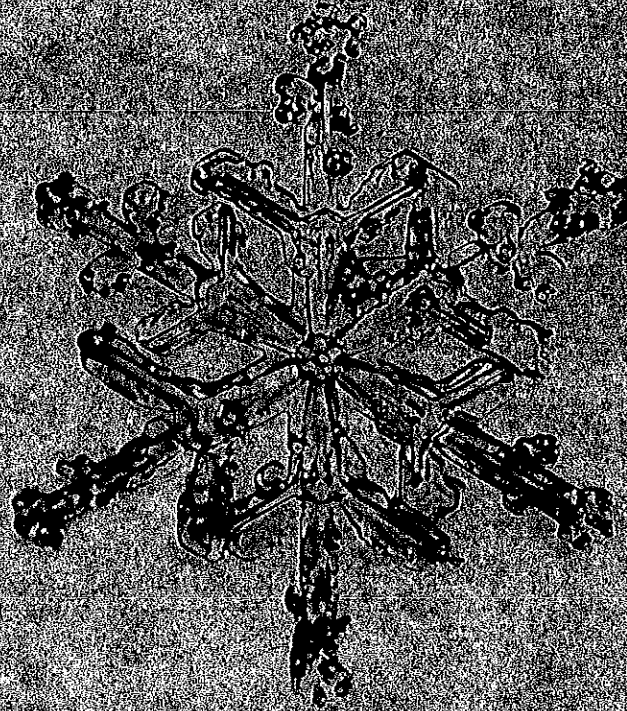


**UTAH AVALANCHE FORECAST CENTER
ANNUAL REPORT
1987-88**



U.S. FOREST SERVICE WASATCH-CACHE NATIONAL FOREST

N.O.A. NATIONAL WEATHER SERVICE

337 N. 2370 W. SALT LAKE CITY, UTAH 84116

MAY 1988

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

Authors:

Bruce Tremper, UAFC Director

Brad Meiklejohn

Tom Kimbrough

May 29, 1988

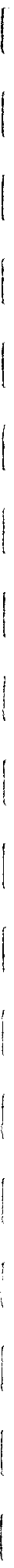


TABLE OF CONTENTS

Weather Summary	1
Accident Statistics	3
Hazard Rating Statistics	6
Call Statistics	7
Personnel	8
Funding	8
Changes This Season	9
Talks	12
Customer Survey	13
Appendix	21

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

Weather and Snowpack Summary 1987-88

Another Dry Season

The 87-88 season, for the second year in a row, was a season most winter recreationalists would rather forget. Not that there weren't some high points, but they were easily forgettable, and scattered sparsely, as they were, between often long periods of dull avalanche activity and horrid skiing conditions. The season started with a whimper, ended with a sigh and fell asleep a couple of times in the middle.

The statistics tell a revealing tale:

Major avalanches with debris on highway in Little Cottonwood Canyon:

1983-84 43 avalanches
1985-86 27 avalanches
1987-88 4 avalanches

Snow Course water equivalent measurements at selected sites:

	Percent of normal for the first of the month	
	April	May
<u>Logan Area:</u>		
Tony Grove Lake	70	59
Tony Grove RS	76	bare
Franklin Basin	--	45
<u>Ogden Area:</u>		
Ben Lomond Peak	57	42
Ben Lomond Trail	55	bare
Farmington Canyon	48	33
Farmington Canyon L.	53	26
<u>Salt Lake Area:</u>		
Parley's Summit	71	26
Lambs Canyon	68	23
Mill Ck	60	49
Mill D South Fork	62	18
Brighton	47	41
Alta Central	66	48
Snowbird Gad Valley	68	--
<u>Provo Area:</u>		
Timpanogas Divide	40	20

Early Season

The whole ugly story began in September and October with some of the finest weather in recent memory, at least for hiking, rock climbing and fly fishing, but not for the operators of the ski resorts. Actually, most avalanche workers were glad to see bare ground in the early season; by contrast, the previous season (1986-87) started with a couple of feet of snow on the ground by the end of September which promptly formed deep layers of dangerous depth hoar on all the more northerly facing slopes--producing deep and frightening avalanche activity throughout the season.

So the 87-88 winter started just the way avalanche workers usually like to see it--snow holding off as long as possible, then coming on strong just in time for the holiday vacations. So goes the theory. However, the first storm of the season on 14 November was, instead, a weak one. Notice the key word here--weak. It set the tone for the entire winter.

Storm totals were a little over a foot in the Cottonwood Canyons and 4 to 8 inches in the other parts of the range. Several more small storms in the second half of November and the first half of December brought the snow depths up to only two feet at most locations above 8,000 feet. It was only the fourth time Alta had missed a Thanksgiving opening in 50 years. In the mean time, the snow was once again rotting into depth hoar--not as deep as the 86-87 season, but dangerous nonetheless.

At last, on 22 December, a storm began that covered some of the rocks, got most of the ski areas open, saving their Christmas season in the nick of time. However, in the backcountry, there was about 2 feet of well-developed depth hoar, and to top off a classic scenario, a thick varnish of surface hoar coated nearly every nook and cranny. The storm started without wind and gently put down 3-6 inches of light snow, then heavier snow on top of that. Needless to say, we issued our first series of avalanche warnings.

Although not a large storm--about 3 inches of water equivalent over three days--it predictably produced extensive activity from avalanche control work at ski areas, and widespread areas of spontaneous avalanches in the backcountry. In almost all cases, the snowpack collapsed on depth hoar causing the slide to fracture and run on the surface hoar above it. (Surface hoar has a lower coefficient of friction than well-developed depth hoar.)

Several skier-triggered slides occurred, almost all of them by ski patrollers at ski areas, but there were several public taking rides at ski areas also. In the backcountry, the public seemed to heed our warnings and there were no serious accidents. This instability persisted into the new year.

January

During January, the weather began to make up for lost time as it produced more days with measurable precipitation than any other period of the winter. The Alta Department of Transportation forecast station recorded 21 consecutive days with some snow although in many cases, amounts were light. Between the 5th and the 9th, Alta received 43 inches of new snow and once again, we called for a high hazard on the steep north-facing slopes. On the 11th 100 mph winds were loading slopes resulting in another Warning. Most of the releases at this time were in areas that had slid in December where the snowpack remained thin and correspondingly weak. Also the Park City side of the range, which had received about half as much snow as the Tri-Canyon area, exhibited weaker snow, as several people discovered when they kicked off slides.

Just when it began to look like a repeat of the dangerous winter before, a strategically placed warming trend during the last week in January settled and stabilized the snowpack. The avalanche dragons lurking in the depth hoar began to slink away and they did not return to bother us for the rest of the winter.

February

By the 8th of February, the snow in the backcountry had been heavily tracked-out. There were an increasing number of confrontations between helicopter-skiing concessions and the backcountry skiers. Our forecasts began advising people to look for unskied snow out of the Park City and Tri-Canyon areas.

The only excitement of the month came with a foot of very heavy 17% density snow accompanied by 60 mph winds on the 9th of February. We issued another avalanche warning. Lots of people took rides in avalanches, but again, no one was killed. Avalanches caught an avalanche-surfing snowmobiler near Logan, and took three experienced Alta ski patrolmen for rides--all in separate incidents. For the next 10 days occasional releases were reported to us, including another snowmobile triggered slide near Ogden. Again, buried surface hoar was the culprit weak layer.

But on the 19th, a major warming trend began that lasted almost two weeks. It set the stage for a very interesting avalanche cycle in March. Long periods of clear, warm weather, are kind of a double edged sword. On one side of the sword, they stabilize the snowpack; on the other side of the sword, on the more northerly facing slopes, they make the top 20-or-so centimeters of the snowpack weaker through diurnally-induced temperature gradient metamorphism.

This is exactly what happened. But by late February, temperatures became so warm that the snow surface, even on north facing slopes at elevations below about 10,000', was becoming damp enough to form a thin melt-freeze crust. On March 2nd, about 2 inches of cold light snow fell without wind, and sat there for two more days of cold clear weather. So there we have it--cold light snow on top of a warm wet crust--the perfect scenario for temperature gradient metamorphism within the new snow. We found widespread areas of it in our field work.

March

Then, on March 6-7, 16-20 inches of new snow fell accompanied by wind and there was widespread areas of avalanche activity within the new snow. Many avalanche workers attributed it simply to new snow sliding on a melt-freeze crust, however, it was actually sliding on an upper level temperature gradient layer. We remained concerned about these buried layers as we were finding quite widespread areas of weak snow buried especially in the Park City Mountains. Why they were not as prevalent in the Tri Canyon Area remains a matter of conjecture--the most likely explanation being the higher elevation.

