

THE

A Publication of the American Avalanche Association

Avalanche

REVIEW

US \$4.95

VOLUME 23, NO. 1 • OCTOBER 2004

Web site: www.AmericanAvalancheAssociation.org

NAC 2003 / 04 Season Roundup

In the height of winter, you know what's going in your local mountains. But keeping up with what's happening elsewhere is not easy. You might hear vague stories about snow droughts or big storm cycles well after the fact. Sometimes you might hear conflicting rumors about the same event. This issue's feature article is your chance to catch up before the upcoming season gets started. As it has for the past two years, *The Avalanche Review* is starting its season by featuring reports from the Forest Service Regional Avalanche Centers—the centers that issue avalanche advisories for backcountry skiers, snowmobilers, snowboarders, and other winter recreationists. These reports summarize weather and avalanche conditions, any notable incidents or accidents, and center activities and growth. We're also featuring an analysis of off-piste accidents in France last season. Take a look; find out what happened in the backcountry last season.

—story starts on page 14



Dave Kikkert explores the crown of an avalanche that occurred overnight January 1-2, 2004. The avalanche was on the east face of Mendon Peak in the Wellsville Mountain Wilderness Area near Logan, Utah. *photo by Toby Weed*

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OCTOBER 2004 • VOL. 23 • NUMBER 1

The Avalanche Review is published each fall through spring by the American Avalanche Association, Inc., a non-profit corporation. The *Avalanche Review* welcomes the submission of articles, photographs and illustrations.

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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 promote and act as a resource base for public awareness programs about avalanche hazards and safety measures;
- F. To promote research and development in avalanche safety.

Subscription: \$20 per year (4 issues). Subscription is included with membership dues to AAA. For subscription and membership information, see www.AmericanAvalancheAssociation.org.

Contributions: Please submit material eight weeks prior to publication date. Include address and telephone number. Please submit typed manuscripts by e-mail or disk (3.5", Zip or CD), using any popular word processing program. Submit any figures in B & W, or as a TIFF or JPG file (300 dpi resolution at 100%). We will return materials if you include a stamped, self-addressed envelope.

Articles, including editorials, appearing in *The Avalanche Review* reflect the individual views of the authors and not the official points of view adopted by AAA or the organizations with which the authors are affiliated unless otherwise stated.

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from the president: russ johnson

Welcome to another year of *The Avalanche Review*. As I write this sitting on a dock in the brilliant sunshine of Lake Tahoe, it is hard to imagine that another winter is right around the corner and the twenty-third year of TAR is underway. In this column I would like to focus on the relationship of the American Avalanche Association with the American Institute for Avalanche Research and Education (AIARE). At last fall's annual AAA meeting we held a one-day education seminar and invited Tom Murphy, one of the founders of AIARE, to speak. At that time—and again at the spring Governing Board meeting at Sugar Bowl—Tom outlined AIARE's mission and goals. I think he answered a lot of questions and left the impression with the audience that AIARE is a healthy, growing endeavor educating hundreds of people.

I have often been asked, "How does AAA feel about AIARE? Aren't we in competition?" To those questions I have to reply that I have never felt that we were in competition. AIARE is a provider of curriculum and training to instructors. They are essentially a franchiser of their curriculum materials. AAA has consistently and consciously avoided providing curriculum for avalanche courses. What we have provided are curriculum guidelines. Those schools which cover the guidelines can advertise this if they choose. The only competition between our organizations might be for

avalanche education dollars. Even here our funding sources are completely different. AIARE is funded by grants, the sales of their curriculum and instructor training courses. AAA's funding is almost entirely derived from membership dues and donations.

Another source of confusion is the notion that AIARE is "certifying" instructors in conflict with AAA certified instructors. Again, I think there are two separate things happening. Technically, AIARE is not "certifying" instructors but rather just training them. There is not a rigorous pre-requisite to take an AIARE instructors' training course. The AAA instructor certification is a high bar with tough pre-requisites, and someone so certified can put together courses, teach all parts of the curriculum, etc.

From the beginning, it has been AIARE's agenda to standardize avalanche curriculum for the United States. In their ideal world, every avalanche school in the country would purchase their curriculums, and all the instructors would be AIARE trained. It should be emphasized that AIARE allows some leeway in instructing the courses as far as providing material or mixing the lesson plans around as long as the points in the curriculum are covered. The goal is to standardize avalanche education curriculum so that a student coming into a Level 2 course has had a Level 1 which is consistent across the country and their level of education is known.

What came up at the spring meeting of the Governing Board was a request from Tom Murphy for the AAA to

"endorse" AIARE and enter into a "partnership." Granting this request would seem to me to make AIARE sort of the "official" avalanche school curriculum of the AAA. While it has been the long-standing policy of AAA not to "certify" individual schools, there may be no good reason not to "endorse" the AIARE curriculum. At the same time, there is no good reason not to "endorse" the curriculum of other non-AIARE schools as well.

One question that did arise concerned AIARE schools which last only two days and therefore do not comply with the AAA curriculum guidelines. Another issue is that, currently, AAA has no guidelines for a level 3 avalanche course. It is difficult to endorse an AIARE Level 3 school when we have no course guidelines of our own on which to base a decision. It will be a project of the education committee to come up with guidelines for level 3 as well as to review the level 1 and level 2 guidelines. In the meantime, it was the sense of the Governing Board that we express support for the educational efforts of AIARE. We acknowledge

that avalanche schools have wide ranging differences in competence and that there is inherent worth in creating curriculum which can be counted on from one school to the other. We are not endorsing AIARE exclusively, but we do acknowledge that they have made a significant and unique contribution to avalanche education.

In other summer news, Ethan Greene and members of the Research, Education and

Standards committees have completed the immense project of compiling Observation Guidelines and Recording Standards for the United States. These will be available for purchase at ISSW as well as online through the AAA internet store. This has been a daunting undertaking which Ethan spearheaded, and the avalanche community owes him a debt of gratitude for this selfless volunteer effort. If you run an avalanche school, ski patrol, backcountry service or other avalanche-related business, these new guidelines are the standard for recording your observations. They have much in common with the Canadian OGRES which many of us have been using, as well as with the old green and blue Forest Service sheets we used in years past. The effort here is to get everyone on the same page using commonly accepted standards and symbols. The document is one which can be revisited and modified over time as the need arises. For now, get a copy and get comfortable with it, and let's see how it works out in the field.

Finally, this summer, Michael Jackson, the new chairman of the Education Committee, has been working on curriculum for an "avalanche operations course." He traveled to Canada to get ideas from their courses and is putting together an AAA course aimed at advanced avalanche training for professionals. The AAA envisions it as a multi-day (8 or 10), in-depth course emphasizing forecasting, travel problem solving, avalanche mitigation, etc. More on how this is coming along at the ISSW. We'll see you there.



The Avalanche Review: A Call for Submissions

- Seen any good avalanches lately?
- Got some gossip for the other snow nerds?
- Developing new tools or ideas?
- Learn something from an accident investigation?
- Send photos of a crown, of avalanche workers plowing roads, throwing bombs, teaching classes, or digging holes in the snow.
- Pass on some industry news.
- Tell us about a particularly tricky spot of terrain.

Write it up; send it to us. *The Avalanche Review* is only as good as the material you send. TAR is accepting articles, stories, queries, papers, photos. We can help if you're not sure how to write it up.

Send text as .doc or .rtf files.
Send photos as grayscale .jpg files.

Editorial Submission Deadlines

Vol. 23, Issue 2 October 15, 2004
Vol. 23, Issue 3 December 15, 2004
Vol. 23, Issue 4 February 15, 2005

The Avalanche Review

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correspondence

Dear AAA Members,

I'd like to thank the AAA Board for fitting me into their meeting at Donner Pass on April 12th. It was encouraging to receive their support for what AIARE is doing.

I had the opportunity to sit in on the meeting prior to my presentation and having never been to an AAA board meeting before, I was very impressed. The people we have on the AAA board are a dedicated and passionate group, concerned about the organization and its members. I attempted to thank each one of them individually and recommend that should you know or run into a board member, that you take the time to shake their hand and let them know you appreciate their efforts.

Tom Murphy, AAA Professional Member / AIARE Executive Director
www.avtraining.org • info@avtraining.org

correction

Due to a formatting error, two symbols in the *100 Inch Storm* article in Issue 22-3 (May, 2004) was misprinted. The proper abbreviations for Potential Temperature and Equivalent Potential Temperature are θ and θ_e . The error was TAR's, not the authors'.



Members of the AAA Board after the April Meeting at Sugarbowl, CA.

(left to right): Janet Kellam, Andy Gleason, unknown, Bill Glude, Ethan Greene, Bill Williamson, Mark Mueller, Lynne Wolfe.
Photo by Doug Richmond

metamorphism

New Professional Members Spring 2004

Robert Athey, Salt Lake City, UT
Dean Cardinale, Snowbird, UT
Sarah Carter, Juneau, AK
Peter Carvelli, Aspen, CO
Mark E. Fisher, Minden, NV
Jim Fitzgerald, McCall, ID
James Garrett, Salt Lake City, UT
Geoff Gross, Girdwood, AK
Debbie Kelly, Aspen, CO
Bart Mitchell, Big Sky, MT
Will Paden, Truckee, CA
Chuck Rea, McCall, ID
David Simeral, Reno, NV
Aaron Sparling, Portland, OR
Ben Stratton, Girdwood, AK
Dave Swanwick, Salt Lake City, UT
George Willis, Zephyr Cove, NV

New Member Affiliates Spring 2004

Jake Amadon, Ketchum, ID
Adam Babcock, Copper Mtn, CO
James DiIanni, Redmond, WA
Mark Fisher, Victor, ID
Nate Greenberg, Mammoth Lakes, CA
Colin Grissom, M.D., Park City, UT
Matt Levenson, Wilmington, NY
Richard Mullowney, Kenai, AK
Brooke Munro, Juneau, AK
Patrick Stanton, Redmond, WA
Simon Trautman, Bozeman, MT

New AAA Certified Avalanche Instructors

Kellie Erwin, Golden, BC
Bill Glude, Juneau, AK
Dan Moroz, Frisco, CO

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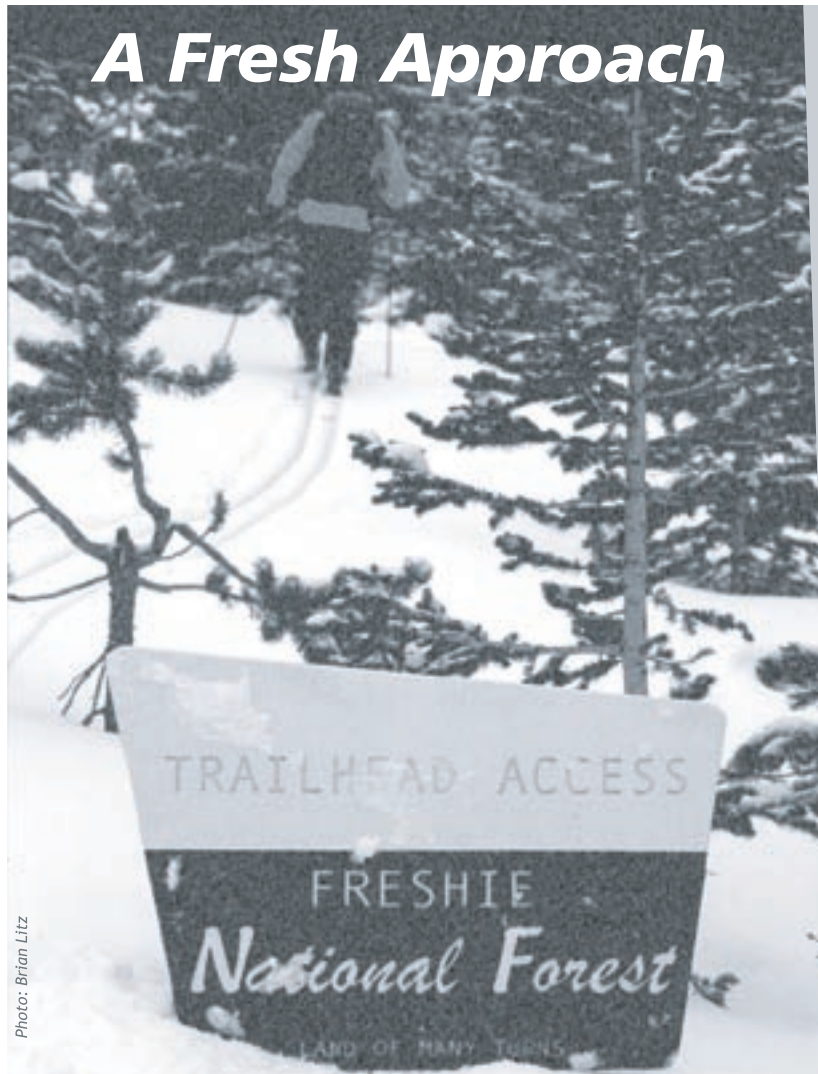


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aaa news

AAA Membership Profile, Summer 2004

The following profile of our membership was compiled in July 2004 and represents the best information available at that time.

TYPE	Summer 04	Spring 04	Spring 03	Fall 02	Spring 02	Fall 00	July 98
Hon	14	14	14	12	12		
Life	10	10	9	9	9		
Pro	368	341	341	320	329	419	274
PROa	4	21	22		17	6	36
Exp Pro	44	51	29	33	49		
Mem	105	93	87	82	75	80	62
MEMa	3	9	14		18	1	16
Exp Mem	24	27	14	24	30		
Sub	232	212	224	243	229	198	221
Exp Sub	52	76	43	3	34		
Trade	17	16	18	17	17	30	23
Comp	36	37	34	32	30		
Total	909						

a = applicants Exp = memberships and subscriptions expired as of 10/31/03.



President Russ Johnson presiding over the April AAA board meeting at Sugarbowl, California. Photo by Doug Richmond

Membership by Activity—

many engage in multiple activities

Ski Area.....	235
<i>Includes 66 Ski Patrol Directors, Asst. Directors, Snow Safety Directors and Asst. Snow Safety Directors</i>	
Guides	
Mtn and Ski Guides.....	81
Heli-Ski Guides.....	46
Cat Ski Guides.....	16
Snowmobile Guides.....	1
Educators.....	96
Forecast Center Staff.....	57
NSPS/CSPS.....	47
DOT/Transportation/Industry.....	30
Consultants/Engineers.....	29
USFS Personnel.....	28
Professors.....	22
Snow- and Avalanche-related	
Businesses.....	21
SAR/Mtn Rescue.....	19
Dog Handlers.....	13
Students.....	10
Authors and writers.....	8
NPS Personnel.....	7
College Outdoor Programs.....	7
Libraries.....	7
Hut operators.....	5
Attorneys.....	2
USGS Personnel.....	1

US Membership by State—

includes all membership categories

Alaska.....	43
Arizona.....	6
California.....	107
Colorado.....	199
Connecticut.....	3
Dist. Of Columbia.....	1
Georgia.....	2
Idaho.....	65
Illinois.....	2
Indiana.....	1
Kansas.....	1
Massachusetts.....	5
Maryland.....	9
Maine.....	5
Michigan.....	1
Minnesota.....	2
Missouri.....	1
Montana.....	59
New Hampshire.....	9
New Mexico.....	9
Nevada.....	16
New York.....	14
Ohio.....	2
Oregon.....	27
Pennsylvania.....	2
Rhode Island.....	1

South Carolina.....	1
Utah.....	82
Virginia.....	9
Vermont.....	12
Washington.....	74
Wisconsin.....	1
West Virginia.....	2
Wyoming.....	36

**membership currently includes 33 of 50 states and the District of Columbia*

Foreign Members—

includes all membership categories

Australia.....	1
Austria.....	5
Canada.....	39
Chile.....	2
France.....	4
Germany.....	2
Iceland.....	1
Italy.....	3
Japan.....	6
New Zealand.....	3
Norway.....	4
Russia.....	1
Scotland.....	1
Spain.....	3
Sweden.....	4
Switzerland.....	12
Turkey.....	1

Top 10 States—

includes all membership categories

#1 Colorado.....	199
#2 California.....	107
#3 Utah.....	82
#4 Washington.....	74
#5 Idaho.....	65
#6 Montana.....	59
#7 Alaska.....	43
#8 Wyoming.....	36
#9 Oregon.....	27
#10 Nevada.....	16

Planting Grassroots in the Snow

Sierra Avalanche Center joins the list of collaborative avalanche forecasting efforts

Story by Mike Colpo

With budget cuts a common theme for today's land management agencies, it comes as no surprise that funds for avalanche forecasting are an increasingly rare commodity. To date, government-supported avalanche forecasting has typically fallen under the purview of the U.S. Forest Service. A relentless stream of federal-level budget cuts is severely undermining this resource and forcing avalanche forecasters to face the difficult reality of trimming avalanche forecasting funds from their budgets. The majority of today's centers are no longer supported by the USFS, but rather by "Friends" organizations through cooperative agreements that allow the transfer of funds to support the centers. With the exception of a few isolated programs, Forest Service funding dried up many years ago.

Forest Service managers concerned with maintaining the standards of their agencies' avalanche forecasting have a tough row to hoe. Robert Moore, of the U.S. Forest Service's Truckee Ranger District, located in the Central/Northern region of the Sierra Nevada, joins a growing list of administrators who have learned the importance of ingenuity and flexibility in maintaining their avalanche-forecasting services. To this end, Robert Moore has worked with Phil Caterino (of Cyberspace Snow and Avalanche Center [www.csac.org] background) to help form the Sierra Avalanche Center (SAC). The newly formed SAC is the latest in a growing list of grassroots avalanche awareness groups. The SAC is a non-profit fundraising organization with a board of directors made up of seasoned avalanche locals working in conjunction with Moore and the Tahoe Ranger District. The SAC will kick off their 2004 fundraising efforts on November 4th, with a slide show event at Patagonia's Distribution Center in Reno, NV.

In forming this collaborative arrangement with the SAC, Moore joins the ranks of other forest service districts such as the Bridger-Teton National Forest in the Jackson area, the Gallatin National Forest in and around Bozeman, and the statewide Utah Avalanche Center. All are examples of federal agencies that have concocted unique blends of federal infrastructure, non-profit fundraising, and private-sector

support to create a workable avalanche advisory program for their area. The AAA's "Friends" Avalanche Center support network provides yet another creative solution to this problem, providing an umbrella under which perennially cash-strapped forecasting centers can seek tax shelter and a broad support network.

Through collaborative agreements with private business and non-profit groups, federal agencies typically provide office space, vehicle(s), computers, uniforms, and other elements necessary to conduct a regular forecast. Despite this solid level of support, a full-time forecaster needs to earn a paycheck. This is where organizations such as the Sierra Avalanche Center come in.

The present need for a full-time Sierra forecaster is imperative. The marked increase in winter backcountry accessibility made possible by technological advances in snowmachines, skis, snowboards, and snowshoes only increases the need to maintain consistent, reliable snow-safety reporting on our public lands. And with well over 33 million people living within a three-hour drive of the Sierra Nevada, the need grows ever more urgent. The past four seasons have seen six avalanche-related fatalities in the Central/Northern Sierra.

As if these statistics don't speak for themselves, consider that among the tens of thousands of internet pages falling under the USDA Forest Service's purview, Moore's advisory page ranks as the 62nd most-visited page, demonstrating a clear public desire for the information offered in the Central Sierra Avalanche Advisory.

