

THE AVALANCHE REVIEW

2015-2016 SEASON
2012-2019 SUMMARIES

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FEAR AND *Fascination* CONTEST WINNERS

TURNAGAIN PASS, ALASKA—February 2015—Remote triggered avalanches on WSW face of Tincan Common. Collapse initiated by removing a ski to dig left-most snow pit while tracking stability in a near-surface facet layer. Weak layer was buried by 60cm of storm snow. Bed surface was pencil hard melt freeze crust. Propagation to furthest avalanche from trigger site is estimated at 250 meters. Avalanches triggered while collecting data on effectiveness of extended column tests and propagation saw tests to accurately show deeply buried weak layers in a maritime snowpack. *First Place Photo* [John Sykes](#)

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THE AVALANCHE REVIEW

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Nick D'Alessio is an AMGA Ski Guide based out of Girdwood, Alaska. He teaches with the Alaska Avalanche School, guides heli-skiing with Chugach Powder Guides and offers backcountry skiing trips and private courses with his own company Remarkable Adventures. Most recently he happily extended his winter work season south of the equator in New Zealand.



Knox Williams Knox Williams worked in the snow and avalanche world from 1970-2006 as a researcher, forecaster, educator, director of the Colorado Avalanche Information Center, and past president of the AAA. Now in semi-retirement, he has time to work on a new edition of *The Snowy Torrents*.



Karl Birkeland has spent more than 35 years in the snow and avalanche industry and is currently the Director of the Forest Service National Avalanche Center. He loves to spend as much time in the mountains and on rivers as possible with friends and family, and for some strange reason he seems enjoy sitting in snowpits for entire days trying to unravel various questions about snow and avalanches.

Look for notable quotes recorded by Scott Savage throughout this issue.

FROM THE EXECUTIVE DIRECTOR

BY JAIME MUSNICKI

Over the past three years since I came into my role as Executive Director, we've seen some significant changes take place. Our membership has grown nearly 50% from around 900 members in the fall of 2013 to nearly 1350 members now. We have changed the face of *TAR* to this beautiful and infinitely more readable version you hold in your hands right now; I like to say that the face of *TAR* now more accurately reflects the high quality content within its pages. We have embraced a new logo and new website, both of which provide the AAA a fresh professional look to more effectively communicate our priorities and our identity to current and future members and supporters. We have invested countless hours into drawing key stakeholders to the table and engaging them to re-envision avalanche education in the U.S., revise our education guidelines, and create the AAA Pro Training Program.

As we've undergone these changes, we've also continued to provide core programs and support to the avalanche industry that have been our mainstays for years – publication of *TAR*, publication and distribution of the SWAG manual, support of regional avalanche workshops through our Pro Development Workshop grant program, funding of snow and avalanche research with our academic and practitioner grant programs, maintenance of avalanche.org as a resource to connect the general public with pertinent, useful resources around the country, and running our annual AVPRO training course. Ultimately, we view our role as being a connector and information hub within the avalanche industry, and we think this is a valuable role for us to be playing. We hope that our efforts are providing tangible benefits to you, our members, and to the avalanche industry as a whole. Based upon responses we received in our membership survey this past spring, we think that we're moving in a good direction, and we also know that there is more work to be done! The most consistent theme in constructive feedback for the AAA was that many members want to see us do MORE to support and represent them and the avalanche industry.

In addition to the core projects mentioned above, we also have a handful of new projects in the works right now. Some may be familiar and some may be new to you. Our current priority projects include:

- Launching the AAA Pro Training Program. We have finalized most program details at this point, have shared these details with the AAA membership, and will be hosting three Pro Trainer Workshops this coming winter to help “train the trainers” for future pro courses. The first Pro Training courses will be offered by AAA-approved course providers in winter 2017/18. This coming season is a transition season as prospective new Pro Course Providers and instructors prepare for winter 2017/18 (in addition to continuing to offer their regular lineups of great avalanche courses!).
- Publishing *The Snowy Torrents*, Volume 6. It's been 20 years since the last volume of this valuable educational series was published. This volume will cover a period from the mid-90s to the early-2000s with books ready for distribution by early December (just in time for the holidays... hint, hint). Make sure to reserve your copy now, and take advantage of our early-bird sale online.
- Revising and publishing a new edition of *Snow, Weather, and Avalanches: Observation Guidelines for Avalanche Programs in the United States (SWAG)*. New SWAGs will be available for purchase starting at ISSW. We are also releasing an e-book version with this edition to make SWAG a more mobile and accessible tool, even in the field.

In addition to all these projects and programs we're working on, we have also been taking time in recent months to focus inwards on our organizational priorities and structure. This past spring, prior to our regular spring board meeting, the AAA Governing Board and staff participated in a full day of strategic planning facilitated by a company called Leadership at Play. During this session we identified our top five organizational priorities for the coming 3-5 years, and then focused on defining steps to support our pursuit of these priorities. Our priorities are:

- Increase revenue for the AAA (to be better able to provide programs and services to our members and the industry!),
- Follow through on our current projects/programs (e.g. Pro Training Program, revision of the SWAG manual, publication of *The Snowy Torrents*, Vol. 6, support regional avalanche workshops, maintain and improve utility of avalanche.org),
- Improve Governing Board and organizational function (so we have a solid foundation in place to sustainably and effectively support our programs and projects),
- Focus on forming partnerships with similar-minded organizations,
- Continue to grow and engage our membership.

So, here we are, pushing up our sleeves, ready to keep forging ahead with current projects, taking steps to improve our performance, and envisioning how we can be a more relevant, effective, and useful organization within our industry and reach our potential. Stay tuned for more details and changes in the next year and beyond. And as always, please don't hesitate to be in touch with questions, suggestions, comments, or concerns any time.

Happy ISSW, and here's to another successful winter season! ▲



Jaime atop the Grand Teton in August 2016.

FEAR AND FASCINATION

BY LYNNE WOLFE

Friday September 2: Driggs, Idaho: It rained today. That's news here in the Tetons, where we've had a smoky “non-soon” season for most of our summer, which has made for leisurely rambles off tall summits, “forgetting” rain pants, crispy vegetation, and moon-dusty trails. The advent of rain and weather puts us back on good behavior – we monitor the sky, we don't dawdle at breaks, and we discuss our exposure and vulnerability. Sounds like backcountry skiing to me. Sounds like I'm looking forward to winter...

The Avalanche Review is looking forward to winter as well. I'll be at ISSW, surveying this year's offerings for you folks who don't like conferences or who don't have the time or the inclination to wade through presentations to find relevance to your practice. For my friends and colleagues who will be at ISSW and/ or at any of our regional continuing education workshops, I ask you to think of *TAR* when you hear a presentation that jump-starts your curiosity, causes you to make a note or store a quote, or inspires a question for future exploration. Point me towards these ideas, or gently steer the presenter towards *TAR* if you think the topic needs investigation. I'm always looking for what intrigues or befuddles you.

REGIONAL SNOW AND AVALANCHE WORKSHOPS

- 10/01/16 Colorado SAW – Breckenridge, CO
 - 10/15/16 California Avalanche Workshop – South Lake Tahoe, CA
 - 10/23/16 Northwest SAW – Seattle, WA
 - 10/24/16 MSU SAW – Bozeman, MT
 - 10/29/16 Wyoming SAW – Jackson, WY
 - 11/04/16 Southcentral Alaska Avalanche Workshop – Anchorage, AK
 - 11/05/16 Southeast Alaska SAW – Juneau, AK
 - 11/05/16 Eastern SAW – Fryeburg, ME
 - 11/05/16 Northern Rockies SAW – Whitefish, MT
 - 11/05/16 Utah SAW – Sandy, UT
 - Spring 2017 Sawtooth Professional Development Seminar – Ketchum, ID
 - Spring 2017 Sierra Professional Development Workshop – Truckee, CA
 - April 2017 Gallatin Professional Development Seminar – Bozeman, MT
- Visit the AAA website for more information on these workshops.

Above you'll find a list of regional workshops that the AAA is proud to support with your membership dollars this year; we hope you can take advantage of these continuing education opportunities at local levels and more intimate scales.

In this issue of *TAR*, you'll find season summaries from our front lines – the avalanche centers. I am astonished when I look at their numbers: how many advisories written, how many public backcountry users reached with important travel advice, how many miles skied and how many cups of strong coffee consumed before sunrise. Their insights from last season have set a high bar for this next winter, and it looks like every outfit is ready to get to work on the shoulders of last year's achievements. Forecasters and patrollers, guides and educators, sledders and skiers and splitboarders and cat drivers: you're doing the real work, and we want to help you make better decisions, sort through data faster and more easily, and understand more about the fear and fascination of the avalanche phenomenon. ▲



Photo David Bowers

MEMORIAL LIST NEWS: SPRING 2016

BY HALSTED MORRIS, AAA VICE PRESIDENT AND AWARDS AND MEMORIAL LIST CHAIR.

At the Spring 2016 Board of Directors meeting; I proposed a change to the criteria for being listed on the AAA memorial list. The Governing Board approved the new criteria. The new requirements for being listed are:

The American victim must meet one of the following criteria to be included on the Memorial list:

1. The victim was working in a professional or volunteer capacity performing avalanche hazard mitigation, avalanche research, avalanche education, avalanche forecasting, avalanche rescue work, or guiding in avalanche terrain at the time they were killed.
2. The victim was employed as an avalanche professional and was killed in an avalanche while off-duty.

The reason for the change is that there have been some avalanche fatalities of avalanche professionals that happened while not officially “on-the-clock,” under the old criteria. In one accident, a backcountry ski guide was killed while checking out the snowpack a day before his clients arrived for their guided trip. While not officially “on-the-clock,” he was conducting himself in a professional manner, looking out for the welfare and safety of his clients. The “on-the-clock,” phase was much too limiting in several cases, thus the reasoning for the change.

I invite *TAR* readers to submit the names of those individuals that they think will qualify for listing on the memorial list, with these new criteria. Please contact me via email at HM1Hacksaw@aol.com.

The following individuals were added to the AAA Memorial list by the Governing Board at the spring meeting:

Rick “Oz” Oswald, Mt. Bailey (Oregon) snowcat ski guide who was killed in an avalanche while ski guiding on March 22, 2016. He had guided for Mt. Bailey since 1981.

Darren Johnson, ski patroller at the Yellowstone Club, was killed in an avalanche on January 19, 2016, while collecting snowpit data with MSU graduate students.

Kip Rand was the director of the Willowa Valley Avalanche Center. He was killed in an avalanche while skiing with a friend on Mt. Joseph, on March 8, 2016.

Peter “Pi” Inglis, was a professional ski patroller at Telluride and an AMGA-certified ski mountaineering guide. He was killed in a cornice collapse avalanche on April 1, 2015; in the Wrangell – St. Elias National Park and Preserve.

Brian Roust was a professional ski patroller and control route leader at the Canyons ski resort. He was killed in an avalanche in the Thousand Peaks area of the Utah Uinta mountains on January 31, 2002.

The addition of these five individuals brings the total number of 66 individuals on the AAA Memorial list. The Memorial list is to honor the memory of these individuals and to remind us all that we work in a dangerous industry. ▲

METAMORPHISM

Welcome Matt Schonwald



The AAA is pleased to welcome Matt Schonwald as our new AAA Pro Training Coordinator as of August. Matt takes the AAA Pro Training reins from Dallas Glass and brings a diverse background of experience to the position. He has spent 17 years mountain and ski guiding and has taught over 100 Level 1 and Level 2 courses. Matt worked for seven seasons as a pro ski patroller at two Class A ski areas, including five years as a staff trainer. He has managed staff training programs for avalanche, ski, and alpine guide staff. Matt is currently a pro observer and instructor for NWAC and has served six years on the NWAC board.

He is a AAA Pro member and Certified Instructor and also has an MBA in sustainable business.

Matt will base his work for the AAA from Seattle, WA, where he lives with his wife, daughter, and dog. Even if you don't reside in the northwest, you will likely have an opportunity to meet him in person at ISSW and/or your regional avalanche workshop this fall. Matt will be traveling to various events this fall and winter to help connect directly with avalanche professionals about the AAA's Pro Training Program.

Matt is wrapping up a summer of guiding work in Washington as he integrates into his new position with the AAA. Conveniently, he already has familiarity with the Pro Training Program having assisted with work on Pro Training documents this past winter and having attended the inaugural Pro Training Workshop this spring. Dallas continues to contribute to the AAA Pro Training Program as his schedule allows. AAA Executive Director, Jaime, is also stepping in on specific tasks to further support Matt and help keep the AAA Pro Training Program on track through the summer and into fall. Don't hesitate to reach out to Matt or Jaime with questions anytime. Matt can be reached at aaa.protrainingcoordinator@gmail.com or 206.799.4092, and you can reach Jaime at aaa.jaimem@gmail.com or 307.699.2049.

Meet Melis Coady — New Leader of the Alaska Avalanche School:



Photo David Bowers

The Alaska Avalanche School welcomes a new Executive Director this fall. Melis Coady is excited to put her contagious positive energy and strong dedication to community service to use at the AAS. Melis has called Alaska home since 1999, but she has worked and climbed on all the seven continents in the last decades. She comes to AAS with a robust resume in the mountains as a mountaineering instructor for NOLS, a lead guide with Alaska Mountaineering School, a mountaineering ranger for Denali National Park & a climbing guide at Exum Mountain Guides. Her effective educator skills have been honed through years of teaching wilderness medicine for NOLS Wilderness Medicine. Additionally, Melis has a deep understanding of non-profit organizations through her involvement with Colorado College's Ritt Kellogg Memorial Fund & Denali Rescue Volunteers.

The AAS pioneered avalanche education in Alaska 40 years ago and is one of the most respected independent avalanche schools in the U.S. Each season AAS teaches approximately 1,200 students, youth and adults, with an independent curriculum that meets American Avalanche Association guidelines. In the recent years, the School has experienced several leadership transitions. A few talented Executive Directors helped the school to maintain sustainable finances, strengthen curriculum, and grow program offerings. As a long time Alaskan, Melis is ready to steady the ship and continue to move school forward in its intended path. She feels strongly about sustaining strong avalanche education in the state. “In Alaska, all the different populations need avalanche education, from professionals to school kids, since avalanche terrain is literally everywhere”, explains Melis as her main motivation to take on the ED position.

Melis's start date is at the time of ISSW 2016 – say hello to her in Breckenridge and have a chat about the upcoming season at the Alaska Avalanche School.

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Northwest Avalanche Center Announces New Executive Director, Scott Schell

The Northwest Avalanche Center (NWAC), a collaborative effort between US Forest Service meteorologists, multi-agency cooperators and the non-profit arm, announces Scott Schell as the new Executive Director of the non-profit. Since 1976, NWAC has grown capacity and resources to improve forecasting and educational outreach in Washington's Cascades and Olympics as well as Oregon's Mt. Hood. Schell begins his new position in July in preparation for the upcoming snow season.



Scott previously served as NWAC's Program Director for the past five years and has driven innovative educational programs and a professional observers network. He is a certified AMGA Ski Mountaineering Guide who has guided throughout the US, Alaska, Canada, and Europe. An avid ski mountaineer, Scott brings nearly 20 years of backcountry ski industry experience—as an avalanche instructor and instructor trainer. He is a co-author of the popular backcountry skiing handbook, Backcountry Skiing, Skills for Ski Touring and Ski Mountaineering. Scott and his wife Meghann welcomed daughter Barrett Thomas Schell to the world on May 18, 2016. Barrett has already been to several NWAC events showing stoke for the upcoming La Nina winter.

"NWAC is fortunate to have Scott step into role of Executive Director," said Justin Davis, NWAC Board President. "Scott brings tremendous experience and relationships to the role and has been an integral part of the NWAC team for the last five years. His vision and dedication can be seen in the growth of our avalanche awareness programs and forecast products."

Scott takes the leadership position at a time of tremendous growth for the organization. In the most recent season, the NWAC website hosted 1.7 million sessions to 450,000 unique users. Scott led projects that proved innovative on a national scale including the "Going Deep" education series for intermediate to advanced users, and the NWAC app, which is a collaborative effort with the Colorado Avalanche and Information Center (CAIC).

NWAC has continued to tailor its educational offerings while recommitting to serve five key recreational communities: backcountry skiers, backcountry snowboarders, snowshoers, alpine climbers and snowmobilers. The organization will continue to expand its efforts around youth education and reaching out to the wider, more diverse community of winter backcountry recreationalists.

"I've used NWAC products for over 20 years and I'm proud to be a member of this community," Schell said. "I'm honored to lead the non-profit team, and excited to work with our forecasters and partners to communicate the most accurate and usable information available—so that we can all manage risk in the mountains."

ABOUT NWAC: The Northwest Avalanche Center (NWAC) is a collaborative effort between the US Forest Service Northwest Avalanche Center and the non-profit Northwest Avalanche Center. The mission of NWAC is to save lives and reduce the impacts of avalanches on recreation, industry and transportation in the Cascade and Olympic Mountains of Washington and northern Oregon through mountain weather and avalanche forecasting, data collection and education. For additional information, please visit www.nwac.us or call 206-276-4729.

**LEE METZGER
RETIRES FROM CAIC**

BY ETHAN GREENE

The end of the 2015-2016 avalanche season marked Lee Metzger's last with the Colorado Avalanche Information Center (CAIC). Lee retired at the end of August after 23 years at the CAIC. He worked with the Colorado Department of Transportation (CDOT) to manage the threat of avalanches to the highways that run through Colorado's northern mountains. Lee has been a mainstay in avalanche communities of Colorado's Grand, Clear Creek, Summit, and Eagle Counties. He will be sorely missed.

Lee move from New Jersey to Summit County Colorado in the early 1970s. After a few years in the area he joined the Breckenridge ski patrol and remained there into the early 1990s. During that time he saw the ski area expand from a few lifts on Peaks 8 and 9, into Peak 10 and Horseshoe Bowl. He was part of the multi-day rescue effort after a large avalanche caught eight people, killing four of them, in the then out-of-bounds area of Peak 7.

In the fall of 1992, Knox Williams and Ed Fink began a collaborative effort between the CAIC and CDOT to reduce the threat of avalanches to Colorado's highway system. The first year they opened an office in Silverton to focus on the southern mountains. The next year the effort moved north and they opened an office at the Eisenhower Tunnel. Lee was the first forecaster hired and he has remained in that office ever since. He worked with Nick Logan and Ray Mumford to shape the program, building on work done by Wit Borland, Dick Stillman, Dale Gallagher, Don Bachman, and Art Judson.

Everyone at the CAIC will miss Lee this coming winter as he moves from his usual hectic winter work schedule to a more relaxed pursuit of finding good hunting and fishing locations. He brought a refreshing no-nonsense approach to avalanche safety. In addition to keeping people safe, he was always aware of the people we serve, helping CDOT staff and motorists even when he has been on the road for many hours. Lee, if you ever feel like taking a midnight drive over a high mountain pass in heavy snow and strong winds, you know where to find us. Until then, we wish you all the best in whatever comes next. ▲



Lee Metzger working with Betsy Hodgetts, high above I-70 as it runs over Vail Pass. Photo courtesy CAIC

L	Comments	Elev	Dist	Slope	Winds	Time
HRF11	Daytonas Hut	3120	~	~	~	~
HRF1	Col du Noyades	3160	~	~	~	~
HRF2		3160	0	123	N	23
HRF3	Base NE Ridge of Mt. Oly	3130	90	196	SE	10
HRF4		3130	0	± 146	SE/W	2
HRF5	Col d' l' Eveque	3220	± 150	19	NE	24
HRF6	Top back of mountain	3280	± 110	7	N	19
HRF7	Base NE Ridge of La Janga	3200	± 90	16	SE	24
HRF8		2930	± 250	14	SE	42
HRF9	Col du M. Brule	3120	± 200	17	SE	37
HRF10	Base E Ridge of Mt. Oly	3230	± 110	15	SE	17
HRF11		3130	± 100	6	E	16
HRF12		3130	± 100	6	E	16
HRF13		3130	± 100	6	E	16
HRF14		3130	± 100	6	E	16
HRF15		3130	± 100	6	E	16
HRF16		3130	± 100	6	E	16
HRF17		3130	± 100	6	E	16
HRF18		3130	± 100	6	E	16
HRF19		3130	± 100	6	E	16
HRF20		3130	± 100	6	E	16

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IN MEMORIUM: KIP RAND

BY MIKE HATCH

There are those who leave an indelible mark on your soul. Kip Rand was one of those special individuals. On March 8th, 2016 while out on a big ski tour in the northern Wallowa Mountains with his long time friend Ben Vandembos, a large cornice fall the size of a tractor-trailer broke off along a ridgeline of Chief Joseph Mountain and carried Kip 1200 vertical feet down the mountainside. Despite Ben's valiant rescue efforts, Kip succumbed to injuries sustained in the fall before SAR teams could reach the men. The tight-knit community of northeast Oregon was devastated by the loss and grief rippled outward across the country as Kip was a dear friend to so many.

Kip was born in Seattle on December 7, 1986. In his early years Kip's family lived in some diverse places like Washington, Australia, Massachusetts, and Idaho.

His mother Barbara recalled an outing to a beach near Adelaide, South Australia, "One time, Kip struggled from the confines of his stroller and by the time I scooped him up he had already reached a rim of rocks bordering the beach. He was on a mission to climb those rocks and frustrated that I had thwarted his progress. Kip's tenacity and determination emerged at an early age."

Barbara also had this to say about her son's early years, "In the first few months of middle school, Kip came up with an elaborate schema to better understand the complex and enigmatic social structure of pubescence. He found plenty of intellectual stimulation at Boise High School from teachers who inspired and challenged him. He discovered a love of history which would be his major course of study at the University of Montana and for which he would receive an award at graduation. He pursued a second bachelor's degree in Resource Conservation.

In Missoula, a haven for wilderness advocates and recreationists, he found an amazing group of life-long friends who would partner with him in every manner of outdoor adventuring during his short, exuberant and fully-lived life."

I first met Kip in the fall of 2011. Just off a season of river guiding for ROW Adventures in Idaho, Kip was a strapping young lad - dark-haired, tall, and quite tan. Through ROW Kip met Wallowa Alpine Huts owner Connelly Brown and became enamored with the idea of becoming a backcountry ski guide and following, as he put it, "the water cycle," from frozen mountains to liquid rivers. For reasons that soon became obvious, I was instantly drawn toward Kip and his subtle charm, Buddha smile, and easy-going demeanor. Our lives paralleled each others in fascinating ways: we both grew up in Boise, learned to ski at Bogus Basin, went to college at University of Montana, participated in the same Wilderness and Civilization interdisciplinary program, majored in Resource Conservation, and then both of us ended up as ski guides in the Wallowas.

Ten years Kip's senior, I was happy to mentor where I could, especially in the realms of avalanche education and ski guiding, but Kip with his keen intellect, thirst for knowledge, intense drive, and ceaseless curiosity had a lot

Photos by Mike Hatch of Kip in his element.



to teach me as well. Kip was also a history major and for a time pondered a teaching career. He was well known on the river for his breadth of knowledge of natural and local history. He excelled at a myriad of outdoor sports like kayaking, rock climbing, mountaineering, and skiing. Recently he had even taken up farming with his sweetheart Robin Davenport.

The mountains called to Kip and as I worked and guided with him over the years I came to understand that he, like myself, was drawn to any occupation that maximized time in the backcountry. I watched Kip become a top-notch backcountry ski guide and snow safety professional. Client care was a top priority; he always went above and beyond to make sure clients needs and wants were satisfied. A natural born storyteller, guests were treated to fascinating tales of Kip's many harrowing exploits and gourmet Dutch oven desserts. He was a keen observer and quickly learned the trade of ski guiding and in a short time was leading trips out of the WAH huts in the northern and southern Wallowas. A voracious learner, Kip soon focused his energy on becoming a snow safety instructor. I was surprised by how quickly he picked up on the complexities and nuances of snow science and the passion and zeal he demonstrated being an educator. Over the course of several winters he worked through the AIARE instructor progression becoming a Level 1 course leader and Level 2 instructor. We taught numerous courses together in the Wallowa and Elkhorn Mountains and he instructed in Idaho and Montana for Sawtooth Mountain Guides and Avalanche Education Specialists.

For a number of years Kip was a Professional Observer for the Wallowa Avalanche Center. His observations were thoughtful, concise, and extremely valuable. When WAC went in search of its first paid director position after founder Keith Stebbings moved to Utah, I knew Kip would be an excellent choice to continue Keith's legacy and grow the organization. Like everything he did in life Kip tenaciously dived head first into the position and even though he had little administrative experience he began taking meaningful steps to make WAC a more responsive, relevant, and model non-agency avalanche center. Kip constantly sought out advice and strove to be inclusive and fair in his dealings and interactions. Under Kip's leadership the future of WAC looked vibrant and promising.

On a personal level I was extremely enamored with Kip's humility, generosity, loyalty, determination, humor, and wild spirit. His mother pointed out his "capacity for deep attachments." When his long-time partner, Robin Davenport, decided she was going to return to upstate New York to work on the family farm last summer, Kip left his Rocky Mountain roots to embark on a new adventure with the love of his life. I saw his generosity when he told the WAC board that he was taking a big chunk of his salary and returning it to WAC to further its mission. I witnessed his humility as he told students in AIARE courses about being caught in an avalanche and the poignant lessons to be gleaned from the experience. I saw the determination as he put in countless hours in the field recording critical snowpack data and disseminating it to the public. I beheld the loyalty in the unbelievable outpouring of love that came from all corners of the country after his death. I viewed his wild spirit in the way he charged up the skin track leaving everyone in the dust, or the countless days of "epic" monster vertical tours in the Wallowa and other ranges throughout the West, or the way he crushed leading a crux pitch at a local crag. Kip lived fully, embraced the moment, gave generously, and sucked hard the juicy marrow of life.

Kip had so many redeeming qualities. He was fair, honest, a tremendous friend, spirited, and above all - joyful. He moved through this world wanting to experience wildness authentically. And he inspired so many of us to go a little farther, to look over the next horizon, to ski that mountain of possibility, to be humble, and love every moment - even the five-mile slog through brush, downfall, and mud. "Don't go to bonk town, people," was a famous saying of his. I will always remember a certain look Kip would have when contemplating something deeply, which was many things. His eyes would narrow and seem to be looking at the back of beyond, a slight up-turned smile would creep across his face, and a hand would rise and gently stroke his beard. He was the consummate philosopher and true mountain mystic. All of us who were graced with knowing Kip can find solace that his final resting place is in all our wild hearts, and just like the water cycle he loved so much, pours over us like a two-foot powder day and rushes through us like whitewater on the mighty Salmon River. ▲



SUMMER'S EVE, HOW CAN FALLING ICE HAVE BROKEN MY FAVORITE WALKING STICK?

—Utah Avalanche Center forecaster Tom Kimbrough's tribute to colleague Seth Shaw who was killed in an ice fall in Alaska May 2000.

An open letter to Barbara Rand, Robin Davenport, and the friends and family of Kip Rand

Dear Mrs. Rand;

I never met your son, but I feel like I knew him all the same. I too was hired as an avalanche forecaster when I was 29 years old. This was long ago, but in some ways it feels like yesterday. I can easily imagine his joy with his new job. He must have been so in love with the world. I can also imagine him on his long day in the mountains on March 8th. A good friend in town, them sharing something good and lasting that really is the essence of life.

The news of Kip's death must have been immediately crippling and I cannot imagine your grief. There is nothing I can do to mitigate or lessen your grief, but I want you to know a couple of things. In the summer I work as a mountain rescue technician in Grand Teton National Park where I often hear people asking about the injured or the deceased. "Were they in over their heads? Were they taking too many risks?" Most of the time, I attribute their accidents to bad luck. Rockfall, a minor slip on wet lichen, a moment's inattention. Kip's fall through a cornice that pulled 20' back from the edge fits well in this category. We have a profession that involves risk and we need to spend time in the mountains and in the snow for credibility and legitimacy in providing the safety information to the public that is the avalanche forecast.

