was hit by the slide near the top was able to resist its fury by hugging a tree, while another victim survived by a combination of luck and an airbag. Unfortunately, three other skiers perished in the slide, all local and long-time Leavenworth residents which left the area stunned.

Overall, ENSO winters (such as the past La Niña) seem to affect how the snowpack develops in different regions and its resulting "character," and recently updated correlations between ENSO events and avalanche fatalities in the US suggest that significant increases or decreases in average annual avalanche fatalities may occur during such winters, depending on time period considered and geographical region.

As terrible as February 19 proved to be, it could have been much worse, as there were other accidents that occurred that day with more fortunate outcomes. In the Crystal Mountain backcountry a party of three were involved in two separate avalanche incidents in the same day! The second slide caught all three, totally burying one member and partially burying the other two, who, once self-rescued,



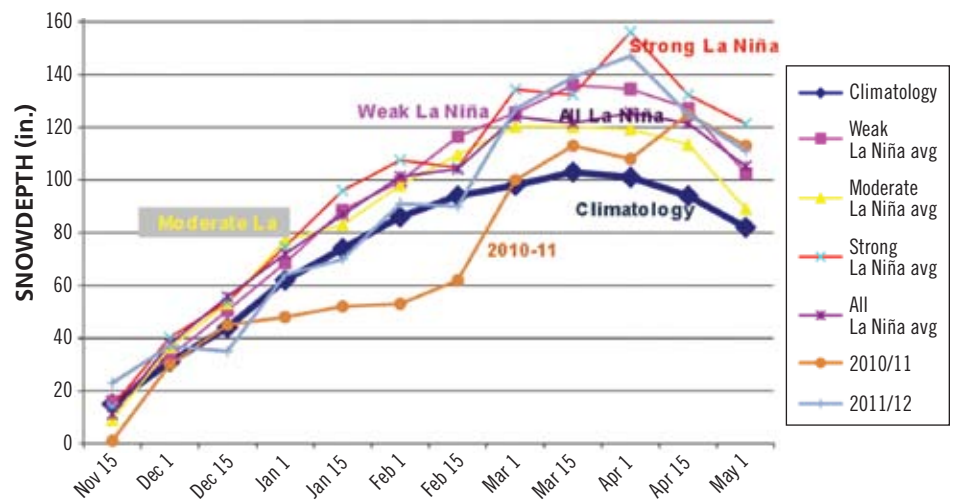
were able to use a transceiver, probes, and shovels to rescue their partner alive! Those involved in the accident describe it and show pictures at www.turns-all-year.com/skiing_snowboarding/trip_reports/index.php?topic=23827.0

Also in the Crystal Mountain area a solo skier was caught, carried, and arrested on a tree, sustaining life threatening injuries and later airlifted to safety.

The storms kept coming over the days following the tragic accidents with rising freezing levels and heavy precipitation leading to the second period of extreme

danger levels of the season. Between 2" to over 5" of water fell in 24 hours ending February 22 at rising freezing levels, prompting the extreme danger warning well ahead of time. This mid-late arrival of stronger winter conditions in the Northwest seems to be associated with La Niña events as the figure here indicates for Stevens Pass, a representative Northwest location at the 4000' level.

The storm cycles continued for much of March at even lower freezing levels. For a monthly period from February 17 to March 17 some impressive snowfall amounts were recorded during this mid-late La Niña winter (see the figure below for some representative data on how La Niñas affect Northwest snowpack development). Most west-slope areas received 150-200" of snowfall with Mt Baker totaling 290"!



Stevens Pass, WA: La Niña snow depth evolution versus normal (climatology). Winter 2010/11 was a strong La Niña while the past winter was a weak to moderate event.

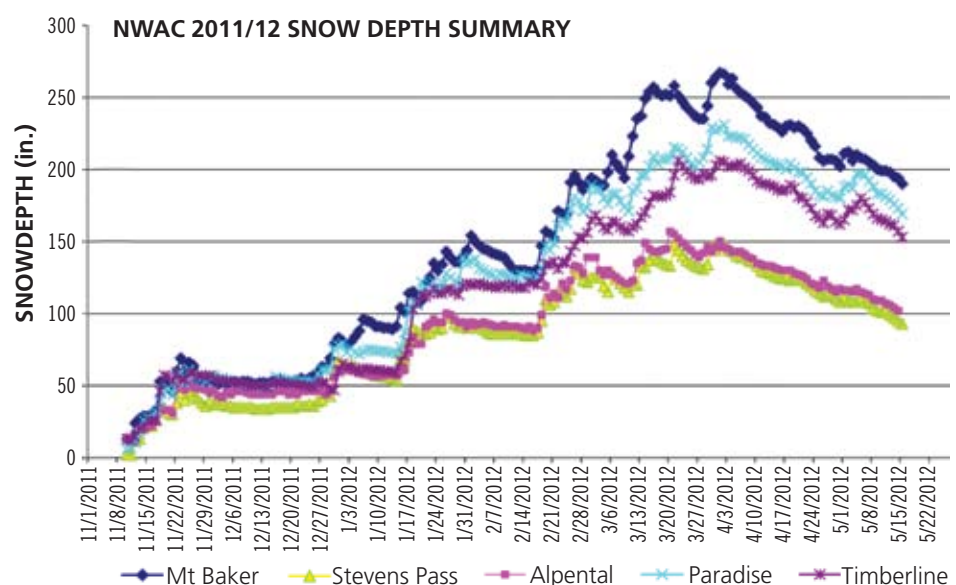
The third avalanche warning for extreme danger occurred after 9' of snow in six days was followed by warming and 1-2" of water on March 15. The warning clearly verified as a very large natural slab – with an estimated crown of 15' – released early on the morning of the 15th from Shuksan Arm in the Mt Baker Wilderness Area to the east of the ski area. The avalanche was noted as the largest ever seen in the area over the past 40 years by long-time general manager Duncan Howat. The fracture line propagated a long distance and debris ran toward the base of a chairlift, destroying a tree buffer of 2'+ diameter trees before coming to rest within the lower part of a closed run. Fortunately, due mainly to this event, ski area management wisely decided not to open the ski area at all that day. Duncan Howat announced his decision in the lodge that morning to a crowd of anxious and powder hungry skiers and boarders. Contrary to the anticipated response, the decision was met with rousing cheers, clapping, and ultimate support, knowing their safety had been put first and foremost.



Massive natural avalanche releases adjacent to Mt Baker ski area, March 15, 2012. View up lower Rumble Gully. Photo by Mike Trowbridge

March goes out like a lion! Another strong storm cycle finished off the very active month of March. Cool weather in the first week of April gave way to rising freezing levels and a dry period toward the middle of April allowed the NWAC to put to bed another winter season of avalanche and mountain weather forecasting on April 15.

In other NWAC-related news for 2011/12, we installed a new remote weather station along the Cascade east slopes at the WSDOT Berne Snow Camp (with strong support from the Highway Department), bringing the data network total to over 45 separate sites. We also unveiled a controversial GIS-based display of avalanche danger rose information (through collaboration and support of the Friends of the Avalanche Center and Western Washington University), with plans to add geographically tagged snowpack and avalanche observations to the display next winter. —Kenny Kramer, forecaster



■ Chugach National Forest Avalanche Information Center

It's hard to describe the 2011/12 winter without thinking in comparison terms. 2010/11 was a bust unless you were interested in examining persistent weak layers, skiing shallow snow, and didn't mind a dangerous snowpack. 2011/12 was the exact opposite, with a generally stable snowpack and more steep face-shots each week than we saw the entire previous season. Frequent snowfall with cold – but not too cold – temperatures produced the kind of consistent deep layering that stabilizes quickly after each storm. The superlatives that skiers and riders used to describe the backcountry quality were not exaggerations. Hard facts backed up the comments with Anchorage setting a new all-time season snowfall record.

An almost complete absence of persistent weak layers until mid-March kept the backcountry safer than average. Several stretches of high pressure weather produced backcountry stability that allowed “safe” riding in the very steep terrain across our forecast area. The lack of snow in the lower 48 brought many professional freeride skiers and film crews to Alaska early to take advantage of our exceptional conditions. While we get our fair share of filming done in Alaska, they rarely come during the cold and perpetual twilight days of December and January.

Despite the general stability, we still got plenty of larger avalanches. The mid-season jet stream directed Pacific storms into the Bering Sea and across Alaska or north into the Gulf which gave south-central Alaska numerous direct hits. The larger storms created correspondingly large direct-action avalanches from rapid snowfall and wind reaching 120mph on several occasions. We spent much of January and February replacing damaged ridgetop weather stations and getting instruments back online. DOT road crews stayed busy shooting down avalanches and clearing debris from the highway after quite a few big storm cycles. The stability trend favored a quick transition from the big storm events to a stable snowpack and the scary avalanches typically happened when nobody in their right mind would be in the mountains anyway.

On March 26 the spring switch was pulled, and cold snow gave way to a rapid meltdown. Large, deep slabs were ripping by mid-April, and the deep snowpack combined with an unusually sunny spring season resulted in a long and dramatic shed cycle. As of late April, persistent sunny weather was keeping the rivers running high and stability poor in the afternoon.

Accidents and burials this year remained relatively few, due to the exceptionally stable snowpack during most of the winter. We had a couple of injuries, but no fatalities within our region (as of late April). An incident in February happened during a Considerable/High forecast as snow and wind impacted our region. One skier was fully buried after another party remotely triggered a slab on top of him while the group was ascending (*see story in TAR 30-4*). A quick rescue got everyone home safely with only moderate injuries.

Another incident in mid-March went unreported by those involved but required a nighttime Air National Guard helicopter rescue to extract one man injured with a leg fracture. We believe this slide was triggered on a south-facing slope very late in the day (after many hours of hot sun exposure) and may have involved buried sun crusts and associated weak layers. Getting accident reports from the public remains one of our biggest challenges as an avalanche center.

