

SNOW AND AVALANCHE

COLORADO AVALANCHE INFORMATION CENTER

ANNUAL REPORT

1987-88



COLORADO GEOLOGICAL SURVEY
COLORADO DEPARTMENT OF NATURAL RESOURCES
1313 SHERMAN STREET, ROOM 715
DENVER, COLORADO 80203

JUNE, 1988

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COLORADO AVALANCHE INFORMATION CENTER

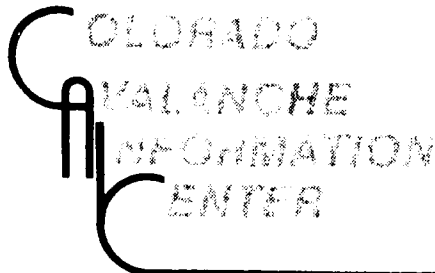
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Colorado Department of Natural Resources

Colorado Avalanche Information Center
10230 Smith Road
Denver, Colorado 80239
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DIRECTOR'S STATEMENT

To Our Sponsors and Patrons:

Snow avalanches have always posed a threat to people living in and visiting the Colorado mountains, and have caused, on a regular basis, property damage and loss of life. It was a problem that begged solution, and the roots of the Colorado Avalanche Information Center can be traced to avalanche research performed by the U.S. Forest Service in the 1960's and 70's.

In 1983 the Center was founded within the Colorado Department of Natural Resources on the belief that the impact of avalanche hazards on those living, working, visiting, or recreating in the Colorado mountains could be lessened by a program of education and forecasting. In that year a group of sponsors who believed in this mission came together to share the costs of the program.

We have completed our fifth year of operation, and our first year within the Colorado Geological Survey. We feel that it was an especially successful year. Some highlights were:

- Our sponsors have voiced strong support in carrying out our mission of public service and safety.
- We have built a credible program in the eyes of the public.
- The public has made more use of our avalanche hotlines than ever before.
- Our educational efforts and our participation in Avalanche Back Country Safety Week allowed us to reach more people than ever before.
- Our staff, composed of a team of four avalanche professionals, is stronger than ever.
- Serious avalanche incidents and avalanche-caused deaths were down significantly from a year ago -- in part, no doubt, because of the efforts of the Center and its sponsors.

The Colorado Avalanche Information Center is committed to providing the best possible service to the citizens of Colorado and our sponsors. This Annual Report details the accomplishments of the Center in 1987-88.

It is your support that makes the Center possible. We thank you.

Sincerely,

A handwritten signature in cursive script that reads 'Knox Williams'.

Knox Williams
Director

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EXECUTIVE SUMMARY

Administration: The Colorado Avalanche Information Center is managed by the Colorado Geological Survey of the Department of Natural Resources. Knox Williams is program director.

Funding: The Center is totally cash funded. In FY 87-88, total revenues were \$112,010.

Housing: The Center is housed at the National Weather Service in Denver, with offices also at the U.S. Forest Service in Fort Collins.

Staff: Four forecasters shared the responsibilities of a 7-day work week during the winter season from November through April.

Summary of avalanche events: A total of 1,612 avalanches were reported to the Center this season (about 15% below normal). Avalanche Warnings were posted on 32 days (4 below normal). Five people died by avalanche (one above normal). There was minimal property damage.

Avalanche hotlines: The Center maintains avalanche message phones in seven Colorado cities and towns for the public to call for current conditions. Two new phones were installed this season. Approximately 30,000 calls were made to the hotlines this winter.

Media contacts: The Center logged 194 contacts with broadcast and print media, achieving an accurate dissemination of avalanche information and a high profile for the Center.

Public education: Center personnel presented 44 avalanche awareness talks and field seminars, reaching on a personal level, some 2,673 people. We actively participated in Avalanche/Back Country Safety (ABC'S) Week, held on January 11-18. We continued to distribute to the public the Center's avalanche awareness cards, brochures, and posters.

Hazard grading: Each year the Center grades itself on its daily avalanche hazard forecast. This year the results were 86% correct forecast, 8% over-forecast, and 6% under-forecast.

FUNDING AND BUDGET

The Colorado Avalanche Information Center is totally cash funded. For FY 1987-88, total funding of \$112,010 came from the following sponsors:

Federal

U.S. Forest Service	\$50,000
Rocky Mountain National Park	\$ 2,000

State

Colorado Department of Highways	\$20,000
Colorado Division of Parks, Snowmobile Fund	\$ 2,000

Local Government

Pitkin County	\$ 3,000
Eagle County	\$ 3,000
Summit County	\$ 3,000
Town of Breckenridge	\$ 500

Private

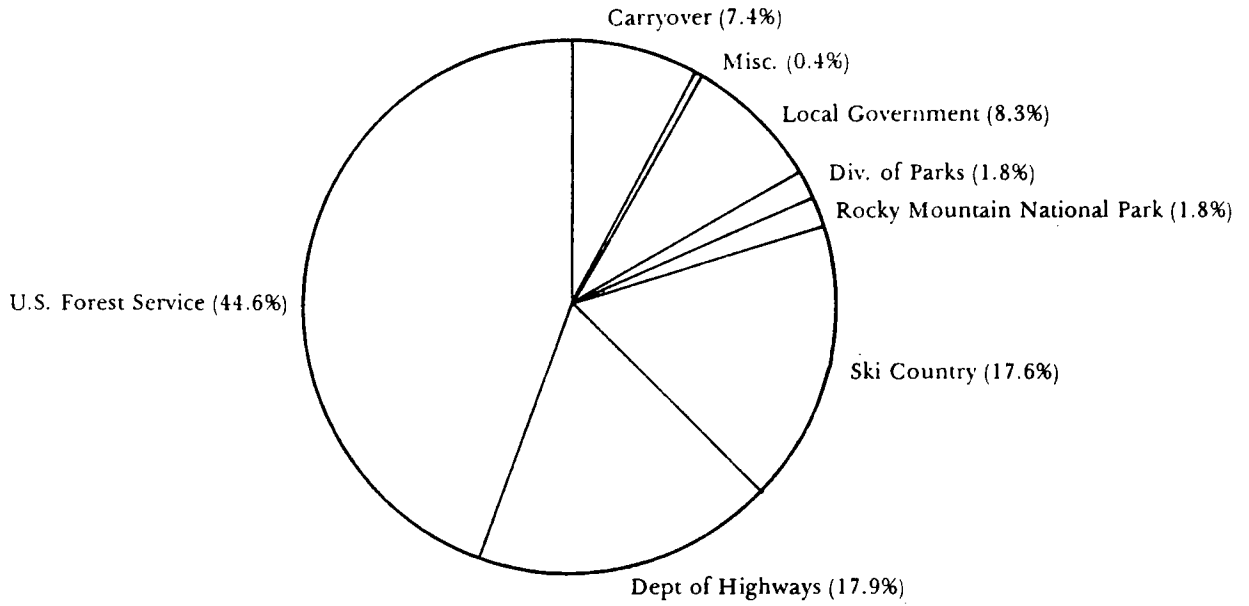
Colorado Ski Country USA	\$15,000
Winter Park Recreational Association	\$ 1,000
Breckenridge Ski Area	\$ 1,000
Copper Mountain Resort	\$ 1,000
Vail Associates	\$ 1,000
Steamboat Ski Area	\$ 750
Colorado Search and Rescue Board	\$ 250
Tenth Mountain Trails Association	\$ 200
Miscellaneous individual donations	\$ 10

Carryover from FY 86-87	\$ 8,300
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TOTAL	----- \$112,010
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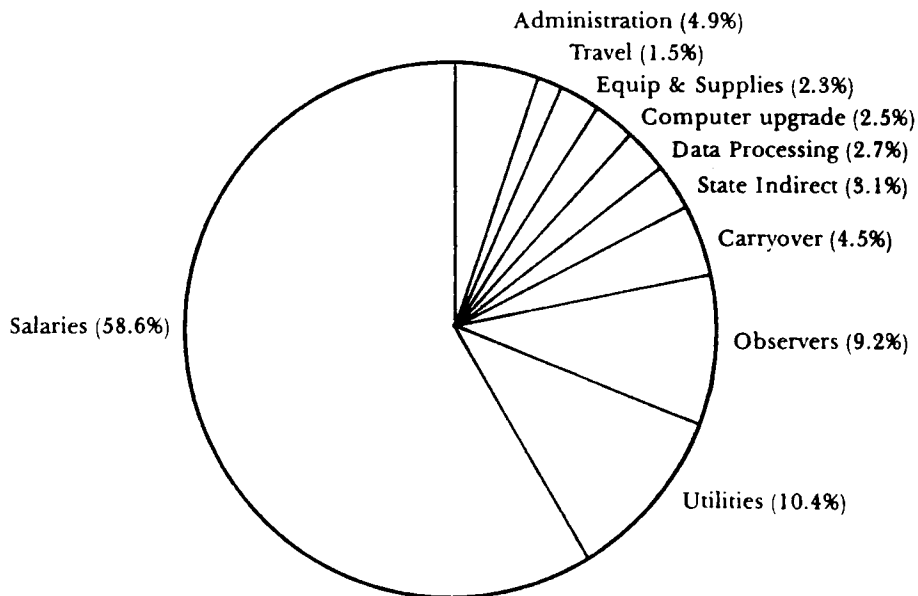
WHERE THE MONEY CAME FROM

REVENUES
\$112,010



HOW THE MONEY WAS SPENT

EXPENDITURES
\$112,010



OPERATIONS

Administration: The Center is managed by the Colorado Geological Survey under the directorship of John W. Rold. Founded in 1983, the Center was administered for four years by the Executive Director's Office of the Department of Natural Resources before moving to the Geological Survey in April 1987. The Center is totally cash funded.

Housing: The Center is primarily housed at the National Weather Service Forecast Office in Denver. The space provided is shared with NWS Fire Weather operations. Secondary office space has also been provided by the U.S. Forest Service in Fort Collins.

Season: The Center operates seven days a week from November through April.

Purposes: The purposes of the Center are to:

- monitor the changing weather, snow cover, and avalanche conditions in the Colorado mountains (see Data Sites below);
- provide twice-daily information to the public, via recorded telephone messages (see Section VII);
- warn of dangerous avalanche conditions by issuing avalanche warning bulletins via the NOAA Colorado Weatherwire and the news media (see Section VII);
- provide specialized information to sponsoring agencies;
- present educational avalanche awareness talks, seminars, and public service announcements (see Section VIII); and
- maintain a computer data set of mountain weather and avalanche events, from Colorado and other mountain states (see Section VI).

Staffing and Duties: Personnel for the 1987-88 winter were: Knox Williams (Director), Nick Logan (Associate Director), Andy Loving, and Dale Atkins. One of the four forecasters was on duty daily from 6:30 am to 4:30 pm, opening day November 13th, until closing on April 30th.

The forecaster was responsible for:

- monitoring mountain weather, snow, and avalanche conditions;
- logging all incoming data from observers;
- evaluating data from field sites and National Weather Service products;
- making daily snow stability evaluations and forecasts;
- updating recorded telephone messages twice daily; and
- issuing and terminating avalanche warnings when warranted.

Data Sites: The Center maintains a network of mountain observation sites for providing weather, snowpack, and avalanche data to the forecast office. Altogether there are 30 manned sites: 20 are ski areas, and the remainder are highway and backcountry locations. The Center supports contract observers at Berthoud Pass, Gothic, and Red Mountain Pass; it also has access to data from remote weather stations maintained by the Soil Conservation Service.

Education: As mentioned above, forecasters present avalanche awareness talks and field seminars to many groups, providing education opportunities to citizens, tourists and avalanche practitioners. In addition, forecasters maintain frequent contact with news media personnel to give broad coverage to current avalanche conditions. Section VIII details our efforts toward public education and safety.

WEATHER AND AVALANCHE SYNOPSIS

The winter of 1987-88 produced a snow cover in the Colorado mountains that showed two distinct avalanche personalities: sinister in the first half of the winter, and benign in the second half. A weak backcountry snowpack led to two fatal avalanche incidents in late December and early January; then the snow cover became unusually strong from late January on, and avalanche events dropped off dramatically.

Seasonal temperatures were near normal throughout the mountains, but seasonal snowfall showed a strong north to south bias. The winters storm track repeatedly brought in weather from the northwest, favoring the Northern Mountains with above-normal snows. The Central and Southern Mountains*, which were below the storm track, wound up with below-normal snows. The number of reported avalanches as well as the number of days with Avalanche Warnings in effect were both below normal. Deaths caused by avalanche were one above the long-term average, yet the number of incidents causing serious injury, death, or property damage was below normal. Property damage was practically nil.

Snowfall

Table 1 shows monthly and seasonal snowfalls for all sites that regularly reported data to the Avalanche Center this year. The snow-year began with a fall season that was one of the mildest and prettiest in recent memory.

On the first of November, there was hardly any snow cover at all in the high country. November snowfall was 65-90% of normal over most of the Colorado mountains, except for the Front Range which ended up slightly above normal.

* The geographical regions called Northern, Central, and Southern Mountains of Colorado are used extensively in this report. The Northern Mountains extend from the Wyoming border on the north to a line from Denver to Hoosier Pass (just south of Breckenridge) to Glenwood Springs as the southern boundary. This boundary roughly follows the I-70 corridor, but dips south in the area of Breckenridge to include the Ten Mile Range. The Central Mountains extend south from this line through Denver-Hoosier Pass-Glenwood Springs to a southern boundary line from Pueblo to Montrose. The Southern Mountains lie between this Pueblo-Montrose line and the New Mexico border.