Kip was involved in important work. Avalanche forecasting saves lives. A few dozen people die in avalanche-related accidents in North America each year. And while it's difficult to quantify how many people make good decisions based upon the avalanche information they have, we know that people every day throughout the world value and hold in great esteem the avalanche forecast that they've come to rely upon each morning before they head into the mountains. Please remember this.

Lastly, I want to say that I am sorry for your loss - all of our losses, really; because after all, Kip was one of us. ▲

Yours,
Drew Hardesty
Forecaster, Utah Avalanche Center



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Piers Solomon deep in thought. Engelberg, Switzerland. Oskar Enander
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COLORADO SUPREME COURT AVALANCHE RULING

BY JAKE HUTCHINSON

May 31, 2016 was a monumental day in the avalanche mitigation and forecasting world. Most of us are currently far from snow and even farther removed from explosives, snowpits, and ski cuts, but the Colorado Supreme Court issued a 5-2 ruling that affirmed an appeals court ruling that stated avalanches are a part of the “inherent dangers and risks of skiing” because they result from “snow conditions as they exist or may change,” “changing weather conditions,” and “variations of steepness or terrain.”

My initial reaction was mostly relief. This decision confirmed much of what we had argued in our lawsuit in 2013 (*Williams vs. The Canyons*) and had been subjected to multiple courts before being upheld by the CO Supreme Court. It also meant the ski patrol and management of Winter Park wouldn't be subject to the anguish of a jury trial, which was one of the most physically and mentally exhausting processes I've endured. And finally, it gives credibility to what we as ski patrol and avalanche mitigation workers actually do and the uncertainty involved.

So what does it mean for the resort avalanche forecaster and avalanche workers? For one it means we continue to do our job to the best of our abilities, understanding we can never 100% eliminate the risk of avalanches. Could you imagine how limited the open terrain at the resort would be if we had a duty to be 100% sure the hazard had been mitigated and changing weather and snow conditions would not change that safety margin even .01%? It also means we have some serious legal backing defending that uncertainty and giving us some peace of mind knowing we won't be held liable in the unfortunate event of an in-bounds slide. Adam Strachan, one of the attorneys on *The Canyons* lawsuit, said this when I asked his opinion:

“...it legally confirms what all experienced skiers and snow scientists knew already. Hopefully the decision will increase awareness that avalanches are just as much an inherent risk as catching an edge.”

What are the ramifications of reduced liability for avalanche accidents? Could a resort operator conceivably stop doing avalanche mitigation work and forecasting? Could explosives budgets be cut and experienced personnel replaced with lower paid, less experienced workers?

First, some background; on January 22, 2012, Christopher Norris died in an in-bounds avalanche at Winter Park Ski Area. His family subsequently sued the ski area arguing that the resort was responsible because avalanches are not specifically covered in the Ski Safety Act; they argued that the resort knew the danger was high that day, the resort failed to warn skiers of the danger, and the resort should have kept the terrain closed that day. They also noted that a teenager was killed in an avalanche at Vail the same day. The family sought damages in excess of the \$250,000 cap set by the Colorado Ski Safety Act.

The ski area argued that the highlighted specific language in the Ski Safety Act covers avalanches:

“Under Colorado law, a skier assumes the risk of any injury to person or property resulting from any of the inherent dangers and risks of skiing and may not recover from any ski area operator for any injury resulting from any of the inherent dangers and risks of skiing, including: changing weather conditions; existing and changing snow conditions; bare spots; rocks; stumps; trees; collisions with natural objects, man-made objects, or other skiers; variations in terrain; and the failure of skiers to ski within their own abilities.”

In the majority opinion from the court, the Justices found that avalanches are by themselves a changing snow condition rather than a specific event as the plaintiffs had argued. In their opinion, the Justices concluded that:

“At bottom, then, an avalanche is one way in which snow conditions may change. As alleged here, snow conditions started with fresh snow on unstable snowpack, and, within moments, changed to a mound of snow at the bottom of the incline. We therefore conclude that Norris's death is alleged to have been caused by changing snow conditions.”

In the dissent, Justice Martinez writes:

“Certainly, ski area operators have ample incentive to mitigate the risk of avalanches and to protect skiers within their ski areas, lest the public take their ski vacations elsewhere. And without question, ski area operators go to great lengths to mitigate avalanche risk. But after today's holding, Winter Park effectively has no duty at all to warn skiers of avalanche risk or to close a dangerous run based on such risk: the SSA does not require ski area operators to mitigate avalanches or to issue avalanche warnings, and the majority's ruling today abrogates any common law duty of care to do so. In fact, under today's holding, a ski area operator will be immune from liability for injuries from avalanches regardless of the circumstances—arguably even for avalanches triggered by the operator's own negligent or reckless actions.”

So we continue to do our jobs, secure in the knowledge that the courts have recognized the uncertainty involved, right? But as I read deeper into the dissent I grow concerned. Was the ruling too broad? Have the ski resorts just been given a “get out of jail free” card? What are the ramifications of reduced liability for avalanche accidents? Could a resort operator conceivably stop doing avalanche mitigation work and forecasting? Could explosives budgets be cut and experienced personnel replaced with lower paid, less experienced workers? It is frightening to me that a resort could potentially be immune from liability even in the event of negligence or its own recklessness as Justice Martinez noted. I like to think that morally we are all above negligence and recklessness in our jobs, but I also know firsthand what it's like to butt heads with your boss or upper management while struggling to pay the bills at home, it potentially puts the worker in a tough place.

So what do we do? Our craft is mostly unregulated and highly variable across mountain ranges and state lines. We answer to some ATF guidelines on storing explosives, in some states we get a ‘Blasters Card’, the NSAA guidelines are mostly followed but only specifically deal with explosives use. There are no enforceable US standards for route safety, record keeping, and professional proficiencies. Most resort's avalanche programs have evolved from some old USFS model into whatever works for their situation. A visit to Little Cottonwood Canyon will show dramatic differences between the two esteemed avalanche programs of Alta and Snowbird. I think the first step is the new Pro Education track. It is the first attempt at ‘certification’ of an observation, recording, and decision-making skill set in the US. The next step is to get the NSAA and other ski area organizations to buy into it, to give it teeth. Without some basic qualification parameters in place, I fear it is the worker who may suffer the consequences most.

My conversations with a few prominent avalanche experts seem to confirm my fears; the ruling may be too broad in our favor and open the door for budget cuts and short cuts by ski area operators. My hope is the opposite, that the uncertainty involved and the moral obligation to provide the safest skiing experience possible will drive operators to invest more time and money in increasing the safety, skillset, and professionalism of the avalanche worker.

In the end, it's the ruling we all hoped for, and I know that we all take the responsibilities of this job very seriously, but I think it's a wakeup call for all of us to elevate our programs and our industry to the next level.

Jake Hutchinson is a lead instructor for AAI and avalanche specialist for the GTSR in Glacier NP. Summers are spent running the military and mountain programs for Gym Jones and exploring the deserts on his KTM's.



Perfect, looks like you got a buck and a doe.

CATSKI US AT ISSW 2016 BRECKENRIDGE



CatSki US will be at the 2016 ISSW in Breckenridge and we would like to meet you, especially if you work in the snowcat ski industry.

You are invited to the

**CatSki US Fall Meeting
on Sunday October 2
8:00am to 3:00pm
Beaver Run Resort (Mercury Boardroom)**

If you cannot make the full meeting please come to our:

**Guest Speaker & Beer Social from 3-5pm
Beaver Run Resort (Mercury Boardroom)**
Before the ISSW opening reception on October 3.

If you are coming to ISSW later in the week please contact us to set up a meeting during the week to learn more about CatSki US.

The mission of CatSki US is to unite our members to ensure the future growth and quality of snowcat skiing in the United States.

Our purpose is to help develop and maintain the best operation and safety standards through cooperative input of our members and qualified external entities, while working to be stewards of the various public lands on which we operate.

CatSki US is a not-for-profit organization founded upon a premise that guided guests should receive certain assurances that snowcat skiing operators strive to provide safe and responsible backcountry skiing/riding experiences. Its membership is made up of the country's finest snowcat ski operations and guides. The association is organized exclusively for charitable, educational, and scientific purposes. CatSki US provides a framework for establishing minimum operating standards and to provide oversight for compliance with those standards. CatSki US will promote and sustain snowcat skiing and strives to increase the overall well being of its members and sponsors. We offer guidance and assistance to new operators and share information and continuing education for member operators, which will benefit guests and the industry as a whole. We do this by collaborating our collective experience in the snowcat ski industry while sharing this knowledge amongst our members through operational reviews and member meetings.

For more information or to set up a meeting please contact:

Billy Rankin
brankin@irwinguides.com
970.275.2745

"You have a new relationship with Chabot?"

"Totally, I'm kind of in love with him."

SNOWPILOT: BY PROFESSIONALS, FOR PROFESSIONALS

BY DOUG CHABOT, DIRECTOR, GALLATIN NATIONAL FOREST AVALANCHE CENTER



In 2002 Karl Birkeland was researching a new stability test, the Stuffblock, and needed willing participants to try it and record their data. Since Karl sits in the cubicle next to me, I was an easy recruit. All that season I filled a stuff sack with ten pounds of snow and dropped it from ever increasing heights, dutifully recording the results in my yellow Rite-in-the-Rain book along with other pit information. It was a relatively easy task. The real work came at the end of season when Karl sent me a spreadsheet to fill in every detail of the pit and test: score, quality, hardness and grain type of the weak layer and adjacent ones, signs of instability and stability rating. Filling in every column and row of the Excel file opened my eyes to a significant hurdle in advancing snow science amongst practitioners: the valuable data in all our pit books was lost to researchers. Instead of being shared, pencil-drawn pits throughout the world were sitting in drawers and on shelves collecting dust, likely never to be looked at again. Scientists ask a question and then collect data to get an answer. What if we collected the data first—all the data in our collective pit books? This would amount to thousands of pits from different snow climates all over the globe populating a database ready for a question. Out of this idea, SnowPilot was born. Software developer Mark Kahrl wrote the program and Conrad Anker found a donor so it could be free for anyone to use.

SnowPilot (www.snowpilot.org) is open-source, free software that allows users to graph, record, share, and database snowpit information. Initially developed during the winter of 2003-2004, SnowPilot was originally created as a way to enter snowpit data into a handheld Personal Digital Assistant (aka PDA, Palm Pilot), a precursor to the iPhone, that would be stored and graphically viewed on a PC. As technology changed, SnowPilot left the PDA platform and became a standalone program for PC and Mac, while still populating the central database with snowpit data for use by avalanche researchers. Currently the database holds over 7200 snowpits from fifteen countries.

At the 2002 ISSW in Penticton, BC, I sat in the audience and listened to some researchers explain the importance of their study relying on a woefully small number of snowpits. It was not compelling. Contrast this to 2016 when Colorado avalanche forecaster Ian Hoyer had a simple question: Are ECTs effective only in the narrow slab depth band of 30-70 cm as taught in his Level 3? He found his answer in the SnowPilot database which revealed 5013 ECTs submitted over nine years by 386, primarily professional, users worldwide. ISSW 2016 Spoiler Alert: Ian's analysis of the SnowPilot data shows that the ECT is effective over a wide range of weak layer depths. If you have a question, SnowPilot may have the answer.

This winter we are excited to unveil an online version of SnowPilot in addition to the software version. It follows the US Snow, Weather and Avalanche Guidelines (SWAG) and the Canadian Observational Guidelines and Recording Standards for Snow (OGRS). After data is entered an image is created that can be downloaded, shared, and printed. All data entered is controlled by the user and error-checked to ensure a clean, robust database. As a user you get to decide who can view your snowpits: everyone, just people in your work group or no one. Regardless of your viewing choices, pits automatically populate the database for future research.

SnowPilot does not charge a fee or collect any personal data other than what gets entered, nor do we advertise or sell anything. We respect privacy. In exchange for providing a free platform to enter snowpit data, SnowPilot gets an expanding database that is readily shared with researchers to advance the field of snow science. SnowPilot snowpits have been in presentations at every ISSW since 2004. To ensure your pits are helping to expand our knowledge about snow and avalanches, join the data collection effort by checking out www.snowpilot.org. ▲



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PRECISION AVALAUNCHER TARGETING

BY JOHN BRENNAN

The world's most technical sniper rifle isn't going to make marksmen out of Mr. or Mrs. Average. The most skilled avalauncher gunner can't hit the broad side of a barn at 1500 yards with a crooked projectile, a flimsy gun deck, or a poorly designed launcher. Long range accuracy and target repeatability require astutely designed projectiles with strict quality control and properly engineered avalaunchers and firing platforms.

One way to check if your existing mount is to blame for poor accuracy is to simply video the machine in action. Kevin Powell, the developer of the Delta K avalauncher projectile, recommends using at least 1000 frames per second. By reviewing the footage frame by frame, if your projectile has left the Barrel before your mount allows significant deformation to your launcher's resting position then your accuracy issues likely lie elsewhere. By having a perpendicular object framed in the background of your launcher video you can more easily note displacement. What may appear a stout launcher deck may actually be allowing quite a bit of deflection when the avalauncher fires.

Alan Jones, principal at Dynamic Avalanche Consulting, reports excellent accuracy and target repeatability with their Falcon GT Avalauncher which is mounted on their customized trailer. Alan is quick to point out that heavy duty jacks, positioned at the four corners of their trailer, make stabilizing their trailer a quick and easy job. It is very important to level the trailer as well. Dynamic monitors a launcher-mounted bubble level as they raise their trailer completely off the ground. Alan notes that that standard trailers lack adequate bracing to be sufficiently rigid: "We were surprised how much movement we got when we filmed in HD, slow motion video."

Colin Mitchell of the Pimentón Mine in Chile has both a fixed mounted and a **mobile mounted Falcon GT avalauncher**. They use a backsighting exercise for some of their mobile firing positions. Basically, they park their trailer in routine positions on their missions- trying to mimic as closely as possible their previous alignments. Then, they fabricate simple cross hairs on the end of their barrel and bore sight on the same nearby fixed objects every mission. By using simple math and their launcher's 360-degree azimuth plate they are able to dial in their shot charts in short order. To add an additional level of precision, Alaska DOT utilizes a fixed rifle scope on their Falcon GT.

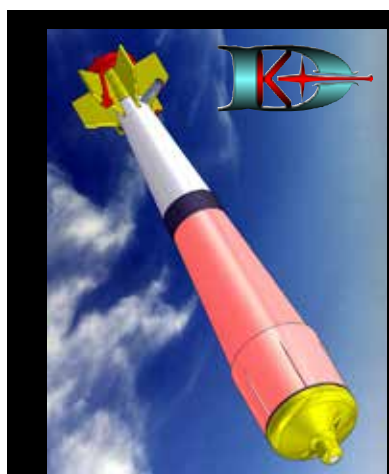
Misconceptions have lingered for many decades about avalauncher accuracy. With modern engineered projectiles, excellent accuracy and target repeatability can be achieved with proper mount design. Please contact us with any questions or comments: jb@avalanchemitigationservices.com. ▲



Mobile mount at the Pimentón Mine, Chile. Photo Courtesy Colin Mitchell



Rifle scope for precise backsighting. Photo Courtesy Alaska DOT



▲ The DeltaLancer System. Under License from Kevin Powell at Delta K Explosive Engineering Systems Ltd.



▲ The New Redesigned CIL Classic Snowlauncher.



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Avalanche Awareness:

A FIRST STEP FOR NEW WINTER BACKCOUNTRY RECREATIONISTS

BY KIRK BACHMAN, AAA EDUCATION COMMITTEE CHAIR AND JAIME MUSNICKI, AAA EXECUTIVE DIRECTOR

This is the first topic in a *TAR* series focused on the AAA's newly revised Guidelines for Avalanche Education in the United States. Look for articles exploring additional topics related to recreational avalanche training throughout the coming season of *The Avalanche Review*.

As a reminder, the AAA is recommending that course providers are aligned with these revised guidelines by winter 2017/18. Current AAA members can view new guidelines by logging into their profile in the AAA database (aaa19.wildapricot.org). Once logged in, go to the "MEMBERS" tab in the menu across the top of the page and select "NEW REC EDUCATION GUIDELINES". The AAA will be actively promoting the revised rec guidelines to the general public starting later this winter season.

Avalanche Awareness programs provide an integral introduction for winter backcountry recreationists to begin to engage with and understand the principles of the avalanche phenomenon, available resources and training, and the importance of applying this knowledge. The AAA recognizes the importance of these programs in the progression of recreational avalanche education. These programs connect people to information

and to potential new backcountry partners. They introduce people to the broader avalanche community and to key tools, such as their local ava-

ent audiences. Below is an initial brainstorm that draws on input from the AAA Education Committee as well as some outside sources who are

THE MESSAGING DETAILS AND PROGRAM STRUCTURE THAT MAY GRAB THE ATTENTION OF A 22-YEAR-OLD SNOWMOBILE ENTHUSIAST IN UTAH ARE DIFFERENT THAN WHAT SPEAKS TO A 50-SOMETHING CROSS COUNTRY SKIER OUT IN WASHINGTON.

lanche forecast, avalanche rescue gear, and sources of continuing avalanche education. They also serve as social motivators, positive peer pressure events to demonstrate who's getting educated and recreating responsibly.

There are a wide array of avalanche awareness programs and campaigns across the country at this point. Programs inevitably vary in structure and content in an attempt to best engage a particular audience in a particular place at a particular time. This variation seems natural and reasonable. The messaging details and program structure that may grab the attention of a 22-year-old snowmobile enthusiast in Utah are different than what speaks to a 50-something cross country skier out in Washington. Yet, we ultimately want both of these people to walk away with a similar basic understanding of the avalanche hazard and specific steps each individual can and should take to make reasonable decisions when traveling through the winter backcountry.

As the AAA Education Committee considers this topic, we're looking to create some basic guidelines for avalanche awareness courses in the U.S. We recognize that these courses are taught by a wide variety of individuals and organizations. In many communities the local or regional avalanche center is a major source of avalanche awareness programming. Other folks may be gaining their initial exposure to the avalanche phenomenon through an event at their local gear shop or sponsored by a local ski/board/snowmobile club. Some young people are lucky enough to have avalanche awareness integrated into their science or PE class. Another person may stumble across an avalanche awareness program on the internet. Again though, regardless of where the awareness program is coming from, the AAA believes there is value in a certain level of consistency in the messages being delivered through these programs.

In crafting guidelines for avalanche awareness programming, the AAA wants to involve a cross-section of stakeholders with various perspectives on and experiences with awareness programs. We seek to provide direction and consistency for avalanche awareness, yet also allow for adequate flexibility in crafting programs of different lengths, in different places, and for differ-

familiar with the array of awareness programs that currently exist in the U.S.

Broad Avalanche Awareness learning outcomes could include:

- Develop awareness that avalanches exist in mountainous winter terrain.
- Stimulate an interest in the winter environment, snow, and avalanches.
- Learn to recognize and identify avalanche terrain and reduce risk by avoiding exposure to avalanche terrain.
- Identify local and regional resources available for persons interested traveling in the winter backcountry (e.g. a professionally-produced local avalanche forecast, local avalanche course providers).
- Standard rescue gear is recommended when traveling in/around avalanche terrain.
- Avalanche training, continuing education, and experience are essential to travel safely in avalanche terrain.

Avalanche awareness programs are the first, integral step for new winter backcountry adventurers to interface with instructors who provide a key role in introducing the basics, and also in making sure students know that there is a progression of ongoing avalanche trainings. Avalanche Awareness course providers can assist students in identifying these next steps, suggest ways of gaining experience and finding good mentors and backcountry partners. Awareness education, as an introduction, will provide a link forward in motivating students towards their next course for further training.

Bottom line, the AAA is starting a conversation about the role avalanche awareness programs play in the greater progression of avalanche education opportunities. If you are interested in being a part of this conversation, especially if you currently run avalanche awareness programs, please be in touch with the AAA to share your thoughts, feedback, and perspective. To be involved with this conversation, contact AAA Education Committee Chair, Kirk Bachman (a3educationcommittee@gmail.com) or AAA Executive Director, Jaime Musnicki (aaa.jaimem@gmail.com). The AAA plans to finalize details of our awareness guidelines by the end of 2016. ▲



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AAA Pro Training Program Update:

PROGRESS REPORT AND A CALL FOR ENGAGEMENT

BY JAIME MUSNICKI, AAA EXECUTIVE DIRECTOR

This fall will be three years since the AAA hosted its informal avalanche education summit in Alta, UT on Halloween 2013 (see *TAR* 32.2, December 2013, p. 6). This meeting brought together representatives from across the industry to discuss the

state of avalanche education opportunities for both professionals and recreationists in the United States. As a direct response to this initial meeting, the AAA has invested countless hours and tens of thousands of dollars into developing the AAA Pro Training Program. The collaborative effort to develop and refine the Pro Training Program has engaged avalanche course providers, their instructors, and myriad other avalanche professionals from across the industry and around the country. In facilitating the development of this program, the AAA has taken a dramatic step forward in being an actively unifying force within the avalanche industry. Throughout this process the AAA has been committed to creating a program that provides more consistent professional training opportunities for avalanche workers in the U.S., striving to keep the big picture of what is best for the ENTIRE avalanche industry at the forefront. Today, we stand on the brink of launching this new program.

WE ARE A STRONGER INDUSTRY WHEN WE WORK TOGETHER, CONNECT WITH OTHERS, SHARE IDEAS, AND ARE OPEN TO LEARNING FROM NEW AND DIFFERENT SOURCES.

ciencies, overall program structure and oversight, and a clear matrix for recognizing prior learning and experience. These details were released to the AAA membership at the beginning of August. Ultimately, we wanted our members, avalanche professionals, to have sufficient time to digest the final details of this new program and start to figure out how their current and/or future training may fit into the new paradigm. If you are a current AAA member, you can access the detailed Pro Training documents online by logging into your profile in the AAA database (aaa19.wildapricot.org). Once logged in, go to the "MEMBERS" tab in the menu across the top of the page and select "AAA PRO TRAINING PROGRAM".

This winter the AAA will be hosting three Pro Trainer Workshops at three different locations around the country. These workshops are "train the trainer" opportunities for future Pro Course instructors. The goals of these 3-day workshops are to familiarize future Pro Course instructors with the program and course structure, review the specific skills, proficiencies, and marking rubrics for each course, and demonstrate and practice consistent student evaluation processes. One of the keys to success of the AAA Pro Training Program is a robust system for supporting and monitoring the consistency and quality of pro courses. The Pro Training Workshops are a proactive piece of this model to encourage consistent course content and student assessment.

As this September issue of *TAR* heads to press, we are finalizing details of these Pro Trainer Workshops. The tentative plan for workshops during the 2016/17 season is:

- December 2016 - Workshop in WY/Teton region
- December 2016 - Workshop in CO/Summit County region
- March 2017 - Workshop in WA/Cascades region

Look for firm details of these workshops from the AAA very soon. We will email the AAA membership as soon as we confirm and finalize plans with our hosting locations.

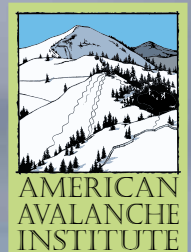
Another goal we have for the AAA Pro Training Program this winter is to feature a series of articles in *TAR* to address common questions and pertinent topics related to the Pro Training Program. This is the first introductory article in that series. We want to do our best to help future course providers, instructors, pro course students, and current or prospective employers of those stu-

dents understand the details of the program and its impacts on them and the industry. Make sure to look for additional articles in future issues of *TAR* to deepen your understanding of this transition within the world of professional avalanche training in the United States.

Heading into this winter, we also plan to be proactive in trying to reach an audience beyond current AAA members with these new program details. You can help us with this task by understanding the new program, proactively sharing details with colleagues and friends, being a resource for questions within your organization or region, and then referring colleagues or friends directly to the AAA when have questions that you can't answer. We are a stronger industry when we work together, connect with others, share ideas, and are open to learning from new and different sources. While the AAA strives to help facilitate these connections and sharing through all our programs, we need your help and engagement to do it more effectively.

If you have further questions for us right now or in the future regarding the AAA Pro Training Program, be in touch with us at aaa.protrainingcoordinator@gmail.com (Matt Schonwald, AAA Pro Training Coordinator) or aaa.jaimem@gmail.com (Jaime Musnicki, AAA Executive Director). ▲

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MOTORIZED CURRICULUM DEVELOPMENT WORKSHOP 2016

BY SARAH CARTER

West Yellowstone Montana has a long history of snowmobile use for recreation and transportation. In the 1950s and 60s Bombardier “Bombs” were used to transport tourists to view Old Faithful within Yellowstone National Park. Since then, the snowmobile industry has grown and changed to encompass a large demographic of users including trail riders who are occasionally exposed to avalanche terrain, hybrid riders who use machines to access ski and snowboard terrain, and mountain riders who target the steeps – treed and open slopes – to test their riding abilities and high powered machines.

This history of motorized use and culture made West Yellowstone the prime location for a recent snowmobile-specific avalanche curriculum development workshop. In January, 2016, ten professional snowmobile riders came together in West Yellowstone to refine and develop motorized specific avalanche curriculum.

Travis Feist, AIARE Training Coordinator, has been planning and looking forward to this event for years. As a Tahoe ski patroller turned motohead, Feist knows that snowmobile culture has the potential to embrace mountain safety. The only problem is that, to-date, snowmobile-specific avalanche education has been very limited, both in offerings and content specific to the mountain tool. The way people use terrain on a snowmobile is quite different from skis or snowboards. The ability to cover fifty miles in a day and go into ten different drainages is something that has not been addressed in traditional avalanche classes.

This is why having ten amazing riders come together to share, collaborate, and build tools that will be used and adopted by the motorized community is a dream come true. Factory riders, professional guides, and motorized riding coaches brainstormed and tried out curriculum Feist has drafted over the two years (with the input of many people familiar with motorized mountain travel). Over three days, the group taught each other techniques to manage motorized groups, used snowmobiles to test and understand snow stability, and applied different approaches to companion rescue.

AIARE is working with this group of professionals to further refine motorized curriculum. It will be adopted and practiced by riders to reduce further avalanche accidents. Snowmobile specific courses will be offered and delivered by some of the best riders around – this is the snowmobile culture that is embracing mountain safety as the new norm and way to have fun in the mountains.

Following are vignette bios for two participants in the Motorized Curriculum Development Workshop.



Sarah Carter works as a forecaster in a region where more snowmobiles than skis track out the slopes. Motorized education is in demand in Alaska.



Brian Lundstedt instructing in the field. Photo Brian Lundstedt collection

BRIAN LUNDSTEDT

*Northern Colorado Avalanche Educator
Tyler's Backcountry Awareness*

In the motorized community, my family were the “educated.” We thought we had the training. What we had was a couple hours of awareness training a year for most of our riding life. What we had was more than many and we were under the impression it was all we needed. We were generally safe riders and in 20 years of riding, had always made it home and with little to no direct interaction with avalanches. **Then the world stopped.**

January 21, 2012, my brother was killed in an avalanche. My surviving brother fought for his life for three days until he was rescued. After the accident, our family and friends held a fundraiser that generated nearly \$40,000 USD. We looked into donating to the regional Search and Rescue or to our local Avalanche Center, but after serious discussion, we decided to use it as seed money to build an avalanche awareness and education organization in memory of my brother, **Tyler's Backcountry Awareness.**

I set out to get educated and quickly learned that I knew practically nothing. I went through A.I.A.R.E (American Institute for Avalanche Research and Education) Level 1 training and continued on to Level 2. My goal was simple: become an instructor and bring the education to motorized users. With persistence and a lot of volunteering, I realized almost instantly that a lack of educational resources was not just a shortcoming in my area. The sledding community was thirsty for education across North America. We had a few classroom awareness seminars, but we wanted the on-snow practical training. Though I had never skied, I figured I would muscle my way through for my community and get educated. This determination led to greater opportunities than I could have ever imagined. After working with several people developing curriculum, directors, and educators, there was now no ignoring the motorized users. I was the driven person they had been looking for. After offering input on how, why and where we travel and many long conference calls, I was invited to the AIARE Motorized Curriculum Development.