More than ever, avalanche forecasting depends upon public support. Without public support (or a drastic change in upper-level administrative priorities for land use), there is simply no way our land-management agencies will be able to continue providing the information backcountry recreationists rely on for safe, enjoyable access to our public lands. The duty of the informed is to share knowledge. Make sure you share your knowledge of local avalanche resources with your backcountry partners and make sure they know how much forecasters appreciate public support.

For more information, or if you're looking for new ways to support your local avalanche-forecast group, visit www.avalanche.org and www.csac.org.

Mike Colpo lives in Reno, NV at the foot of the Sierra Nevada. He is one of the coordinators of the Patagonia Pro Sales program, a backcountry skier, and an instructor for NOLS and the University of Nevada, Reno Outdoor Program.



what's new

Fishing for Dragons

Story by Dave McConnell
 Photos by Michael Stahlschmidt,
 Sideline Sports Photography

With bamboo, tape, rope, and zip ties, patrollers can fix or make just about anything. One snowy afternoon, pro patroller Joe Hurlburt started working on a better system for hanging "air shots" over possible starting zones in our hazard reduction areas. What he came up with was our original "Fishing Pole"—two pieces of bamboo taped together lengthwise, with an eight-foot section of Halloween rope tied to one end. A piece of coat hanger wire was tied to the end as the "hook," formed into a closed loop that could easily be opened or closed like a giant safety pin. The shot was assembled with a small loop of rope to hook into. With its length it was easy to hang the shot over the edge of the cornice while keeping it several feet off the snow surface, creating a nice air blast.

The only problem was skiing with a 14-foot pole.

A week later, we were sitting dispatch at the top shack, when a two-piece fiberglass collapsible limb saw caught my eye. Ten minutes later, the limb saw that was used by the trail crew in the summer became a member of the ski patrol. Much easier to ski with a collapsed six-foot pole!

The only additional modifications involved changing from Halloween rope to the woven type (it holds up better, with less unraveling). We also went to using zip ties for the loop on the 3x8 Unimax hand charge. Just punch a hole



Above: Grand Targhee's original "Fishing Pole" had only one problem: skiing downhill with a 14-foot pole. After modifying the design by utilizing a two-piece fiberglass limb saw, Targhee's Pro Patrol Director, Dave McConnell, demonstrates that it's much easier to ski with a collapsed six-foot pole.

Below: The Fishing Pole is long enough to hook a shot over a cornice edge and bob it several feet off the snow surface, which nets a nice air blast.

through the bottom edge (about an inch from the edge) with your crimpers, run a tie through the hole, and zip the ends together, leaving a large enough loop to tie the rope through easily. These loops are always installed before cap and fuse installation, to eliminate any possibility of the crimpers coming in contact with the cap. If you end up not hanging the charge, but throwing it, zip ties are cheap. Use strong, high-quality ties, however. We have had some experience with cheap ties becoming brittle and breaking while the shot is hung-Dooh!

This also works with Cast Boosters—just lace the tie through the fuse hole, and tape the fuse after it comes out of the cap well to the side of the shot. This may be a better method anyway, as there have been some problems with delayed ignition, possibly caused by the tight 180-degree bend where the fuse comes through the fuse hole and enters the cap well.

Happy fishing!

Dave McConnell is Pro Patrol Director at Grand Targhee Ski Resort.



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License to Learn: Some Thoughts on Avalanche Education

Story by Tom Murphy

Avalanche instructors are faced with a daunting task at the beginning of every course they teach—to impart a lifetime of lessons learned in the backcountry to a varied group of learners, in a short time, all while leaving the participants with information they can retain and apply.

To achieve the goal of leaving participants with information they can retain and apply, teachers use various instructional methods to capture a student's attention. All instructional/teaching techniques have their merits. One of those techniques, sometimes called "creating dialog," can have a great impact on learning not only for the participant but also for the instructor. Generating a connection between the instructor, the subject and the course participant can be a difficult connection to weave, but one that all instructors must strive for. It is within that collaboration that students begin to understand for themselves the questions that need to be asked in their quest to sleuth out answers.

COURSE TIME

As avalanche instructors, we often lament the fact that we have so little time with our students. We worry that an evening awareness course may erroneously send people away feeling they finally got all the avalanche education they needed. We plan Level 1 courses in various weekend formats and occasionally something lengthier such as a college course. Yet "If only we had them just a little longer, then they might get it," is still a common refrain among many educators.

No doubt, longer sessions are desirable from an instructor's standpoint, but just how much can the average Level 1 student actually absorb? The Canadians seem to have nailed it with their shorter Recreational Awareness Course (RAC) as a way for someone to get the basics—then decide whether to continue onto the longer courses offered by the CAA. However, here in the US, the weekend course rules. I suspect many factors are responsible for that: it's when people have built-in time off, it's easy for providers to market, that's all the more education most people suspect they need, etc., etc. Suffice to say that like it or not, awareness, one-day, two-day, one-week sessions, what have you, the average participant should only expect to get so much out of such a course and must leave knowing much is left in his or her court. Think of guitar lessons—whether it's a three-day or one-week lesson, the player still has a long way to go before they can jam with Clapton!

Given a generally limited time frame with course participants, it is imperative we make an impact. How do we do this without dumping endless facts on our students that human minds simply are not programmed to remember? How do we avoid confusing the theoretical with

the practical? I discuss some ideas for achieving these objectives below.

LECTURES

Because avalanche safety is best learned experientially, teaching such a complex subject is difficult. So what are instructors to do? We must compress an enormous amount of information into a short time frame. As instructors we realize it is our duty to impart all of the information we have on this subject to our students; so let the lectures begin! When I think back on my first metamorphism lecture, I remember the instructor being very concerned about getting me straight on TG and equilibrium forms, kinetic and destructive faceting, rounding and how vapor-pressure gradients drove these processes. But I just didn't get it that first time through and was thrown into a tailspin. In particular, I wasn't quite clear what it had to do with ascertaining the day's stability. I was sucked into the idea that if I could only understand the science, then I'd really get it. While the instructor had my best interests at heart, the lecture was just too long and hypothetical.

Thankfully, we are seeing metamorphism lectures shorten in many Level 1 courses. Students need to know that snow changes over time after it hits the ground, and there are direct and indirect weather influences that drive the processes that create crusts, facets, rounds and the like, but they don't really need to know an hour's worth of it! I know that instructors are of two minds on this; the "dumbing down" of such a theoretical discussion is heresy to some while others attempt to reduce abstract concepts to some funny guy standing on beer cans presumably recently emptied!! Save the heavy lecture series for the L2 course or risk losing all but the most scientific minds in the audience.

As instructors who have their students for a short time, we are charged with sharing what we as practitioners do to gather, assess, reassess, share and act on information. The lecture format has its place in avalanche education but good educators know how to mix up presentation and instructional styles. Our discussions need to be tactful and to the point. We need to clear up the mysteries, not create them. Above all, the discussions need to be just that. We need to allow the participant to know that by applying a little common sense, they too can understand these topics.

DIALOG

Well, how do we do that? We do it by doing the things good avalanche instructors have done for years; we create dialog instead of lecture. Creating dialog is not just as simple as asking the audience random questions and hoping something creative results. Instead, we move the subject to the center of the room, and we let the students and instructors share what they know or think they know about the subject.¹ This approach is dangerous because we are inviting strangers into the discussion. If an instructor is not vigilant about keeping people on track, things can explode, though that is not all bad if it turns into a learning experience, especially for the instructor.

If we as instructors can create dialog for each subject, particularly in the L1 classroom, we will be more effective in our teaching endeavors. I will share two topics in which I allow the students, through dialog with the instructor as well as the other participants, to discover for themselves that they probably know more about avalanches than they believe they know.

We begin a course with a case study. Beginning the course with a case study initially seemed a little strange for me. My thoughts were, "These people know virtually nothing about my subject; I must first impart all of my knowledge via a lecture format and then toward the end of our sessions, should the student not need medical attention for the instructor-induced coma, we can start to figure out what people involved in accidents might do differently next time!" So when I tried beginning with a case study and had students look at it and analyze what was happening in terrain, snowpack, weather, avalanches observed and human factors, and had them discuss this case with other participants in small groups, the results were quite surprising.

By keeping the students centered on the key concepts (as listed above), the small groups were each able to come up with practically every error executed

in the case study. The class had hardly even begun, yet by applying some common sense, the students were able to understand most of what had gone wrong. This process allows students to feel that yes, even they, with a little bit of instruction and communication among peers, can come to a better understanding of what initially appears to be a very mysterious subject. It gets the students feeling more at ease and they can learn and share with the instructor and other participants. The particular case study can be used as a touchstone over the length of the course, to which the instructor returns to make specific points.

In **Planning and Preparation**, I have the students again group in twos or threes. The scenario goes as follows; they are airline pilots (on the ground) on a flight from one town to another and their co-pilot has gotten sick and cannot complete the flight. It is up to the remaining pilot (the students) to find another pilot to assist them and to plan for the remaining segment of the flight to the next destination. It's amazing to see how the idea of flight suddenly gets people focused on information. They want indepth information about the new pilot, what their route will be, their bail-out plans, their emergency supplies, the training of the crew the fuel, the location of other airports, and other details. These points can easily be transposed by the instructor onto things we need to do prior to going into the backcountry. Among these are that they need to develop options for routes on their "Ideal Trip" and they also need to have a "Safer" and a "Safest" trip in mind should their "Ideal Trip" become questionable. This hopefully might help to diffuse "summit fever"² or the "commitment factor"³. Interestingly enough, many of the students say they do not have that kind of concern for prior planning when heading into the backcountry. I then explain that all of the pilots I spoke with in researching this dialog looked upon flying as much safer than venturing into the backcountry.

My hope is to eventually turn every topic in a L1 course into such a meaningful dialog as those mentioned above. With help, I think it can be done. In such dialog, the participants and I discuss key concepts in terms that participants can relate to and retain. In the short time we have these people, this must be our goal. We need to emphasize ways for students to continue their education, such as field time and recommended additional learning tools such as reading materials, Web sites, and other courses. However, their Level 1 course must be the knowledge hub they return to with confidence.

An introductory course in avalanche education must be viewed as giving the participant a "license to learn." The passion that the instructor imparts during the course and the tools he or she provides are what will motivate students to become better decision makers.

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FOOTNOTES

- ¹ Parker Palmer, 1998, *The Courage to Teach*
- ² Fredston, J. and D. Fesler, 1994, *Snow Sense: A Guide to Evaluating Snow Avalanche Hazard*
- ³ Ian McCammon, 2002 ISSW, Pentiction, Canada, *Evidence of Heuristic Traps in Recreational Avalanche Accidents*

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Cornices formed by prevailing winds.

PisteHors.com has been publishing information in English about off-piste and backcountry accidents since 2000. During the 2004 winter season, over 300,000 pages of content were accessed, around a third of them news articles. We have also provided background information to newspapers including *The Observer*, *The Daily Telegraph* and *The Independent*. We believe this is a valuable contribution towards educating skiers, snowboarders and snowshoers who are thinking about going off-piste.

We have used the term *off-piste* to describe the area within or in proximity to the ski domain but outside of open and secured ski pistes. *Backcountry* is used to describe the rest of the mountain environment which users will normally access by climbing, either from ski lifts or from the valley. Although the risks faced are similar, there are certain significant differences. I have used the term *skier* to describe all winter sports enthusiasts including snowboarders and snowshoers.

THE DANGERS

The principal dangers faced by off-piste and backcountry enthusiasts are avalanches and falls. Avalanches can kill or injure from impact with solid objects such as trees or rocks, by crushing due to the weight of snow, by suffocation where the victim is buried for a short period or by hypothermia where the victim has an airspace. In general suffocation occurs within 15 minutes of burial and hypothermia after 60 minutes. Small avalanches can also carry the victim over cliffs with serious consequences.

Falls can be due to an error in navigation leading the victim over cliffs, by slipping on steep or icy routes, by falling through cornices or by a fall into a crevasse where a snow bridge has collapsed.

There are also occasional deaths due to collisions with objects such as trees, from hypothermia where the victim has had to spend one or more nights in the open or has fallen into water and from rock and ice falls.

During the period 1st October 2003 to 6th June 2004, PisteHors.com recorded a total of 42 fatalities: 24 from avalanches and 18 from falls. The figure from falls is almost certainly an understatement of the true figure, but the nature of accidents is representative for the purposes of this study.

Figure 1 shows the fatalities for the 2003-2004 season broken down by activity. 16 fatalities occurred during the six-week Christmas and Winter vacation

period, a rate of 2.67 fatalities per week. There were 26 fatalities over the remaining 29-week period, a rate of 0.89 fatalities per week. The long Easter holiday is not taken into account because the number of visits to the mountains does not increase significantly at this time¹.

SOME FIGURES

The typical accident victim is a French adult male who probably lives locally to the mountains. He is also likely to be a skier, either off-piste or in the backcountry. In total, nine nationalities were recorded with British nationals in an, albeit distant, second place.

We used the Web site: www.skirando.ch to analyse backcountry group size. We took a random sample of outings in the Northern Alps covering two periods, weekdays and weekends. The average size of a backcountry skiing group is 2.61 people; however there is significant difference between weekends (3.35, mode value: 2) and weekdays (2.07, mode value: 1). In both cases, groups are about 17% female. During the weekend, 14% of outings were by lone skiers, this figure rose to 33% during the week.

A survey carried out in 2001-2002 for the French Tourism Ministry breaks down snow sports into the following segments: 84.8% ski, 11% snowboard, 3.9% snowblade (miniskis) and 0.3% telemark and monoski. The growth in numbers for snowboarders has flattened. This survey counted people using lifts in 15 ski resorts and therefore will not correspond exactly to off-piste or backcountry. Over 80% of snowboarders now use freestyle or freeride as opposed to alpine boards.

Interventions by rescue services in 2002-2003 showed that skiers and snowboarders had roughly the same number of accidents off-piste (around 2.4%) as a percentage of the total for their discipline. The same report showed that on-piste snowboarders are 50% more likely to have an accident, possibly due to snowparks. A crude analysis would therefore conclude that snowboarders are less likely to go off-piste than skiers. However, it is difficult to extrapolate a great deal from these figures. It is technically easier for a snowboarder to go off-piste although developments of all mountain and fat skis have reduced this advantage over the last five years. Given the average age of snowboarders (25 years) compared to skiers (35 years), one would also expect to see more of them taking part in testosterone-charged radical sports. It may be that

An Analysis of Off-Piste & Backcountry Accidents in France for 2003-2004

Story by David George

This independent study analyses winter sports accidents that occurred outside of open ski pistes in France during the 2003-2004 season. The aim is to see if there are any lessons to be learned by off-piste and backcountry travellers and if improvements can be made in education and safety.

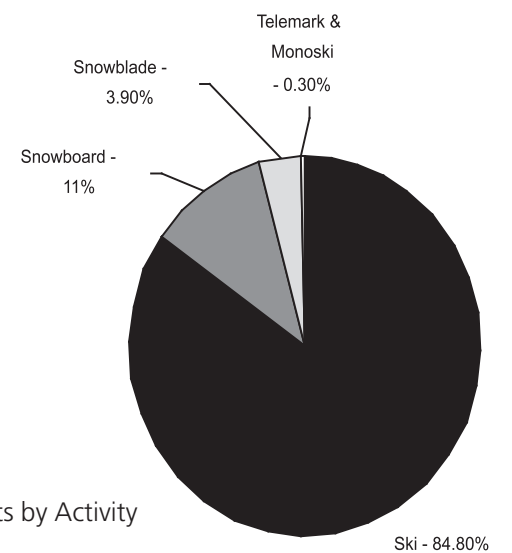


Figure 2: Snowsports by Activity

that the technical advantages of boarding means that they have fewer accidents Off-piste or that boarders are increasingly drawn to the excellent snowparks found in most resorts.

These figures differ markedly from a survey carried out by Médecins de Montage during the 2001-2002 season. The survey interviewed 1,992 people in 11 ski resorts. Of the people interviewed, 38.9% of people said they went off-piste; out of this group, 69.2% were skiers, while the rest were snowboarders. Some of the difference can be explained by the fact that the rescue service figures cover a much larger sample and the calculated figure is a percentage of total skier/days, not just occasional sorties off-piste.

For backcountry access, it is clear that skiers, including telemarkers, are in a large majority. Again a survey of outings on SkiRando showed snowboarders represented around 1% of participants. This is to be expected given the technical difficulties in climbing with a snowboard, either on foot, with snowshoes or using splitboards equipped with climbing skins. Backcountry snowboarding is still a developing market with a large future potential.

26% of snowsport enthusiasts also participate in cross-country skiing as part of their winter break. Snowshoeing is also a growing segment; recently snowshoe sales have overtaken those of cross country skis. There are 1.4 million snowshoers in France and 350,000 pairs of snowshoes. Over 50% of snowshoers go off marked trails.

About a third of visitors to the mountains are not French: British, Italian Dutch, Belgium and Eastern Block countries form the bulk of foreign tourists. The Northern Alps represent over 75% of the economic activity of French Ski stations. Ski resorts have about 50% more visitors during the peak February winter holiday period. Curiously, only just over half of winter tourists in ski resorts practice a winter sport.

AVALANCHES

The main changes in avalanche fatalities compared to last year were in ski touring and off-piste snowboarding. The ski touring deaths were affected in the 2002-2003 season by a major avalanche in early December 2002 which killed four members of a group belonging to the French Alpine Club (CAF). The three snowboard

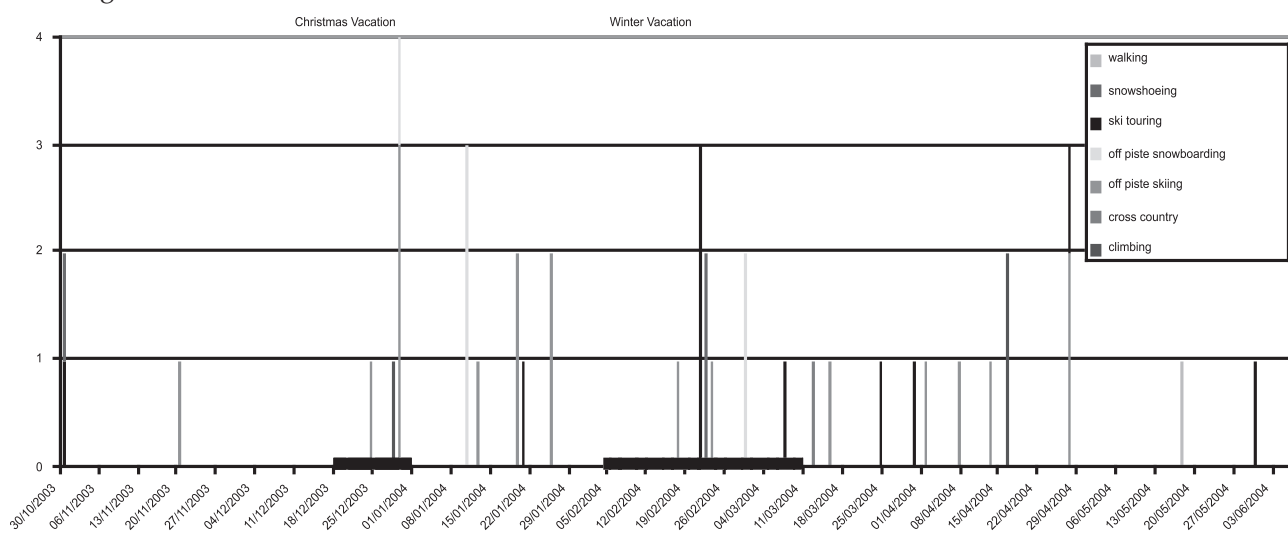


Figure 1: Off-piste and backcountry fatalities during the 2003-2004 season.

