DECEMBER 2ND, 2007 AVALANCHE EVENT IN WASHINGTON STATE

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ABSTRACT: Extreme avalanche hazard is a rare but deadly event. On December 2nd, 2007 an extreme avalanche event transpired in Washington State when a weak early season snowpack was rapidly buried under snow followed by rain. This paper will be a case study in the weather and decision making on three groups traveling in backcountry terrain during that event. They came from a variety of experience levels and motivations, but all had read warnings of the impending hazard. Every member of the three examined groups was either fully or partially buried within 12 hours of each other (including both authors) resulting in five fatalities.

KEYWORDS: Washington avalanche accident fatality extreme hazard

1. INTRODUCTION

The December 2nd event in Washington State was two months in the making. A weak snowpack followed by heavy snowfall and rapidly rising temperatures provided a classic formula for extreme hazard. All the members of three separate groups were either partially or fully buried during this event. Kevin Carter, Devlin Williams, and Philip Hollins were buried and killed while snowboarding in the backcountry adjacent to Crystal Mountain. Stacia Thompson and Craig Stanton were buried and killed while hiking near Snoqualmie Pass. Stacia's husband Mark was partially buried in the incident but survived. Finally, Christopher Morin was completely buried while doing avalanche control work and was rescued by his partner Paul Baugher who was also partially buried by the same avalanche. The decision making in each group was unique but all groups failed to overcome the rapidly increasing hazard.

2. PRECEEDING WEATHER AND SNOWPACK

The three incidents on Dec 2nd occurred in two main geographic areas separated by only about 100kms. No large inhomogeneities in weather patterns where observed between the two locals during the event. Therefore, the weather and snowpack analysis will be focused on the Crystal Mountain area but can be assumed to be analogous for conditions that would be found at both areas. All weather graphs refer to data taken from Crystal Mountain telemetry at the elevation marked.

Washington's snowpack began in mid-October with a moderate snowfall (~2in SWE). This snowfall persisted on through the time period ending Nov 9th, which was characterized by milder temperatures in the 30's and 40's at 6870 feet and clearer weather.

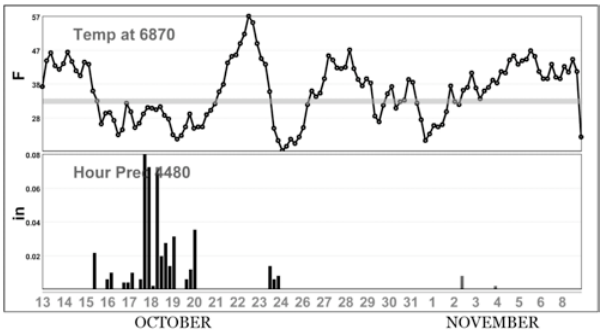

Fig 1. Early Season Weather

However, it was still cold enough on northerly aspects to metamorphose this snow into a faceted layer that would soon be buried. The next 10 days saw 5.81in (SWE) of rain/snow precipitation.

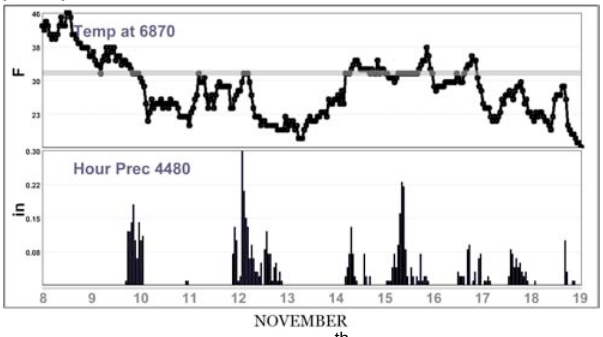

Fig 2. Nov 8-19th weather

Above 6000' this created three distinct crusts interlayered with facets. Total snow depth was approximately 70cm on northerly aspects.