With a participant roster that read like the credits for a compilation film of industry greats, I walked into class in West Yellowstone and looked around. I was struck hard by the realization that these were not just a few rogue educators, here to change what may be important for a motorized class, these were ten of the industry's leading skills riders and extreme backcountry guides getting ed-

ucated. They were here to share their backgrounds and work together to develop a curriculum that would allow for even more educators. I was no longer one man trying to save the world. We were a team that in time will train countless more people than I could have ever hoped to reach single handed. Even though I called a couple of these riders my friends, I half expected to be the odd man out, the nobody. I am not in videos, I don't sign posters. But, I got the best introduction I have ever had, one that almost choked me up. As Travis Feist said my name, world renown rider/guide/educator Dan Adams piped up and said, “He needs no introduction, we all know who he is.”

I've learned a lot in the last four years and with over 20 years in the Colorado backcountry, I know for sure there will always be more to learn. After being invited to such an amazing workshop, I know that I have been part of a cultural shift – one that will keep us riding for years to come.

KEVIN ALLRED

*Idaho and Montana Avalanche Educator
Rasmussen Style Riding*

I have been in the snowmobile industry for nearly two decades as a mountain snowmobile test rider for several media publications. Without question the evolution of the lighter, more capable backcountry snowmobile has been ongoing. Today's mountain snowmobile accesses the steep backcountry terrain with ease. Development in the snow bike industry has been ongoing as well. Current snow bike design allows motorized users to access very steep complex mountain terrain. This, along with track conversion kits for ATVs and UTVs gives motorized users many options to access the backcountry in winter.

Now more than ever, the need exists for motorized curriculum in the avalanche community. Motorized users access many different slopes, aspects, and a variety of snowpacks during the course of a single day. Avalanche terrain awareness, avalanche rescue training, and understanding the advisory are all important skills that motorized users need.

I applaud AIARE for the work and effort put into the development of motorized curriculum. Without question, those behind this effort have the skill level, drive, and clout to achieve this. All motorized users will benefit and lives will be spared. ▲

Kevin Allred connects with students in the field. Photo courtesy Kevin Allred



BACKCOUNTRY ASCENDER: LEVEL UP YOUR BACKCOUNTRY AND AVALANCHE TRAINING

BY CHRISTOPHER MAYER AND MIKE DUFFY

Sled360, in partnership with the International Snowmobile Manufacturers Association (ISMA), the four snowmobile manufacturers (Arctic Cat, Bombardier Recreational Products (Ski-Doo), Polaris Industries and Yamaha Motor Corporation, USA) and Avalanche1 have developed Backcountry Ascender.

Backcountry Ascender is a free and simple backcountry and avalanche educator. The platform uses educational gamification and good-natured competition to encourage rider's awareness and improve their backcountry knowledge, skills, and practical experience.

The engaging and competitive platform is comprised of industry and peer reviewed curriculum of self-directed lessons and in-person courses. Riders earn points for completing lessons and courses to increase their rank as well as their associated club, state association, dealer, and snowmobile brand.

Objective

Backcountry sledding is the largest growing backcountry segment, but knowledge dissemination is not growing at the same rate. In turn, glaring knowledge gaps are becoming evident not only in avalanche education, but in general snowmobiling and backcountry skills as well. To address this issue, Backcountry Ascender has been designed with these objectives in mind:

- Make snowmobilers more prepared and knowledgeable in the backcountry
- Reduce snowmobile avalanche accidents & fatalities
- Make education engaging and easier to obtain
- Create a starting point for new riders
- Reach and involve every demographic
- Foster ongoing education and practice
- Better prepare riders for industry training
- Provide transparency into who and who is not obtaining knowledge

How it Works

Backcountry Ascender starts with self-directed online learning and incorporates existing industry in-person courses. By starting online, riders can learn before hitting the snow and prevent many of the basic mistakes made in avalanche terrain. To move up to higher levels, participants must take industry on-snow classes.

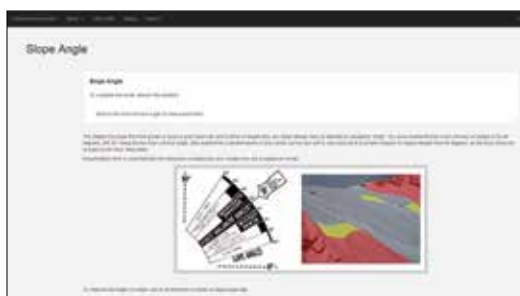
The curriculum is divided into Mission Levels, Missions and Sorties. To complete a sortie a user must provide evidence of knowledge. That evidence, which can range from an answered question to photographic documentation of a field exercise, is then accepted by peer approval. Evidence can be reviewed by senior content administrator or anyone who is at least a mission level ahead.

As mission levels are completed, users earn badges that can be shared with their social media outlet of choice.

The curriculum for Backcountry Ascender is seeded from approved content sources such as the American Avalanche Association and Avalanche Canada and has been peer reviewed by many



GAME BOARD



SORTIE: a short engaging lesson that takes under 10 minutes.



LEADER BOARD

industry leaders. It is not specific to nor does it promote any one avalanche school. The content is dynamic and is expected to grow year after year. If a knowledge gap is exposed mid-season, a new sortie can be added that all users will have to complete to maintain their current badge level.

The idea of Backcountry Ascender is NOT to replace important certification courses, but rather to provide a clear education path and drive greater participation in these courses.

Proven Method and Software

Backcountry Ascender is built on Chrome Warrior, an immersive gamified pedagogy platform developed to provide professional development to educational professionals. The use of Chrome Warrior has helped K12 districts with its successful rollout of professional development curriculum, and has also won a Models of Academic Excellence and Innovation award from the Riverside County Office of Education.

Chrome Warrior has solved three problems generally associated with traditional "sit-n-get" training:

- It allows organizations to train a lot of people quickly by removing the need for arranging classroom time and people's schedules
- It allows people to spend more time focused on high value activities and less time "training" by allowing people to easily fit training to their schedules rather than fitting their schedules to training
- It demonstrates that people have acquired skills by requiring them to provide evidence of completion

With its start in K12 school districts, Chrome Warrior benefited from exposure to professional educators, many of whom have provided invaluable feedback to help make improvements delivering successful training and pedagogical design. Some of these enhancements include:

- Distributed pedagogical design to encourage subject matter experts to provide specialized training
- Distributed peer review to enable greater scalability and to foster personal learning networks
- Conversation based learning to encourage experienced learners to support new learners
- Social network sharing to provide positive reinforcement and encouragement of learning

The fundamental driving principle behind Chrome Warrior is to provide fun training that can be directly applied in the classroom and the field. By following this philosophy, Chrome Warrior is gaining widespread adoption by people and organizations eager for pragmatic learning.

Try It

While designed with snowmobilers in mind, Backcountry Ascender has value to all backcountry users and all are welcome. Give it a try: backcountryascender.com ▲

Christopher Mayer from Snohomish, WA, grew up in the mountains of Kimberley, British Columbia. He has 30 years of backcountry and snowmobiling experience, as well as a decade of helicopter rappel fire suppression, high angle and K9 search and rescue experience. He is the founder of Sled360, the company behind Backcountry Ascender, and founder and co-owner of Alpenspruce Software Inc., the company that developed Chrome Warrior. He also serves as President of the Cascade Drift Skippers, one of the largest and fastest growing snowmobiling clubs in Washington State.



Mike Duffy from Eagle, Colorado is the owner and founder of Avalanche1. Mike is a backcountry skier and snowmobiler with 27 years of experience in CO, ID, UT, WA, and WY. He has 31 years of professional guiding/instructing with an impressive list of experiences:

- 27 years with Mountain Rescue Association specializing in avalanche, whitewater and helicopter rescue
- 22 years avalanche instructing experience following guidelines of AAA
- 60+ level I classes taught
- 11 level II classes taught
- 2000+ days of year-round outdoor guiding/instructing experience



Mike has been instrumental in increasing avalanche awareness within the snowmobile industry and reducing fatalities, including developing snowmobile specific avalanche classes which have led to increased class participation. He is BRP's educational representative to teach snowmobile specific avalanche awareness classes nationwide.

BEACON CHECK



How to Avoid Interference Issues in Companion & Organized Avalanche Rescue

BY MANUEL GENSWEIN

INTERFERENCE: UNDERSTAND, DETECT, MASTER

INTERFERENCE LEADS TO:

- Misleading distance and direction indications → "false positives"
- Range reduction

DIFFERENTIATE "SIGNAL OF A BURIED SUBJECT" FROM "FALSE POSITIVES" [BASED ON ANALOG SOUND]

- Analog sound audible + distance indication = Signal of a buried subject
- Distance indication only, no analog sound audible = "false positive"

SEARCHING IN HEAVILY DISTURBED AERAS

Cut search strip width in half, in extreme cases apply micro search strips and search based on analog sound.

Electronic avalanche rescue devices such as 457kHz transceivers and Recco are the modern primary search tools for companion and organized rescue. Requiring a long reception range in order to shorten rescue time calls for highly sensitive receivers, which are vulnerable to interference from other electronic devices, but as well from metal parts and passive electronics, which may detune the antennas or act as unwanted reflectors in the case of a Recco search.

The percentage of users who carry a wide range of electronic devices such as mobile phones, helmet cameras, music players, heart rate monitors etc. in the outdoors has considerably increased over time and therefore the **negative influence** on an efficient search effort has led to loss of valuable rescue time and disturbance of rescuers on the accident site. This study includes a detailed analysis on the mechanisms of interference, a matrix of influence and potential consequences as well as a new, user group specific recommendation on how to avoid interference issues in companion and organized rescue.

Introduction

Metal parts, magnets and any kind of passive or active electronics potentially cause interference for a transceiver. This may lead to the following effects:

- detuning of the antennas (TX and RX)
- persistent magnetization of the antennas (TX and RX)
- increased power consumption (TX)
- reduction of transmitted field strength (TX)
- inability for proper signal detection in digital search modes (RX)
- reduction of receive range due to receive filters opening up to a broader frequency range (RX)
- increase of noise in analog sound (RX).

TRANSCIVER SAFETY

CHECK YOUR TRANSCIVER FREQUENTLY

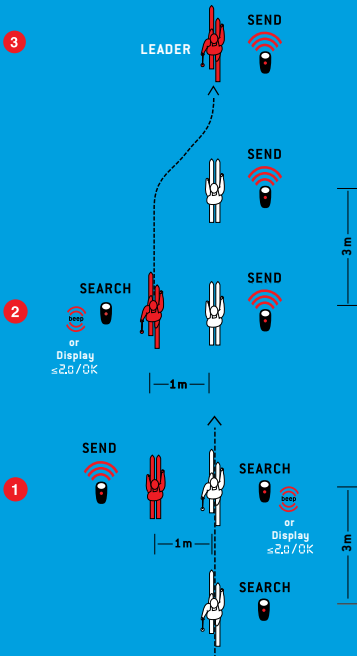
Mechanical damages? Battery contacts clean? Switches lock in position? Carrying system in order?

SELF AND BATTERY TEST

SINGLE GROUP CHECK

DOUBLE GROUP CHECK

NEW GROUP / WEEKLY



Receive / SEARCH

- Transceivers with group check function: use «Group Check»
- Transceivers without group check function: use «SEARCH»
- Analog only transceivers: Volume level, which corresponds to 1m of range

LONG TERM STORAGE

Remove alkaline batteries. Store in a dry place outside of reach of strong magnetic fields.

UPDATES/MANUFACTURER TESTING

Software up-to-date? Periodic verification by manufacturer done?

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Whereas metal parts may detune the antennas and shield the signal, active electronic devices are likely to cause interference resulting in a higher noise floor and/or arbitrary distance and direction indications. The mass, dimension, and characteristics of metals and the amplitude and frequency spectrum of the electronic and electromagnetic interference influence the extent of problems created for the transceiver. It is important to understand that for many sources of interference, the amplitude of the harmful interference increases with proximity by a power of three to distance, i.e. if a certain electronic device causes an interference ring amplitude of level 2 to the transceiver at 20cm distance, the interference reaches an amplitude of level 8 at 10cm distance.

Concept of Interference and Consequences for Transceiver Technology

When speaking about electronic and electromagnetic interference, it is important to understand that an interfering signal may directly influence the electronic circuits of the transceiver and / or be picked up by the antennas of the transceiver. The frequency spectrum of interference often includes frequencies exactly on or close to 457'000Hz, in particular when taking into account that multitudes of harmonics may be in this spectrum. Therefore the interference is in the avalanche rescue transceiver frequency range and can make exactly the same impression to the receiver as the signal of a buried subject. Electronic and electromagnetic interference with different characteristics influence the transceiver in different ways, however, it is crucial to understand that an incoming interfering signal may look to the receiver exactly the same as a "real" signal transmitted by a buried subject. Therefore, a rescuer may experience that the transceiver shows arbitrary distance and direction indications exclusively caused by interference in an area where there is no buried subject or the distance to the buried subject is much greater than the maximum range of the receiver (signal search phase.)

The difference in amplitude of interference compared to the amplitude of the real transmit signal of a buried subject is an important factor which influences to what extent the search may be compromised (SNR = Signal to Noise Ratio). Therefore, we may conclude: 1: The weaker the signal of the buried subject, the lower the tolerance for interference 2: A transceiver with high sensitivity has the capability to pick up very weak signals from buried subjects in a far distance (=long range), however, this equally means low tolerance for interference. => the longer the range of a device, the more it is susceptible to interference => the shorter the range, the lower the sensitivity of the device for „real“ signals as well as for interference. => long range and high interference tolerance are antagonists => long range leads to shorter burial times and therefore increased survival chances (1) => users have to know that their degree of compliance to the rules on avoidance of interference directly influences the efficiency of the rescue actions.

In cases where rescuers experience strong interference despite full compliance to the rules of avoiding interference, such as in proximity to high-voltage power lines, antenna masts, cableways, buildings etc. , where the source of interference cannot be removed or turned off, switching the device to analog mode with manual volume control may be the best option to allow to search for the buried subject. Often this measure needs to be combined with a reduction of search strip width.

Devices such as the Ortovox S1, ARVA Link, or Pulse Barryvox target advanced recreational or professional user groups by offering analog search options with the aim of providing a solution for 100% of the potential rescue situations. The reason behind the much higher tolerance for interference in an analog search compared to a digital search is the greater sensitivity of human hearing to detect the "real" signal when a lot of interference is present and when the signal to noise ratio (SNR) is bad.

Finally, interference degrading the performance and efficiency of the transmit function should be discussed: Transmit mode is less sensitive to interference than receive mode, therefore acceptance of interference is higher and most of the equipment and "gadgets" can be used with only minor restrictions such as respecting a minimum distance of 20cm between metal parts or electronics (active or passive) and the transceiver in transmit mode. In case the recommended safety distance is compromised as equipment and clothing gets dislocated on the body during the course of the avalanche, the transmitted field strength within the nominal transmit frequency range may be reduced leading to a shorter range in which the buried subject can be received. However, range reductions of more than 30% are seldom and would require detuning of the antenna and/or shielding of the signal by a massive or large metal object. In particularly negative cases, this may lead to the fact that the weaker signal of the buried subject is not picked up when applying the search strip width recommended by the manufacturer.

The appropriate rescue tactical measure in such cases is to cut the search strip width in half, which practically means to search on the middle lines of the signal search pattern (i.e. if in the first phase, 50m search strip width has been applied without success, in the second phase, the signal search strip width pattern is shift-

PERSONAL RESCUE EQUIPMENT



3 Antennas
+ marking function



minimum 240cm



Metal!

Read and follow all manufacturers instructions

CARRYING METHODS

Harness: Transceiver must be securely attached to your body at all times

Secure trouser pocket: Zipper must be closed at all times.

Transceiver must be securely attached to your body at all times. LCD is always facing the body.

SELF AND BATTERY TEST

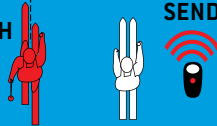
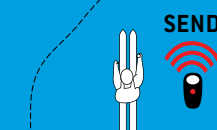
Each time the device is turned on, the result of the battery and self test is verified by the user.



SINGLE GROUP CHECK

DAILY

2



1

SEARCH
beep
or
display
≤2.0/OK

1m

3m

Receive / SEARCH

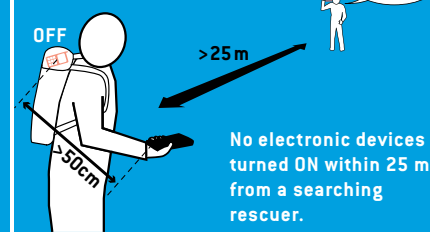
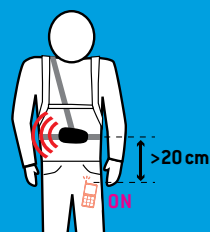
- Transceivers with group check function: use «Group Check»
- Transceivers without group check function: use «SEARCH»
- Analog only transceivers: Volume level, which corresponds to 1m of range

AVOID INTERFERENCE

Sources of interference: electronic devices (even if turned off), metal parts, magnets

Transmit / SEND

Receive / SEARCH



ed by 25m. This approach is equal to a second coarse search in a probe line with a shifted probing pattern when the first grid did not lead to success.

Recommendations Concerning Potentially Interfering Equipment for Professional and institutional Users and Special Applications

Clothing: Avoid wearing clothes with magnetic buttons or larger metallic and/or conductive parts (e.g. nets of heated gloves)!

Storage: Do not store the transceiver close to strong magnetic fields as they can magnetize the antennas with a long term effect.

Magnets and electromagnetic fields: Some transceivers of several brands have a magnetic ON / OFF or OFF / SEND / SEARCH switch and therefore magnets in close proximity can turn the unit OFF, or to SEARCH or SEND at any given moment. Some transceivers of several brands contain an electronic compass and are, especially during search, highly sensitive to magnets and electromagnetic fields.

Transmit mode: In transmit mode a minimum distance of **20cm** has to be respected between the avalanche rescue transceivers and any metal object or electronic device. Although the distance where serious interference of transmit mode has to be expected is for many objects and devices considerably shorter (<3cm), the likely displacement of a carrying system, clothing and potentially interfering objects due to the mechanical impact to the person taken by an avalanche has to be taken into account and therefore the recommended distance has to leave some safety margin.

Search mode: In search mode, a minimum distance of **50cm** has to be maintained between the beacon and the listed objects below which can be used with a transceiver.

Definitive List of Equipment Which Can Be Used With a Transceiver

List of objects and equipment (conclusive), which can be used with a transceiver respecting the rules as mentioned above. This conclusive list includes rescue or operationally critical equipment and equipment which is an integral part of mountain excursions. For equipment which is critical for rescue or operationally, but require more restrictive rules than the 20cm safety distance in transmit and 50cm in receive mode, **the exceptions are specifically mentioned.**

General equipment: metallic frames of backcountry backpacks – camping and cooking equipment, metallic vacuum bottles – non engine driven snow sport equipment (skis, snowboards, snowshoes) – climbing gear (carabineers, ice axes, crampons, etc.) – electric head lamps excluding headlamps with switching power voltage regulators – snow study kits incl. metallic snow saw – improvised repair equipment and tools like pocket knives and pocket multi-purpose repair tools – writing tools – wrist watch without radio functions on the wrist; large, multi-functional watches with large screens should not be worn on the same hand like the searching transceiver is held. – Any kind of food, candy or cigarette box wrapping with metal foil.

Search, rescue and survival equipment: flotation devices (incl. remote release device), Avalung, Avalanche Ball – avalanche rescue transceivers – devices providing a backup transmit function in case of a secondary avalanche – RECCO search devices (3m distance and do not point directly to another rescuer) – RECCO reflectors (reflectors may be placed at any distance without any risk of interference) – avalanche probes and shovels (metallic and carbon probes may not be placed parallel to the snow surface during fine and pinpoint search) – high performance lights and generators for night searches in organized rescue (strong interference may occur and affect a larger zone around the equipment. Interference should be checked with an analog receiver on the highest sensitivity setting and appropriate measures taken accordingly.)

Vehicles: snow mobiles, snow grooming machines, cars, snowplows, snow blowers (The search from such vehicles can be severely disturbed by interferences from the running engine, metal plates and the vehicle electronics. In transmit mode, reduction of range is possible depending on proximity of the transmitter to metal parts of the vehicle. Search accuracy might be compromised in close proximity of the vehicle.) – helicopters (The search from a

helicopter is only efficient with specialized transceivers) Medical equipment: – pacemakers and ICDs (Users of pacemakers/ICDs are advised to carry the device on their right side (adjust the length of the carrying straps. Consult the manufacturer's instructions of the pacemaker with regards to the interference impact.) – portable heart rate monitors (needs to be switched off during search or in 50cm distance to the receiver) – first aid equipment incl. metallic splints – toboggan, immobilization equipment, stretchers

Communication equipment: analog VHF and UHF radios up to 5W transmit power (interference may occur during transmit of the searching rescuer. Loudspeakers of radios produce a strong electromagnetic field and should therefore not directly point towards the transceiver) – digital VHF and UHF radio up to 5W transmit power (interference may occur during transmit, radio needs to be turned off during search) – cellular phones, satellite phones, PLB (personal locator beacon) (inference may occur during communication (incl. synchronization with the network, communication of text messages and data), devices need to be turned off during search for all searching rescuers. As long as the search is in progress, use of these device on the entire avalanche should be restricted to short-lasting emergency calls in minimum distance of 25m to the closest searching rescuer. Based on new measurements, actively searching rescuers must completely turn off cellular phones as some specific, but popular models show even in "air plane mode" in distances up to 100cm interferences which trigger erratic distance / direction indications on the screen in areas where there is no real transceiver signal).

Orientation equipment: electronic and mechanical altimeters – electronic and mechanical compasses – handheld GPS receivers (except devices with radio transmit functions.)

Equipment of armed forces and law enforcing agencies: – guns and pistols, ammunition (weapons incl. optics, but excluding electronic systems; if the weapon is carried diagonally on the front side of the body, the transceiver must be carried sidewise) – body armor systems (carry transceiver sidewise.)

Non Rescue, Mountain or Operationally Relevant Equipment:

(=all equipment not listed above) The variety of electronic equipment (entertainment, video, photo, remote controls, etc) that rescuers have been trying to use in combination with their avalanche rescue transceiver has grown tremendously in the past years. Whereas some of the equipment might not cause an interference problem in combination with a particular transceiver, it does with others and vice versa. It is therefore impossible to make a recommendation for each individual device and transceiver. Several reports from failed or severely disturbed and delayed rescue action in the last years have shown that electronic equipment can have a very unpredictable and severe influence on avalanche rescue transceivers. Therefore, while a search is in progress on the avalanche, all equipment not listed above must be turned off and remain off on the entire avalanche for the short duration of the search compared to the entire duration of rescue.

High voltage power lines and radio towers may as well dramatically reduce the performance of an avalanche rescue transceiver. Often, the digital search mode completely fails and it is necessary to carry out an analog search by applying signal search strips with a very limited width. ▲

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References: (1) Genswein, M., Reiweger, I. and Schweizer, J., 2009. Survival chance optimized search strip width in avalanche rescue. Cold Regions Science and Technology, 59(2-3): 259-266.

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BEACON CHECK



The D'BEST Beacon Check

BY NICK D'ALESSIO

A good beacon check is one of many important decisions we need to make in order to have a successful day in the snow-covered mountains. An incomplete check of your group's beacons can result in the inability to perform a rescue or to be rescued. Many details should be checked to ensure your beacon is working correctly and you are wearing it correctly. The list includes: Display issues, battery strength, what type of batteries are being used (quality, name brand, alkaline, not lithium or rechargeable), where electronics are stored, search mode, transmit mode, and that your beacon is stowed properly. If your beacon is stowed in your pants pocket it needs to be clipped in and zipped shut with nothing else in there. The pocket needs to be relatively protected i.e., not a cargo pocket vulnerable to damage in a fall and not tacked onto the pants. Wear a belt or suspenders so if you get in an avalanche you don't lose your pants. If stowed in the manufacturer's harness have it against a layer you know you will not take off during the day. Display should face in. What else does your owner's manual state?

Common issues seen from first timers to seasoned professionals are: not checking battery strength, not clipped in, electronics in close proximity to smartphones. Beacons of varying manufacturers from time to time have issues with display errors and sometimes not even picking up or transmitting a signal, even brand new ones. If you start your day with a low battery percentage and you are buried your beacon might die and so will you. If you don't have your beacon clipped in and you need to search, there is a good chance you will drop it and watch it slide away or become lost in the snow. If your phone, GoPro, radio, or other electronic device is near your beacon you diminish your chance of transmitting properly and when searching, interference will influence your search. (See article on page 16 regarding interference details.) In short, if you miss key parts to a beacon check, then what is the point of performing one?

That is a lot to remember for a first timer nonetheless a seasoned professional. How are you supposed to remember all those details among the thousands of other decisions going through your head during the day? Even if you do, how are you able to make sure you and your partners are following best practices, each and every time?

I was pondering one early summer morning how to teach a simple, easy to remember, yet complete beacon check which would work every time. I came up with an acronym which includes the vital parts.

It is D'BEST. (Display, Battery, Electronics, Search, and Transmit).

At the Alaska Avalanche School this method has been proven effective for hundreds of students this last season. It is a night and day difference from past years. Two weeks after the first course of the season I went out for a ski with my girlfriend. Leaving the parking lot I ran into a past student, he said "Hey Nick! We are doing our D'BEST beacon check." We both smiled. Later in the season one of my colleagues was at a local restaurant and overheard some students talking about how great the current course was and said, "Yeah and they taught us a really easy way to do a beacon check! It's D'BEST"

With help from Joe Stock we have created an outline for this beacon check which we teach at the Alaska Avalanche School. Whether teaching, guiding or out with friends I use it every day. I would encourage everyone to give it a try to see how it works as your beacon check. The following is an outline to run a daily beacon check. You should also conduct a range check at least once a year. ▲

DISPLAY

Turn beacons on.
Check battery and **display** for errors.

BATTERY

Battery strength?
Replace if 50% or less.

ELECTRONICS

Electronics 50cm away?
Airplane mode, turned off?

SEARCH

Everyone to **search**.
When silent, leader transmits & checks group.

TRANSMIT

Transmit and stow properly.
Leader on search & checks group.

Last person watches leader go to transmit & stow properly.

It kind of feels like peeber...

AIRPLANE MODE?

NICK D'ALESSIO:

I think airplane mode or airplane mode and powering off is an important step to take during a beacon check. Phone batteries will often die when not on airplane mode and then you don't have your phone for gps, emergency calls etc. If people just power off without switching to airplane mode then they will likely turn it on for a photo or use gps and forget to turn it back off.

MANUEL GENSWEIN:

The unfortunate insight is that the user cannot reliably count on reduction of interference in airplane mode and thus there is not a different, less restrictive set of rules for airplane mode.

PROFESSIONAL RESCUE MATTERS: A CASE REPORT FROM POLAND'S TATRA MOUNTAINS

BY DALE ATKINS AND TERRY O'CONNOR, MD

In the mid afternoon of February 15, 2015, a group of cavers was caught by an avalanche in the Wielka Świstówka cirque while approaching the Komin Cave in the western Tatra Mountains. The resulting rescue and medical treatment highlights the importance of professional (aka “organized”) rescue to any avalanche accident. Even when rescuers’ responses might be slowed from grounded rescue helicopters or difficult overland travel, professional rescue brings capabilities to better save a life than what companions can provide.