Continued next page ➔

FRANCE

continued from previous page

deaths occurred in two incidents on the same day. The majority of fatalities occurred when the avalanche risk for the area was 3 (considerable) on the five point international scale (see Table 3 on pages 10-11).

The Savoie and Haute Savoie departments were particularly badly hit with 15 deaths, six of them in the Tignes/Val d'Isère resort. This series over two weeks included a British national skiing with an instructor and attracted the interest of the UK media. The walking accident was most unusual. It happened late in the spring and involved a Dutch tourist who had strayed onto a closed section of the Galibier pass at the same time as highway workers were ploughing snow higher on the pass.

Where there was an indication in the reports, nine of the 24 avalanche victims were either experienced skiers or skiing with instructors. The reported altitude of avalanche accidents was plotted as a polynomial trend line. It decreased towards the second half of January, rising at the end of the season.



ACTIVITY	2004	2003
SKI TOURING	6	10
OFF-PISTE SKIING	8	9
SNOWBOARD TOURING	0	0
OFF-PISTE SNOWBOARDING	3	1
SNOWSHOEING	3	3
CLIMBING	3	0
WALKING	1	0

Table 1: Comparison of avalanche accidents by activity

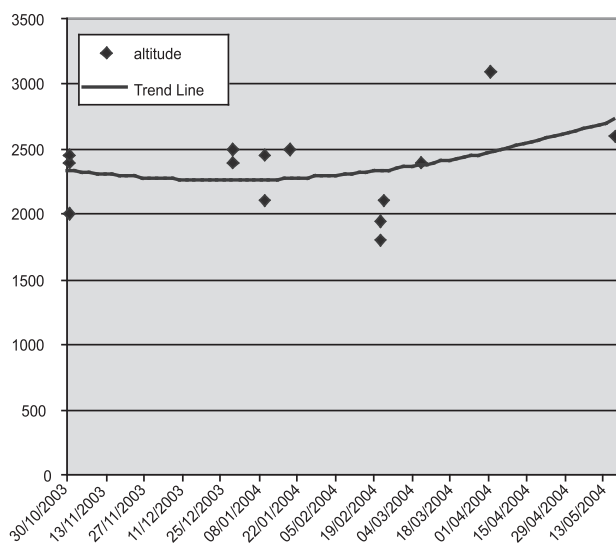


Figure 3: Reported altitude of avalanche accidents

LACK OF EQUIPMENT

Lack of rescue equipment was noted in seven of the reported fatalities. In January, a Boston resident disappeared close to Chamonix after leaving marked pistes; his body was only recovered in May. Later in the month, a former ski instructor from Auron, near to Nice, was hit by an avalanche while backcountry skiing with two friends. They were able to locate him under the slide using their avalanche transceivers but did not have probes or shovels to complete the rescue. They had to wait for the arrival of the rescue services, a delay that may have proved fatal.

A month later, a ski tourer was hit by a large avalanche close to La Rosiere. Neither he nor his friend had avalanche transceivers; the man's body was found by rescue workers. On the same day, two ski tourers were hit by a slide in the Belledonne Mountains close to Chambéry. Witnesses found one of the victims rapidly using avalanche transceivers, but rescue workers found the second some three hours later. Météo France had originally estimated the avalanche risk for the sector as 1 on a scale of 5, but a deepening weather system brought greater snowfall and rain than expected. Updates to the bulletin were issued on Friday night.

In Valloire, a man was killed by an avalanche skiing close to the pistes despite the rapid intervention of the piste patrol. On the same weekend, two snowshoers, members of the French Alpine Club, disappeared. There was a large search at the time, but their bodies were only found with the spring thaw. They had removed their snowshoes to cross a steep slope and had apparently triggered a large avalanche. Neither was equipped with transceivers, which may have at least saved the rescue services time in searching in difficult conditions.

SKIING ALONE

Four of the fatalities involved people skiing alone. A member of the high mountain police disappeared close to Avoriaz. He was an experienced backcountry skier despite his young age but had failed to find a partner for his trip. A large rescue operation was put in place and the man's body was found a couple of days later after his mobile phone company was able to give searchers his rough location. I've already mentioned two other accidents involving people skiing alone: the

Boston resident who left his companion on the slopes of the Brevent in Chamonix to return to the valley by an off-piste route and the Valloire skier killed close to the pistes. An experienced skier was also killed at La Grave skiing in a steep couloir. At least in the last two incidents witnesses were on hand to alert the rescue services who were rapidly on the scene.

SMALL AVALANCHES

An avalanche doesn't have to be big to kill you. In two of the 20 accidents involving fatalities, death was caused by impact with rocks after the skiers were carried by small avalanches or snow sluffs. André-Pierre 'Dédé' Rhem – a pioneering extreme snowboarder – and Alain Géloen, both Chamonix mountain guides, were killed in separate incidents on the Italian side of Mont Blanc after being carried over cliffs by small avalanches. Patrick Berhault, Jérôme Thinières, Edouard Baud and Eric Peymirat complete the list of French professionals killed in mountain accidents during the season.

THE WEATHER

The principal driver of avalanches is the weather and its effect on snowpack. Snow or rainstorms, strong winds, warm weather, and prolonged cold dry periods are all important in avalanche formation and release. The 2003/2004 season got underway with localized snow early in October that fell down to mid-mountain areas (1000-1500 meters). According to Jacques Villecroise, an expert from Météo France, this had only happened once, during October 1974, over the last 40 years.

These early snows soon melted and the first real winter weekend was at the end of October. Despite large snowfall in the last week of November, the unusually warm weather meant that snow cover was patchy until just before Christmas, which saw conditions more like the start of a season.

In the new year right through to the late spring, there was a pattern of warm periods followed by frequent, moderate snowfalls. In May it was possible to ski powder snow down to 1600 meters in the Vanoise and even lower in the Belledonne.

Figure 4 shows snowfall greater than 20cm with a snowflake. This quantity of snow is considered to have an adverse effect on the stability of the snowpack;

larger episodes (around 40cm of new snow) are marked with a higher flake. Snowfall data was obtained from figures recorded by Météo France at their research centre located at 1320 meters on the Col de Porte in the Chartreuse Mountains. This information was correlated against the automatic monitoring stations situated close to Chamonix, La Plagne and La Grave. Overall, the Col de Porte registered some 150 days of snowcover, slightly less than the previous 40-year average of 169 days. This sums up a season of excellent snowfall above 2000 meters but somewhat below average at lower altitudes.

Wind is also a significant actor in the conditions that lead to avalanches. Studies show that as much snow is moved by wind as is deposited by precipitation. Wind removes snow from the windward side of ridges and deposits it on lee slopes. It also breaks down the delicate structure of snow crystals and is instrumental in forming potentially unstable snow slabs.

Wind speeds greater than 25km/h can move snow around; at more than 80 km/h the snow disperses in the air and does not resettle. The public data from Météo France weather stations give wind speed but not direction. Figure 6 shows the wind speed recorded by the Ecrins station. This information is used by avalanche forecasters when preparing daily bulletins for backcountry travellers.

The dotted line on Figure 4 shows the frequency of outings in the Northern Alps extracted from SkiRando. The SkiRando data also includes human observations on snow pack and weather. An analysis of the frequency of outings to weather during the winter season (15th December – 30th April) when there is usually sufficient snow cover to ski showed that the figure is extremely sensitive to weather conditions. Although the SkiRando database is extensive, over 15,000 outings are recorded worldwide with 3000 recorded in the Northern Alps last season, most of the data is free text format making it hard to automate analysis.

The start of the season was marred by two fatal avalanches and a drama that nearly cost the life of another backcountry skier. An avalanche on the Côte Belle Mountain near the ski resort of l'Alpe d'Huez, a favourite with early season backcountry enthusiasts because of its good road access, hit a group of three experienced backcountry skiers, burying one. It took the two rescuers 35 minutes to find and free their

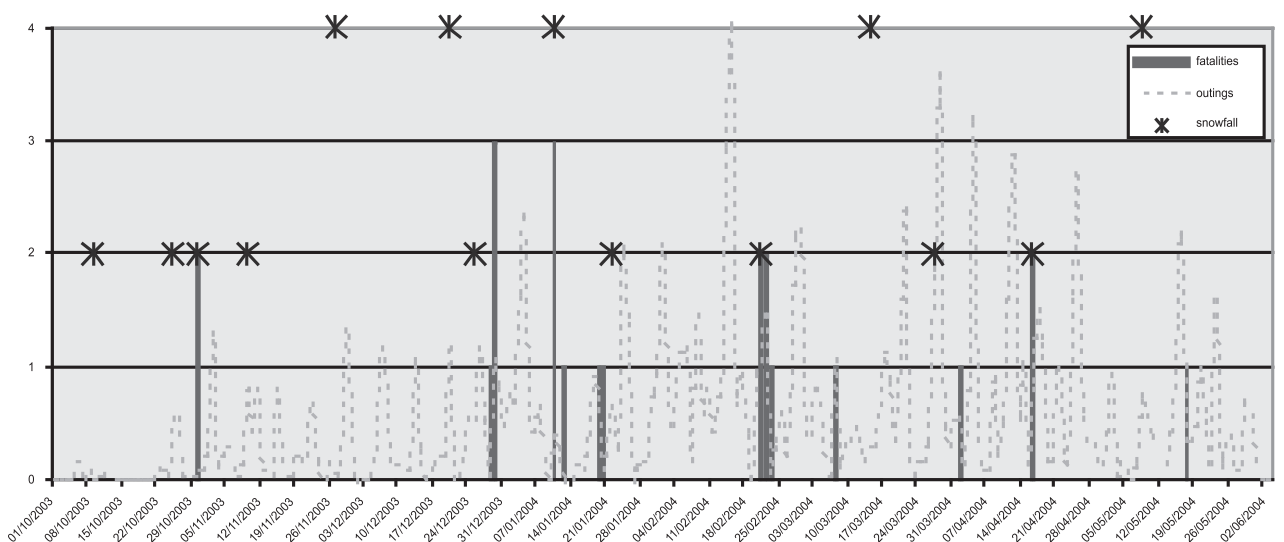


Figure 4: 2004 Avalanche fatalities plotted against outings by backcountry skiers and snowfall events.

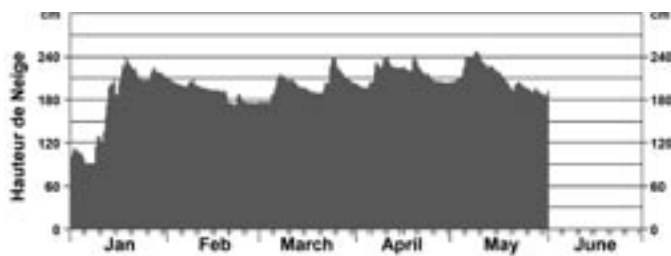


Figure 5: Snowpack depth at the Bellecote (La Plagne) weather station

friend from the snow. Rescue helicopters arrived on the scene 10 minutes later but were unable to land due to the weather conditions.

A particularly bad day on the 29th of December saw four deaths, all off-piste, two of them in the Espace Killy. In two incidents, the avalanches were triggered by other users higher on the slope. In one accident, the overall avalanche risk on the day was 2 (moderate) on a scale of 5. However, the local risk was 3 (considerable) for the sector where the avalanche occurred. Late on the 10th of January, three snowboarders were struck by an avalanche above a lake in the ski resort of Tignes. Two died after being carried into the freezing waters by the slide. Rescue workers had to lay cables across the 250-meter frozen lake and string up floodlighting in order to search for the victims. A boarder was killed in Val d'Isère, also late in the afternoon. On the 12th of January, a skier was killed after going off-piste alone in Chamonix.

All of the above victims were caught in slab avalanches. A slab avalanche is a layer of cohesive snow that slides on a surface underneath, often a weak snowpack layer. Slabs are difficult to identify, especially when they are covered by fresh snow. Even carrying out tests on similar slopes has been shown to be a poor indicator of stability on suspect slopes. Slab avalanches account for the majority of avalanche fatalities. Skiers often assume that thin snowpacks present little danger as there isn't much snow, but a slide measuring 200x300x0.5 meters would mobilize around 7,500 tonnes of snow. If the skier is carried into a narrow valley or hollow or even if there is a sudden change in slope angle, he could be buried under several meters of snow. Locations where one can be buried unusually deeply are known as terrain traps.

Thin snowpacks can also form significant weak layers especially when temperatures are cold and skies clear. Large temperature differences arise between the ground, which is close to zero degrees when insulated under its blanket of snow, and the snow surface, which is cooled by ambient mountain air and cooling radiative effects. A temperature gradient of 5°C acting over 50cm of snow will have the adverse effect of driving water vapour through the snowpack, forming weakly bonded, angular ice crystals known as depth hoar or gobelets. The dangers of thin snowpacks were noted by Claude Rey and Alain Duclos in their study *How to Improve the Avalanche Knowledge of Mountain Guides*, which they presented at the 2002 International Snow Science Workshop.

Depth hoar is not the only danger. Surface hoar is critical in nearly half of all avalanche deaths.³ At night or on northern slope aspects the snow surfaces radiates a lot of heat and becomes very cold. Moisture from still, warm air above the snow will condense onto the surface, forming crystals. This formation process means that surface hoar has an erratic and unpredictable distribution.

Surface hoar forms a thin but very fragile layer. Both depth and surface hoar are extremely persistent,

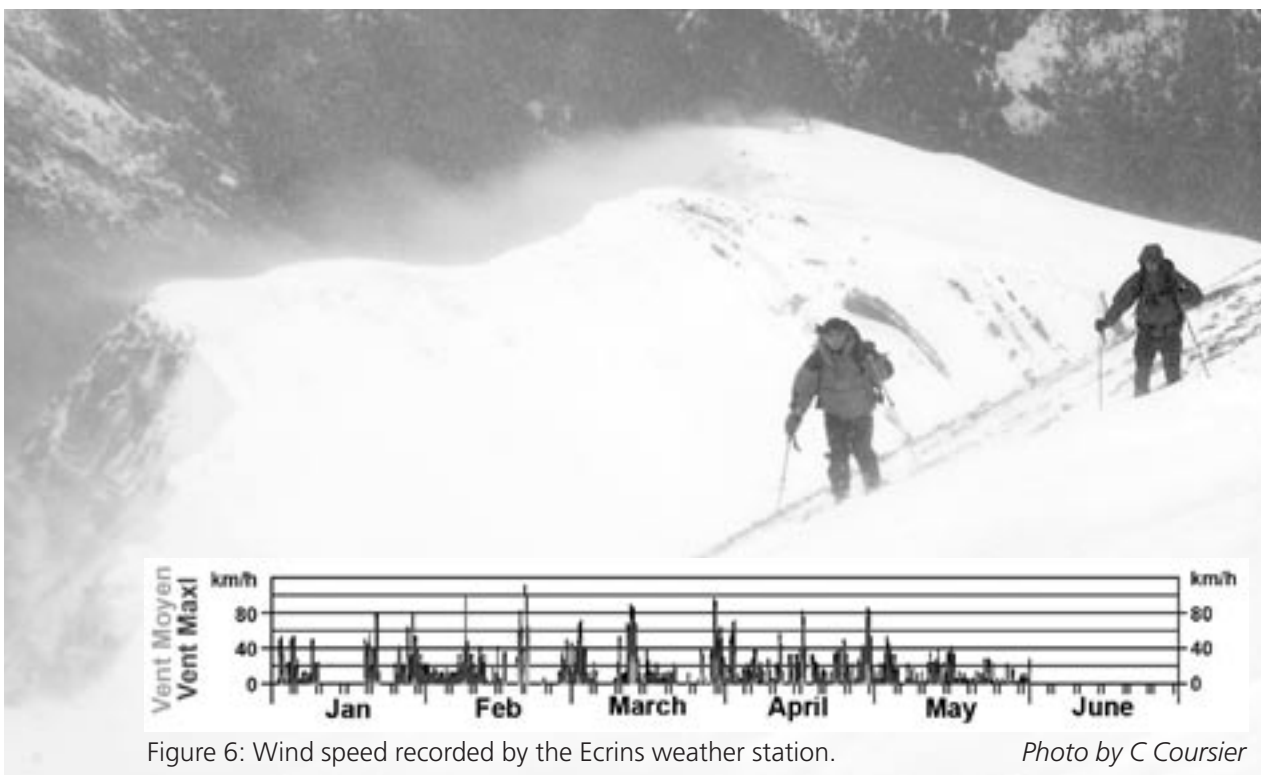


Figure 6: Wind speed recorded by the Ecrins weather station.

Photo by C Coursier

sometimes lasting until the end of the ski season, and probably played a role in the other avalanche accidents during the winter. The fresh snowfalls on the 9th and 10th of January both buried surface hoar layers and would have overloaded any other weak layers making them sensitive to triggering by skiers or boarders. Weak layer collapse is characterised by a characteristic 'whoumphing' noise.

Later in the season the sun begins to play a more significant role. The balance of warming solar effects stabilizes the snow pack. Days are longer and the sun rises higher in the sky, striking the snow surface more directly. The whole snowpack approaches zero degrees and melting begins weakening bonds. At lower altitudes, water can percolate down to grass below and act as a lubricant. Depth-hoar layers, formed at the start of the season, weaken easily and may fail. Full-depth avalanches, called climax avalanches, present obvious high risk.

More commonly, loose, wet-snow avalanches called sluffs become a potent force in springtime because of the high density of water-saturated snow. Backcountry skiers can usually avoid these slides by restricting activity to earlier in the day and avoiding the terrain traps, such as gulleys, where these avalanches flow.

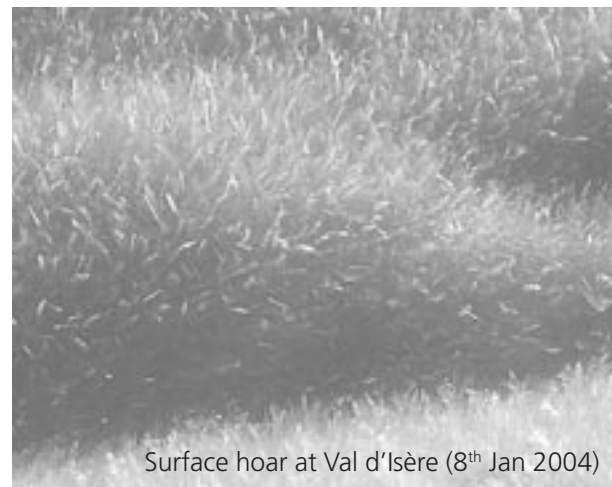
At altitudes over 3000 meters average air temperatures are still usually quite cold. Winter conditions can exist at any time of the year above this elevation. Fresh snowfall is common and slab avalanches possible. A small slab at 3,100 meters killed a skier training for the Derby de la Meije at La Grave at the start of April. A year earlier a German guide was killed in the same area by a large slab avalanche at 3000 meters. Figure 3 shows that the reported altitude of fatal avalanches increases towards the end of the season.