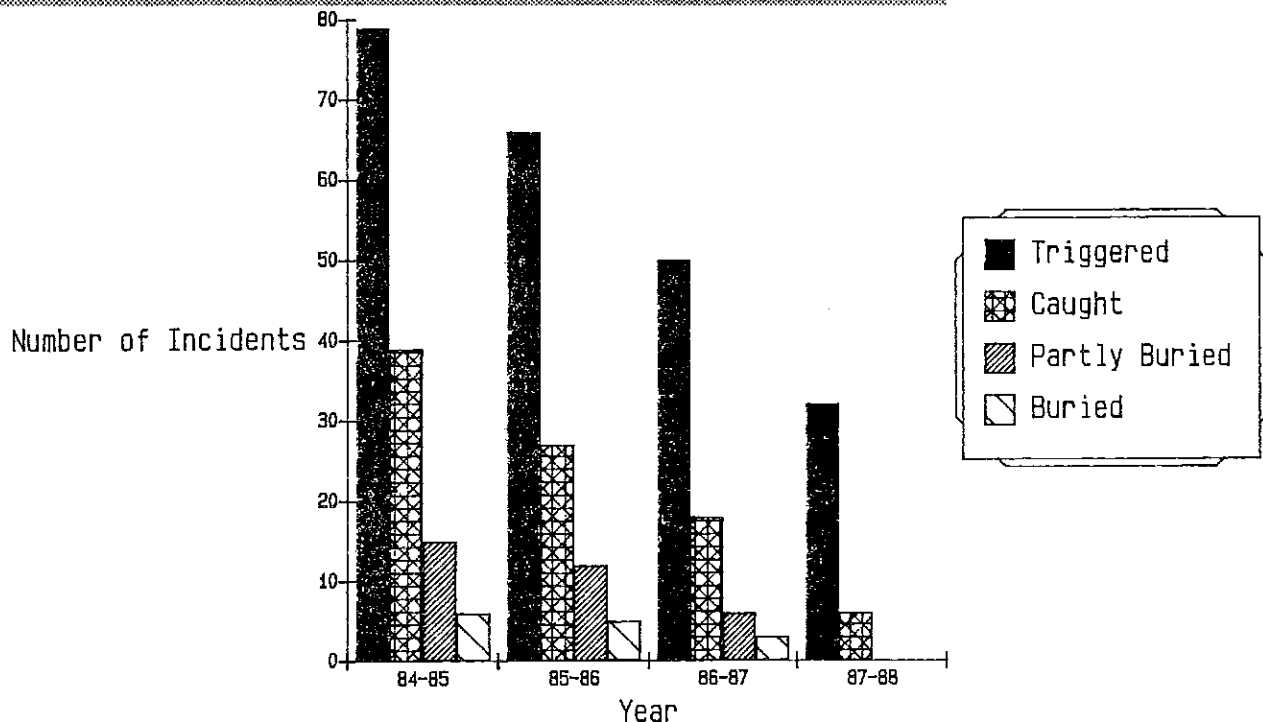
Sure enough, 4 days later, a classic northwest "lake effect" storm arrived delivering 40 inches of snow to Alta and around 2 feet to the mountains near Park West. Avalanche control work in the Salt Lake Mountain produced very little avalanche activity, however, near Park West Ski Area, there were several sympathetic slides from avalanche control work and in the following two days, there were three skier-triggered slides in the backcountry near Park West--all on northeast facing slopes of about 38 degrees or steeper. All slides ran on the fine to intermediate sized upper level temperature gradient layers, either breaking just above the melt-freeze crust (metamorphosed new snow that fell March 2nd) or just below the melt-freeze crust (recrystallized old snow from the February clear period). Fortunately no one was injured. The instability took several days of warmer weather to subside. After that excitement, the remainder of March was rather uneventful.

April

Unfortunately, April was a continuation of the winter's pattern--warm dry and stable. The winter died a slow, lingering death. One by one, the ski areas dropped by the wayside, closing due to lack of snow and/or lack of interest. Even the obligatory round of springtime wet slides were confined mostly to wet sluffs that ran "on schedule" in the sunny afternoons. By the third week of April, after several days where the snow surface failed to refreeze overnight, we became worried about deeper wet slabs breaking to depth hoar layers. However these were only sporadic and the cycle was diminished by a stable snowpack and conveniently placed clouds and cool periods.

By the end, most people wanted to take a big gun and put the suffering winter out of its misery, and make a fresh start next season. It wasn't much of a winter.

Accident Statistics



The number of backcountry avalanche incidents by type for the last four seasons. The number of incidents have been declining.

Table of Accident Statistics

YEAR	TRIGGERED	CAUGHT	AT LEAST PARTLY BURIED	BURIED	KILLED
87-88	32	6	0	0	0
86-87	50	18	6	3	2
85-86	66	27	12	5	5
84-85	79	39	15	6	2
TOTAL	224	90	33	14	9
	100%	40%	15%	6%	4%
		100%	37%	16%	10%
			100%	42%	27%
				100%	64%

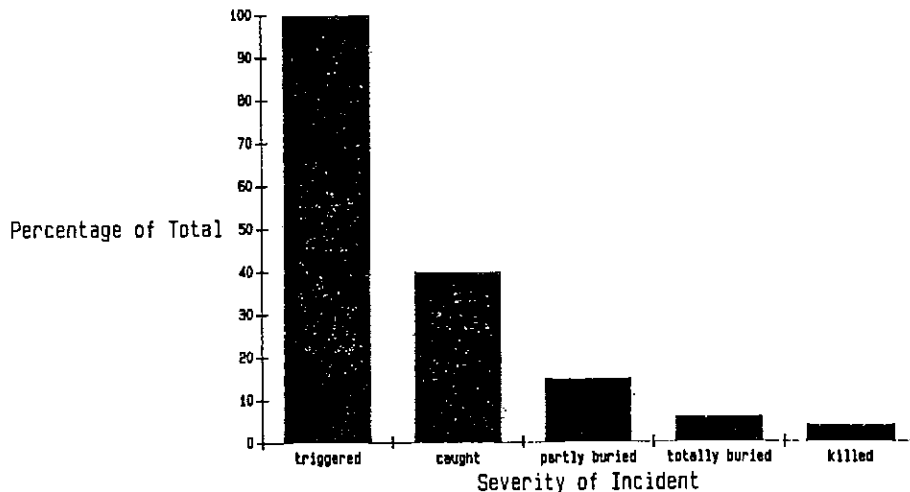
These numbers reflect only backcountry incidents. We do not keep reliable records of incidents by ski patrolers at ski areas. If ski area incidents were added, the numbers would be almost double for the categories, triggered and caught.

As you can see the number of accidents was down dramatically from previous years, and we feel the most important reason for this is the lack of snow and stability of the snowpack. While most low-snow years are unstable snow years, this was not the case this winter. However, there were periods of high instability, and the number of backcountry incidents during these times was surprisingly low. There were several sunny, powder weekends when the local rescue groups were certain they would have to go out, but not once was there a need for an organized rescue. It is during these times when our message is most important, and it really seems as if people pay attention. We have had many of the professionals in the field tell us that we regularly save lives; we can only hope so.

We have also seen a consistent drop in the number of accidents that have occurred in the backcountry during recent years. This is an interesting fact since, if anything our network has improved so that we hear of more accidents than before. Also, there are now more people getting into avalanche terrain than ever before. So we hope that our information is allowing skiers to make better-informed decisions.

The statistics also reveal some other interesting facts. As we have suspected, avalanches are both benign and deadly at the same time. The table, as well as the accompanying figure shows that a very small percentage of people who inadvertently trigger avalanches are killed in them. As a matter of fact, statistically you could trigger 25 slides before you were killed, but if you were caught in a slide, the odds are one in ten that you would not come out alive. If do happen to get totally buried by the slide, your chances are only 1 in three that you'll get another chance.

AVALANCHE INCIDENTS BY SEVERITY 84-88
224 TOTAL INCIDENTS



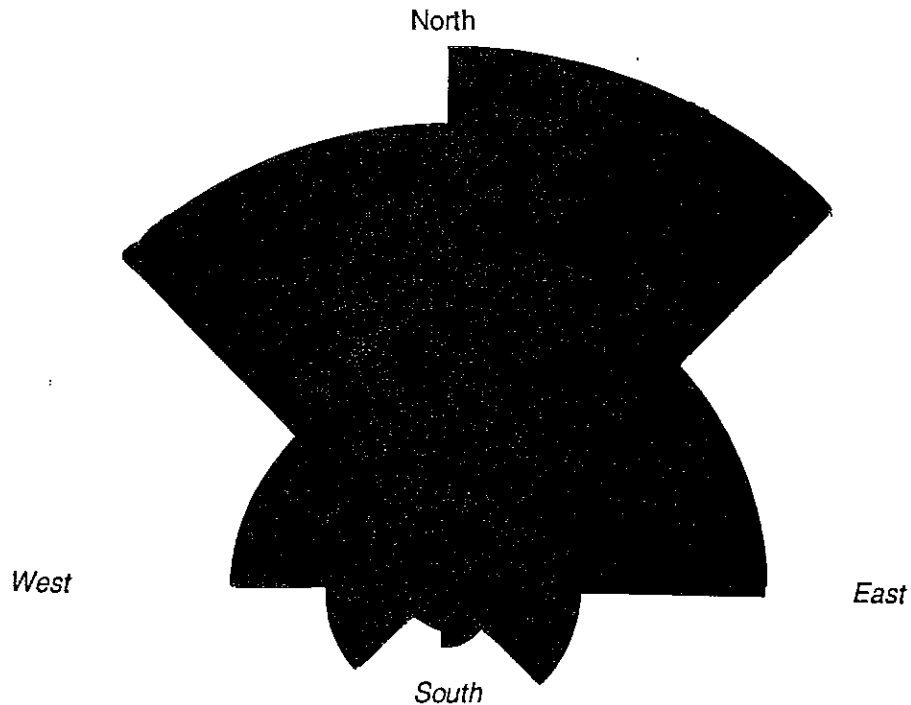
Three of the more significant avalanche incidents involved people on snowmachines, and resulted in the only burial of the year, albeit only a snowmachine. There was one incident on the Logan district, one near Monte Cristo on the Ogden district, and a third adjacent to Deer Valley ski resort. The most notable similarity between the three incidents is that, for the most part, the snowmachines were able to outrun the slides. Being able to accelerate to 70 mph rapidly is an obvious benefit for surviving slides, and it may help explain why so few fatalities have occurred involving snowmobilers.