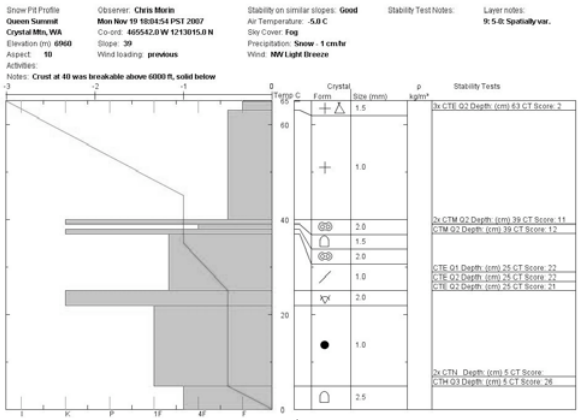

Fig 3. Nov 19th snowpack

The next 11 days through Nov 30th saw little precipitation (.86 in SWE) with freezing levels in the teens and 20's at 6870'.

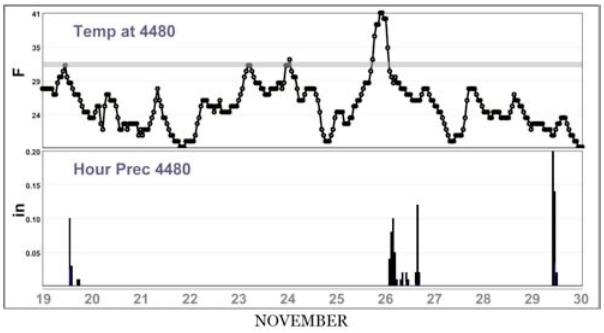

Fig 4. Nov 19th – 30th weather

This enhanced the faceting process between the crust layers and on the ground.

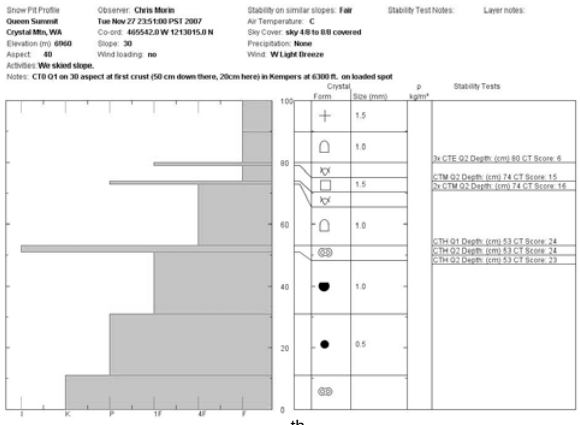

Fig 5. Nov 27th snowpack

3. WEATHER DURING THE EVENT

On the afternoon of Nov. 30th the Northwest Weather and Avalanche Center issued an Avalanche Watch for the upcoming weekend (see attachment). Rapidly increasing precipitation, temperatures, and winds were expected to start mid-late Saturday and peak by late Sunday. It is believed both groups at Crystal had read this report before heading out, Wesley (2008). It is unknown if the Snoqualmie group had read the avalanche forecast, but they were aware of the incoming weather, Castro et al. (2007).

On the night of December 1st, 20 inches of snow fell with a SWE of 1.07in. It came in with rising temperatures, but overall it was quite cold with a maximum temperature of 26°F at 4480'. The snow continued to fall during the day with another 10in (.91in SWE) by 3pm. This came in with continued rising temperatures, reaching 32°F at 4480' and 26°F at 6870' by 3pm. Vertical line delineates 3pm on Dec 2nd, when Paul Baugher and Christopher Morin were buried at Crystal Mountain and Stacia Thompson, Mark Thompson, and Craig Stanton were buried near Snoqualmie:

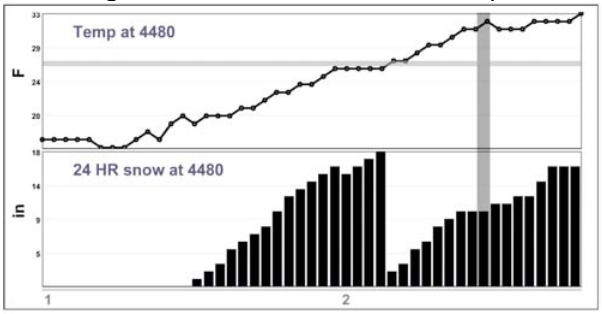

Fig 6. Dec1st – 2nd weather

This snow came in with a predominately WSW flow with winds averaging in the mid 20mph. Over the next two days through Dec 4th Crystal received 6+inches of rain, making the storm total over 4 days 8+inches of water. Precipitation rates reached .5in an hour of water. Almost all slopes above 30 degrees released to the ground during this time.