OUT OF SEASON ACCIDENTS

The period from the 1st of May to the 15th of December is considered to be outside the main ski season. Except for limited glacier skiing in the summer and autumn, ski domains are closed during this period. In general, accidents involve climbers, backcountry skiers and snowboarders. JP Zuanon analysed this period over 23 years using statistics from the ANENA and found that 20% of avalanche accidents occurred out of season but there was considerable variation between one year and another.



A buried weak layer



Surface hoar at Val d'Isère (8th Jan 2004)

Figure 7 compares the dates of avalanche fatalities for the 2003 and 2004 seasons. The 2003 season was characterised by heavy snow over Christmas and during January followed by an extended period of stable conditions (high pressure) during February and March with little fresh snowfall. Most of the avalanches were concentrated during the winter. After the 13th March, there was only a single avalanche fatality.

Figure 8 shows outings for the Northern Alps taken from the SkiRando Web site for the seasons 2003 and 2004 plotted as a seven-day moving average. There were 2580 outings entered in between the 1st October 2002 and the 31st May 2003 and 3020 outings entered during the same period in 2004. It seems reasonable to assume that this increase is not due to a sudden rise in popularity of backcountry skiing. One factor is the longer season in 2004 and another is the increase in popularity of the Internet, especially with always-on broadband connections which grew 72% in Europe over the period. In order to compare the two seasons, each day was plotted as a percentage of the total outings for the season.

The graph clearly shows that the 2004 season started about three weeks earlier than 2003. The long period of good weather in February and March 2003 meant that there were more outings over this period, but the figures for 2003 tail off rapidly with the start of the summer heat-wave at the end of the spring. After a period of poor weather in late April and early May 2004, the snowfall it brought gave a boost to the figures for the end of the season. As an additional random data-point, the gap used for the Galibier road gap competition held in mid-May was 8-meters high in 2003 and 13 meters in 2004.

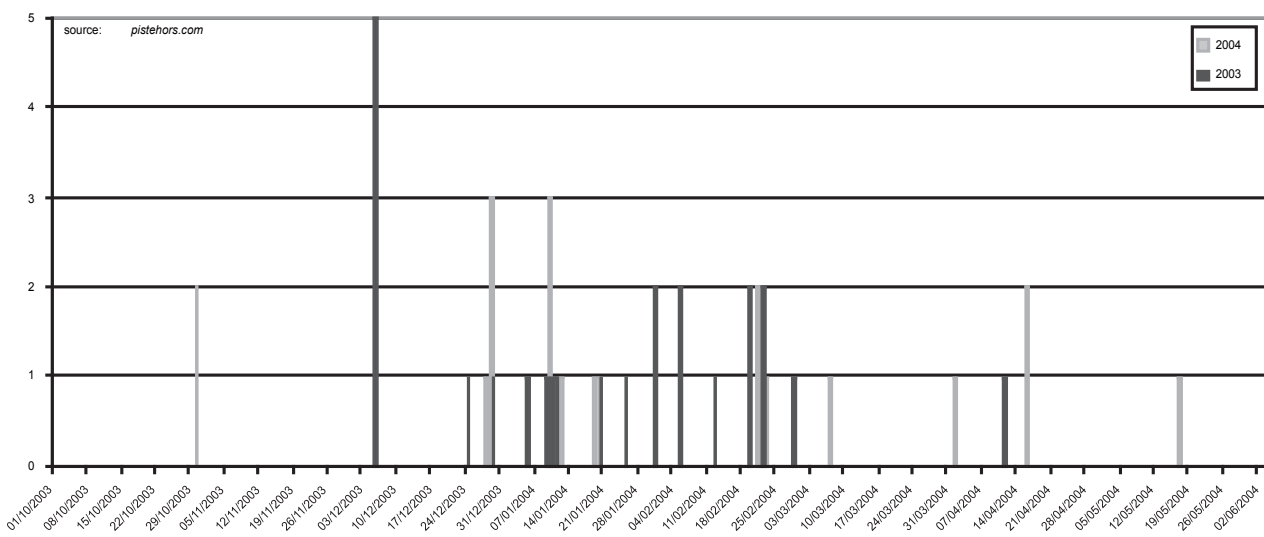


Figure 7: Comparison of avalanche fatalities for 2004 against 2003

FRANCE

continued from previous page

WEEKENDS

One common complaint for 2004 was that the weather was poor for a lot of weekends but was this born out by fact? Around half of all outings take place at the weekend. We also know that weekend groups are larger, 3.35 people on average as opposed to 2.07. Between the 15th of December and the 30th of April there were 2099 outings in 2003 and 2298 outings in 2004 for the Northern Alps region. Figure 9 shows weekend outings plotted as a percentage of total outings for the period.

Calculating the standard deviation of outings gives 18.79 for the year 2003 and 23.52 for 2004. If outings are an indication of weather conditions then the weekend weather in 2004 was more volatile compared to 2003. During the period covered by Figure 9 there were 1258 outings over the weekends in 2003 and 1259 outings over the weekends in 2004. Expressed as a percentage, 59.9% of outings occurred at weekends in 2003 as opposed to 54.7% of outings in 2004. This may imply that the weekend weather conditions were less favourable in 2004.

ACTIVITY	
SKI TOURING	5
OFF-PISTE SKIING	8
OFF-PISTE SNOWBOARDING	4
CROSS COUNTRY SKIING	1

Table 2: Comparison of accidents by activity

FALLS

The second major cause of death for off-piste and backcountry enthusiasts are falls. In Table 2 (above), crevasses were responsible for two of the ski touring falls and one of the off-piste falls. Six of the 18 victims were non-French, a higher percentage compared to avalanche fatalities. There was also a higher percentage of off-piste accidents. The most recent study by the SNOSM covering the 2002/2003 winter season recorded seven deaths off-piste from falls and collisions.

These accidents can be broken down into falls from cliffs, falls into crevasses and slides on steep terrain. Falls from cliffs were more likely to involve off-piste skiers and snowboarders.

On Christmas Eve a man fell 80 meters over cliffs in the Pyrenean resort of Gavarnie while skiing off-piste. In mid-January a Belgian man skiing alone fell 30 feet over cliffs in the resort of les Deux Alpes. He'd been returning alone to the resort in poor weather. In February, a 17-year-old British man fell 70 meters over cliffs in Méribel after following tracks off-piste with friends. Later in the month, two Dutch snowboarders perished after falling 80 meters over cliffs in the Grandes Rousses sector of l'Alpe d'Huez. The routes through the Grandes Rousses are difficult to navigate, and it was their first day in the resort. A month later a Danish skier died in the same resort after falling over cliffs in the Sarenne sector. He'd been skiing alone.

The notorious off-piste fissures at Flaine continue to claim victims. These deep, narrow cracks in the rock are formed by chemical erosion. Early in the season they are concealed by fragile snow bridges and the off-piste domain presents the same dangers as crevasses on a glacier. On the 29th of December a French snowboarder was killed after falling 50 meters and a British girl, also on a snowboard, had a lucky

escape after spending two hours trapped at the bottom of one of the cracks.

After last summer's heat wave, glaciers had limited snow cover as the 2004 season began, and many crevasses were poorly bridged. In November, a German skier died after leaving pistes on the Grande Motte glacier in Tignes, and at the end of March there were three fatal falls into crevasses on Mont Blanc. In two cases, the skiers had become separated from their group. In the third, the skier was alone.

In March, there was a rare cross-country ski fatality when a man left the marked trails and slid, colliding with trees. In April, an off-piste skier was killed after sliding 200 meters in a steep couloir in la Grave, and a ski tourist fell from cliffs below the Crêtes d'Argentière near Valloire. In both cases the icy conditions may have been a contributory factor. At the start of June, a ski tourist fell from the ridge leading to the Aiguille du Grand Fond above Bourg St Maurice. He'd been skiing alone.

Finally Edouard Baud, son of extreme ski pioneer Anselm, was killed in the steep Gervasutti Couloir below the Mont-Blanc du Tacul. He was hit by a sérac (ice) fall. Sérac falls are not predictable.

CONCLUSIONS AND FURTHER STEPS

As has been shown, the 2003-2004 season was longer than the previous year, but with fewer avalanche fatalities: 24 as opposed to 26. In the 13 years to 2002, the ANENA calculated the average number of avalanche deaths per year at 30.8. One possible factor behind the relatively good figures last winter is poor weekend weather during the main winter season which reduced the number of outings. The risks of off-piste and backcountry skiing should not be exaggerated, especially when the increase in popularity of the activity is taken into account. The growth in snowboarding and snowshoeing may have an adverse impact on the figures in the future. To put some kind of perspective on the fatality figures, during the summer season 90 people drown off the coasts of France, and there are around 100 deaths in the mountains, over half of them walkers. When proposing methods to reduce deaths and injuries, an inevitable cost/benefit analysis must be made.

Lack of suitable personal rescue equipment was noted in seven of the avalanche fatalities. It is impossible to determine if this would have made any difference in the outcomes, but it would certainly have aided the rescue services. Rescue workers are exposed to risk while searching and rescuers in dog or probe-line searches reduce the resources available to respond to other incidents. Swiss research on accidents between 1980 and 1999 found that victims were buried on average 150 minutes before being found by rescue services, a delay that in most cases proved fatal. A victim is four times more likely to survive if found by his companions.

The principal search tool is the avalanche transceiver. The average burial time over the period studied is 20 minutes with a 50% survival rate, but this has improved to 15 minutes over the last five years with a 75% survival rate. This improvement is probably a result of better training and the significant improvement in transceiver technology (note: digital transceivers were not in widespread use in 1999). In the Swiss study, 75% of survivors were buried less than 80cm from the surface. Deeply buried victims are harder to locate, take longer to dig out, and are more likely to be injured or suffocated. Skiers crossing avalanche-

Date	Injuries	Deaths	Range	Department	Location
30-Oct-03	0	1	Alps	Hautes-Alpes	Col de la Rou
30-Oct-03	1	0	Alps	Isère	Côte Belle
30-Oct-03	0	1	Alps	Haute-Savoie	Avoriaz/Arare
01-Nov-03	1	0	Alps	Savoie	Tignes/Gd M
20-Nov-03	0	1	Alps	Savoie	Tignes/Gd M
24-Dec-03	0	1	Pyrénées	Hautes-Pyrénées	Gavarnie
28-Dec-03	0	1	Pyrénées	Hautes-Pyrénées	Gèdre
29-Dec-03	0	1	Alps	Savoie	Tignes/Tufs C
29-Dec-03	1	1	Alps	Savoie	Val d'Isère/G
29-Dec-03	0	1	Alps	Haute-Savoie	La Clusaz/Bal
29-Dec-03	1	1	Alps	Haute-Savoie	Flaine/Gde Pl
10-Jan-04	1	2	Alps	Savoie	Tignes/Tufs
10-Jan-04	0	1	Alps	Savoie	Val d'Isère/S
10-Jan-04	1	0	Alps	Savoie	Val d'Isère/Fo
12-Jan-04	0	1	Alps	Haute Savoie	Rouges
19-Jan-04	0	1	Alps	Savoie	Ste Foy/Col d
19-Jan-04	0	1	Alps	Isère	Les Deux Alps
20-Jan-04	0	1	Alps	Alpes-Maritimes	Auron/Mont
25-Jan-04	0	1	Alps	Savoie	Tignes
25-Jan-04	0	1	Alps	Isère	Les Sept Laux
17-Feb-04	0	1	Alps	Savoie	Méribel
21-Feb-04	0	1	Alps	Savoie	La Rosière
21-Feb-04	0	2	Alps	Isère	Allevard/Refu
22-Feb-04	0	2	Alps	Savoie	Val-Premond
23-Feb-04	0	1	Alps	Savoie	Valloire/Sétaz
29-Feb-04	0	2	Alps	Isère	Grand Rousse
07-Mar-04	0	1	Pyrénées	Hautes-Pyrénées	d'Huez
12-Mar-04	0	1	Alps	Isère	Aure/Pic de C
15-Mar-04	0	1	Alps	Isère	Vercors/Corre
15-Mar-04	0	1	Alps	Haute-Savoie	Mont Blanc/M
23-Mar-04	1	0	Alps	Hautes-Alpes	La Grave/Giro
27-Mar-04	0	1	Alps	Haute-Savoie	Mont Blanc/V
30-Mar-04	0	1	Alps	Haute-Savoie	Mont Blanc/G
01-Apr-04	0	1	Alps	Hautes-Alpes	La Grave
06-Apr-04	0	1	Alps	Isère	Alpe d'Huez/S
13-Apr-04	0	1	Alps	Hautes-Alpes	Orcières-Merl
16-Apr-04	0	2	Alps	Hautes-Alpes	Monetier-les-
24-Apr-04	0	1	Alps	Hautes-Alpes	La Grave
27-Apr-04	0	1	Alps	Savoie	Valloire/Crête
					d'Argentière

prone slopes should consider the consequences of a slide by asking questions like: Are there cliffs? Are there terrain traps or a rapid change in slope angle that will increase deposition? In the case of the Tignes accident, snowboarders swept into a frozen lake had minimal survival chances.

The chance of a successful rescue by the emergency services is affected by a number of factors:

- 1. Travel time.** In general, it takes longer to arrive at the scene of a backcountry incident and it is harder to mobilize a large rescue effort.
- 2. Weather.** If there is low cloud, helicopters may not be able to land.
- 3. The hour.** In the case of the Tignes avalanche mentioned above, rescue workers had to lay cables and floodlighting to search as the avalanche occurred after nightfall.
- 4. Mobile phone coverage.** In many backcountry areas phone coverage is poor to non-existent.

Off-piste and backcountry skiers should take all these factors into account.

It can be seen that transceivers are not a guarantee of survival and should not be an excuse to take on more risk. A skier should always ask himself if he would be willing to cross the slope in question without a transceiver. The Swiss study found that 97% of partly buried victims survive. Releasable ski and snowboard bindings and swimming in an avalanche (not easy when it consists of a hard blocks of snow) can keep a skier on the surface. The ABS system, a device consisting of two gas-filled balloons, can aid buoyancy,

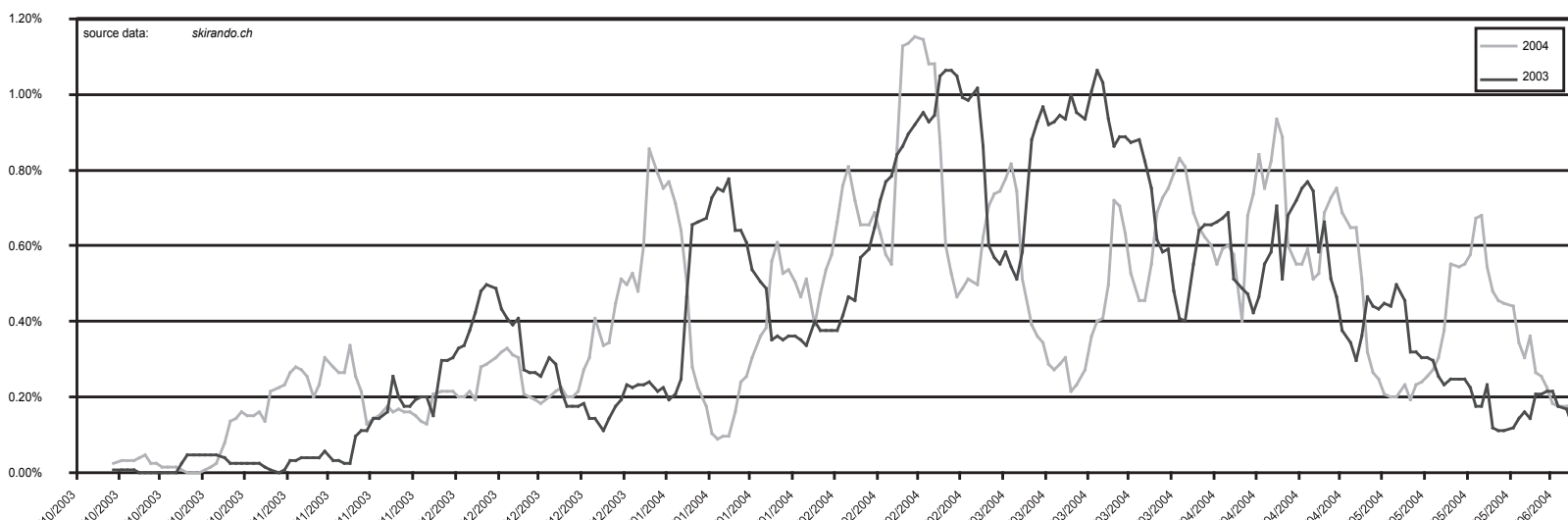


Figure 8: Backcountry outings for Northern Alps plotted as seven-day moving average

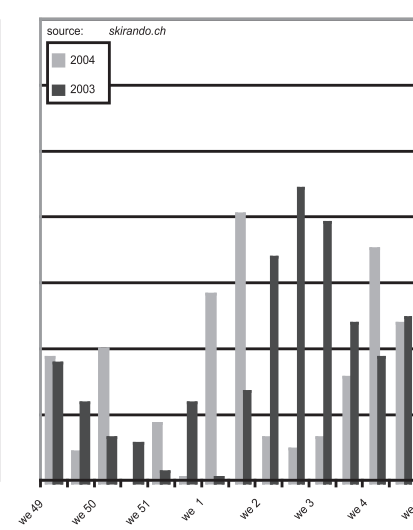


Figure 9: Weekend outings over th

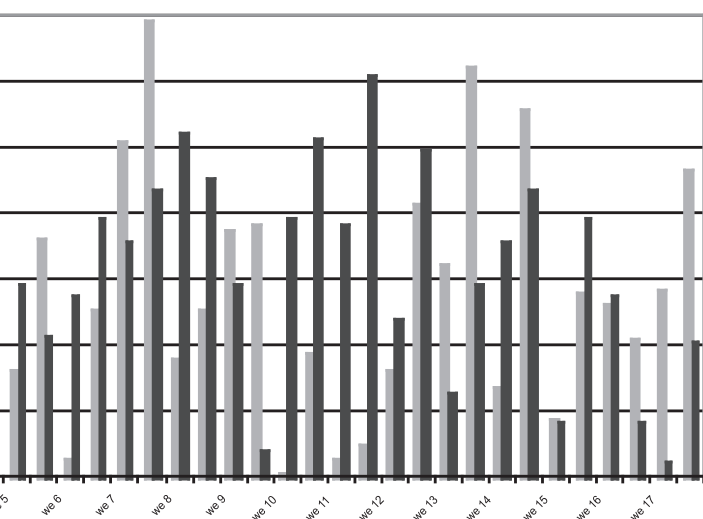
	Experience	Activity	Cause	Remarks	Rescue	Time	altitude	Risk		
annette		Snow Shoeing			Transceiver	French	13h00	2400	n/c	
	Experienced	Ski Touring			Transceiver Probe/Mobile	French		2450	N	n/c
les-Crozats	Mountain Police	Ski Touring Off-piste		Skiing Alone	Phone	French		2000		n/c
otte		Snowboarding			Pisteurs	British				n/c
otte		Off-piste Skiing	Fall	crevasse/head injuries	Pisteurs	German		3300		
		Off-piste Skiing	Fall	80 meters		n/c				
		Climbing				Spanish				
ouloirs	With Instructor	Off-piste Skiing		Impact with rocks	Transceiver	British	12h30	2500	NW	3
l Vallon		Off-piste Skiing		Triggered by boarder	Probe/Dogs	French	16h00			3
me		Off-piste Skiing Off-piste		Triggered by skiers	Dogs	French	15h30	2400	NW	2 to 3
atière		Snowboarding Off-piste	Fall	fissure		GB/FR	18h45			
		Snowboarding Off-piste		Carried into lake	Dogs/Probe	French	16h45	2100	NW	4
Santons	Experienced	Snowboarding				French		2450		4
net guilles		Off-piste Skiing		broken femur						4
		Off-piste Skiing		alone	body found 3/May	American	late			4
e l'Aiguille	Piste Patrol	Off-piste Skiing		Securing Piste 30 meter fall in bad viz.	Transceiver	French	16h00	2500		4
es		Off-piste Skiing	Fall			Belgium	late			
Ténibre	Instructor	Ski Touring		No probe/shovel	Transceiver	French	12h00			2
	With Instructor	Off-piste Skiing			Transceiver	Belgium				3
		Off-piste Skiing Off-piste	Fall	100 meter fall		French				
	Young	Snowboarding	Fall			British	14h30			
	Local	Ski Touring			PGHM	French	12h00	1950		3
ge Oule	Local	Ski Touring		No Transceiver	PHGM/Friends	French	12h00	1800		2
Pralognan	Local	Snowshoeing		Experienced CAFiste	PGHM	French		2100		3
es/Alpe		Off-piste Skiing Off-piste		parallel to piste slipped on steep slope	Piste Patrol					3
		Snowboarding	Fall			Dutch		2150	S	
uneille	Local/Young	Ski Touring			PGHM/Friends	French	12h00	2400		3
nçon		Cross Country	Fall	Off-piste alone/seen by wit- ness						
Mont Vallet		Off-piste Skiing	Crevasse	Alone/30 hrs in						
esse		Ski Touring	Crevasse	Crevasse Separated from	PGHM	Czech				
allée Blanche		Ski Touring	Crevasse	friend Separated from	PGHM			3000		
id Mulets		Ski Touring	Crevasse	group	PGHM	Polish		3200		
	Experienced	Off-piste Skiing		head injuries	Witnesses	French	16h00	3100	N	3
Sarenne		Off-piste Skiing	Fall		CRS	Danish				
ette	Gendarme	Off-piste Skiing	Fall	Fall skiing alone		French				
Bains		Climbing			PGHM/Dog	Italian			N	3
s	Elderly	Off-piste Skiing	Fall	200 meter slide						
	Elderly	Ski Touring	Fall	Alone	PGHM	French				