But probably the more important reasons are: First, snowmachines can't travel in deep snow very easily, so they are forced to wait until new snow settles and, with respect to avalanches, stabilizes. Second, as in the case of the popular hill-climbing areas around Monte Cristo such as Whiskey and Beer Drinker Hills the amount of snowmachine traffic is enough to compact the snow much like a ski area. This can be a very effective avalanche protection technique as long as it is practiced from the very beginning of the year. The trouble would come during at the beginning of a year in which some snow, not enough to ride a snowmobile on, sat for a period of time and became weak. Once a thick weak layer became established, it would be hard to completely compact it.

However, snowmachines are not immune to the danger of avalanches, and their ability to outrun avalanches may provide a false sense of security. We are continually frustrated by our inability to access this group of backcountry users, and we feel that it is dangerous that very few snowmobilers carry avalanche beacons or shovels. Somehow this seems to fit into the attitude of domination of natural forces which is arrogant at best and dangerous at worst.

**Avalanche
Accidents
by
Aspect**

In another analysis of Utah avalanche accidents, 95 avalanche incidents were plotted by slope aspect. As you can see, it tells a story of temperature gradient metamorphism as the lions share of the incidents occurred on northwest, north northeast and east facing slopes--all slopes commonly affected by the temperature gradient process. Because the more southerly facing slopes are almost always free from deep slab instability, we often advise people to stick to south facing slopes after storms, and to give the fragile north and east facing slopes time to adjust their loads.

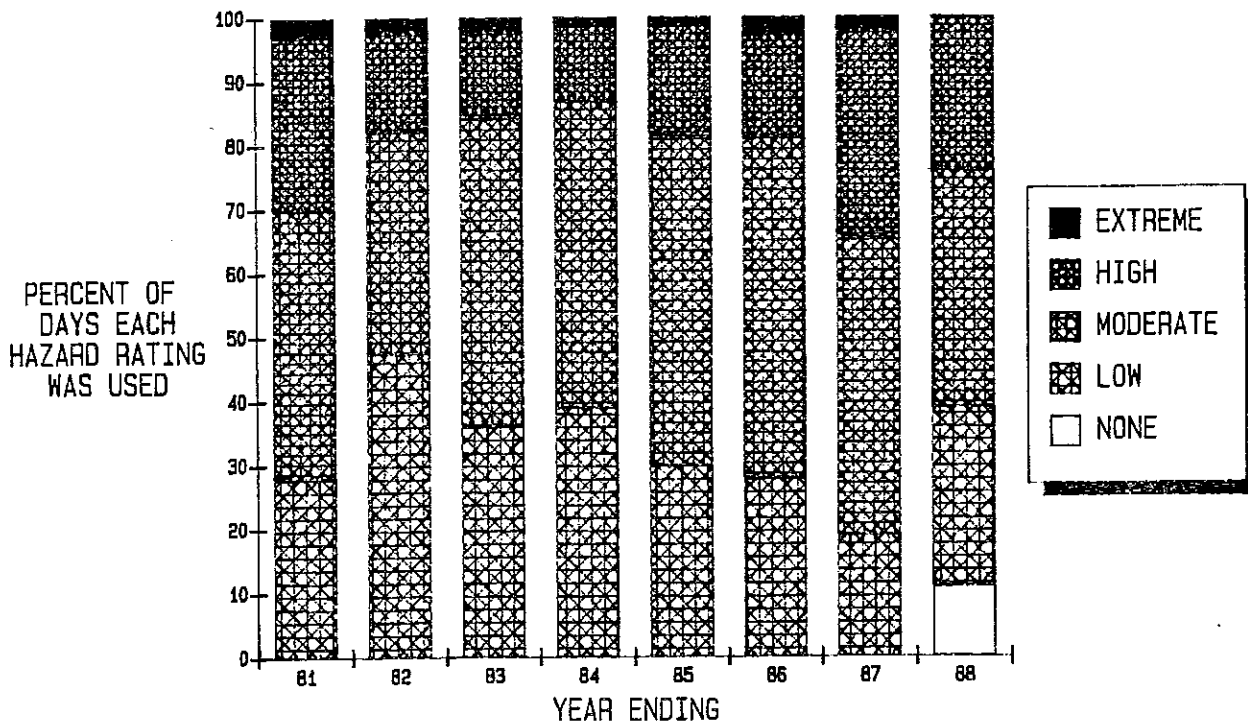
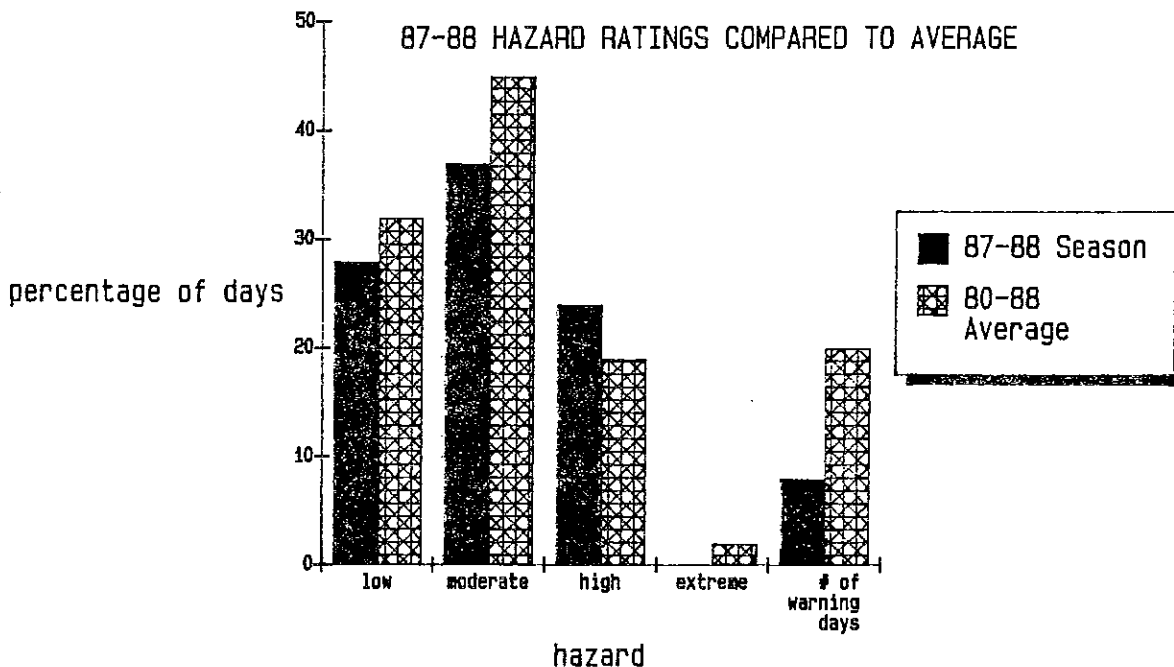


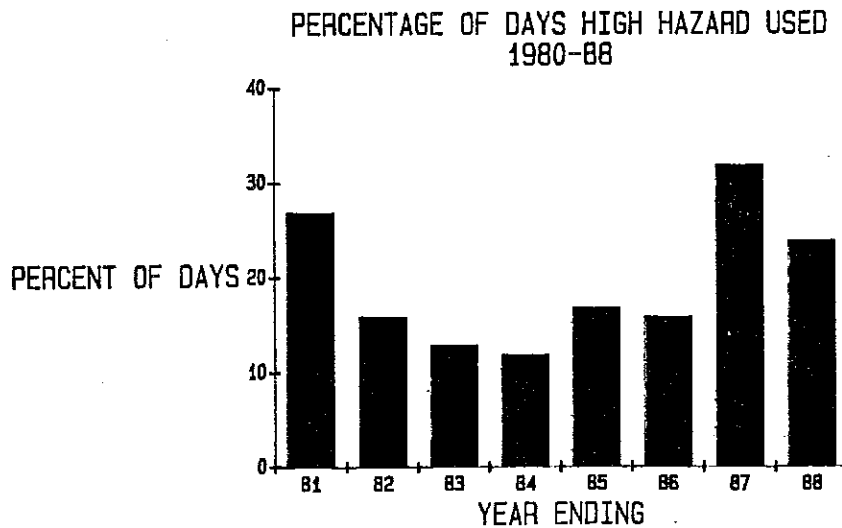
95 avalanche incidents plotted by aspect, in 45 degree increments. The plot tells a tale of temperature gradient metamorphism--which occurs primarily on northwest through east facing slopes.