4. PAUL BAUGHER AND CHRISTOPHER MORIN

On the second day of public winter operations for Crystal Mountain, December 2nd 2007, Chris Morin was called to do avalanche control work in the Northway area with patrol director Paul Baugher. They were to provide a safe passage for lift workers along the new Northway chairline. No previous control work had been done in the area.

3 teams were assembled at Mountain Top. Snow safety director Chet Mowbray and Cooper Self accompanied Paul and Chris to the top of Morning Glory and were their closest contacts during the control route. Specifically, Paul and

Chris were sent towards Flush Gap and then over to Upper Penny Dawgs. Results from their control work produced releases both within the new storm snow and on a variety of faceted forms near the ground. Results on the deeper faceted snow produced nearly full path slides, but due to the shallow snowpack most were relegated to D2 force and did not have large deposition zones. Interestingly, Chet and Cooper were experiencing very few results. However, with the rapidly rising temperatures and precipitation rates, they were most likely just a few minutes too early to catch the rising instability. Paul and Chris were also delving into lower elevations and therefore higher temperatures, which may have been enough to produce greater results. Regardless, the danger in Paul's area was quickly rising past high to extreme, with natural avalanches certain. Kim and Kim, the third control team, had already witnessed a significant natural avalanche early in their route, and undoubtedly all teams would have witnessed widespread natural activity had they been in the area for a few hours longer.

After finishing their control route with explosives, Paul and Chris skied down the Exit Chute of Lower Penny Dawgs which had been the biggest result of the day releasing on the ground; R4D2. They descended to the Northway Chairlift line just above tower 9 and quickly discussed their exit route with Chet. It was decided that they would exit via the Northway Drainage. As soon as entering the drainage it was obvious that the snow was too deep to travel through without skins on and they stopped to gear accordingly. They were about 5m apart on the skier's left side of the gully. Chet radioed and asked if they were clear of the Penny Dawgs runout. Due to the new terrain caused by the chair, Paul was uncertain and asked Chet for a few more minutes. It was approximately 3pm.

Chris had his gear together first and began breaking trail to give some spacing. He had moved about 15 meters away when he was hit by an avalanche released from above. He was already waist deep in the snow before the avalanche hit and was immediately thrown face down on the snow surface. The following recounts his personal experience at the time:

"I was able to cover my face with both arms in an attempt to get an air pocket. I also pushed my face down into my jacket. At the last second I threw a hand towards the surface. I was packed tightly and could not move at all except for my hand near the surface which was only an inch or two deep. My jacket fabric was pressed hard against my face and it was immediately hard to breathe. It was quiet and dark and I waited for Paul to call Code 2 (Crystal's avalanche code) on the radio."

Unfortunately Paul was buried up to his neck by the same release. His personal account follows:

"I had lost both skis and after I extricated myself I immediately went toward Chris. I determined that movement without my skis would have taken me 20 minutes to cover the 20' I needed to reach Chris. I returned immediately to look for my skis and found them quickly. I received a radio call and responded that I would not respond to any calls while searching for Chris. I then moved on skis to Chris who had by this time gotten a hand to the surface and was shaking it. I got to Chris and dug him out while yelling into the snow that he was going to be OK. I exposed his pack to the point where I could reach one of the shoulder straps, put my arm through it and levered backwards (as you would pull a person into a raft with their life vest). His head came out right away. He was breathing OK but said he was starting to have difficulty breathing just before he came out. I notified dispatch that Chris was OK and we were preparing to move out of the area toward lower Northway."

