

## UTAH AVALANCHE FORECAST CENTER

### 1986-87 ANNUAL REPORT

#### 86-87 SEASON SUMMARY

##### Weather and Snowpack Summary

The 1986-87 season totaled the lowest snowfall since the Utah Avalanche Forecast Center has been in operation. Consequently, thick layers of temperature gradient snow formed within the thin snowpack and the Wasatch experienced the most persistently unstable winter in the last decade. Fifty backcountry human triggered avalanches were reported to us yet there were only two deaths.

It seems that early season mountain weather often plays the role of the trickster. The 1986-87 season was no exception as it started out looking like a great snow year with a late September snow storm which laid down 1-2 feet of snow and also produced the first human triggered avalanche of the season. Powder Mountain became the first ski area in the country to open, albeit briefly.

However, a great snow year it was not to be and the first hint of this came as October and the first part of November remained warm and dry (figure 1). We watched with nervousness as that September snow grew weaker and weaker, from temperature gradient metamorphism on the more northerly facing slopes, knowing all the while what this would mean when the real snow came. We spent much of our field work making mental notes on the aerial extent of this weak layer.

The winter finally arrived November 8 when 2-3 feet of snow fell from a classic northwest cold storm. This instantly produced high hazard conditions on the more northerly facing slopes as the weak September temperature gradient (TG) snow collapsed easily under the load. Not surprisingly, several human triggered avalanches occurred in these areas. Our recordings warned people about the weak TG snow and its persistently unstable nature. Although we did not know it at the time, this would be the first of hundreds of times we warned people about the TG layers throughout the season. Even we would get tired of hearing about it.

The end of innocence came before the ski areas opened for the season on November 20th when a Czechoslovakian employee at Alta took a solo nighttime walk up the mountain into the Devils Castle/Sugarloaf area and stumbled into one of many areas of unstable snow. He was not reported missing until the following morning and was subsequently found with the Alta Patrol's probe line under 5-6 feet of snow. This was the first of 14 avalanche deaths to occur in the rocky mountains for the season.

The ski areas welcomed a small storm November 23, just in time for the Thanksgiving vacation. However, Alta and Snowbird were the only areas able to open on natural snow.

We all patiently awaited the anticipated string of December storms which would rescue us from the fearsome temperature gradient dragons sleeping beneath the snow by insulating and compressing them into submission. For the entire month of December, each day we waited and each day no storms came. Instead, the snowpack grew weaker by the day with clear skies keeping snow surface temperatures cold, turning the entire seasons snowpack into a very weak, thick,

temperature gradient monster, the likes of which the Wasatch had not seen in many years.

Especially in the early season, snowflakes equal dollar signs for the ski areas. Even in the traditionally snow laden Wasatch, Christmas vacation came and went with many ski areas looking on in horror as they did not have enough snow to open. Alta, however, had a record number of skier days as they were one of the very few western ski areas open with good skiing on natural snow. Several other Wasatch areas were open but with marginal conditions.

The drought finally ended with a storm on January 2-6 which put down 2-4 feet of snow with strong winds initiating one of the most widespread deep slab avalanche cycles in recent memory. As expected, the deep buried TG layers were slow to stabilize and we issued avalanche warnings for 10 straight days. On January 8th, a Snowbird patroller triggered a hard slab while doing control work. It buried him under 3 feet of snow and his very capable partners located him with beacons and dug him out within 8 minutes with no injuries. During these days, the powder starved backcountry tourers seemed to avoid the backcountry due to the obvious instabilities broadcast via persistent warnings.

Through the rest of the month, the public got its first taste of the persistently unstable nature of the thick TG layer. Day after day, our recording said moderate and high hazard. We warned them of chronically dangerous areas. We gave them clues and signs of instability to look for. They listened closely to our forecasts as the limited powder supply forced them to push close to the edge, and they needed any advantage they could muster to keep them on the good side of the fence between ecstasy and disaster.

There were many close calls including a totally buried backcountry skier near Brighton who was located by beacon and dug out by his partners--the second beacon rescue of the month. One seasoned snow safety director told me, "I've never seen so many people take so many rides and so few people get killed." We breathed a sigh of relief at the end of the month that so many had been so lucky. We wondered what February would bring.

The first half of February gave the snowpack a much needed rest with no new snow falling and fairly warm temperatures. However moderate hazard was the word for the day--day after day--and there was several more close calls with partial burials. The deep TG layers had started to stabilize in areas with deeper snow such as Little Cottonwood canyon, and for the rest of the season, most of the action was elsewhere.

By this time, the snowpack had become extremely complex. Several of the slide paths that had run in the early January cycle were filling up and running again. An upper level temperature gradient layer had produced several human triggered slides. Wind loading events, surface hoar events, and radiation recrystallization layers combined in an extremely complex fashion until it became impossible for us to give any clues to the pattern on the short 2 minute recording. We were forced to say:

"The only clues we can give you is to do a careful stability analysis on each slope. Some are stable while others are not. You must investigate yourself to know the difference."

Although the TG layers formed during December had stabilized enough to quit producing human triggered slides, we knew we would hear from them again and again with each significant loading event. They finally did speak to us again with the deep throaty roar of several large avalanches in mid February when 1-2 feet of new snow fell accompanied by strong west winds.

A Salt Lake area physician and his wife were skiing a large northeast facing slope between Brighton and Solitude ski areas when he triggered the slide that killed him while his wife looked on from above. Rescuers were on the scene within minutes. He had a rescue beacon in his pack but it was not turned on presumably because his wife did not have a beacon. Consequently, his body was not located until nearly one and a half hours had passed. It was especially tragic because the examining physician estimated that he had lived almost an hour under only 2 feet of snow.

More snow fell for the rest of February producing several more close calls. Possibly because of the recent avalanche death, people were able to restrain themselves and no more deaths occurred.

March entered like a lamb with warm temperatures and clear skies. By mid March small amounts of snow began to fall each day, one foot here, six inches there, until the weight added up to a staggering 7 inches of water in the form of light cold powder over a period of a week and a half. And once again, the scenario repeated itself, just like a broken record, as large deep slab avalanches breaking to the December TG layer began to occur. These were the largest avalanches of the season as they involved the entire seasons snowpack.

They occurred mostly in the Park West and Gobblers Knob areas where the snow remained thin throughout the winter and the deep layers did not have the chance to stabilize. Miraculously, no human triggered slides occurred however backcountry explosive tests by the helicopter concessions produced widespread areas of large and scary avalanches.

April produced some of the finest corn snow skiing in several years with sunny days and cold, clear nights. We finally breathed a sigh of relief as we used the term "low hazard" for the first time in several months. But our sigh was only a half-hearted one because--you guessed it--we knew the December TG layer would again become active when percolating meltwater saturated those layers. This finally happened, as forecast, after several nights of above freezing temperatures and sunny slushy days. Large wet slab avalanches began to roll and they continued until near the end of April when, with great relief, we put on our end of the season message.