Hazard Rating Statistics

Description of Hazard Ratings

We use hazard ratings to describe the avalanche potential. We do not use a single hazard rating for an entire region; instead, we use several ratings, using the parameters of elevation, aspect and slope steepness. For example, "There is a high ahzard of human triggered avalanches on north and east facing slopes, above 10,000 steeper than 35 degrees, especially in areas with new accumulations of wind transported snow. We feel there is a moderate hazard on" etc. The following, are plots of the highest hazard rating used each day for the Salt Lake area mountains (Tri-Canyon area).



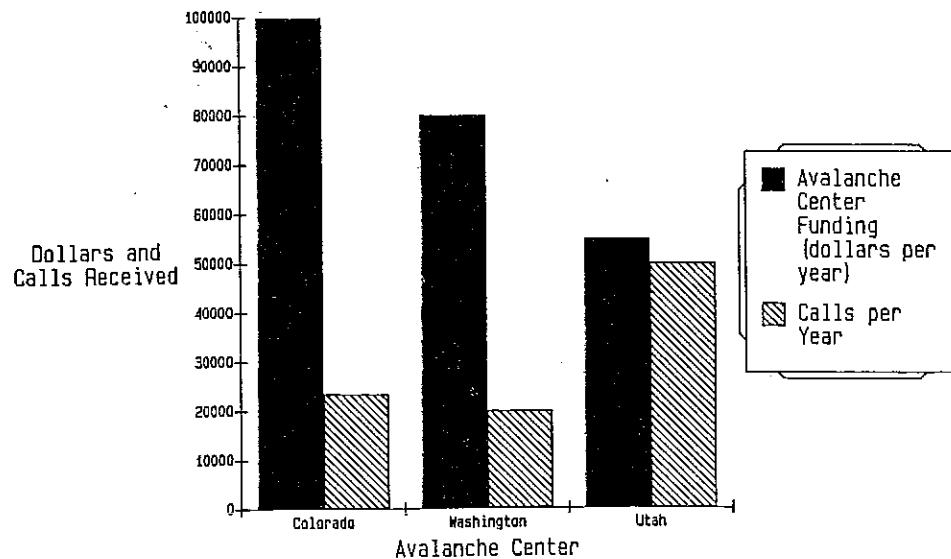


Call Statistics

By the end of April, we received 39,614 calls on the regular Salt Lake 2-minute public recording and 4020 on the 5-minute "observer line. Because we were using new recording machines for the outlying areas of Logan, Ogden, Provo and Park City, we were not able to attach call counters to those machines. We plan to do so for next season. Since this season was fairly similar to last season, we can assume about 2,500 calls to each of the outlying areas, bringing to total calls to around 53,000.

In past years, we have noticed that the call rate tends to closely follow snowfall amounts. However, for the past 2 seasons, the call rate for the Salt Lake public recording has remained near an all-time high even though both seasons were very low snow years. So apparently, the use of the recording is increasing.

The call rate for Utah is over twice as high as any other avalanche forecast center in North America. The reasons for this are subject to debate, however, we feel it is because of the close proximity of the mountains to the heavy population areas of the Wasatch Front, the easy access to backcountry skiing areas, the large populations of backcountry skiers in Northern Utah, and, of course, we hope that our very detailed, useful and entertaining forecasts have something to do with it.



Personnel

This season, we expanded from three to four people--three and a half, actually. The bad news, was that veteran forecaster, Al Soucie, decided to move on to other career opportunities by transferring to the Salt Lake District of the Forest Service as a snow ranger for Big Cottonwood canyon. The good news, is that the Salt Lake District fulfilled its obligation to participate in the Utah Avalanche forecast Center network by releasing Al to forecast for us one day per week.

This was the best of all possible scenarios, because it freed up funds to hire another forecaster. We were lucky enough to be able to choose from three very qualified candidates. By unanimous choice, Tom Kimbrough was chosen.

Tom comes to the UAFC with some hefty experience behind him. He was the Director of the Ski Patrol at Alpine Meadows California, the most active avalanche area in the country. After that, he spent two seasons developing avalanche control plans for the proposed Galena Ski Area in California. Finally, Tom had worked several years as an Alta patrolman. He spends his summers as a seasonal climbing ranger in Grand Teton National Park, which he has done for 12 seasons. Tom is a strong backcountry skier and during his first season, he has earned the praise of countless people for his solid judgement and soft-spoken, tactful manner.

The four person crew is rounded out by Brad Meiklejohn and Director, Bruce Tremper.

All stories, however, do not have a happy ending. Al Soucie has returned to his native state of Connecticut and the Salt Lake District must replace him. Al leaves some large shoes to fill and I hope that his replacement will be able to forecast for us, as Al did. Replacing Al's experience and judgement, I'm afraid, will be an impossible task.

Funding

Currently, the UAFC is funded solely by the U.S. Forest Service, Wasatch-Cache National Forest. In-kind funding is provided by the National Weather Service in the form of office space, long distance telephone service, weather forecasting, computer support, and countless other necessities. We work closely with the National Weather Service forecasters and although our paychecks come from the Forest Service, we feel we are just as much a part of the National Weather Service team.

There are two other fully funded avalanche forecast centers in the U.S., the Northwest Avalanche Center in Seattle, and the Colorado Avalanche Information Center located in Denver. Both of these other centers have more diversified sources of funding. For example, both receive significant funding from the their respective Departments of Transportation for providing mountain weather forecasting. In Colorado, they also receive funding from the local counties, ski areas, rescue groups National and State Parks and Colorado Ski Country.

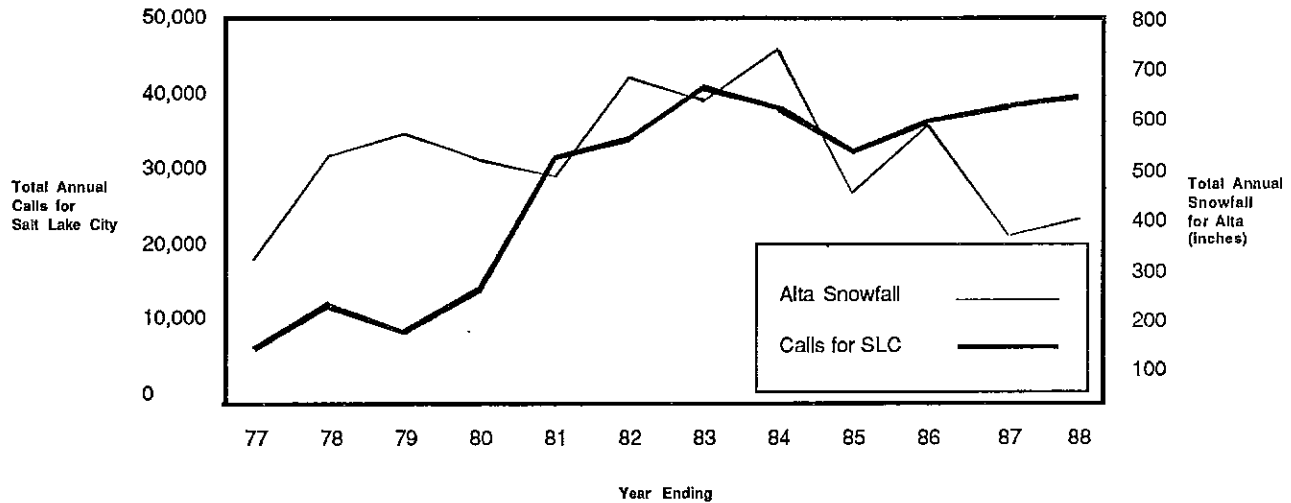
However, in Utah, we have had very little success in finding funding outside of the Forest Service. The reasons for this are varied, however, the bottom line is that we desperately need a higher level of funding. The accompanying figure illuminates this fact as our service is over twice as heavily used as any other forecast center in North America, yet we have a third less funding than the Northwest center and less than half the funding of the Colorado center.

The situation is getting critical. The present demands on UAFC personnel is very high. We find ourselves often putting in volunteer overtime just to keep up with the present quality of our forecasts. Also, we constantly find ourselves saying no to any requests that would increase our work load including added speaking engagements, teaching avalanche classes, participation on committees and increasing the level of our service to ski areas and the regular users of the

recorded avalanche advisory. It seems that everyone wants more from us yet we are not only at our limit, but we have significantly surpassed it.

The prospects for increased support from Federal and State agencies looks bleak. We are presently looking into several sources for private funding including grants, donations, and selling our product to various sources including radio stations. Unfortunately, time spent hustling for money takes away from regular forecasting duties.

Call Rate versus Snowfall



The number of calls for the Salt Lake public recording plotted with total snowfall for Alta. Notice that since 1981, when the Avalanche Forecast Center was in full swing, the call rate tends to follow snowfall rate., however for the last two seasons, the call rate has increased despite drastically reduced snowfall.

Changes this Season

Saving Money on the 1-800 Number

In the past, the only direct line to the UAFC office was a 1-800 number. It was used by all the ski areas to report their weather and avalanche information and to receive weather forecasts from us. It was also used by anyone in Salt Lake City to call the UAFC office. The line cost around \$20.00 per hour whether it was a local or long distance call, and totaled up to around \$4,000 per year. It was clearly an absurd situation.