Table 3: Backcountry Accidents in 2003/2004, www.pistehors.com/articles/avalanche/avalanche-accidents.htm

but is less helpful against injury from collisions or falls. In 40 avalanches where victims wore an ABS, only one victim was completely covered by snow and died due to being buried in a terrain trap. In six cases the skier failed to activate the device, and in two cases there was a possible technical failure. Increased use of the ABS would save lives and the devices can now be rented in specialist shops in Chamonix, Tignes and Val d'Isère. As with transceivers, ABS devices should not be used to take on more risk. It should be remembered that even with an ABS, a skier may need assistance to free himself from the slide. There are arguments of cost (currently about 500 Euros), weight (1.8kg), and volume, which are significant factors for backcountry skiers. Last season Tignes, Val d'Isère and Valfrejus equipped their piste patrols with ABS and a further 300 sets were sold to the public in France. The AvaLung™, a device that helps a skier breathe under snow, may also give rescuers a longer window of opportunity.

In nine of the accidents, victims were either experienced or skiing with an instructor. Four other victims were local. A similar figure was noted for the previous season. Local and experienced skiers as well as guides and instructors spend many more days skiing than casual recreational skiers and often tackle more challenging terrain. In some cases it seems that technical ability exceeds avalanche knowledge. Interestingly, research by McCammon has shown that groups with some avalanche training use this training to take on more risk.

Research has shown that 90% of fatal avalanches are human-triggered and therefore potentially avoidable.



the winter season

In at least two cases, avalanches were triggered by people riding above the victims. On popular itineraries, off-piste users must be aware of people below them. Where there is a risk of avalanche, the rule of skiing/snowboarding one at a time should apply. Skiers should also remember that the second they leave pistes they are at risk, as the nine off-piste accidents, particularly the accident close to the pistes at Valloire, demonstrate. French off-piste domains are generally too large to secure. Avalanche control is carried out in accordance with a document called the PIDA (Plan d'Intervention et de Déclenchement des Avalanches) to secure ski pistes. A survey of ski resorts by *Montagnes Magazine* at the start of last season found around a third of them do avalanche control on popular off-piste runs, a measure they don't publicize. Over 40% of resorts will also close lifts which give access to itineraries considered at risk from avalanches. Skiers must remember that even early in the season when there is little snow cover, there is a high risk of slab avalanches and this risk can persist at altitude late into the season. At lower altitudes, the risk is more often from wet snow avalanches on slopes exposed to the sun for any period of time. The exposure of a slope to terrain traps such as lakes, hollows, narrow valleys and cliffs can make even small avalanches deadly.

The French Weather service, Météo France, publishes an avalanche bulletin (BRA) every day at 16h00 during the winter season. This gives a headline avalanche risk on a five point international scale for each department in the Alps, Pyrénées, and Corsica. A weekly summary bulletin (BSH) is published in the late autumn and spring. The bulletin goes into detail about localised risks. Most of the avalanche accidents during last season occurred at risk 3 (considerable) or 4 (high). At these risk levels, it is considered probable that a single skier, snowboarder or snowshoer can trigger an avalanche. There is no evidence that any of the victims consulted the avalanche bulletin, but from conversations with other skiers, they state that the overall risk rating is used when making decisions to go off-piste. Most consider 1-3 to be a go, 4-5 stay in bed. It is notable that the majority of avalanches happen at level 3 and 2. Figure 4 shows that many fatalities occur immediately after snowfall, the phenomenon of the "first sunny day" and "powder fever."

Météo France is not infallible. On Friday the 20th of February, the avalanche bulletin covering the Belledonne Mountains gave the risk as 1 (low) for

the following day. A deepening weather system brought large quantities of snow, accompanied by wind, and led Météo France to revise its risk to 3 (considerable). Two skiers were caught by an avalanche in the region. Rather than criticise Météo France for "getting it wrong" when there is no evidence that the two victims even consulted the bulletin, this incident serves as a reminder that a bulletin is advisory. Backcountry travellers must complement it with their own observations on the ground. Avalanche scoring systems such as the NivoTest™ and the Munter 3x3 Method could prove their worth in many cases. An avalanche scoring system is a statistically-based procedure for determining the avalanche risk based on an analysis of the terrain, nivological (snow) and weather conditions, group size and dynamics.

This incident does highlight the need to improve the distribution of alerts. Jacques Villecrose, the late director of the Centre d'Etude de la Neige assisted SkiRando (a Swiss private limited company) in setting up a distribution of French avalanche bulletins by e-mail, but there is no mention of this service on the Météo France Web site. This channel could be improved. It would also be useful to be able to consult past bulletins, at least for the last week from the Web site. All of this could be subsidized with limited and targeted advertising. In the case of a number of recent natural disasters, Météo France did announce extreme weather alerts through the mainstream media and this mechanism might also be better used for avalanche warnings, particularly on local radio stations.

The survey by *Montagnes Magazine* found that 80% of ski resorts publish the avalanche bulletin. Most also display coloured warning flags around the station, but the Médecins de Montage survey showed that these were not always clearly understood. A study by Parks of Canada using focus groups found that 79% participants understood a symbol portraying a buried skier.

There is a dearth of information for non-French-speaking skiers (who make up over 30% of the visitors to the French mountains). Météo France publishes the avalanche bulletin in French. Only 10 resorts offer an English translation and three offer translations in other languages. The avalanche bulletin uses many standard phrases; it should be possible to codify it to simplify either human or automated translation using a software package trained for the task. In addition, research shows that subtle differences in wording that can occur with free text warnings can affect the information conveyed to people.⁴ In fact, a prototype of such a system, INFOLOG, was developed in the mid-'90s by Swiss researchers. INFOLOG consists of a specialised editor with a number of standard terms and phrases and can publish avalanche bulletins simultaneously in five languages.

Despite its extreme-sport image, it can be seen that few snowboarders are involved in fatal accidents off-piste. Just six out of 41 fatalities for avalanches and falls were snowboarders: 14.6% of all accidents. However, this is in line with the number of participants. 75% of fatal avalanches occur in the Northern Alps—that is, the two Savoies and Isère, including the Ecrins Mountains. The Northern Alps resorts account for 75% of visitors for ski resorts. On SkiRando, 86% of the outings last season were from this region. It should be remembered that the Northern Alps lie in the Rhone-Alpes region, an affluent and technologically savvy area and is probably over-represented in the SkiRando database. Prices in the Northern Alps ski resorts are generally higher than elsewhere, so the turnover figures probably overestimate the number of skiers in the region. Still, there is an indisputable link between skier/days and accidents.

It would be interesting to calculate the avalanche fatality rate for skier/days (outings). French ski resorts record about 50 million skier/days per year. Comparing extensive figures for on- and off-piste interventions by the rescue services, about 2.5% skier/days are spent off-piste. With 11 off-piste deaths last season (the 13-year average is 8.5), this gives an approximate fatality rate of one per 96,000 skier/days for off-piste skiing. If the rate is similar for backcountry accidents, this would imply that at present only about 2% of outings are recorded in the SkiRando database. The figures in this paragraph are presented more as an academic exercise and should be treated with caution.

Continued next page ➡



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FRANCE

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Off-piste solo skiing is often regarded as a near suicidal activity. The SkiRando database shows that 14% of outings are by lone skiers on weekends, rising to 33% on weekdays. This is probably because fewer partners were available. The overall figure is 25%; but only one of the six ski touring avalanche fatalities involved a lone backcountry skier. It would seem that lone skiers take less risk than groups, though this conclusion is in conflict with other published studies such as McCammon. Given the number of lone outings on popular routes such as the Chamchaude, above Grenoble, it is possible lone skiers favour well-tracked routes that will be stabilized by skiing. The accident rate for lone skiers rises for off-piste incidents and falls. It is highly recommended that crevassed and avalanche-prone terrain are environments where skiers should never venture alone. Obviously the consequences of an accident for a lone skier are severe.

French ski areas generally have large off-piste domains which are difficult to secure. In particular, it is difficult to signpost every hazard. Case law currently obliges resorts to signpost dangers on off-piste routes that are accessible by lift and, because of the configuration of the ski domain, regularly used by skiers. Hazards are rarely obvious from above. Skiers need to familiarize themselves with hazards they will encounter by reading route descriptions in guide books and by examining the terrain from the safety of ski lifts or pistes before venturing off-piste.

Some falls may be mitigated by changes to clothing, such as using fabrics which offer more grip on snow. Freeride skiers have generally adopted helmets and dorsal protection but this is generally done to take on more risk.

Group management was a factor in at least two of the crevasse falls where a group member was not missed until long after the accident.

The image presented by ski resorts is somewhat conflicting. Tourist office brochures are full of pictures of skiers and boarders having fun in deep, off-piste powder; often doing risky things such as jumping cornices. Ski lifts, unless they are the latest, powerful model, and pistes rarely feature. At the same time, there is a hardening of attitudes by piste security. This year saw the attempted prosecution of two skiers who triggered an avalanche in the off-piste domain of Saint-Jean-Montclar injuring a pisteur. The resort of Superbagnères considered prosecuting four snowboarders who triggered an avalanche which hit skiers on a piste. Some resorts (Montgenève and La Mongie) have experimented with local bye-laws banning people from going off-piste when the avalanche risk is 3 (considerable) or above. Such bans are legal only when they are temporary in nature and respond to a clear danger. They are difficult to police and fail to recognize that some routes are practical, even when the overall risk is considerable. On a more constructive note, the Swiss resort of Zinal has experimented with automatic avalanche gates which only let skiers pass when they are equipped with an avalanche transceiver. This may be a model that will be followed in France.

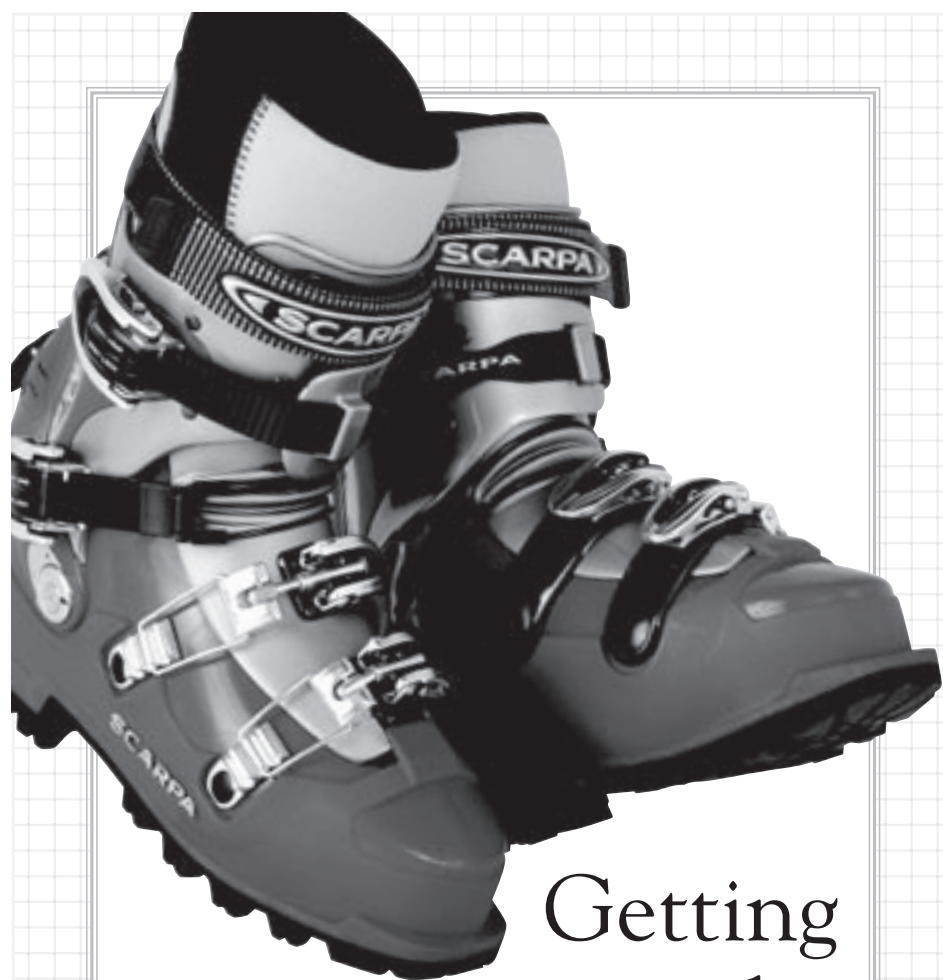
The rate of fatalities during the winter holiday period is nearly three times higher than during the rest of the season. This is alarming as ski resorts have only 50% more guests, and SkiRando shows that there are only 40% more outings during this period. Given that this is the main school and university holiday period, it is possible that this population of skiers is less "mountain aware."

Although a number of bodies are involved in winter sports accident prevention, the French Avalanche Research Association (ANENA) has the primary role in educating winter sports enthusiasts to the risks posed by avalanches. ANENA, established after the major avalanches of 1970 that resulted in over 100 deaths in France, works with the SNOSM, Météo France, Cemagref, Mountain Rescue Services, and Piste Security, as well as with researchers in French universities. Last season ANENA distributed 22,000 leaflets giving basic avalanche information to ski mountaineers and snowshoers. This information was also reproduced in the catalogues of some winter sports shops. A further 50,000 leaflets aimed at freeriders were distributed by Glénat in their ski, snowboard, and mountaineering magazines. A set of information panels were produced in English and displayed in UCPA and Club Med centres. An educational weekend for freeriders was organized at la Grave.

There are also a number of other initiatives. Avalanche talks and transceiver training are organized by Henry Schniewind⁵ in Val d'Isère (last season the author gave a talk on route finding). Les Deux Alpes offers weekly *Free Respect* sessions appealing to younger winter sports enthusiasts. La Grave has built a permanent transceiver training centre in conjunction with Mammut / Barryvox. The piste patrol at Tignes also organizes regular transceiver training. There is a permanent avalanche training centre⁶ in the resort of Valfrejus.

Given that budgets are restricted and that currently ski resorts spend only around 4% of their budgets on safety, further education initiatives should prioritize some of the issues raised in this study. An off-piste safety campaign should focus on the main winter holiday periods. This campaign could include information where skiers congregate such as lift pass offices. Information should be available at the very least in English. Lift companies provide limited safety information on piste maps. This is not always translated into English, and where it is, there are sometimes confusing errors. Piste patrols could also be more proactive in providing information. Representatives of Tour Operators could be given short off-piste awareness sessions focusing on the risks, particularly from falls, and give information about guides and rental safety gear in the resorts. These initiatives would have to be tackled in a sensible way, as ski resorts are understandably reluctant to over-dramatize dangers.

There is also a need to improve awareness of existing backcountry travellers. The growing activity of snowshoeing should be addressed with warnings about the dangers of thin snowpacks (snowshoers find it easier than skiers or snowboarders when



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snow cover is limited), group spacing in dangerous terrain and the risk of walking along cornices. This could be accomplished through magazine articles and internet resources such as bulletin boards and eZines (online magazines). Some of the excellent initiatives mentioned above could also target this community.

To cater for the increased interest in free-riding, ski resorts could provide more secured off-piste itineraries. In the more litigious culture, there are obviously some reservations about doing this. Recently Tignes and Méribel have created free-ride areas by not grooming existing pistes. Whether these limited areas can respond to demand remains to be seen.

ENDNOTE

In addition to analysing the avalanche reports found on PisteHors.com, this study has shown that mining databases such as SkiRando can provide additional insights into the motivations of backcountry skiers beyond the intentions of the database designer.

During the course of this study, we became aware of some improvements that could be made to the SkiRando database to simplify this kind of analysis—in particular, by providing

standard definitions for weather conditions rather than free text. It might also be valuable to add a field for the number of participants in an outing and adding another field for avalanche risk.

We obtained our data through the public Web interface of SkiRando using the Client URL Request Library and a program written in the Bash scripting language.

POSTSCRIPT

There was an avalanche accident on the 10th of July, 2004 following heavy snowfall at altitude in the Alps. The accident occurred on Mont Blanc at 3900 meters and involved a Chamonix guide and his Dutch client. The slab avalanche was on the north face of the Mont Blanc du Tacul and the victims were carried into a crevasse and buried under about 6 meters of snow. A further reminder that avalanche dangers are present throughout the year especially after fresh snow and strong winds.

David George has been backcountry skiing since 1991. He holds a first class Bachelor of Science degree in Information Systems. He holds a level II certification in Snow and Avalanches from the Federation Française de la Montagne et de l'Escalade (FFME).

DISCLAIMER

The source data for this report comes from eye-witness and media sources. Only a small proportion of non-fatal accidents get reported to us. The figures for avalanche fatalities correspond with those collected by the ANENA directly from the rescue services and are believed to be accurate. Given the relatively small amounts of data available for a given season, readers should be aware about drawing rigid conclusions from any particular incident. However, the figures are in line with incidents reported over previous years by IKAR⁷ countries. None of the comments in this report should be taken as a criticism of the conduct of the parties involved.