All in all, the 86-87 season was a forecasters nightmare--or a forecasters dream come true--depending on your liking of challenge and anxiety. We feel pleased that we were on top of each changing condition throughout the season--often before the snow safety personnel at ski areas were. And we passed on this information in a clear concise understandable format to our thousands of faithful callers. They ventured out each day into very hazardous terrain, often armed only with our information, and only two did not come back alive, and neither of those people called our number before they went out.

#### Avalanche Incidents and Accidents:

This year there were 50 backcountry avalanche encounters reported to us. All of these were triggered by the parties involved. Not surprisingly, this parallels the historical trend that the vast majority of people caught in avalanches trigger their own slides. Of the 50 human triggered slides, 18 people were caught, 6 were at least partly buried, 1 was totally buried and rescued by his partners, and 2 were buried and died of suffocation. (figure 2). Conservative estimates are that we hear of only half of the avalanche incidents that actually occur.

These figures do not include avalanche incidents within ski area boundaries while they are in operation. Although we do not keep track of these statistics, if we did, we would have to add about 20 triggered, 10 caught, several partial burials and one complete burial with a live rescue.

BACKCOUNTRY INCIDENTS BY TYPE  
1986-87

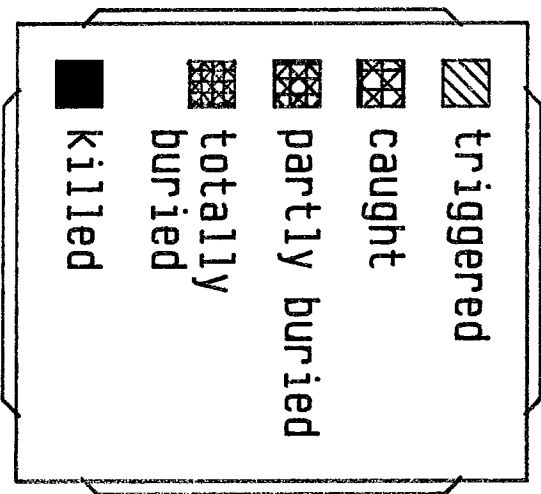
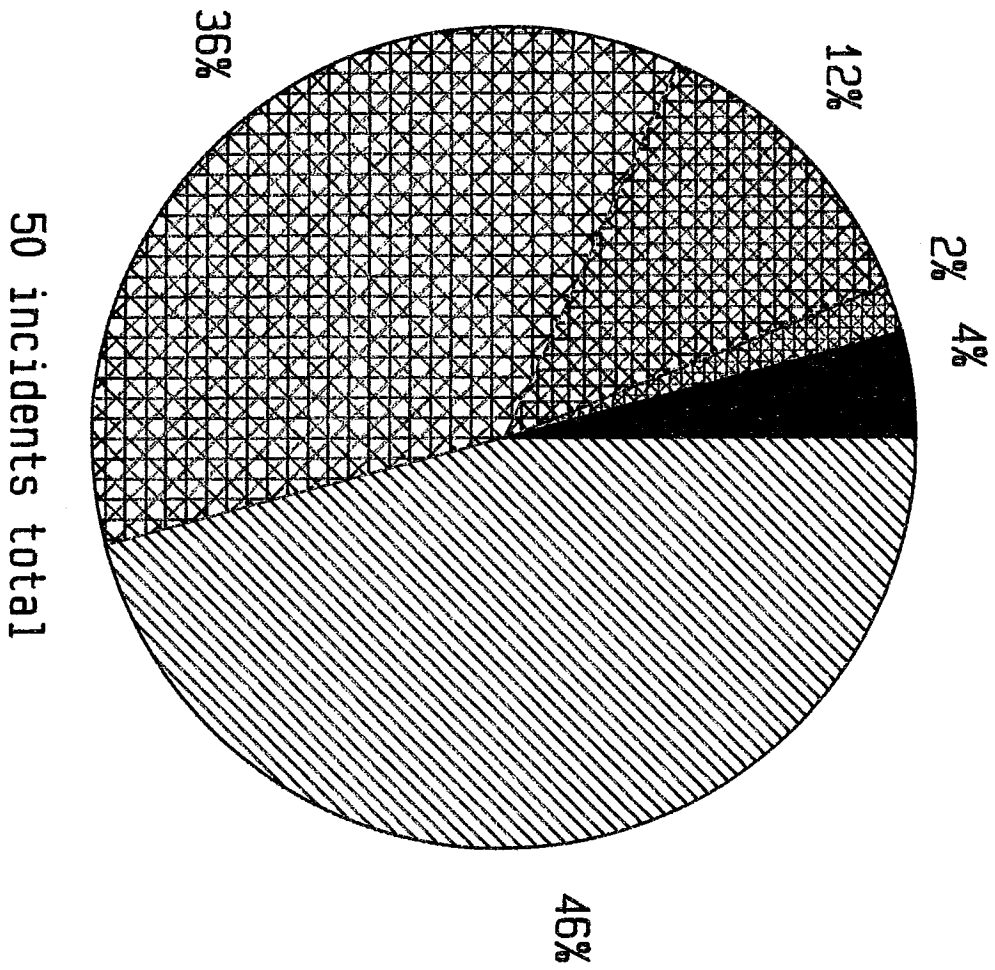


Figure 2 Backcountry incidents by type of incident for the 86-87 season.

21 of the accidents occurred on days when we had rated the avalanche hazard as high, 23 were on moderate hazard days, and 1 took place when we felt the hazard was extreme (figure 3). No accidents occurred on days when we had issued a low hazard rating. There seems to be a continuing misunderstanding about what moderate hazard means, as year after year, most of the accidents happen on moderate hazard days. (See the section on hazard categories and figure 7.)

Fortunately, the number of avalanche incidents involving snowboarders was much lower this year than last year, as there were only a few minor events. We would like to believe this is the result of the free clinics that were sponsored by the Wasatch Backcountry Rescue Group, in which we participated.

While it is some relief that we did not have as many fatalities as last year, any avalanche fatalities are tragic. The goal of the UAFC is to be able to reach everyone so that no fatalities occur. In the case of the two deaths, neither person had sought any avalanche information before heading out.

Since 1980, Utah has averaged 2 avalanche fatalities per year, and if we keep on this track, avalanches will have claimed 20 people by the end of the decade. In fact, more Utahns die from avalanches than from any other natural hazard.

This year, of the 50 avalanche incidents, 8 of them occurred when people with ski lift passes left the area boundaries.

Colorado had this same problem, where 8 of their 11 fatalities happened this way. This is a very important problem which the various agencies involved are struggling to resolve. No one wants to close off access to public lands, but this may be one of the ways of protecting people from themselves.

The problem arises because the attitude of people who head out into avalanche terrain from a ski area is different from that of the average tourist who sets out from a trailhead. The ski area user does not seem as aware of the hazard, nor as willing to accept responsibility for him or herself. Part of the responsibility for this situation may lie with the ski areas, which have long presented themselves as "safe zones" where the word "avalanche" is almost taboo.