Table 1. 1987-88 snowfall totals in inches (percents of normal are for sites with 10 or more years of record)

	Nov	Dec	Jan	Feb	Mar	Apr	Total Dec-Mar	% of Norm	Total Nov-Apr	% of Norm
NORTHERN MOUNTAINS										
ARAPAHOE BASIN	29	46	54	47	55	37	202	97	268	96
BERTHOUD PASS	47	54	54	43	66	44	217	107	308	102
BEAR LAKE	33	50	47	30	61	30	188		251	
BEAVER CREEK		70	68	44	70		252			
BRECKENRIDGE	38	41	51	40	61		193	90		
COPPER MOUNTAIN	31	46	49	39	55		189	105		
KEYSTONE	30	41	57	35	64		197			
LOVELAND	34	52	61	54	84	55	251		340	
MARY JANE		84	82	60	83		309			
STEAMBOAT		58	105	84	66		313	125		
VAIL	49	71	85	57	74		287	109		
WINTER PARK	36	47	53	41	47	30	188	123	254	113
CENTRAL MOUNTAINS										
ASPEN HIGHLANDS		46	43	21	42		152			
ASPEN MOUNTAIN		42	46	22	40		150	92		
CRESTED BUTTE		30	57	22	25		134	76		
GOthic	31	51	89	43	53	49	236	91	316	95
MONARCH	52	51	90	25	41		207	117		
SNOWMASS		51	43	26	50		170			
SUNLIGHT		37	62	40	40		179	91		
SOUTHERN MOUNTAINS										
RED MOUNTAIN PASS	42	39	61	29	58	33	187		262	
TELLURIDE		37	50	15	30		132	88		
PURGATORY		48	56	18	20		142			
WOLF CREEK	57	60	80	33	19		192	63		

December snowfall showed large variability over short distances. In the Northern Mountains, values ranged from 75-118% of normal, while in the Central Mountains the range was 65-138%. The Southern Mountains, however, saw normal snows throughout.

January proved to be an active month for weather and avalanche events. Snowfall was heavy: Monarch topped the list with 188% of normal, while almost all other sites accumulated 105-135% of their normals. January was also the pivotal month in the development of the snowpack: following a series of storms in mid-month, the weather turned abruptly warmer and created a thick, strong layer in the mountain snowpack which persisted until the end of the winter.

February marked the start of a weather trend which brought repeated storms into the Northern Mountains at the expense of the Central and Southern Mountains. Snowfalls in the North ranged from 133-84% of normal, while they were 66-51% in the Central and Southern Mountains.

This pattern of snowfall continued in March. The Northern Mountains got 116-88% of normal, while the Central and Southern Mountains managed only 78-61%, and Wolf Creek got but 21% -- its driest March ever!

April saw a typical mix of spring weather; snow showers and warm days for the majority of the month, and a spring storm during the last few days. April snows averaged 80-85% in the North, but Gothic in the Central Mountains recorded 150% of normal.

For the seasonal trend, note in Table 1 the percent-of-normal totals for December-March. The north-south bias in snowfall is clearly evident, as the Northern Mountains attained 90-125% of normal snows; the Central Mountains, 76-117%; and the Southern Mountains, 63-88%. Only four data sites have long-term snowfall records for the six months of November-April, and this longer snowfall season showed little change from the December-March totals.

Avalanches

A total of 1,612 avalanches was reported to the Avalanche Center from November through April. This number is roughly 15% below the average of 1,900 avalanches. Table 2 shows the monthly distribution of the avalanche total. January was the big month for avalanches; it included a 10-day siege in which 520 avalanches were reported to the Center.

There were two main reasons why the avalanche total was below normal this winter. First, there was virtually no snow cover in the high country until early to mid-November. This meant that the environment for developing depth hoar in the snowpack was not nearly as favorable as it was a year ago. (Depth hoar is a large, weak, unstable snow grain that grows in a cold, shallow snow cover and often leads to dangerous avalanche conditions.) Remember that last year started out with a 2 to 3-foot snow cover in early November that turned entirely to depth hoar.

Depth hoar, did in fact, develop in the snow cover which built up in November, but the grain size and thickness of this layer were not nearly as great as they were last year. This was a good sign, because it hinted that the Colorado mountains would be spared the weak avalanche-prone snow cover that plagued us last year. November produced very few avalanches (76, as shown in Table 2), but December was active (349 avalanches) as the developing snow cover was still overall shallow and weak.

The second main reason for the subnormal avalanche total was a dramatic warmup in the weather on January 26-29. It caused a few wet slides at the time, but the lasting effect was that strength was put into the snowpack. The avalanche totals for February, March, and April fell to fractions of their normal values. By April, snow depths were not deep enough to produce a significant cycle of wet-slab avalanches.

Table 2. 1987-88 winter summary of avalanches, hazard days and accidents.

	Nov	Dec	Jan	Feb	Mar	Apr	TOTAL
No. of avalanche warning periods	0	2	3	2	1	0	8
No. of days with warning in effect	0	8	17	5	3	0	33
No. of observed avalanches	76	349	680	156	211	140	1612
No. of days with 1 or more avalanches	15	22	30	20	28	23	138
Northern Mountains							
No. of days with:							
low hazard	10	7	0	11	11	23	62
moderate hazard	2	17	11	14	18	7	69
high hazard	0	7	20	4	2	0	33
extreme hazard	0	0	0	0	0	0	0
Central Mountains							
No. of days with:							
low hazard	10	7	0	10	18	24	69
moderate hazard	2	17	8	16	13	6	62
high hazard	0	7	23	3	0	0	33
extreme hazard	0	0	0	0	0	0	0
Southern Mountains							
No. of days with:							
low hazard	10	8	0	14	21	25	78
moderate hazard	2	16	6	13	10	5	52
high hazard	0	7	25	2	0	0	34
extreme hazard	0	0	0	0	0	0	0
Avalanche accidents							
people caught	4	15	10	1	7	5	42
people partly buried	2	7	7	0	4	0	20
people buried	1	2	3	0	0	0	6
people injured	1	0	0	0	1	0	2
people killed	0	2	3	0	0	0	5
vehicles caught	0	0	1	1	0	1	3
property sites damage	0	0	0	0	0	0	0

Avalanche Hazard and Warnings

Tables 2, 3, and 4 present several looks at the avalanche hazard and warning days this season. Table 2 shows the daily hazard ratings (low, moderate, high, extreme) for the Northern, Central, and Southern Mountains on a monthly basis. The figures for all three mountain areas show the same trend in the hazard: in November it was mostly "low"; in December, mostly "moderate"; and in January, mostly "high". Then the trend reverses, such that February and March were mostly "moderate to low" and April was mostly "low". There were no days with an "extreme" hazard, which reflects the lack of intense, prolonged storms.

Table 3 shows a monthly summary of warning days for the 1987-88 season, plus the previous 13 seasons. (A warning day is one on which the hazard was rated high and an Avalanche Warning was issued.) Warnings were issued on 32 days, four days below average. There were no warnings issued in November and April, while January had twice the average number of warning days.

Table 4 breaks the warning days this season into regional statistics for the Northern, Central, and Southern Mountains. In a more typical year the Southern Mountains would have the most warning days, but this year it was the Northern Mountains which had the most, which reflects the seasonal north-south snowfall bias across the state.

Table 5 shows the impact of avalanches this season on Colorado mountain highways. It lists the number of events and dates on which both natural and artificially triggered avalanches reached highways. The total of 15 natural releases and 6 triggered events is far below normal. The main reason for this was the light snowfall that affected the avalanche-prone highways in the Southern Mountains (U.S. 160, U.S. 550, and Colo 110.)

Avalanche Accidents

The last part of Table 2 lists a monthly breakdown of avalanches involving people and property in 1987-88, while Table 6 compares these same statistics with long-term annual averages. The winter of 1987-88 was slightly worse than average: the number of people caught and partly buried was above normal, and the number of people killed -- 5 -- was one above the long-term average. However, all accident categories showed improvement over last year. Finally, there were no property sites damaged this year.

Table 7 lists all accidents reported to the Avalanche Center this winter. Note that there were only two fatal accidents (on December 29 and January 10), and the only damage of the year (approximately \$10,000) occurred on January 9 when a car was hit on Berthoud Pass.

This synopsis has presented a general and statistical overview of the 1987-88 winter season, with Tables 1-7 showing different aspects of the season. For a more detailed description of events, the reader should continue to the next section, the Detailed Winter Summary.

Table 3. A 14-year summary of avalanche warning days

Winter	Nov	Dec	Jan	Feb	Mar	Apr	Total
1974-75	0	9	16	10	15	2	52
1975-76	3	4	6	12	4	0	29
1976-77	0	4	7	5	5	2	23
1977-78	2	5	7	8	15	0	37
1978-79	0	13	12	0	9	5	39
1979-80	6	5	20	9	5	4	49
1980-81	0	6	2	6	16	5	35
1981-82	4	8	3	3	4	0	22
1982-83	1	7	3	14	16	5	46
1983-84	8	15	3	3	12	9	50
1984-85	2	10	4	6	12	3	37
1985-86	12	3	0	12	0	0	27
1986-87	0	0	15	6	5	0	26
1987-88	0	8	17	4	3	0	32
Total	38	97	115	98	121	35	504
Average	2.7	6.9	8.2	7.0	8.6	2.5	36.0

Table 4. Avalanche warning days* by region, 1987-88 (dates in parentheses)

Region	Nov	Dec	Jan	Feb	Mar	Apr	Total
Northern Mountains		(11-14) (23-26)	(5-6) (9-14) (23-26)	(10-11)	(24-26)		
Days	0	8	12	2	3	0	25
Central Mountains		(23-26)	(5-14) (23-26)	(10-11)			
Days	0	4	14	2	0	0	20
Southern Mountains		(23-26)	(5-14) (18-20)	(3-4)			
Days	0	4	13	2	0	0	19
Total	0	16	39	6	3	0	64

*A warning day is one on which the hazard was rated high and a warning was issued.

Table 5. Avalanches reaching Colorado highways, 1987-88

Highway	Location	Natural aval.	Triggered aval.
I-70	Vail Pass	1 - Jan. 11	
U.S. 6	Loveland Pass	4 - Jan. 23 Mar. 2, 4, 24	5 - Nov. 19 Jan. 13, 24, 31 Mar. 25
U.S. 40	Berthoud Pass	1 - Jan. 9	
U.S. 50	Monarch Pass	1 - Jan. 6	
U.S. 160	Wolf Creek Pass	1 - Feb. 3	
U.S. 550	Red Mountain Pass	6 - Nov. 17 Dec. 23 Jan. 11, 20, 21 Feb. 28	
U.S. 550	Coal Bank Hill		1 - Feb. 3
Colo. 110	Cement Creek	1 - Jan. 13	
Total: 21 avalanches; 15 natural and 6 triggered.			

Table 6. Summary statistics of Colorado avalanche victims

	1970-87 Total	(17 winters) Average	1987-88 Total
People caught	575	34	42
People partly buried	160	9	20
People totally buried	109	6	6
People injured	54	3	2
People killed	67	4	5

Table 7. Colorado avalanche accidents, 1987-88 (* = fatal accident)

Date	Location	Details
10/25	Telluride	1 ski tourer caught & buried
11/7	Gothic	1 ski tourer caught & ptly buried
11/8	Independence Pass	1 ski tourer caught & ptly buried
11/14	Telluride	1 hiker caught and injured
12/1	Breckenridge	1 patroller caught
12/6	Loveland Pass	2 ski tourers caught; 1 ptly buried
12/8	Aspen	1 patroller caught
12/11	Snowmass	1 patroller caught & ptly buried
12/11	Vail	1 lift skier in closed area ct & pb
12/11	Vail	1 lift skier in closed area caught
12/12	Loveland Basin	1 patroller caught and ptly buried
12/20	Jones Pass (near)	1 ski tourer caught
12/23	Snowmass	1 patroller caught & ptly buried
12/29	Berthoud Pass	1 ski tourer caught & ptly buried
12/29	Timberline	1 lift skier in closed area caught
12/29	Berthoud Pass/2nd Ck.*	2 ski tourers caught, buried & killed
1/5	Hoosier Pass	2 ski tourers caught & ptly buried
1/7	Snowmass	1 patroller caught & ptly buried
1/7	Telluride	1 ski tourer caught & ptly buried
1/9	Berthoud Pass	1 car and occupant ct & ptly buried
1/10	Castle Ck (nr Ashcroft)*	3 ski tourers caught, buried & killed
1/16	Jones Pass	1 snowmobiler caught & ptly buried
1/18	Aspen Highlands	1 in-bounds skier ct, ptly bur & inj
2/3	Wolf Creek Pass	1 vehicle and driver caught
3/5	Vail	1 ski tourer caught & ptly buried
3/8	St. Mary's Glacier	2 ski tourers caught
3/9	Aspen Snowcat Tours	1 guide caught & ptly buried
3/9	Telluride	1 out-of-bounds lift skier caught
3/19	Greywolf Mountain	1 snowshoer caught & ptly buried
3/27	Chair Mountain (near)	1 ski tourer ct, ptly bur & injured
4/2	Vail Pass	2 snowmobiles buried
4/3	Telluride	1 ski tourer caught
4/7	Red Mountain Pass	1 car ct & damaged; 2 occupants ct
4/9	Loveland Pass	1 ski tourer caught
4/16	Copper Mountain	1 patroller caught

DETAILED WINTER SUMMARY

The following narrative is a month-by-month description of weather trends and events of the 1987-88 winter season and the avalanche activity that resulted from the interaction between the weather and the developing mountain snowpack.

October

October weather was what many of us have come to Colorado for: clear skies, mild temperatures, and few storms. A high pressure ridge sat over the mountains keeping any hints of the upcoming winter out of Colorado until the 12th when an upper-level storm approached from the west. This 4-day storm left just .20" of water in the Northern Mountains, but 1-1/2 inches of moisture fell in several areas of the San Juan Mountains.

Another week of beautiful mild days followed this first winter storm, then another short-wave impulse of stormy weather came into Colorado from the southwest on the 23rd. This storm gave Southern Colorado another week of variable wet weather. Rain fell at lower elevations; snow, at high elevations. Skies cleared on the 31st and temperatures became unseasonably mild, causing most of the high-elevation snow cover to disappear.

Early season snows brought a few eager folks into the backcountry, and the first avalanche incident of the season occurred on the 25th near Telluride. A ski tourer and his dog were completely buried in a small slide, but were luckily recovered uninjured by the quick actions of their companions. Though none of the party members were carrying rescue equipment, they found the victim by frantically probing with their ski poles.

November

November began with only a scant, patchy snow cover in the high country. This was remarkably different from last year, when November began with a snow cover that averaged about 3 feet in depth. It appeared that at this early date the potential for developing a dangerously deep layer of depth hoar at the ground was not nearly as great as a year ago.

The unseasonably warm temperatures which began the last day of October were briefly disrupted by a fast-moving storm which brought 16" of wet snow to Wolf Creek on November 2nd. Other mountain areas of Colorado got a few flurries from this storm, but accumulations of snow were very light. By the afternoon of the 3rd, this storm moved east and warm temperatures returned to the Colorado high country.