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ACKNOWLEDGEMENTS

Dr Geraldine Gadbin of the University of Paris assisted with the French documentation and read the initial draft. Gary Brill, www.geocities.com/garyabrill/avalanche.html, an avalanche educator and professional member of the American Avalanche Association, reviewed the text and provided many technical suggestions.

GLOSSARY

ANENA — Association Nationale pour l'Etude de la Neige et des Avalanches, www.ana.org

AVERAGE — The sum of data values divided by the number of data values (arithmetic mean).

BACKCOUNTRY — Terrain outside of the ski domain reached by climbing, either on touring skis, snowshoes or foot.

CEMAGNEF — Public agricultural and environmental research institute. Evaluates avalanche risks to buildings.

MODE — The mode is the most common (frequent) value.

MOVING AVERAGE — An average of data over a certain prior time period divided by the number of samples.

NIVOLOGICAL YEAR — 1st October to the 30th September of the following year.

OFF-PISTE — Parts of the ski domain outside of opened pistes that can be reached by gravity from the ski lifts.

SKIER/DAYS — A skier day counts each day lift pass sold. On average a skier covers 4,500 vertical meters in a day. We also use it to cover an off-piste outing.

SNOSM — Système National d'Observation de la Sécurité en Montagne, part of the Ecole National du Ski (ENSA).

STANDARD DEVIATION — The square root of the variance of a data set. It is a measure of volatility of the data.

TRANSCIEVER — Radio transmitter that enables skiers to be located under snow.

WINTER SEASON — 15th December to 30th April.

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FOOTNOTES

¹ Direction du Tourism, SOFRES (SDT 2000)

² Skirando is a web community for backcountry ski and snowboarders

³ Schweizer and Jamieson, International Snow Science Workshop, 2000

⁴ Warnings and risk communication.

Wogalter, MS. DeJoy, D. Laughery, K

⁵ <http://www.henrysavalanchetalk.com>

⁶ <http://valfrejus.avalanche.free.fr/>

⁷ International Commission for Alpine Rescue

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NAC 2003 / 04 Season Roundup

Utah Avalanche Center

Like most of the West, we had a relatively relaxing year with a predominately stable snowpack. Despite this, we had four fatalities in two different incidents. Both occurred during large snow or wind storms with rapidly changing avalanche conditions. In contrast to the past several seasons, snow began early and never let up until mid winter, giving us a deep, stable snowpack without depth hoar; always something to celebrate in the western U.S. It snowed nearly every day of November and December; piling up 170 percent of normal snow for November and 164 percent for December. It was some of the finest powder on top of some of one of the most stable snowpacks any of us could remember.

Christmas brought a whopper of a snowstorm, which dumped 3-4 feet of snow in the valley and 5-6 feet in the mountains over three days. The day after Christmas, my Subaru plowed a deep trough through billowing, light, unbroken snow as it barely made the journey across town at 3:30 am to put out the forecast for the day. It was the second largest snowstorm ever recorded in Salt Lake and nearly brought the town to a standstill. For several days afterwards, most streets remained unplowed and many areas went without power. Unless people shoveled twice per day for three days, parking spaces and sidewalks remained hopelessly buried until spring.

The day after Christmas, in the Aspen Grove area in the Provo area mountains, despite an avalanche warning in effect, 14 different people were playing in the runout of one of the largest avalanche paths in Utah. The natural avalanche descended nearly 5,000 vertical feet, catching six people and completely burying three snowboarders in their early 20s. The debris covered an area the size of 11 football fields to a depth of 10-25 feet. In a gruesome event that dominated the media for a number of days, one body was recovered with a probe line two days after the accident and the other two bodies melted out in spring.

The snow spigot turned off for most of January, which allowed choking smog to build up in the valleys while extensive layers of near-surface faceted snow and surface hoar formed in the mountains. The February storms teased us along as none of them added enough of a load to send us into a major avalanche cycle. But finally, on February 26, a big wind storm overloaded many slopes and on a low elevation slope just on the outskirts of Park City, a snowshoer visiting from Houston triggered a small avalanche in a narrow, wooded, low-elevation gully and was buried about four feet deep without a beacon. Local residents just a few hundred yards down the road responded and recovered him but it was too late.

March is usually the snowiest month of winter for Utah, but other than one storm in the first week, nearly no snow fell all month. Combined with record high temperatures, the mountain snowpack not only lost a record amount of snow in March, but it lost an incredible 400 percent more than any previous March on record. April was disappointing as well and both months finished with a little over half the average snowfall for the month. Thus, the season ended with a whimper.

We finished the season with four fatalities—slightly over average—but we recorded only 56 unintentional human-triggered avalanches in the backcountry, which is nearly half our yearly average of 100. Demands for our products continue to grow rapidly and we are approaching a million annual accesses, including all of our Web hits, automated e-mails of avalanche advisories, and calls to the recorded telephone advisory.

—Bruce Tremper

Southeast Alaska Avalanche Center

We had a good winter in Southeast Alaska this year with a long season, plenty of good snow, quite a few avalanches and some scary near-misses, but no fatalities. We did have an unusually warm and lengthy Pineapple Express thaw period from mid-January through mid-February, and spring arrived about four weeks early. The rapid spring warming produced a significant region-wide cycle of large and fast, skier-triggered wet sluffs, glide avalanches and big wet slabs. Cornice breaks triggered 0.5 to 1.5 meter deep wet slabs.

The city and borough of Juneau formally adopted an avalanche-response plan, an important first step toward a voluntary buyout of the affected properties. With 62 houses, one hotel, two sections of expressway, two sections of state highway, a number of back streets, and a boat harbor in the main urban avalanche zones, we have the largest potential avalanche disaster in North America. Thanks to disaster coordinator Cheryl Easterwood, the city has done more to address the problem in the last few years than it has in the previous 20 years.

Our center had no operating budget at all this year, so our program was limited. Director Bill Glude volunteered all his time except when he was actually teaching courses, and student intern Kent Scheler volunteered all his time as well. Local searchdog group SEADOGS provided a grant to cover basic expenses such as supplies and utilities, and a grant from the Skaggs Foundation will cover accounting assistance and a Web site overhaul this summer.

Despite the lack of funding, we offered a full slate of courses and taught 622 people—24% in field courses. We had to discontinue the snowpack-update program, but still conducted regular fieldwork and served as the community and media source of avalanche information.



Janet Kellam's dog Dottie supervises excavation of the thick January surface hoar. Photo by Janet Kellam

The weather station at our Fish Creek Knob research site, operated jointly with the University of Alaska Southeast, spearheaded by Kent Scheler, and supported by a number of local business and community entities, went on the web with current data and archives available in graphic format. It stayed online for most of the winter, until the radio modem died and we were unable to donate any more time or equipment to the project. We are moving the weather station into the Eaglecrest ski area this summer for easier maintenance and better reliability.

We continued work on our two main research projects this season: development of a sized-block snow test and snow temperature probe studies. We also continued field observations on melt-layer recrystallization and some related phenomena, which are common sources of the major avalanche cycles in our area.

—Bill Glude

Sawtooth National Forest Avalanche Center

The Sawtooth National Forest Avalanche Center (SNFAC) began posting Snow and Avalanche Information on November 5, 2003. A total of 127 advisories were issued, with the end of operations April 5, 2004. User numbers increased again this season in spite of a late start for daily advisories, several extended dry spells and an early season end with the warm spring. Advisory accesses showed an increase of 36% over last year. Direct links were provided to www.avalanche.org and to the avalanche advisories from Boise and Pocatello National Weather Service pages, Idaho NRCS SNOTEL and Idaho Department of Parks & Recreation (IDPR) Web sites. Avalanche class numbers grew thanks to additional funding from grants and partnerships, including regional snowmachine classes funded by IDPR.

Snow Conditions: 2003-2004 proved to be a winter with prolonged periods of good powder conditions but some significant instability. Early season depth hoar persisted until late December. A series of Christmas storms followed by a deadly New Year's storm created a stable, homogeneous snowpack. We received little new snowfall until late January, then we developed a deep slab instability after several snowstorms.

During the New Year's storm, which recorded precipitation rates of up to 4" snow/hour, two people were killed and five others survived when a wind-loaded slope released above a cabin near Fairfield, Idaho. The family dog was miraculously found alive, eight hours later, having been shoved into the fireplace and up the chimney as the snow filled the first floor rooms of the cabin. Several homes in the city of Ketchum were hit by slides with minor damages occurring. Intense rates of snowfall on pre-existing light density snow and strong winds were responsible for the avalanche activity, not depth hoar. A ski instructor was reported missing within the Sun Valley ski area only to be found by an avalanche dog 2 ½ days later, buried in a tree well type situation on an open ski run. He appeared to have died of asphyxiation and his death was not avalanche related.

A dry, cool January produced widespread near-surface facets and surface hoar in two persistent layers that were buried approximately 1-foot and 3-feet deep by February storms. Numerous unexpected human-triggered avalanches occurred beginning the 20th of February. Increasingly larger slides were reported triggered each day until February 28 when a snowmachiner was killed while highmarking in the Apollo Creek drainage of Baker Creek. By late February, most backcountry travelers became ultra-conservative and very few were venturing onto steep slopes. Persistent shears within the snowpack and a strong wind event (65mph Baldy, 116mph Soldier Mtn) added to the conservative thought pattern. March 7, a skier triggered a fairly large slide on a steep slide path above the Williams yurt in the Sawtooth Mountains, lost his gear, but was only partially buried. The last three weeks in March brought record setting warm temperatures and very good spring snow conditions at mid to upper elevations, but produced isothermal conditions, bare slopes and avid bicyclers at lower elevations.

The last week in March, we were thrilled to have Dr. Thomas Wiesinger from the Swiss Federal Institute visit Ketchum, the NAC and the SNFAC for several days. It was a great opportunity to exchange forecasting techniques and ideas and to discuss contemporary avalanche issues as we spent time in the office and in the field. Our only disappointment is that the visit was so brief.

Staff: Janet Kellam returned for her eighth season with the avalanche center, Greg Johnson completed his second season and two new forecasters joined the team. Jake Amadon worked part time as a new forecaster and instructor for the SNFAC and part time as a guide with Sun Valley Heli-Ski. Jeff Halligan, recently relocated as a Recreation Specialist from the Payette National Forest and Avalanche Center, was able to forecast one day a week and help teach classes.

Media: Extensive media attention on the local, regional and national level brought avalanche awareness to hundreds of thousands of people. Newspaper articles in the Wood River Valley, Twin Falls, Boise, Idaho Falls, Mountain Home and even the *New York Times* were based on press releases and interviews with SNFAC staff. Radio stations throughout southern Idaho produced specials on avalanche awareness. Boise, Twin Falls and Sun Valley television stations all did avalanche awareness specials and produced a number of news programs about the Fairfield cabin fatalities. Forecaster Greg Johnson appeared in a news clip on Tom Brokaw, MSNBC, ABC affiliates and the *Today* show after the New Year's fatalities. *National Geographic Explorer* has released a new film and a Web site about avalanches and interviewed our staff. Wood River Valley's KECH radio provided countless community service and news broadcasts about current avalanche danger and the contact numbers for the daily advisories.

—Janet Kellam



The Fairfield cabin and slide path, New Year's, 2004. Photo by Janet Kellam

The U.S. Forest Service Mt. Shasta Avalanche Center

2003-2004 was the sixth season for the Mt. Shasta Avalanche Center as a type II regional avalanche center. The snow started to fly around the beginning of November with a total of 70" of snow for the month. We began issuing avalanche statements twice a week from November 19 up until the start of December. Then from December 1 through April 20, 2004 we produced a daily advisory by 7am.

The storms started to line up for December and we consistently received 3-6" of snow totaling up to 104.5" of snow and 11" of H2O by the end of the month, according to the weather station in the Old Ski Bowl on the southside of Mt. Shasta at 7600'.

We had a fairly large and widespread natural avalanche cycle in the early morning of December 14. Most of the slides occurred above treeline and ran on a weak layer of graupel provoked by 20" of new snow and gusts of up to 70mph, (1.39" of SWE). Crown faces were 1-3 feet deep and breaking up to a quarter-mile wide. Some slides ran over 1,000' with 8-10' of deposition. One climber triggered an avalanche right before Christmas Eve. He was wandering around in a storm on Green Butte ridge above a known avalanche path called Sun Bowl. Fortunately he triggered the avalanche on top of the ridge and it did not take him for a ride. The crown was 2' high, 200' wide & it ran approximately 500'.

The New Year started out with a bang! We measured 22" of new snow in 23 hours starting New Year's Eve. Temps were averaging a cool 13F during that time with very little fluctuation. This storm produced a class 4 slide in Avalanche Gulch, which is a SW/W aspect. The width of the starting zone and depth of the crown was unknown. Eric and I estimated the starting zone originated left and right of the Heart in Avalanche Gulch at around 13,200' on an approximately 36-degree slope. The runout was 5,600 vertical feet below with the toe of the deposition zone at 7600', which is an impressive three miles away from the starting zone! The debris was over 25-30' deep with the air blast from the avalanche scattering Shasta Red Fir boughs as far away as 500' from the deposition area.

The rest of the month was fairly quiet until Jan 24th when we received 2" of snow overnight with W/NW winds blowing 44-70mph by mid morning. Some natural slides ran and several small slides were remotely triggered during this wind event by skiers and snow machiners.

February was an active month with over 109.5" of snow and plenty of avalanche activity. There were five human triggered slides reported with no injuries or fatalities. In one of these incidents, the individual who triggered the slide took a 600' ride with no injuries and was able to stay on top. He did lose some equipment and it was reported as a 20'-wide slide on a 40-degree NW aspect. A number of large naturally occurring avalanches ran on a variety of aspects and elevations. One slide in the Avalanche Gulch area had a 5 to 8'-crown face and wrapped from south to northwest. Starting at 10,460 feet, the slide ran approximately 3,000 vertical feet and 2 linear miles with deposition 20 to 30-feet deep.

March was a relatively quiet month for precipitation but exciting for winds and warm temps. The temps hovered in the mid 30s to high 50s at 7,600 feet. The winds recorded at 8,000' during the beginning of the month were cranking well over 100mph from the NW. It seemed most of our snow on the upper mountain was transported to McCloud and beyond. The stripping, as well as the warm temps, left some of the well known landmarks such as the Heart in Avalanche Gulch at 12,000' bare down to the rocks.

Some wet slide activity occurred during the last week of March. Of note, snow survey totals at 7,900' on the south side of Mt. Shasta showed that the beginning of March was at 150% of average for snow. By the end of March snow totals had dropped to 115%, although SWE was 134%. Typically, March is a big month for snow accumulation, not a loss. Daily advisories ended April 20 and we continued to do weekly avalanche statements until the end of the month. Overall, it was pretty quiet with only 13" of snow and light winds.

The Crystal Ball: In the future we would like to continue to expand our program in education, weather information, and the forecast area. We would like to continue to receive more education pertaining to the unique weather phenomena that occurs on Mt. Shasta. We would also like to expand our snowmobiler educational programs. We look forward to the winter ahead, and in continuing to provide a professional and quality product for the public.

We want to give a BIG THANKS! We feel very fortunate to have such great support from the Friends of the Mt. Shasta Avalanche Center. They threw another great fundraiser called the "Snowball" that produced over \$7,000 to be used for more weather telemetry and rescue caches. Many businesses locally and from out of the area donated prizes, beverages and food.

Thanks to the National Avalanche Center for their support and guidance. All the observers deserve a huge pat on the back for their invaluable information. Medford NWS did a good job of providing us with weather information. Brenda Graham from the USFS Fire Weather Forecast Center in Redding, CA gave us invaluable guidance and meteorological education. Special thanks to Dept of Water Resources for the excellent weather telemetry and help in installation, and to Dave Trevisan and Mike Hupp for continued support and faith in the avalanche center. Last but not least, enormous thanks go to our patient and beautiful wives for putting up with early mornings and long hours.

—Matt Hill

Northwest Weather and Avalanche Center

Very heavy snow began in late November, which gave a good start to the season. Snowfall of 15-25 inches in 24 hours was seen on many different days at different sites in late November. Thus, the NWAC began regular winter forecasting services on the 24th of November.

Steady storm cycles continued through December and into early January. We saw heavy snowfall the night of 13-14 December, with 1-2 feet accumulating at most sites west of and at the Cascade crest. Particularly heavy snow was seen again on January 7 with a 20-30" snowfall in 24 hours at Paradise and Timberline. Two snowshoers survived a miraculous 24 hours of burial near the Mt. Baker ski area from December 12-13, but their third member died of hypothermia. On December 13, a snowshoer was caught and buried under a large boulder at Snoqualmie Pass and rescuers needed a week to find her body. Then on December 17 a snowmobiler highmarking near Blewett Pass triggered a large avalanche, which buried and killed him. He was the only one in his group without a transceiver.

Storm cycles were heaviest in the south Cascades but also more intermittent during mid January to late March. In late January, 10-20 inches of 24-hour snowfall was common. On January 31 two snowmobilers were buried 2- and 5-feet deep in a triggered avalanche in the central Cascades, and both were rescued using transceivers. Another fairly heavy storm cycle was seen the third week of February with 5-10 inches of 24-hour snowfall persisting from the 16th to 19th. This apparently caused a buried surface hoar layer to become reactive in the vicinity of Stevens Pass, where several slab avalanches were triggered and one person received face injuries when an avalanche carried him into a tree. Another 5-15 inches of 24-hour snowfall occurred over several days in early March. A snowmobiler was killed on March 5 while highmarking near Snoqualmie Pass. He was wearing a beacon, but was buried 8-feet deep in avalanche debris. Two other lucky snowmobilers survived an avalanche they triggered near Stampede Pass on March 6. One was buried upside down with his feet showing and the other nearly completely buried but with a bit of glove showing.

Major dry and mild periods led to a quiet end to winter during the remainder of March and early April. The NWAC ended full forecasting services on April 11. A reminder that the avalanche season is not over in the spring came on April 26. A person snowboarding by himself near the Mt. Baker ski area was killed when he was caught by a small wet-snow avalanche and partly buried upside down in a bergschrund.

We had 23 days through the winter with warnings or special statements, which is slightly below the annual average of 26 for the last 10 years. There were five avalanche fatalities (two snowshoers, two snowmobilers, one snowboarder) in the Cascades this season, which is the most since the winter of 1996/1997 when five people also died. As usual, it was amazing that other close calls didn't result in more fatalities. We had over 2-million Internet hits to our weather station data and over 620,000 hits to our forecasts. With the help of our intrepid volunteers we provided about 25 avalanche-awareness presentations to various groups. Our avalanche center, opposed to many others, leaves any additional avalanche courses to the private sector.

One thing that still amazes me about this operation is that we maintain or help maintain about 40 mountain weather stations in the Olympics and Cascades. This continues to get gradually easier with equipment upgrades and the elimination of long line runs between data loggers and sensors. Another upcoming NWAC office project is to revise the NWAC Web site and move it to the avalanche.org server system.

The Friends of the Northwest Weather and Avalanche Center (FOAC) continues to do a great job supporting our efforts. The FOAC hosted their annual Snowbash party

Continued next page ➡

NAC ROUNDUP

continued from previous page

last fall and held several film events through the winter. The FOAC and the NWAC began a Web-based Northwest Snowpack Information Exchange where backcountry enthusiasts can exchange snow-stability information. Although the Exchange only began in February, many people used it by the end of the season. In addition, the FOAC plans to revise their Web site and the Exchange for 2004/2005.