Ski areas can make significant contributions to public safety if they attempt to educate their users about avalanches--not the keep people from skiing out of bounds but to help them to do it safely. Also, various agencies, especially in Colorado are now working to resolve these questions. One important step is to standardize out of bounds policies and signing of boundaries. A similar analogy is driving a car; we all know it is dangerous but with uniform laws, signs and enforcement we do it with relative safety.

#### Fatalities:

- \* November 20, 1986, Paul Janda, 27, A Czechoslovakian employee at Alta's Alpenglow walked alone at night into the Devil's Castle/Sugarloaf area and triggered the slide which killed him. He was reported missing the following morning and was subsequently found by the Alta patrol's probe line under 5-6 feet of debris.
- \* February 15, 1987, Steven VanderVoort, 37, a Salt Lake area physician was skiing with his wife in the backcountry Near Twin Lakes Reservoir near Brighton and Solitude ski areas when he triggered the slide which killed him while his wife looked on. He had a beacon in his pack which was not turned on. Consequently, although rescuers were on the scene within minutes it took them nearly one and one half hours to locate him under 2-3 feet of snow.

## UTAH BACKCOUNTRY AVALANCHE INCIDENTS 86-87 SEASON

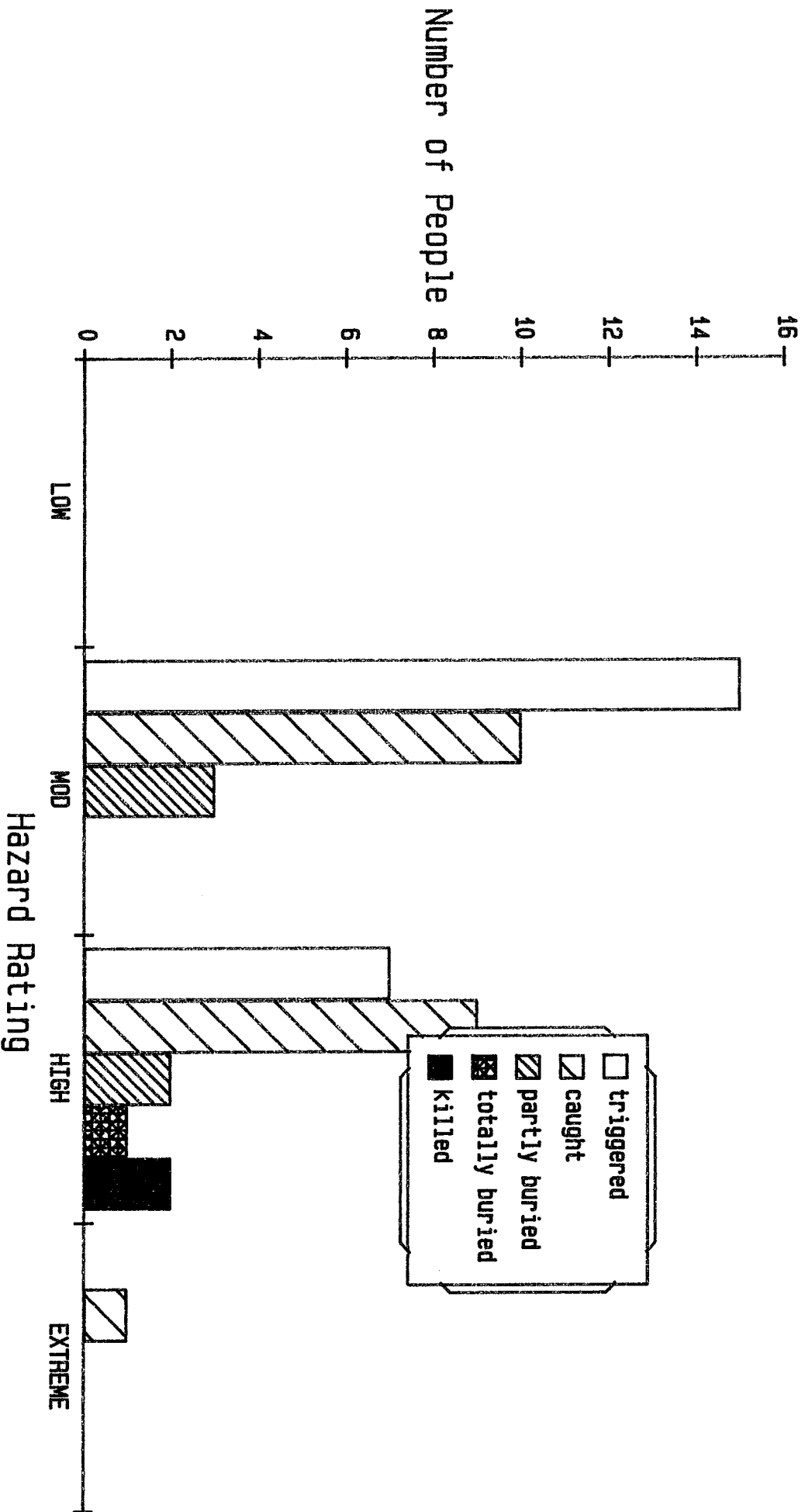


Figure 3 Number and type of incidents versus the highest hazard rating used for the day the incident occurred.

Detailed reports of each fatality as well as several other avalanche incidents are kept on file at the UAFC office.

#### Avalanche Education:

We know that in order to travel safely in hazardous avalanche terrain, you need more than just the information we provide on our forecasts. Avalanche education is just as important--if not more important--than avalanche forecasting. For this reason, we participate in as many avalanche education opportunities we can fit in to our schedule. About 3,000 people attended these lectures and group talks.

Talks given by UAFC personnel include:

- Alaska Avalanche School workshop, 4 days, Hatcher Pass, Alaska.
- Geological Engineering class, University of Utah, Snow as a material.
- Rotary Club, avalanche awareness talk.
- Sierra Club, avalanche awareness talk.
- Wasatch Touring Shop, avalanche awareness talk.
- Wasatch Cache National Forest, Logan Ranger District, training for volunteer backcountry observers.
- Wasatch Backcountry Rescue Group, avalanche awareness lecture for snowboarders at Brighton and East High Schools.
- KALL radio, live interview about avalanche safety on a weekly basis.
- REI Sports, avalanche awareness talk.
- Wasatch Mountain Club, avalanche awareness talk.
- National Ski Patrol, mountain meteorology talk.
- Utah County Sheriff and Backcountry Rescue, mountain meteorology and mountain snowpack.
- Brighton High School, avalanche awareness talks to two different assemblies.
- Utah State University, avalanche dynamics class, talk on mountain meteorology.

#### COMPARISON WITH PREVIOUS YEARS:

##### Breakdown of Hazard Ratings:

Comparing the hazard ratings used this year with other years, figure 4 really tells the story. You can see that the winter of 86-87 was definitely a high anxiety season. But even though we had a persistently unstable snowpack, we put out fewer warnings than in any other year because there were so few large storms (figure 5).

Wasatch skiers have become accustomed to deep, relatively stable snowpacks these last several years. However the widespread areas of temperature gradient snow so prevalent this season, is notorious for remaining persistently unstable until a significant amount of new snow causes most slopes to avalanche or the snowpack becomes thick enough to decrease the temperature gradient and compress the weak layers. As a result, we teetered on the brink of disaster for a long time.