The forecasting staff continued the transition from our complete turnover in 2010/11. Graham Predeger joined the team as the district's recreation supervisor and brought his previous snow and agency experience from Vail Pass Recreation Area. Graham made significant progress with our snowmobile outreach this year, which has become more important as the motorized segment of our backcountry community continues to grow. Chris Engelhardt joined us for a detail opportunity at the tail end of the season from the Lake Tahoe Basin Management Unit. Chris brought many years of avalanche experience from his time at Silverton, Mammoth, and Stevens Pass. Adam Clark was an all-star intern this season, joining the program as he finished his masters thesis work at the University of Montana. Adam refined our weather recording system for the Summit Lake region and provided strong support to the forecasting work in that zone. Another big administrative change was getting Wendy Wagner and myself a title change from *forestry technician* to *meteorological technician* to keep us consistent with the Forest Service avalanche specialist standard.

This year goes in the books as a memorable one for the exceptional recreation quality. Residents with 30 years of local insight were throwing out comments like “best ski season in a decade” and “best ski day ever.” We're certainly not going to disagree.

—Kevin Wright, director

■ Mount Washington Avalanche Center

Winter 2011/12 will be remembered by the Mount Washington Avalanche Center (MWAC) as a superlative season for several reasons: regional records for high temperatures, low winter snowfall totals, and unusually large snow events in the fall. The season looked like it would start with a bang with solid October and November snowstorms. Just to the south of us, 144-year-old records were smashed by an October 29 snowstorm, but every early storm was followed by complete melt off before the next one. It wasn't until early January that we had enough snow to begin forecasting daily.

When winter conditions finally did settle in, the mid-winter temperatures averaged a couple degrees above normal while snowfall for the period remained paltry, despite receiving almost daily up-slope dustings. In January, the Mount Washington summit recorded 27 days with measurable snow, but it totaled only 34"! This trend continued through the winter; by the end of March we had received about 55% of our historical average snowfall, with very few real snow storms and only a couple of good avalanche cycles. On the upside, the prevailing westerly winds did blow these small amounts into our ravine in quantities sufficient to yield a number of boot-top ski days. The famous spring skiing season in Tuckerman Ravine appeared threatened during a mid-March heat wave and rain event. During those seven days, average temps were 20-34 degrees above normal. With nighttime temperatures staying well above freezing, the thin snowpack began to vanish before our eyes. Early April snowstorms helped somewhat, as slopes were freshened up by 32" of



A ski patroller grabs some turns below a 12+ foot crown on the North Face of Alyeska. This class 4 avalanche happened naturally overnight and snapped some mature trees. Photo by Kevin Wright

snow, but in the minds of many New Englanders, ski season was already over. 2012 could possibly have been the quietest spring ski season in several decades.

Last year, two veteran MWAC forecasters moved on to other Forest Service positions. Frank Carus and Joe Klementovich, both accomplished mountaineers and team leaders for the volunteer Mountain Rescue Service, were hired as seasonal snow rangers. The rescue, medical, and snow skills they brought to the program this season proved very valuable, allowing Chris and Jeff a little breathing room after losing two very competent forecasters. The process of hiring two full-time forecasters is currently underway and should be completed by the end of the 2011/12 season.

The first Eastern Snow and Avalanche Workshop was held in November and was well attended, selling about 90% of the available seats in the first day of pre-registration. Numerous avalanche instructors, ski patrollers, local guides, and volunteer rescue personnel attended, and the feedback was overwhelmingly positive. This event educates the local community, and funds raised are allocated to the White Mountain Avalanche Education Fund. We are all looking forward to the second annual ESAW this fall.

The MWAC acts as lead agency for search and rescue operations within our forecast area, and snow rangers have responded to eight incidents to date, ranging in severity. On the humorous side we had a pair of hikers who thought they were separated from one another when in fact they weren't. Sadly, two hikers lost their lives in sliding falls down the area known as the Lip. The second fatality was a unique situation for us, in that we were not able to immediately recover the body. The fall occurred in steep terrain shortly after the March heat wave and rain event opened up numerous glide cracks. The victim slid 500' then fell 30' into one such slot on a 40-degree slope. To complicate matters for rescuers, the victim disappeared 40 or more feet down a melt channel between the snow and a 70-degree rock slab. Following a strong effort right after the incident, recovery efforts were suspended due to excessive risks to the rescuers. The victim was recovered seven weeks later. As far as avalanche accidents, this was a rather light year. To our knowledge, only two avalanche incidents involving people took place, both in the Central Gully slide path. Neither resulted in burial or severe trauma.

We continue to receive greatly needed assistance from the Mount Washington volunteer ski patrol on busy spring weekends. This group has been an integral part of the Tuckerman spring skiing scene since 1939, and they continue to astonish us with their dedication and commitment. As a group, they logged 178 volunteer days in less than three months. In addition to the established Friends of Tuckerman Ravine, the Friends of MWAC was recently formed to help generate funding for our operational efforts. This group is in the building stage, but they have already formed relationships with many individuals and businesses. Without all these groups, we would be challenged to provide the high level of information and service our visitors have come to expect.

Outreach and education continues in the ethersphere. Greater efforts to post regularly on Facebook have paid off, yielding 1000+ fans after the first full season. Our relatively new Web site continues to be tweaked and gets about 2000 hits per week, many of which come on Monday mornings. We think this reflects our role in the Northeast as a consistent and reliable source of snow and weather information, particularly to the crowd of people who are thinking about snow even when they probably should be thinking about work.

Overall it was an interesting season, if not a spectacular one. However, if there is one thing New England snow junkies are highly practiced at, it's being patient and hoping for a better snow year next season. And now that the black flies are swarming, we are already looking forward to those early season snowstorms.

—Frank Carus & Jeff Lane, snow rangers

Continued on next page ►

SEASON SUMMARIES 2011/12

continued from previous page

■ West Central Montana Avalanche Center

The 2011/12 avalanche season began with anticipation of another La Niña winter and copious snowfall. Late November storms promised to deliver but a lengthy December dry period dashed thoughts of deep and safe powder rides for Christmas. 50-70cm of depth hoar at the New Year is very rare for western Montana, and most skiable slopes were plagued by this instability. High avalanche danger warnings were issued for several days around the New Year holiday, and several skiers reported close calls or experienced triggering avalanches. Snowmobilers found riding conditions too difficult to be able to reach remote, steep terrain so snowmobile-related incidents were at a minimum until New Year's Day when a rider triggered a class 3 avalanche in the Red Lion area near Phillipsburg. The individual was strained through trees and died from his injuries at the site.

The area where this incident occurred lies in between the West Central Montana Avalanche Center (WCMAC) and the Gallatin NF Avalanche Center (GNFAC) and has no avalanche forecasting service. WCMAC is the closest center, so we were asked to conduct an investigation for the Ranger District. Snowpack conditions were similar over a broad area in western Montana that weekend. We issued an avalanche warning that day as did the GNFAC. Two other avalanche fatalities occurred on the same day near Cooke City.

In Montana, several island mountain ranges lie between the three avalanche centers where no avalanche information is available to the recreating public. These areas are larger than the acres covered by the three centers, and it is difficult to provide consistent usable snow stability information to the public.

Such is the case with the Flint Creek Range where the Red Lion accident occurred. Other avalanche fatalities have occurred in this small range over the past 10 years. An attempt to provide at least an information point of contact for backcountry users is being examined by the Beaverhead-Deerlodge National Forest in Dillon. This action may partially fill the gap of timely snowpack information for the island ranges between the WCMAC and GNFAC. Alex Dunn is the contact person, and we wish him well in this endeavor.

We also conducted an investigation of a close call that happened on March 4, 2012, near Marshall Lake approximately 11 miles northwest of Seeley Lake in the southern Mission Mountains. This incident involved two snowmobilers who were caught, with one partially buried and the other fully buried after another rider from a separate party rode above them and triggered a class 2.5 avalanche. Multiple riders from different groups witnessed the avalanche and converged at the toe of the slide. Someone immediately spotted an arm sticking out of the snow, and the completely buried rider was dug up in under five minutes with no injuries.

This was a classic case of one rider getting stuck, a second rider walking up the slope to help his partner, while a third rider, unaware of others on the slope, rides directly above their location cross-slope on a 40-degree rollover and triggers a massive soft-slab avalanche.

In early February a dry period created a surface hoar layer that was buried and persisted in nearly all mountain locations in western Montana. This particular weak layer was the culprit in many other human-triggered avalanches reported to us the previous three weeks and was the primary concern in most stability testing since it was buried. Complete incident details are available for review at missoulaavalanche.org/documents.

Avalanche Forecasts: Our biweekly advisory started December 16 and ended April 6, 2012. We issued 37 individual forecasts with six special updates due to high avalanche danger or significant change in weather and snowpack conditions. We issued three avalanche warnings and two early season information statements.

Our small operation covers a lot of ground, so we have a large pool of trained observers who gather important snow profile and other stability information from their respective ranger districts. They are regular Forest Service employees who have the support from their managers to do this work as long as it does not interfere with their normal jobs. Since the avalanche center receives very little program money, salary and transportation costs are contributed from their home units. 10-12 individuals dedicate one or two days each week to collect data for the advisory. Contributed time makes it possible for us to provide an avalanche advisory for areas outside Missoula County.

Bitterroot NF provides two employees to cover the southern Bitterroot range south of Hamilton. Clearwater NF provides two employees to cover the area near Lolo Pass in the central part of the range. Lolo NF provides three employees and the Idaho Panhandle provides one employee to cover the northern Bitterroot range from Hoodoo Pass to Lookout Pass. Two residents of Seeley Lake, recent retirees involved with the local SAR and National Ski Patrol, volunteer their time to collect snowpack information for us. Lolo NF also provides two employees to cover the Rattlesnake/ Sheep Mountain areas. Dudley Improta, Steve Karkanen, Kris Laroche, and Logan King are employed by an employment agency (Express Services) under an agreement with the Forest Service to provide instruction and forecasting services to the avalanche center. Funding for this comes from the Friends group for forecasting and from a MT Fish, Wildlife and Parks Recreation Trails Program grant for education services.