Dry, warm days continued throughout the first half of November. The mountain snowpack became thin, with only a shallow snow cover being reported in a few high-elevation, north-facing starting zones.

After this dry period, the first of several storms to move through Colorado began the 14th. This storm dropped 4-6" of snow in the mountains west of the Continental Divide, but then most of the storm's energy shifted to the Front Range. By the 15th, 17" of snow had fallen in Rocky Mountain National Park and 34" on Mount Evans. The intensity of the storm diminished by the 16th, but another 7-10" of snow fell in the Northern Mountains over the next few days as unsettled weather lingered behind the center of the storm. By the 18th, several areas of the Central and Southern Mountains also had received generous snows; Monarch, with 33", got the most.

Several days of toasty weather returned to Colorado after this storm, and most mountain areas recorded high temperatures in the mid 40's. Another short-wave disturbance entered Colorado on the 22nd. This storm came in from the northwest, giving the Northern Mountains 6-11" of snow by the 25th, while the Central and Southern Mountains only got 2-4" for the same period.

The last week of the month attempted to re-establish above normal temperatures, but another storm developed to the southwest. On Thanksgiving Day, the 26th, a mild southwest wind brought 2-10" of snow into the Central and Southern Mountains, while the Northern Mountains received only a T-1". Winds stayed light as the storm center stayed well south of Colorado. As skies began to clear on the 27th, a few more inches of new snow were added to the storm stakes. A cold airmass had followed this storm into Colorado, and the last days of the month,

though sunny, remained cold with daytime temperatures staying in the teens and mid 20's.

The Avalanche Center opened November 13th. No major avalanche cycles and no Avalanche Warnings were issued during the month due to the lack of sustained snowfall. Still, the few storms that did arrive were fairly productive during their brief visits. 76 avalanches and three avalanche incidents were reported to the Center: on the 7th, a ski tourer was partly buried near Gothic; on the 8th, a ski tourer was partly buried on Independence Pass; and on the 14th, a hiker near Telluride was injured when he was swept off a 40-foot cliff.

Snowfall totals for the month were well below normal in most areas of the state. Arapahoe Basin reported 63% of normal; Vail, 65%; Gothic, 72%; and Copper Mountain, 91%. However, two Front Range sites benefitted from upslope storms and managed above-normal snows: Berthoud Pass got 105%, and Winter Park, 110% of normal.

At this point in the season, the snow cover was shallow in all mountain areas of Colorado. The severity of the avalanche season would likely depend on what happened to this early snow cover. If it metamorphosed into a lasting, deep, and dangerous layer of depth hoar (which happened last year and could happen again if December were especially dry), this would be a severe avalanche season. If, however, strong layers formed, bridging over and nullifying the depth hoar underneath (which would happen if December were warm and snowy), then the season would not be nearly so avalanche-prone.

December

The first week of December brought mild, dry, fall-like weather. The mountain snowpack was shallow in early December, with 1-2 feet in the Northern and Central Mountains, and 1-1/2 to 3 feet in the Southern Mountains. The mild weather contributed to strong temperature-gradient (TG) development and the growth of depth hoar in the snow cover. Some observers reported their snowpack going to all TG grains. In early December this posed little danger to the backcountry traveller because of the absence of a slab, except in isolated pockets above treeline. On December 1, a ski patroller at Breckenridge was caught

while ski packing a steep slope, and on the 6th on Loveland Pass a snowboarder and skier were caught. The snowboarder escaped to the side, and the skier was partially buried.

The mild weather ended on the 8th as the first of three fast-moving short waves brought orographic snows, primarily to the Northern Mountains, through the 12th. The first disturbance brought 3-6" of snow to the Northern Mountains in general, but Beaver Creek reported 17". The Central Mountains received up to 10" (at Monarch), while the Southern Mountains reported 1-5". An Aspen ski patroller was caught by a small slide on the 8th.

Observers reported additional snow in the Northern Mountains and increased winds as the second short wave crossed over the mountains on the 10th. Most sites reported 2-5", but Mary Jane received 9". Strong west to northwest winds began to load starting zones (which would cause several accidents on the 11th.) Mines Peak at Berthoud Pass had a maximum gust of 92 mph on the 10th.

On December 11th observers reported continued strong winds and 2-6" in the Northern Mountains from the third short wave. The Central Mountains reported 1-2" generally, but Monarch received 7". The Southern Mountains remained dry. An Avalanche Advisory was issued near midday and was upgraded to the season's first Avalanche Warning (for the Continental Divide between Winter Park and Arapahoe Basin) later in the afternoon. The Warning would stay in effect until the 14th.

The strong winds loaded snow onto steep slopes, increasing the possibility of triggered avalanche releases, and on the 11th, four accidents occurred. Patrollers were caught and partially buried at both Snowmass and Loveland; and at Vail two incidents occurred when lift skiers triggered releases in closed areas, resulting in one skier being partially buried. All were uninjured. During the storm period, 65 avalanches were reported to the Center.

On the 12th the Northern Mountains reported 1-6" of new snow, the Central Mountains a T-2", while the Southern Mountains went dry once again. That afternoon brought clearing skies and arctic air that kept

temperatures cold until the 15th. Many observation sites reported high temperatures that did not even reach zero.

Fair weather continued and temperatures moderated through the 18th as Colorado sat in the doldrums of split flow. This kept the Northern and Central Mountains fairly dry, but the Southern Mountains did receive some light orographic snows from the southwest flow.

A broad trough centered over Colorado on the 19th-20th brought good orographic snows to all mountains with observers reporting 3-6" on the 19th. The next day the Central and Southern Mountains reported 1-6", while the Northern Mountains received 2-11". During this storm on the 20th at Jones Pass (near Berthoud Pass), a ski tourer was caught in a large hard slab avalanche, but escaped injury by riding out the slide on a large block of snow.

December's snowiest period occurred between the 22nd-28th, as a strong storm developed northwest of Colorado. As the storm dipped southward it tapped a band of subtropical moisture extending from Hawaii, causing abundant snowfall for all mountains. An Avalanche Advisory was issued on the 21st as this system developed. Observers on the 22nd reported 2-6" with winds of 15-25 mph. The wind created a tensioned slab layer which raised the hazard to high for all mountains above treeline. On the 23rd the Northern Mountains reported 2-13" of new snow; the Central Mountains, a T-8"; and the Southern Mountains, 0-2". Even where snowfall was light, winds of 20-35 mph transported snow into starting zones. .

The combination of new snow and winds necessitated December's second Avalanche Warning to be issued on the 23rd for all mountains. On that day at Snowmass two ski patrollers were caught and partially buried, and a bank slide briefly closed U.S. 550 on Red Mountain Pass. Winds decreased substantially on the 24th, but snow continued to accumulate, with 2-9" in the Northern Mountains and generally 2-6" in the Central and Southern Mountains, but Powderhorn, Purgatory, and Wolf Creek received 14", 14-1/2", and 16", respectively. As the low positioned itself just south of Colorado, it kept calm, cold air over the mountains for Christmas day and the 26th. The Warning was

terminated the afternoon of the 26th. More than 160 slides, mostly triggered, were reported during the warning period.

As the low-pressure center moved into eastern Colorado on the 27th, snowfalls were concentrated along the eastern slope while the mountains got only a few inches. The 28th dawned clear, but by the 29th southwest winds of 20-35 mph (gusting to 50) sprang up ahead of the next front. This loaded starting zones enough to cause a few natural releases. In addition, control work on the Seven Sisters on Loveland Pass released several slides that briefly closed US 6. The avalanche hazard was rated moderate for all mountains with pockets of high hazard near and above treeline.

Several accidents occurred on the 29th. First, a lift skier at Timberline skied into a closed area, triggering a slide but escaping uninjured. Second, a ski tourer cut across a steep road cut on U.S. 40 on Berthoud Pass, triggering a bank slide that partially buried him. And third, it was probably on the 29th that the first avalanche fatalities of the season occurred. Two experienced ski tourers traveling in Second Creek, just north of Berthoud Pass, triggered an avalanche that totally buried them both. The accident was not discovered until the 1st of January when a passing ski tourer spotted a ski, still attached to one victim, sticking out of the avalanche debris. Rescuers with probes found the second victim on January 2nd. (This accident occurred above timberline in terrain that the Avalanche Center had designated as having a high avalanche hazard at the time.)

The month ended with a broad trough settled over Colorado on the 30th-31st; 1-3" of snow fell in all mountains on the 30th, and 1-7" on the 31st.

December snowfalls were quite variable. In the Northern Mountains, Arapahoe Basin was 75% of normal; Breckenridge, 77%; Steamboat, 81%; Copper Mtn., 95%; Vail, 100%; Berthoud Pass, 109%; and Winter Park, 118%. In the Central Mountains, Crested Butte was 65%; Sunlight, 81%; Gothic, 102%; Aspen Mtn., 114%; and Monarch, 138%. In the Southern Mountains, both Telluride and Wolf Creek were 100% of normal. The snowpack was typically unstable in all mountain areas, as December

snowfalls were not heavy enough and temperatures were not warm enough to build a strong snow cover. The month was active avalanche-wise, with 349 slides being reported to the Center (233 from the 22nd-28th). Fifteen people were caught, seven were partly buried, and two were buried and killed.

January

The month of January started out cold: high temperatures reached only the single digits and low teens, while clear skies at night helped temperatures plummet to well below zero. By the 4th the Central and Southern Mountains were beginning to see the first flakes of what would soon develop into a long snowy period for the Colorado mountains.

On the morning of the 5th up to 14" of fresh snow had fallen at some locations, and the first Avalanche Warning of the month was issued -- for all mountains -- in anticipation of continued snowfall. Three avalanches reached U.S. 550 over Red Mountain Pass, and two cross-country skiers were caught and partly buried in an avalanche on Hoosier Pass. By the next day 16-30" accumulations were reported in the Central and Southern Mountains, and a small slide closed Monarch Pass for half an hour. With little fresh snow to the north, the Northern Mountains were dropped from the warning area on the 6th. A tally on the 7th showed close to 180 avalanches had occurred, including two small slides that partly buried skiers at Snowmass and Telluride.

The Warning remained in effect in the Central and Southern Mountains, and by the morning of the 9th, snow caught up to the Northern Mountains again and they were included in the warning area for the second time. Later that morning, a car and driver were caught on Berthoud Pass by the Stanley avalanche path that closed the road for nearly four hours. The car was severely damaged, but the driver escaped with only minor injuries. He described his ordeal by saying, "It was just a bumpy, loud, noisy ride down; then the car stopped, and the first thing I noticed was the windshield wipers were going, but it looked funny because there was no windshield." A lucky motorist indeed!

But January was not without its share of tragedy. The Avalanche Warning continued as snowfall persevered and stronger winds began to

compound the dangerous avalanche situation. On Sunday the 10th, three cross-country skiers and a dog lost their lives in an avalanche that they triggered near Pearl Pass south of Aspen. Two of the victims, who were wearing avalanche rescue beacons, were recovered that day. The third victim was not wearing a beacon and could not be located. Rescue teams were forced out of the search area the next day by adverse weather conditions and a threatening avalanche hazard that jeopardized their own safety. It was decided that recovery efforts would begin again when conditions were deemed safe. (The woman's body had still not been recovered as of mid-May.)

The Warning continued another four days before its termination on January 14th. Four more slides reached Colorado highways (Vail, Monarch, and Red Mountain Passes, and Colorado 110 north of Silverton) before it was over, but no additional accidents were reported. After a grizzly 10 days of avalanche warnings, the final count included eight people caught with three fatalities, one car destroyed, and 520 recorded avalanches. This would be the worst avalanche bout of the winter.

There was only a brief reprieve, if it can be called that, before the next system moved into Colorado. Strong southwest winds ahead of the cold front that was due to pass through the mountains late on the 15th kept the avalanche hazard high with blowing snow. Strong winds that night reached velocities of 50-75 mph, and Crested Butte recorded a peak gust of 120 mph! The resulting snowfall, though, was only 2-8" and temperatures in the 20's and 30's helped to stabilize the new snow layer.

Another storm was right on its heels and moved into portions of the San Juan Mountains in earnest on the night of the 17th. While the Northern and Central Mountains received only 1-7", Red Mountain Pass, Purgatory and Wolf Creek got 13", 17" and 22", respectively. A second Avalanche Warning was issued at 6:30 am on the 18th, only four days after terminating the first one.

By the 19th, 20-40" of fresh snow had fallen in three days in portions of the Southern Mountains. Wolf Creek led these amounts with 42". The Warning was cancelled on the 20th as the morning dawned clear

and very cold -- Taylor Park recorded the coldest temperature in Colorado on this morning, a numbing 54 below zero. Forty avalanches were counted during this period, and only one incident was reported -- a skier at Aspen Highlands that was partially buried.

Occasional light snow fell up to the 23rd which was not a problem until the jet stream descended over Colorado to provide howling west to northwest winds with gusts in excess of 60 mph. Mines Peak at Berthoud Pass had a gust to 120 mph on the 23rd. The wind produced zero visibility with blowing snow much of the time, and necessitated issuing January's third Avalanche Warning on the afternoon of the 23rd. While all areas saw very strong winds (Purgatory ski area had to close some of its chairlifts), only the Northern and Central Mountains received snow, up to 9" by the 25th. The following day, temperatures rose and skies cleared. Twenty avalanches had been recorded when the Warning was terminated on the 26th.

On the 26th-29th, a major warmup brought temperatures in the 30's and 40's and light winds. The upper snowpack settled and stabilized dramatically. Temperatures were warm enough to cause isolated wet-snow avalanches. The significance of this was not the short-term instability, but rather the long-term stability that would follow.

Another moist weather system passed through Colorado on the 30th-31st. On each of those days, 2-6" of snow fell in the Northern Mountains; 3-10", in the Central Mountains; and 2-4", in the Southern Mountains. Accompanied by light winds, this storm did not significantly increase the avalanche hazard. About 20 slides were reported for these two days, but all were released by explosives and no natural events were observed.

January was an active month for weather, avalanches, and accidents. Almost all areas got above-normal snows: Monarch accumulated 188%; Telluride, 135%; Winter Park, 133%; Vail, 125%; Crested Butte and Gothic, 118%; Arapahoe Basin and Aspen Mountain, 115%; Copper Mountain and Sunlight, 112%; and Berthoud Pass, 105%. Surprisingly Wolf Creek managed only 88%, and Breckenridge had 86%. Warnings were issued for 17

days. The total number of reported avalanches was 693, 10 people were caught in slides, and 3 people died. One vehicle was destroyed.