It is estimated the total time of Chris Morin's burial was about 7minutes, taken from the time log on his Mammut Pulse transceiver. The slide was about 40 feet across and 6-12" deep. It released within the new storm snow. The slope was only about 100 vertical feet by 70 feet across, SS-N-R3-D1.

After his burial Chris and Paul moved over to the right wall of the drainage to remove themselves from the main paths coming off of the left side. During the subsequent hike out large collapsing was observed in all areas and eventually they had to revert to foot as the snow was so unconsolidated at lower elevations skis would simply get stuck in the undergrowth. The two other control groups in the area followed the same exit path but moved much more expediently due to the trail already being broken.

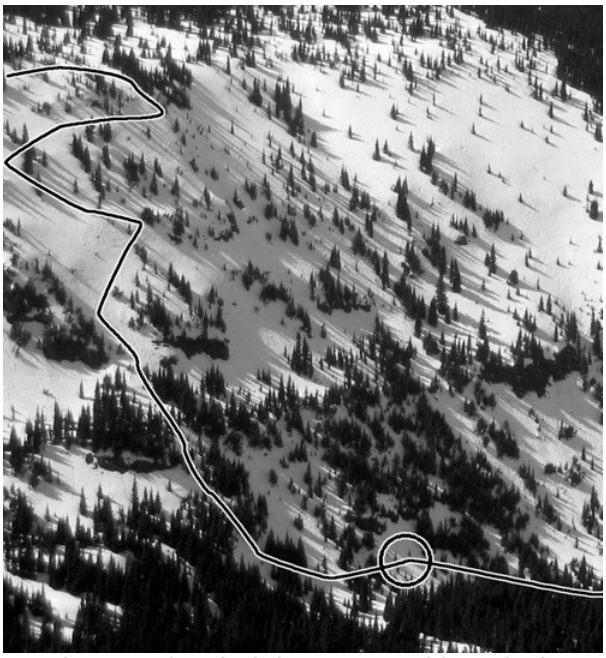

Fig 7. Paul and Chris' route, accident site is circled.

4.1 PAUL AND CHRIS' DECISION MAKING

Due to the poor conditions Crystal's patrol would not have considered doing control work in this area had it not been for an urgent request from senior management. This was a special mission to protect workers in getting the new Northway lift on line. After initially saying "no", patrol determined they could do the mission safely. It is important to note here that had patrol insisted on "no" they would not have had to do the mission. However, this is a classic "risk versus reward" problem, Adams (2006).

The accident occurred in an area that was "relatively benign terrain". By stopping in the area the group had made a decision that they were in a safe zone. This is a common factor in accidents involving ski patrollers during high hazard; locations that are usually safe areas may cause a false sense of security during extreme events, Blanchard (2007).

Before this accident had occurred the maintenance mission was called off by the maintenance supervisor when the full measure of the storm and difficulty of travel was appreciated. This caused some frustration on the groups part and may have diverted their attention from the dangers present. It is important for professionals in leadership positions to realize that the added burden of coordinating large projects adds distraction and "mental traffic" to other decision making processes. This is an especially important concept for those new to a leadership position.

The danger in the area being controlled had reached extreme by the time Chris was buried, this includes the concept that "Natural avalanches are certain". It is a rare occurrence that in-area terrain reaches such a state. It should be worth discussing amongst patrols if it is possible to do control in their area when the hazard is extreme, and if not, making this designation a cut-off to going out. Depending on terrain this cut-off may only apply to certain areas. Of course every situation is unique, but this may provide one more layer of safety checks to prevent accidents in the future.

5 KEVIN CARTER, DEVLIN WILLIAMS, PHILIP HOLLINS

On the evening of Friday, November 30, 2007, three Seattle snowboarders arrived in the parking lot of the Crystal Mt Ski Area. "The three men were Kevin Carter, 26, Devlin Williams, 29, and Philip Hollins, 41. All were from the Seattle area"- *Pierce County Sheriff's Department spokesman Ed Troyer*. Due to the lateness of their arrival it is believed they bivouacked somewhere in the immediate vicinity that evening.