We also have a robust group of backcountry enthusiasts who routinely provide good snow information to us through the public observations link on our Web site. Many of these voluntary reports are excellent with a few really getting into it with comprehensive profiles and photos to document what they see. With this level of support, we are able to provide accurate avalanche information for a very large area.

Education: Providing avalanche safety education in our advisory area communities is the most important part of our mission. We were again very busy and successful in providing education opportunities. Six level 1 classes were offered with 84 participants. We also sponsored and provided an instructor to an American Avalanche Institute Level 2 avalanche class.



During the accident investigation of a close call near Marshall Lake in the Mission Mountains in early March, Dudley Improta (the photographer) and Steve Karkanen, of the WCMAC, were struck by how the slab pulled all the way back over the steep rollover to create a crown on 30-degree terrain. The upper part of the slab acted more like a hard slab, whereas the lower section and the debris were more like soft slab, making victim extrication relatively easy.

Kris Laroche and Logan King gave over 70 basic avalanche safety talks in middle and high schools throughout western Montana. The program has been very popular and attendance continues to rise each year. This year over 1800 students attended this session which is tailored to meet the age and interest level of the students. Some of the schools added a field component as part of other science classes. The school program uses the *Know Before You Go* DVD and PowerPoint along with local area slides and video.

The University of Montana Outdoor Program sponsored a free advanced avalanche class that involves two three-hour evening sessions and a field day covering snowpack assessment, route-finding, transceiver use, and rescue principles. Approximately 75 people attended the classroom sessions. The Outdoor Program also sponsored two one-hour awareness lectures with approximately 45 participants each and two avalanche transceiver workshops. Additionally, REI sponsored two similar awareness classes in October.

The Rocky Mountaineers, a local backcountry recreation club, along with the Trailhead sponsored a free avalanche-awareness evening with a two-hour lecture detailing recent local avalanche incidents as well as current conditions. Avalanche safety talks were presented to the Bitterroot Ridgerunners and Missoula Snowgoers snowmobile clubs as well as the Bitterroot Nordic Ski Club. Both Dudley Improta and Steve Karkanen gave several one- to three-hour talks on a variety of avalanche safety topics to Missoula County Search and Rescue, Saint Patrick Hospital Life Flight, UM risk management class, UM wilderness management class and others.

In all, over 2583 individuals attended our avalanche safety classes this year with 1800 middle through high school students and 783 adults.

Social Media: We launched our Facebook and Twitter accounts in 2010, and the missoulaavalanche.org Web site now allows automated updates whenever we issue an advisory or avalanche warning statement. RSS feeds are also available from our Web page. An email list serve has several hundred subscribers, and we continue use of a telephone hotline recorded message.

Friends Organization: The West Central Montana Avalanche Foundation, a 501(c)(3) nonprofit, continues fundraising efforts that ensure viability of avalanche center operations. The group's signature event, Burning Dog - Pray for Snow Party, brought in several thousand dollars. The group maintains three transceiver parks – at Lost Trail Pass, Lolo Pass, and Montana Snowbowl – and has plans to purchase parks for Seeley Lake and St. Regis. Most of the avalanche education in the future will be sponsored by the friends group with assistance from WCMAC.

Organization: Currently the WCMAC has three part-time forecasters, two part-time instructors, and 10-12 part-time observers. Steve Karkanen has served as director since 2006. This has been as part of his full-time position in fire management as the Lolo Hotshot Crew superintendent. Karkanen retired from the agency in May of 2011 but continued working with the WCMAC as director through an agreement with Express Services, a local employment agency. The same agreement employs Dudley Improta and the two school program instructors. There are many advantages to this. There is no guaranteed funding to justify hiring a part-time GS-9 agency employee, and the costs involved in required IT, HR, and security training for new agency employees are prohibitive. The other advantage to the agency is that all administrative or HR details such as OWCP, unemployment coverage, etc., are taken care of by Express at a significant savings to the FS.

Tim Laroche, one of the forecasters, is now the Hotshot Crew superintendent on the Lolo and has the training, experience, and desire needed to absorb the director responsibilities. Over the next few months we plan to transition Tim into the director position so as to maintain agency leadership of WCMAC.

We closed down operations on April 6 with mountain snowpack at close to 100% of average as of this writing.

— Steve Karkanen, director

■ Kachina Peaks Avalanche Center

Like most in the lower 48, Arizona had a lean snow year. It didn't start that way; in fact, early season storms lured us into thinking we might escape La Niña's evil wand as we had in 2010/11. Arizona Snowbowl ski area opened on December 9 with the holidays on their heels and ~30" of settled snow on the undisturbed snow survey stake at 10,800'.

Unfortunately, this was the beginning of what would become a winter of poorly producing storms followed by extreme winds. Shallow snow remained below tree line, but was stripped from most high-elevation terrain throughout the season. Some wind loading was occasionally observed, but equal quantities were lost to atmosphere or redistributed to the Painted Desert. Where the snow did linger it was ugly, a mixture of well-developed facets and crusts. When it didn't snow, it was sure to blow as numerous short-wave lows approached the state only to stream north at our western border. Our weather stations at 11,500' recorded high velocity winds in excess of 50mph on eleven separate occasions. The highest gusts were during a post-storm event on March 2 when velocities of 70-82mph were logged.

The season ended with a couple significant storms, but these were too late to do more than provide a few ephemeral powder days. The recorded snowfall at 10,800' totaled 208", 26% of which fell in a single storm. The total seasonal snowfall represents 80% of average, based on the 30-year mean of 260" winter.



March 3, 2012: Snuck into some steep trees where Roadway Chute crosses the Weatherford Trail and dug a pit.

NE aspect, 10900, 42 deg
95 cm total depth

0 - 54: fist at top, 4 finger at bottom
54 - ground: fist and softer. 2 to 5+cm advanced facets, chains of facets
ECTP15 Q1 sudden planer. Failed at ~54cm down (at the top of the facets). Impressive.

Photo and pit by Troy Marino

other agencies. In reality almost no natural avalanche activity was reported from this event. A final decent storm deposited 12-16" at 10,800' on April 14-15 after the resort had closed its lifts. These end-of-season storms were simply too little, too late – a few days of blissful powder skiing were the only vindication.

Summary: Despite exceedingly weak snowpack structure, widespread slabs above never developed, or by the time they did the basal snowpack was gone. Even patrol mitigation efforts failed to produce any significant results. Backcountry and slack-country activity was significantly limited by inconsistent snow coverage; some pockets of good skiing could be had, but getting there and back was a challenge. The greater hazards were in encountering snow snakes and walking on loose rubble, not avalanches. There were no backcountry rescues on the Peaks this season, and no reports of near misses or skier-triggered backcountry avalanches.

KPAC General: Despite the seasonal disappointments, modest advances were made by our fledgling program. We purchased and installed an upgraded weather station and a number of hazard warning signs at key locations. Our most notable sign marks the backcountry access gate at the top of Arizona Snowbowl chair one, the most popular access to the backcountry. Here a beacon sensor and clear cautionary words remind skiers of backcountry hazards and safety equipment standards often taken for granted in more mainstream localities. Although the tide is turning, past surveys have shown that transceivers, probes, and shovels are not perceived as mandatory equipment among many of our backcountry users.

Web Site: In November 2011, we launched a new Web site at kachinapeaks.org. A



Fracture/crown lines and deposition in Silverton Bowl. Likely occurred during the storm of February 27-28, 2012, when the Snowslide Springs inner basin SNOTEL showed 10" of new snow (1" of SWE). The Agassiz station showed SW winds during that storm.
Photo by Troy Marino

menu-driven layout gave users easier access to resources, weather links, and maps with avalanche-path overlays. From December 1 through May 1, 2012, kachinapeaks.org had 15,700 page views from 4000 unique visitors, and our public discussion/observation boards had 30,200 page views from 1300 unique visitors.

Winter Backcountry Permits: Coconino National Forest issued 345 permits this winter, 185 of which were requested from Agassiz Lodge at Arizona Snowbowl, less than half the number issued the previous winter. This is a free winter season permit required of backcountry users who enter or exit Kachina Peaks Wilderness from Arizona Snowbowl or the ski area's access road. The primary purpose of the permit system is to encourage backcountry preparedness and increase user awareness of potential avalanche conditions.

Avalanche Education: Brutally thin snowpack in the backcountry forced the cancellation of our first level 1 course of the season. We managed to sneak in three courses during February and March, but not without extensive support from Arizona Snowbowl, who generously allowed lift access and use of closed upper bowl runs for much of our test pit digging. Contrived as this seemed, participants gave positive feedback on the educational value despite deficiencies in such elements as critical route-finding exercises. We served a total of 32 students. This year two of our students were recipients of full scholarships made available by an annual fundraising effort honoring Mikee Linville, a local skier who died tragically in a skiing accident several years ago. We hope to expand this program to enable more backcountry enthusiasts to participate on their limited budgets. In addition to level 1 courses, we conducted two free avalanche awareness clinics for about 40 people. These numbers were disappointing, but attendance for all avalanche courses is historically proportional to snowfall.

Fundraisers: Our strategies remained static this year, but have continued to develop slowly. We continued our annual Teton Gravity Research film fundraiser, earned some money from co-sponsored level 1 avalanche courses, and conducted our second annual Mikee Linville avalanche education scholarship dinner. These activities along with sparse individual contributions and sales of t-shirts and hoodies earned us approximately \$10,000, just enough to keep our exclusively volunteer organization afloat.

— David Lovejoy & Troy Marino

■ Eastern Sierra Avalanche Center - Inyo National Forest

The winter of 2011/12 was the fifth driest year in the eastern Sierra since snow measurements began in 1931 on Mammoth Pass. The winter was not quite as dry as the infamous dry years of 1976-1977 but only by 2" of water. At peak accumulation in mid-April, the eastern Sierra snowpack had 87" of snow with 16" of water on the ground at 9400' in the Mammoth Lakes Basin.