So we did two things: first, we installed a direct local line into our office--something that should have been done years ago. Second, we asked the ski areas to please call us on the local line instead of the 1-800 number. Most of the ski areas had direct local lines anyway and even if they didn't, most were willing to pay for the call. After all, it is a small price to pay for free weather forecasts and access to the avalanche information network.

In this way, we have been able to save around \$3,000 per season in telephone charges, which is money which is desperately needed for other UAFC activities.

Observer Line

At present, we have a 5-minute recording of more detailed avalanche, snow stability and mountain weather information. This recording was originally set up for the mountain observers such as ski areas, so they could keep abreast of changing conditions. However, we talk by telephone to all the ski areas each day so the use of this line by ski areas has fallen off in recent

number is not published. So why fight it? This season we planned on publicizing the line for the local skiers. However, we were not sure if it would be swamped with calls. Also, we wanted to be certain that the information on avalanche control results at ski areas was not considered "sensitive". So we held off on publicizing the number while we were working out these details.

We did, however, publicize the number for the last month of the season as a trial period to see how it was received. We were happy to see that the line was not saturated as we had feared. Also, our user survey conducted this season showed overwhelming support for the service. So next season, we will publicize the number throughout the season and add another line to the recording if callers are getting a busy signal too often.

Radio Telephones

This winter, the Salt Lake Ranger District loaned the UAFC two King programmable radios which also have a telephone keypad. These radios were able to use the Forest Service repeater on Mt. Ogden as a telephone relay, so that we could call the office from many locations in the field. This was very convenient, as we were able to pass along timely field information rapidly.

For example, there were several occasions in which we were able to issue much more accurate afternoon updates, because without radios, backcountry information usually doesn't get passed along to the Forecast Center until the field observers return home at the end of the day. In another incident, from a nearby ridge, Bruce observed a backcountry skier take a ride in an avalanche. Coincidentally, personnel from the local helicopter skiing company also observed the avalanche and began doing a beacon search of the debris. Bruce was able to radio them that no one was buried in the slide.

New Announce Machines

This season, we replaced the older model multi-line recorded message machines with newer single line models. These machines are located in areas outside the Salt Lake City area in Logan, Ogden, Provo and Park City so the public can access the recorded avalanche advisory without paying for long distance telephone charges.

There was a multitude of problems with the old machines. 1) Each machine was capable of answering 5 calls at once--a clear case of overkill considering the sparse populations in those communities. 2) We were confined to a 2-minute format because they use a loop tape. 3) They require two phone lines, one for recording the announcement and the second for the public to access the announcement. 4) The machines were getting old and were spending much of their time in the repair shop.

The new machines, Dictaphone industrial grade answering machines, are superior because they only require one phone line instead of two. (The savings in phone charges pay for the units in the first year.) Also, because they have a variable length announcement tape, it is much easier to customize the forecast for each remote location instead of being held to the rigid 2 minute format.

Unfortunately, these machines do not have adequate call counters. Because of time and budget constraints, we were not able to find any adequate add-on call counters. Consequently, we do not have accurate numbers for the total calls received from the remote locations. In past years, calls received from outside the Salt Lake City area account for only about 15 percent of the total calls. Since this season was so similar to the past season, we are assuming the call rate remained about the same. Next season, we plan on adding suitable call counters.

Volunteer Network

This year for the first time, the UAFC implemented a volunteer observer program to increase the amount of information which we receive from the outlying areas. The main reason behind this is that we are unable to get to all the portions of our forecast area often enough to provide as accurate a forecast as is expected from us. In the past, we have relied on U.S. Forest Service snow rangers and an informal network of backcountry observers.

To increase the flow of information and reduce the work load for ourselves and the snow rangers, we set up a volunteer program whereby we would pay \$10 per observation to a designated group of individuals.

The money was intended to be an incentive to interested people to relay to us the information that they normally collect on a trip into the backcountry.

We contacted a group of about 30 people who we felt were knowledgeable about snow and avalanches and who were regular backcountry skiers. We were initially concerned with being overwhelmed with information, however, as we had hoped, by mid-season the less

dedicated observers lost interest and we were down to about a half-dozen observers who were giving us regular, quality information that was very useful to us.

In all, we received 134 observations from our observer network, at a cost to us of \$1,340. This is a very small price for a lot of information that would have cost us quite a bit more if we even had time to get it ourselves. For example, the cost for a field day for one of the UAFC staff is from \$60-100, not including the additional travel costs, which to an area such as the Logan mountains, can be as much as \$50.

Another reason why getting more information from the outlying areas is important is that they are becoming increasingly popular as the pressure on the backcountry in the Salt Lake vicinity rises. Over the past few years, the amount of use that we have seen in the outlying areas has risen dramatically, and it is now common to see several groups where it would have been rare to see any two years ago.

TABLE VOLUNTEER PROGRAM OBSERVATIONS

NAME	NOV/DEC	JAN	FEB	MARCH
LOGAN				
Bryan Dixon	7	3		1
Ron Stagg	3	4	2	5
Larry Rodgers	3			
Kevin Kobe		5	7	4
OGDEN				
Brian Smith		4	5	2
Brad Bodily		1	3	3
Derron		1		
PARK CITY				
Greg Dolhausen	11	5	8	13
Brad Makoff	2			
Sean McCabe	4	2		1
Lu Warner		2		
Rip Griffith		2	6	6
SALT LAKE				
Joe Borgione	2	3	2	2
Carol Petrelli	1			
TOTAL	33	31	33	37

We feel that the program has been a success. If nothing else, it flushes the local talent out of the woodwork and we get a chance to work with them--to find, through natural selection, the most valuable observers. In the future, we may just put the more talented and dedicated observers on contract yet still keep the \$10 per day deal going to maintain an open avenue for new talent to join the network. No effort was made in the Provo area to organize a volunteer program, although we have a list of names of interested individuals. Hopefully we will finally find the time to initiate the program there next year.

**Slope
Compaction**

Through the month of December, very little snow fell, and the snow that was on the ground became dramatically weaker. All the avalanche workers in the area knew that we would have major TG problems, and began to perform compaction methods, as some areas had done in previous seasons. We even suggested that backcountry skiers could do boot or ski pack their favorite slopes, and the suggestion was followed in a few areas.

There were a couple instances where the benefits of compaction were obvious; at Solitude, for instance, one part of a slope that hadn't been compacted slid while the other half that had been boot packed didn't slide. We feel this is an important part of early-season avalanche control, and support any such efforts. In addition to increasing avalanche safety, it provides a firmer, longer lasting snow base. For ski resorts, snow on the hill is money in the bank no matter how you look at it.

Talks

DATE	PERSONNEL	LOCATION	TYPE OF TALK	NUMBER
11/11/87	Soucie	REI	Avalanche Awareness	50
11/17/87	Tremper	Blasters Seminar	Explosives and Snow	150
11/18/87	Tremper	U of U Geography Dept	Avalanche Awareness	16
11/21/87	Tremper	Montana Aval Fcst Cnt	Avalanche Awareness	140
12/5/87	Tremper	Snowbird	Avalanche Awareness	100
12/7/87	Meiklejohn/ Tremper	IME	Rescue Beacons	6
12/9/87	Meiklejohn	IME	UAFC Functions	10
12/10/87	Meiklejohn/ Kimbrough	Brighton High School	Avalanche Awareness	55
12/10/87	Soucie	Roland Hall	Avalanche Awareness	12
12/16/87	Tremper	KSL Radio interview	Avalanche Awareness	37,000
12/29/87	Tremper	KSOP Radio	Avalanche Awareness	50,000
12/30/87	Tremper	Park City TV Station	Avalanche Awareness	6,000
1/8/88	Meiklejohn	Utah State University	Avalanche Awareness	30
1/9/88	Meiklejohn	Logan	Volunteer Training	10
1/13/88	Tremper	Logan	Volunteer Training	15
1/16/88	Meiklejohn	Ogden	Volunteer Training	10
1/19/88	Meiklejohn	REI	UAFC/Weather Talk	12
1/21/88	Tremper	Snowbird	Avalanche Awareness	80
2/8/88	Tremper	U of U Snow Dynamics	Snow Mechanics	25
2/10/88	Tremper	Layton	Avalanche Awareness	120
2/17/88	Tremper	Salt Lake City	Avalanche Awareness	40
2/24/88	Kimbrough	Mt. Bell Telephone	Avalanche Awareness	45
2/25/88	Kimbrough	Jordan School	Avalanche Awareness	35
2/26/88	Kimbrough	Int. Mtn. Equip.	Mountain Weather	12
Total in-person audience				973
Total radio/television audience				93,000

Customer Survey

This season, we conducted a very detailed user survey of our customers, to see how we are doing and how we can improve our service. Questionnaires were distributed by leaving them under windshield wipers at popular trailheads, leaving them at sports shops and soliciting callers on the recorded public avalanche advisory. In all, 154 surveys were returned to us. The survey was conducted under the independent guidance of Dr. Tim Larson, Department of Communications at the University of Utah. Questions for the 4 page survey were formulated cooperatively by the UAFC staff and Dr. Larson.

The Colorado Avalanche Information Center conducted a similar survey last season. So we included some key questions from the Colorado survey--worded identically--so we could make some comparisons between the populations.