According to interviews with friends and family the group had planned to spend the weekend backcountry snowboarding in, and or near, Union Creek Basin. This is a backcountry area on the east side of the cascade crest several miles east of the Crystal Mountain ski area. The group of snowboarders had a moderate level of experience in backcountry snowboarding. Philip Hollins was perhaps the most experienced and had summited Mt. Rainier multiple times. They also had local knowledge of the Union Creek Basin area and had made numerous trips to the area to build a makeshift shelter. They planned on returning to the makeshift shelter during this trip. This was however their first winter trip into the area.

Their "last seen area" was on the east side of the cascade crest, below the Bullion Saddle, descending into Union Creek Basin Saturday December 1. They were observed by a local backcountry skier:

"… They dropped in at the saddle between Bullion and Union. Since we skied the Union drainage the day before I noticed that there were snowshoe marks and what looked like a splitboard that had broken way from my uptrack. The reason I identified the boarders is that I was yelling at them

from a distance of 50 feet to not slide over the uptrack put in Union Creek the day before..."

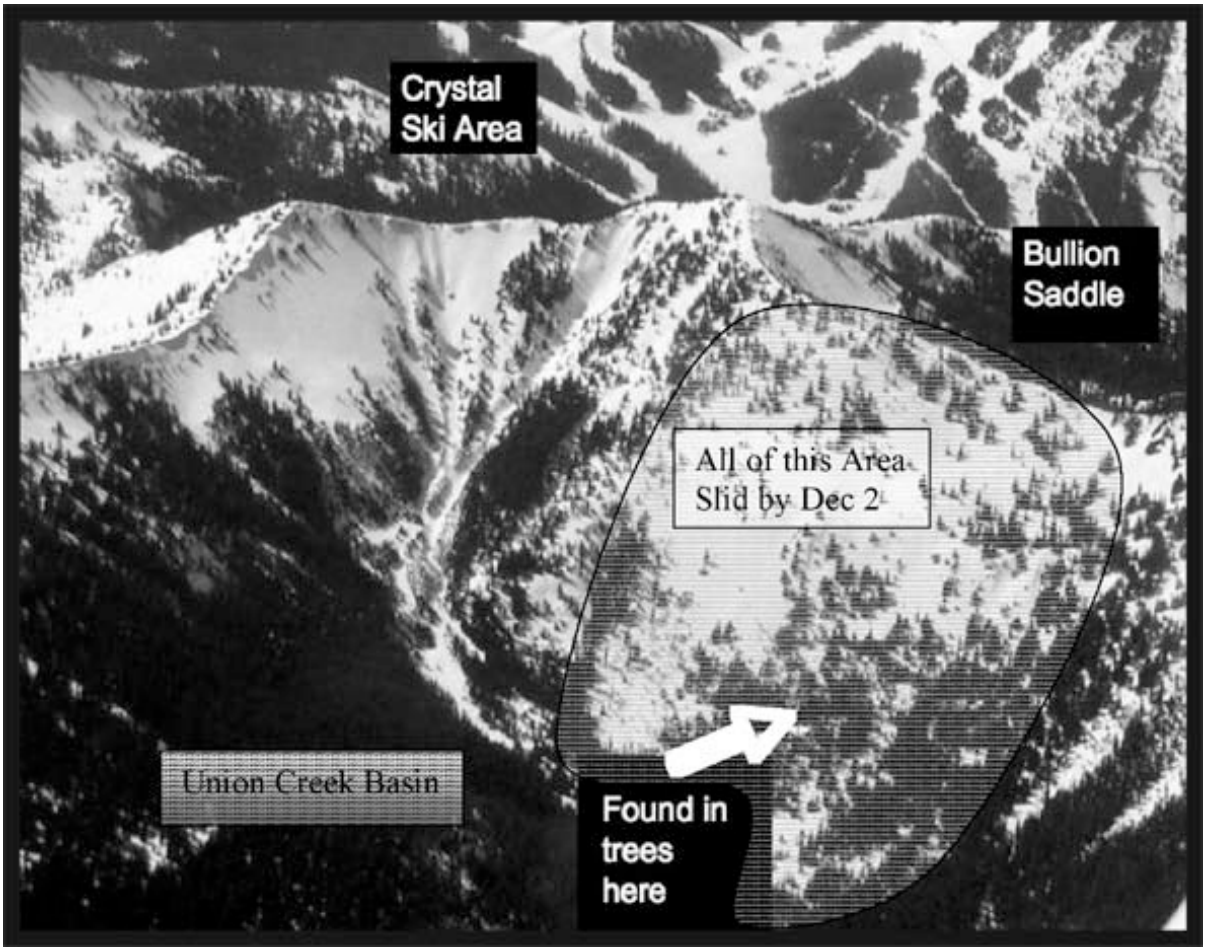

Fig 8. Union Creek accident location

It is unknown where they traveled or rode on Saturday or where they camped on Saturday night. It is also unknown if they moved at all on Sunday December 2. The group was reported missing Sunday night. By Monday December 3, Pierce County Sheriffs began a SAR operation. Crystal Mountain Ski Patrol was contacted late Monday. The weather began to clear on Tuesday and using Crystal Mountain as a base of operations the search process began. The air search confirmed that nearly all of the steep slopes in the area had released large climax avalanches running full path distances. The freezing level also dropped on Tuesday dropping the avalanche danger to low. This did however make travel difficult for ground teams in the area. There were numerous areas of deposition to be searched.

The search involved elements of Pierce County Sheriffs, Mountain Rescue, and Crystal Mountain Ski Patrol. These groups searched the area on the ground and by air continuously until Saturday December 8th. There were no significant findings and a decision was made to suspend the search operations until substantial snowmelt occurred in the area.