Backcountry locations south of Mammoth did not fare as well, with 20-40" of snow and 6-12" of water. As a result, most winter recreation was confined to the Mammoth and June Mountain regions. Eternal vigilance in the form of watching for rocks was the price of backcountry skiing. Ski shops busy repairing core shots were the only thriving businesses in town.

The jet stream played hardball with the eastern Sierra this winter. After the higher elevations of the eastern Sierra picked up 20" of snow in October and 30" in November,

Continued on next page ▶

SEASON SUMMARIES 2011/12

continued from previous page

the season's depth hoar layer found a perfect home to grow and prosper. With only 9" of snow on the ground in December and most of January, no one was skiing. Rock climbing became the outdoor activity of choice after Christmas and through the first three weeks of January. The June Mountain ski area opened on December 17 with enough snowmaking to open two ski runs. Mammoth Mountain opened in November thanks to the many hundreds of acre-feet of groundwater that supplied adequate coverage for alpine skiing from the top to the bottom on Mammoth Mountain.

All winter, we looked north only two hundred miles and lusted for the storm snow that fell in the Sierra Avalanche Center forecast area. The trademark multi-day Pacific storms that drop 60-100" of snow in two or three days never materialized. The depth hoar layer never received enough loading to fail until a mid-March storm dropped 40-48" of snow in two days. A widespread natural avalanche cycle then occurred south of the Mammoth area on steep northerly aspects on depth hoar.

March was the big month for snow this season: 74" fell at Mammoth Mountain compared to 174" in March 2011. Over 33% of the winter snow fell in March in one storm. Most of the near misses and human-triggered slides occurred from March 17-19 when numerous volunteer slope-stability testers tried to make up for the scarcity of the winter's powder skiing. There were some close calls; fortunately no one was seriously hurt, and there were no fatalities.

The dry winter took a toll on Web site usage. Visits were down 55% compared to the big winter of 2011. The biggest part of the percentage loss came from the local population in Mammoth and nearby Bishop, but there was a percentage increase in visits from the Los Angeles, San Francisco, and Salt Lake City areas.

This year, the avalanche center gained the support of the electric power utility, Southern California Edison. SCE generously provided 33% of the avalanche center's operating budget. The Forest Service is grateful for SCE's support. The Friends group purchased an ONSET weather station in early February. The weather station provided several months of trouble-free weather data. The ONSET weather station provides valuable infrastructure support to inform specialists' advisory writing and danger-rating evaluation.

—Sue Burak, forecaster



February 21, 2012: Freeing an entrapped snowmobile from the Lost Johnny avalanche in the Swan Range, Montana. Photo by Stan Bones

■ Kootenai – Flathead National Forests Avalanche Center (formerly Glacier Country Avalanche Center)

The winter weather of 2011/12 was exceptionally varied for northwestern Montana. The moisture disparity and weather variability across the region was startling. Conditions generally transitioned from being moist in the west portion of the region to much drier in the east, but even within that broad scheme there were pockets of local variability. While some locations were registering at or well above average for precipitation, other areas relatively nearby could be well below.

Initially October's precipitation was above average over most of the region. Warm temperatures produced rainfall and not snow. It wasn't until early November that temperatures cooled and snowfall began to accumulate. December then was exceptionally dry. A big storm at Christmas deposited snow onto the resulting weak base of faceted grains. This loading initiated the first major avalanche cycle of the season. Through January and the first half of February snowfall was near normal at most locations. Then after mid-February the mountain snowfall dramatically increased, fulfilling the long range forecast for a La Niña weather pattern. By April most mountain locations were showing at or above average accumulations of snow-water equivalent. Cool wet weather lingered in May and June, and this maintained snow cover on the ground at many high-elevation sites over northwestern Montana well into July. This was in vivid contrast to much of eastern Montana and many other locations in the Rocky Mountain chain.

Air temperatures throughout the winter generally tended warmer than normal. Even though winds overall were near normal, the region did experience several strong wind events in conjunction with heavy snowfalls. These resulted in the formation of some very impressive cornices at many ridgetop locations.

The first avalanche fatality of the season occurred on February 1, 2012, when a backcountry skier, touring with his brother, skied out onto and triggered an unintentional cornice collapse. He was subsequently caught, completely buried, and killed in the resulting massive deep-slab avalanche in the Jewel Basin area of the northern Swan Range.

In early February a strong high-pressure system lingered for several days over northwestern Montana. This dry, stable air mass produced mostly clear skies with variable valley clouds and fog from approximately the 3rd to the 6th of the month. As a temperature inversion developed, surface hoar formed at many mountain sites. By mid-February this weak layer was becoming increasingly buried and stressed beneath new snowfall, setting the stage for the second and third avalanche fatalities of the season.

On February 20, two snowmobilers from south-central Washington were caught in an avalanche in the Lost Johnny Creek drainage of the northern Swan Range. One was partially buried uninjured, while the other was totally buried and died of trauma after impacting a tree. The following Saturday, February 25, two Montanans riding motorized snowbikes were caught in an avalanche in the Skyland Creek area, near the Continental Divide in the Lewis & Clark Range. One was partially buried uninjured, while the other was totally buried except for a hand and died of asphyxiation. On March 10, a party of snowmobilers was involved in a snow slide in the Purcell Range on the Kootenai National Forest, near the Canadian border in the extreme northwest corner of Montana. One rider deployed his BCA airbag pack, but was able to outrun a triggered avalanche. Another rider was tumbled from his snowmobile, but neither he nor the machine was buried.

National Forest recreational users in northwestern Montana were again able to attend three separate advanced avalanche awareness classes offered by the Flathead and Kootenai Forests at no cost. While the Kootenai session was a joint user program, the Flathead classes were again directed at two separate groups. The first 12-hours-in-the-classroom and 12-hours-in-the-field session in early January was tailored to skiers, snowboarders, and mountaineers. The second session presented in late January and early February focused on snowmobiling. The National Forests again received a grant from the Montana Department of Fish, Wildlife & Parks trails program for avalanche education. The recently formed Big Mountain Ski Patrol, Inc., hosted their first low-cost Level 1 public avalanche safety training. This was very successful, and next year's plan is to expand the offering.

Avalanche advisories were posted twice weekly this season on the new Flathead National Forest Web page as well as being offered via email and phone voice message. Flathead National Forest selected three individuals (Joy Sather, Derek Milner, and Seth Carbonari) from the existing workforce and began involving them in the forest's avalanche program and assisting the two existing avalanche and snow specialists, Stan Bones and Tony Willits. Plans for next season involve developing new partnerships, expanding the information offerings on the Web site, and maintaining as much as possible our avalanche safety training programs.

—Stan Bones, avalanche & snow specialist

■ Utah Avalanche Center – Wasatch

The 2011/12 winter season started with a large snowstorm in early October which was followed by nothing until November. This produced the first weak layer that, once the November storms came, claimed a life (*see TAR 30-3*). These November storms were then followed by a very prolonged period of little to no snow well into January. All of the early season snow turned into one thick layer of dangerous depth hoar. This weakness ultimately led to four more fatalities.

Around January 18 a large storm moved in and produced a thick layer of snow that capped off all the weak snow from earlier in the season. A large natural avalanche cycle occurred along with many human-triggered avalanches. The weakness would be relentless.

Another dry period followed January's large storm, and storms started again in mid-February coupled with more natural and human-triggered avalanches. There were a large number of close calls where people were caught and either fully or partially buried. Many airbags were deployed. Toward the end of February and early March, the now deeply buried weak layers were more stubborn but still posed a threat. March only really had two large storms, otherwise, spring was well on its way with warming temperatures.

These warming temperatures tickled the buried weak layers again producing a natural avalanche cycle on the sunny east-, south-, and west-facing slopes. Once this cycle passed, the early season weak layers went dormant until it got warm enough in early May to once again reactivate them on the north-facing slopes with the last natural deep-slab cycle.

The weak snowpack was widespread throughout Utah, and the five fatalities that occurred reflect that. Three occurred in the Central Wasatch: one in the Fish Lake area east of Richfield, and one in the La Sal Mountains near Moab. All the accidents shared a similar weak layer that formed in the early part of the season. There was a large number of very close calls as well as people caught in big avalanches who were either partly or fully buried but ended up okay. A number of people deployed airbags that probably saved their lives. Others were lucky enough to have successful rescues by their partners. Some sustained some serious injuries. For those who weren't so lucky, our hearts go out to the people that the accident has affected.

—Brett Kobernik, forecaster

■ Colorado Avalanche Information Center

Winter conditions were slow to come to Colorado during the 2011/12 operating season. The snowpack that formed in November and December was shallow and weak. Fieldwork during this time generally involved sinking through the faceted snow to find rocks, shrubs, and dirt. The snowpack was too shallow for snowmachines. This made for difficult travel, but the large depth hoar (up to 10mm) on the ground was fascinating for the snow geek. Colorado Avalanche Information Center staff spent most of the early season tracking the spatial distribution of this incredibly weak snow layer. An unusual and dangerous avalanche cycle was all but certain. The challenge was forecasting when it would start and how long it would last.

During the dry early season there were several avalanche incidents of note. On November 26, an avalanche caught six ice climbers outside of Silverton on a route

known as Stairway to Heaven. The climbers were anchored in, but lost a significant amount of gear in the avalanche debris. On New Year's Day, a large hard slab near Berthoud Pass resulted in a helicopter evacuation of a skier injured during a gnarly ride through rocks and over a cliff band. This slab was rated as a HS Asu R3D2.5. The dimensions of the slide were impressive given how little snow had fallen across the state to that point in time. The crown was from 13-48" deep, 250' wide, and ran 520 vertical feet.

Winter finally arrived during the second week of January, and a spate of avalanche accidents quickly followed. On January 18 a skier who had exited the Snowmass ski area was killed in a very small, soft-slab avalanche. The slide ran about 30 vertical feet, but the debris buried the skier in a deep and narrow gully. The actual slab was about 3' deep. No one in the group was carrying ascension or avalanche rescue equipment, and the victim's two partners were unable to wallow uphill in time to save him. On January 22 eight people were caught in five separate incidents. Of those eight people caught, three were killed and one was injured. A lone skier was caught and killed inside the Winter Park ski area, three skiers were caught and one was killed inside the Vail Mountain ski area, and two snowmobilers were caught and one was killed in an avalanche near Buffalo Pass in northern Colorado. The surviving snowmobiler spent two nights in the backcountry before being rescued. There was little rest; on January 27 four more people were caught in four separate incidents. On January 28 two more skiers were caught in two separate incidents.