In many years, the avalanche hazard decreases rapidly 24 hours after a storm event. However, because of the persistently fragile TG layers, we commonly saw avalanche releases as much as a week after any significant weather. This meant we had to stay with a "moderate" to "high" hazard for longer periods than in other years. This can cause a credibility problem when people start to think you are "crying Wolf" all the time. Fortunately, both

Percentage of days high hazard used 1980-87

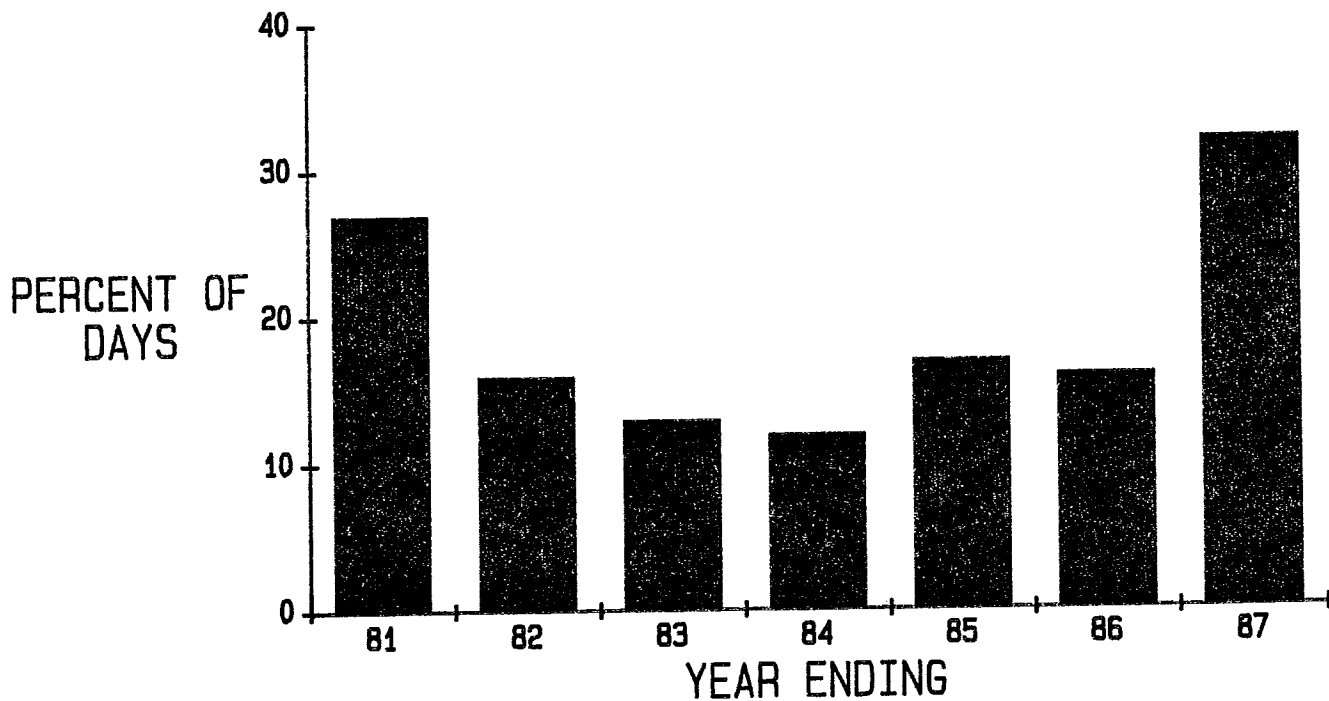


Figure 4 The percentage of the number of days per season that a high hazard rating was used on the public forecast for the years 1980-87.

86-87 hazard ratings compared to average

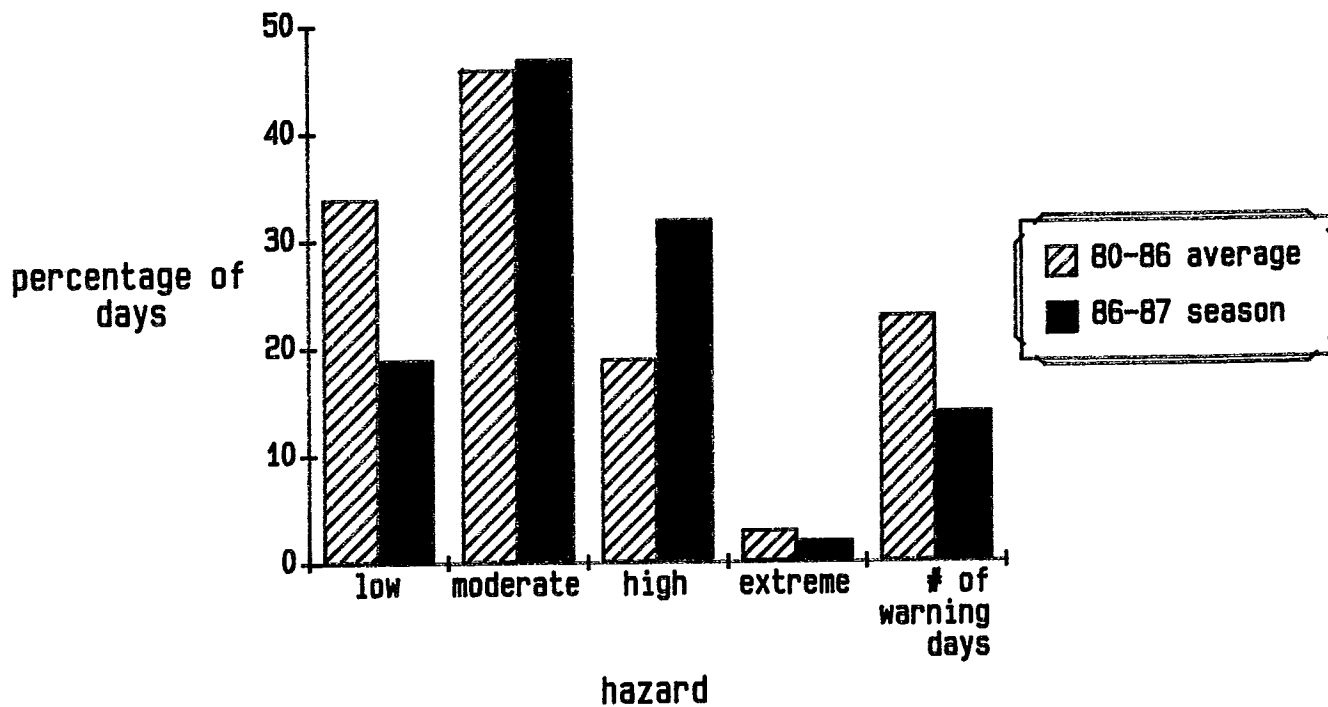


Figure 5 A breakdown of the percentage of the number of days each hazard category has been used during the seasons 1980-86 compared to the 86-87 season.



human triggered and natural slides did come down often enough that we had the proof we needed.