This rescue in Poland also highlights that the best opportunities for saving lives result from an attitude of rescuers that are focused on rescue and resuscitation, and not resigned to ‘body recovery.’ This is part of an integrated “system” that starts with the immediate call for help and then involves the coordinated efforts of companions, professional rescuers, prehospital and hospital

professionals. In a style likely different from many (or even most) mountain rescue operations, the Polish mountain rescuers contacted a regional hypothermia treatment center within minutes of receiving the alarm of the accident. The center’s medical staff, from their remote position, became involved in coordination of the medical treatment during the entire rescue operation from prior to rescuers finding the victim to receiving the patient in their hospital many hours later.

Within this article we give a summary of the rescue and care of a remarkable story of a woman who survived a lengthy burial, suffered severe hypothermia, endured a prolonged hospital stay, and made a full recovery. You will also find web links for additional details about the rescue and medical care. We also hope you will recognize the value and importance of professional rescue.

Below the Komin Cave the first mountain rescuers with Tatrzańskie Ochotnicze Pogotowie Ratunkowe (TOPR) arrived as the last victim had just been found alive and was being dug out after a nearly two-hour burial. While awaiting evacuation gear she went into cardiac arrest (ventricular fibrillation, aka v-fib). An Automated Electronic Defibrillator (AED) delivered two defibrillations, but her heart quickly reverted back to v-fib. The AED electrode pads then became unusable because of the water from melting snow. To make matters worse, their mechanical CPR device also failed due to the cold temperatures and snow blowing and falling into the device.

What followed was just over three hours of manual CPR on a SKED litter being dragged across rugged off-trail terrain first by skiers and then by snowmobile for 2.5 miles in a windstorm. Medics had intubated her to manage her airway, and ventilations were done with a bag-valve-mask. She was then transferred to an ambulance where another mechanical CPR device was applied. By then her body’s core temperature had dropped to 17°C (normal is 37°C). The ambulance ride took more than an hour to a waiting medical helicopter that whisked her 128 km to the Severe Hypothermia Treatment Center in Cracow. There her temperature was measured at 16.9°C (62.4°F).

CPR ended after nearly seven hours when she was put onto ECMO (think cardiac bypass but ECMO can be used for days as the artificial heart and lungs). It took an additional hour before her heart was successfully defibrillated back to a normal rhythm when her body had warmed to 24.8°C (still nearly 12°C below normal). On day four she was removed from ECMO but still spent another three weeks in the hospital. Finally, on day 26 she was discharged neurologically intact. A year later she was found to be “fully recovered” both physically and mentally.

Summary details of her medical treatment were presented in a letter to the editor — The longest persisting ventricular fibrillation with an excellent outcome—6h 45min cardiac arrest — in the August 2016 issue of the medical journal *Resuscitation* ([dx.doi.org/10.1016/j.resuscitation.2016.05.022](https://doi.org/10.1016/j.resuscitation.2016.05.022)).

Additional information about the weather conditions, rescue, and medical care can be viewed from presentation at the 2015 ICAR (International Commission for Alpine Rescue) meeting presented by rescuers from TOPR and doctors from the Severe Hypothermia Treatment Centre. The presentation can be downloaded from ICAR at bit.do/ikar_poland_2015.

Not mentioned in detail but learned from TOPR was that AutoPulse® failed because of cold, mechanical complexity, wetness, and the small chest diameter of the patient. The AutoPulse is designed to work at temperatures above 0°C, but colder temperatures during the rescue had an adverse effect on the device and its batteries: multiple batteries failed. The AutoPulse is a complex device and has an International Protection Code rating of 24, which means the enclosure is designed to keep out objects that are greater than 12.5mm (like fingers). It is not “dust protected,” which would be necessary to keep snow out of the moving parts, so the rollers that pull the band that exerts the compressions repeatedly clogged with snow, causing the device to stop working. The device is also only splash resistant and as snow melted, the standing water or moisture was thought to have penetrated the device. Also the patient was very slender, just within the range of the device’s operation. When the patient slipped around inside the SKED the device would stop



The Wielka Świstówka cirque sits in the Miętusia Valley of the Western Tatras mountains about 10 miles southwest of Zakopane in southern Poland. Zakopane is known informally as the “winter capital of Poland,” and the limestone mountains of the Western Tatras are the center of Poland’s caving activities. More than 650 caves with 60+ miles of passages have been identified in this small, 23-mile long mountain range. Rescuers accessed the avalanche accident site from the small village in the lower right corner of the photograph and followed a summer road to the drainage. Rescuers call the terrain in the Miętusia Valley as “famously uninviting.”

Doesn't anyone else find pants uncomfortable?

working and had to be restarted. After a dozen or more restarts the rescuers went back to manual CPR with their lightest rescuer straddling the patient.

The weather conditions that TOPR experienced – cold, windy, and blowing snow – are common to many avalanche rescues. Rescuers should be alert to the limitations of their electronic medical devices for operating in austere environments. Doctors Joslin and Biondich note in a recent editorial in the journal of Wilderness & Environmental Medicine (v27, 1, 2016) that while the LifePak AED has an operating temperature range of 0°C to 50°C, it must be kept within that operating range for at least two hours prior to use.

Furthermore, trained rescuers should be well accustomed to the limitations of routine Advanced Cardiac Life Support in this austere environment with the severely hypothermic patient. As reflected in this case, malignant arrhythmias are often refractory to defibrillation attempts until core temperature threshold is reached (often 24-30C). In fact, in current hypothermia resuscitation guidelines, only a single defibrillation attempt is recommended if core temp <30C, and further efforts should be focused on extrication and rewarming (WILDERNESS & ENVIRONMENTAL MEDICINE, 25, S66-S85 (2014). Drug metabolism is also affected. The European Resuscitation Council and Wilderness Medical Society recommend epinephrine withheld until the core temperature is higher than 30°C.

Finally it is important to maintain perspective that, although such successes after a lengthy burial and prolonged resuscitation efforts in the field and hospital are rare, they do happen. As one of this article's authors, Dr. O'Connor pointed out in his TAR article *Not Dead Yet: Lessons Learned From Being Buried Alive* (TAR 33.3, 2015), a "slim chance does not mean no chance."

The accident and rescue did not have a perfect ending. The other buried caver died. That person was buried for 20-25 minutes, but their airways were obstructed by snow. Companions performed CPR for 85 minutes. After evaluation on a cardiac monitor, TOPR rescuers discontinued resuscitation. With limited personnel and difficult terrain they focused on the other salvageable patient. To refresh yourself on how to triage your resuscitative efforts based on our best available current evidence see (A follow-up article – *Still Not Dead Yet...* by O'Connor et al in TAR 34.2, 2016.)

Yes, professional rescue has limitations, but they also provide capabilities — additional means to find victims, higher level of medical care, and the ability to transport the injured — that cannot be matched by companions. This time the "system" which includes "professional" rescuers (even volunteers like the members of TOPR) working inline with the prehospital and hospital programs. The system and the role of professional rescue in avalanche rescue should not be ignored. All buried victims deserve the opportunity to be placed into the "system" and perhaps be that next "lucky" survivor. ▲

The best opportunities for saving lives result from an attitude of rescuers that are focused on rescue and resuscitation, and not resigned to 'body recovery.'

Dr Terry O'Connor is an Emergency Medicine physician in Sun Valley, ID. He is the EMS Medical Director for the Sawtooth Region and Sun Valley Ski Patrol. He previously lived the lives of a ski patroller, NPS climbing ranger, high altitude researcher and expedition physician. In that time he has cataloged an over-indulgent amount of après ski canned beer with forecaster friends. The fates continue to conspire to place him in the pages of *The Avalanche Review*.



Dale Atkins is a long time rescuer and avalanche professional, and works for RECCO AB. While he has been on scores of avalanche rescues, he prefers skiing to digging.



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AVALANCHE EDUCATORS AND TEENAGERS:

My name is Emery Rheam and I am looking for teens ages 14-18 who live in mountain communities to take a quick survey about backcountry use and avalanche education. If you fit this age group or might be able to send out the survey to anyone who does it would be greatly appreciated. This is for a project that will be presented at some upcoming snow workshops. Thank you.

<https://goo.gl/forms/rmIPwoJ5FLd92Uot1>

questions: email emeryrheam@gmail.com

LEAVE YOUR THERMOMETER AT HOME... BUT DON'T FORGET YOUR LOUPE!

Editor's Note: We first printed Kevin and Ethan's article in the April TAR, but inadvertently omitted some important graphics. Please enjoy it in its entirety.

Recent AAA funded research shows that rather than capturing coarse resolution temperature profiles in your midwinter snowpit, your time may be better spent analyzing the snowpack stratigraphy and characterizing snow grain types found near suspected weak layers.

BY KEVIN HAMMONDS & ETHAN GREENE

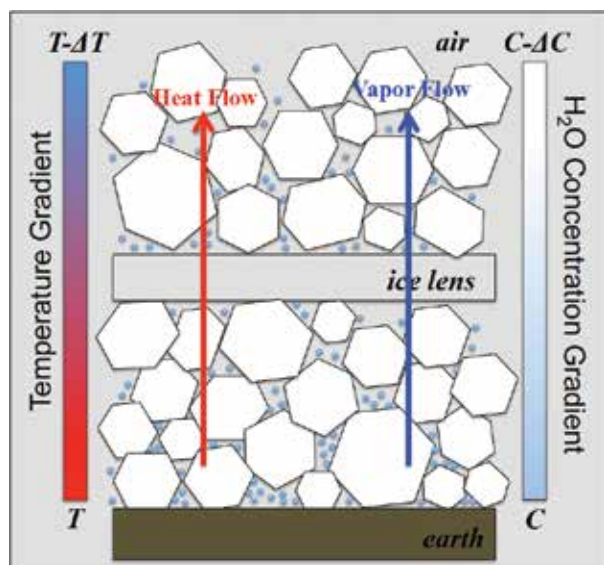
As it turns out, spending many an extra cold and blustery minute trying to get those last few temperature readings from your snowpit wall for a textbook perfect “every-ten-centimeter” temperature profile may not be all that helpful, and if anything can even be misleading. Based on recent laboratory research conducted at the Dartmouth Ice Research Laboratory (see Hammonds et al. 2015) and succeeding other earlier but similar work (see Greene 2007), it would appear that perhaps the most critical of temperature gradients are those that cannot be directly measured...at least not with your standard field-based instrumentation.

In Hammonds et al. (2015), a study funded by the AAA, the authors created an artificial snowpack consisting of an ice lens sandwiched between two layers of old natural snow grains. They placed the sample under a controlled temperature gradient for 48-hours and observed the microstructural evolution of the ice-snow interface via micro-CT imaging while recording the temperature gradients within the sample with a custom built micro-thermocouple array. From the micro-CT imaging, new ice crystal growth occurred from the bottom surface of the ice lens while the top remained smooth. This observation was in line with the previous work of Greene (2007). In addition to Greene (2007), however, were the temperature gradients that were recorded near the ice-snow interface on a sub-millimeter scale. At these small scales, local temperature gradients were observed to be as much as 40 times that of the bulk temperature gradient that had been imposed over the sample. These results are thought to be of significance to avalanche forecasters for two primary reasons:

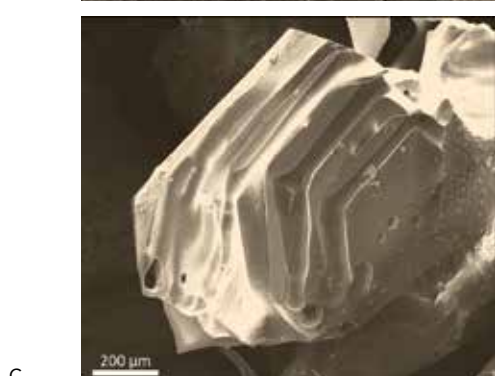
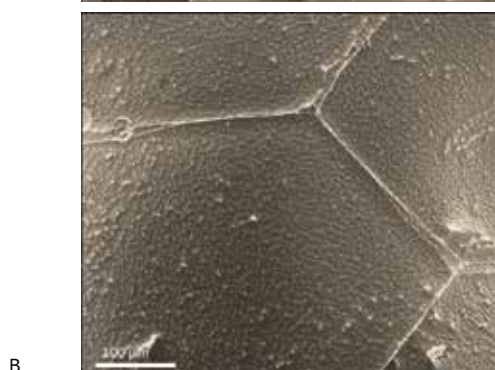
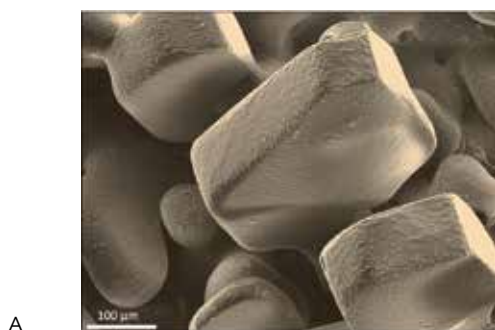
1. Slab avalanche activity has long been observed to occur near icy layers or crust/facet combinations in a region of the snowpack that did not necessarily have a measurable temperature gradient indicative of kinetic snow metamorphism. (Jamieson et al. 2001, Greene & Johnson 2002, and others)
2. Hammonds et al. (2015) showed that very large increases in the temperature gradient occur at very small scales in the snowpack around ice crusts. Such localized jumps in the temperature gradient on a sub-millimeter scale are not currently measurable with standard field instrumentation. Most temperature probes are themselves two millimeters in diameter and the typical resolution of a good dial-stem thermometer is +/- 0.5 °C.

“What causes the jumps in the local temperature gradient near the ice-snow interface?” This occurs because such icy layers can act as thermal discontinuities to an otherwise thermodynamically homogeneous snowpack. Such results are not exactly intuitive...“isn't snow just made of ice?” The answer is “yes”, but due to the crystalline structure and long range atomic order of solid ice versus the more disordered and loosely packed icy version of what we know as snow, thermal conductivities of ice compared to snow can differ by as much as a full order of magnitude (Petrenko & Whitworth 1999, Riche & Schneebeli 2013). This causes problems when individual snow grains come into contact with solid ice, as the pathway for conduction through the snow/ice matrix is compromised by the finite number of contact points that actually exist between the two, termed the thermal contact resistance. A function of the connectivity between the ice lens and the adjacent snow layers, the thermal contact resistance has been shown in a secondary study (Hammonds & Baker 2016) to be ultimately what is responsible for the marked increases in the sub-millimeter scale temperature gradients observed near the ice-snow interface. Although never before directly measured, many have suggested in the past (Colbeck 1991, Colbeck & Jamieson 2001, Greene 2007, and others) that such super-temperature gradients were likely to exist near an ice-snow interface and that enhancements in kinetic snow metamorphism could result. As a pertinent and memorable example of this scenario, large and widespread avalanche cycles associated with the Martin Luther King (MLK) rain crust in 2011 (see *TAR Vol. 30 No. 3*) were more than likely the result of such enhancements in kinetic snow metamorphism occurring near the ice-snow interface. This MLK crust was observed to be a repeat offender as it would avalanche and then reload with a new snow slab. This is thought to have occurred because once formed, such ice lenses can only degenerate by the natural mechanisms of sublimation (slowest), destruction by an avalanche (fastest), or by becoming so significantly buried that compressional forces of the overlying snow slab aid in the bonding of the adjacent snow layers to the icy layer itself, thus limiting the effects of thermal contact resistance (most unsure and unsettling scenario).

So, to answer the question “Is it always worth getting a perfect every-ten-centimeter temperature profile in your snowpit?” The answer is quite simply “No.” In fact, focusing too much on such large-scale temperature gradients can even be misleading as it may add bias to your



FUNDAMENTALS OF THE ICE/SNOW INTERFACE: Phenomenological representation of how an ice lens may affect the thermophysical properties of an ice-snow interface. Developing a better understanding of what happens to the heat and vapor flux at the ice-snow interface was the motivation behind Hammonds et al. 2015.



Scanning electron microscope images show (a) ice crystal growth on the bottom surface of the ice lens, (b) smoothness of the top surface of the ice lens, and (c) kinetic snow metamorphism of an adjacent snow grain above the ice lens after 48 hours under a -100 °C/m temperature gradient. Figure adapted from Hammonds et al. 2015.

opinion of what your observations of grain type actually mean. For instance, if you measure a bulk temperature gradient less than $-10^{\circ}\text{C}/\text{m}$ and identify a faceted crystal structure, it becomes very easy to assume the regime of “facets-going-to-rounds”, when it may actually be the opposite that is occurring. Thus, based on physical evidence from recent laboratory testing (Hammonds et al 2015) that is in direct support of long-standing avalanche theory (Colbeck 1991, Colbeck & Jamieson 2001), it would seem most advantageous for us all to begin spending less time looking at our temperature plots and perhaps more time looking through the lenses of our loupe. ▲

Kevin Hammonds is a Ph.D. Candidate at the Thayer School of Engineering at Dartmouth College, where he also serves as the Manager of the Dartmouth Ice Research Laboratory. <http://sites.dartmouth.edu/khammonds/>

Ethan Greene is the current Director of the Colorado Avalanche Information Center (CAIC).

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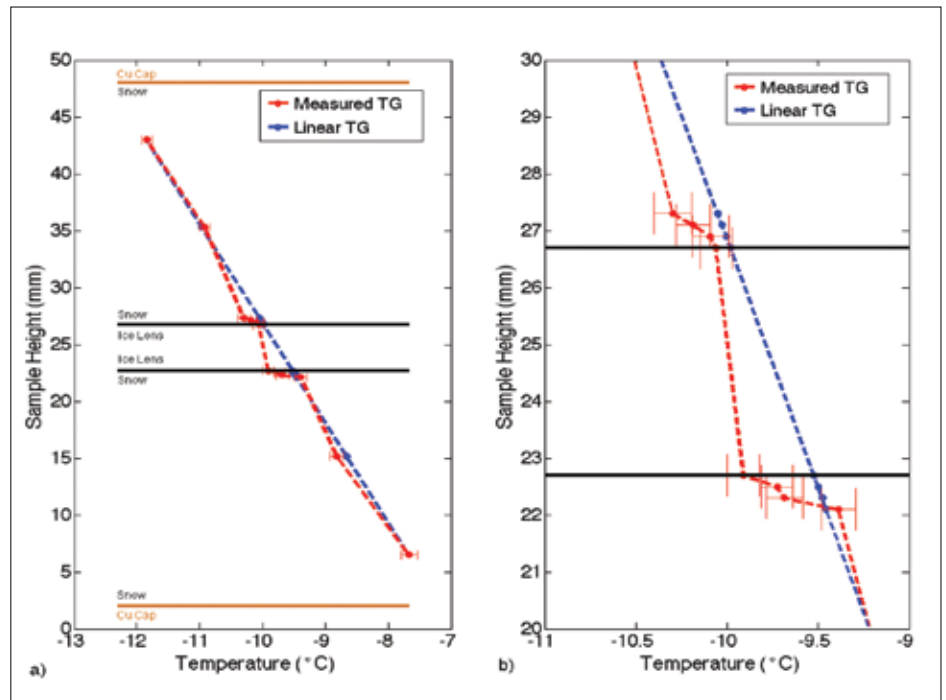
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Temperature gradient measurements taken with a micro-thermocouple array near a 4 mm ice lens over (a) the entire height of the sample, and (b) within one millimeter of the top and bottom surface of the ice lens. Figure adapted from Hammonds et al. 2015.

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FEAR AND *Fascination*



Prelude to an Avalanche

by Lee Watson

It sure wasn't a dark and stormy night. Those are pretty straight forward. You check the wind. You check the snowfall. You call in the troops and get a good night sleep because in the morning it's going to be a full on assault to get things open or explain why they're not. No this was a cold, clear night with a brilliant full moon lighting up the hoarfrost like a sea of diamonds and this is just a glimpse across a few moments in time on that night.

Beautiful and awesome as it was, Paul stared out the window and let out a long deep "aaarrggghh!" he hated nights like this. The sigh was half a Charlie Brown frustration sigh and half Napoleon Dynamite, anguishing over the inevitable. There was nothing you could do but sit and wait while Mother Nature stacked up her weapons against you, building mountains full of fragile structures that would plague you for weeks, maybe months. Sure he could bark about it in the morning meeting and assign teams to go ski up all the starting zones, and he probably would. But in the end there would be thousands of pockets untouched, pristine in their sparkling glory, at this elevation, at that strange aspect, left to be buried by the next storm cycle. With the full moon he couldn't sleep anyway so with his dog Cooper snoring at his feet, Paul surfed the weather sites, piecing together the scenarios that might unfold. A promising storm off the coast. Maybe it would push a little warmth

in front of it and melt tonight's layer before it dumped a foot of powder. Canada had some moisture too, maybe the storms would collide just right and put down so much snow that the days of avalanches would obliterate the weak layer. It was something to dream about, maybe he would get some sleep tonight.

Half way across town, Doug had just closed down the Cat's Paw Bar and was heading to his car when he noticed the frosty menace, encasing every vehicle. "Well this will be interesting," he said to himself out loud as he stared off past his forecasting office and toward his real office, high in the mountains to the south. Then he turned to check out his other office to the north, the Bridger sidecountry. It was a day off tomorrow, maybe a few runs at the ski area with just a casual observation of the new layer. Of course he would start with a leisurely breakfast at Sobys and a big ass cup of coffee on the way up. He would just check it out, it wasn't like he would be working or anything, it was just...interesting. When he got home he would have to look at the weather models to see where this might be going. For now though a line from the last song of the night was churning through his head. "There's a lady who's sure all that glitters is gold" "Yeah, not surface hoar," he thought to himself.



CONTEST WINNERS

In spring 2016, the AAA wanted to offer free ISSW registration to two AAA members who might not otherwise be in attendance. Our winners would be the essays and photos that best exemplified the Fear and Fascination of the Avalanche Phenomena. The top vote-getter for the photo entries was John Sykes' photo *Remote Trigger* in Turnagain, which graces the cover. The three photo runners-up can be found on these pages, as well as Lee Watson's winning essay below. Look for more stunning entries in further issues of this volume of *The Avalanche Review*, and congratulate John and Lee when you see them at ISSW.

LEFT: Johnny Bressette, Avalanche Tech for Alaska Electric Light & Power in Juneau, Alaska checks out the filled in crown from a size 3.5 avalanche that struck a splitting wedge at tower 4/6 on the Snettisham Transmission line. The slide destroyed 200+ year old trees, but the all steel splitting wedge did its job and protected the tower. Just four years prior this same tower was completely destroyed by a class 4 slide. Photo Mike Janes

TOP RIGHT: Compelling photos make you wonder what happened. These images make us uneasy, but we can't look away from the flames. We want to know more. What happened? In the future, a similar slope may kindle fear, rational or irrational, but we want to know more. If we ski this slope, what will happen? Will fear or fascination prevail in the face of uncertainty. In this scene, a small event had serious and unanticipated consequences. The classic 'everything is fine, until it's not, and then things got worse.' You want to know more don't you? Fascinating. Photo Doug Krause

BOTTOM RIGHT: There are times while avalanche hunting when you know instability exists but it is hard to find. That nagging angst trying to balance the desires to ski it while your gut tells you better test it. Here a 2lb hand charge after several larger shots triggered this monster. It was the classic "right place" on the rocky convexity. The crown was up to 6' deep and it propagated about 1,000' wide out of the frame of this photo. Photo Billy Rankin

Still farther across town, on the campus at MSU, Allen was just leaving the Subzero facility after coming in to make the 12-hour measurements and adjustments that were critical to the study they were conducting. Temperature, humidity, wind, long and short wave radiation, all these factors he had to get just right to create hoar frost in the lab. Now as he looked at the work Mother Nature had just accomplished coating every surface from there to his dorm, well for that matter, probably half the county, he had to laugh at the irony that he had been spending weeks just to make maybe a meter of this stuff. At least his little meter wouldn't be causing any trouble. He would be done with this part of the project in couple days and would have to melt his beautiful creations. But what if he didn't melt it? What if he used this serendipity to go a little further? This natural hoar was so like what he was growing in the lab, it could be used to test how well the artificial represented that in the field. He pulled his caliper out of his pocket protector and measured the crystal structures at his feet. Hmm, same size as in the lab. This could be great. As the next storm cycle arrived, he could bury his project with the same layers that were added up on the slopes. This would be a really good reason to get out in the field a lot more this winter.

Cuddled up in her blanket on the couch of her not so well insulated cabin on the mountain, the growing problem had not escaped Ellse's attention. Not really a problem at the moment but more of an opportunity as it wasn't that it just had her attention but the magic in those crystals had her absolute focus as she tried to comprehend the power and beauty in them that so reflected her own. She had been anticipating this and had set up her unbelievably complicated camera equipment to slow motion film this whole growth process and the only real problem was going out into the freezing cold in her slippers to check camera batteries. Someday she would have an actual budget and get the cold environment equipment designed to do this kind of stuff. For now though she was just happy to be living the dream, with a ski patroller's budget and one, out of her hundred ideas for a project, well under way.

Weeks later, Paul, Doug, Allen and Ellse would happen to meet up at a potluck held for a couple of visiting Canadian patrollers. There had been a number of near misses with avalanches that week, all on the same layer. One of the Canadians entered the group and ventured to ask, "Do you folks know much about the layer that's been causing so much trouble?" ▲

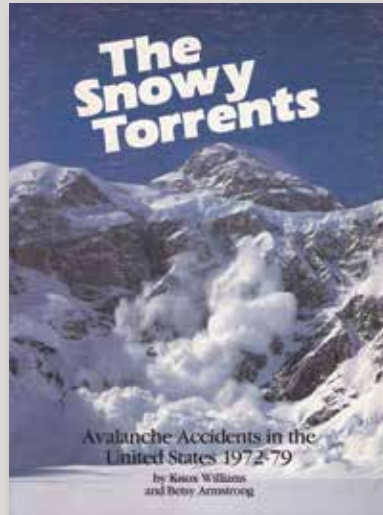
THE SNOWY TORRENTS PROJECT: A SHORT HISTORY



Photo Don Bachman



Photos #2-#4 Knox Williams



BY KNOX WILLIAMS

If avalanches were merely spectacular—but harmless—events, there would be no need for our profession... no forecasters, scientists, educators, mitigators, or American Avalanche Association. But we live in the real world where avalanches are of deadly consequence in snow-covered mountain terrain.

There are two good reasons to document important avalanche events. The first is that they are news events like all other natural disasters in that they destroy and kill, and therefore make headlines. The second is that they are teaching opportunities wherein we can learn from the experiences or mistakes of others.