The survey produced a wealth of valuable information. In general, we found that most people answered the questions more or less the way we expected they would. However, the purpose of a survey is not to find out what you already know but to reveal the surprises--to find out the misconceptions you may have had about your customers. And luckily, in this survey, there were some surprises and consequently we were able to illuminate some ways we can improve our service.

The gross tabulation of percentages is presented here. In some questions, these numbers are meaningful while in others, it may be misleading. I have marked the misleading ones and provided explanations when appropriate.

As you can see, the average caller is male, between the age of 25-35, lives in the Avenues or near the University, most are backcountry skiers, ski area skiers and climbers. Apparently most of the respondents are quite sophisticated as far as their skiing and avalanche skills and their avalanche experience. We suspect, however, that because we conducted the survey toward the end of the season, we sampled the more "hard-core" population of the Wasatch and that the more casual caller is perhaps under represented.

But as we originally suspected, when asked to rate both their skiing skills and their avalanche skills, almost everyone ranked at least one notch higher in skiing skills than avalanche skills. In other words, the majority of people's avalanche skills are not keeping up with their skiing skills.

I'm assuming the reasons for this are because improving on ones skiing skills is fun while improving on avalanche skills takes a certain amount of discipline. Another reason may be that although there are a large number of avalanche classes offered along the Wasatch Front, many seem to be out of date; since the Forest Service has relinquished its role in avalanche research and dispersal of information, the trickle-down from the well-funded European and Japanese avalanche programs simply does not occur. As a result, many American avalanche classes seem to about 10 or 15 years behind the times.

So it's no wonder that 76 percent of the respondents indicated that they have been involved with an avalanche sometime in their life. Also, the average person has witnessed 5.2 human triggered avalanches, has triggered 2.6 avalanches, been caught and carried in .408, been partly buried in .2 and totally buried in .008 avalanches. It seems that most of the people have been learning about avalanches through trial and error.

Apparently, that is the way they do snow stability analysis too. Based on all the information available to them, including from snowpits, only a small minority indicated they could decide if the slope was safe or not with a reasonable degree of certainty (with 90 percent confidence). Many of us feel strongly that if people were taught up to date snowpit techniques, and with some experience, most of them could decide if a slope was safe or not at least 90 percent of the time.

In the past two seasons, we have tried to make the forecasts more entertaining by including humor where appropriate, using active voice instead of passive voice, and including analogies where possible. In this way, the forecast became more humanistic and sounded less like a "government recording". The statistics indicated that people called more often and we feel this is an important step in avalanche education; we have more opportunities to "preach the avalanche gospel" and callers tend to follow the evolution of the snowpack day by day.

**Skiing
Skills
versus
Avalanche
Skills**

**"Entertain-
ment"**

UTAH AVALANCHE FORECAST CENTER

USER SURVEY 1988

Once again, the Utah Avalanche Forecast Center is surveying our users. We want to know how we can improve the service and gather some general statistical information on the typical backcountry users of the Wasatch. We are asking you to carefully fill out this survey and answer the questions as honestly and thoughtfully as possible.

This survey is conducted under the guidance of Tim Larson, PhD, Department of Communications, University of Utah.

Please check the appropriate box:

Gender: 80 Male 20 Female

Age: 1 0-18 8 18-25 68 25-35 19 35-45 3 45-55 1 55-65 0 65+

Zip Code _____

Nine highest ranking zip codes:

<u>84105</u> 15.8%	<u>84106</u>	8.6%	<u>84092</u>	5.0%
<u>84103</u> 13.7%	<u>84102</u>	7.9%	<u>84060</u>	5.0%
<u>84108</u> 10.1%	<u>84121</u>	6.5%	<u>84321</u>	2.9%

Indicate the number of days each month you typically spend doing the following activities::

<u>5.3</u> backcountry skiing	<u>4.7</u> Ski area skiing
<u>.07</u> backcountry snowboarding	<u>.07</u> ski area snowboarding
<u>.16</u> backcountry snowmobiling	<u>2.4</u> mountaineering/climbing
<u>1.2</u> X-C skiing on gentle slopes	<u>.65</u> Other backcountry recreation

How many years have you been using this service? 4.5

How many years have you been traveling in winter backcountry avalanche terrain? 7.4

Have you been involved with an avalanche? yes 76 no 23

If yes, please indicate the number of times you have been involved in each of the following:

HUMAN TRIGGERED AVALANCHES

5.2 witnessed a triggered avalanche
2.6 triggered an avalanche
.41 been caught and carried
.2 been partially buried
.01 been totally buried

NATURAL (SPONTANEOUS) AVALANCHES

4.3 witnessed a natural avalanche
.04 been caught and carried
0 been partially buried
0 been totally buried

Please indicate the areas you tour or would consider touring:

52 Willow Heights 50 Broad's Fork 81 Silver Fork 64 Beartrap
73 Maybird 74 Gobbler's Knob 15 Stairs Gulch 68 Grizzly Gulch
84 White Pine 78 Cardiff Fork 69 Dog Lake 65 Mill B South
59 Superior summit 50 Sunset Peak 36 Dutch Draw 19 Mountain Dell

Rate your skill level. Can you comfortably and consistently ski or snowboard on a backcountry slope of equivalent steepness as:

0 less than a beginner hill at a ski area or do not ski
0 a beginner slope at a ski area (10-25 degrees)
8 an intermediate slope at a ski area (25-30 degrees)
19 an advanced slope at a ski area (30-35 degrees)
48 an expert slope at a ski area (35-40 degrees)
25 extreme skiing (40 +)

Rate your level of avalanche education and/or skill:

- 1 have no knowledge of avalanches
9 have some knowledge of avalanches but not read books or taken classes
26 have read at least one avalanche book and/or attended a 1 hour avalanche awareness talk.
45 have read several avalanche books and/or have taken a 1-4 day seminar from a reputable instructor, or equivalent
16 have taken a week-long course or equivalent
4 feel comfortable being an instructor for a multi-day avalanche course.

If you only had information available to you from one or more snowpits from the slope in question, check the percent of time you could give an accurate stability analysis?

0 100% 3 90-100% 14 80-90% 21 70-80% 23 50-70% 19 30-50% 20 0-30%

Based on all the information available to you, if you decide to cross a slope, what percentage of time are you confident that the slope will not slide.

3 100% 30 90-100% 27 80-90% 19 70-80% 11 50-70% 5 30-50% 5 0-30%

Pretend you are about to cross an avalanche path of average size with a weak layer buried 2 feet down. If someone could tell you with certainty, what the probability of that slope sliding, what level would you feel is acceptable.

14 0% 37 0-5% 17 5-10% 10 10-20% 4 20-30% 6 30-50% 11 50-70%

Note: So many people apparently misunderstood this question that the results are probably meaningless. If we assume that all the people who checked the two highest categories misunderstood the question, we can reclassify their answers into the respective lower end categories, then the question may yield some meaningful results.

If the Avalanche Forecast Center gives a hazard rating for a certain type of slope in a particular area, what do you feel is the probability of triggering an avalanche if you crossed that slope: (feel free to check more than one box if appropriate.)**LOW HAZARD:**

44 0-5% 33 5-10% 8 10-15% 8 15-20% 4 20-50% 3 50-70% 0 70-100%

MODERATE HAZARD:

2 0-5% 16 5-10% 21 10-15% 26 15-20% 23 20-50% 10 50-70% 0 70-100%

HIGH HAZARD:

0 0-5% 2 5-10% 9 10-15% 8 15-20% 21 20-50% 42 50-70% 17 70-100%

EXTREME HAZARD:

0 0-5% 1 5-10% 0 10-15% 7 15-20% 8 20-50% 17 50-70% 67 70-100%

On an average-sized avalanche path, what do you feel is the probability of being killed or injured in:**a 6 inch deep sluff:**

40 0-5% 25 5-10% 19 10-15% 9 15-20% 4 20-50% 2 50-70% 2 70-100%

a 6 inch deep soft slab breaking 100 feet wide:

4 0-5% 17 5-10% 19 10-15% 20 15-20% 25 20-50% 11 50-70% 4 70-100%

a 1 foot deep soft slab breaking 100 feet wide:

0 0-5% 3 5-10% 11 10-15% 13 15-20% 32 20-50% 27 50-70% 14 70-100%

a 1 foot deep hard slab breaking 600 feet wide:

0 0-5% 0 5-10% 4 10-15% 8 15-20% 12 20-50% 36 50-70% 41 70-100%

a 2 foot deep hard slab breaking 600 feet wide:

0 0-5% 0 5-10% 0 10-15% 4 15-20% 5 20-50% 18 50-70% 72 70-100%

If the Avalanche Forecast Center says "moderate hazard" for a particular type of slope, what does this mean to you?

Underrate the hazard --3.6% About right---50.0%
Overrate the hazard---14.5% Way off base --31.9%

Do you travel alone in the backcountry?

24 never 27 almost never 15 seldom 21 sometimes 9 often 3 almost always 0 always

Do you carry an avalanche rescue beacon and a shovel?

10 never 3 almost never 1 seldom 1 sometimes 3 often 17 almost always 65 always

How many times per season do you practice with your beacon? _____

mean= 3.3

mode= 2.0

So you camp overnight?

20 never 19 almost never 28 seldom 26 sometimes 7 often 0 almost always 0 always

Do you dig a snowpit to see if the slope is safe?