But January also sowed the seeds of a stable snowpack for the remainder of the winter. Each storm was followed by a warming trend, which had the effect of strengthening the upper layers of the snowpack. And with the warmup on the 26th-29th, such a strong layer had been created in the upper half of the snow cover that it nullified the depth hoar at the bottom. Thus, for the rest of the winter, this snowpack would have great difficulty producing deep-slab avalanches.

February

The mountain storm that began on January 30th continued into February and brought generous snows to all mountain areas on the 1st-3rd. Some of the heavier amounts were, in the Northern Mountains, Vail, 12"; Beaver Creek, 15"; Mary Jane, 23"; and Steamboat, 23"; in the Central Mountains, Snowmass, 13"; Crested Butte, 15"; Gothic, 21"; and Sunlight, 22"; and in the Southern Mountains, Red Mountain Pass, 16"; and Wolf Creek, 26".

These snows prompted an Avalanche Warning -- the sixth of the season -- which was issued early on the 3rd and terminated on the 4th. Thirty-five avalanches were reported to the Center on the 3rd and 4th; and in the only avalanche incident reported in the month, a small slide on the 3rd on Wolf Creek Pass struck a car. No damage or injuries resulted.

A high-pressure ridge brought clear skies to the mountains on the 4th-7th. A change came on the 8th when another storm system hit the Northern and Central Mountains, and snow totals the next three days were 14-21" in the Northern Mountains and 6-16" in the Central Mountains, while the Southern Mountains got skipped altogether. Winds gusted to 60 mph on the 10th, and this prompted an Avalanche Warning on that morning for the Northern Mountains and the Crested Butte-Gothic-Monarch area of the Central Mountains. This Warning was dropped on the 11th. About 60 avalanches were reported in the warning areas during this episode.

The 12th and 13th were warm, clear days, but a vigorous cold front ripped through the mountains on the night of the 13th and brought snows of 2-7" to the Northern Mountains (except Steamboat got 11") but only 1-2" to the Central and Southern Mountains. Wind gusts of 60-85 mph accompanied frontal passage. Unsettled weather with snow showers continued in the Northern and Central Mountains on the 14th-16th, while fair weather prevailed in the Southern Mountains.

Clear skies on the 17th gave way to clouds and snow showers on the 18th-20th. Another cold front slammed the mountains on the night of the 21st with terrific winds but almost no snowfall. Mines Peak (elevation 12,500 feet) at Berthoud Pass recorded three gusts to 120 mph overnight.

A large ridge of high pressure developed on the 23rd and stayed in place over Colorado through the 27th. This brought clear, bluebird skies and temperatures in the upper 30's to mid-40's -- a tantalizing preview of spring. The ridge cracked slightly on the 28th-29th as Pacific moisture flowed into the mountains and brought snows of 1-4".

Monthly snowfalls showed wide variation, with the Northern Mountains getting far more than the Central and Southern Mountains. In fact, the Southern Mountains received virtually all of its snow on the 1st-3rd. Snow totals, as a percent of normal, were: in the Northern Mountains, Winter Park, 133%; Arapahoe Basin, 124%; Copper Mountain, 113%; Vail, 105%; Berthoud Pass, 97%; and Breckenridge, 84%; in the Central Mountains, Gothic, 66%; Monarch, 66%; Aspen Mountain, 61%; and Crested Butte, 54%; in the Southern Mountains, Wolf Creek, 56%; and Telluride, 51%.

The month's avalanche numbers reflect the low snowfall over two-thirds of the mountain area. Only 156 avalanches were reported, far below normal. Warnings were only effect four days. There were no backcountry avalanche incidents whatsoever, only the minor incident on Wolf Creek Pass mentioned earlier.

The weather of February had the effect of maintaining an overall stable mountain snowpack, a stability initiated by the mid-January warmup. All avalanches during the month were shallow slabs or loose-snow

releases resulting from fresh loads of falling and blowing snow. The strength of the middle snowpack was sufficient to prevent avalanches to the ground.

March

March weather would continue the pattern set in February and bring above-normal snowfalls to the Northern Mountains, while leaving the Central and Southern Mountains wanting. In fact, Wolf Creek would record its driest March on record.

The first stormy period of the month had begun on February 28th and continued through the first week of March. This storm was generally weak and unorganized. Still, there was good moisture available and a few areas in the Northern Mountains had 18-19" of new snow by the morning of the 5th. The Central and Southern Mountains averaged 3-6" of new snow for this period, but there were two exceptions: Gothic got 17", and Red Mountain Pass, 16".

The next two days brought clear, bluebird skies to the Colorado mountains before the next storm appeared on the 7th. For the remainder of the month, this pattern would be repeated time and again as impulses of stormy weather brought 2-3 days of snow, only to be replaced abruptly by warm sunny skies. These were typical spring storms of the fast-moving, hard-hitting variety. Snowy periods were the 7th-8th, 10th-13th, 16th-17th, 23rd-25th, and 28th-31st.

Accumulations of snow from these storms averaged 10-11" for the Northern Mountains, 7-8" for the Central Mountains and 6-7" for the Southern Mountains. Wolf Creek, however, was only able to average 3.3" per storm this month.

Snow accumulations from the 3-day storm ending the 25th will help illustrate the north-south bias this month: the Northern Mountain areas received 8-21" while the Southern Mountains recorded only a T-2". This storm prompted the only Avalanche Warning posted for March. This Warning was issued for the Northern Mountains and began the 24th and ran through the 26th. 25 slides were reported for this warning period, which was the eighth and last of the season.

March snow totals expressed as percent of normal were: in the Northern Mountains, Berthoud Pass, 116%; Steamboat, 115%; Breckenridge and Winter Park, 110%; Copper Mountain and Vail, 104%; and Arapahoe Basin, 88%; in the Central Mountains, Aspen Mountain and Gothic, 78%; Monarch, 75%; and Crested Butte, 61%; and in the Southern Mountains, Telluride, 67%; and Wolf Creek, 21%.

The backcountry snowpack generally became stronger as the month progressed, as warm temperatures between storms helped settle new snows. 221 avalanches and five avalanche incidents were recorded for the month. Six people were caught, three were partially buried, but no injuries occurred.

April

As if on cue, the last quick-hitting storm of March ended abruptly on the 31st, only to leave brilliant, sunny skies for the beginning of April. This warming trend continued, with temperature highs reaching into the 40's, until late on the 4th when a fast-moving storm slipped through the mountains during the night. The morning of the 5th found 3-8" of new snow in the Northern Mountains, but true-to-form with the winter's trend, snow in the Central and Southern Mountains measured no more than 3" at any location. Even though the storm packed winds of 30-40 mph, it had little effect on the existing low avalanche hazard.

From the 6th-8th, temperatures returned to the 40's and 50's, and spring was here to stay. Aside from occasional snow showers and a typical spring storm near the end of the month, the weather remained relatively mild with no further threat of either severe blizzards or arctic cold fronts for the remainder of the season.

During this same time, two things were happening in the snowpack. First, upper snow layers near the surface were gaining heat rapidly during the day. This was helped along with warm overnight low temperatures near the freezing level, and in some cases above freezing. The short-lived warmth produced an increase in shallow, wet-loose avalanches that released from high-elevation, steep terrain that had sunny aspects. Second, the snowpack was beginning to show signs of

becoming isothermal -- a spring-time condition in which the snow temperature warms to the melting point from the ground to the surface.

A weak trough of low pressure moved into Colorado the night of the 8th and continued through the 9th. It was a familiar story: the system produced up to 8" of snow in the Northern Mountains, gave a scant trace to the Central Mountains, and left nothing in the Southern Mountains. The resulting cool temperatures killed any possibility of continued wet avalanche activity until the next warming trend.

High pressure took over once again on the 10th, and mostly fair weather, with some occasional clouds, was the norm for the next five days. A spring storm, tracking south of Colorado, then began pumping moisture in from the southwest. From the 15th-20th, the mountains saw periods of snow showers and light snow that provided a T-6" of snow. Temperatures remained warm during this period, and reports from several sites confirmed that the snowpack had gone isothermal, including the Berthoud Pass study plot at an elevation above 11,200 feet.

April 20th was to be the only nice day out of the next six. A trough of low pressure was deepening along the West Coast and its projected track was right through the Colorado mountains. Moisture moved into the area on the 21st, and by the next day, 5-11" of snow had fallen, this time with equal distributions in the Northern, Central, and Southern Mountains. Light snow fell intermittently until the 26th, and some areas acquired a surplus of snow before the season's end. Berthoud Pass received 21", Red Mountain Pass got 22", and Gothic logged 33" in these six days. This was the last major precipitation period of the month as April ended with clear skies and mild temperatures in the 40's.

There were only 123 avalanches reported in April (100 less than April 1987), and the avalanche hazard was rated low every day except for three; those carried a moderate hazard rating. Although there were four avalanche accidents, none were serious. On the 3rd, a cross-country skier was caught in a slide near Telluride; on the 7th, two people were caught in their vehicle on Red Mountain Pass (the car sustained minor damage); a ski-tourer was caught near Loveland Pass on the 9th; and on

the 16th, a ski patroller was caught at Copper Mountain while doing avalanche control work.

Of the four observation sites that made daily reports for the entire month, snowfall was slightly below average, except for one area: Gothic recorded 150% of normal, while Winter Park and Arapahoe Basin each got 80%, and Berthoud Pass had 83% of normal snowfall. April was a quiet month indeed, and relatively easy on mountain residents.

INFORMATION ACQUISITION

Daily Weather, Snowpack, and Avalanche Data

The Avalanche Center relies on incoming data to make accurate assessments of current avalanche stability, and to make mountain weather and avalanche hazard forecasts. There are two main sources of these data -- the Colorado observer network and the National Weather Service.

Colorado observer network: The Center has established a network of some 30 manned observation sites in the Colorado mountains. Twenty of the sites are developed ski areas, from which snow-safety personnel report current weather, snowpack, and avalanche data. The remaining 10 sites are highway, heliski, and backcountry sites, from which volunteers or contract observers report to the Center. One additional backcountry observation site will be in place for the 1988-89 season, providing valuable data from the Elk Mountains in central Colorado.

A toll-free WATS line, linked to a Code-a-phone, is available for the observers' convenience. This gives quasi-24-hour reporting capabilities. Observers make mandatory morning calls, plus timely updates during changeable conditions. All data are logged by the forecaster at the Center.

National Weather Service: Avalanche Center personnel have access to all the products and expertise of the NWS staff. Computerized weather maps (including the prototype DARE work-station), satellite photos, radar data, radiosonde data, information from manned and remote weather stations, and written analyses and forecasts are available. Additionally, discussions with NWS forecasters in interpreting data and products are an immense help.

Westside Data Network

The Colorado Avalanche Information Center is responsible for the administration of the U.S. Forest Service Westwide Data Network. A portion of the funding received from the Forest Service is earmarked for managing this computer data base. In this capacity, the Center serves as a repository for mountain weather, avalanche event, and avalanche accident data for avalanche-prone areas of the United States. The weather and avalanche data from some 60 sites in the mountain West are computerized and stored on magnetic tape at the Colorado State University Computer Center in Fort Collins.

The Center also compiles Avalanche Notes, a monthly newsletter which contains summaries of the computerized weather and avalanche data, as well as avalanche accident information. The newsletter is distributed monthly from November-April to 300 contributors and other interested people and agencies.

These data are used by Center personnel for keeping current on present conditions during the winter and also for later analysis. Trends in avalanche accidents, relationships between survival and burial times and depths, and types of rescues are essential information to be passed on to snow scientists and the public. Lectures, field seminars, media contacts, and publications by Center personnel are some of the methods for disseminating this information. Additionally, the Center responds to 10-20 requests a year for raw or tabulated data. These requests come from the ski industry, Forest Service offices, universities, snow researchers, and lawyers.

DISSEMINATION OF HAZARD FORECASTS

The Colorado Avalanche Information Center provides avalanche and mountain weather information to the public, and to specialized audiences. The following are the outlets used by the Center to disperse avalanche hazard forecasts:

Public Hotlines

Residents in the Southern Mountain region were happy to have their own avalanche hotline in place for the first time this winter. The new public message phone, located in Durango, was provided by the U.S. Forest Service. The Center now has seven telephone systems in Colorado that the public can call for a current mountain weather forecast, snow conditions and an avalanche hazard evaluation. The public made good use of this service as more than 29,380 calls were placed to the hotlines this season. This represents an increase of 25% over last year! The following are locations and call-counts for each phone:

Denver: Telephone messages are recorded twice daily on the U.S. Forest Service telephone in Lakewood. A total of 16,562 calls were made to this phone (236-9435) this winter from the Denver/Boulder area, an increase of 4% over last year.

Fort Collins: This message phone, sponsored by The Mountain Shop, was back in operation in November to serve callers along the northern Front Range. The recording system is owned by the Avalanche Center and is housed and administered by the Larimer County Sheriff's Office. Some 2,835 calls were made to the 482-0457 number this winter, an increase of 20% over last winter.

Colorado Springs: This is the third year of operation for this phone, and call counts continued to increase. With more than 3,100 calls to the 522-0020 number, the count went up by 23% over last season. As with the Denver and Fort Collins telephones, updates were made on a twice daily schedule, seven days a week. This system is jointly sponsored by the Avalanche Center and the Mountain Chalet (where it is housed).

Summit County: Residents in the Summit County area experienced a pleasant surprise when they called their local hot line (668-0600) in January. The Summit County Rescue Group purchased a new phone system to replace the one previously provided by the U.S. Forest Service in Dillon. Longer and more complete messages with specific local information was now being dispensed to listeners in this high-use area located amidst much avalanche terrain. Call counts were not available with the old phone, but the new system recorded more than 2,850 calls from the end of December through April. The new phone is housed by the county.

Eagle County: The public message phone, housed and maintained by the Forest Service in Minturn has no call counter, so the volume of use is not known. In addition to this hotline, the Vail and Beaver Creek Ski Patrols use daily information from the Center to update their own recorded message phone -- a service available to skiers leaving the ski area boundary.

Pitkin County: The Forest Service in Aspen maintains a public message phone for residents and tourists. Forest personnel get daily information from the Center's WATS line and transfer an appropriate message to their recording. An estimated 1,260 calls were made to this phone this winter.