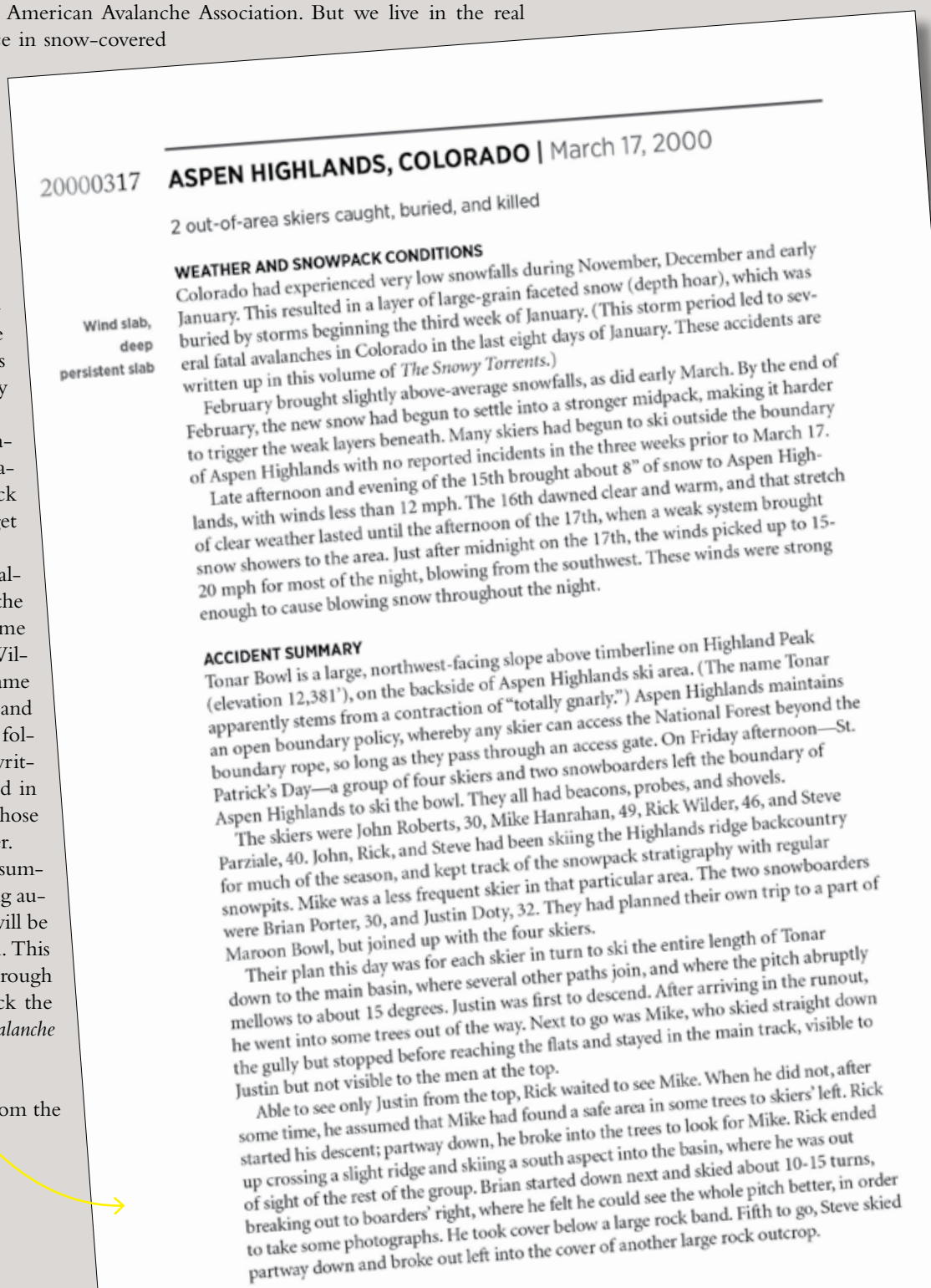
It was from this second point of view that *The Snowy Torrents* project began in the 1960s. The title was taken by a quote—“The snowy torrents are like the deep sea; they seldom return their victims alive”—taken from *Der Kampf über den Gletschern* by Walter Schmidkunz (1918).

The purpose of these books is to promote avalanche awareness. The authors—along with educators—want to help break the cycle of repeated lack of awareness, unsafe behavior, and mistakes that get people killed by avalanches.

The first in the series was authored by Dale Gallagher in 1967 and documented accidents in the United States from 1910–66. The second volume was published in 1975, was written by Knox Williams, and covered the period of 1967–71. Then came volume three in 1984 written by Knox Williams and Betsy Armstrong and covering 1972–79. That was followed by volume four that covered 1980–86, written by Nick Logan and Dale Atkins and published in 1996. Throughout the series, the authors look for those “teachable moments” that will stick with the reader.

The project has been revitalized as of spring and summer of 2016. Volume 5 of *The Snowy Torrents* is being authored by Knox Williams and Spencer Logan and will be published by the American Avalanche Association. This volume covers the winter seasons of 1996–97 through 2003–04 and is due out in December 2016. Check the AAA’s website and the next few issues of *The Avalanche Review* for final information on ordering.

On this spread you will find a sample case study from the upcoming volume of *The Snowy Torrents*. ▲



20000317 **ASPEN HIGHLANDS, COLORADO** | March 17, 2000
2 out-of-area skiers caught, buried, and killed

Wind slab,
deep
persistent slab

WEATHER AND SNOWPACK CONDITIONS

Colorado had experienced very low snowfalls during November, December and early January. This resulted in a layer of large-grain faceted snow (depth hoar), which was buried by storms beginning the third week of January. (This storm period led to several fatal avalanches in Colorado in the last eight days of January. These accidents are written up in this volume of *The Snowy Torrents*.)

February brought slightly above-average snowfalls, as did early March. By the end of February, the new snow had begun to settle into a stronger midpack, making it harder to trigger the weak layers beneath. Many skiers had begun to ski outside the boundary of Aspen Highlands with no reported incidents in the three weeks prior to March 17.

Late afternoon and evening of the 15th brought about 8” of snow to Aspen Highlands, with winds less than 12 mph. The 16th dawned clear and warm, and that stretch of clear weather lasted until the afternoon of the 17th, when a weak system brought snow showers to the area. Just after midnight on the 17th, the winds picked up to 15-20 mph for most of the night, blowing from the southwest. These winds were strong enough to cause blowing snow throughout the night.

ACCIDENT SUMMARY

Tonar Bowl is a large, northwest-facing slope above timberline on Highland Peak (elevation 12,381’), on the backside of Aspen Highlands ski area. (The name Tonar apparently stems from a contraction of “totally gnarly.”) Aspen Highlands maintains an open boundary policy, whereby any skier can access the National Forest beyond the boundary rope, so long as they pass through an access gate. On Friday afternoon—St. Patrick’s Day—a group of four skiers and two snowboarders left the boundary of Aspen Highlands to ski the bowl. They all had beacons, probes, and shovels.

The skiers were John Roberts, 30, Mike Hanrahan, 49, Rick Wilder, 46, and Steve Parziale, 40. John, Rick, and Steve had been skiing the Highlands ridge backcountry for much of the season, and kept track of the snowpack stratigraphy with regular snowpits. Mike was a less frequent skier in that particular area. The two snowboarders were Brian Porter, 30, and Justin Doty, 32. They had planned their own trip to a part of Maroon Bowl, but joined up with the four skiers.

Their plan this day was for each skier in turn to ski the entire length of Tonar down to the main basin, where several other paths join, and where the pitch abruptly mellows to about 15 degrees. Justin was first to descend. After arriving in the runoff, he went into some trees out of the way. Next to go was Mike, who skied straight down the gully but stopped before reaching the flats and stayed in the main track, visible to Justin but not visible to the men at the top.

Able to see only Justin from the top, Rick waited to see Mike. When he did not, after some time, he assumed that Mike had found a safe area in some trees to skiers’ left. Rick started his descent; partway down, he broke into the trees to look for Mike. Rick ended up crossing a slight ridge and skiing a south aspect into the basin, where he was out of sight of the rest of the group. Brian started down next and skied about 10-15 turns, breaking out to boarders’ right, where he felt he could see the whole pitch better, in order to take some photographs. He took cover below a large rock band. Fifth to go, Steve skied partway down and broke out left into the cover of another large rock outcrop.

The time was 12:15, and John was last to ski. About three turns into his run, the avalanche broke about 1' deep, and he yelled "Avalanche!" Several of the other men watched as John was riding it and staying upright, but after about 100 vertical feet, the slab released to the ground, about 4' deep. John was last seen tumbling in the flow.

Brian, standing on the side, later reported that as the avalanche went by, he could hear rocks rolling in the avalanche—similar to rocks being tumbled in the spring runoff of a river. In the runout, Justin saw the avalanche coming and yelled to Rick and Mike. Both Rick and Justin began moving diagonally down in opposite directions to escape the flow. Rick later recalled that "the sky went dark, the wind picked up, and I thought it was over." Both Rick and Justin were able to outrun the debris flow.

Justin, from his position near the bottom of the slope, was the only one of the party who saw Mike, who was standing low in the track, get hit and disappear in the avalanche. The debris rapidly decelerated and spread out after reaching the bottom of the track.



RESCUE SUMMARY

Brian and Steve had stopped their runs partway down the slope and on opposite sides. After the avalanche, they yelled for John and then began to move down the path, which the avalanche had polished smooth. They had several large rocky areas to contend with to get to the debris. Their beacons were on "receive" the whole trip down.

After the powder cloud cleared, Rick reported dead silence; he did not know where anyone was. He re-skinned and returned to the debris pile.

Justin's fast ride to escape the avalanche had taken him well below the debris. With no idea of who was left standing, and knowing that the trip back up in snowboard boots would be too long, he went for help. He reached the Maroon Creek Road and reported the avalanche to the T-Lazy-Seven guest ranch at about 12:45. They, in turn, notified the Highlands Ski Patrol and the sheriff's department.

The patrol responded for the county sheriff with a hasty team of three people. The only information they had was that a party of six was involved in a fairly large avalanche, and that the reporting party (Justin) was sure that the avalanche caught at least Mike.

Meanwhile, back at the avalanche site, the three searchers—Rick, Steve, and Brian—were certain of only one thing: that John had been caught. They all began picking up two beacon signals, which confirmed that Mike was also involved. They had some trouble initially with the double signals, but were eventually able to pinpoint. With some probing, they located the first body, which they dug up. Mike's lips were white and his face was completely blue. After clearing his airway, they were able to find no signs of pulse or breathing, and, in the correct triage fashion, they turned his beacon off and began to search for John.

They quickly were able to pinpoint, and they probed and dug out John, who was at approximately the same elevation and within 100 horizontal feet of Mike. John had

obvious signs of trauma. They could not detect any pulse and did not attempt CPR. After marking the bodies and re-activating the beacons, they skied towards Maroon Creek Road.

When they got to the road, they met up with a team of ski patrollers. It had gotten late in the day, and the weather was starting to deteriorate. The patrol went in to confirm the identities of the two victims, mark their locations with probe poles, and take some coroners' photos.

Mountain Rescue Aspen recovered the bodies the next morning.

HS-AS-3-G

AVALANCHE DATA

The avalanche released at an elevation of 12,200' on a northwest-facing slope, and it fell 1,100 vertical feet. The crown varied from 1-5' deep and was 500' wide. The avalanche was classified as HS-AS-3-G.

COMMENTS

Tonar Bowl is a high-risk, high-reward backcountry area. This was a very experienced and well-equipped backcountry skiing group, and they knew the terrain as well as anyone. Rick, John, and Steve had been digging snowpits all year and had begun skiing on Thanksgiving Day 1999. They properly skied the slope one at a time and did a fair job of keeping eyes on each person as he skied. Most of the group picked safe locations to stop away from the open slope. Altogether, they did a good job of minimizing their risk. And when their rescue skills were needed, their self-rescue technique was flawless, and all kept their composure during adversity.

But one error was obvious: Mike's bad choice of a place to stop. He was directly in the path of the avalanche and could not escape before it hit him.

A second error may have occurred as well. Several of the group had been digging snowpits throughout the winter. But we don't know if they dug one on this day. If they had, would they have detected the windslab that had formed overnight? In a pit, that fresh slab may not have shown signs of being unstable. After all, five skiers and snowboarders descended without incident. It was the sixth man who triggered the windslab, and once that released, it triggered the deep persistent slab that collapsed the depth-hoar layer to the ground.

This accident serves to underscore the inherent danger in backcountry skiing on steep avalanche terrain during a winter season when a thick layer of depth hoar lurks at the bottom of the snow cover.

This report was based on an excellent account written by Kevin Heinecken of the Aspen Highlands Ski Patrol.

The snowy torrents are like the deep sea; they seldom return their victims alive.

— taken from *Der Kampf über den Gletschern* by Walter Schmidkunz (1918)

The Snowy Torrents, Volume 6 early-bird sale is underway. Save 25% off regular prices. Limited time (through November 15th) and limited quantity offer (250 hardcopy, 250 ebooks, and 250 bundles available). Buy your book online today at aaa19.wildapricot.org/page-1270719! Books will be ready for distribution in early December (just in time for the holidays).

He's like a tater tot with an attitude.

MOUNT WASHINGTON: Does it seem like there are more users in the backcountry? A common sight at Tuckermans. Photo Chris Joosen



U.S. AVALANCHE FATALITY TREND FLAT OVER THE PAST 22 SEASONS

BY KARL BIRKELAND

Where were you during the winter of 1994/95? Knox Williams, Bruce Tremper, and Mark Moore headed up the three big avalanche centers in Denver, Utah, and Seattle. Jim Kanzler was running the center in Jackson Hole, Brad Ray led the avalanche center at Mount Washington, and a small avalanche center I started in Bozeman was in its fifth season. Avalanche centers didn't even exist in the Chugach, at Tahoe, or Mt Shasta. Almost all backcountry skiers used telemark gear, with some (including yours truly) in leather boots. Snowmobiles didn't come close to the machines of today in terms of power, mobility, and weight. Most ski areas had closed boundaries and the term "sidecountry" wouldn't be widely used for more than a decade. Finally, the Internet was only just starting to gain traction, with the first avalanche advisories being posted to the web at the end of that season.

Would it surprise you if I told you that since that 1994/95 winter the annual number of U.S. avalanche fatalities has not increased? That's right, for the past 22 seasons as we've transitioned to smart phones, social media, lightweight AT gear, powerful snowmobiles, and a literal explosion in backcountry use, the number of seasonal U.S. avalanche fatalities have remained steady (Figure 1). Also interesting is that the number of snowmobile fatalities is flat over this time period (Figure 2), while there is some evidence that the number of backcountry skier/snowboarder fatalities may be rising slightly (Figure 3).

This flat line would be no big deal if backcountry use was also flat. However, anyone who has been in the backcountry for the past 22 years knows full well that – anecdotally of course – **use has skyrocketed**. Although it is challenging to get good, solid numbers on dispersed winter recreation, we can utilize avalanche advisory usage as an imperfect proxy. For example, over the past 22 seasons the Utah Avalanche Center reports a 12-fold increase in avalanche advisory usage, the Colorado Avalanche Information Center's usage increased 17-fold, the Gallatin National Forest Avalanche Center

has seen a 36-fold increase, and the usage at the Northwest Avalanche Center increased 60-fold! Clearly, some of these increases can be attributed to the ease with which folks can obtain avalanche information these days, but this still indicates many more people are going into the backcountry.

Assuming an extremely conservative estimate of use increasing 8 times and combining it with our flat fatality trend means our fatality rate (avalanche fatalities per backcountry user day) has dropped dramatically. In fact, this suggests that **our fatality rate has dropped by at least a factor of 8 (and probably more) over the past 22 years**. If our fatality rate had stayed steady while the use increased we might well expect over 200 U.S. avalanche fatalities per winter!

Our community will continue to do all we can to push the number of fatalities toward zero. However, we also need to take a step back and recognize that this flat line for U.S. avalanche fatalities is a big deal. It's a win for avalanche educators at all levels, from those providing professional courses to those giving *Know Before You Go* awareness presentations. It's a win for backcountry guiding and ski area operations that work to protect and educate their clients. It's a win for equipment manufacturers who have developed an array of great equipment, including much improved avalanche beacons, Avalungs, lightweight helmets, and airbag packs. And, it's a huge win for our regional avalanche center network that provides the public both with avalanche education and with current, solid avalanche information for the areas where folks are recreating. Ultimately, this flat fatality trend during a period of explosive backcountry growth shows that what we are doing works, and that is something that should make all of us proud.

Acknowledgements: The Colorado Avalanche Information Center provided the data for this short article. Our entire community owes a huge debt of gratitude to the CAIC, the CAIC personnel that compile the data, and the other folks who report and document avalanche accidents so that the rest of us can benefit from the lessons learned. Thanks also to Simon Trautman, Doug Chabot, and Spencer Logan for their constructive reviews and feedback. ▲

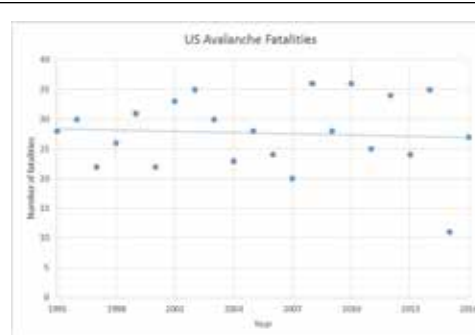


Figure 1: U.S. avalanche fatalities from the 1994/95 winter through the 2015/16 winter. The slightly decreasing least squares trend line is not statistically significant ($p = 0.7$), indicating that there is no statistical evidence of a change in the number of avalanche fatalities during this time period.

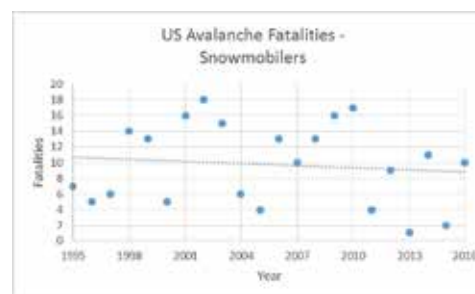


Figure 2: The number of snowmobile avalanche fatalities, like the overall fatality rate, has not changed over the past 22 seasons. The slightly decreasing trend line is not statistically significant ($p = 0.6$).

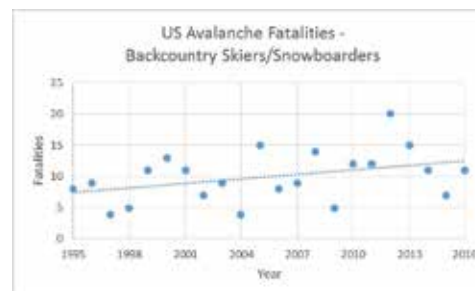


Figure 3: The number of backcountry skier and snowboarder avalanche fatalities is also relatively flat, though there is some statistical evidence ($p = 0.07$) of a slight increase over the time period.


**NATIONAL
AVALANCHE
CENTER**


The 2015/16 winter at the National Avalanche Center was

marked by completion of draft Forest Service Policy pertaining to avalanche centers. Interestingly, although the FS has policy for almost everything we do, the avalanche program has operated without policy for more than 40 years. This has been a handicap for the program, especially when decision makers unfamiliar with avalanches and avalanche forecasting are asked to support our programs. It's going to take a while for the draft to become official, but in the meantime Joe Meade, the Director of Recreation, sent out a letter recommending the use of this draft to guide our decisions. Frankly, this is a big deal – both to have this draft completed and to have the support of upper level folks like Joe.

Ultimately we hope to translate this support into more resources for the avalanche program, though we still have a way to go. Our next step is to work with all the avalanche centers to develop a new and comprehensive set of Avalanche Center Guidelines. If the policy mentioned above describes 'why we do what we do,' the guidelines will detail 'how we do what we do.' In other words, this resource will work toward defining a series of avalanche center best practices.

In addition to the bureaucratic underpinnings, we were able to work on a couple fun and applied projects:

- We released an animated tutorial on the North American Avalanche Danger Scale (www.fsavalanche.org/danger-scale) and will follow it with a video describing the practice of using 'avalanche problems' this fall. Many thanks to the CAIC, AIARE, and the AAA for their support and contribution in this regard.
- Karl completed some more work on crack propagation this winter. He will be presenting his work on the effect of loading on crack propagation at the ISSW in Breckenridge.
- We facilitated the development of an API that allows avalanche centers to use a common software to display their remote weather station data. This project is ongoing and we plan to improve the software application this summer.
- We are working on a strategic partnership between the NAC and the AAA. If successful, we will be able to leverage our resources in order to facilitate technologies that support avalanche risk communication.

Most importantly, I want to recognize the important work done by all of the US avalanche centers. These operations come in all shapes and



MOUNT WASHINGTON: A low angle transition collapse fracture adjacent to steeper failure. Photo Joe Klementovich, joe@klementovichphoto.com

sizes, but the work they do to help people stay safe is universal. As Karl will talk about later in this version of *TAR*, we are at a point in our history where it is evident that the efforts of the US snow and avalanche community are paying off (www.fsavalanche.org/news/).

In short, the combined efforts of forecasters, educators, and equipment manufacturers have kept fatality numbers (relatively) stable despite rapidly increasing use. Effectively, we are saving lives. I don't think this means we can sit back, grab a beer, and reach for the remote. Rather, I think it means that we should be proud of our work and that we should strive to improve ... because what we do matters.

—Simon Trautman


**MOUNT
WASHINGTON
AVALANCHE
CENTER**

Back in 2015, many western states struggled with snow while across the east we enjoyed a banner year. Unfortunately, the positions flip flopped in 2016, so while western states were getting hammered with storm after storm, winter never really gained much traction in the eastern mountains. Words such as "bony", "thin", "rocky", "blue water ice", and "crust" dominated our lexicon. But despite the overall lack of snow, we sometimes heard a happy tale of good skiing and riding.

How little snow fell last year? The summit weather station recorded a total of 185" from November through April. Compare this to 317" the previous year and 299" in 2014. At the USFS manual snow plot near the bottom of Tuckerman, the snow depth

typically peaks around 2 meters around the middle to end of March. We reached a peak of only 104cm on March 8, 2016. After that, we helplessly sat by watching the meager snowpack melt away reaching 0cm at the early date of May 11.

This lack of snow must have altered the mindset of eastern skiers and riders. The usual crowds that flock to Tuckerman for the spring ski season by and large stayed away, even though the snow conditions were often quite good.

At the Mount Washington Avalanche Center, heavy use in a concentrated area means we need to keep our guard up even in lean snow years. On January 17, five people were caught and carried in a slide path called "The Chute," and many more were in the immediate vicinity including a level 1 avalanche class. Thankfully, this incident only resulted in two people receiving minor injuries (see tinyurl.com/MWACavalanche for details.) Even more thankfully, these were the only avalanche-related injuries of the season that we know of.

Due to the poor winter we transitioned into full forecasting mode quite late, issuing only 91 5-scale advisories in addition to numerous general bulletins. To put this in perspective, in 2015 we issued 5-scale advisories 119 days from December 14 through May 11, and in 2014 we issued 103 advisories.

2015-6 was a light year on the education front for MWAC. The highlight for many was the Eastern Snow and Avalanche Workshop (ESAW), which was held at the historic and opulent Omni Mount Washington Resort. Approximately 200 attendees were treated to a full day of snow and avalanche presentations with some socializing with like-minded people, mixed in to liven things up. We were very grateful to all our speakers, but particularly Don Sharaf, Bruce Jamieson, and Rudi Mair who all traveled great distances and were tapped heavily with



MOUNT WASHINGTON: The wind sculpting of Mount Washington. Photo Joe Klementovich, joe@klementovichphoto.com

multiple talks. We're looking forward to the upcoming ESAW 2016 to be held on November 5.

There are big changes underway in MWAC staffing. After 26 years on Mount Washington, Chris Joosen will be leaving as the Lead Snow Ranger and Avalanche Center Director, only the third Lead in the program's 65+ year history. Chris leaves many friends and takes many memories as he rejoins his wife who transferred to the Deschutes National Forest in April. His heart will always have avalanches as a deep persistent problem, occasionally mixed with Mount Washington steel wind slabs. He will move on to be the Health and Safety Manager for the Mount Hood and Gifford Pinchot National Forests in Oregon and Washington. He may still be dealing with avalanches yet again....who knows. Snow Ranger Jeff Lane also leaves the program after 10+ years with the Forest Service and a total of 14 years on Mt. Washington. He also continues to have avalanches on the brain as he moves on to new challenges. They may very well still remain a part of his new life. This leaves Frank Carus and Helon Hoffer to carry the torch into the future. They bring a high level of field skills, steadfast commitment to avalanche work, and solid temperament when crowds march into new wind slabs. They carry on a long White Mountain National Forest history of serving publics coming to a notoriously unforgiving Presidential Mountain Range. We certainly hope their future is a little more snowy than 2016.

—Chris Joosen

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NORTHWEST AVALANCHE CENTER

Snow lovers here were concerned when a strong El Niño started brewing in late 2015, but we ended up with a pretty good winter confirming that strong El Niño winters don't necessarily mean bad snow years in the Northwest.

Our snowiest month this winter by far was December. NWAC stations along the west slopes had 100 to nearly 200 inches of snowfall in December. Snoqualmie Pass had their snowiest week ever in mid-December (112 inches of snowfall) and snowiest month ever (193 inches of snowfall). March was also fairly snowy with 60-100 inches of snowfall at NWAC stations along the west slopes.

We also had at least six heavy rain or atmospheric river events between the start of November to mid-February. Each of these events caused two-day rain amounts of 4 to 11 inches at sites along the west slopes.

I think our pro-observers are helping us better identify PWLs than in the past. PWLs were a problem in parts of the Cascades due to layers buried in late November and about January 3rd, January 11th, February 11th and February 27th.

By mid-March we had accumulated above normal water (120-150% at NRSC stations) but only normal snow depths due to overall warm temperatures during the winter.

Then much of the normal snowpack was erased by warm dry weather in April.

We had two avalanche fatalities this season and some injuries and close-calls. Also the body of a person who went missing during a very heavy snow period at Snoqualmie Pass on December 19th was found this spring. The cause of death is not

officially confirmed but evidence points to a third avalanche fatality.

We issued much fewer avalanche warnings than usual this season. These reasons could include our evolving forecast schedule and better information available to our forecasters such as via our pro-observers.

Most of our 40 some weather stations worked well and we are transitioning more of them to Internet access. But there were also some challenges this year. A staff injury, an Internet provider change at the forecast office, and other demands of the program limited our time to attend to stations that needed attention. A couple of stations with long standing issues that we hope to repair this summer are at Alpentan and Timberline.

Education, Outreach and the Pro-Observers

We had a great year for avalanche education with a total of 167 classes (89 Adult, 68 Youth, 8 Adult Snowmobile and 2 Youth Snowmobile). This was also our fourth year running our Going Deep program. Going Deep targets experienced backcountry skiers and riders by addressing some of the limitations of conventional avalanche education. This season all five classes were hosted at the Seattle REI and we are fortunate to have great sponsorship to help keep participation costs low.

The organizing of NSAW recently passed from Michael Jackson to the NWAC. On November 8th we packed the University of Washington Husky Union Building with over 650 snow professionals and recreationists. Topics included effectiveness of avalanche airbags, hypothermia, hazard evaluation, over-confidence, changes in avalanche education, back country ethics, snowpack modeling and decision making with uncertainty. The next NSAW is scheduled for October 23rd at the larger venue of Town Hall Seattle.

Traffic on our website is still on the rise with 1.7 million sessions from over 450,000 unique us-

NORTHWEST: A particularly chunky natural wind slab avalanche near Paradise on February 24th. Photo Peter Ellis



ers – the highest numbers by a significant margin. We now have close to 10,000 fans on Facebook and over 5600 followers on Instagram, these are 40% and 65% increases from last year respectively. Hooray for evermore fans and followers!

Our seven pro-observers spent over 250 days gathering snowpack information for the forecasters. In addition to the information submitted directly to the forecasters, the observers regularly submitted images and videos to the NWAC YouTube channel and Instagram.

We made several improvements to our mobile app and website this season. For the app we added an observation submission capability and a mountain weather forecast display. Improvements to the website include control of our homepage map and weather station roll-over information in the third tier of the avalanche forecast.

We are beginning a multi-season project to rebuild our mountain weather forecast on both the website and the mobile app. Over the next two years we plan to rebuild how we create the forecast, how it's entered into the website (to save forecaster time) and ultimately how the user obtains the information.

Personnel Changes at the NWAC

Significant personnel changes are in progress at the NWAC.

On the non-profit side Executive Director Benj Wadsworth and Program Coordinator Nick Rustigian recently headed for new horizons. Former Program Director Scott Schell was chosen in late June from among 40 candidates to be the new Executive Director.

On the forecast office side we are going to permanently fill the third forecaster position that is temporarily held by Dennis D'Amico and we have gathered the needed funds for a fourth forecaster. The hiring process for both positions will take place over the summer of 2016.