Finally on Saturday, June 21, 2008, the three missing snowboarders were found in Union Creek by a group of backcountry skiers and friends. In a remarkable effort arranged via the local backcountry skier's website one of the searchers in the timber below the victim's last seen area spotted a yellow stuff sack hanging from a tree. The tree had been knocked over in an avalanche. After a concentrated search in this area the three missing snowboarders were found buried under the snow.

The snowboarding trio was found at the 5420 ft level in the lower track in a copse of dense cedars and silver fir (probably 30-50 years old) near the bottom of Union Creek Basin. According to friends this was along the "shortcut exit" (Bullion saddle) they had taken from the hut to return to

Crystal on previous trips. The victims themselves were found hunkered down in their sleeping bags with a tarp under them (a tarp that had previously been rigged over the bivouac site as shelter had been ripped off and taken further down slope by the slide). Their beacons were found turned off.

5.1 KEVIN CARTER, DEVLIN WILLIAMS, AND PHILIP HOLLINS DECISION MAKING

They carried full winter camping packs capable of staying out for several days or more in winter conditions. The group carried shovels (# unknown) and all of them had avalanche beacons. They consciously packed in a manner that would allow them to outwait the storm if need be. It appears they did attempt to enact this plan. Unfortunately the rapidly deteriorating weather may have caught them in an area that was unsafe at the time.

One of the men used a split board and the other two carried snowshoes (very small). Visibility and travel, especially with the small snowshoes and big packs they carried, would have been extremely difficult and dangerous when the storm arrived.

It is believed that no one in the group had participated in any formal avalanche hazard evaluation training. Some of the groups avalanche gear was bought specifically for this trip. However, Phillip Holins had read various books on the subject. The group had some experience digging snowpits and looking for instability, but they were still at the early stages of their learning process, Wesley (2008)

However, they were known to regularly read the avalanche forecasts put out by NWAC. Based on their late arrival at Crystal Friday evening they could have seen the special avalanche statement issued Friday November 30 (see appendix). In the time leading up to the trip there had been some talk between the group and their friends about the incoming weather. According to a friend of the group, Kevin Carter noted that it “looked sketchy”.