Durango: The Avalanche Center, and local residents alike, were pleased to have a weather and avalanche hotline operating in the Southern Mountains this winter. Since this is a first, there is no call count comparison. But enthusiasm for the service spread quickly, and the Center watched the tally climb to 2,764 calls by the end of April. Impressive usage for the first season!

Radio Broadcasts

We are pleased to be finding radio stations in various mountain communities airing our daily messages. This has given us access to a large listening audience not previously reached. The following stations convey our bulletins.

For its third season, the public radio station KVNF-FM in Paonia continued to record and broadcast our daily messages throughout the season. Transmitting on a main frequency of 90.9 MHz, and three translators reaching out on 88.9, 89.1, and 89.9 MHz, this station services the towns of Paonia, Montrose, Delta, Ouray, Ridgway, and other communities in southwestern Colorado. Funding comes from contributions to a memorial fund for an avalanche victim killed near Ridgway in 1984.

Radio station KOTO in Telluride also broadcast our messages throughout the winter to residents in that area. They did so by recording the message on the Durango hotline. This provided increased avalanche awareness to an area that had four deaths due to avalanches in 1986-87. There were no major accidents in that region this year.

In Summit County, K-Summit television and KSMT-FM radio continued to support the Center's efforts in reaching the public with timely weather and snowpack information. They aired our messages, provided live talk-show time, and taped interviews with Center personnel that were televised throughout the county.

NOAA Colorado Weatherwire

When the avalanche hazard is rated high or extreme, forecasters issue Avalanche Warning bulletins, twice daily, until the hazard subsides and an Avalanche Warning Termination bulletin is issued. Special Avalanche Advisories may be sent out as well during transition periods into the higher hazard category. These bulletins are transmitted to the media via the National Oceanic and Atmospheric Administration (NOAA) Weatherwire. Sample warning and advisory bulletins are shown in Appendix A, and Tables 3 & 4 contain related information.

News Media

Forecasters respond to and initiate contacts with television, radio, newspaper, and magazine reporters for broad news coverage and high visibility. There were 194 contacts in 1987-88, only 13 less than last season. This is significant because the winter was less active -- fewer accidents, fatalities, warning periods and avalanches -- than last year.

Media personnel frequently called for information on current avalanche warnings, public interest stories, avalanche accidents, and current avalanche and mountain weather conditions. In addition, many live and taped interviews were conducted for radio and television broadcasts.

About 20 inquiries came from outside Colorado including calls from the New York Times, Los Angeles Times, USA Today, NBC, CBS, Washington Times, UPI, Associated Press, Baltimore Sun, KOBS-TV in Farmington, NM, and National Geographic. A call to the Center from outside the United States this season came from Dutch International Television.

PUBLIC EDUCATION

One of the main responsibilities of the Center is to provide avalanche education. Through education and public awareness, we feel that accidents will be kept to a minimum. The Center provided education to the public this season through three outlets:

Avalanche Awareness Talks and Field Seminars

Avalanche presentations began as early as November 1st at the 10th annual National Avalanche School, held in Denver this year. By the time the last two talks were given on May 9th, the Center staff had spoken on 44 different occasions, with a total of 2,673 persons attending 1-hour seminars to 2-day field sessions. This represents an astounding increase over last year by 68%! Participants had the opportunity to learn about such topics as mountain meteorology, avalanche terrain recognition, the Colorado snowpack, safe travel techniques, and survival and rescue techniques. The students' backgrounds ranged from professional ski patrollers, search & rescue volunteers, Colorado Mountain Club members, ski clubs, and members of the general public. Table 8 lists these courses in more detail.

In order to monitor our efforts in providing avalanche awareness, this season was the first time Center personnel logged the time spent in course preparation, driving time and presentation length. The outcome was: preparation - 36 hours; driving time - 81 hours; and 152 hours spent teaching the various courses.

ABC's Week

The Center was involved in a statewide avalanche awareness program known as Avalanche/Back Country Safety Week (ABC'S Week) on January 11-18. ABC'S Week was organized by Howard Paul of the Colorado Search and Rescue Board (CSRB), primarily in response to the 11 avalanche fatalities of the 86-87 season. This program was the first of its kind designed to reach: (1) the Colorado public in general, via radio and television public service announcements (PSA's), and a special printing of 500,000 King Soopers shopping bags which presented safety tips and the phone numbers of the seven CAIC avalanche hotlines in Colorado; and

Table 8. Scheduled contacts with organized groups by Avalanche Center personnel, 1987-88

Date	Personnel	Group	Attendance
11/1-5	KW & NL	National Avalanche School, Denver	210
11/11	N. Logan	Public Awareness Talk, Breckenridge	125
12/1	K. Williams	North Face, Colorado Springs	60
12/2	K. Williams	North Face, Boulder	40
12/3	K. Williams	North Face, Denver	25
12/4	N. Logan	Summit Telemark Series, Durango	17
12/12-13	KW, NL, AL, DA	Summit Co. Rescue Group, Breckenridge	120
12/14	K. Williams	Public Awareness Course, Steamboat	100
12/17	N. Logan	Breckenridge Elementary School, Breck.	25
12/18	N. Logan	Summit Telemark Series, Leadville	18
1/3	N. Logan	Breckenridge S. A. employees, Breck.	33
1/4-6	N. Logan	National Avalanche School, Copper Mtn.	24
1/12	K. Williams	Mountain Shop, Ft. Collins	180
1/13	D. Atkins	Avalanche Awareness Week talk, Denver	300
1/14	D. Atkins	Avalanche Awareness Week talk, Golden	300
1/15	A. Loving	Summit Telemark Series, Aspen	4
1/16	A. Loving	Pitkin Co. Public Awareness, Aspen	150
1/16	N. Logan	North Face, Berthoud Pass	25
1/19	N. Logan	Public Awareness, Breckenridge	32
1/20	K. Williams	Mountain Rescue, Boulder	40
1/21	K. Williams	Beaver Creek Ski Patrol, Beaver Ck.	15
1/22	D. Atkins	Grayland Elementary School, Denver	65
1/22	K. Williams	Vail Ski Patrol, Vail	25
1/25-26	N. Logan	Summit Co. Pro. Aval. Course, Summit Co	18
1/26	K. Williams	Weathercasters Conference, Snowmass	25
1/26	K. Williams	Snowmobile Club, Glenwood	40
1/27	N. Logan	Mountain Chalet, Colorado Springs	65
1/29	D. Atkins	Grand West Outfitters, CS/Hoosier Pass	42
2/1	N. Logan	Winter Park Natl. Ski Patrol, Denver	49
2/8-9	N. Logan	Breckenridge Ski Patrol, Breckenridge	6
2/18-19	N. Logan	Breckenridge Ski Patrol, Breckenridge	5
2/20	N. Logan	NSPS Patch Course, Winter Park	14
2/27	N. Logan	Aspen Awareness, Snowmass	28
3/1	K. Williams	CSU class (Hal Boyne), Ft. Collins	12
3/3	K. Williams	Colo. Blizzards Snowmobile Club	24
3/5	N. Logan	Summit Telemark Series, Breckenridge	40
3/11	N. Logan	Minturn Middle School, Minturn	58
3/13	D. Atkins	NSPS Instructors Clinic, Loveland S.A.	23
3/15	K. Williams	Colo. Mtn. Club Mtn. School, Boulder	80
3/19-20	K. Williams	NSPS Patch Course, Winter Park	14
4/9	D. Atkins	NSPS Patch Course, Boulder	22
4/16	D. Atkins	NSPS Patch Course, Loveland Ski Area	28
5/9	D. Atkins	Evergreen Jr. High School, Evergreen	65
5/9	N. Logan	Colorado Mountain Club, Denver	82
TOTAL			2673

(2) the backcountry traveler in particular, via avalanche awareness lectures, slide programs, and field seminars.

Financial sponsors for ABC'S Week were Mountain Bell and KUSA-TV (Channel 9 in Denver). The Avalanche Center, U.S. Forest Service, and Rocky Mountain Division of the National Ski Patrol System served as active participants in the program. The program had long been scheduled for January 11th-18th, and tragically the season's only two fatal incidents occurred just days prior to ABC'S Week. However, because of these accidents, considerable media attention and public interest developed over the program.

Knox Williams assisted the CSRFB in developing the themes for the public service announcements and provided technical information for accuracy and appropriateness in format and presentation. Dale Atkins prepared a written basic avalanche awareness course curriculum for use by mountain search and rescue teams and forest rangers to present a 1 to 1-1/2 hour avalanche awareness program in their area. In the Denver area, the curriculum was used in programs reaching over 1,000 people. Atkins also was a speaker at two evening programs with a combined audience of almost 600. Williams spoke to almost 200 people at Ft. Collins, while Andy Loving spent time in Aspen assisting Mountain Rescue Aspen in a three-day course. Also just prior to, during and shortly after ABC'S Week, all CAIC forecasters took part in television interviews, radio talk shows, and newspaper interviews.

The CSRFB produced a media and materials kit consisting of three separate 15, 20, and 30-second PSA's, produced by KUSA-TV on video cassettes for use on local cable TV. The on-air spokesman was Olympic skier Hank Kashiwa. (He was caught in a large avalanche many years ago.) KUSA-TV aired the PSA's from January 4th to the end of February. Also included were eight reproduction-ready educational and safety ads for local print media, six pre-written newspaper feature stories, eight pre-written 30-second radio PSA's for local stations to record or air live, and a reproduction-ready copy of the USFS brochure "Snow Avalanche: How to avoid and survive avalanches". Lastly, the kit included a copy of a USFS 17-minute avalanche awareness video and a series of posters to be displayed in stores, restaurants and trailheads

promoting ABC'S Week. These kits were distributed to 36 mountain search and rescue teams and 8 selected Forest Service Ranger Districts across the state. These organizations were encouraged to present their own avalanche awareness programs to people in their local areas.

Just prior to the start of ABC'S Week, a media seminar was held in Denver to formally introduce ABC'S Week and to present the media with key contacts and channels for obtaining information on avalanche incidents. It was well attended by the local Denver media as well as the major network affiliates. The program was hosted by the CSRБ with a representative from the Colorado Sheriff's Association and Atkins from the CAIC as speakers.

The Center was very pleased with ABC'S Week. The Colorado Search and Rescue Board is in the process of evaluating the size of the audience reached so as to determine its impact and effectiveness. Near the end of April the CSRБ received a letter from Governor Roy Romer thanking the CSRБ and the participating agencies and organizations for ABC'S Week.

Avalanche Cards and Brochures

Printed material in the form of wallet-size avalanche cards and brochures is distributed at all lectures and seminars, and is included in return letters of correspondence with the public. The cards contain all of the public hotline phone numbers and a definition of the four hazard ratings. The brochures carry this information, as well as basic information and diagrams about avalanches -- how to recognize areas where they occur, and how to avoid them.

The Summit County Rescue Group printed special cards similar in nature but designed specifically for the Summit County area. This was in conjunction with the new phone system installed in this area in January. Their personnel distributed and maintained avalanche poster/card holders in Summit County which generated much use of the new phone.

HAZARD GRADING

For the fourth year, the Avalanche Center has used a grading system for evaluating its performance of avalanche forecasting. This prediction focuses on the "avalanche potential" based on incoming weather and snowpack data. To arrive at a forecast, the forecaster makes an evaluation for the next 24-hour period for the Northern, Central, and Southern Mountains. This is based on field data of current stability and the weather prediction. Each afternoon the forecast is logged in the "Daily Hazard Information and Decision Chart" using one of the four categories. On the following day, the actual hazard rating -- based on the observers' estimates -- is compared to the previous day's forecast. A grade of "correct forecast", "under forecast", or "over forecast" is then entered onto the chart.

Avalanche hazard forecasts are expressed by using the terms "low", "moderate", "high" or "extreme" to depict the hazard in a given area. This has been slightly modified from last season. Forecasters previously had the freedom to combine two of these terms to describe the current hazard rating. It was felt that by doing so, the listener was getting too general a forecast. This season each forecaster could choose only one of the four terms to describe the hazard.

The scores for this and previous years are shown in the following table:

	<u>1987-88</u>	<u>1986-87</u>	<u>1985-86</u>	<u>1984-85</u>
Correct forecast	86%	95%	92%	81%
Over forecast	8%	2%	5%	12%
Under forecast	6%	3%	3%	7%

We are still satisfied with the results, for two reasons. First, the "correct" forecast is maintaining an acceptable percentage in a field that is as much art as science. We will remain pleased with accuracy figures greater than 80%. Second, the "over" forecast rate still exceeds "under" forecasts. It is more desirable to err on the side of overestimating the danger rather than underestimating.

SAMPLE AVALANCHE WARNINGS AND ADVISORIES

This section shows examples of products that Avalanche Center forecasters issued via the NOAA Colorado Weatherwire. This includes Avalanche Warning Bulletins and a Special Avalanche Advisory. Page 44 is an example of a Special Avalanche Advisory; while pages 45-48 represent a four-day avalanche warning at the end of January, and pages 49-52 are bulletins selected from the longest-running warning period of the season.

TTAAOO KDEN 092245
SPECIAL AVALANCHE ADVISORY
COLORADO AVALANCHE INFORMATION CENTER
NATIONAL WEATHER SERVICE DENVER CO
3:45 PM TUESDAY FEBRUARY 9, 1988

...NORTHERN AND CENTRAL COLORADO MOUNTAINS...BACKCOUNTRY AVALANCHE
HAZARD INCREASING...

THE AVALANCHE PUBLIC MESSAGE TELEPHONE FOR THE DENVER/BOULDER AREA IS
TEMPORARILY OUT OF SERVICE. WE ASK THAT YOU PASS ALONG THIS AVALANCHE
ADVISORY ... UNTIL OUR PHONE IS BACK IN SERVICE IN A DAY OR TWO.

THE BACKCOUNTRY AVALANCHE HAZARD IN THE NORTHERN MOUNTAINS OF COLORADO
IS CURRENTLY RATED MODERATE WITH POCKETS OF LOCALIZED HIGH HAZARD ABOVE
TIMBERLINE. IN THE CENTRAL MOUNTAINS IT IS RATED MODERATE. SNOW AND WIND
TONIGHT COULD INCREASE THE HAZARD ABOVE TIMBERLINE IN THE NORTHERN AND
CENTRAL MOUNTAINS TO ... HIGH OVERALL.