12 never 14 almost never 12 seldom 27 sometimes 21 often 10 almost always 3 always

Do you avoid avalanche terrain?

1 never 3 almost never 7 seldom 25 sometimes 28 often 30 almost always 6 always

If there were no risk of avalanches, would you enjoy the backcountry more?

5 never 1 almost never 4 seldom 20 sometimes 18 often 18 almost always 34 always

Do you enjoy the challenge of travelling in hazardous avalanche terrain?

19 never 9 almost never 12 seldom 32 sometimes 18 often 7 almost always 2 always

Do you call the avalanche recording before you go out?

0 never 1 almost never 1 seldom 3 sometimes 6 often 40 almost always 50 always

Why do you call the avalanche recording? for:

New snow amounts 2 never 4 seldom 9 sometimes 31 often 54 always

snow stability 1 never 1 seldom 4 sometimes 22 often 72 always

mountain weather 1 never 1 seldom 9 sometimes 25 often 65 always

what to wear 41 never 20 seldom 17 sometimes 9 often 13 always

where to go 18 never 13 seldom 28 sometimes 25 often 16 always

road conditions 45 never 32 seldom 13 sometimes 5 often 5 always

If you could call a 5-minute recording that provided more detailed information than the standard 2-minute recording, how often would you call it?

1 never 1 almost never 4 seldom 25 sometimes 20 often 26 almost always 22 always

Is the snow and avalanche information accurate?

0 never 0 almost never 0 seldom 2 sometimes 26 often 67 almost always 5 always

Is the mountain weather information accurate?

0 never 0 almost never 0 seldom 12 sometimes 36 often 48 almost always 4 always

Please check which of the following subjects you would like to hear about in more detail, even if it makes the message a little longer?

57 mountain weather information (temp. wind, clouds, precipitation, etc.)

76 snow stability information (layering, weak layers, distribution, etc.)

86 avalanche information (types, where, why, dimensions, etc)

Is the message:

0 too long 0 too complicated 4 too "entertaining"
27 too short 20 too simple 10 not "entertaining" enough
73 just right 80 ust right 86 just right

How important are the adjectives used to describe the avalanche hazard (low, moderate, high and extreme)?

0 not important 7 somewhat 13 neutral 28 mostly 52 very important

What is your present overall satisfaction with the content, quality, and accuracy of the message?

0 totally unsatisfied
1 moderately unsatisfied
5 neutral
36 moderately satisfied
58 totally satisfied

How important is this service to you for staying alive in backcountry avalanche terrain?

1 not important 7 somewhat 7 neutral 25 mostly 60 very important

What is your overall opinion of the value of this service?

0 worthless 1 poor 1 fair 12 good 86 excellent

What can be done to improve the service?

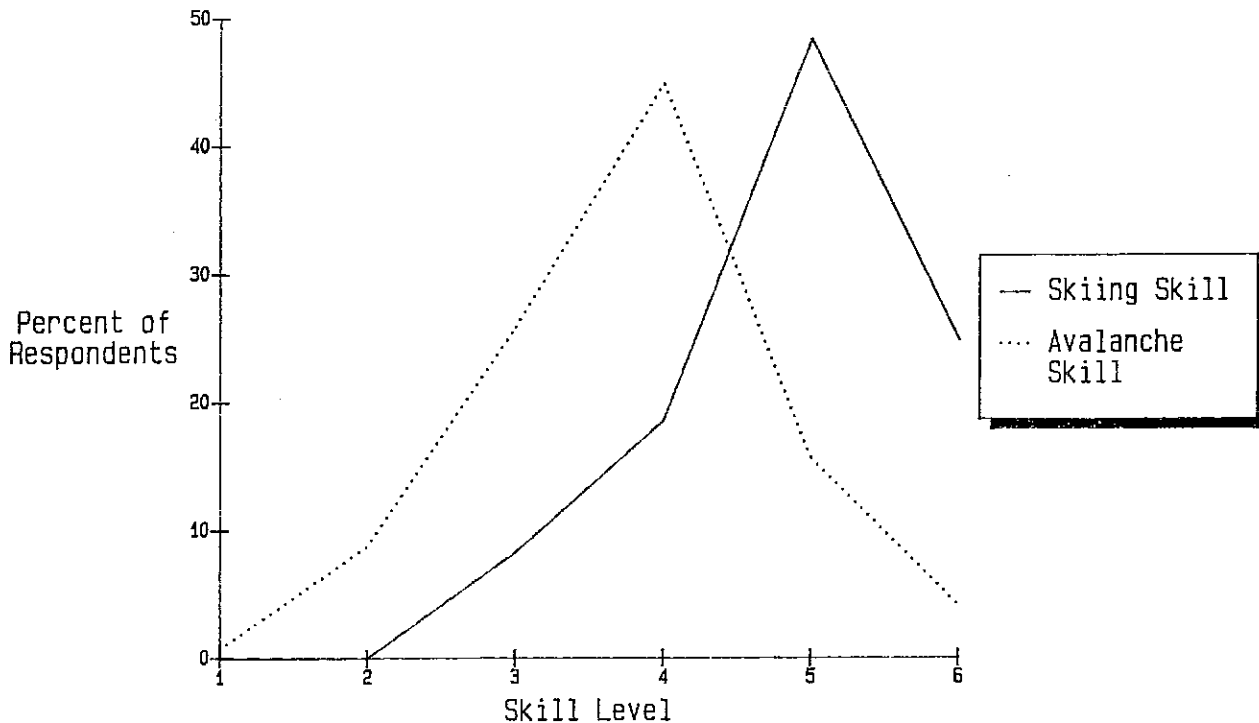
These free-form answers generally fell into the following categories:

More information or more detailed information---67.7%
Earlier forecasts-----11.5%
Unrealistic demands -----9.4%
Say where the helicopters are skiing -----4.2%
Poor recording quality-----4.2%
More afternoon updates-----2.1%
Talk too fast-----1.0%

What do you like about the service?

These answers were not categorized because of the very wide variety of wonderful things people said.

Only if you wish, leave your name, address and telephone number, if we have further questions.



Skiing skills plotted against avalanche skills. Notice that most people's skiing skills rank at least one notch above their avalanche skills.

Beacons

We became concerned that we had become "too entertaining". So in the survey we asked the question, "Is the survey too entertaining, not entertaining enough or just right." We were relieved that the vast majority of the survey respondents said that the forecast was just right, and over twice as many people said that we were not entertaining enough rather than too entertaining. In fact, in the comments section, many people said they "loved the humor and the personal touch". So we plan on continuing the entertainment but not at the expense of more important information.

We were pleased to see that 82 percent of the respondents said they always or almost always carried beacons and shovels. You should note that this number also includes those who only ski at ski areas. If we refigured the number to included only backcountry recreationalists, the number would be around 90 percent. In contrast, the Colorado Avalanche Information Center estimates that only about 40 percent of Colorado backcountry users carry beacons.

However, one of the more frightening statistics is that the average respondent only practices with their rescue beacon 2-3 times per season. Actually, this doesn't surprise us. On the recordings and in our talks, we often preach about practicing with beacons. For example, most professional patrollers practice once per week. It is a skill which must be well refined to be useful because a victim dies rather quickly under the snow. If nothing else, you find out if your beacon is working or not. We have always suspected that although most people carry beacons, most people could not find their partner in time to save their life--or at least their brain tissue--the first part of the body to die from lack of oxygen. We will continue to preach about practicing with beacons.

Perception of Hazard Categories

One of the main reasons we wanted to conduct the survey was to find out what people's perceptions are of the various hazard ratings, low, moderate, high and extreme. We have always suspected that people had a fuzzy understanding of these ratings--moderate hazard in particular.

When asked to check what they felt the probability of triggering a slide for the various hazard categories, most people predictably checked in the 0-10 percent range for low hazard; however for moderate hazard, there was a large scatter of answers mostly from 5 through 50 percent. For high hazard, there was also a fairly large scatter from 20-100 percent and for extreme, most

people felt there was between a 50-100 percent probability of triggering a slide.

If anything, people's perceptions of the human triggered potential seems too conservative; most people chose higher probabilities than we, as forecasters, would have chosen. For example, in polling the UAFC forecasters, we would guess that low hazard would include less than 5 percent probability of triggering a slide, moderate hazard about 5-20 percent, high hazard about 20-40, and extreme hazard about 40-80 percent. The customers response seems to match the forecasters response more closely in the low and extreme categories, and less so in moderate and high.

In another question on moderate hazard, we asked the respondents to tell, in their own words, what moderate hazard means to them. I put each response into one of four categories: 1) underrating the danger, 2) about right, 3) overrating danger, and 4) a category I called "way off base". An example of underrating the hazard would be "go skiing, it's safe". For someone to be counted in the "about right" category, they must say something about digging snowpits, or analyzing the snowpack for themselves or localized areas of human triggered potential-- something to that effect. The overrating the hazard category included answers like "50-100 percent chance of an avalanche" or "you're gonna die!" etc. Finally in the way-off-base category would include something like "there's a large probability of a small slide and a small probability of a large slide". Nice try but no bananas.