For a more detailed annual report visit our Web site at www.nwac.us.

—Garth Ferber

Payette National Forest Avalanche Center

Thanks to early season snows in west-central Idaho, the Payette Avalanche Center started forecasting on November 21, 2003. We issued advisories three times a week and operated until the end of March, producing our last advisory March 31. We created about 50 advisories, primarily on Wednesday, Friday, and Saturday. The Avalanche Center utilized four paid and two volunteer forecasters. The advisories were distributed using the internet and a multi-line phone recorder. This was the first year using a new Web site paid for by the Friends of the Payette Avalanche Center, which allowed us to post our own advisories and utilize remote access. This was a real highlight for the forecasters. Before, we had to go through a Forest Service Web master and often were unable to post advisories when the Forest's system was shut down for maintenance. (This happens often on Friday afternoons or holidays). We also added a counter to the site and had 7,801 hits for the season.

The Center put on five classroom and two field sessions of basic avalanche awareness instruction, and participated in instructing two level I avalanche courses. One of the awareness courses was taught in Boise, the rest in McCall. The two level one courses were taught near Cascade, Idaho. Idaho Department of Parks & Recreation partnered on a snowmachiners avalanche class and some advisory sponsorship. IDPR is keen about the avalanche programs and is committed to pursuing some long term goals for class promotion and attendance.

The challenges remained the same: we struggle with meeting increasing demands for avalanche education and maintaining remote weather stations throughout the season.

—Jim Fitzgerald

Idaho Panhandle National Forest Avalanche Center

The first week in December, the Idaho Panhandle National Forest Avalanche Center began issuing advisories with 5 feet of snow in the mountains. Snowfall had been consistent after the first dustings arrived in early November, and winter came on with a bang around the middle of December. The St. Joe Range and the St. Regis Basin developed problem layers early in the season due to rainfall, which formed crusts and faceted layers. Natural slides as well as human triggered avalanches started off the season in these areas. The crust/facet layers were responsible for several human-caused avalanches reported to the IPNF avalanche center. One involved a group of snowmobilers in the St. Regis Basin and the other was a group of several skiers touring in the Copper Lakes basin. Colder temperatures to the north meant snow instead of rain crusts in the Selkirks and Cabinet Mountains. Buried surface hoar began to accumulate in the pack around the end of December and became a hazardous weak layer by the beginning of January. Also during the early part of January, IPNF areas experienced a drastic cold snap that lasted a little over one week. The cold was due to the weather coming predominantly from the north and making it feel even colder were strong northerly winds. Most often these cold snaps just bring cold temperatures but this one brought quite a bit of low-density snowfall. It is rare to get much snow during single-digit temperatures in the Panhandle. We were completely surprised to see significant snow accumulations in spite of the mercury dropping to well below zero. Snow loads came gradually and due to the low density of the new snow, not much hazard was associated with the additional loads. As the cold snap ended we became worried about a predicted warming trend. All of our observers and forecasters were in a frenzy. However, the rise in temperatures happened gradually and no widespread avalanche activity occurred.

Through the remainder of January and into February, we had periodic problems with the old crust layers that had developed associated facets and surface hoar. On the 2nd of February, a highmarking snowmobiler triggered a large avalanche in the Selkirk Mountains northwest of Bonners Ferry. Eleven people were witness to the nearly 600-vertical-foot avalanche, but only four were caught and buried by the slide. No one was killed by this large event. We were not notified until several days later by the Glacier Country Avalanche Center, as the snowmobilers were from Kalispell and reported the accident there. Going to the site the following week we noted one of the larger slides seen in this area.

By March we had developed a relatively unstable pack. Numerous layers were present. Surface hoar and facets were located above & beneath different crusts. On the 6th of March we experienced our first and only fatality of the year. We had issued a HIGH danger rating for the weekend with an added expletive, *"The weather that is predicted for the weekend will greatly increase the avalanche danger on a currently unstable snowpack."* One snowmobiler was caught, buried, and killed in an avalanche on an east aspect about 10 miles north of the Schweitzer Ski Area. After this weather event, which temporarily raised the avalanche danger, the rest of March was atypically mild. The snowpack settled out considerably and we had no major concerns the rest of the forecasting season. The last advisory was issued on March 26. On the 5th of April we posted a general spring conditions advisory. The forecast season ended about two weeks early due to the fact that we had not received any appreciable snowfall in the prior month and a half. In the Cabinet Mountains the winter maximum-depth snowpack was recorded on the 8th of March. To the south, the Lookout Pass SNOTEL showed its maximum winter snowpack on the 10th of March. As of this writing on April 19 the Schweitzer SNOTEL was still accumulating snow but only gradually since late March. All other SNOTEL sites for the Panhandle region had a slow but steady decline in snow water equivalent

from mid to late March. A very unusual situation for north Idaho.

Public education classes were conducted on 11 different occasions with a total of about 192 people in attendance. Attendance was generally low for most workshops, including a well-publicized state and federal cooperative event for snowmobilers. After advertising for a month prior to the scheduled date only two participants showed up to a free two-day workshop put on by the IPNF avalanche center and the Idaho Department of Parks and Recreation. This was disappointing. We feel that an avalanche safety representative from the snowmobiling community who is actively engaged in the classes would help, and would be an asset for education opportunities.

—Kevin Davis, Ed Odegaard, Piper Goessel, Tom Sudul, Bob Kasun

Mount Washington Avalanche Center

The season began for the Mount Washington Avalanche Center with our first general advisory avalanche bulletin posted on November 14, 2003. We went from late fall conditions with no snow to full-on winter conditions within a day and a half. With the onset of an early season nor'easter, daily forecasting began on December 6, 2003. We issued a total of 185 advisories in the seven-month season.

Excitement built as New Hampshire was hit with a nor'easter, which dumped 106 cm of snow on Mount Washington in 48 hours. This was followed three days later with 8.1 cm of rain. The snow on the ground survived the deluge of water and four days later a new storm dropped an additional 42 cm of snow. Unfortunately, three days later yet another rainstorm arrived, dumping 10.9 cm of rain. The result was an impressive wet & loose slush avalanche that was ~80 meters wide and ran over 330 meters. The debris covered the floor of the ravine and was littered with snow, rock, dirt, and large boulders. This same storm also produced a slush slide at Wildcat Ski Area which pushed a snowcat into the Gondola shack with slush a meter deep. As we looked back on the season, we pined for the big snowstorms of December which never returned.

In last year's season summary I spoke of the cold temperatures of January. This year topped last! January was the coldest month on record for Mt. Washington with an average temperature of -21C (-6.6F). That doesn't seem bad until you look at the week of January 13 when the low temperature on the summit of Mt. Washington stayed below -40C (-41F) for four days and the average wind speed was 178kph (111mph). January 16 was notable with a temperature of -42C (-44F) and a wind speed of 233kph (145mph). Needless to say we did not dilly-dally in our forecasting field duties that day. Mt. Washington had six days of new record lows (-38 to -45F) in January, 2004.

February and March brought a few small storms but nothing of note until March 26 when we received 3 cm of rain in a 12-hour period. The result was an impressive wet slab slide. The crown face was 2-meters deep and 175-meters long and it ran over 300 meters. This avalanche received a lot of local press due to the onset of spring ski season. It didn't do much for the skiing in the ravine except to make it even more of a challenge. Warm spring temperatures and rain came early to the ravine and our season ended on Memorial Day with the least amount of snow we have seen in years. Mt. Washington ended the winter season 254 cm below normal snow fall. It was a season of extremes.

This year we upgraded our manual snow-plot capabilities with the addition of a new snow plot for Huntington Ravine and new weather instrumentation for our Hermit Lake plot.

We recorded four human triggered avalanches this season (luckily with no injuries) and 57 natural triggered avalanches, though we are confident many cycles went unrecorded since they occurred during storms. In addition to the avalanches noted above, our most interesting period was during the January cold spell when we had a number of avalanches occurring on buried near-surface facets. These buried weaknesses produced avalanches with fracture line depths up to 220 cm.

In addition to the avalanche incidents we had about 20 skiing and climbing accidents and one fatality in the Ravines this year. The Mount Washington Volunteer Ski Patrol (MWVSP), who are all Forest Service volunteers, contributed 174 days (1,740 hours) helping visitors by giving out current safety information, responding to search and rescue events and caring for the injured.

More than 20 avalanche courses were held in the local area. The Mount Washington Avalanche Center staff participated in the field portion of most classes and some of the classroom sessions. Over 350 people attended these courses. This year also marked the second year that we held a special avalanche course for the local search and rescue community. Our Snow Rangers presented numerous educational talks about our program to the local community. Cutler, our yellow Labrador, also had good training opportunities through the winter and is fully operational. Our Web site—www.tuckerman.org—received over 181,000 visits (2.2 million hits!). We are excited to see the increase in numbers of people looking for avalanche and safety information.

The "Friends of Tuckerman Ravine" held their fourth annual "Son-of-Inferno" pentathlon (run-kayak-bike-hike-ski) in April to raise funds for the Avalanche Center and the ravine. The low snowpack made the course a challenge but overall the race seems to have been a success.

Happy for a summertime break, we are secretly longing for a nor'easter to dump lots of snow come fall.

—Marianne Lebermann

Logan, Utah • Bear River Avalanche Information Center

The Avalanche Center in Logan is a regional branch of the Forest Service's Utah Avalanche Center in Salt Lake City. There is only one federally paid forecaster for the center. Tremendous support comes from local backcountry observers and volunteers. Through the Friends of the Utah Avalanche Center-Logan, Dave Kikkert, a graduate student at Utah State University, was able to provide significant operational and technical assistance.

The Logan District lies in the Wasatch-Cache National Forest and a substantial percentage of the active avalanche paths in the region are located within the boundaries of the Wellsville Mountain and Mount Naomi Wilderness areas. There are no ski areas or helicopter guide services that do regular avalanche control work

in the mountains surrounding Logan, so we receive all local observations from those involved in purely backcountry recreational pursuits. We also rely heavily on consistent and frequent early morning communications with the Salt Lake Center for pertinent avalanche observations and accurate weather forecasts.

The 2003-2004 winter season began with a heavy Halloween snowfall in the Logan area mountains that kindled hope among optimists for an end to the lengthy drought firmly gripping the region. Snow continued to fall throughout the first days of November allowing for earlier than normal backcountry access and good powder conditions at high elevations. On Monday, November 10, several inches of dense snow fell on the higher elevation slopes of the Bear River Mountains. The snowfall buried and preserved a weak layer of feathery surface hoar that had formed during a brief period of clear weather over the previous weekend. On Tuesday the 11th, light snowfall was accompanied by an increasing westerly wind. Overnight, the southwesterly wind on Logan Peak reached hourly averages of around 30 mph with 50 mph gusts. It began to transport lots of snow onto upper elevation lee slopes. On Wednesday morning, November 12, despite generally shallow conditions in the Logan area mountains, I released the first of our regularly scheduled avalanche advisories for the season to warn backcountry travelers of the increasing danger of wind slab avalanches

In my view this was the first day of the season that human-triggered avalanches were possible in the region and, as luck would have it, the first and perhaps the most serious avalanche incident of the season took place that very day. On November 12 at around 11:30 am, an extremely experienced snowmobiler and prominent local businessman triggered and was buried by a shallow wind-slab avalanche on a northeast-facing slope near the summit of the 9700-foot Logan Peak. Despite his extensive riding experience in the avalanche-prone terrain surrounding Logan Peak and because of shallow snow conditions, the victim and his party did not carry transceivers or probes and they had not checked the avalanche advisory. Luckily, the snow that covered the rider when the avalanche stopped was fairly light and he was able to clear an air space in front of his face before the deposition set up. It was an even more incredible stroke of luck that without transceivers and probes, the victim's son, who was searching with his feet, found his father just downslope of his partially buried snowmobile. He had been buried under a couple feet of snow for about 10 minutes. Blue and unconscious, the victim was recovered by his frantic party, and when the snow was cleared from around his chest and helmet, he spontaneously began to breath and quickly regained consciousness. When Cache County Search and Rescue met the party at the victim's cabin on the shoulder of Logan Peak, he was happy to have survived and was already recovering from hypothermia.

Snow continued to pile up almost incrementally in the Bear River Range throughout November and into the last month of 2003. By mid-December, the upper-elevation snowpack had become quite varied and complex. At the end of November, rain fell on all but the highest slopes, and a crust of widely ranging thickness formed on many avalanche paths in the region. Sandwiched between the regularly occurring snowstorms, short intervals of dry clear nights resulted in the development of classic thin layers of surface hoar and near-surface facets. On December 14, a productive snowfall added two inches of water to the remote Tony Grove Snotel site and was accompanied by strong southerly winds. The Campbell Scientific weather station on Logan Peak measured wind speeds averaging 30 mph, with gusts in the mid 40s. Clear weather the next day assisted our search for suspected natural avalanches, and our efforts in the Naomi Peak Area were rewarded by the discovery of a large avalanche on a steep, northeast facing slope called Castle Rock. As if to accentuate the dangers of backcountry travel in the limestone-based topography of the region, the avalanche had packed a huge pile of deposition into a vertical, rock-sided sink-hole. The 4-foot-deep and 200-foot-wide crown showed us a weak layer consisting of small faceted crystals that had formed near the snow's surface during a brief clearing in the first week of the month. The weak layer was overlain by two substantial wind-slabs, evenly divided by a distinct rime-crust formed on February 13.

Snow began to fall again in earnest at the onset of the holidays, and with little reprieve. The "Christmas Eve Storm" soon stretched on into the "Third Storm Since Christmas," and then into the "New Year's Storm." On the morning of December 30, after receiving sustained southwesterly winds and almost 80 inches of snow since Christmas, snow-safety personnel at Snowbasin, in the Ogden area mountains, (several miles south of the Logan area mountains), triggered a handful of large and destructive hard-slab avalanches with 2-lb avalancher rounds. In the Logan area, copious holiday snow fell, even at the lowest elevations. Exceptionally heavy precipitation hit the northern Wasatch Front. Between Christmas Eve and January 2, the Snotel site at 8000' on the flank of Ben Lomond Peak picked up 13.2 inches of water. The final weather event, which triggered a huge natural avalanche cycle in



The aftermath of the January, 2004 avalanche cycle in John F. Stevens Canyon where slides struck a train of empty grain cars. The derailed cars were pushed off the railbed in order to speed cleanup in hazardous conditions. *Photo by Darwon Stoneman*

the region, came on New Year's Day in the form of gale-force winds. To our south, the new anemometer on the summit of Mount Ogden recorded southwesterly wind gusts of over 90 mph for several hours, with an incredible 106 mph reading coming at around 5:00 in the evening. Early in the morning of the 2nd, the Forest Service Utah Avalanche Center issued an Avalanche Warning for the backcountry in all the mountains of Northern Utah.

Just after dawn on January 2, I stepped out of the windowless Forest Service office and looked across the snow shrouded Cache Valley at the eastern slopes of the Wellsville Mountains, over 10 miles away. For a few short minutes, I could clearly see the shadows of tremendous, long crown lines stretched across the range below the sharp ridge top. I could see fresh white swaths down low on the opposite bench where deposition from wide-spread and very large hard-slab avalanches had blasted out of the bottoms of narrow canyon funnels and leveled many acres of mature aspen, box elder, and maple trees. In the following days I explored the evidence and destruction brought about by the largest avalanches I had ever seen. The extensive hard-slab avalanches, which ran overnight on the first night of the year, were 4-6 feet deep and up to a half-mile wide. The numerous natural avalanches had nearly simultaneously released on a thin weak layer formed in early December.

A strong high-pressure system set up over the region for most of the remainder of January, and snow cover in the lowlands of Cache Valley helped to create a stubborn and smoggy temperature inversion. While stagnant air remained trapped in the valley, sunshine and clear cold nights played with the snowpack in the mountains. Conditions became quite varied. With slick brittle sun-crusts on sunny slopes, mature surface hoar and near surface facets on shady slopes, and well-developed depth hoar on shallow lower-elevation slopes, we were set up for dangerous conditions in the event of any major storm. Thankfully, when snowy weather returned at the end of January it came in small, almost incremental doses and the snowpack remained intact. On January 30, warm temperatures and rain on lower elevation slopes caused several destructive, natural wet point-release avalanches below the 7000-ft elevation level.

Incremental snowfalls continued into early February, and buried weak layers from the January high-pressure system continued to haunt us. On a daily basis backcountry observers reported heart-stopping collapses. Despite lingering paranoia, the snowpack adjusted to the gradual addition of weight and we were spared from a large avalanche cycle. In mid-February unseasonably warm temperatures again returned to the region. The warmth led to a couple of human-triggered slab avalanches on shallow slopes in southeast Idaho, the east-central Wasatch Range, the southern Wasatch Mountains near Provo, and in the western Uinta Mountains, which forced us to keep our guard up. On February 18 several large wet point-release avalanches descended from steep lower-elevation shady slopes in the Logan area. A couple of soggy avalanches crossed the popular Logan River Trail in lower Logan Canyon, and a few impressive wet avalanches temporarily dammed the Logan River at the Blind Hollow trailhead, about halfway up the canyon.

Winter returned at the end of the month, and a large snowstorm stalled over the region. The last weekend of February brought dangerous soft-slab conditions to mid-elevation slopes in the Logan area mountains. My assistant, Dave Kikkert, remotely triggered a substantial new-snow avalanche (approximately 2-feet deep and 200-feet wide) in the Hell's Kitchen area in Franklin Basin near the Idaho border. Over the weekend, backcountry observers reported directly and remotely triggering similar avalanches throughout the Bear River Range. Fortunately, the warm temperatures of the middle of the month seemed to have locked up the deeply buried instabilities formed during the January high-pressure system, and no avalanches were reported releasing on old weak layers.

The next windy storm hit the Bear River Range just in time for the first weekend in March. The now familiar southwesterly wind picked up strength overnight on Friday the 5th and, as you might expect, it rapidly built big touchy cornices and drifted stiff wind-slabs onto lee slopes with the past few days' worth of fresh snow. There were two very close calls in the Logan Area backcountry that weekend, and several locals, who may have underestimated the forces of winter weather in the northern Utah mountains, are happy to have survived. In a potentially catastrophic situation, early on the morning of March 6, 39 Boy Scouts on an annual weekend winter camping outing were buried by rapidly accumulating wind-drifted snow and cornice falls as they slept in their snow-caves in a drift a few hundred feet from Highway 89 in the Amazon Basin area. There were no injuries; in fact, many of the boys did not know what had occurred until rescue diggers woke them up! On Sunday the 7th, a group of six snowmobilers triggered, survived uninjured, and did not report an avalanche in an area that has recently been closed to wintertime-motorized travel. The crown line of the avalanche, in the upper reaches of the Bunchgrass Creek drainage, was around 3-feet deep and well over 400-feet wide.

The remainder of March was historically dry and warm, and the snowpack rapidly diminished, leaving only upper elevation and shady slopes in the region covered with snow. The weather in March clinched the fact that the six-year drought in the area would continue. In typical spring-like fashion, the high angle of the sun caused the powder snow from storms in late March and early April to quickly turn to the consistency of mashed potatoes, and wet point-release avalanches were common. There was also some isolated soft-slab activity associated with the spring storms, but there were no more human-triggered avalanches or close calls in the region. I released the last regular avalanche advisory for the season on April 9. The Forest Service Utah Avalanche Center in Logan saw a marked increase in public usage this season, with thousands of calls to our avalanche hotline and over 13,000 hits on the Avalanche.org based web site.