A MODERATE HAZARD MEANS THAT NATURAL AVALANCHE RELEASES ARE
UNLIKELY...BUT AREAS OF UNSTABLE SNOW EXIST AND SKI OR SNOWMOBILE
TRIGGERED RELEASES ARE POSSIBLE ON STEEPER SLOPES.

A HIGH HAZARD MEANS THAT BOTH NATURAL AND TRIGGERED AVALANCHE RELEASES
ARE LIKELY IN STEEPER AREAS. WE RECOMMEND THAT BACKCOUNTRY SKIERS AND
SNOWMOBILERS AVOID STEEPER TERRAIN AND LIMIT TRAVEL TO GENTLE TERRAIN
AND MAINTAINED TRAILS.

THIS STATEMENT IS OF PARTICULAR INTEREST TO PERSONS USING THE
BACKCOUNTRY OUTSIDE OF DEVELOPED SKI AREA BOUNDARIES. WHERE NECESSARY,
SKI AREAS USE AVALANCHE CONTROL METHODS WITHIN THEIR BOUNDARIES.

FOR ADDITIONAL AVALANCHE INFORMATION CALL ... 236-9435 IN DENVER AND
BOULDER ... 482-0457 IN FT. COLLINS ... 520-0020 IN COLORADO SPRINGS ...
668-0600 IN SUMMIT COUNTY ... AND 247-8187 IN DURANGO.

WILLIAMS
COLORADO AVALANCHE INFORMATION CENTER
8788

TTAAOO KDEN 240007
AVALANCHE WARNING BULLETIN NO 1
COLORADO AVALANCHE INFORMATION CENTER
NATIONAL WEATHER SERVICE DENVER CO
5:00 PM SATURDAY JANUARY 23, 1988

...AVALANCHE WARNING FOR NORTH AND CENTRAL COLORADO MOUNTAINS...

AN AVALANCHE WARNING IS IN EFFECT IMMEDIATELY FOR ALL MOUNTAIN AREAS NORTH OF A LINE FROM PUEBLO TO MONTROSE. THIS WARNING IS IN EFFECT THROUGH SUNDAY JANUARY 24. NEW SNOW OF 3 TO 6 INCHES IN THE CENTRAL MOUNTAINS, AND HIGH WINDS OF 30 TO 50 MPH IS TRANSPORTING THIS NEW SNOW INTO AVALANCHE STARTING ZONES.

THE AVALANCHE HAZARD FOR ALL COLORADO MOUNTAINS AT AND ABOVE TREELINE IS RATED HIGH. BELOW TREELINE THE HAZARD IS RATED MODERATE WITH AREAS OF HIGH HAZARD ESPECIALLY ON SLOPES FACING SOUTH TO EAST. TRIGGERED AVALANCHE RELEASES BY A SKIER OR SNOWMOBILER ARE LIKELY IN THESE AREAS OF HIGH HAZARD. WE RECOMMEND THAT BACKCOUNTRY TRAVELLERS AVOID ALL STEEP SNOWLOADED SLOPES OF 30 DEGREES AND STEEPER NEAR AND ABOVE TREELINE.

THIS STATEMENT IS OF PARTICULAR INTEREST TO PERSONS USING THE BACKCOUNTRY OUTSIDE OF DEVELOPED SKI AREA BOUNDARIES. WHERE NECESSARY, SKI AREAS USE AVALANCHE CONTROL METHODS WITHIN THEIR BOUNDARIES.

FOR ADDITIONAL AVALANCHE INFORMATION CALL ... 236-9435 IN DENVER AND BOULDER ... 482-0457 IN FT. COLLINS ... 520-0020 IN COLORADO SPRINGS ... 668-0600 IN SUMMIT COUNTY ... AND 247-8187 IN DURANGO.

ATKINS
COLORADO AVALANCHE INFORMATION CENTER
8788/5-1

TTAAOO KDEN 242318
AVALANCHE WARNING BULLETIN NO 2
COLORADO AVALANCHE INFORMATION CENTER
NATIONAL WEATHER SERVICE DENVER CO
4:20 PM SUNDAY JANUARY 24, 1988

...NORTH AND CENTRAL MOUNTAINS...AVALANCHE HAZARD HIGH...

AN AVALANCHE WARNING REMAINS IN EFFECT FOR ALL MOUNTAIN AREAS OF COLORADO NORTH OF A LINE FROM PUEBLO TO MONTROSE. THIS WARNING WILL REMAIN VALID THROUGH MONDAY JANUARY 25. SNOWFALL OF 3 TO 7 INCHES OF SNOW LAST NIGHT WITH ADDITIONAL SNOW EXPECTED TONIGHT IN THE NORTH AND CENTRAL MOUNTAINS ACCOMPANIED BY STRONG WINDS OF 30 TO 50 MPH WILL CONTINUE TO LOAD AVALANCHE STARTING ZONES NEAR AND ABOVE TREELINE.

THE AVALANCHE HAZARD FOR ALL COLORADO MOUNTAINS AT AND ABOVE TREELINE IS RATED HIGH. BELOW TREELINE THE HAZARD IS RATED MODERATE WITH AREAS OF HIGH HAZARD ESPECIALLY IN SLOPES FACING SOUTH TO NORTHEAST. TRIGGERED AVALANCHE RELEASES BY A SKIER OR SNOWMOBILER ARE LIKELY IN THESE AREAS OF HIGH HAZARD. WE RECOMMEND THAT BACKCOUNTRY TRAVELLERS AVOID ALL STEEP SNOWLOADED SLOPES OF 30 DEGREES AND STEEPER NEAR AND ABOVE TREELINE.

THIS STATEMENT IS OF PARTICULAR INTEREST TO PERSONS USING THE BACKCOUNTRY OUTSIDE OF DEVELOPED SKI AREA BOUNDARIES. WHERE NECESSARY, SKI AREAS USE AVALANCHE CONTROL METHODS WITHIN THEIR BOUNDARIES.

FOR ADDITIONAL AVALANCHE INFORMATION CALL ... 236-9435 IN DENVER AND BOULDER ... 482-0457 IN FT. COLLINS ... 520-0020 IN COLORADO SPRINGS ... 668-0600 IN SUMMIT COUNTY ... AND 247-8187 IN DURANGO.

ATKINS
COLORADO AVALANCHE INFORMATION CENTER
8788/5-2

TTAAOO KDEN 251811
AVALANCHE WARNING BULLETIN NO 3
COLORADO AVALANCHE INFORMATION CENTER
NATIONAL WEATHER SERVICE DENVER CO
11:15 AM MONDAY JANUARY 25, 1988

...NORTH AND CENTRAL MOUNTAINS...AVALANCHE WARNING EXTENDED...

THE AVALANCHE WARNING HAS BEEN EXTENDED FOR THE NORTHERN AND CENTRAL MOUNTAIN AREAS OF COLORADO. NEW SNOWS FORECAST FOR THE NORTHERN AND CENTRAL MOUNTAINS LAST NIGHT DID NOT ARRIVE AND AVALANCHE HAZARDS ARE NOT BUILDING AS QUICKLY AS EXPECTED. STILL, STRONG NORTHWEST WINDS OF 30 TO 50 MPH WILL CONTINUE TO LOAD AVALANCHE STARTING ZONES TODAY.

THE AVALANCHE HAZARD FOR ALL COLORADO MOUNTAINS IS RATED HIGH AT AND ABOVE TREELINE. BELOW TREELINE THE HAZARD IS RATED MODERATE. WITH STRONG WINDS TODAY, AVALANCHE HAZARDS WILL CONTINUE TO BUILD IN THE STEEP STARTING ZONES LOCATED BOTH ABOVE AND BELOW TREELINE. THE AVALANCHE HAZARD IN THESE STEEP SNOWLOADED AREAS BELOW TIMBERLINE IS RATED HIGH, ESPECIALLY ON SLOPES FACING SOUTH TO NORTHEAST. TRIGGERED AVALANCHE RELEASES BY A SKIER OR SNOWMOBILER ARE LIKELY IN ALL AREAS OF HIGH AVALANCHE HAZARD. BACKCOUNTRY VISITORS SHOULD AVOID ALL STEEP SNOWLOADED SLOPES AND GULLIES WHICH ARE 30 DEGREES AND STEEPER. SAFER SKIING MAY BE FOUND IN THE GENTLE TERRAIN WELL AWAY FROM STEEP AVALANCHE PRONE AREAS.

THIS STATEMENT IS OF PARTICULAR INTEREST TO PERSONS USING THE BACKCOUNTRY OUTSIDE OF DEVELOPED SKI AREA BOUNDARIES. WHERE NECESSARY, SKI AREAS USE AVALANCHE CONTROL METHODS WITHIN THEIR BOUNDARIES.

FOR ADDITIONAL AVALANCHE INFORMATION CALL ... 236-9435 IN DENVER AND BOULDER ... 482-0457 IN FT. COLLINS ... 520-0020 IN COLORADO SPRINGS ... 668-0600 IN SUMMIT COUNTY ... AND 247-8187 IN DURANGO.

LOVING
COLORADO AVALANCHE INFORMATION CENTER
8788/5-3

TTAAOO KDEN 261557
AVALANCHE WARNING TERMINATION
COLORADO AVALANCHE INFORMATION CENTER
NATIONAL WEATHER SERVICE DENVER CO
9:00 AM TUESDAY JANUARY 26, 1988

...NORTH AND CENTRAL MOUNTAINS...AVALANCHE WARNING TERMINATED...

THE AVALANCHE WARNING HAS BEEN TERMINATED FOR THE NORTHERN AND CENTRAL MOUNTAIN AREAS OF COLORADO.

THE AVALANCHE HAZARD FOR ALL COLORADO MOUNTAINS IS RATED HIGH AT AND ABOVE TREELINE. BELOW TREELINE THE HAZARD IS RATED MODERATE. WINDBLOWN SNOW HAS ACCUMULATED ON STEEP SLOPES AND GULLIES LOCATED BELOW TREELINE. THE AVALANCHE HAZARD IN THESE STEEP SNOWLOADED POCKETS BELOW TIMBERLINE IS ALSO RATED HIGH. THIS IS ESPECIALLY TRUE FOR SLOPES WITH NORTHEAST THROUGH SOUTH ASPECTS. TRIGGERED AVALANCHE RELEASES BY A SKIER OR SNOWMOBILER ARE LIKELY IN ALL AREAS OF HIGH AVALANCHE HAZARD. BACKCOUNTRY VISITORS SHOULD AVOID ALL STEEP SNOWLOADED SLOPES WHICH ARE 30 DEGREES AND STEEPER.

THIS STATEMENT IS OF PARTICULAR INTEREST TO PERSONS USING THE BACKCOUNTRY OUTSIDE OF DEVELOPED SKI AREA BOUNDARIES. WHERE NECESSARY, SKI AREAS USE AVALANCHE CONTROL METHODS WITHIN THEIR BOUNDARIES.

FOR ADDITIONAL AVALANCHE INFORMATION CALL ... 236-9435 IN DENVER AND BOULDER ... 482-0457 IN FT. COLLINS ... 520-0020 IN COLORADO SPRINGS ... 668-0600 IN SUMMIT COUNTY ... AND 247-8187 IN DURANGO.

LOVING
COLORADO AVALANCHE INFORMATION CENTER
8788/5-4

TTAAOO KDEN 051722
AVALANCHE WARNING BULLETIN NO. 1
COLORADO AVALANCHE INFORMATION CENTER
NATIONAL WEATHER SERVICE DENVER CO
10:30 AM MST TUESDAY JANUARY 5, 1988

...AVALANCHE HAZARD HIGH ABOVE TIMBERLINE ALL COLORADO MOUNTAINS...

AN AVALANCHE WARNING IS IN EFFECT IMMEDIATELY AT AND ABOVE TIMBERLINE FOR BACKCOUNTRY AREAS OF ALL COLORADO MOUNTAINS. THE CAUSES OF THE HIGH BACKCOUNTRY AVALANCHE HAZARD ARE OVERNIGHT SNOWFALLS OF 4-14 INCHES AND WINDS ABOVE TIMBERLINE OF 20-40 MPH.

THIS WARNING IS VALID THROUGH WEDNESDAY MORNING.

POOR VISIBILITY IS HAMPERING BACKCOUNTRY AVALANCHE OBSERVATIONS ... BUT THUS FAR SLIDES HAVE BEEN REPORTED AT TELLURIDE AND RED MTN PASS IN THE SOUTHERN MOUNTAINS ... AND AROUND GOTHIC IN THE CENTRAL MOUNTAINS. MORE AVALANCHE ARE EXPECTED AS MOUNTAIN SNOWS ARE EXPECTED TO CONTINUE.

WE RECOMMEND THAT BACKCOUNTRY SKIERS AND SNOWMOBILERS LIMIT TRAVEL TO GENTLE TERRAIN ... FOR NATURAL AND TRIGGERED AVALANCHES ARE LIKELY ON SLOPES EXCEEDING 30 DEGREES STEEPNESS. IT IS A GOOD TIME TO SKI AT A SKI AREA.

THIS BULLETIN IS OF PARTICULAR INTEREST TO PERSONS USING THE BACKCOUNTRY OUTSIDE OF DEVELOPED SKI AREA BOUNDARIES. WHERE NECESSARY, SKI AREAS USE AVALANCHE CONTROL METHODS WITHIN THEIR BOUNDARIES.

FOR ADDITIONAL AVALANCHE INFORMATION CALL ... 236-9435 IN DENVER AND BOULDER ... 482-0457 IN FT. COLLINS ... AND 520-0020 IN COLORADO SPRINGS.

THE NEXT AVALANCHE BULLETIN IS SCHEDULED FOR 4 PM TODAY.

WILLIAMS
COLORADO AVALANCHE INFORMATION CENTER
8788/3-1

TTAAOO KDEN 092145
AVALANCHE WARNING BULLETIN NO. 10
COLORADO AVALANCHE INFORMATION CENTER
NATIONAL WEATHER SERVICE DENVER CO
2:45 PM MST SATURDAY JANUARY 9, 1988

AVALANCHE WARNING EXTENDED TO SUNDAY...ALL COLORADO MOUNTAIN AREAS

AN AVALANCHE WARNING REMAINS IN EFFECT FOR ALL BACKCOUNTRY AREAS OF THE COLORADO MOUNTAINS. THE AVALANCHE HAZARD FOR THE NORTHERN, CENTRAL AND SOUTHERN MOUNTAINS REMAINS HIGH BOTH ABOVE AND BELOW TIMBERLINE.