We had very few low hazard days to give us a breather from a nervous season like this one. In fact, 16 of the 33 low hazard days came during a long dry spell in December; most of the rest came near the end of the season.

We had a couple other obstacles to deal with to keep people's attention. Everybody loves to ski powder, but this year there was so little that there was a lot of frustration. After listening closely to us most of the winter, late in March a number of folks seemed to ignore us and went skiing in some very dangerous spots. Surprisingly, no accidents occurred at that time, and this made us look a little foolish.

However, we were confident of our assessment as our snowpits showed us that the snow was still unstable and explosives tests done by the helicopter operations produced some large avalanches. Yet skiers on what we considered dangerous slopes did not trigger avalanches. The closest call may have come on Gobbler's Knob when a touring party of 12 skied together all day on a slope that the next day produced the largest slide of the year when it was hit with 2 bombs from the helicopter operation, taking out most of the touring party's tracks.

Because the hazard did not exist in all areas of the Wasatch, and because we had so few large storms, the times when we needed to issue avalanche warnings was lower than other years.

#### Call Rate Versus Snowfall:

In terms of overall snowfall, this is the lowest amount received in any year since the UAFC has been in operation. In addition, it was the lowest recorded annual snowfall at Snowbird and the 5th lowest at Alta since 1940. The snow totals in figure 6 are for Alta, which regularly has at least twice as much snow as other areas outside of Little Cottonwood Canyon. What this means is that some areas had less than 200" of snow for the season, barely enough to cover the rocks in some places.

Figure 6 shows that, at least since 1980 when the UAFC was in full swing, the rate at which we receive calls closely parallels the amount of new snow that falls. This really isn't too hard a concept to grasp, as people like to ski new snow and consequently they tend to ski the backcountry more after new snow events. Also, perhaps they are aware that most avalanches occur during or immediately after snow events. Therefore, in a low snow year, you would expect to see fewer calls.

However we were pleased to see that our total call rate remained about the same as previous years and the call rate on our Salt Lake line was above last years amount. Perhaps the persistently unstable snowpack accounted for this but we would like to believe that the improved accuracy and our more personalized forecasts has a lot to do with it.

The lack of snowcover took its toll in a number of ways; many ski areas closed much earlier than normal. Sundance did not open until early January and was done for the year before March came to an end. Outside of the Salt Lake area mountains, the amount of terrain available for touring was pretty limited. There were many areas which we normally visit but could not this season because of the lack of snow. The way that this affected us is that we saw a decline in the call rate from our peripheral areas, especially from the Logan area. I really believe this is no fault of our own, but just a result of a poor winter.

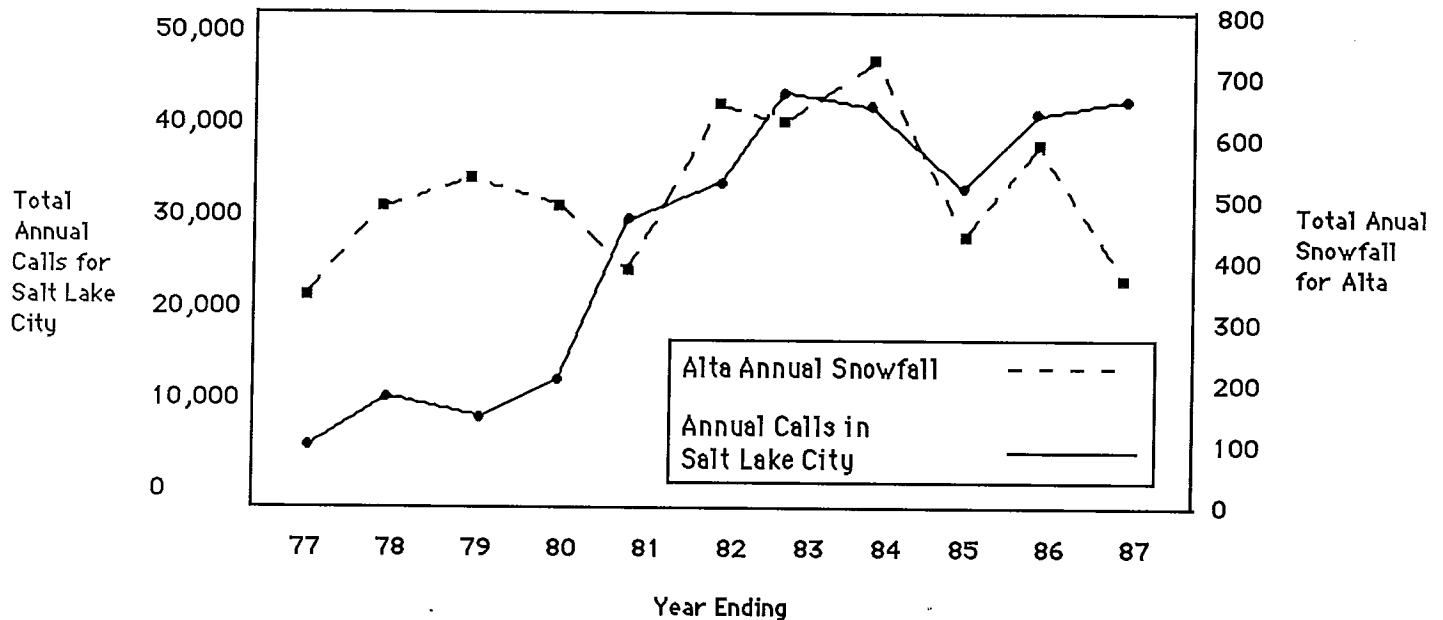


Figure 6 The number of total calls per season for the Salt Lake City area compared with the total annual snowfall for Alta ski area for the years since the UAFC has been in operation. Notice that since 1980 when the UAFC was in full swing, the total calls closely parallels the total annual snowfall. Also notice that the 1987 season, experienced a record low snowfall, yet the call rate rose to an all time high.

UAFC Personnel:

We feel lucky to have a well rounded, strong and capable staff making up the UAFC. This becomes a necessity because there are only three of us and we are terribly overworked during the avalanche season, leaving no room for a weak link in the chain.

I came on board this season as the new director of the UAFC. I came here by way of doing avalanche control for several years at Bridger Bowl ski area in Montana. Then I went back for a Master's degree in geology at Montana State University where I studied avalanches and did my thesis on snowpack accumulation. I then took over the avalanche control program at Big Sky Ski Area, Montana where I remained until I worked for the Alaska Avalanche Forecast Center last season.

Brad Meiklejohn joined the UAFC during the 85-86 season. Originally from New Hampshire, Brad studied avalanches for his thesis while earning a Bachelor's degree in glaciology from Middleberry College. He moved to Utah several years ago and worked as a patroller at Solitude Ski Area before doing volunteer work for the UAFC. Brad is a valuable addition to the program for more reasons than I have room to mention here, but most notably, his passion for snow science, his hefty skills as a snow stability forecaster, he is a top

notch backcountry skier, and puts out a very informative, yet entertaining forecast.