50 percent were about right, 4 percent underrated the danger and 14 percent overrated the danger. This is especially interesting, because before we conducted the survey, our gut feeling told us that most people underrated a moderate hazard. Perhaps the reason we felt this way is illuminated by the fourth category, way off base, in which 32 percent of the responses unfortunately fell. In other words, 32 percent of the people filling out the surveys did not have a clear enough perception of what moderate hazard means to adequately verbalize it.

And finally, when asked how important the adjectives are in describing avalanche hazard (low, moderate, high and extreme) although the majority (52 percent) said they were very important, a sizeable chunk were more lukewarm about the adjectives. 48 percent picked somewhat, neutral or mostly--not a resounding show of support for the hazard categories. In a similar question on the Colorado survey, only 33 percent indicated they were "absolutely helpful" and 50 percent checked "mostly helpful".

For these reasons, among others, we still feel that avalanche hazard categories are far from perfect in describing avalanche danger. At this time, we have no other viable alternatives, so we will continue to use them in the future. However, we usually bury them in the general discussion in order to force people to pay attention to the more important information and not to make simplified decisions based on simplified categories.

One of the more interesting questions is, "Do you enjoy traveling in hazardous avalanche terrain?" Almost half of the people chose sometimes, often almost always or always. In other words, there is a significant number of people who enjoy the factor of risk, probably the same way a rock climber enjoys pitting his or her skills against very inflexible rules of nature with similarly inflexible consequences for mistakes.

This finding is supported in a recent survey conducted by Mike Jenkins et. al., of Utah State University in Logan. They surveyed 200 backcountry skiers at trailheads. The results indicate that although most of the skiers were beginners or intermediates in skiing skill as well as avalanche skill, 34 percent of the skiers felt that risk enhanced their experience and 10 percent considered risk to be a major factor in their enjoyment of skiing and they look for opportunities to encounter it.

For this reason, it is important that avalanche classes address those people who are out there to beat the odds. In other words, they need to teach up to date techniques on snow stability analysis and safe ways to ski avalanche terrain.

In the interesting-psychological-aspects-of-conducting-surveys department, when I was tabulating the survey, I was very interested to see that about a third of the people refused to divulge their zip code. The question seem rather harmless to me. Perhaps the problem was that it was the third question on the survey and we were just hitting people with it too soon. I say this because the last statement of the survey said, "Only if you wish, please leave your name, address and phone number." Almost everyone did, including all the folks who refused to leave their zip codes in the third question. Interesting.

The key question on the survey was "What is your present level of satisfaction with the

Risk Taking

Everyone Wants More Information

content quality and accuracy of the forecast?". I was originally disappointed to find that only 58 percent were totally satisfied and 36 percent were moderately satisfied. However compared to the same question asked on Colorado's survey last season, the Utah customers were much more satisfied with the Utah forecast than the Colorado customers were with the Colorado forecast. For example, in Colorado, the majority, 61 percent, indicated they were only moderately satisfied, while only 24 percent said they were totally satisfied.

But the good news is that of all of the Utah respondents who indicated they were less than totally satisfied, most of them (77 percent) said their chief complaint was that they simply wanted more information; 8 percent said they wanted more afternoon updates (we issue afternoon updates only during times of changing conditions); and 7 percent said they wanted earlier forecasts (we issue them by 7:30).

This is very interesting because one of the chief reasons we conducted the survey was because of our concern that we were presenting a higher level of detail than most people could absorb. However, the survey results indicate just the opposite--that too much information is better than not enough.

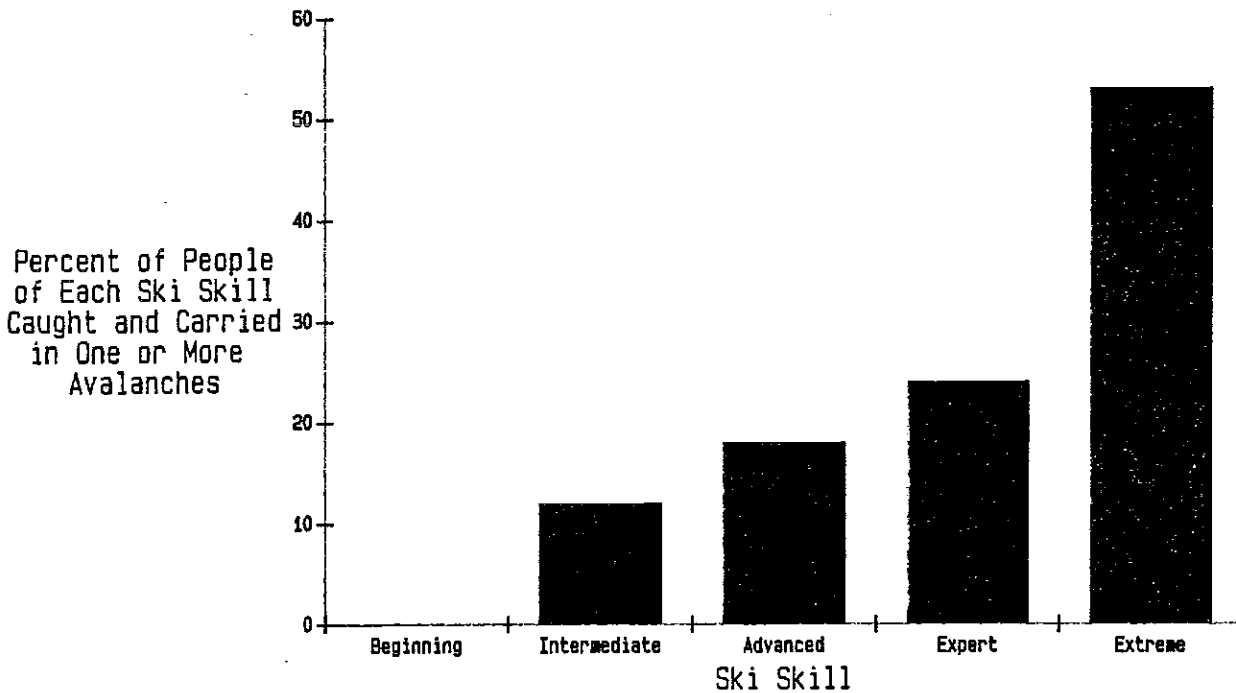
Consequently, next season, we plan on issuing afternoon updates on a more regular basis, increasing the length of the message from 2 minutes to 2 1/2 minutes, and publicizing the number for the 5 minute recording where extremely detailed information will be available.

Finally, when asked, "What is your overall opinion of the value of this service?", 98 percent said either good (12 percent) or excellent (86 percent). So in summary, people resoundingly think the service is valuable. Also, they are generally satisfied with the content of the message but those who are less than totally satisfied want more information. In other words, people like what we are doing, but they simply want more of it.

Crosstabs

This summer we plan to perform numerous crosstabulations on the data to find some of the other interesting relationships. We did have time to run some of the more simple crosstabulations before the writing of this report. One interesting relationship is that the greater the skiing skill, the more likely that that person will be caught and carried in at least one avalanche. We will present a more detailed report of crosstabulations in the fall.

SKI SKILL VERSUS AVALANCHE INCIDENTS



A plot of skiing skill against the number of times someone has been caught and carried in a human triggered avalanche. Notice that the greater one's skiing skill, the greater chance of being caught and carried in an avalanche.

Appendix

ACCIDENTS

YEAR	TRIGGERED	CAUGHT	AT LEAST PARTLY BURIED	BURIED	KILLED
87-88	32	6	0	0	0
86-87	50	18	6	3	2
85-86	66	27	12	5	5
84-85	79	39	15	6	2
TOTAL	224	90	33	14	9
	100%	40%	15%	6%	4%
		100%	37%	16%	10%
			100%	42%	27%
				100%	64%

HAZARD CATEGORIES

TABLE SUMMARY OF FORECAST HAZARD RATINGS

HAZARD	LOW	MODERATE	HIGH	EXTREME	NONE	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
87-88	42 28%	56 37%	36 24%	0 0%	17 11%	8
AVERAGE	32	45	19	2		20

TABLE 3

	TOTAL CALLS FOR YEAR		SNOWFALL FOR YEAR AT ALTA
	All areas	SLC	
1976-77	6,522		314.5
1977-78	11,258		524.5
1978-79	9,924		588.0
1979-80	14,469		514.0
1980-81	30,736		391.0
1981-82	41,610	33,099	696.0
1982-83	53,315	40,355	637.0
1983-84	54,325	38,408	743.5
1984-85	43,498	32,476	457.0
1985-86	52,322	36,535	599.0
1986-87	50,760	38,841	378.0
1987-88	?	39,614	410.3

TABLE 4

MONTHLY CALL RATE

	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY
79-80	714	1,514	4,274	2,967	3,389	1,313	
80-81	2,200	4,800	6,257	7,277	6,887	3,135	172
81-82	1,761	6,879	8,522	5,485	6,361	3,416	675
82-83	2,741	6,804	7,614	7,731	9,911	5,339	315
83-84	3,216	10,708	7,073	7,032	5,983	4,396	
84-85	2,827	5,704	5,260	8,399	7,122	3,021	
85-86	4,119	4,703	6,298	10,628	6,255	3,706	
86-87	3,903	3,911	10,022	8,201	8,364	3,406	621
87-88	2,390	6,534	10,201	7,297	9,208	3,780	