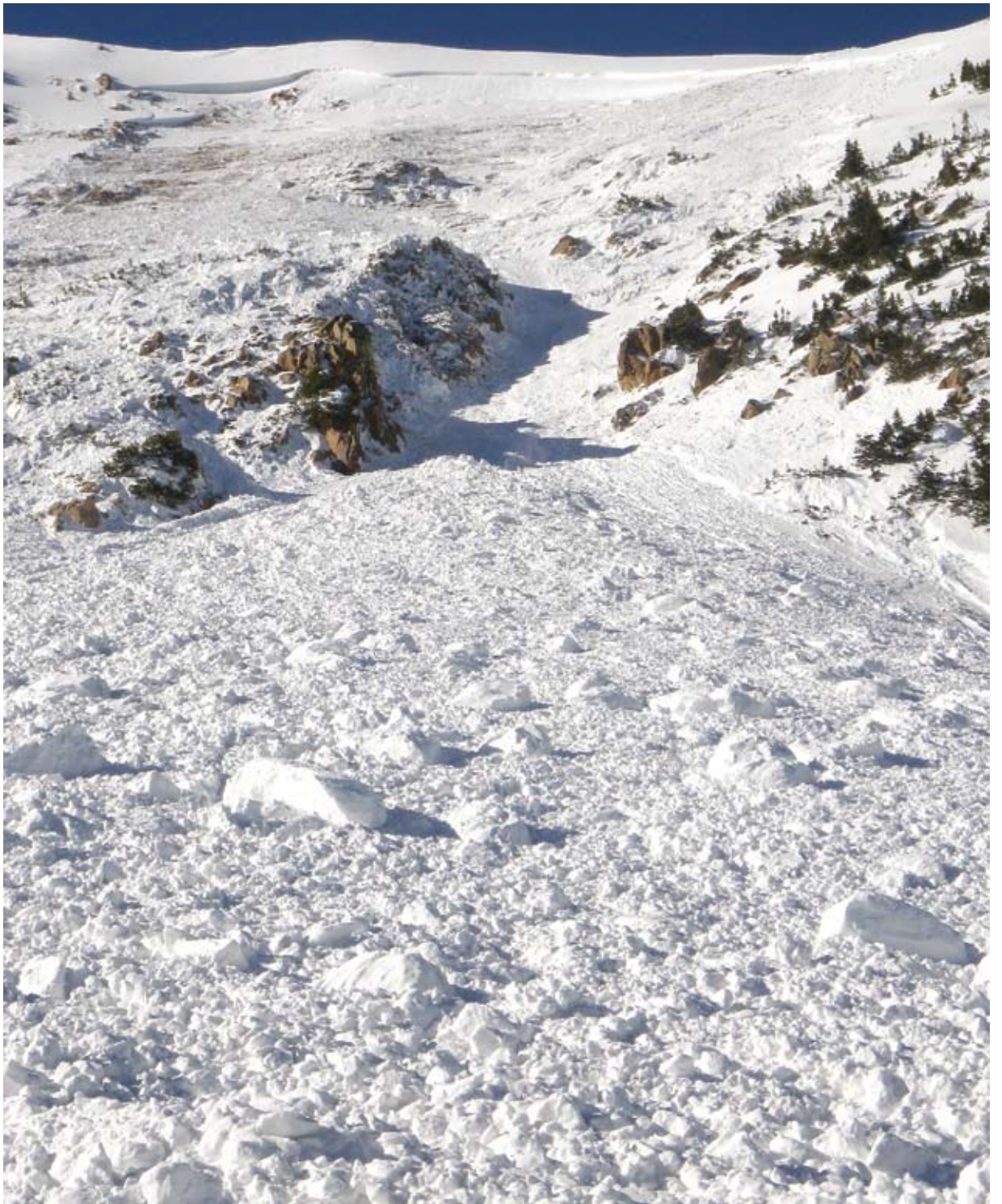
The storm track continued to pound Colorado into February. With the new snow came an increasing desire to ride a resource that thus far had been in short supply. On February 13 two slides on opposite ends of the state resulted in full burials. In the first incident a skier jumped off a 30' cliff into Mushroom Bowl near Vail and triggered a soft slab that ran through moderately dense forest. The skier was completely buried and suffered extensive injuries but was able to evacuate to a nearby hospital with the help of his two companions. The second incident involved a solo snowboarder who exited the Telluride ski-area boundary (Bear Creek drainage). He triggered a small avalanche and rode it over 1000 vertical feet through trees and over cliffs. Despite having ample avalanche rescue equipment, including an AvaLung and an airbag pack, he died of his injuries. On February 16 a skier was caught and injured in an avalanche path adjacent to Mushroom Bowl while CAIC staff were investigating the February 13 incident. This accident resulted in a broken femur and required an evacuation to a nearby hospital. Also on February 16 a group of three well-trained skiers got caught in a large avalanche near Wolf Creek Pass. All three skiers were caught, one was partially buried and injured, and another fully buried and killed.



Matt Steen, CAIC backcountry forecaster for the north and south San Juan zones, in the track of a large wet-slab avalanche that killed a backcountry skier on March 30, 2012. The avalanche was on an east-southeast aspect near Ophir Pass. The slab fractured at an elevation of 12,800' and ran over a mile in linear length.

Photo by Ann Mellick, CAIC/CDOT forecaster for the Highway 550 corridor

Winter seemingly ended as fast as it had arrived. With the dearth of snowfall in March came unseasonably warm temperatures. The snowpack rapidly turned isothermal, and the state teetered on the brink of a significant wet slide cycle. Fortunately, a widespread cycle was averted, but isolated wet slides could not be avoided. On March 30 the last fatality of the season occurred around 3:30pm near Ophir and Red Mountain Passes in southern Colorado. This very large wet slab was triggered by a skier about 50' down slope from the ridgeline on an east-southeast-facing slope at 12,800'. The debris ran over a linear mile and resulted in an extensive debris pile. This was one of the last major avalanches of the season as a series of cold air masses and small new snow events did little to raise the avalanche danger. The last daily



1-1-12 accident near Berthoud Pass (Second Creek).

Photo courtesy CAIC

forecast of the season was published on April 9. Although the CAIC continued to issue statewide summaries into May, the date of the last daily forecast was unusually early. Most of the staff was happy to see an end to an intense winter.

Between October 1, 2011, and April 9, 2012, the CAIC issued 10 avalanche warnings, nine avalanche watches, and two special advisory statements. 2257 avalanches were reported with 50 people caught, 17 partially buried, 11 buried, 11 injured, and seven people killed. These are some fairly high numbers given the brevity of winter conditions across the state. The actual avalanche season may have been shorter than average, but it was more than made up for with intensity.

— Scott Toepfer, forecaster

■ Utah Avalanche Center - Moab

The 2011/12 season for the Utah Avalanche Center in Moab started with avalanche forecaster extraordinaire Dave Medara stepping down after his ninth season with the center to pursue colder and darker pursuits above the Arctic Circle during the winter months in Alaska. Stepping up to the plate for his sixth season as an avalanche forecaster for southeast Utah was Max Forgensi, hot off a fire season as an engine captain for the Manti-La Sal National Forest. His duties shifted from fire to trail planning and finally to winter recreation on December 8, when snow blanketed the mountains in white.

Sporadic precipitation followed by rapid warming affected the mountains of southeast Utah from the beginning. Early snow events in the La Sal Mountains on the October 10 and 25 deposited 20cm at 10,000' at the Gold Basin Study (GBS) plot. Besides a storm on November 4 (30cm), high pressure and warm temperatures dominated the region throughout November, leaving faceted crystals on only the most northerly aspects until December 8, when a series of small squalls deposited a total of 20cm at the GBS. The snow event could not have been timed any better. An article in the *Moab Times-Independent* announced the avalanche center opening, and the first avalanche advisory for the season was issued on December 10. On the same day, the Lower Utah Nordic Alliance and Grand County Search and Rescue conducted their annual trainings at the Geyser Pass winter trailhead. The winter community was cautiously optimistic of another banner year. A week later, a warm and wet southwesterly storm dropped 30cm at GBS bringing the total at the plot to 75cm. The first avalanche warning for the region was issued and a widespread and spectacular avalanche cycle ensued, failing on the early season basal layers. As a forecaster, I couldn't ask for a better beginning – avalanche paths flushing out the depth hoar, alpine touring protected from these massive slides. The reset button was pushed...but then nothing happened. High pressure locked in overhead, the snow on the ground began its faceting process again, and our equipment began to break.

The first foray into the northern massif of the La Sals with previous UAC forecaster

Continued on next page ➡

SEASON SUMMARIES 2011/12

continued from previous page

Pat Lambrose on December 20 gleaned information on the much shallower and weaker snowpack structure as we headed farther north in the La Sal range. The first snowmobile-triggered avalanche was also reported (two caught, one partially buried) on an east-facing road cut on the east side of Geysers Pass. This event foreshadowed a similar event with different results. Holiday excitement kept backcountry skiers and snowmobilers heading to the mountains, but my exuberance was curtailed on December 27. Shallow snow, wind, and sun had made travel officially dangerous...tiger traps and rocks reigned supreme, and every turn uncovered another hazard. With a broken snow-sensor, three snowmobiles in the shop, and a mildly torn shoulder, I managed risk by turning my attention to desert pursuits under cloudless skies.