Al Soucie is the seasoned veteran of the UAFC with seven years of experience. He has an infallible and uncanny ability to think like snow. He knows the patterns of the Wasatch better than anyone. Both Brad and I listen to him closely.

#### CHANGES DURING THE 1986-87 SEASON:

##### Hazard Categories:

We continued to grapple with the avalanche hazard categories this season because we feel that using categories such as "low, moderate, high or extreme", often do not give an accurate picture of the avalanche conditions. We are frustrated because the public seems dependent on the hazard ratings yet frequently misinterprets them.

When we issue advisories, we feel a need to communicate the degree of instability--or how sensitive we feel a particular slope is to human triggers. Thus, avalanche forecasters have traditionally used hazard categories for this purpose. The public seems to understand the meaning of some categories more than others. For example, the categories high and extreme seem self explanatory enough. We also notice that on days when our recording indicates widespread areas of high or extreme instabilities, we see very few travelers in the backcountry.

On the other end of the spectrum, "low hazard" is often misinterpreted by the public as "no hazard" which can certainly be dangerous. Fortunately, humans rarely trigger avalanches in low hazard areas, consequently it is seldom a life threatening misconception.

Instead, it is the vast middle ground of "moderate hazard" is where we feel that our greatest communication gap occurs--where the interaction between backcountry travelers and avalanche danger reaches a maximum (figure 7). And not surprisingly most human triggered avalanches occur in moderate hazard areas. Even the word "moderate" alone is confusing enough. Does this mean that avalanches are moderately dangerous? Certainly not. We mean that in these areas some slopes will slide while others will not. Each party should do a careful stability analysis before entering any of these slopes. Also, we use the category of moderate hazard more than any other category. For example, from 1980-87, the word moderate was used 46 percent of the days versus 32 percent for low, 19 for high and 2 percent for extreme, (figure 5).

In my experience with the Alaska Avalanche Forecast Center, we never used hazard ratings. Instead, we simply told it like it was. For example, we might say,

"We feel that the snow is mostly stable however there is still some human triggered avalanche potential lingering on lower elevation wind protected slopes steeper than 35 degrees where sensitive surface hoar layers still remain buried about 2 feet deep."

Alaskans seemed quite comfortable with this as the call rate was one of the highest per capita in the country.

At my urging, we decided to try something different this year. Starting in early November, we began issuing avalanche information without using the hazard categories. The response was swift and decisive; people did not like it and we were roundly criticized for changing a good product.

## Avalanches versus People

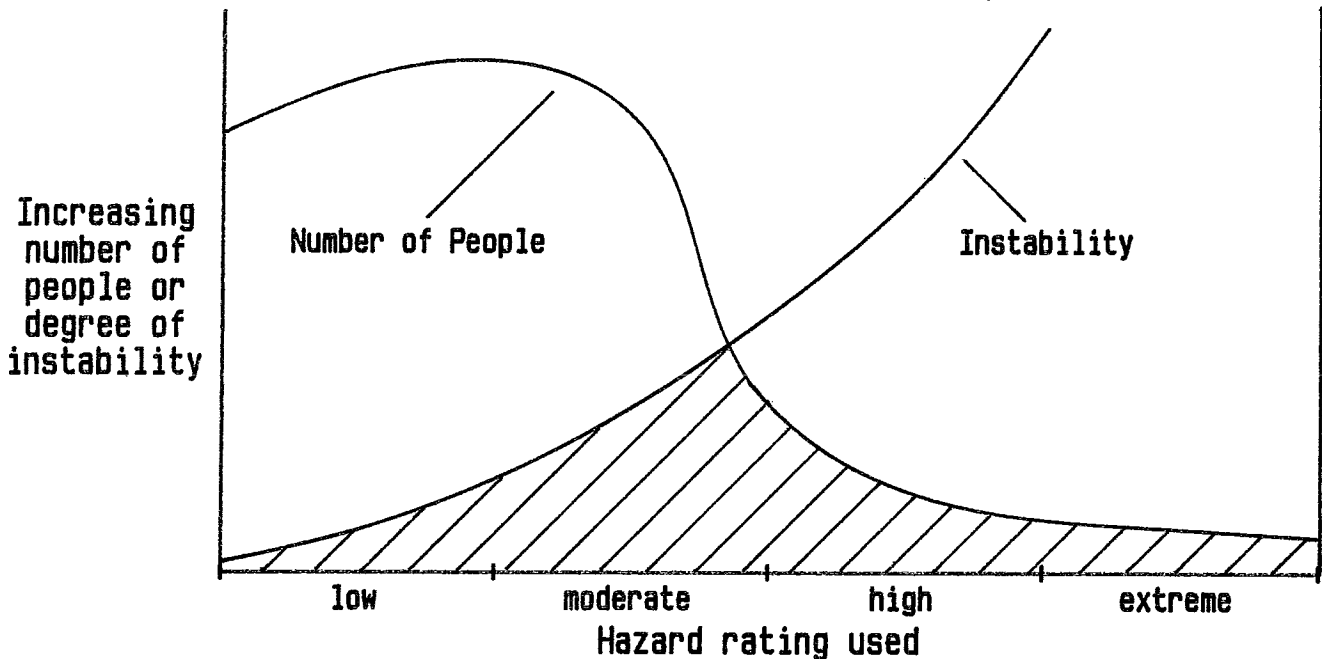


Figure 7 A conceptualized relationship between the estimated number of people traveling in the backcountry in winter versus the degree of instability—for the various hazard ratings. The shaded area represents the interaction between people and avalanches.

So we pulled back, realizing the established precedent would not allow for sudden change. But we were not going to give up on this issue. Since it seemed we were stuck with using these categories, we went to work to clarify the terminology. At first we tried to redefine the hazard categories, listing out all the possibilities but this, too, became futile, as the scenarios are endless.

To backtrack a bit, the forecast format from past years would issue a blanket hazard rating for the snowpack in general and would define the hazard in the lead sentence of the forecast. For example,

"Moderate avalanche hazard ...areas of unstable snow exist and avalanches are possible on steep snow covered slopes and gullies. Backcountry travelers should use caution...",

This season, we instead, made two important changes: First we described the avalanche conditions as accurately as we could and we buried the hazard rating within that description. For example,

"...In these areas, backcountry travelers may be able to trigger a slab avalanche up to 2' in depth. We feel this is a moderate hazard not

because these slides are moderately dangerous but because they are erratically distributed. You should especially watch out for areas above 9000' on east through north facing slopes steeper than 35 degrees with new accumulations of wind drifted snow."

Second, instead of giving a blanket hazard rating for the day, we gave hazard ratings to each geographic area and each slope within that area in as much detail as we could. For example:

"Today, you can find high hazard areas on northwest, north and northeast facing slopes, above 9,000' steeper than 35 degrees, especially on large open slopes. You will find the safest skiing in the low hazard areas which include all south facing slopes and areas below about 8,000' and all slopes less steep than 30 degrees. Moderate hazard areas include all the other slopes. Today your clues to instability include...."