—Toby Weed

Glacier Country • Northwest Montana

For northwestern Montana, the winter of 2003-04 started slowly. Precipitation was near normal in October, but temperatures were warmer than usual and consequently snow accumulations lagged behind. Snow accumulations were somewhat below the norm until the later part of January. At this point snow accumulations increased

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NAC ROUNDUP

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rapidly within a week's time. For February, snow accumulations were near normal. March brought an abrupt end to winter with higher than normal temperatures and very little precipitation. The past three years, our March and April months had been a time to continue snow pack accumulations. This year it leveled off and early melt transpired.

A generally shallow early season snow pack spelled a relatively quiet winter. It seems the number of backcountry parties who got involved in avalanches were within the norm. A brief but spectacular avalanche cycle affected U.S. Highway 2 and the railroad in John F. Stevens Canyon. This cycle delayed traffic on the highway for a couple of days. Railway traffic was suspended for a time to clear derailments and provide safe work areas. Fortunately, none of the incidents involved fatalities or serious injury.

The avalanche center continued with its normal program of educational classes and twice-weekly avalanche advisories. The non-profit side of the program hosted their third year of level II classes, which they developed and taught with local instructors. They also taught numerous transceiver clinics and a combined Level I and Wilderness First Aid course, and organized an Avalanche Awareness Days program modeled after and in conjunction with Canadian Avalanche Awareness Days. All these were well received. The Web page continues to experience increased use. It not only provides access to our advisories, but it offers a forum for backcountry observation reports. The Forest Service received another substantial Montana Department of Fish, Wildlife, & Parks trails grant for avalanche education. Our plans for next season involve maintaining our programs and serving our area users. —Tony Willits

Gallatin National Forest Avalanche Center



Snowmachiners enthusiastically dig in to an IDPR avalanche class in West Yellowstone, MT.

While GNFAAC forecasters were at the National Avalanche School in Reno last October, southwest Montana was hit with record low temperatures and its first snowfall. Trick-or-treaters had to wear down jackets and long johns in order to survive the brutal cold. Thinking this was surely the start of a fantastic winter we rushed home just in time to have the snow stop. And...it didn't start again until December. We were blessed with a thin snowpack and cold temperatures through all of November; a sure recipe for job security.

The depth hoar formed nicely, and then it started to snow. December was the snowiest month of the season with most of it falling the last week of the year. A Christmas

dump dropped 100 inches of snow at Bridger Bowl, a local record. This storm also brought the SWE (snow water equivalent) at most locations to above average. As expected, the November depth hoar couldn't support all this new weight and we experienced many avalanches.

A two-week dry spell during the middle of January promoted a banner crop of surface hoar in the southern mountains. This layer survived long enough to be buried during a storm on January 25-29 and reacted as expected; it avalanched. We issued the season's only avalanche warning as widespread avalanche activity was reported, most of it natural.

February was dry and formed even more surface hoar and near-surface facets. Small storms buried and preserved these, but it wasn't until a snowstorm Feb 23-29 that we had lots of slides. We measured 3-5 inches of SWE falling during this event. A snowmobiler was fully buried and rescued by his partner at the beginning of this storm. Luckily, this was the only complete burial of the winter. Amen.

March came in like a lion, but went out like a lamb. Most of the precipitation occurred during its first week. The deepest snowpack of the season was recorded on March 5-6; 65 inches was measured in the mountains around Bozeman with almost 90 inches in the mountains around West Yellowstone and Cooke City. We kept thinking that winter would return, but spring settled in like an unwanted houseguest. Hot and dry weather prevailed during the last weeks of the month setting record high temperatures. For at least one day, high temperatures at 9,000 feet were above 55 degrees. Wet snow avalanches occurred but were not widespread. We waited and waited for the annual April dump, but it never happened. We quietly put out our 122nd and last advisory on April 10.

We all feel lucky that we had no avalanche fatalities this winter. We were on pins and needles many times expecting our rescue beepers to go off, but they remained silent. We were as busy as ever with education and gave 56 lectures to over 2,800 people. Many people sat in on different classes, so to be fair in our accounting, (especially in light of Enron), we counted 2,098 unique attendees in 43 separate classes. Close to 1,000 people heard our snowmobile lectures, which totaled half of our classes. We were grateful to have Janet Kellam as a guest lecturer and field instructor for our two-day, record-setting attendance snowmobile class in West Yellowstone. Additionally we had Chris Lundy share our teaching burden for the second year in a row. His energy and hard work allowed us to take on almost all teaching requests.

The number of people getting our advisory flattened for the first time. We had 4% growth, still more than a bank CD, but not the double-digit growth of years past. Overall we averaged 1,580 accesses a day through our e-mail service, Web page, phone line and faxes. We also owe a huge debt of gratitude to the Utah

Avalanche Center for loaning us their unused digital voice recorder when ours suddenly died this winter.

SnowPilot is finally up and running with people collecting data on their PDAs. You can check it out at www.snowpilot.org. We received further funding from the Omega Foundation, so next winter we hope to get every avalanche center a newer and faster PDA so folks will actually start using it! —Doug Chabot and Ron Johnson

Chugach National Forest Avalanche Information Center

2004 marked the second full year of operation for the Chugach National Forest Avalanche Information Center, (CNFAIC). A joint effort from Alaska Railroad, Alaska DOT and the Forest Service allowed us to install another weather station in the very popular Turnagain Pass area. The first snows fell on November 11 and the first advisory was posted on November 24.

The Center operates a call-in hotline and a Web-based advisory issued five days a week. Avalanche-education classes started at the Glacier Ranger District in November and finished up at the end of December. From January on, the CNFAIC was lucky enough to once again team up with the Alaska Mountain Safety Center, Alaska Avalanche School; and Snow Dynamics to provide additional avalanche education throughout the rest of the season. The total number of backcountry enthusiasts taking part in formal education was approximately 250. CNFAIC avalanche technicians pursued in-the-field contacts and informal education as often as possible. Snowmachine trade shows and presentations for special interest clubs and groups provided additional educational programs.

The CNFAIC started the season with Jeff Nissman and Carl Skustad staffing the center. On January 22, 2004, our organization and the mountain community lost Jeff Nissman to a tragic accident. Nissman and I were heading to the field for observations when an unexpected roof avalanche at our workcenter broke loose and crushed one of our own. Jeff was an integral part of our small center and had created the Web site so many Alaskans look to each snowy morning. Jeff had worked for the Forest Service for seven years. He led the Glacier Ranger District public use cabins program during the short Alaskan summers when his skis got a brief break. We miss him dearly. Looking toward the future we have hired two new technicians to assist the CNFAIC in 2004-2005. Matt Murphy and Dan Valentine will be very important assets to the center.

As funding seems to be on everyone's mind in this business, it was also on ours. We received a significant earmark this past season. This great opportunity allowed us to upgrade our computers and educational equipment, purchase two new snowmachines and an enclosed trailer, as well as build a weather station and rescue cache. We can only hope this is the start of a trend that all of the avalanche centers will all experience.

The Chugach snowpack started with October snows, then shifted to cold clear weather until mid November. Consequently we were plagued with persistent depth hoar. This is somewhat unusual for the Chugach's coastal snowpack. The large precipitation events in December sufficiently buried this depth hoar and did increase stability. A fairly even distribution of above-average snowfall continued throughout much of the winter season from sea level to high alpine ridges. The most notable instability of the season was due to buried surface hoar, which formed February 26 at alpine elevations on multiple aspects. This weak layer was the factor in some very close calls including several skier and snowmachine triggered avalanches. Outcomes ranged from partial burials to total burials. Thanks to very quick recoveries and good travel practices, no casualties occurred from these burials. The Chugach had only two backcountry avalanche fatalities this season: one snowmachiner was buried from a terrain trap below the slide and one climber killed when a cornice broke.

The CNFAIC is a small center with an ever-growing backcountry group to serve. We could not do the job without the assistance of the Alaska Railroad, Alaska DOT, Alyeska Ski Area, Chugach Powder Guides, Snow Dynamics, Alaska Mountain Safety Center, our Friends Group, and many volunteer observations. Thank you all! —Carl Skustad

Colorado Avalanche Information Center

The CAIC opened for public forecasting on November 7 and the first reported avalanche occurred on November 9 in Rocky Mountain National Park near Long's Peak. Early-season snows fell with high water content, helping to initially develop a strong base.

A mid-November avalanche cycle had all mountain areas of the state experiencing some avalanche activity. The Copper Mountain ski patrol released two large slides on the 18th of November that fell 800- to 1,000-vertical feet and took almost the entire winter snowpack. Later in the month came the traditional November cold snap, then dry conditions with slowly warming temperatures. November snow was well above normal. Of note: in the northern mountains, Steamboat reported 220% of normal, although Keystone, A-Basin and Berthoud Pass were only 100-110%. In the central and southern mountains, Gothic reported 188%, Red Mtn Pass and Wolf Creek were 195%.

A series of weak storms in early December brought on the first avalanche cycle of the month. Telluride and Red Mountain Pass were hit the hardest. The next slide cycle occurred mid month. This storm cycle also favored the Telluride area, but slides reported from Berthoud & Loveland Pass helped verify just how weak the snowpack was in the Summit County and northern Continental Divide areas.

Late December, a couple of days of steady snow and wind and the snowpack became overly stressed, triggering the first major slide cycle of the season. Initial activity was in the San Juans, but by the 30th avalanche activity had picked up statewide. CDOT crews put in some long days as numerous control missions were called for in both the northern and southern mountain highway corridors. The backcountry snowpack was growing weaker. One person was completely buried but was quickly dug out by his friends. For the record, no one was hurt in the avalanche cycles of December.

The leading line for our January 2 snowpack discussion was a quote from the robot in the Space Family Robinson television series of the 1960s: "Danger, danger,



An April avalanche on Berthoud Pass. CAIC photo by Jeff Russell

Will Robinson!" The storm cycle of late December roared into January with large snowfall amounts and strong winds for the central and southern mountains of Colorado. The CAIC issued its first avalanche warning of the season on the 2nd and it extended into the 4th of January. All the major San Juan passes were closed because of natural avalanches and CDOT-triggered slides. Heavy snows the first week of January resulted in the first closure of Wolf Creek Pass for avalanche danger in seven years. Mark Mueller reported, "Every known avalanche path was active and many more than once." Several new avalanches were observed from unexpected places and also reached the highway. Even though the weather turned dry and mild after the 4th, we received daily reports of triggered hard-slab avalanches, many due to mid-pack weaknesses. People triggered several of these slides and a number were triggered by explosives, as avalanche crews worked to catch-up.

The dry and mild weather following the early January avalanche cycle was turning the upper snowpack to faceted grains on the colder aspects, while sun crusts formed on top of faceted layers on the sunny, warmer aspects. These layers would define our avalanche season well into February and March. All that was missing from the dry mid-January was fresh slab; another storm cycle would stress these new, weak surface layers. Right on cue, a series of small storms beginning on the 20th did the trick and triggered the second and last avalanche cycle for January. A couple of noteworthy incidents were reported. The first was near Snowmass in the Elk Range, when a skier triggered a sizable slab from some distance away. The slide was 300-feet wide and ran nearly 1,000-vertical feet. The second was near Red Mountain Pass in the San Juans when a skier triggered a slide from 200 feet away. Observers noted that our snowpack was very tender now that the mid-January weak layers were buried. When people are triggering avalanches from several-hundred feet away, forecasters always take note.

Avalanches were reported almost every day in February. On the 15th the worst avalanche accident of the season to date happened a few miles east of Eisenhower Tunnel. Two people ascending an avalanche path known as Herman A, just north of Interstate 70, triggered a slide that swept them approximately 700-vertical feet into a gully. One person was critically injured. This incident was not a surprise as the snowpack had shown signs of lingering instability for some time. Conditions were such that it was not a matter of *if*, but rather it was only a matter of *when* an accident would happen. February snowfall strongly favored the southern mountains, while the central and northern mountains saw highly variable amounts.

On February 17 a quick warm-up in the San Juans produced the first wet avalanche cycle of the season. Temperatures reached into the mid 30s on the mountain at Telluride and Durango Mountain Resort, and into the 50s in Silverton and Pagosa Springs. In the northern mountains high temperatures were in the middle to high 40s. By the 19th Colorado moved back into the storm track as a series of Pacific systems pounded the San Juans, bringing persistent snowfall through the end of the month. This potent little burst brought on the second avalanche warning of the season. There were some interesting avalanche incidents. One car was struck by a slide on Grand Mesa on the 4th, though no one was injured. An ice climber was caught near the ghost town of Eureka on the 21st and broke his leg. A snowmobiler was buried for 20 minutes on Groundhog Mountain near Dolores on the 23rd, and was found with a beacon and dug out with no injuries. And an avalanche in the Spring Gulch Path near Ophir on the 29th damaged a power line.

March weather started fairly tame, but the run of avalanche activity starting at the end of February continued into March. Though not much new snow fell during this first week, avalanches continued to run. The northern mountains saw the most active early March cycle. The first avalanche fatality of the season occurred on March 10. A snowmobiler highmarking a slide path on Mt. Guyot in Summit County triggered a large slide that overran his location. He was buried about 3-feet deep for an hour and a half before a random probe of a rescue team member located the body.

Warm dry weather would ease the avalanche danger through the second week. However, this warm dry spell was instrumental in a significant melt down—Eldora hit 64 degrees on the 12th! A wet avalanche cycle began on the 18th. This warm-up also played a role in the second avalanche fatality of the season. On the 20th, a 22-year-old climber was swept down 1,600 feet and buried by a wet-slab avalanche on the west slope of La Plata Peak in Chaffee County. One other person was caught in the same slide but escaped serious injury. The wet avalanche cycle was one of the most active Colorado had seen in years. Temperatures in March may have been record highs at some locations, and snowfall was below normal.

Early April brought welcome snowfall, following a March that had been much drier than normal. It also brought the third avalanche death of the season on Browns Peak, just north of Huron Peak, a Fourteener in the Sawatch Range. A snowshoer

triggered a large slide on a west aspect that turned into a wet avalanche lower on the slope. He was buried and killed, while two others escaped being caught. The last reported avalanche incident of the season came from Ski Hayden Peak near Aspen on April 26. Two backcountry skiers were retreating off a slope after snowpit data indicated a very weak layer. Before they could get to a safe spot they triggered a slide catching both, completely burying one. The buried person was quickly dug out with only minor injuries. Public forecasting ended on April 25, though most of our observation stations were closed by mid-April.

—Scott Toepfer

Bridger-Teton National Forest Avalanche Center

October was warm and dry in the Tetons. However, by mid-November there were great powder conditions at mid and upper elevations. Temperatures during December, January and February were well-below average. December was characterized by above-normal precipitation, snowfall and snow depths. Precipitation was below average in January, and well-below average in February and March. Due to the cold temperatures, the monthly snowfall and snow depths were near average in January and February. March was very dry and hot. As the season ended in April snowfall was slightly below normal, snow depths were about 85% of normal and the water content of the snowpack was significantly lower than average.

The season started with a very stable snowpack. Backcountry users took advantage of the situation and were entering active avalanche paths and terrain traps without a second thought. Storm cycles at the end of December and January produced significant avalanche activity, especially at the lower elevations. These events ran on buried surface hoar layers that grew during clear periods in December and January. Temperature inversions enhanced the growth of these faceted layers in the valley bottoms. Ray Azar, a longtime local backcountry skier, guide and Life-Link Backcountry Products employee, died in an avalanche on January 31. Ray liked to ski a large avalanche path on the Pyramid, a 9,660 foot peak in the southern Tetons. On the 31st, in this path, he triggered a large slab that swept him to his death. Ray routinely called the center with observations and humorous stories. He will be missed.

There were few if any dry-snow avalanches during the period of March 10 to mid April. Spectacular wet slides occurred on hot days in outlying areas that had a shallow faceted snowpack. Wet-slide cycles impacted the highways in the Snake River Canyon on February 8 and in the Hoback Canyon on March 9 and 10.

Avalanche education efforts included the development of a course specifically designed for snowmobile guides who were employed by permitted outfitters in the National Forest. This effort was in response to new requirements imposed upon the outfitters by the Forest and a need for a course with a field session that specifically addressed avalanche issues for non-skiing guides. This training was very well received and we learned a lot. Doug Chabot's input and the experience of the Gallatin Center was invaluable. Mark Kozak and Margo Krisjansons helped the center provide this service.

The BTNF continued to expand, in its fourth year in partnership with the State of Wyoming Trails Program. Seven new backcountry weather stations were installed. An Operations and Maintenance Manual for the existing network of remote automated weather stations was completed. Two new snowmobiles are in the process of being purchased and backcountry avalanche paths have been mapped using Global Positioning System (GPS) and Geographic Information System (GIS) technology. This project won a 2004 national achievement award from the Coalition for Recreational Trails in the Education & Communication category. Bob Comey traveled to Washington DC in June to accept this award on Capitol Hill.

Progress continued on the development of an avalanche atlas for the Jackson Hole Mountain Resort and the extension of this mapping into the backcountry. Over 300 slide paths have been mapped with starting zones and delineation of class I-V events. The atlas interacts with our historic weather and avalanche database and is the foundation for the visual display of queries from our GeoWAX nearest neighbor program.

The BTNF avalanche center participated in two infrasonic research projects with Inter-Mountain Laboratories, Inc (IML). Both projects explored the use of arrays of multiple sensors to detect avalanches as they occur. One was funded by a National Science Foundation grant and was conducted at the Jackson Hole Mountain Resort. The other was funded by a Wyoming Department of Transportation research grant and was conducted on the Glory Bowl and Twin Slides paths on Teton Pass. Ernie Scott of IML and Chris Hayward from the Department of Geological Sciences at Southern Methodist University have been working to develop programming that processes the signals from the arrays to determine the size and location of avalanches in near real time. Chris McCollister has been working full time since last June assisting in the development of the data-processing program, and writing programming that collects the data from the sensor arrays and transmits it to a valley computer via spread-spectrum radio frequencies. Jerry Hamann, John Pierre and Robert Kubichek, professors in the electrical engineering department at the University of Wyoming, have also been an integral part of this project. In addition to numerous other tasks, they are using a library of avalanche signals to classify characteristics that will enable computers to identify avalanche events and prevent false alarms. Bob Comey and Ernie Scott have submitted papers regarding this exciting project for presentation at ISSW '04. The knowledge gained this season is being used to redesign sensors and reconfigure arrays for next season's research. It is anticipated that these new sensors and arrays will be installed and operational for the ISSW field trips.

In May and June, the center worked on a local museum exhibit that highlights the history of avalanche science in the valley. It focuses on the early efforts of Juris Krisjansons, Rod Newcomb, John Simms, Gary Poulson, and others in the development of avalanche weather instruments and management programs that lead to the establishment of the center in the early '70s.

The infrasonic projects, mapping projects, Web page upgrades and preparations for ISSW '04 will keep us busy and out of trouble during the summer. We look forward to seeing everybody at ISSW and the avalanche bulletin writer's workshop in September.

—Bob Comey ❄️

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A Publication of the American Avalanche Association

Avalanche

REVIEW

OCTOBER 2004 • VOLUME 23 • NUMBER 1

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



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