Longtime forecaster Garth Ferber is also planning to retire at the end of 2017. Tentative plans are to replace Garth with a possible combination of avalanche specialists and a weather station technician.

—Garth Ferber



WALLOWA AVALANCHE CENTER

Eastern Oregon saw the first significant snowfall in mid November continuing with several storm cycles into the first part of December. The common strong winds in the alpine contributed to widespread wind slabs in the early season snowpack. A strong storm during the first week of December led to our first Avalanche Warning of the season. We continue to have a great relationship with the National Weather service in Pendleton and they disseminate our warnings through the NWS channels.

The early December storm also left us with a crust that we kept an eye on throughout the season. As the calendar year came to a close, we experienced a cold dry spell with associated surface hoar concerns. The storms returned in mid January, quickly burying the surface hoar layer several feet. We even had some perfect powder days during the last week of January!

Through coordination with the National Avalanche Center, we followed new guidance for the recently defined Type 2 avalanche centers. Over the years, our audience made it clear that a danger scale

was what they wanted, and we delivered that during the 20014-15 season. This season, our advisory was modified to emphasize problems without assigning a danger scale. With our large forecast area and limited forecasting resources, it makes it hard to assign accurate danger scales. Feedback from this new product has been mostly positive, although some miss the danger scale while other commenters miss the more detailed and technical condition summaries we originally published.

Special thanks to the University of Idaho and Hyperspod Sports for their support of the avalanche center through a Winter Wildlands Film Festival fundraiser in late January. We were able to present several awareness talks around the area, also thanks to the support of our many sponsors and donors. In late February we participated in the 4th annual Eastern Oregon Backcountry Festival organized through Eastern Oregon University and Anthony Lakes Mountain Resort.

Throughout the season we observed many natural slides and received reports of a couple of close calls. In early March our otherwise great winter came to tragic end when our director, Kip Rand sustained fatal injuries in a cornice fall while skiing off in the Wallows. Much has been written about this great man already, see page 6 of this TAR for more on Kip, and the support from the avalanche center community throughout this ordeal has been amazing. We received so much help, support, and encouragement from so many people all over the country. Thank You!

—Julian Pridmore-Brown



IDAHO PANHANDLE AVALANCHE CENTER

An active Pacific winter weather pattern began with multiple light storms in early November. By the end of the month Northern Idaho had a good covering of snow but colder temperatures resulted in a less dense base. The CPC prediction of El Niño conditions had many winter enthusiasts depressed about a repeat of the deplorable winter of 2015. The difference that had me optimistic was that this El Niño was predicted to be strong, and strong El Niño's in the past had produced some of North Idaho's legendary winters. Winter weather was quite agreeable in December, through the holidays, and into January. The temperatures stayed on the cold side, snowfall was consistent and as a result North Idaho experienced an extended period of Low avalanche hazard. Ski areas in our region were very busy during the holiday season, and although the snowpack was still a little thin, the quality was great. Then the weather changed.

Most long range forecasts predicted that El Niño conditions would influence the weather pattern after mid-January. Almost right on cue, El Niño swept in from stage left. After several weeks of consistently calm weather a strong Pacific front rolled in on a Tuesday evening. On Wednesday it was still snowing heavily. A group of skiers from Spokane, Washington was skiing at Lookout Pass when they left the ski area for the backcountry in St. Regis Basin. What happened out of bounds was an epic story of survival when one skier triggered a large avalanche and was swept 400 feet down a convex slope. On that day, January 13th, I got in from the field at 3PM. As soon as I walked to my desk the phone rang and one of our forecasters informed me about the avalanche accident that was unfolding in the Basin. I spent the



IDAHO PANHANDLE: I got to ride a snowbike for the first time. Timbersled, a Sandpoint based company sold to Polaris. Photo courtesy IPAC



IDAHO PANHANDLE: At a January avy class Eric Morgan leads the Border Patrolmen in a shovel conveyor race to the probe demonstration. Everything was a competition with these guys. Photo courtesy IPAC

next two hours stuck to the phone with forecasters, rangers, reporters, and weather service. Luckily the victim used a Spot device that alerted Two Bear Air out of Whitefish, Montana. At 5PM the Superior District Ranger called and informed me that the helicopter had yet to recover anyone. In the dark and under heavy snowfall the pilot recovered two of the three skiers, the last had to ski out of the valley. The victim likely would have died from a compound femur fracture that day but survived because of an ABS airbag, competent friends, and one badass pilot.

But what about fun stuff, you ask? IPAC partnered with Panhandle Backcountry (P-B) to teach an avalanche workshop for SheJumps, an organization focused on increasing female participation in outdoor activities. One hundred women attended the fun evening event at Gonzaga University in Spokane. Another tag team with P-B in Spokane was the Snowlander Snowshow. This is our third year checking out skis, talking with ski area reps, and talking avy safety with the public while drinking micros. Pit Day with P-B happened at Lookout Pass ski area to target the Coeur d'Alene and Spokane areas. The director of Lookout Pass was supportive of the event and gave us the upstairs bar to conduct the classroom portion of the day, then we headed out. IPAC also coordinated an avalanche awareness class for the US Border Patrol and we partnered with Idaho Parks and Recreation for several snowmobile classes.

An early season bonus was traveling to Revelstoke to attend the preseason workshop with Avalanche Canada. All were very gracious in sharing their knowledge about their operation and the local watering holes. It was a learning experience meeting with Laura Adams, Karl Klassen, and Roger Atkins. Thanks to NAC and FIPAC for that opportunity!

The Friends of IPAC awarded the third Doug Abromeit Avalanche Scholarship to Danielle Crow. The 21-year-old Crow wrote a very inspiring essay and she is motivated to become a role model for women in backcountry skiing and mountaineering. She attended



PAYETTE: PAC Avalanche Specialists Dave Bingaman and George Halcom surveying the scene one day after fatal avalanche at Twin Lakes. One snowmobiler caught and buried for over 20 minutes. Photo Kent May

an AIARE level 1 class on Mount Baker in March. FI-PAC President Scott Rulander began work on our operational and instructional videos. IPAC will be working with Scott to finish the filming this winter and have videos edited this spring/summer.

Dan Frigard led IPAC's Know Before You Go (KBYG) outreach to over 300 kids. Dan not only presented the KBYG message but also got kids up to Lookout Pass and Mt. Spokane State Park more than once for a lesson on Snotel sites, snowpit investigations, crystal ID, and avalanche transceiver practice. This is Dan's last year with the Forest Service and IPAC and we wish him many more years of skiing in the mountains. Thanks Dan!

Once again, IPAC concluded the season with the class for the Spokane Mountaineers Mountain School and Scott Rulander came along to do some filming. This was our sixth season in a row helping with the Mountain School program. Some additional great news, IPAC received a RAC grant for \$40,000 dollars to fund a director. I won't say that this is my last year as the director because you never know how things are going to go. With luck, I will be back next year as a certified avalanche instructor and will focus on providing level 1 avalanche classes for our community.

El Niño conditions brought much rain and as a result we began to lose low elevation snowpack very this year. I feel like we barely scraped by with snow on the peaks during the warming trends and we just made it to an average snowpack at most Snotel sites. A warmer spring is depleting our snowpack sooner and in early May SWE percentages are only ½ to ¾ of median values. Excuse me while I get out for the last turns of the season and imagine the big La Niña brewing for next winter!

—Kevin Davis



PAYETTE AVALANCHE CENTER

“It used to snow like this all the time.”

That statement that resonated through lift lines, snowmobile parking lots, and Nordic ski centers around the West Central Mountains of Idaho throughout the winter of 15-16. It was always said with a skosh of hesitance, because no one wanted to jinx what was shaping up to be a great snow year.

Weather and Snowpack

What started out as a fairly dry fall with fantastic mountain biking, ended abruptly at the end of October with our first real snow that stuck in the high country. On November 1st we got the first reports of people attempting to slide on a rock/grass/snow mixture on the well-manicured slopes of Brundage Mountain Resort. We received 30 inches of snow in the month of November, which fell in mostly small increments every other day. The month ended with some good ski days, and basal facets that we hoped would not plague us through the winter.

Not to be outdone by its predecessor, December proved to be the month of powder skiing, the burying of stumps allowing more snowmobiling off groomed trails, and learning a new website for the PAC staff. By month's end the advisory area had picked up 125 inches of snow at 6,000 feet with much more in the higher elevations. The PAC issued the first advisory of the season on December 12th, shortly after a drenching warm and wet storm soaked the snowpack all the way into the upper el-

evations, putting the basal facet concern to bed. The onslaught of storms ended at the end of December, and we rang in the New Year with the development of widespread surface hoar and near surface facets from nearly two weeks of clear and cold conditions.

January's cold and clear weather brought our first LOW danger ratings of the winter, the low avalanche danger was fun while it lasted. January 14th was the beginning of a series of storms that would bring wind, snow, and CONSIDERABLE avalanche danger for almost two weeks. Through the month of January we tracked what was now referred to as our 'New Year's Surface Hoar' (NYSH). Fortunately the NYSH became harder to find and less reactive as it got buried under a meter of snow by month's end in most areas. Some isolated areas of the NYSH persisted on northerly aspects around 7,000 feet and would remain intact and reactive through the end of March. On January 31st the NYSH was the culprit in an unfortunate fatality of a snowmobiler in the PAC advisory area. The individual triggered a slab avalanche while climbing a steep chute above Twin Lakes, which is a popular destination for snowmobile assisted skiers, and snowmobilers alike. For a full report of this unfortunate accident: payetteavalanche.org/sun-01312016-1300-twin-lakes-avalanche-fatality.

February brought the warm up that nobody wanted, except if you are an avalanche specialist wanting to stop your incessant discussion of a buried surface hoar layer. Finally after almost two months of warning our readers, on February 25th we took the persistent slab problem (NYSH that was responsible for January 31st fatality) out of our forecast.

March started off with rain to 8,000 feet. Despite the almost complete saturation of the snowpack, the intact NYSH was still found buried at 1.5 m down in a few isolated areas. March produced some great cold, spring powder days followed by rapid warmups into the mid 50's. Skiers and sledgers experienced some blower days that didn't last much more than 24 hours. Was this the end of winter? Should we get our bikes tuned up or make plans to go ski somewhere else?

Much like our low elevation snowpack, our funding melted away, and seven day a week advisories ended on March 26th.

Education and Outreach

PAC started the season off with 12 scheduled avalanche education events. By winter's end PAC Avalanche Specialists were able to reach members of the community through 16 avalanche awareness classes. Our audiences ranged from 'Know Before You Go' for middle school science classes, local graduate students, Idaho Power Lineman, 'Sleducation', Women's only avalanche awareness, and partnering with McCall Fire and Rescue to teach basics of avalanches and rescue fundamentals for the rescuer. All in all, we were able to reach nearly 250 people through the season.

Our audience and user group has continued to evolve. With the word slowly getting out amongst the motorized community about the deep snow and unlimited riding potential of the mountains around McCall, this winter local snowmobile parking lots were packed throughout the season and overflowing on weekends and holidays with many of the vehicles sporting out of state license plates. Our 'Sleducation' classes continue to have fewer participants than we would like despite the growing numbers of motorized users and more close calls in that user group. Conversely though, the PAC received more reports and avalanche observations from motorized



FLATHEAD: Large slab avalanche in the Swan Range that was presumed to be triggered by a cornice fall and stepped down to deeper weak layers 2.5 to 3 feet from the surface. Photo Michael Reavis

users this winter than from any other group. Snow-bike conversions also made a big debut this winter in the PAC advisory area. With the growth of this user group we also found a huge gap in our education and outreach efforts that we hope to address better next winter.

—Kent May, Dave Bingaman, and George Halcom



FLATHEAD AVALANCHE CENTER

Average. Average is good in the context of snowfall. While above average is certainly more welcome, we will certainly take an average snowpack year. This year's much hyped El Niño delivered an average amount of snowfall, but rang true in its promise of above average temperatures. On the programmatic end of operations the Flathead Avalanche Center (FAC) and the Flathead National Forest realized a long-term goal this year by issuing daily (7 days/week) avalanche advisories with a full-time staff of three avalanche specialists. We began issuing public avalanche information on October 28, 2015, and finished with our last advisory of the season on April 11, 2016. The FAC advisory area consists of portions of the Swan Range, Flathead Range, Lewis Range (southern Glacier National Park), Apgar Range (Glacier National Park), and the Whitefish Range. The season's funding and resources for FAC allowed for daily advisories and numerous education classes including free avalanche awareness, Introduction to Avalanche courses, companion rescue courses, and avalanche basics for school-aged students throughout Flathead Valley. Avalanche information product season totals:

- Pre-season avalanche information updates (beginning on October 28) = 10
- Daily avalanche advisories (December 9-April 11) = 125
- avalanche classes that reached 882 students
- 8 motorized specific classes
- Reached 346 students under 18 in collaboration with Flathead NF Winter Recreation Education program

The operational success of this year would have been unattainable without the collaboration and support of our valuable partnerships. First, the Friends of the Flathead Avalanche Center (FOFAC)

provided both financial and in-kind support this year beginning with the wildly successful Northern Rockies Snow and Avalanche Workshop in Whitefish, MT. FOFAC volunteers also assisted with numerous education events throughout northwestern Montana. Another extremely valuable partner this year was Glacier National Park (GNP). GNP provided financial assistance, and also contributed numerous field observations from their skilled team of park rangers. Flathead Valley Community College also aided our operations by supporting our Introduction to Avalanche classes, including Ladies Only classes. Finally, we always appreciate the continued support of Ted Steiner of Hamre and Associates/BNSF Avalanche Safety and of Whitefish Mountain Resort Ski Patrol for the valuable professional partnerships. Unfortunately, there are far too many others we'd like to list in this short amount of space, so we extend our gratitude to the entire community for your support.

As mentioned, precipitation hovered just above and below average at most locations through the entire season. However, temperatures at all remote mountain stations reported warmer than average temperatures for December through April and for every individual month (for each period of record).

November/December: The typical start to winter was again a bit sluggish with the first real storm arriving around Thanksgiving.

On December 9, a wet storm truly kicked off winter by depositing 1.5-3.0 inches of precipitation on top of a weak and shallow early season snowpack. Snow levels hovered around 6000 feet and a widespread natural avalanche cycle ensued. The first avalanche warning of the season was issued above 6000 feet. Toward the end of the month precipitation continued. The Swan Range was favored with this flow, and over a period of five days, the Swan Range picked up over five inches of snow water equivalent.

January: The first week in January brought high pressure to the advisory area with upper elevations flirting around the freezing mark. The typical "Juneary" pattern lasted for about 10 days. Weak layers such as surface hoar and near surface facets formed at and near the top of the snowpack. Then, the proverbial fire hose pointed back toward the Swan Range and the area picked up 3.2 inches of snow water equivalent in 24 hours and a storm total of 5.4 inches in three days with over 45 inches of new snow. This new snow fell on a widespread layer of freshly

buried surface hoar and a freezing rain crust. The second avalanche warning of the season was issued for the Swan Range. Other parts of the advisory area did not receive as much, but both natural and human triggered avalanches were reported throughout the advisory area. After the storm ceased, the weather remained unsettled with 5-10 inches of new snow about every 3rd or 4th day. Unfortunately, an avalanche fatality (snowmobiler) occurred on Saturday, January 23, 2016 in the Swede Creek area in the Whitefish Range, MT. One rider was partially buried up to his neck, and another rider was fully buried and subsequently died.

February: Buried surface hoar and near surface facets were spotty in distribution, but remained problematic for backcountry travelers. This variability led to avalanches that propagated far and wide in numerous, but not all, locations. Backcountry users were forced to use conservative decision-making and careful terrain selection during this time. We issued the second avalanche warning of the season on February 15 due to a potent storm depositing over 20 inches of new snow in 24 hours accompanied by strong winds on top of this variable snowpack. The rest of the month was a fairly continuous stream of storms with moderate to strong winds keeping the danger elevated at the upper elevations.

March: Warm temperatures but sporadic storms created a mix of days with good stability interspersed with storm days. By this time in the season the persistent slab problem disappeared, and wind and storm slab avalanches were the main problems throughout the month. Later in the month, spring emerged in full force and a widespread wet, loose avalanche cycle occurred. Glide cracks began to grow and glide avalanches also started occurring. Large cornices that formed over the course of the season began to release triggering wind slab avalanches, and even a few isolated persistent slab avalanches.

April: We issued our last advisory on April 10. A blocking ridge during the month of April created unseasonably warm temperatures. The snowpack made a rather early and quick transition to a wet, spring snowpack throughout. Large glide avalanches occurred in Glacier National Park just outside the advisory area in the first week of April. Observations in the actual advisory area were sparse, but similar activity was observed by those holding on to winter.

Finally, we'd like to express our sincerest gratitude to Becky Smith-Powell of the Flathead National Forest. Becky retired in June, and she has been the primary driver for turning FAC into an avalanche center that supports the community and produces high quality information. Her tireless work to help secure support for FAC and provide a solid avalanche center is unparalleled. Thank you, Becky, for all of your efforts. We greatly appreciate it, and you will be missed.

—Erich Peitzsch



FLATHEAD: A glide avalanche and a wide (~1500 feet) avalanche occurred on the same slope on Heavens Peak in Glacier National Park in early April. Photo Going-to-the-Sun Road Avalanche Program



SAWTOOTH NATIONAL FOREST AVALANCHE CENTER

Thanks to the vision and hard work of Butch Harper, Doug Abromeit, Janet Kellam, and others, the Sawtooth Avalanche Center celebrated its 25th anniversary last winter. The SAC welcomed two new forecasters, Ethan Davis and Matt Wieland, to the team as Scott Savage returned for his fourth season (second as Director). Daily Avalanche Advisories began with an Avalanche Warning on December 8th – talk about kicking it into HIGH gear! December dropped 80-110” at mid-elevations across the advisory area, prompting seven days of HIGH danger and all four of our Avalanche Warnings. Fortunately, tracking storm totals in the Sawtooth and Western Smoky Mountains was a little easier thanks to off-season work installing three new remote weather stations. A dry spell to start 2016 formed a persistent weak layer of surface hoar and facets that would keep us on our toes into February. Record setting high-pressure and warm temperatures in mid-February initiated a wet avalanche cycle that sent slides across two roads near Ketchum. In March, a 30-60” storm brought “all-time” powder conditions – so deep it was barely skiable on slopes under 35°. As the slab settled and wind kicked up, we had one of our most significant slab avalanche cycles of the season. By late March, spring had arrived with authority along with the requisite wet avalanches and corn cycles to round out the season.

On December 14, 2015 a skier was caught, carried, and critically buried on Bald Mountain in the



SAWTOOTH: Crown of the slab avalanche that critically buried a skier just outside the Sun Valley Ski Area Boundary. Photo SAC



SAWTOOTH: Sun Valley sidecountry provides a serious forecast challenge; alluring, lift-accessed powder laps in steep, consequential terrain. Photo SAC

backcountry adjacent to the Sun Valley Ski Area. The skier survived but sustained serious chest and internal injuries. This was the second accident here in the past three years. The Sun Valley sidecountry provides a serious risk-messaging and educational challenge: alluring, lift-accessed powder laps in steep, consequential terrain. As a kid, I experienced my first avalanche on Sargent’s Mountain after hiking out of nearby Brundage Mountain Ski Area. The slab broke two feet deep, sweeping my friend into a stand of trees and burying him up to his chest. Rather than hightailing it out of there, a few of us continued higher – oblivious to the hazard. How many events like these go undocumented near ski resorts in your area? I didn’t report mine, primarily because I had only a vague clue of what I experienced let alone not knowing who to report it to.

SAC staff offered a wide range of public outreach and educational events, including on-the-hill training for youth ski team athletes, a Level 1 Motorized-specific course, and professional development for local guides, forecasters, and ski patrollers. We are proud of our educational efforts aimed at motorized users and area youth and ski athletes but realize we can do more to address the “backcountry” skier or snowboarder that logs 50 days without ripping skins or starting a sled. As we gear up for the 2016-2017 season, we are investigating additional ways to communicate with and educate the diverse sidecountry user group. What programs are effective in your area? Give us a call; we’d love to hear what’s working and what isn’t in other regions.

—Ethan Davis



WEST CENTRAL MONTANA AVALANCHE CENTER

If this was an El Niño year, we’ll take it. There was plenty of snow for skiing and riding in West Central Montana this season and the West Central Montana Avalanche Center, for the first time in 15 years, did not issue a single avalanche warning. In fact, during one storm cycle, the snow was as deep and stable as I can remember in 35 years of backcountry skiing in the area.

The Avalanche Center issued three advisories a week, along with updates, from October 20 through April 9. The danger rating went to “Considerable” 12 times without ever tipping the scale to “High” and the local snowpack was measured at 100 percent of normal at the end of the season.

The Avalanche Center along with the “Friends” group, the West Central Montana Avalanche Foundation (aka missoulaavalanche.org) ran 46 classes ranging from one-hour lectures to level 1 courses. These courses reached over 1300 participants including local schools, snowmobile clubs, search and rescue organizations, University of Montana students and the general public.

This season Travis Craft and Logan King transitioned into the avalanche specialists positions for the Center. They issued most of the advisories, as well as monitoring snow conditions and teaching courses. Logan and Travis attended the National Avalanche School this past October.

Travis and Logan have strong backgrounds in ski patrolling and control work and outdoor education. We were fortunate to have a “classic mentoring” situation with these two working with Steve Karkanen and myself (Dudley Improta) for the past few years.



WEST CENTRAL MONTANA: Congratulations to Dudley Improta, hardworking avalanche specialist and co-founder of the Western Central Montana Avalanche Center, on his retirement from the Forest Service. It’s been a great pleasure working with you over the years, Dudley, from all of us at the AAA. Photo of Dudley in his office by Travis Craft.

This was my last season as an avalanche specialist and I leave knowing there is a strong core crew with Steve, Travis, and Logan.

The West Central Montana Avalanche Center is hosted on the Lolo National Forest. 16 years ago Steve Karkanen and I, along with Gene Thompson, founded the West Central Montana Avalanche Foundation (501 3c non-profit) to support the Avalanche Center. The Foundation is now doing all the “heavy lifting” financially, even though the Forest Service started the program in the 1980s. Planning and discussions with the Forest Service and the Foundation are ongoing to fund and improve the program in the future.

—Dudley Improta



GALLATIN NATIONAL FOREST AVALANCHE CENTER

It was another busy season for the GNFAC with Doug, Eric, and Alex issuing 138 daily advisories resulting in 230,000 visits to the website. The average duration of each visit was nearly two minutes. The GNFAC also made 77 videos over the course of the winter, which received over 100,000 views on Youtube. The Friends of the GNFAC taught 99 avalanche education classes to 4,690 people. The GNFAC also did 60 interviews with various media outlets around the Bozeman area.

A big change to the GNFAC this season was the replacement of long time forecaster Mark Sta-

GALLATIN: Doug Chabot rides under a slide that partially buried a snowmobiler in the Lionhead area near West Yellowstone. The slide was remotely triggered near the ridge and hit a rider waiting in the runout. The slide failed on depth hoar, which plagued the snowpack during the first half of the season. Photo GNFAC



Don't get left behind.

Snowmobiler: BCA Rep, Dwayne Paynton Photo: Thunderstruck Films



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ples with new forecaster Alex Marienthal who has a master's degree in snow science from MSU and five years of ski patrol experience at Bridger Bowl. Alex is also education coordinator for the Friends of the Avalanche Center, a near full time job in itself. He did an excellent job managing a high level of responsibility while learning the involved process of avalanche forecasting.

The winter of 2015-16 snowfall exceeded most expectations. By April 1st the snowpack around southwest Montana was near 100% of normal. This was a surprise to most as the infamous El Niño had many predicting another below average season. During the fall, talk of El Niño prompted a high number of "pray for snow" parties where a huge number of skis and boards were burned. These sacrifices were ignored by Ullr through October and November. By Thanksgiving, the mountains of southwest Montana had 1.5 to 2 feet of snow and most people feared the worst.

The dread of El Niño was exacerbated by a cold, dry spell during the first week of December. This cold snap faceted the thin snow cover and produced a well-developed layer of depth hoar. By the 7th of December two feet of faceted snow existed in the hills of southwest Montana. Backcountry skiers and riders braced for unstable conditions which became reality on the 8th of December when the first large storm impacted the area. This storm favored the mountains around Cooke City and West Yellowstone with well over a foot of snow totaling more than 1" of SWE.

While heavy snow was a welcomed change, the GNFAC issued its first avalanche warning on December 8th. Heavy snow continued and the Avalanche Center issued five more warnings in the following ten days. Sadly, the first fatality happened



GALLATIN: Depth hoar plagued the snowpack during the first half of the season in southwest Montana. This slide occurred outside of Cooke City and was snowmobile triggered. The crown ranged from 3 to 8 feet deep. Fortunately nobody was injured. Photo S. Strenge

on December 19th when a snowmobiler was killed in an avalanche outside Cooke City during an avalanche warning. Natural and human triggered avalanches occurred for ten days straight following the fatality. December proved to be a snowy month with most mountain locations receiving 5-7 inches of SWE.

December's heavy snows proved to be a blessing and a curse as snow quality improved but stability remained poor. High pressure set in during this first week of January and snow returned the second week of the month, once again bumping up the avalanche danger. The depth hoar that formed in early December remained the primary layer of concern and continued to produce avalanches. On the 19th of January a second fatality occurred when a skier died in an avalanche on Cedar Mountain in the Northern

Madison Range. The victim was a pro patroller from the Yellowstone Club with six years of patrolling experience. This accident caught everyone off guard and was a heavy blow to the skiing community.

February began with light to moderate snowfall followed by a week of high pressure from the 4th through the 11th. Temps during this time were above average, which helped the depth hoar layer gradually gain strength. However, this high pressure period formed a well-developed layer of surface hoar which was capped by subsequent storms from the 14th through the 20th. This new buried weak layer produced multiple natural and human triggered slides over the next few weeks, fortunately without incident.

By the beginning of March, the buried surface hoar layer had become less reactive. This was helpful since the big faucet in the sky once again turned

on. Most Snotel sites in southwest Montana recorded between 4-6 inches of SWE during March. The snowpack handled the new snow well and very few avalanches were reported during the last two weeks of March. During this time, both snow quality and stability were good, producing superb backcountry skiing and riding.

For better or worse, snow shut off in April when warm, dry conditions returned. The snowpack held together during the initial warm up, but strength and stability gradually deteriorated as above freezing temperatures took their toll. By the second week of the month, large wet snow avalanches were occurring across the advisory area and access was becoming difficult. This combination quickly reduced numbers of backcountry travelers, prompting the GNFAAC to issue the last daily advisory on the 10th of April.

—Eric Knoff



BRIDGER-TETON NATIONAL FOREST AVALANCHE CENTER

Western Wyoming had near normal precipitation and above normal temperatures for the second season in a row. These conditions produced a denser than average end of season snowpack. Snow began to accumulate in the mountains in late October. December and January were wetter and warmer than normal with several extended storm cycles, dry periods, and a stretch of bitterly cold weather during the holidays. February was exceptionally warm and dry. March was colder than normal. Drier conditions prevailed in April and May. Season snowfall totals exceeded 400 inches in the Teton Range, 350 inches in the Salt River Range and were just below 300 inches on Togwotee Pass.

Avalanche hazard bulletins were issued in the morning and in the evening from November 2 to April 17. Snowpack summaries were posted on a weekly basis from the end of September through May 26. The Bridger-Teton National Forest Avalanche Center also operated a website that crowd sourced snowpack and avalanche observations and provided weather forecast for the Medicine Bow National Forest in southeast Wyoming.

During this season there were 17 events when people were caught and carried by avalanches. Nine people were partially buried, four were fully buried, two were seriously injured, and four were killed. Three of those fatalities involved persons who accessed the backcountry from a ski resort boundary.