This improves the forecast in two ways, first we have increased the accuracy of the information provided, using mainly the variables of elevation, slope compass direction, and slope angle. Second, by getting more specific and detailed, we have been able to draw attention away from the hazard categories. We would like to think that by "burying" the hazard statement, we can get people to listen to the more important information.

#### Format Changes:

The goal of our advisories is to most accurately communicate snow stability information to the public. In order to accomplish this, we changed the format in two important ways:

First, we expanded the length of the recording from 90 seconds to 2 minutes. This allows us to give more detailed information which we felt was essential to give the public an accurate picture. However, we know there is a limit on how much information can be digested from a phone message. We may have been pushing the envelope when we experimented with a two and a half minute tape.

The second change in the format is probably most important. We made the recordings much more personal in several ways: First, we made the text more entertaining and less bureaucrat sounding. Also we used active voice instead of passive voice, for example, instead of, "snowpits were dug" we would say, "we dug snowpits". Lastly, we simplified our language and used technical words only when we defined them or they were obvious in context. For example, "The culprit weak layer is the weak, sugar-like layer of temperature gradient snow."

As a result, we constantly got feedback from people who said they were enjoying our recordings much more than previous years and would call them even when they weren't going skiing. This is a big step in getting people to think for themselves, as they begin to follow the snow on a day to day basis rather than just on weekends. We also noticed that even though this was a near record low snowfall year, our call rate for the Salt Lake line remained above last year and very near a record high.

We also make every attempt to communicate the degree of instability as close to reality as possible. In other words, the advisories are never "sugar coated" or exaggerated just to keep on the safe side. After all, accuracy equals credibility. The users seem to appreciate this and we often hear comments that they listen closely and call often to keep abreast of changing conditions.

Another format change that we are attempting to phase out is telling people that "backcountry travel is not recommended". We feel that even under the most extreme avalanche conditions there are safe routes of travel. Granted that safe areas may not exist in areas such as Little Cottonwood canyon, where there are times when you don't even want to step out the door. Instead, we tell people to travel only in flat lying areas well away from avalanche runout areas and we suggest several safer areas, for example the more flat lying areas near Park City or Big Cottonwood Canyon.

#### UAFC Accessibility:

This season, we began publicizing our toll free number on the public forecast and encouraged people to call us to report snow and avalanche information. I feel strongly that the UAFC should be easily accessible to our users. In this way, the public can easily report avalanche accidents, call us to request avalanche talks or further information or just give us general comments about the forecast.

We were not swamped with calls as some initially feared. Instead, we have received more feedback from regular tourers than ever before. The benefits of this are obvious; we hear about more avalanches and avalanche incidents, and we end up going on tours with these people.

#### UAFC Visiting More Extreme Terrain:

This season, we made a special effort to regularly visit the more extreme terrain. This has become more feasible due to the recent addition of myself and Brad Meiklejohn as we both share a passion for this type of skiing. Al Soucie likewise has always been a very capable backcountry traveler. Because of this, we are slowly gaining the respect of the most experienced tourers whose needs were often not met in the past.

This has paid off in several ways as we receive more feedback from regular tourers than ever before. And often we ski with them and have the chance to demonstrate what we are looking for in snowpits, thus their feedback becomes much more valuable to us. Lastly, we get the chance to set an example of safe routefinding and stability analysis techniques which often get passed along to others in the extreme skiing community.

#### More emphasis on outlying areas:

We had decided early in the season that each forecaster would commit at least one field day a week to the outlying areas of Provo, Logan and Ogden. Since each forecaster has a little less than three field days per week, this represents 37 percent of our available field days. When you consider that only 15 percent of our calls come from these outlying areas, perhaps we are spending too much time there. Even so, we still feel somewhat out of touch with these areas.

Several things save us. First, the snowpack is thankfully much easier to forecast in these areas because storms do not tend to hit these lower mountains nearly as hard as the Salt Lake area mountains and consequently conditions change less rapidly. Second, we get a high density of information from the Salt Lake area mountains from ski areas, several good snow rangers and most important, a growing network of volunteer observers that are out on a regular basis.

#### Forest Service District Offices:

Working with the Forest Service District Offices has been an ongoing problem. Each of three districts shares a blanket allotment of \$10,000 from

the UAFC budget each year with the agreement that they provide useful snow stability information from their local high use backcountry areas. All three districts do this by funding snow ranger positions. Therein lies the problem because, with the exception of the Salt Lake District, the acting snow rangers do not have the necessary skills in backcountry travel or snow stability assessment to give us useful information from the areas most frequently visited by backcountry travelers.

This season, we made a special effort in hopes to rectify this old problem. We held meetings with each district in the early season to outline their obligations and we attempted to spend more of our severely limited time with them throughout the season. Although there is still ample room for improvement, we at least received more information than past seasons.

The Logan District deserves special praise as they have solved the problem by organizing volunteer observers from whom we get good information. However we still get very little useful information from the Ogden District although there is some improvement over last season.

This is particularly a sore point among the UAFC staff. Each year, inflation eats up an increasing amount of the fixed UAFC budget to the point that it barely covers our operating costs. The \$10,000 allocated to the districts each season represents one sixth of our total budget and it stands out as a glaring inequity because we get very little information from that money

The most obvious, as well as the most efficient, use of the money would be to contract a capable field person to visit the various outlying areas, or, pay per diem and travel costs to several capable volunteers in these areas.

For example paying per diem and travel for volunteers would cost about \$20 per day and yield about 500 days of field work per season. Hiring one additional field person at a GS-6 level would yield 138 field days per season.

This season, the present system yielded only 50 field days--68 percent of which come from the Logan area volunteer network. This means that the cost to government is \$200 per field day--and most of the work is done by volunteers!

For these reasons, we plan to withdraw the funds from the districts and pay either the contract or volunteer observers directly. In this way we can theoretically get up to 100 times more information from the same amount of money.

#### DIRECTIONS FOR THE FUTURE:

##### Telephone Systems:

As far as the nuts and bolts of the operation, we plan on making several changes in the telephone service for next season. First, we get all of our information from the ski areas as well as from volunteer observers over a 1-800 line which is the only direct line into our office. This line costs us around \$20.00 per hour even if it is a local call, totaling around \$4,000 per year. Consequently, we plan on adding another direct but local line into our office and we will encourage our observers to call us on that line if possible. Many of the ski areas--who use the phone the most--can just as easily call us on a local line and they have expressed willingness to do this. We will still retain the 1-800 number for long distance callers.

Second, the recordings for Logan, Ogden and Provo now operate on older recording machines that require two phone lines--one for recording the forecast and one the public uses to hear the forecast, whereas modern answering machines do both, using the same phone line. Also, we find that these older machines now

spend much of their time in the repair shop thereby costing us even more money. Consequently, we plan to replace these with industrial grade answering machines. In this way, we can save the cost of one phone line per location, save on repair costs and best of all, we are not limited to a fixed length tape required in the older machines. Also, the cost of purchasing the answering machines will pay for itself within the first season.