It is unknown where they camped on Saturday night. The makeshift shelter that they had built over summer and told friends they planned to stay in was found during the December search operation at the 5700’ level. It was found in a very clean state. If they had stayed there, it appears they did not leave in a hurry. Alternatively, they may have camped where they were found. This location is just below where they were last seen on Saturday. It is unlikely that they would have been buried there that night (too early in avalanche cycle). By Sunday morning they either decided to remain in that camp or ended up there after moving. The group had bivouacked many times before. A friend at the recovery site commented that their final camp was consistent with past campsites of theirs and did not appear to be made in a frantic manner. This mentality combined with their slow methods of travel makes it possible to understand why they didn’t retreat back to the hut that was only .5 mile away. In either case, staying in camp or deciding to abandon travel and hunker down was a good decision.

Unfortunately the location they had chosen for their camp may have given them a false sense of security. The density of the timber in this part of the avalanche track may have offered protection from a small avalanche but not from one of this magnitude. There was no direct visibility of the steep open slope above them from their camp. However, they had descended this same open slope on Saturday.

They were found with their rescue beacons turned off. The assumption would be that they were camped in a secure spot and this would allow them to conserve batteries. Statistically it is much less common for avalanche victims to die in camps but it does happen. At least 11 fatalities in 3 separate avalanche accidents have occurred in this way in Washington Avalanche.org, (2008).

6. MARK THOMPSON, STACIA THOMPSON, CRAIG STANTON

On the morning of Saturday December 1st, three hikers departed the Alpental parking lot at Snoqualmie Pass. There plan was to spend the night at Snow Lake and hike back out the next day. The intended route of travel traversed multiple avalanche paths along the South Fork of the Snoqualmie River drainage after which it switchbacked up and over a pass to Snow Lake. They reached their campsite by early afternoon and set-up for the night.

On Sunday morning the group broke camp and began their hike back to the parking lot. The large amount of snow (~70cm at this point) would have made travel slow, but their initial hike back up to the pass was aided by a strong tailwind that had also been stripping the slope of snow, Gibson et al. (2007). When they had reached the ridge they chose to drop back into the basin towards their path from the day before. Mark Thompson was leading the group when at about 1300 hours he heard yells from behind and was hit by snow and carried downward. During his ride

he struck and broke his left leg and ended up being partially buried. He was able to dig himself out but was unable to locate his partners. He had also lost his gloves in the slide which exasperated his situation. After searching and failing to find anything more than a pack he was forced to focus on his own survival. He was able to partially set up a tent and tend to his injuries.

The group was reported missing Monday morning. Due to the very poor weather, no response was possible on Monday. On Tuesday morning the Professional Patrol of Alpental Resort sent a team of two patrollers and a trained avalanche dog into the area. When the hazard was deemed acceptable they were followed soon after by the King County Sheriff Department. The two patrollers made contact with Mark Thompson by 1000 hours and initiated a dog search for the missing victims. Both victims were found within 20 minutes and both had already expired. Mark was winched from the scene by a rescue helicopter an hour later.

6.1 MARK THOMPSON, STACIA THOMPSON, CRAIG STANTON DECISION MAKING

The group knew the weather would deteriorate during their trip and cause the avalanche danger to increase. Their plan was to beat the weather on Sunday and "be in the truck and on the way home before the weather turned", Castro et al. (2007).

"Beating the weather" is a common strategy in alpine travel. It can be a very unforgiving plan due to unforeseen circumstances delaying progress combined with the inherent uncertainty of the timing in forecasting weather. In these situations predetermined departure or turn-around times can sometimes be set beforehand with adequate additional time buffers to allow for a more heuristic approach and therefore lessen the effect of human errors.

Once already in a perilous situation on Sunday the group decided to drop off the ridge into the basin. This decision was fueled in part by the very poor weather on the unprotected ridge. Mark was in the lead trying to sluff off some of the load from the slope and must have known danger was present. However, external environmental forces (similar to external pressures faced by Paul and Chris) influenced their decisions. Again it was a classic risk vs reward situation, traveling an unstable slope vs being protected by the weather.

Finally, the grouped lacked adequate rescue gear and training. Although always a last resort, a beacon, probe, and shovel provide a greater possibility for a positive outcome.