APPROXIMATELY 25 AVALANCHES, BOTH NATURAL AND TRIGGERED, HAVE BEEN REPORTED TO THE CENTER TODAY. THESE SLIDES HAVE GENERALLY BEEN CONFINED TO THE NEW SNOW WHICH HAS BEEN MOVED TO LEE SLOPES AND GULLIES BY RECENT STRONG WINDS ABOVE TIMBERLINE. ONE NATURAL SLIDE ON BERTHOUD PASS CAUGHT AND DAMAGED AN AUTOMOBILE THIS MORNING. THE SINGLE OCCUPANT OF THE CAR WAS NOT INJURED. HIGHWAY 40 WAS CLOSED FOR APPROXIMATELY FOUR HOURS.

NATURAL AND TRIGGERED AVALANCHES ARE LIKELY IN THE AREAS OF THE COLORADO BACKCOUNTRY WITH A HIGH AVALANCHE HAZARD. THOUGH NATURAL RELEASES ARE LESS LIKELY IN AREAS WITH A MODERATE HAZARD, TRIGGERED RELEASES REMAIN POSSIBLE IN STEEP SNOWLOADED SLOPES OF THIRTY DEGREES OR STEEPER, FACING NORTH THROUGH SOUTH-EAST.

BACKCOUNTRY SKIERS AND SNOWMOBILERS SHOULD CONTINUE TO AVOID STEEP SNOWLOADED SLOPES AND GULLIES. SAFE SKIING IS AVAILABLE IN THE GENTLE TERRAIN WELL AWAY FROM AVALANCHE PRONE AREAS, THOUGH WE DO NOT RECOMMEND TRAVEL IN THE BACKCOUNTRY AT ALL, TODAY OR TOMORROW.

THIS BULLETIN IS OF PARTICULAR INTEREST TO PERSONS USING THE BACKCOUNTRY OUTSIDE OF DEVELOPED SKI AREA BOUNDARIES. WHERE NECESSARY, SKI AREAS USE AVALANCHE CONTROL METHODS WITHIN THEIR BOUNDARIES.

FOR ADDITIONAL AVALANCHE INFORMATION CALL ... 236-9435 IN DENVER AND BOULDER ... 482-0457 IN FT. COLLINS ... 520-0020 IN COLORADO SPRINGS ... AND 247-8187 IN DURANGO.

THE NEXT AVALANCHE BULLETIN IS SCHEDULED FOR 11 AM SUNDAY.

LOVING
COLORADO AVALANCHE INFORMATION CENTER
8788/3-10

TTAAOO KDEN 102311
AVALANCHE WARNING BULLETIN NO. 12
COLORADO AVALANCHE INFORMATION CENTER
NATIONAL WEATHER SERVICE DENVER CO
4:00 PM MST SUNDAY JANUARY 10, 1988

...AVALANCHE WARNING EXTENDED IN ALL COLORADO MOUNTAINS...

AN AVALANCHE WARNING REMAINS IN EFFECT FOR ALL BACKCOUNTRY AREAS OF THE COLORADO MOUNTAINS. THE AVALANCHE HAZARD IS RATED HIGH BOTH ABOVE AND BELOW TREELINE. THIS WARNING WILL REMAIN IN EFFECT THROUGH MONDAY.

THREE BACKCOUNTRY SKIERS IN THE CENTRAL MOUNTAINS NEAR ASHCROFT HAVE BEEN REPORTED BURIED IN AN AVALANCHE TODAY AND A SEARCH IS UNDERWAY THIS AFTERNOON.

NATURAL AND TRIGGERED AVALANCHES ARE LIKELY AT THIS TIME. BACKCOUNTRY SKIERS AND SNOWMOBILERS ARE URGED TO AVOID STEEP SNOWLOADED SLOPES AND GULLIES AND STAY WELL AWAY FROM STEEP OPEN SLOPES ABOVE YOU.

THIS BULLETIN IS OF PARTICULAR INTEREST TO PERSONS USING THE BACKCOUNTRY OUTSIDE OF DEVELOPED SKI AREA BOUNDARIES. WHERE NECESSARY, SKI AREAS USE AVALANCHE CONTROL METHODS WITHIN THEIR BOUNDARIES.

FOR ADDITIONAL AVALANCHE INFORMATION CALL ... 236-9435 IN DENVER AND BOULDER ... 482-0457 IN FT. COLLINS ... 520-0020 IN COLORADO SPRINGS ... AND 247-8187 IN DURANGO.

THE NEXT AVALANCHE BULLETIN IS SCHEDULED FOR MONDAY MORNING

LOGAN
COLORADO AVALANCHE INFORMATION CENTER
8788/3-12

TTAAOO KDEN 142332
AVALANCHE TERMINATION BULLETIN NO. 17
COLORADO AVALANCHE INFORMATION CENTER
NATIONAL WEATHER SERVICE DENVER CO
4:15 PM MST THURSDAY JANUARY 14, 1988

...ALL COLORADO MOUNTAINS ... AVALANCHE HAZARD EASING...

THE AVALANCHE WARNING FOR THE COLORADO MOUNTAINS HAS BEEN CANCELLED. LITTLE ADDITIONAL SNOWFALL, LIGHTER WINDS, AND WARMER TEMPERATURES ARE HELPING EASE THE HAZARD. HOWEVER, THE AVALANCHE HAZARD IS STILL RATED HIGH FOR ALL AREAS AT AND ABOVE TREELINE. BELOW TREELINE, THE HAZARD ON SLOPES FACING NORTH TO SOUTHEAST IS STILL HIGH. ON SLOPES FACING SOUTH TO WEST TO NORTH BELOW TREELINE, THE HAZARD IS MODERATE.

OVER 520 AVALANCHES WERE REPORTED DURING THE WARNING PERIOD. AVALANCHES TRIGGERED BY A BACKCOUNTRY SKIER OR SNOWMOBILE ARE STILL LIKELY IN THE AREAS OF HIGH HAZARD, IN AREAS OF MODERATE HAZARD, TRIGGERED RELEASES ARE POSSIBLE. BACKCOUNTRY TRAVELLERS ARE ADVISED TO AVOID STEEP, SNOWLOADED SLOPES, EVEN THOSE BELOW TREELINE...AND AVOID STEEP OPEN SLOPES FROM ABOVE.

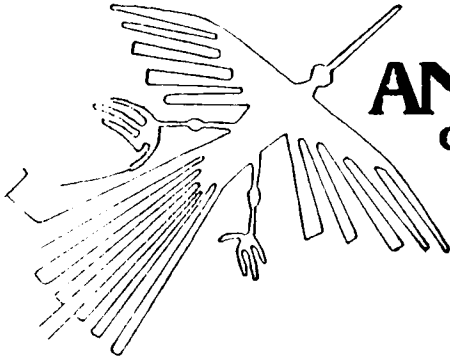
THIS BULLETIN IS OF PARTICULAR INTEREST TO PERSONS USING THE BACKCOUNTRY OUTSIDE OF DEVELOPED SKI AREA BOUNDARIES. WHERE NECESSARY, SKI AREAS USE AVALANCHE CONTROL METHODS WITHIN THEIR BOUNDARIES.

FOR ADDITIONAL AVALANCHE INFORMATION CALL ... 236-9435 IN DENVER AND BOULDER ... 482-0457 IN FT. COLLINS ... 520-0020 IN COLORADO SPRINGS ... AND 247-8187 IN DURANGO.

ATKINS
COLORADO AVALANCHE INFORMATION CENTER
8788/3-17

LETTERS AND NEWSPAPER ARTICLES

This appendix includes several letters commenting on the service provided by the Avalanche Center and a sampling of newspaper stories which helped the Center get its information to the public.



ANDEAN OUTFITTERS

Outfitters & Guides for South America

Hastings Mesa
22/ April '89

Avalanche Hazard Center
Denver

Gentlemen:

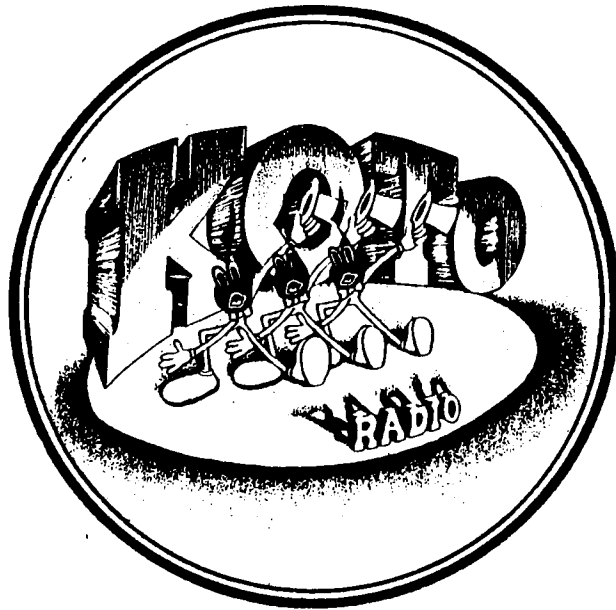
Just want to say I really appreciate your winter storm and avalanche forecasts. We, out here, spend about six months a year with the snowpack, and your service is deeply appreciated.

Your weather forecasts, as heard on Radio KOTO, Telluride, are the best they have had in the 9 years I've been listening. Glad to get them -- wish you could keep it up all year.

Thanks,

A handwritten signature in cursive script, appearing to read "Jack Miller". The signature is fluid and somewhat stylized, with a prominent loop at the beginning.

Jack Miller



COLORADO DEPARTMENT OF NATURAL RESOURCES
COLORADO AVALANCHE INFORMATION CENTER
10230 SMITH ROAD
DENVER, COLORADO 80239

MAY 12, 1988

DEAR FOLKS,

WE WOULD LIKE TO EXPRESS OUR SINCERE APPRECIATION FOR THE FINE SERVICE THE COLORADO AVALANCHE INFORMATION CENTER PROVIDED THIS PAST WINTER. WE UTILIZED THE DURANGO BRANCH OF YOUR SERVICE ON A DAILY BASIS, AND IT BECAME AN INTEGRAL PART OF OUR NEWS AND WEATHER DEPARTMENT.

AS YOU KNOW, WEATHER AND AVALANCHE CONDITIONS FOR AN AREA AS LARGE AND AS VARIED AS COLORADO CAN BECOME RATHER VAGUE, BUT YOUR REPORTS WERE SOMEWHAT PERSONALIZED WHEN 'TELLURIDE' AND 'THE SAN JUANS' WERE SPECIFICALLY MENTIONED. IT WAS A FAVORITE WITH OUR LISTENERS.

THANKS VERY MUCH FOR THE SERVICE AND WE HOPE THAT YOU CAN CONTINUE YOUR REPORTS NEXT WINTER. WE LOOK FORWARD TO IT.

SINCERELY,

BEN KERR
PROGRAM DIRECTOR
KOTO-FM

91.7 FM COMMUNITY RADIO IN TELLURIDE
THE SAN MIGUEL EDUCATIONAL FUND • BOX 1069 • TELLURIDE, CO 81435 • 728-4333/4

jim bedford

box 601
540 w. galena ave.
telluride, co 81435

Colorado Avalanche Information Center
10230 Smith Road
Denver, CO 80239
4.19.88

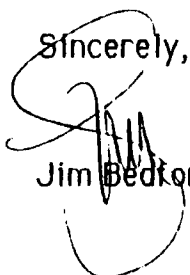
Dear Avalanche Folks:

Thanks for another great season! Your continued clear and area specific reporting adds to the safety and welfare of all citizens and visitors to the mountains of Colorado.


Our local radio station, KOTO-fm, has broadcast reports all season from your service. Last year, four back-country skiers were killed by avalanches in this area. This year, there were no deaths, and only a few small incidents which caused no bodily harm. I really believe that if this service is expanded, and certainly continued, that we can get Colorado avalanche deaths down to zero. I only wish we could get fools to hear and understand the dangers that you warn about are no joke, and to take those warnings seriously.

Keep up the good work, and hope to hear from you next year.

Sincerely,



Jim Bedford



1951 SO. HWY. 24
P.O. BOX 280

MINTURN MIDDLE SCHOOL

MINTURN, COLORADO
81645 (303) 827-5721

March 16, 1988

Eagle County Commissioners:

Yearly, the Minturn Middle School 7th graders participate in an interdisciplinary Snow Unit. Our objective is to understand survival in our environment. This year we were very fortunate to have a speaker from the Colorado Avalanche Information Center, which had not been available in the past.

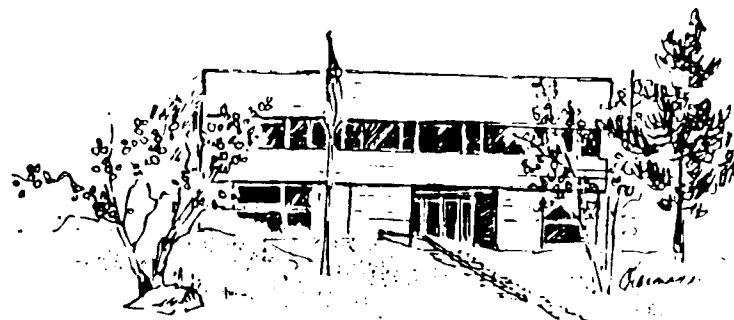
Nick Logan presented information using lecture with slide and film presentations. He covered all of the aspects of snow safety, avalanches, awareness while skiing or being in the back country and general information about snow. His talk was very profound and informative. He addressed the audience on their level.

I understand Eagle County helps support the Colorado Avalanche Information Center and we hope they continue to do so because they are a valuable resource.

Danna Neuse John Bueh
Tracy J. Flick
Mark L. Sandoval

7th Grade Teachers

cc: Nick Logan



COLORADO OUTDOORS

Published by the Colorado Department of Natural Resources, Division of Wildlife, and dedicated to the conservation and enjoyment of Colorado's outdoors — its animals, fish, soil, forests, prairies and waters.