Finally, at present, we have 5 minute recorded message for the Salt Lake area containing more detailed avalanche and mountain weather information which was originally set up so observers could get updated information. Although this number has never been publicized, many of the local regular touring population know about it and they call it regularly. In fact, probably more public call the number than observers.

So why fight it? Next season, we plan on adding another line to the recording and advertising it on the regular public recording. For example, "If you would like more detailed information please call 364-1591." Also, about the only complaint we hear concerning the public recording is that they would like more detailed information. In this way the public can get two levels of information, depending on the detail they want.

#### Database and Networking Systems:

The UAFC is the central nerve center for much of the avalanche communication that occurs in the Wasatch. As such, we have access to a staggering amount of information on weather, snowpack and avalanches. Since computer-aided information processing technology is growing at such a rapid rate, we feel that we should keep pace with these developments.

For example, each day, each ski area gathers information on weather, avalanche and snowpack. Each area gathers the information differently and stores it under different formats. Some computerize the data. Others simply file it away. Very few of the areas do systematic analysis of the data. We would like to provide a framework that would encourage the various areas to store the data in a more universal format that can be used by other ski areas.

In order to do this, we are developing a database at the UAFC which includes all the parameters normally collected by each area as well as any imagined future parameters. We are developing this on an IBM compatible Dbase III system--a very universal and adaptable database system. We will also include all the historical data now stored on the Westwide Avalanche Network computers in Fort Collins, Colorado. In addition, we have contracted to have all the historical Alta data from 1940 onward, compiled and keypunched into the system.

In this way, it keeps all the data in a universal format in a centralized location and accessible to all the users via telephone link to our computer. Various ski areas or researchers could statistically analyze the data. It will also enable all the areas to be linked with an electronic networking system where everyone's information could be shared as well as more effectively distributing weather forecasts and products.

#### Skier Attitudes and Avalanche Education:

One thing which has been disturbing to us is the way in which local skiers evaluate snow stability. Granted, there are lots of folks around who are very experienced and have managed to survive all these years. But we rarely see anybody digging a snowpit, even when they are skiing the scariest spots. It is also disconcerting when people get away with going to areas that we suggest they avoid.



In defense of the people skiing dangerous terrain, it is easy to see how it comes about; everyone complains that there are more and more people competing for the powder. For example, it used to be only the domain of the more radical backcountry cross country skiers. Each year more and more skiers must share the same terrain. And especially in the last two years snow boarders now share much of the same terrain. Finally, each day the helicopter concessions gobble up a sizeable portion of the untracked powder. The lure of powder is very strong, and for some it quickly overrides the importance of safety. People are pushing the edge of disaster farther and farther--much of it because of competition and crowding.

How can we solve this? I'm not sure that we can. It seems that the "Greatest Snow on Earth" is being loved to death--death sometimes being the result of this love.

But even though the general level of avalanche awareness in the Wasatch is quite high, we seldom see people making snow stability decisions based on data. For example, we sometimes see people skiing slopes where a snowpit would clearly reveal is dangerous; in the same way, we see people habitually avoiding a stable slope because "someone was killed there last year". These "voodoo methods" of decision making frighten us.

When compared to the large population of backcountry tourers in the Salt Lake area, it seems there is a disproportionately low number of quality avalanche classes offered. Perhaps I feel a bit spoiled from my Alaska experience where the state-subsidized Alaska Avalanche School was considered the best avalanche school in the country. Because of this, next season, we plan to co-sponsor an avalanche workshop in conjunction with the Alaska Avalanche School personnel in the Salt Lake area. Perhaps this will help to turn the tide to more responsible decision making.

One thing we could also do next year is offer to travel with small groups of people to the field to show people how to evaluate snow stability. There are some very simple and quick tests that can give you lots of information. We should also encourage people to get better educated, and we should work to improve the level of avalanche education available in this area.

Many people rely on our information to get them safely through their day in the backcountry. Often when we ask people why they don't dig snowpits they respond, "Why should we. We just listen to what you guys say." This, of course makes us nervous. As we make our forecasts more and more accurate and detailed, people will increasingly make their life and death decisions based on our advisories, and they then take even less responsibility for their own decision making. We continue to have mixed feelings: On one hand we want to be helpful by providing accurate and detailed information. On the other hand, the day when we will inevitably be proven wrong, it may open us up to greater liability.

## CONCLUSIONS

The 1986-87 saw one of the lowest snow years in recent history which was consequently one of the most persistently unstable years. Because of this, the backcountry use seemed to be down from previous years yet we saw a near record number of avalanche incidents. Miraculously there were only two avalanche deaths in Utah this year while Colorado, with a very similar snowpack, experienced 11 deaths. We feel we deserve some credit for this as we logged many days in the more extreme terrain and communicated the information in an accurate, easy to understand yet entertaining format.

Most experts agree that the Wasatch has the largest population of winter backcountry users in the country--all crowded into a small area with very dangerous avalanche conditions--making the Wasatch a place where the maximum interaction between people and avalanches occur.

The statistics show this point well: The Wasatch-Cache National Forest sees six and a half million visitor days per year. (Yellowstone National Park has one and a half million visitor days per year.) And at the same time, Alta and Snowbird regularly rank in the top five avalanche areas in the country based on the number of avalanches per year. Clearly, the Salt Lake area has a great need for an effective, credible avalanche forecast center.

We remain dedicated to achieving the highest quality of avalanche forecast possible--through giving accurate, timely and useful information--communicated in an efficient, easy to understand and entertaining manner. We have made several changes this season in the forecast content, format and delivery. This has elicited a rash of positive comments from the public and we also see our call rate for the Salt Lake area rise to near a record high during a season with near record low snowfall and consequently low backcountry use.

The Wasatch has a unique situation. There are large numbers of capable winter backcountry users, easy accessibility to acutely hazardous avalanche terrain, a high density of snowpack and weather observations, and most important, a dedicated and talented staff at the UAFC. Because of this, we feel that we define the state of the art in avalanche forecasting. However, we also feel committed to the future--through several planned changes--to push the definition of the state of the art to new levels.

Bruce Tremper

Bruce Tremper  
Director, Utah Avalanche Forecast Center

APPENDIX

TABLE 1. SUMMARY OF FORECAST HAZARD RATINGS

HAZARD	LOW	MODERATE	HIGH	EXTREME	WARNINGS
80-81	49 28%	73 42%	47 27%	6 3%	32
81-82	92 48%	67 35%	31 16%	3 2%	34
82-83	61 36%	81 48%	22 13%	4 2%	25
83-84	69 39%	83 48%	20 12%	1 1%	16
84-85	52 30%	90 52%	30 17%	2 1%	17
85-86	44 28%	82 53%	25 16%	4 3%	19
86-87	33 19%	81 47%	55 32%	3 2%	14

TABLE 2

TOTAL CALLS FOR YEAR

Logan	2,587	Salt Lake recording	38,841
Ogden	2,518	* Observer's recording	4,693
Provo	2,121		

Total calls: 50,760

\* The observers recording is a more detailed 5 minute summary of snowpack, avalanche and mountain weather information originally set up for observers but now widely used by the public.