7. CONCLUSION

All three groups discussed had knowingly gone into deteriorating conditions on December 2nd and three separate plans were formulated and followed. One group tried to out wait the danger, another outrace it, and another traveled directly though it. Implemented in a flawless manner it's possible any of these techniques could be successful. Unfortunately, the mountains are a very unforgiving place during extreme events. The smallest of errors can have devastating effects.

Some of the errors can be attributed to the lack of an accurate “mental model”, Adams (2006), for extreme hazard events. So rarely are users confronted with such conditions that it is hard to rely on past experiences for guidance and instinct. In extreme events this can be true for both experienced and inexperienced backcountry users. In fact, experience can actually compound the problem by lending familiarity to a location deemed to be safe under most conditions. This can lead the victims to believe their actions are appropriate although the hazard has now increased, McCammon (2002). Paul and Chris stopped in a place that had been a safe zone during most of their previous experiences in the area. The Union Creek snowboarders’ final campsite was in a location of trees thick enough to allow cover under all but the most extreme events.

Being one of the persons buried that day I would like to think that my groups experience and backup safety nets allowed me to survive the event. Using the basic safe travel skill of spacing out in avalanche terrain prevented both of us from being completely buried. I realize however that luck also played a role in the outcome.

There are multiple extreme avalanche hazard events every year, but it is rare they come at such a cost. Why did this event cause so many deaths? First it was on a weekend, when the greatest number of people would be utilizing the backcountry. Second it was early in the year during a very shallow snowpack when backcountry travelers may not have had the avalanche danger on the forefront of their minds. Lastly, the unprecedented speed at which it came in made it hard to grasp how dramatically conditions were about to change. This contributed to the short time span within the parties were caught.

As in many events the overall picture can be reduced back to skills learned in any avalanche

I course. Mainly, during extreme hazard "Travel in avalanche terrain should be avoided."

It can be easy to try and brush off these warnings by basing decisions on more "advanced" training, but this undermines the decision making process by not beginning at the basics. The avalanche that buries you does not care how many or how few avalanche courses you have taken.

For the professional forecasting world, one point of discussion that should be raised is not how to more accurately forecast the weather, but how to make those forecasts more understandable for the common user with or without training. This is important specifically during extreme hazard events, where it can be argued that the forecast will reach the greatest number of people, and be applicable to many of whom have very little training and generally only travel in "safe" areas. When normalized for days forecasted, far more people die on extreme hazard days than during any other rating, Greene et al. (2006). Perhaps "Travel in avalanche terrain should be avoided" does not convey a strong enough message to some backcountry travelers during these extreme events.

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ATTACHMENT

SPECIAL AVALANCHE STATEMENT FOR THE OLYMPICS WASHINGTON CASCADES
AND MT HOOD AREA
NORTHWEST WEATHER AND AVALANCHE CENTER SEATTLE WASHINGTON
130 PM PDT FRIDAY NOV 30 2007
...AVALANCHE WATCH FOR THE OLYMPICS, WASHINGTON CASCADES AND MT HOOD AREA FOR SUNDAY AND MONDAY...

With an already unstable snowpack in place, abundant new snowfall mid-late Saturday and Sunday should combine with increasingly strong winds Sunday and a significant warming trend mid-late Sunday into Monday to produce a substantial increase in the avalanche danger both Sunday and Monday. Although a still relatively shallow snowpack in some areas is helping to limit the avalanche danger presently, significant new snowfall anticipated mid-late Saturday and Sunday should help to cover much of the current terrain and vegetative anchors. Large amounts of increasingly dense wind slab should load and stress a variety of buried weak layers on Sunday. Consequently, both natural and human triggered slides should become increasingly likely in steeper avalanche terrain, especially on lee slopes above 4 to 5000 feet where a deeper snowcover exists. Initially, most slides that release should primarily involve only the most recently deposited new snow received late Saturday and early Sunday. However, with more significant warming and sustained heavy loading likely later Sunday, larger slab slides ranging up to 3 to 5 feet or more should become probable as the increased stresses affect more deeply buried weak layers.
As a result, back country travelers should remain very aware of the significantly increasing avalanche danger over the weekend and into early next week