The jet-stream changed on the third weekend of January, aiming the hose at Utah, including southeast Utah. The mountain bike was put away and the skis cleaned of red rock desert sand. Up until January 21, only 105cm had been recorded at the GBS since the beginning of the water year. During the next six weeks, 215cm of snow was recorded at the GBS. This six-week time frame *is* the ski season, which unfortunately ends with a fatal avalanche accident. Consistent snow fall started to bury the weak basal faceted layer, its interface still shallow enough for human-triggered avalanches to occur. Buried persistent weak layers resulted in shooting cracks and test slopes failing, backing seasoned enthusiasts off their primary objectives to ski lower-consequence terrain. By the middle of February, the Abajo and La Sal Mountains were still in shallow conditions; the total snow on the ground at the GBS hovering just above a meter in depth.

Starting February 19 over a meter of snow fell and clear blue skies were on tap for the first weekend of March. Advisory highlights for Saturday, March 3 attempted to keep the human factor in check, warning of "blue-sky syndrome" and "powder fever" along with reporting a large avalanche cycle that had just occurred in the La Sal Mountains, where snow stability was trending toward good in some places but tenuous in other wind-loaded locations. Unfortunately, the advisory did not reach the eyes or ears of a party of snowmobilers starting their tour from Gateway, Colorado, that Saturday morning.

At approximately 10:30 am, the party remotely triggered a large soft-slab avalanche in Beaver Basin from a summer road in the runout zone. The group was the first to enter Beaver Basin for the season, and the poor snowpack structure and ground cover combined to trigger the fatal avalanche, which also triggered a half-dozen sympathetic avalanches, all on the persistent weak basal layer. At dusk that evening, the victim was found with a random spot probe 12' below the surface of the avalanche debris. This tragic accident was the fifth avalanche fatality in the La Sal Mountains and the tenth fatality on the Manti-La Sal National Forest in the past 20 years.

The weather in southeast Utah changed a couple days after the accident in an act of solidarity with the victim's community and family. The wind hammered the Abajo and La Sal mountain ranges, whipping snow away and creating hard wind slabs in the deepest glades, scouring every bit of powder away. A tour on March 8 confirmed the dire snow conditions, further illustrated by empty parking lots. Backcountry enthusiasts had to wait for corn skiing conditions to ripen, more than likely a short corn season.

The Utah Avalanche Center - Moab puts its last forecast out on March 30. A total of only 331cm was recorded at the GBS, the lowest ever recorded in the last 20 years. During the 2011/12 season 29 advisories were issued: four special announcements, 12 moderate danger ratings, 11 considerable danger ratings, and two high danger ratings. Two avalanche warnings were broadcast through the National Weather Service out of Grand Junction, Colorado. Persistent weak layers did not allow for a single, blanket, low-avalanche danger rating to be issued. The UAC - Moab taught three basic avalanche classes and two on-snow courses to a total of 85 students. The annual AIARE Level I class was canceled in January for the first time in over 10 years due to a lack of interest.

Notable accomplishments for the UAC - Moab during the season included the construction of a new weather station located on Abajo Peak. This is the third weather station maintained by the Friends of the La Sal Avalanche Center and UAC - Moab, all part of the MESOWEST network. Two winter trailhead kiosks were constructed at heavily used snowmobile parking lots, one in both the Abajo and La Sal Mountains. A new snowmobile was purchased for the UAC - Moab, bringing the total fleet to four, which includes grooming snowmobiles. Looking forward to the next season, the UAC - Moab looks forward to utilizing social media networking sites to spread advisories into the lives of more individuals who look toward the mountains of southeast Utah for winter recreation.

—Max Forgensi, forecaster

■ Gallatin National Forest Avalanche Center

In southwestern Montana winter started with La Niña's flirtatious promises. We believed she would send us gifts of deep and plentiful snow, but instead she wouldn't return our calls. The snowpack remained shallow (less than 2') for up to 76 days. Even though extremely cold temperatures never came, depth hoar formed as the snowpack remained shallow for so long. We issued intermittent bulletins until beginning daily advisories on December 7 and issued our first avalanche warning on December 30. Before sunset on the 31st two separate avalanche fatalities



This wet slab was triggered by a snowmobiler who was fortunately above the crown when it slid. He couldn't stop his sled during the descent, but was able to jump off and watch it jump the crown and tumble down the bed surface. Photo by Eric Knoff

occurred near Cooke City. Forecaster Eric Knoff witnessed the first fatality and assisted in the SAR response. The second fatality occurred the same day, but the victim's wife did not return to town alerting SAR of the fatality until that evening. Unfortunately she had an old beacon with weak batteries and was unable to find her buried husband. Miraculously the couple's dog, a Welsh corgi, survived a five-day burial until it dug itself out of the debris and walked back to the hotel where the couple had stayed. Seven weeks later another huge storm led to a third fatality near Cooke City. This slide killed a snowmobiler parked on the groomed road under an avalanche path that few would recognize as such.



This corgi survived a five-day burial near Cooke City. Photo by Natasha Baydakova

Over the course of the winter we issued five separate avalanche warnings, a new record. On a more positive note, we helped with one successful marriage proposal by posting it in an advisory. She said yes, and the newly engaged couple reported, "The only facets we found were placed on her finger...and future storms will adhere well to this layer for epic days ahead."

The snowpack started simple: all facets. Then we added a slab on top. In early February, a week of high pressure produced a layer of near-surface facets. A total of six large storms produced widespread avalanche activity on these two weak layers. Conditions in March became complex with rain, very warm weather, and many nights above freezing. Two storms in mid-March caused dry-slab avalanches at high elevations and wet-slab avalanches at low elevations. Many of these slides broke at or near the ground. On March 27 following extremely warm weather and a storm with 1.8" of SWE at Bridger Bowl, the ski patrol triggered six massive wet slab avalanches. These avalanches ran further than anyone could remember and became a popular attraction for local skiers. By the start of April most SNOTEL sites were approaching their 30-year average for SWE.

It was an exciting year for many other reasons with many achievements of which we are very proud. On the education front we offered a Level 2 avalanche class for snowmobile guides taught by former forecaster Scott Schmidt. After years of attending basic level avalanche classes, local guides were hungry for more advanced training. Fortunately the unstable snowpack kept them eager to continue dig pits and see exciting stability test results. They routinely emailed us snowpit profiles and showed their clients (many from the Midwest) unstable layers in the snowpack. Other snowmobile guides have already requested another level 2 for next season. Together the GNFAC and the Friends of the GNFAC taught 80 avalanche classes attended by 4411 people. These classes were offered throughout Montana as well as one in Tampa, Florida, for the Polaris international dealers meeting. On March 7 we sponsored a professional development workshop organized by Scott Savage. The topic was *Decision-Making and Psychology for Avalanche Professionals*. We filmed each talk and posted them on YouTube. Our successes in avalanche education would not have been possible without help from Jay Pape, Scott Savage, Scott Schmidt, Dale Gullett, Tim Campbell, Angela Patnode, Alex Marienthal, Marcie Knoff, Beau Fredlund, and Ben Nobel.

On the social media front, we continued using Facebook and Twitter for the third season, and this year we ramped up our postings with afternoon updates, embedded videos, interesting articles, etc. For the sixth season we used YouTube to post videos that had over 117,000 views this winter on 56 videos. As for our advisories, the number of people receiving them continues to grow. On average, 4365 people received our advisory every day, a 15% increase from last year. We also worked closely with Big Sky Search and Rescue in their backcountry safety campaign, which began in the wake of a fatality and massive search last season, to produce a short video. We regularly reexamine our efforts targeting sidecountry skiers in discussions with Bridger Bowl, Big Sky Search and Rescue, and other Forest Service personnel. While there is no silver bullet, we'll keep trying something new each year and look for feedback from other ski areas and forecast centers in educating this ever-growing population.

On April 8 we issued our final and 138th avalanche advisory and closed the doors. Running the GNFAC is a community effort relying on volunteers and broad financial support for our daily operations. The Friends of the GNFAC continue to play a huge role in fundraising and avalanche education. Yamaha and Cooke City



This massive wet-snow avalanche was triggered by the Bridger Bowl ski patrol in late March. See page 16 for another view of the same slide. Photo by Doug Chabot

Ski Days that traditionally bring in the bulk of the funding for the program suffered significantly due to decreased lift ticket sales. However, contributions from local shops, individual donors, and fundraising parties increased.

The most significant sponsors for the 2011/12 season in alphabetical order were: Alpine Meadows Ski Area, Backcountry Access, Bear Valley Mountain Resort, Heavenly Ski Resort, Kirkwood Mountain Resort, Mt Rose - Ski Tahoe, Northstar at Tahoe ski area, Porters Sports Lake Tahoe, Resort Sports Network, SnowBomb.com, Squaw Valley USA, Sugar Bowl Resort, and Truckee & Tahoe Independent Radio KTKE 101.5. Each of these sponsors provided cash, goods, or services in excess of \$3000. The board still contributed 44% of the funding for the program and held onto enough savings to provide a financial cushion in the event of lean times in the future. The board added a paid position

Motorsports loaned us two new NytromTX sleds with 162" tracks made for deep snow and mountain riding, and we look forward to working with them again next season. We are indebted to the recreation community and local businesses for supporting the Friends every year. The success of the GNFAC is a direct reflection of these strong local ties.

—Mark Staples, forecaster

■ Sierra Avalanche Center

Unusual winters lead to unusual snowpack conditions, and a shallow mid-winter snowpack is a shallow mid-winter snowpack regardless of where you are. With the seasonal snowpack at just 30% of average on February 1, conditions were ripe for weak layer formation. For three weeks from the end of January to mid-February, 7-15cm of snow sat sandwiched between a rain crust and a surface melt-freeze crust on NW-N-NE aspects both above and below treeline.

Near-crust faceting processes ensued, and weak-layer instability became readily apparent in snowpit data after this layer was buried by 10-23cm of new snow February 13 and 14. Snowpack stability reached the tipping point during the February 29 through March 1 storm cycle when 0.6-1m of new snow further buried and loaded this weak layer. On March 1 and 2, this layer contributed to human-triggered avalanches that resulted in the fatality of a skier and a snowmobiler.