These fatalities are always tragic. On January 19 a snowboarder, riding alone in dangerous terrain south of the Jackson Hole Mountain Resort (JHMR), was partially buried and died from trauma. Five days later two out of town skiers were swept over a cliff and fully buried outside of the boundary of JHMR. Both died from trauma. On February 21 an alpine skier clicked out of his skis for a photo opportunity near the summit of Grand Targhee Ski Resort. He walked through a double roped barricade onto a cornice that overhangs a cliff area. The cornice collapsed and started an avalanche. That man also died from trauma.

A fifth fatality occurred in the Big Horn Mountains of Central Wyoming. The Big Horn Range is a six-hour drive from Jackson Hole. This event involved a snowmobiler who was thrown from his sled, hit a tree, and died of trauma. Historically there

has only been one other avalanche fatality in the Big Horn Range. That incident occurred in January 1975 and involved a backcountry skier.

Our Southwest Trails forecast area, which is comprised of the Wyoming Range, Salt River Range, and the Greys River drainage, experienced one of its most stable seasons in 38 years. Although there were some periods of instability and isolated areas of persistent instability, avalanche activity was notably limited.

The first ever Wyoming Snow and Avalanche Workshop organized by Teton County Search & Rescue was held in November. Our staff provided avalanche education courses to snowmobile guides and clubs in December and January and hosted a field session of the National Avalanche School in January. A new Recreational Trails Program grant was awarded to the Bridger-Teton Avalanche Center in February. This grant project will fund statewide avalanche education efforts during the next two seasons. It will also fund field work and weather station maintenance efforts.

Specialized web cams that were purchased in partnership with the Wyoming State Trails Program were operational on six of our automated weather stations this season. During daylight hours these web cams provided hourly images of the weather conditions in remote areas of our forecast region. These images were a huge asset to our forecasting program and were well received by the public. Images from these web cams were posted in a new section of our website with links to other local web cams.

Other projects included the development of a new snow density calculator that uses 40 seasons of daily hand measurements and historic weather data to forecast new snow density based on current weather data. An analysis of measured snow settlement rates and their potential relationship to deep slab instability is in process and will be presented at ISSW 2016.

In January one of our forecasters visited a new cat skiing operation in the Changbaishan Mountains near the North Korean border in China. This trip included visits to two other ski resorts in northeast China, one of which will host ski events during the 2022 Olympics. In May a forecaster spent several weeks in Norway visiting colleagues from the Norwegian Avalanche Forecast Center.

—Bob Comey

BRIDGER-TETON: This image was taken on May 23, 2016 on a low elevation glacier near Bergsfjord, Norway at about 70 degrees north latitude, which is well above the arctic circle. An avalanche forecaster from BTAC is assisting Norwegian avalanche forecaster Emma Barfod while conducting annual glacier measurements. These efforts used an aluminum snow auger to collect SWE totals for this season's snow accumulation on the glacier. This glacier is one of the lowest in Europe and has been the subject of annual measurement for 50 years. Photo courtesy Bob Comey



UTAH AVALANCHE CENTER

Be careful what you wish for. Last season (2014-15) had most everyone packing up their skis and sleds early after enduring disappointingly low snowfall amounts. But this season was a whole different ballgame. The snow arrived early and kept steady well into spring. Most of Utah enjoyed a fairly "normal" winter with a few weeks of cold and then otherwise seasonal temperatures.

Mark Staples, new director of the Utah Avalanche Center, was chosen to replace Bruce Tremper after a competitive search with many qualified candidates. Arriving from Bozeman, Montana, with family in tow, Mark, with snowmobile, ski, patrol, backcountry forecasting and snow science experience, has proven to be a great match for Utah's diverse recreation and avalanche issues.

The UAC worked with the CAIC, AIARE, the NAC, and Avalanche Canada, along with other avalanche centers, brands and professional video producers to overhaul the popular Know Before You Go program which was launched in the fall with a new slide deck, website and video. This collaborative effort has sparked a series of follow-up awareness projects in partnership with others. Spearheaded and produced by the Utah Avalanche Center's Craig Gordon and Trent Meisenheimer, the introductory video is nearing a half million online views. The content has been distributed to avalanche educators in 19 states and 15 countries and AIARE has added KBYG to their instructor training program. KBYG is rapidly becoming the international standard for presenting introductory avalanche awareness, building on 10 years of successful Utah experience.

In other video news, Drew Hardesty teamed up with Trent Meisenheimer to produce "Backcountry Responsibility," espousing the importance of backcountry etiquette as well as developing a culture around "Knowledge, Awareness and Wisdom."

The Utah Avalanche Center non-profit, run by Executive Director Paul Diegel, continued to be an effective partner to the USFS Utah Avalanche Center, managing and supporting avalanche education, videos, USAW, forecasting and the observers programs. Fundraising was productive with a record level of grants and business sponsorships as well as personal donations and a number of successful events. A major effort to further build board capacity to support continued growth was undertaken.

The UAC led 167 KBYG presentations in Utah, along with 26 avalanche education classes including a Level 1 for sledders, a snowbiker class, companion rescue classes, sidecountry-focused classes, and introductory backcountry classes reaching a total of about 8,700 people.

With snowfall totals near normal and interest in backcountry recreation high, forecasters throughout the state made a huge push to provide avalanche information and education opportunities to as many of the mountain regions as possible. As of April 18, 2016, Alta received total snowfall of 399", Beaver Mountain, 265", Brian Head, 273" and Sundance, 256" and overall SWE on the stakes ranged from 60-80% in the middle parts of the state to 90-100% in the far north and far southwest corners.

Like many winters past, an early season faceted layer formed at the ground, persisted and produced widespread avalanche cycles mid-winter, as well as a few isolated slides into April. Many slopes that

produced avalanches during a Solstice avalanche cycle on these facets remained thin and the facets became weaker. These slopes (repeaters) continued producing avalanches with each storm while other slopes formed a deeper and stronger snowpack. The persistent slab problem transitioned to a deep slab problem and UAC forecasters were faced with the dilemma of how to communicate the nature of this tricky avalanche problem to the public. Amid the many days of excellent powder, there were 82 unintentionally triggered avalanches reported with 51 people caught, six injured and two killed.

Fatality: Gobblers Knob, Big Cottonwood Canyon, January 21st, 2016.

Two backcountry skiers (one guide and one client) triggered and were caught in an avalanche, with one carried over 1000' vertical, fully buried and killed. The slide released on a thin layer of facets that developed below a crust over the previous 2 weeks. An avalanche warning was in effect at the time.

Fatality: Park City ridgeline, near Pointy Peak, January 31st, 2016.

The second fatality of the season occurred when a solo, out-of-bounds skier triggered a slide failing on the basal facets in a shallower snowpack area. He was completely buried and, without a witness, search and rescue operations were prolonged.

Avalanches caught and injured numerous avalanche professionals including a UAC forecaster who was caught in a repeater avalanche path. The snowpack was tricky for a while and even the best learned some hard lessons.

Amidst the normal chaos of the season, the Salt Lake forecast team of Mark Staples, Drew Hardesty and Evelyn Lees welcomed long-time observer Greg Gagne as a part-time but completely invaluable interim forecaster to help balance out the load.

Central Utah

The Utah Avalanche Center expanded operations into central Utah with Brett Kobernik moving to the Sanpete Valley and tackling forecasting and education responsibilities on the Manti Skyline. He doubled the number of weekend advisories from the previous year and added 100 mid-week as well. Brett gave a number of avalanche talks, performed field education sessions and focused on connecting with regional SAR teams.

Moab

The La Sal Mountains had a banner year; significant snowfall, great riding conditions, an increase in use and a full education schedule kept lone forecaster Eric Trenbeath hopping. Due to the frequent and continual storms, Trenbeath posted an average of four advisories a week, totaling over 100 for the season. He also posted weekend advisories for the Abajo Mountains 50 miles to the south.

Snowfall started the first week of November and didn't let up until the first week of February, when the snowpack totaled 180% of normal. Two large natural avalanche cycles occurred, including one on December 26 that produced widespread activity on all aspects with fractures four to seven feet deep.

Logan

The Logan satellite office, staffed by forecaster Toby Weed and outreach and education specialist Paige Pagnucco, dealt with avalanches right from the get go. Remote-triggered avalanches were fairly common in the early season and an experienced and educated local snowboarder got caught, carried and buried suffering moderate injuries. Hard-slab ava-



UTAH: The crown of one of two adjacent avalanches that occurred March 17 and 18 in the Logan area mountains. The one pictured here was triggered by a snowmobile and buried four riders, who all survived. The other avalanche (March 17) is just out of the picture to the left and was also triggered by a snowmobile, partially burying one rider. Photo Paige Pagnucco

lanches buried one lucky rider who was rescued and sustained only minor injuries as well as another rider near Logan Peak. A February wet cycle made life exciting as loose wet avalanches slammed Hwy. 89 and the Logan River Trail. A local fisherman reported being way too close to a large, natural wet avalanche while looking for trout. March had a few close calls involving multiple riders and airbag deployments.

Uintas

The Uinta satellite office, staffed by forecaster Craig Gordon and Trent Meisenheimer, cruised through the season with only one significant avalanche accident. At the end of January, one snowmobiler triggered and was caught, carried, and buried four feet deep by a large hard slab avalanche near Currant Creek. Lucky for him, his brother managed to clear his head in under three minutes and he amazingly suffered no injuries.

Partnerships were key to the western Uinta advisory program and both the Heber-Kamas and Evanston USFS Ranger Districts were instrumental in supplying field partners and in-kind support to the avalanche center. Park City Powder Cats, Tri-City Performance, Polaris, Weller's Recreation and BRP/Ski-doo were invaluable with their generous donations of high-end sleds that allowed forecasters to visit more terrain and issue more accurate advisories.

—Paige Pagnucco



COLORADO: Clearing debris from a skier-triggered avalanche that hit US 550 and closed the road for over 7 hours. Photo Jeff Davis



COLORADO AVALANCHE INFORMATION CENTER

Colorado's 2015-16 avalanche season had uncharacteristic periods of good stability punctuated by a few large storms and avalanche cycles. In three of the ten forecast zones, the CAIC never issued a HIGH (4) danger rating. The much-hyped El Niño produced a snowy season for Colorado despite a short mid-winter drought. We stayed near or above historic average snowfall for most of the state throughout the season.

During the 2015-16 avalanche season there were approximately 2500 avalanches reported to the Colorado Avalanche Information Center (CAIC). We documented 29 incidents, with 35 people caught and 4 killed, all below seasonal medians. The four fatal accidents occurred over three weeks from mid January to early February, mirroring a nationwide spike in accidents during that same period. Three of the victims were not wearing transceivers. Three of the victims were motorized users, including the first snowbike fatality in Colorado. The fourth victim was a climber.

Snowfall started in late October, and the first reported avalanche of the season occurred on October 23. A series of storms followed, including one major storm with up to a meter of snowfall in the first week of November. Ample early season snow and plenty of wind created layers of hard slabs by the second half of November.

The winter's first avalanche incident occurred November 21, at the end of a five-day storm cycle. A solo backcountry tourer was descending Bald Mountain near Breckenridge. He triggered and was caught in a very large avalanche (HS-ASu-R3-D3-G) that broke up to 4.5 m deep. The skier broke both legs, and finally got his call connected to 911 on his twenty-second attempt, just before nightfall. This would not be the last close call of the season.

Layers of faceted crystals formed during dry weather in early December, which set the stage for

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the first major avalanche cycle. A pair of vigorous storms the week before Christmas brought heavy snow and strong winds to the whole state. Parts of the Central and Southern Mountains picked up 1.2 to 1.5 m of snow and 100 mm of snow water equivalent, resulting in a widespread avalanche cycle. At least five people were caught, including a ski patroller doing avalanche mitigation work, and three partially buried. Fortunately, there were no major injuries or fatalities.

The next powerful winter storm began January 15. On January 16, an avalanche (HS-U-R3-D2.5-O) caught a solo climber and buried him in a lake below St Mary's Glacier, northwest of Idaho Springs. Continued avalanche danger and the lack of a transceiver delayed locating the victim. He was located a week after the accident by a search dog team. On January 21, the second avalanche fatality of the season occurred west of Crested Butte, when a snowmobiler triggered an avalanche (SS-AMu-R3-D2-O). Over the following four days, six more people were caught in avalanches and one was seriously injured.

Another potent winter storm began January 30. By February 2, storm totals approached 1 m of snow and 100 mm of water. As the storm began to clear on February 2, the third avalanche fatality occurred near Wolf Creek Pass. A snowmobiler triggered an avalanche and was buried in a gully (SS-AMu-R3-D2-O). The victim was riding with partners, but was not wearing a transceiver. Three days later on February 5, a solo motorized snowbiker triggered and was killed in an avalanche (SS-AV-R2D2-O) near Cottonwood Pass, west of Buena Vista. The victim was not wearing a transceiver.

The weather dried out for a bit in the second week of February. As conditions stabilized, backcountry riders pushed into bigger and more consequential terrain. The first major warm period occurred in the Southern Mountains. February 12 was the warmest day of season so far, and ridgeline temperatures were above freezing by noon on February 13. That day a backcountry tourer triggered a large avalanche in a path that threatens US 550 over Red Mountain Pass. The avalanche initiated in dry snow in the starting zone, but gouged into wet snow at lower elevations. The skier took a scary ride, but avoided injury. The avalanche buried both lanes of US 550 with debris twelve to fifteen feet deep over 270 linear feet,

closing the road for over seven hours. This incident served as a stark reminder that backcountry recreation increasingly has the potential to impact assets outside the backcountry.

Towards the end of February, a significant wind event deposited a layer of dust on the snow surface in the southern two-thirds of the state. Snowfall buried the dust layer on March 6. This interface continued to produce avalanche activity with loading events throughout March. Several storms during the last week of March resulted in numerous and close calls, but fortunately no serious injuries.

April began with a long period of warm temperatures, but wet avalanche activity was mostly small and

COLORADO: Climber triggered avalanche near St. Mary's glacier. Note the ripple waves frozen into the lake surface.
Photo Scott Toepfer



intermittent. An unsettled weather pattern returned in late April and continued into May. The cold and snowy May pushed snowpack depths to well above median by early June in all but the southwest corner of the state. The late spring warm-up came in ebbs and flows, and allowed the snowpack to ease into “summer” conditions without a widespread wet slab avalanche cycle.

On the education front, the CAIC and Friends of CAIC implemented the updated Know Before You Go program statewide with great success. Combined with our other educational programs, CAIC staff and trained instructors across the state conducted around 200 education events and reached approximately 11,000 students. We look forward to improving and expanding these programs for next season.

—Brian Lazar



**CRESTED BUTTE
AVALANCHE
CENTER**

The 2015-16 winter season in Crested Butte, Colorado was highlighted by two major storms and avalanche cycles, repeat offenders plaguing our snowpack, and some unusual and challenging persistent weak layers. Our forecast center made dramatic improvements this year: we brought on our first full-time forecaster/director since the center opened in 2002. Forecaster field days increased by 30%, fieldwork media content (videos, profiles, and photos) on our website quadrupled, both our social media content and audience doubled, and attendance at outreach events and our fundraising both increased by roughly 30%.

Avalanche season kicked off on November 7, 2015, when a pair of skiers triggered a large slab avalanche on Mt. Baldy. A series of small storms and long dry spells into December established our classic early season snowpack: shallow, faceted, and ready for show time. The Christmas storm cycle seems to be a recurring pattern here in Crested Butte, consistently adding an overwhelming layer of water-laden stress to the holiday season. This year’s storm landed on December 21, and doubled or tripled our snowpack by the time it exited the day after Christmas. Although we didn’t quite reach the volume for full track avalanches, the extent of avalanching was the most impressive I’ve seen in my five years here. Dry conditions returned for the next few weeks, and while booming collapses on low angle terrain continued to rattle the nerves of travelers and our forecast team, it became increasingly clear that most paths had flushed full width or in a big way during our “Christmass cycle”. It was also painfully obvious that our low angle snowpack assessments for the rest of the season would hold little value in comparison to most of our start zones which were now shallow and becoming exceptionally weak and faceted again once again.

The next load began to arrive mid January, but only for our favored snowbelt. The Ruby Range picked up over five feet of snow between January 14 and 21, while most of our forecast zone accumulated less than a foot. Although the danger wasn’t as blatantly obvious as the Christmass cycle, incremental snowfall and northwest windloading were building another round of slabs onto leeward slopes where a tricky facet/crust combination lurked from our early January dry spell. On the



CRESTED BUTTE: 2/1/16. CBAC forecaster Zach Guy investigates a slide remotely triggered on a layer of surface hoar at the culmination of a major storm that ended on February 1st. Coincidentally, our forecasts took on the theme of the movie Groundhog’s Day for the next couple weeks, given these tricky persistent weak layers. But unlike Bill Murray’s character, who quickly develops expertise with each passing day to improve his situation, our Crested Butte snowpack doesn’t give travelers the same kind of direct feedback on each slope or on a regular basis. *Photo Ian Havlick*

first clear day after the storm, a group of six locals opted to forego a tour into bigger terrain given the dangerous snowpack conditions. Instead, they picked a seemingly safer alternative to build and session a jump in some small rolling terrain. Two members remotely triggered a three-foot persistent slab on the slope above them while snowmobiling to the jump. Sadly, one of the riders was caught and buried deeply near some trees. Despite efforts from their group and Irwin Guides, the rescue was unsuccessful. We share our deepest condolences with friends and families involved.

It usually takes the jet stream and big Pacific moisture to line up overhead to deliver a knock-out storm for the rest of our zone which doesn’t do as well orographically. Those stars aligned at the end of the month, with 3+ feet of snow (2.5”+ SWE) arriving between January 31 and February 1 across our whole forecast area. The combination of shallow, rotten start zones from our Christmas cycle and facet/crust/surface hoar combinations from sunny weather in January stood no chance, and we saw yet another widespread persistent slab cycle with hundreds of repeat offenders and im-



CRESTED BUTTE: 1/21/16. The crown of the avalanche that took the life of a local near Ruby Peak. The slide was remotely triggered from below the slope by two snowmobilers riding abreast, and one of the riders was buried deeply near a tree well. *Photo Dave Kozlowski/ Irwin Guides*

pressive crowns littering the landscape once again (Figures 3 and 4).

Four weeks of mostly dry and unusually warm weather carried us through February and into the first week of March. A record setting wind event on February 18 flattened hundreds of trees and brought a layer of desert dust with it. Scarp Ridge hit 117 mph, and nearby Monarch Pass recorded the highest wind speeds ever measured in Colorado, at 148 mph. After two weeks of low avalanche danger, we finally waved goodbye to the dominant high pressure ridge on March 7th, and a series of three progressively stronger storms arrived on weekly intervals through the rest of the month. The dust layer marked the boundary of our month-long dry spell, and this dust/facet/crust combination continued to plague us through the month on shady aspects (Figure 5). With each storm, we saw a handful of slabs failing on that layer, and these slabs became increasingly larger and more unpredictable with each storm. In the last few days of March, there were two close calls involving this dusty persistent weak layer. The first was a skier caught and partially buried on Schuykill Ridge, a slope with dozens of previous tracks that week. The second was a snowboarder who triggered a large slab low in the Climax Chutes but rode off of it before significant debris ran over a large cliff band.

Warm, spring weather arrived in April, and multiple nights without refreezing spurred a wet avalanche cycle at lower elevations around April 10th. We published our last daily advisory on April 17, but El Niño continued to bring wet weather into May. As always, the CBAC optimistically but unrealistically looks forward to a deep and stable snowpack next year.

—Zach Guy



**MOUNT SHASTA
AVALANCHE
CENTER**

The winter season wrapped up for the US Forest Service, Mount Shasta Avalanche Center (MSAC) with the region sitting just above normal (101%) for precipitation received during the wet season, October 1 to the end of April. Considering that the last three winters were all well below normal, this was a refreshing change of pace for the north state. While California continues to suffer drought conditions, the winter provided us with some reprieve. A drive past Shasta Lake and a look at the infringed high water mark is testament to the generous amounts of snow and rain the 2015-2016 winter delivered.

December and January delivered heaps of snow for all forms of winter recreation. February brought a lull in the stormy weather with sunshine and above normal temperatures. A “Miracle” March followed with almost two straight weeks of heavy rain and snow. We finished off the month with sun heralding in the spring season only to be followed by a short wintery regression near the end of April.

The Mount Shasta Avalanche Center was able to bump up the number of days that it provides a forecast from three to seven days a week. Of all the feedback the avalanche center received, this was the number one request, and we are proud to have delivered. Information and danger warnings about the current avalanche conditions, mountain weath-



MT. SHASTA: A gorgeous aerial photo from the window of his son's personal plane, late February. *Photo Jimmy Williams*

er forecasts, and current climbing conditions were made available each and every day this winter on our website www.shastaavalanche.org and advisory hotline (530-926-9613).

The Mt Shasta Avalanche Center's avalanche forecast area comprises about a 60-square-mile area, including Mt Shasta, the McCloud area east of the mountain, and the Castle Lake/Mt Eddy ranges west of Interstate 5. The past couple winters have only provided snow for upper elevations of our forecast area, mainly just Mt Shasta. Other normal zones did not have enough snow for avalanche danger to be a concern. However, this season, lower snow levels and a wet El Niño winter provided snow to the entire forecast area. With all terrain in play, this kept two of us hopping to provide observations and isolating avalanche problems to different local micro climates. Mount Shasta, the mountain itself, could almost host a stand-alone forecast!

The MSAC continues to maintain their fleet of four weather stations. Two new weather station projects east of Mt. Shasta, on Ash Creek Butte, continued this year. The snow depth station, below tree line, is functioning well. Unfortunately, riming, heavy wind and other issues will keep the wind station in the execution stage for next year.

Frequent snowfall, wind, and rapid temperature fluctuations all contributed to periods of instability in the snowpack this season. Fortunately, most of the avalanches we observed or reported were naturally triggered and nobody was caught or killed. The majority of our avalanche activity occurred during or immediately after storms. Stormy December and January months saw frequent small to medium sized slides that occurred both naturally and human triggered. We did not see any large scale avalanches this season until March arrived with its consistently large storms. When the clouds broke between systems on March 7th, the remnants of a wind/storm slab avalanche with a crown over a half mile in width was visible on the southeast aspect of Casaval Ridge on Mt Shasta.

The Mount Shasta Avalanche Center's educational component continued by providing four Basic Avalanche Awareness and Companion Rescue clinics, free of charge, on the first Friday and Saturday of each month, December through March. We had record attendance for the January clinics with close to 40 people participating. The MSAC added similar presentations and clinics this season in Ashland,

Oregon as well as at Crater Lake National Park. Further, the MSAC held a free, one full day, snowmobile specific avalanche awareness and companion rescue workshop.

The FRIENDS of The Mt Shasta Avalanche Center (FMSAC) is essential to the operation of the MSAC. They continue to provide funding, effort, and equipment towards sustaining the Shasta Trinity National Forest Mount Shasta

Avalanche Center. The FMSAC has been in solid hands with Justi Hansen in her second year as the executive director. The FMSAC strives to maintain a central hub for dependable information used to make smart decisions in the backcountry by making avalanche safety training opportunities accessible to everyone. The non-profit Friends organized several fundraising events this season that continued to bring our community of backcountry users together to celebrate and support a common purpose. The events included several movie nights, the awesome and exciting 3rd annual Mt Shasta Ascension backcountry ski and split board race and the always popular 14th Annual Snow Ball party that brought in record profits. The Mt Shasta Ascension backcountry ski and split board race, held at the Mt Shasta Ski Park, had near record attendance and perfect conditions for what has become a local's favorite event. The evening of race day participants and community alike got to enjoy food, beverages, and great live music at the 14th annual Snow Ball, held at the city park. The bands and community blew the doors off the place that night! The FMSAC truly represents the soul of adventure and passion for backcountry mountain recreation in the greater Mount Shasta area.

MT. SHASTA: This day in mid-December was purely magic, the clearing of the storm. I have never experienced such amazing light. I battled between just enjoying the moment and snapping a ton of pictures! *Photo Nick Meyers*



The Mt Shasta Avalanche Center's central mission is to enrich the Mount Shasta Area backcountry experience by providing professional forecasting, real-time information, and avalanche safety training. The MSAC is approaching 20 years since the center began operations and is chugging along for many more to come!

Snow Safety...Information...Knowledge...Community...Stoke! Thank You!

—Nick Meyers



TAHOE NATIONAL FOREST SIERRA AVALANCHE CENTER

Buried Surface Hoar in the Sierra and exciting new hires at the Tahoe National Forest Sierra Avalanche Center

The 2015–2016 winter season started off right with the fall hiring of Steve Reynaud in a new third forecaster position behind returning Director/Lead Forecaster Brandon Schwartz and Forecaster Andy Anderson. David Reichel was hired as a professional field observer along with returning professional observer Travis Feist. With these additions to the team, the Tahoe National Forest Sierra Avalanche Center began the winter more prepared than ever. From being able to present more outreach talks to collecting significantly more observations in an unusual winter the benefits of having more staff became abundantly clear as the season unfolded.

Buried surface hoar represented one of those unusual features of this winter. Surface hoar forms on a regular basis within the Greater Lake Tahoe area. Over 99% of the time it is destroyed prior to burial under new snow by gale force winds and warming air temperatures prior to the onset of snowfall. During the winters of 2003–2004 through 2014–2015 (the past 12 seasons) surface hoar became a buried weak layer within the TNF/SAC forecast area on a total of three occasions. Each time the associated avalanche cycle was short lived as large Sierra snowfall events quickly overwhelmed the weak layer and cleaned it out within 48 hours.

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During December 2015 and January 2016 (this winter), surface hoar was buried four times within the forecast area. The December layer acted similar to those of the past decade and was quickly wiped out. The January layers were different, loaded much more slowly and no significant pre-storm wind destroyed them. The associated storm cycles were atypical in that they were small by local standards, coming in with little wind and deposited less than 30 cm of storm snow in each event.

The Jan 5, Jan 9, and Jan 13 buried surface hoar layers contributed to a widespread, two-week-long January avalanche cycle. This avalanche cycle accounted for 7 of the 15 reported incidents this season of individuals caught in avalanches. Of these seven, one was a live recovery of a fully buried victim and one was a full burial asphyxia fatality. Numerous stories of additional close calls and partial burials reached the forecaster's ears, but were never officially reported to the avalanche center. Unfortunately these stories had to be treated as rumors and were not included in the official record keeping.

During this avalanche cycle the TNF/SAC forecasters worked hard on messaging. Advisory wording targeted those with very Sierra-centric experiences who were not used to managing persistent slabs associated with buried surface hoar. Many local backcountry users had never experienced these conditions, having previously managed only wind slabs, storm slabs, and periodic persistent slabs associated with near crust facets.

Once the January surface hoar avalanche cycle came to an end, the forecast area enjoyed the return of near average snowfall, a welcome event after the past four drought years.

Fundraising and TNF-SAC partnership success

The winter of 2015-2016 once again exhibited the fundraising and management strengths of the not-for-profit Sierra Avalanche Center (SAC) in partnership with the Tahoe National Forest. The proven business plan between these two organizations goes beyond typical Friends Group support with the SAC Board of Directors providing 75 percent of the avalanche

TAHOE: Pit wall with the Jan 5 SH layer visible and the soon to be buried and named Jan 9 SH layer on the surface. Photo Brandon Schwartz



center's total operating costs this past season. This ever-evolving relationship, executed through an annual operating plan and collection agreement, allows the SAC to collaborate with the Tahoe National Forest to provide continued avalanche center operations while also collectively focusing on future development.

The Board of Directors continued to employ Don Triplat as the Executive Director to help raise funds and manage fundraising efforts. Don collaborated with other avalanche center friends groups to enhance potential fund raising opportunities. The Board of Directors had a record fundraising year.

The Board of Directors funded the two Professional Field Observer positions. The observations provided by the Professional Observers remain an invaluable asset as an addition to the field observations collected daily by the TNF forecasters. Their top quality data collection and analysis help make the avalanche forecasts more accurate across the entire forecast area.

On the Forest Service side, the continued support for three forecaster positions highlights the Forest's commitment to the program and its long term importance. Monies from Region 5 (\$17,000), and Region 4 (\$8,500) echoed this message of support.

Over the course of the winter we issued one early season conditions update and 121 daily avalanche advisories. These products covered the Sierra Nevada Range of California and Nevada from Yuba Pass south through the Lake Tahoe Basin and Carson Pass down to Ebbetts Pass. This spanned areas of the Tahoe National Forest, Humboldt-Toiyabe National Forest, Lake Tahoe Basin Management Unit, El Dorado National Forest, and Stanislaus National Forest.



EASTERN SIERRA: Andy Parker watches over another skier in the Morrison Col (Convict Lake drainage). Spring in the Sierra means perfect corn skiing and stable conditions making this a fun and safe tour. *Photo Nate Greenberg*

This season website traffic increased in page views by 151% and unique visitors by 127% over the previous year. A total of 726,510 page views from 144,872 unique visitors were recorded during the daily forecast season.

—Brandon Schwartz



**EASTERN SIERRA
AVALANCHE
CENTER**

The 2015/16 season marked a major milestone for the Eastern Sierra Avalanche Center. For the past decade the Eastern Sierra Avalanche Center has operated as a cooperative public/private partnership between the Friends of the Eastern Sierra Avalanche Center (FOESAC) and the Inyo National Forest, which is the most common avalanche center model throughout the western United States. FOESAC was formed as a community-based effort to support the Eastern Sierra Avalanche Center (ESAC) through fund-raising events, membership drives, setting the strategic vision, and building community support.

In 2015, after a series of lean snow years, FOESAC's board of directors felt that the Center needed to reinvigorate community interest and support for the Eastern Sierra Avalanche Center while broadening coverage. To achieve this, the board decided to sever its ties with the Forest Service in order to provide ESAC the greatest flexibility to meet current and future needs of the backcountry community. As ESAC moves forward, it will continue to refine its mission and focus to meet the community's needs and maintain local support.

One of the key successes this season was achieving the public outreach education goals determined for the season as well as renewing working relationships with government agencies, Search and Rescue, the National Avalanche Center, and other regional avalanche centers. In addition, the National Avalanche Center and ESAC have agreed to work together in developing guidelines for Level 2 Centers.

Additional operational enhancements for the season included upgrading the ESAC website's weather resource page. Future anticipated website upgrades will target greater integration of social media.

As the 2015–2016 season approached, FOSAC hired Doug Lewis as the Lead Avalanche Forecaster

and Josh Feinberg for the second Avalanche Forecaster position. The unofficial season started December 3 with a pre-season meeting with the ESAC board and the avalanche forecasters to discuss the season opening, the seasonal fund raising gala, and develop an operational framework for the season.

The Center issued three summaries a week, initially on Friday, Sunday, and Wednesday. After some time with this schedule, we shifted to Thursday, Saturday, and Monday to better meet the needs of weekend users and to better support local avalanche education programs. The first official summary was issued on December 8 with regular updates being issued thereafter.

ESAC's season kickoff gala and fundraiser was held December 5th and was a huge success with over 400 attendees. At the event we raised over \$14,000 dollars from contributions, auction items, and raffle ticket sales. The event's success highlighted the pent-up demand from the previous four lackluster snow years.

For the 2015/16 season, the Avalanche Center's avalanche education outreach program set and achieved a goal of providing three avalanche clinics during the course of the season as a good starting point with plenty of room for future expansion and development. These three clinics targeted the public, Mammoth School District, and Mono County Search and Rescue. All the clinics were extremely well attended and the material and information well received.

The first education outreach event offered this season was an Avalanche Awareness Clinic held in January, held at the Mammoth Brewing Company with over 150 people in attendance. Many participants were eager to hear more about the Center's operations and about how to submit observations.

Eastern Sierra Avalanche Center provides snowpack stability information for an area that extends from Virginia Lakes to Aspendell, nearly 70 linear miles and about 180 square miles. Collecting snowpack data from the four main watersheds covered by the Snowpack Summary is a massive undertaking with the Center's limited staff. To help remedy this situation, ESAC organized an Observer Network Clinic in February to reach out to members of the backcountry community interested in contributing snow and avalanche observations to the Center. The clinic highlighted gathering critical information, then clarified terms and the submission process. Over 35 people participated in the clinic, then over the season, six observers posted more than half of the

54 snowpack and avalanche observations published on the website. ESAC intends to expand the observer network to include more people and methods of compensation.

Additional outreach efforts included: Mono County Search and Rescue Avalanche Awareness Clinic (25 members attended) which set the stage for further training in the upcoming 2016–2017 season that will further develop Mono County Search and Rescue response capability through targeted trainings and exercises.

The winter of 2015–2016 was a highly anticipated El Niño winter with lots of media sources prognosticating a greater than average winter. Season totals for the Mammoth Basin through June Lakes region were near normal; northern regions of the ESAC's operational area ranged from 5% to 10% below normal, and south of Mammoth Basin snowfall tapered off dramatically with 80% to 85% of normal being recorded. ESAC issued sixty-one advisories from mid December to May 2.

—Doug Lewis



**KACHINA PEAKS
AVALANCHE
CENTER**

Another winter of global weirding in Arizona

Fall and Early Winter – the season started nicely with some small storms in October and moderate storms in early and mid to late November. Sizable storms occurred between December 12–14 and January 4–8, each of which dropped 25–30 inches of snow and 2–3 inches of SWE. Our first avalanches were observed on November eleventh, the earliest in recent history. Several wind slab avalanches were reported on December 29th in the vicinity of Snowslide Canyon. These were probably a result of wind loading from a Christmas rime ice event.

The most notable avalanche occurred during of our big January storm cycle. Several D2 and D3 slide debris fields and crowns were observed at a variety of Inner Basin locations (Humphrey's Cirque, Core Ridge, Soft Core Ridge and southwest Face of Agassiz Peak). These avalanches probably occurred on January 7 or 8 as a result of new snow on old facets.

By January 15, a settled base of 69 inches (172 cm) was recorded at 10,800 feet at Arizona Snowbowl resort, representing a fairly good start compared to the previous two winters. Huge excitement was generated around the potential for a bumper year. Predictions of near record El Niño Southern Oscillation further fed high hopes of redemption from disappointments of the recent past.

In late December and early January we also observed what was dubbed “The Post Christmas Hoar,”



KACHINA PEAKS: Surface hoar on January 13th, 2016. *Photo Troy Marino*



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a layer of buried surface hoar in the vicinity of Sickie Moon Slide Path, Inner Basin. Later on January 15, well-developed surface hoar was observed in a number of locations but particular in the Hippy Tree area between Freemont and Agassiz Peaks. This is only notable because of its relative rarity in our region. Low relative humidity and strong storm winds tend to stifle the formation of surface hoar, or obliterate its preservation prior to burial. Thankfully, this layer proved less reactive than anticipated. During this period, great powder skiing left locals high with anticipation of what was surely to come during the rest of the winter.

Late January to April Fool's Day – Dang that southwest, it happened again: record-breaking warmth, high snow stripping winds and only one storm between late January and the end of April. On February 9th a crampon advisory was issued. There was a two-week period when temperatures at 11,500 feet hardly dropped below freezing. Ironclad high

pressure was locked in, briefly breaking down and reestablishing again. The result was nearly complete loss of snowpack from high and low elevations, and brutal obstacle strewn conditions in mid elevation trees. Except for pockets in shaded wind protected areas, avalanche starting zones were bare. Diehard backcountry skiers and snow boarders hiked both up and down to access a few turns on wind buffed patches or hidden gullies.

Springtime moisture— Similar to last year, during April and May a series of short wave troughs passed through our region at weekly intervals making up for much of the seasonal deficit in precipitation, however in terms of recreation, it was too late, the spark was gone, as was any base. Only the truly dedicated took advantage of late season conditions in north facing chutes.

When Arizona Snowbowl closed for the season on April 10, 213 inches of snowfall had been recorded at the mid mountain study site (10,800 feet). By

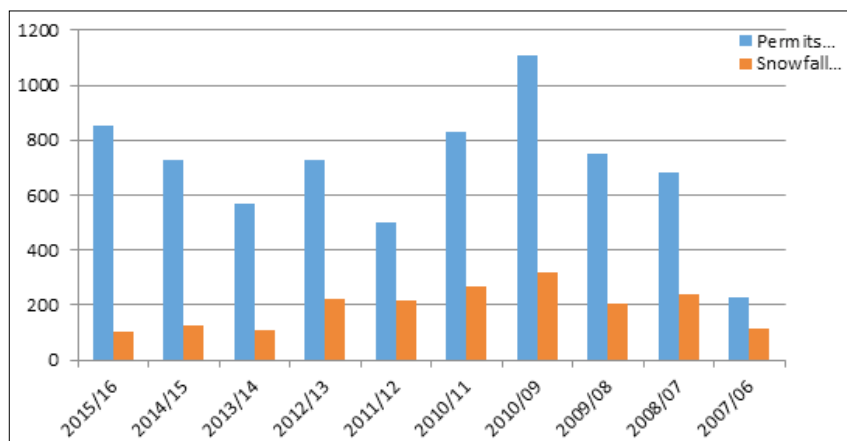
April 17, snowfall total had increased to 228 inches, rising from 82% to 88% of mean. Another “unofficial” 10-18 inches fell by mid May. What felt like a marginal winter, dominated by poor backcountry coverage, may in the end have actually come close to reaching the 30-year mean of 260 inches.

Noteworthy Details:

- KPAC published 19 weekly snowpack summaries or updates between November 6 and April 28
- We ran three free “Introduction to Avalanches” workshops to approximately 100 participants in the Flagstaff area
- Our avalanche simulator was featured at Flagstaff's Festival for Science/Science in the Park event, and the STEM conference at Northern Arizona University
- We served a record 38 students in Level 1 and Level 2 avalanche courses through our MOU with Prescott College, Adventure Education Department
- During January, we ran our first successful level 2 course, with an extended backcountry component, utilizing the Inner Basin Snow Survey Cabin through an MOU with the City of Flagstaff
- We canceled two fully enrolled level 1 courses because of insufficient backcountry snow coverage
- CocoNiño National Forest issued 851 free winter backcountry permits, which is the highest number in the last 6 years, and second highest number in the last decade
- We had 3,774 unique visitors to kachinapeaks.org, and a record 1,972 unique visitors who accessed our snowpack-summary page

KPAC has survived another year of interesting and challenging snowpack conditions. This season represented our 11th year since inception and 10th year in operation. Let the roller coaster continue to both run and attract riders.

—David Lovejoy



KACHINA PEAKS: Graph illustrating second greatest number of winter backcountry permits issued despite far less than mean winter snowfall. Image Patrick McGervey-CocoNiño NF



AAA is running a **fall fundraising drive**. Help support the AAA, avalanche professionals, and the avalanche industry.

Please **donate** online anytime, when you renew your membership, or send us a check in the mail.

Specific projects we're supporting with this drive include: our support of **ISSW 2016** and **regional SAW events**, publication of **The Snowy Torrents, Vol 6**, and revision of the **SWAG** manual.

We'll have **monthly raffles** amongst our donors throughout the fall for great prizes from our generous **Industry Supporting Partners**.



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Alaska experienced another unseasonably warm winter with heightened avalanche activity across many parts of the state in late November and again at the New Year. Impressive glide activity began in February and continued to affect many of the coastal mountains through the end of the season. March and April kept our forecasters busy with storm and spring thaw activity.

AAIC supports six community avalanche centers across the state. Expanded outreach includes partnerships with municipalities, land managers, local newspapers, public radio, Alaska Department of Public Safety, snowmachine clubs, and universities. Our educators taught many community awareness classes as well as AIARE Level 1 & 2 courses. Statewide AAIC 2015-16 Outreach Stats:

Published Forecasts: 290 • **Website Hits:** 295,000 • **Education Programs:** 66 • **Individuals/students served through Education Programs:** 2930

CORDOVA:

Our season began with hope for a colder winter than last year. However, that hope changed to indifference by the New Year as the freezing line rose and left us with no snow below 1000 feet. Ample snow fell in the upper mountains and typical avalanche cycles occurred. The lack of snow in lower elevations, however, limited backcountry use and avalanche exposure. The lack of snow also kept any avalanche activity from reaching the highway. Prevailing warm temperatures brought spring shed early.

—Hoots Witsoe

EASTERN ALASKA RANGE (EARAC):

The Eastern Alaska Range Avalanche Center's first year was busy and productive. Early season storms (September to November) followed by over three



ALASKA: Three Mile Copper River Highway path ran naturally below the snowline March 21, 2016. Photo Hoots Witsoe

months of relative drought, wind events, and warmer than normal temperatures produced widespread PWLs throughout the area. These were then buried by successive storms in mid to late March, which resulted in an active snowpack with widespread natural and human triggered avalanche hazards.

While EARAC does not yet provide forecasting services, we worked to develop our observer network with great success using both social media and website platforms. Facebook page 'Likes' are up 93% from March 2015 and we've had a Facebook Reach of 80,521 in the last year.

During the Arctic Man Ski and Sno-Go Classic in April, EARAC worked with AAIC forecasters to provide an avalanche forecast for five days during the event. EARAC volunteers participated in the rescue, and subsequent accident investigation of two fatal avalanche accidents in April.

EARAC hosted 16 educational classes ranging from awareness to Level 2, and reached over 300 students.

—James Smith

HAINES (HAIC):

This season started off strong, if not a little late, with 1-2m of heavy snowfall above 2000ft the first half of November. This set up most of our ski terrain with good coverage and a stable base, which is just what we like to see. The top layers of very loose, dry powder (which made for great skiing for a week or so) became a curse by late November.

Then the region was walloped by a Pineapple Express with 100mph south winds, 30-60cm of very wet snow followed by heavy rain up to mountain top level, and temperatures that rose 30o F in 24 hours. In advance of this storm we coordinated with AAIC's forecasting director, and other forecasters around the state. It was agreed the conditions could reach into the Extreme category for avalanche danger. We issued the Extreme rating the evening of Nov. 19th, lasting through the 21st. We produced a special press release that went out on the airwaves to warn of unusually high avalanche danger. The storm hit hard, closing the Klondike highway almost immediately due to avalanche. Reports came in all weekend of people hearing large avalanches coming down the mountains nearby. After the storm had passed we could see that nearly every path had slid, several of them to size 4. One very large slide covered nearly 5,000 vertical feet and tossed trees into Chilkat Lake (this area has several private cabin lots that sit in the runouts of large avalanche chutes). Over the next several days, members of the public commented to us that they appreciated hearing our warnings over the radio ahead of time.

That November Pineapple Express was the beginning of a persistent warm regime. Snow levels remained near 2000ft for most of the winter. The season became remarkable for not having a single strong outbreak of arctic air (defined as temperatures below 0°F in town). There was little in the way of skiing below treeline, so riders shifted their focus to the high terrain of the Chilkat pass.

The rest of the season played out as pretty standard. A couple of surface hoar events caused some significant avalanche trouble from February-March. We had seven close calls reported to us, plus three burials. One slide at Chilkat Pass in April led to a fatality – the fifth in five years. Since it occurred across the border in British Columbia, Avalanche Canada is producing a report on this accident.

HAIC produced 45 advisories this season. We taught 15 free community avalanche courses in



ALASKA: Snowmachine triggered fatal avalanche, Courage Mountain, Eastern Alaska Range April 12, 2016
Photo Conrad Chapman

Haines and Skagway, and contributed to education efforts and forecasting at the Arctic Man ski and snowmachine race near Fairbanks. Our website hits continue to increase, and our Facebook page has been hugely popular with about 19,000 post views. We are building partnerships with local stakeholders: skiing, guiding, and mining operations. Funding continues to increase each year, as does backcountry use, and sense of community.

—Erik Stevens

VALDEZ (VAC):

Over twenty-two storms, Thompson Pass received 505" snow with 57" water equivalent. The town of Valdez received 178" snow with 40" water equivalent.

Our region experienced six widespread avalanche cycles related to storm snow avalanches that posed HIGH danger to backcountry travelers. Diverse user numbers continue to increase (listed in order): motorized, motorized hybrid with ski/snowboard/kite, touring ski/snowboard, mechanized ski/snowboard, and kite ski/board. March and April had many close calls with human triggered storm slab avalanches; some over surface hoar, with some stepping down to deeper weaknesses or glacier ice. A few individuals were captured, pulled their balloon-pack and successfully came to rest on or near the surface with minor injury.

Our membership has grown to 140 individuals, businesses, and community partners supporting the forecast and education programs. Beginning in October, 145 forecasts were published. An average of 300 people view the forecast each day with almost 50,000 views this season. Peak days during March and April saw over 800 visits. Our instructors taught several awareness classes in our schools and community including the annual Beacons & Eggs and Tailgate Mountains skills programs.

This is the fourth year the City of Valdez has funded the Valdez Avalanche Center. Private sector businesses and individual member donations have grown the center from a solely volunteer effort to paying seven forecasters, observers, and educators for their hard work.

—Sarah Carter



HATCHER PASS AVALANCHE CENTER

Hatcher Pass Avalanche Center had an eventful 2015-16 season despite three unfortunate avalanche fatalities: a skier, snowmachiner, and snowshoer. HPAC provided avalanche advisories every Saturday, November through April, and dozens more as warranted by weather conditions and accidents.



The CNFAIC extended their observation platform to Hatcher Pass, making HPAC public and professional observations visible on both HPAC and CNFAIC's websites. This partnership has resulted in an increased number of public observations, as well as improving intercommunication between HPAC, AK State Parks, AK Avalanche School, AK Pacific University, CNFAIC, and AK DOT professionals.

HPAC provided a free rescue workshop with over 80 participants in conjunction with the CNFAIC, AK Avalanche School, and local groups, thanks to a grant from the Department of Public Safety/AAIC.

HPAC saw a significant increase in website users this season, ranging from 1000-3000 hits/day.

Hatcher Pass received just about all its snow in November and March, with little in between—giving pause to ripen up our famous square powder. November's significant avalanche cycle resulted in an avalanche that crossed and closed the road for over a week. The old timers had to scratch their heads trying to remember the last time they lowered the avalanche gate, likely around the time of the lace up tele boot, the Elan sno-go and Tom Murphy caretaking the Independence Mine.

This avalanche path is near the "Road Run," a popular high school winter recreation area. The same path ran in March, stopping nearly 10 feet from the road and adjacent to a recently used campfire site.

HPAC involvement was integral in the avalanche accident search for Liam Walsh (found on June 8,



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2016, by a planned recovery search with Alaska Search and Rescue Dogs and Alaska Mountain Rescue on the southeast edge of Skyscraper Peak, near Eldorado Bowl), avalanche accident investigations, interviews with avalanche fatality victims, AAA accident write-ups, and collaboration with just about every agency within 100 miles. As a result of the accidents, community support has skyrocketed, assisting HPAC in raising over \$8000 for "Are You Beeping" signs for next season.

Over 180 people filled the ski chalet for an outstanding fundraiser and cabin fever reliever including "bluegrass-beer-bunny boots-boogying" all to help further the mission of the avalanche center. With a successful fundraiser, and sold out raffle, our little grassroots center is growing. Overall, the support, encouragement, collaboration, and involvement of many avalanche professionals and community members made this a remarkable season for HPAC.

—Allie Barker



HATCHER PASS: This frequent flier slope off Marmot Ridge, in the Hatcher Pass advisory area, is not far from the Marmot Ridge weather station. Photo Jed Workman



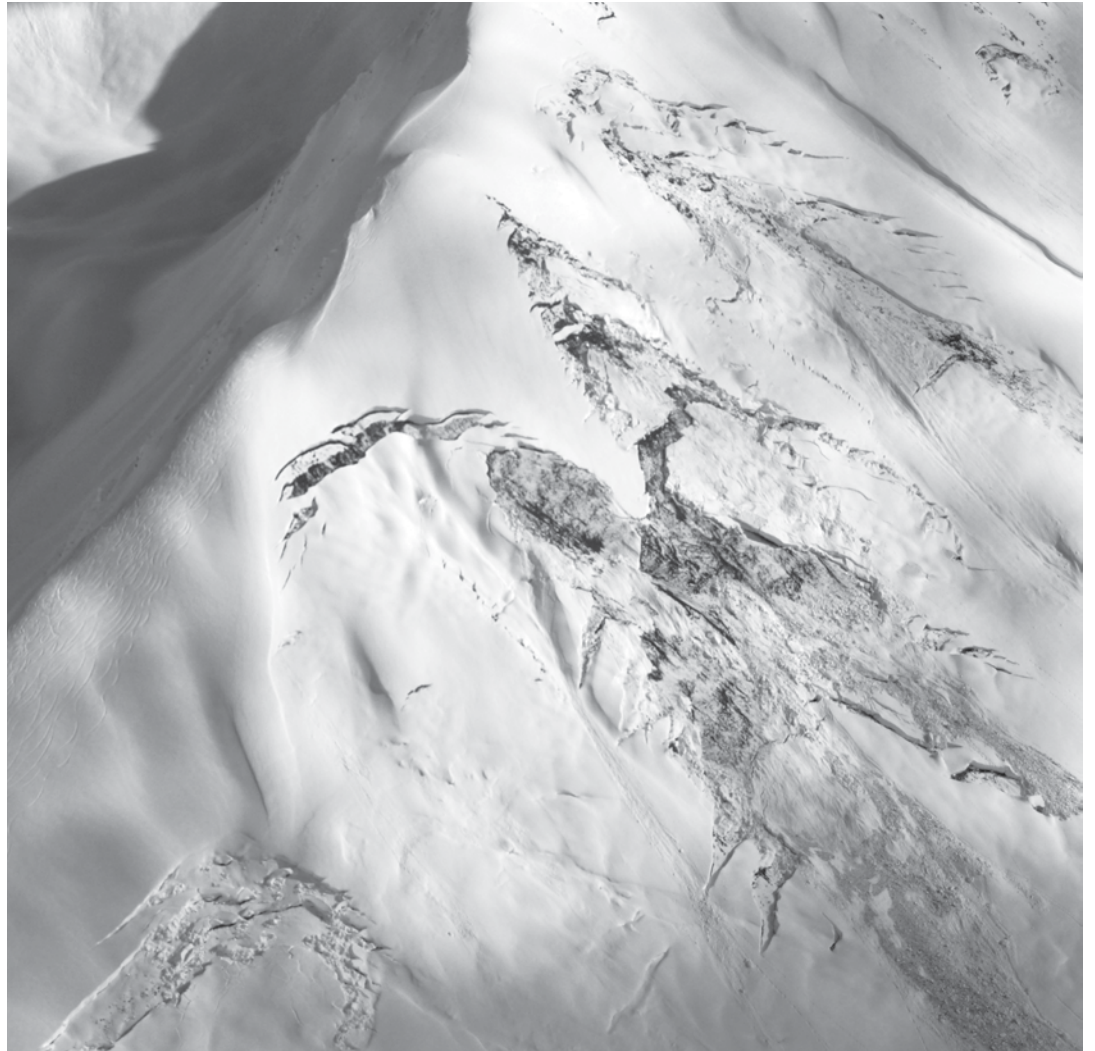
**CHUGACH
NATIONAL FOREST
AVALANCHE
CENTER**

What happens during a winter with no high pressure? No arctic outbreaks? Few splitter-sky days? In our case, a deep and stable snowpack with precipitation accumulating to an impressive 176% of normal by April 1st. We had a plethora of large direct action avalanches, yet rapid stability and generally Low Danger followed.

However, this is not the end of the story. There are two key points I'd like to make with a season like this one: 1) When a region lacks 'high pressure' periods, taking advantage of the deep filled-in snowpack is difficult. Low visibility days were the norm and folks had to make an effort to squeak in backcountry time on those few clear-ish days in between storms.

And 2) is how this gooey 3-4 meter snowpack was not sticking to the mountainsides. It was a glide crack and glide avalanche extravaganza at Turnagain Pass, in Girdwood Valley, and the surrounding regions. Countless numbers of glide cracks formed and released during the entire season, not just spring and fall with a cycle during the January warm-up. As a forecasting entity, public messaging became a challenge. These glide releases were smack in the middle of popular slopes and the challenge was trying to explain that danger persisted even though human triggered avalanches were unlikely.

Aside from the snowpack, we had an exciting shift in the center's structure this season. After years of hard work by the Friends of the CNFAIC and the Forest Service, the CNFAIC was able to create and fund a GS-9 Permanent seasonal Avalanche Center Director. This is the first permanent position solely dedicated to the avalanche center and assists with meeting a long-term goal of sustainability within the CNFAIC. I am extremely honored to have been selected for this position. Rounding out the



CHUGACH: 'Glide crack management' was, by far, the most useful tool for avalanche mitigation in the backcountry this season. Look closely at the tracks on the ridge. For more insight into Turnagain Pass glide cracks, see "Don't Mess with the Brown Frown" in TAR 34.4. Photo Jared Gross

CNFAIC staff were forecasters Graham Predeger, Heather Thamm, and Aleph Johnston-Bloom while Alex McLain continues to be our eyes and ears in the Seward and Summit Lake areas.

Other CNFAIC highlights include the re-installation of a BeadedStream snow temperature array. Through a generous partnership with BeadedStream and Kasteler Consulting, Inc, we have developed a 'Tincan Snow Study Plot', which sits right at treeline. The instrumentation measures snow temperature at 15cm intervals throughout the snowpack as well as snow depth. The snow depth sensor provided key storm snow information at elevations close to start zones, which has always been a challenge at Turnagain Pass.

Community relations continue to build with all user groups on the Forest. While maintaining steady growth in outreach to human powered sports, we have also reached out to hundreds of backcountry snowmachiners this season. Our public events focus on free awareness talks and field-based rescue workshops. Public demand for these has turned out to exceed our resources – and expectations – which is very inspiring!

We are appreciative and fortunate to have had four seasons now with a brand new loaner SkiDoo Summit from local dealer AMDS and Ski Doo/BRP. With these high-end mountain machines we are able to cover large areas and provide the public with more accurate and pertinent information. We also made a fifth annual appearance at Arctic Man, an event in the Eastern Alaska Range that draws up to 10,000 people for a week in April.

Public observations? These have skyrocketed this season with a 275% increase compared to last year! Clearly we are stoked, but making this even more dra-

matic is the fact that this was during a 'mostly stable' season (we tend to get many observations at times when human triggered avalanches are occurring). Additionally, we added the Hatcher Pass Avalanche Center (HPAC) to our observation platform, which was extremely successful. These reports get pushed straight to the HPAC website and streamline the public observation process as our user bases overlap.

Although the Chugach National Forest is once again fortunate to report zero avalanche fatalities for the season, we are sad to report other areas of Alaska did not fare as well. There were six fatalities statewide, three in Hatcher Pass, two in the Eastern Alaska Range, and one in the Northeastern Chugach Mountains.

Some Numbers:

- **160** – Turnagain Pass avalanche advisories
- **31** – Summit Lake weekly summaries
- **2** – Avalanche Warnings
- **1** – Special Avalanche Bulletin
- **1,783** – People connected with directly with through outreach and education events (this is 1,000 more people than last year!!).
- **43** – Total outreach/education events
- **17** – Awareness talks
- **8** – Field based rescue workshops
- **89** – Days Seattle Ridge anemometer was rimed over

Lastly, we could not function without our incredible Friends group. Roughly half of our budget comes from our non-profit arm through their hard work and the generous support from our public and corporate sponsors!

—Wendy Wagner



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