During the ensuing weeks, backcountry travelers pulled way back into conservative terrain, leaving many traditional slopes untraveled. Snowpit data continued to indicate likely propagation on the persistent weak layer that continued to facet and consume the crusts above and below. The next storm cycle, March 13-17, deposited rain and snow for a total of 0.6-1.6m of new snow. During the pre-dawn hours on March 17 a natural deep-slab avalanche cycle occurred above and below treeline on NW-N-NE aspects. Large destructive avalanches with crown depths of 1-3.3m with propagation over 500m wide occurred above and below treeline on slopes 35 degrees and steeper. Slopes 30-34 degrees displayed deep fractures with no slab motion.

Snowpit data continued to show likely propagation on this deeply buried weak layer through the end of March. Additional snowfall occurred bringing the snowpack up to 54% of average for April 1 after 150% of average snowfall for the month of March. During April the weak layer remained deeply buried with a very strong overlying slab, making any further triggering very difficult. Snowpit data still continued to show likely propagation. As of the writing of this article in late April, the wait is on to see if a deep wet-slab cycle occurs once free water percolates down to the PWL.

Despite the meager winter, the nonprofit Sierra Avalanche Center board of directors managed to raise \$51,000 through a variety of fundraisers. The

to its ranks in hopes of leveraging more funding for the program in the future. The board continued to fund two observer positions for Steve Reynaud and Travis Feist, whose observations remain an invaluable asset to the avalanche center. Their data, analysis, and willingness to dig deep into the snowpack help make the avalanche forecasts more accurate across the entire forecast area.

On the Forest Service side of things, Andy Anderson and Brandon Schwartz moved into permanent positions as avalanche forecasters with the Tahoe National Forest. The implementation of these positions highlights the Forest's commitment to the program and its long-term importance. Monies from the Lake Tahoe Basin Management Unit (\$17,000), Region 5 (\$17,000), and Region 4 (\$6050) echoed this message of support by providing 56% of funds to operate the program this year.

Over the course of the winter we issued three early season conditions updates and 163 daily avalanche advisories. These products covered the Sierra Nevada Range of California and Nevada from Yuba Pass south through the Lake Tahoe Basin and Carson Pass down to Ebbetts Pass. This spanned areas of the Tahoe National Forest, Humboldt-Toiyabe National Forest, Lake Tahoe Basin Management Unit, El Dorado National Forest, and Stanislaus National Forest. This season, Web site traffic decreased by about 30% from last year, probably as a result of a winter that recorded around 50% of average precipitation. A total of about 400,000 page views from 80,000 unique visitors were recorded this season. A new single day record of 13,553 page views was set on March 2, 2012. We are planning an update to the site for the 2012/13 season to make it even more user friendly and informative. Our users continue to send us positive feedback on the accuracy, reliability, usefulness, and timeliness of the forecasts and other information provided by the avalanche center.

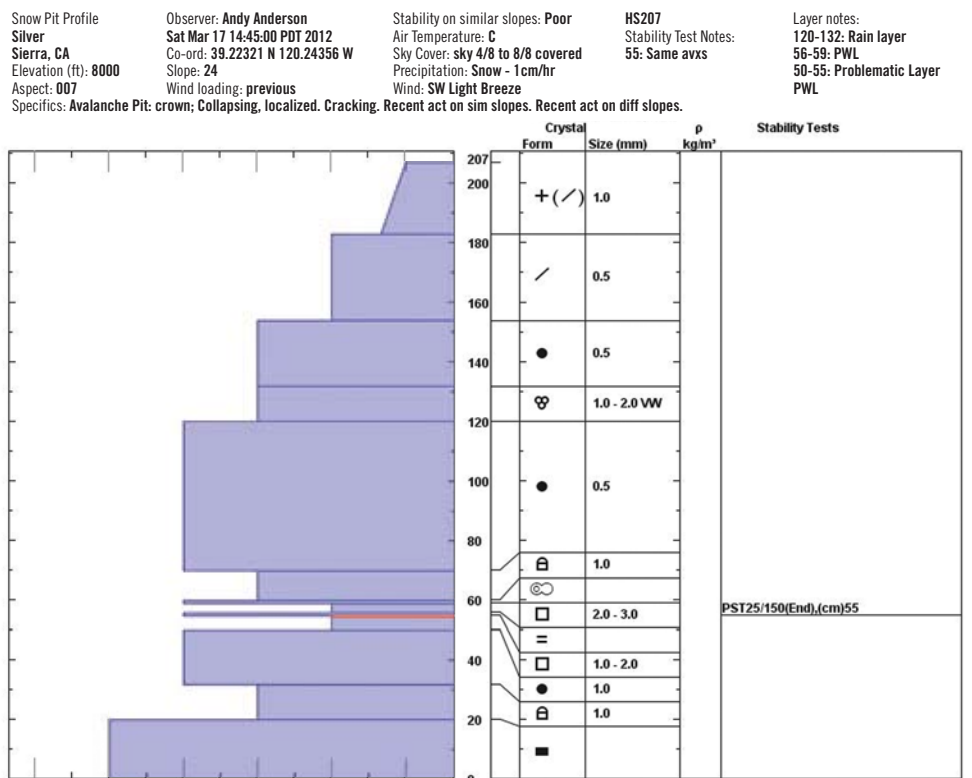
The winter of 2011/12 once again exhibited the fundraising and management strengths of the not-for-profit Sierra Avalanche Center in partnership with Tahoe National Forest. The proven business plan between these two organizations goes beyond typical Friends Group support. This ever-evolving relationship, executed through an annual operating plan and collection agreement, allows the SAC to collaborate with the Forest Service to provided continued avalanche center operations while also collectively focusing on future development.

—Brandon Schwartz & Andy Anderson, forecasters

Continued on next page ➡



This deep-slab avalanche occurred March 17 (snowpit profile, right). Photo by Andy Anderson



SEASON SUMMARIES 2011/12

continued from previous page



Wind event on Mt Shasta on February 14-15, 2012. Green Butte/Sargents Ridge on right, Casaval Ridge on left. Photo by Mike Hupp

■ **Mt Shasta Avalanche Center**

Dismal, non-existent, and depressing were words commonly heard among snow lovers for most of the Mt Shasta winter, as week after week the storm track headed north and left the mountains looking wind-scoured and snowless. In fact, the beginning of the season until mid-January was one of the driest on record. And then there was miracle March. The jet stream finally shifted south bringing us more than 10" of water in town and 8-9' of new snow in the mountains. In six weeks we climbed from 37% to 63% of our seasonal water average, and March itself ended at 173% of normal. The snow continued in early April, and by the end of the month our mountain snowpack had reached 100% of normal with about 10' of snow on the ground at 8000'.

Unlike the suspicious snowpacks in the Rockies and Pacific Northwest, Mt Shasta experienced very little instability for much of the season due to limited accumulation. We did see persistent facets near ground level in some locations, but these were generally well anchored and did not result in slides. The usual suspects began making an appearance during our March-April storm series, but for the most part, naturals were isolated and small, and trailhead road closures during our largest storms kept folks from testing skier- or machine-triggering potential. A total of 47 avalanche advisories were published as well as multiple mid-week updates as conditions warranted. For the dates issued, avalanche danger was posted as Considerable 28% of the time, moderate 32%, and Low 40%. From December through April, our Web site (www.shastaavalanche.org) received 41,732 visits.

Staffing issues improved this season. In January the Friends of the Mt Shasta Avalanche Center (FMSAC) board of directors voted to provide up to \$6000 emergency funding to hire a seasonal avalanche forecaster through April 30, 2012. Once it became clear that federal funds would not be available to provide a second forecaster through the Forest Service, a plan was implemented that would allow a seasonal forecaster to be paid by FMSAC but work as a volunteer for the Forest Service. Although this was intended as a short-term solution until the FS filled its second forecaster vacancy, it provided valuable time and energy to accomplish outreach goals.

Keith Potts expanded his role as FMSAC executive director by working 15-20 hours per week assisting Forest Service Avalanche Specialist Nick Meyers in forecasting, field observations, avalanche-awareness training, and public outreach. Keith worked as a voluntary forecaster from 2004 through 2007 for MSAC, writing advisories and accompanying Matt Hill and Eric White in the field. He has worked as a Shasta Mountain Guide for 10 years, holds a Level 2 avalanche certification, and is an Affiliate member of the American Avalanche Association.

Nick Meyers has been a seasonal Mt Shasta climbing ranger for 10 years, and last year he received the permanent lead climbing ranger/avalanche specialist position on the district. This season was Nick's first full season as lead avalanche forecaster for the MSAC. He greatly appreciated the help from Keith, as running an avalanche center with one person is not easy! Nick is adjusting to his new duties and is learning tons every day. He looks forward to improving his forecasting skills and working with



MSAC Director Nick Meyers gets a feel for the snowpack. Photo by Keith Potts

and meeting more of the avalanche community in the future.

Highlights for the season included special avalanche and winter travel training for Southern Oregon University students, Siskiyou County Search and Rescue, and a climbing presentation at the Siskiyou Sportsmen's Expo in Yreka. Nick and Keith taught avalanche awareness and transceiver clinics throughout the season, collaborated with the Mt Shasta Ski Park to set up and demonstrate a BCA Beacon Basin, and held several Forest Service awareness trainings. Field time consisted of data collection as well as ski and snowmobile patrols.

The Friends of the Mount Shasta Avalanche Center kicked off the season with its annual Movie

Night, showing Sweetgrass Production's *Solitaire*, which features Mt Shasta native Forrest Coots. January brought the 10th Annual Snow Ball with local band Blue Relish keeping the dance floor buzzing until midnight. In March FMSAC hosted splitboard-mountaineer Kyle Miller as he presented a slideshow of his accomplishments, along with a showing of *FreeRider*, a Crest Pictures documentary of Kyle "living his dream." All told FMSAC raised close to \$10,000 for the avalanche center to support education and outreach campaigns, forecaster compensation, Web site hosting fees, weather station maintenance, and community scholarships.

Looking ahead, goals for the 2012/13 season include upgrading general weather station communication to avoid gaps in data, retooling the MSAC Web site to provide clearer and more functional advisory information and continuing to develop a reliable and informative observation network.

—Nick Meyers, lead climbing ranger/avalanche specialist, and Keith Potts, forecaster

■ **Payette Avalanche Center**

Looking back at the 2011/12 winter I remember a lot of stormy days and just a handful of sunny ones, which is odd considering our winter weather started late, then was punctuated by several high-pressure cycles and an abundance of mid-winter rain. Reflecting on the avalanche problems over the winter, I realize we saw literally every crazy combination of weather possible as well as some of the most frightening snow structure imaginable, yet had no serious incidents in our area.

After a truly "facetnating" December, it turned hot and heavy (literally) in the West Central Mountains. Going into Christmas week, PAC had issued no advisories, and local ski resorts were lucky to open a few beginner runs on man-made snow. The 50cm of rotten facets sitting on the ground combined with above-average temperatures, five months of precipitation packed into 2 ½ months of winter, and high winds made for some exciting natural avalanche cycles. Our backcountry updates all sounded the same: "The facets are growing, be careful when we start getting new snow."

PAC issued the first avalanche advisory on December 29 following several days of post-Christmas storms with Considerable hazard on all aspects and High hazard on all northerly aspects. During this time we also had our first round of

shallow natural and skier-triggered avalanches, but luckily the masses were still waiting for a little more snow before venturing into the backcountry.

Cue the rain: after a week of heavy snowfall we got hosed to the top of our highest peaks. This additional moisture was just enough to trigger slides all the way down to the basal facets. Several big slides crossed groomed snowmobile trails, and most of our north- and east-facing terrain experienced a widespread cycle with crowns in the 1-1.5m range. In retrospect, the big slides on the perceived "safe" groomed trails may have helped prevent accidents within the backcountry snowmobile community as the winter progressed. The beginning of the New Year and a return to sub-zero temperatures marked the end of the 2011 snowfall; another lengthy high pressure nearly convinced even die-hard skiers to give up any hopes of a powder season.

After two weeks of sun crust and near-surface facet formation above the late December rain crust (the beginning of a persistent facet-on-crust problem) the NWS gurus promised a return to "normal" winter conditions. The mid-January storms did not let us down; we picked up nearly 150cm (15+cm of SWE) in seven days with high winds and another four days of High hazard. This two-week storm cycle ended with partially buried crowns that camouflaged how big the avalanche cycle had been. The weather did not cooperate to document all the action, but skiers and sledgers triggered several slides during this period. Most of our leeward slopes experienced another substantial natural cycle; some areas failed in the new snow layers and others failed at the facet/crust interface.

February started out much like early January with high pressure, improving stability and additional NSF, surface hoar, and melt freeze crusts building. By February 20, snow was falling again on the West Central Mountains, and an extremely high wind



This slide occurred 12/28/11 during our first big natural cycle of the winter, when a big slab began loading our December facets. It ran just below a groomed snowmobile route, and was either a natural or triggered remotely from above. Photo by Dave Bingaman



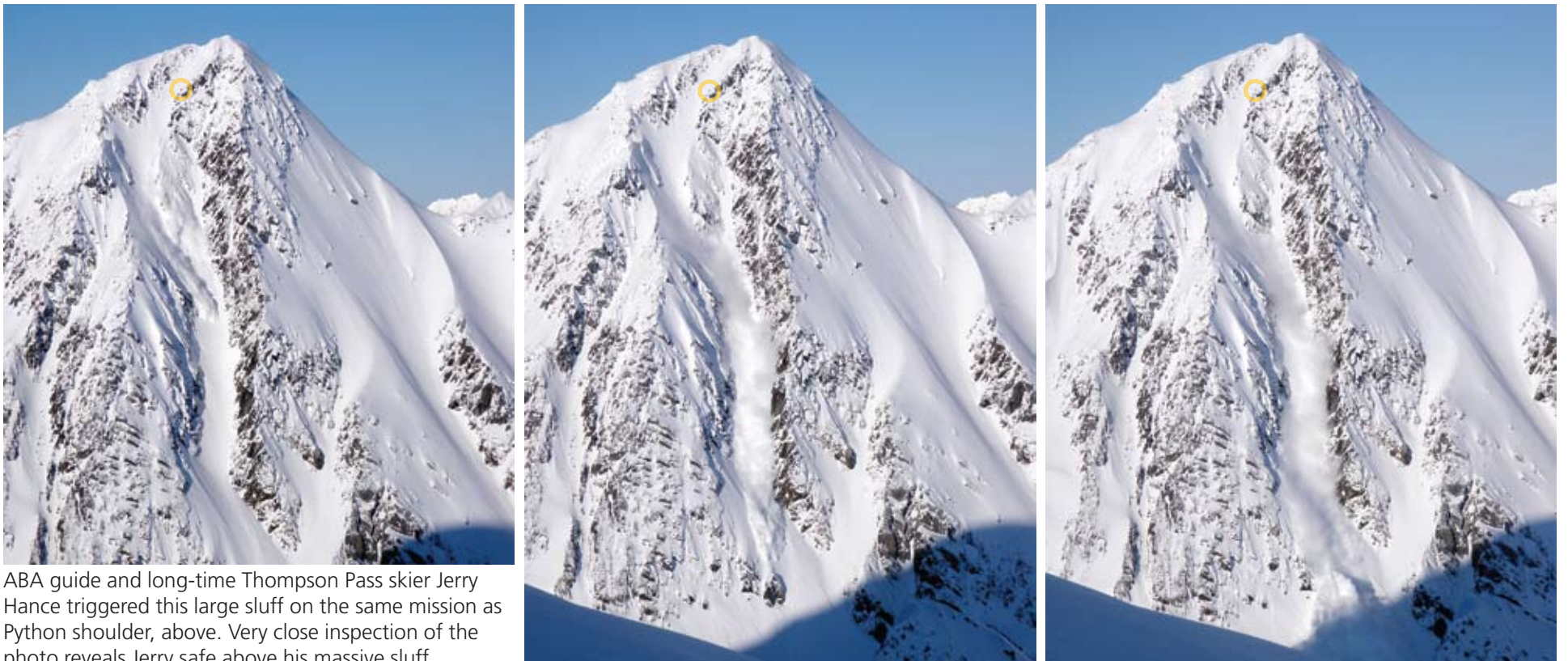
This natural avalanche from 1/25/12 occurred at the end of a 50"+ warm storm cycle on top of the problematic crust-facet combo that plagued us through the season. Photo by Steve Jones

Alaska 2011/12: 2 photo sequences

Photos by Andy Brooks



ABA guide Paul G skier-triggers a new-snow soft slab avalanche on Python shoulder, Thompson Pass, AK, less than 24 hours after a 2' storm. He went for a little ride and left lots of lurking hangfire behind him.



ABA guide and long-time Thompson Pass skier Jerry Hance triggered this large sluff on the same mission as Python shoulder, above. Very close inspection of the photo reveals Jerry safe above his massive sluff.

event ushered in two more weeks of constant storms and smaller avalanche cycles. Temperatures between storms and even within storms varied wildly with light-density snow being followed by graupel, high-density snow, and even more high-elevation rain. Pit profiles showed at least three individual layers of graupel, partially preserved surface hoar, and two rain crusts – including the December crust-on-facet weakness and the remnants of the early basal facets that were still intact in some areas despite the thick snowpack. Skiing and riding conditions at the end of the month were the best of the winter with below-average temperatures and plenty of moisture. Going into March, lee slopes were filled in with more than 3m of snow above 7000'.

Early March was a mix of small storms and warm days with another major precipitation event that started on the 13th and evolved into a wildly inverted snowpack with high winds and two significant rain events coming on top of 60cm of light-density snow. Over a 30-hour period, local SNOTELs picked up 6-9cm of SWE with temps averaging between 1.5-2C. This was more than enough to reawaken some of the deeper instabilities, causing some paths to release for the third time during the winter with timber-snapping results. No reprieve was in store as we picked up additional snow and another high-elevation soaking on March 21 followed by dropping temps which set up the saturated middle- and lower-elevation snowpack into something resembling an ice rink. This layer set us up for a slick bed surface for the storms that would keep the hazard at Considerable through the middle of April. Our forecast season ended on April 7, but the avalanche season did not end and culminated April 28-29 with a widespread natural avalanche cycle that possibly ran all the way to the early January rain crust/facet interface. We were unable to investigate but received some observations from late-season snowmobilers and local pilots. The May cycle left us with some of the largest crowns we have ever observed in our area.

Despite the prevalence of dangerous conditions through the winter, we had only a few near misses and no reported burials or fatalities in our forecast area; winter use in the area seemed to be slightly above average. PAC issued 39 advisories with only one full-time forecaster on staff compared to 57 from the previous year with two full-time forecasters. PAC also hosted two basic avalanche classes, a Search and Rescue class, and two snowmobiler-specific awareness classes, and we participated in a regional



The new PAC Sleducation trailer, acquired with grant help from the Idaho Department of Parks and Recreation, is a great visual aid for parking lot presentations and informal conversation.

Photo by Dave Bingaman

SAR drill with local rescue teams. Because of the reduced staff, PAC relied heavily on volunteer travel and teaching partners and logged 40+ field days with volunteers.

PAC also finalized a grant with Idaho Department of Parks and Recreation which allowed us to purchase a fully wrapped, enclosed snowmobile trailer which became an attention-getter at local trailheads and snowmobile events. The Sleducation trailer also became a backdrop for our snowmobile avalanche classes with companion-rescue graphics courtesy of BCA, red flag warning signs, danger scale, and a few choice photos from local sled photographers. The trailer also functions as a rescue tool outfitted with necessary gear to aid in local SAR avalanche operations.

Lastly, PAC helped our Friends group organize and re-establish their 501(c)(3) status. They have become a valuable partner in our outreach and education efforts as well as to establish an entity to help with fundraising as federal and state budgets become increasingly tight. Going into next season, PAC hopes to return to two full-time forecasters and will continue to work with our Friends to provide avalanche information and education to the West Central Idaho area.

—Dave Bingaman, last man standing at the PAC ❄️



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