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Safeguarding Colorado's Backcountry

The Avalanche Information Center
is the early warning system
for backcountry travelers

By ERROL WILLETT

PHOTO BY RICHARD ARMSTRONG

ON FEBRUARY 19, 1987, five skiers at the Breckenridge ski area eyed the deep untracked powder on Peak Seven from the rope that marks the ski area boundary. Passing a large danger sign and heading into the uncontrolled area seemed a small risk compared to the fun of the deep powder skiing awaiting them. But seconds later, four of the five were buried in an avalanche that held the state and much of the country breathless for 48 hours. They did not survive.

The snow was described as "like concrete" and had piled up as high as 40 feet where the avalanche came to rest. The fracture line near the top of the bowl was a half mile wide and up to 10 feet deep. The victims weren't equipped for avalanche danger and hadn't heeded the numerous warning signs. They didn't have a chance.

Thousands of skiers take the same risk every year. Most are concerned more with losing their lift pass than losing their life. Many are experienced skiers, but ignorant of backcountry safety equipment and prediction methods that could turn the odds in their favor if they decide to "go for it."

In a 1986 slide on Berthoud Pass, Ron Brown was luckier. The veteran snow-

Erroll Willett is a free-lance writer living in Boulder, Colorado. During the winter he teaches handicapped people to ski at the Winter Park ski area.

safety patrolman narrowly escaped, in large part due to the experience and quick work of tow partners. Back at work at the Berthoud ski area shortly after the accident, Brown confessed that his knowledge of snow science accounted for only 50 percent of his avalanche forecasting. "The rest is intuition," he said.

When Brown went down in the slide he knew to free himself of his daypack and poles and to use a swimming motion

Telephone numbers to the Colorado Avalanche Information Center hotlines:	
Denver/Boulder	236-9435
Ft. Collins	482-0457
Colorado Springs	520-0020
Dillon (all Summit County)	468-5434
Vail	827-5687
Aspen	920-1664
Durango	247-8187

to stay near the top of the snow. When the slide stopped he formed an air pocket in front of his face. Brown wore a transceiver, a device that emits and receives a radio signal. His partners also were equipped with transceivers as well as shovels and experience. Most groups aren't this well prepared.

And so Knox Williams, Director of the Colorado Avalanche Information Center, predicts at least four skiers won't be so fortunate this year. That's the yearly average in Colorado, and he credits the Avalanche Center's forecasting and in-

formation hotline with helping to keep the number of fatalities that low, despite continuous increases in skier use.

The Breckenridge disaster is the worst on record in Colorado, a state with the distinction of having the most avalanche fatalities in the U.S. since 1950. But the numbers are low when compared to the 1910 disaster that buried 96 passengers inside tow train cars crossing Stevens Pass in northern Washington, the most deadly avalanche in recent American history. Or when compared to the 1970 ice avalanches in Peru that overwhelmed the city of Yungay, killing 20,000.

The Colorado Avalanche Information Center was originally part of a U.S. Forest Service program headquartered at Ft. Collins. The program included research in snow science and avalanches but that part of the funding was cut by the Forest Service in 1985, ending the last significant snow science study in this country.

"It's an area of research where we still have a lot of work to do," says Williams. "Currently, however, the Japanese and Europeans are doing it."

Despite the cutbacks in research, funding for the Avalanche Center has continued. In addition to the \$50,000 from the Forest Service, the Center also receives funds from Colorado Ski Country, Rocky Mountain National Park, the Colorado Division of Parks and Outdoor Recreation, the Colorado Department of Highways and some ski areas. Williams operates the Center's telephone hotline from a small office provided by the

National Weather Service in their headquarters near Stapleton International Airport in Denver.

The hotline has local numbers in Aspen, Dillon, Durango, Vail, Ft. Collins, Colorado Springs and Denver/Boulder. It provides daily updates on backcountry weather and snow conditions. Areas are risk-rated low, moderate, or high. The information is essential for recreationists beginning a backcountry ski-tour, snowmobile ride or mountaineering expedition.

Betsy Armstrong, avalanche specialist and co-author with Williams of *The Avalanche Book*, says the Breckenridge slide was an "accident waiting to happen." It was a classic soft-slab avalanche, the type that create huge white clouds and move at speeds up to 200 miles per hour.

It occurred after nearly two feet of fresh snow had fallen on a weak layer of sugar snow, known by the experts as temperature-gradient snow and often described as ball bearings or marbles. Temperature-gradient snow is formed when the snow crystals near the bottom of the snowpack are altered by the passage of water vapor from the warmer layers at ground level up through colder layers. This rising water vapor freezes, forming rounded, larger crystals that are poorly bonded to one another.

Temperatures after the storm at Breckenridge remained cold, preventing the newly fallen snow from settling and stabilizing. (Warming after a storm will make snow more cohesive as a unit.) Ski patrollers across the state were thinking avalanche. The Avalanche Information Hotline reported moderate-high risk. Colorado hadn't had the continuous, heavy snowfalls that create a homogeneous, well bonded snowpack. And the forecasters knew that the majority of avalanches happen during and immediately after storms.

When asked how the accident at Breckenridge could have been prevented, Brown responded, "skiers enjoy the solitude in the backcountry. We're not out here to tell people stop, don't go. What we're saying is listen. Do your homework."

No one should be going into the backcountry without a transceiver, a shovel, and a weather update from the Avalanche Information Center's toll-free hotline, says Brown. Brown does not use an avalanche cord and so is not sure if he wants to endorse the device which trails behind the skier and after a slide leaves a clue on

the surface to the buried skier's whereabouts. But he does recommend using ski poles that screw together to form a probing pole.

With experience, a buried skier can be found with a beacon in minutes, and a shovel works at least 10 times faster than hands or skis. This can mean saving someone's life. And it makes the cost of the equipment, \$150 to \$200, seem inconsequential.

Brown, as well as many experts, also recommends becoming familiar with a hasty snowpit, so named because it is made hastily. The snowpit should be dug on safe terrain in an area similar in aspect to the steeper hill to be skied. It exposes the layers in the snow which represent the accumulations of different storms, wind crust, and freezethaw. Hardness can be tested by poking different layers, and a shovel shear test shows how easily the bonds between layers in the snow are broken.

When starting out on a questionable slope, experts agree that skiers should stay as high as possible so that if they trigger a slide, there is a good chance it will be below them. They recommend crossing one at a time and following the same track. Pack straps and pole straps should be loosened so they can be quickly discarded should a slide occur. And don't fall. Many avalanches are caused by the third or fourth person across who loses balance and falls. The slab under stress may be able to support the skiers but not the impact of the fall.

Climbing straight up a dangerous slope is safer than using switchbacks which are more likely to cause a horizontal fracture.

Experts agree there are no foolproof techniques for predicting snow slides, only educated guesses. Experienced intuition is as valid a guide as computer-generated forecasts. Avalanches are fluky. As Armstrong says, "snow is a nasty material to study. It's changing all the time." So take the right equipment along, heed hotline reports and the advice of local ski patrollers.

A day after the last body was pulled from the snow below Peak Seven, skiers in a Breckenridge bar were asked if the avalanche would change their view of out-of-bounds skiing. Almost unanimously, the group agreed that skiers would continue their cavalier, powder-basing despite the tragedy. Let's hope they take their beacons and shovels along. □

METRO

Avalanche deaths decrease this year

By Paul Hutchinson
Denver Post Staff Writer

A more stable snowpack may explain why deaths in the high country have fallen from 11 last winter to five for the 1987-88 season, according to avalanche experts.

But they caution that recent snows may make conditions treacherous for the next several days.

"The snowpack has been a little more stable this winter," said Andy Loving of the Colorado Avalanche Information Center.

'Pretty good shape'

New snow coupled with strong winds "could make conditions a little tender" for several more days, Loving said. "But I think we're in pretty good shape for the rest of the year."

The avalanche center counted about 1,200 slides through February of this year, compared with 1,400 for the same period last winter. Twenty-five people have been involved in avalanches this year, compared with 51 last year.

The 11 deaths last winter marked the most deadly Colorado avalanche season in 80 years, since a time when "white death" posed a far greater threat to miners than to outdoorsmen. Last year's total included four skiers who died in a single, massive slide while skiing out-of-bounds at Breckenridge.

1 above average

The five deaths this year are one above the average for winters since 1980, Loving said. The toll includes two cross-country skiers who died in Second Creek Basin on Berthoud Pass, and three back-country skiers killed south of Aspen.

In both cases, carelessness was a factor. The Berthoud Pass skiers — although knowledgeable about the back country — inexplicably failed to equip themselves with beacons, avalanche cords and probes or shovels. And the three skiers killed near Aspen ignored warnings about dangerous conditions.

The timing of the Berthoud Pass slide helped bring attention to Avalanche Safety Week, a January series of lectures and demonstrations across the state. Attendance in the Denver-Boulder area topped 1,000, according to organizer Howard Paul.

But Paul was hesitant to credit better awareness for this year's drop in deaths.

"That would be too presumptuous. But the timing of that avalanche certainly worked to our advantage. Some good came out of it," Paul said.

Crackdown

Last year's avalanche deaths prompted some mountain sheriffs to crack down hard on skiers at commercial areas who venture out of bounds. Apparently, skiers are taking heed.

Out-of-bounds skiing has decreased in San Miguel, Summit and Pitkin counties this season, sheriffs say.

San Miguel Sheriff Bill Masters said a few skiers have been cited for going into areas posted as closed, but generally the practice is on the decline. Masters has arrested only one out-of-bounds skier this season.

"Overall, I think there is a maturing process going on among our back-country skiers," Masters said.

The Associated Press contributed to this report.

Local

Economist sees gloomy '88 for Denver

By JOHN REBCHOOK
Rocky Mountain News Real Estate Editor

DALLAS — The Denver-area economy will continue to suffer in 1988, despite some improvements in telecommunications and exports, a top economist said at a national home-builders convention yesterday.

Lawrence Horwitz, chief economist for Wharton Economics in Bala-Cynwyd, Pa., said the Denver-area economy has yet to hit bottom.

"I think it's going to go lower," said Horwitz, following a panel discussion at the National Association of Home Builders 44th annual convention in Dallas.

Horwitz, whose topic was "Regional Economies — What is Hot and What is Not," said Denver is definitely not hot.

"Basically, there is a glut of oil," Horwitz said. "Our own predictions put oil stabilizing at about \$17.50 per barrel. But if they stay at the \$14 or \$15 range, areas like Denver are going to be hurt. Energy is still a big piece of the economy for that entire region."

The only economic bright spots appear to be telecommunications and exports, he said.

"I would expect that part to do a lot better," Horwitz said. "On the other hand, you have so much overbuilding that it is going to take years to clean up. Your absorption rate is not very strong."

In a separate panel discussion, financial experts estimated there are \$500 billion in troubled real estate loans nationwide.

Michael Sumichrast, senior economic adviser for the National Association of Home Builders, said a large majority of the loans, either in foreclosure or default, are located in oil-patch states such as Texas and Colorado.

"It's huge, it's large, it's difficult to define, and I don't think it's disappearing," Sumichrast said. "The major, absolutely overriding problems are found in the 10 oil states."

One of the main culprits are houses that dropped in value along with oil prices, said Gary Kramlich, chairman of the board for the Federal Home Loan Bank Board in Des Moines, Iowa.

"The oil belt states really are the problem," Kramlich

said. He said most of the over-appraising of houses took place in the states that depended on the energy business, which helped lead to the record number of foreclosures.

However, Merrill Butler, president of the American Real Estate Group, said that he believes Colorado will rebound slowly. American Real Estate Group, based in Irvine, Calif., is a private organization that helps financial institutions work out their real estate and loan problems.

"I see Colorado as slowly recovering," Butler said. "But I don't see any quick recovery. You just have to sweat it out."

Since April 1985, the organization has disposed of more than \$1.8 billion in troubled real estate for lenders.

In Colorado, his group took over the Lakewood Sheraton Hotel for the lender, renovating it and changing the management. He also is involved in several properties along the Western Slope, Butler said.

Butler said he is unwilling to unload properties at fire-sale prices.

"If I can't sell it, we will hold it on the books, change the management and wait for the market to improve."

Avalanche prediction mostly art

By MICHAEL ROMANO
Rocky Mountain News Staff Writer

If weather forecasting is an inexact science, predicting avalanches in Colorado's high country is an imprecise art — a subjective combination of raw data and expert intuition.

Yet this blend of science and guesswork has become a well-established part of the state's wintertime weather forecast, helping outdoor enthusiasts pinpoint the different levels of avalanche danger in three regions of Colorado's backcountry.

"You never really know when (an avalanche will occur) — and you never really know where, at least up to a point," said Dale Atkins, one of four forecasters with the Colorado Avalanche Information Center in Denver. "We've got good ideas. It's not a science. It's an art. And it's very difficult to quantify."

WHAT CAN be quantified is the human cost. During the 1986-87 season, 11 people died when tons of snow unexpectedly hurtled down Colorado mountains. It was the worst season for avalanche deaths in 81 years — three times the average number of avalanche deaths in the state. So far this year, five skiers have died in avalanches.

"What we try to do," says Knox Williams, the director of the avalanche center, "is give people the chance to plan their outing. Once they go into the backcountry, the responsibility for safety is theirs."

More than 23,500 calls were placed to the seven phones lines across the state that include an avalanche-warning message taped twice each day by one of the center's four forecasters.

THE NATIONAL publicity surrounding last year's death toll helped attract state-wide support and contributions for the avalanche center, which opened 15 years ago in Fort Collins as part of the U.S. Forest Service.

Now, operating on a \$110,000 budget as



LINDA McCONNELL/Rocky Mountain News

Avalanche forecaster Dale Atkins says, "You never really know when (an avalanche will occur) — and you never really know where, at least up to a point. We've got good ideas. It's not a science. It's an art."

part of the Colorado Department of Natural Resources and the state Geological Survey, the avalanche center is housed in a cramped cubicle in a corner of the National Weather Service office east of Stapleton International Airport.

"There's a certain segment of the population that will take any kinds of risks," said John Rold, a state geologist and the director of the Colorado Geological Survey. "But there's a much larger segment of our population that, if they know the risks and are able to evaluate the conditions, will make reasonable, logical choices, and avoid risks. That's why the avalanche center is so important."

Last year, forecasters recorded 1,960 avalanches — or about 3% above normal during the six-month season. This year, nearly 1,000 slides have been registered — 110 last Wednesday alone. For each one

reported, 10 go unseen, the center estimates.

The avalanche forecast begins to develop each morning at about 6:30, when weather data and other information begin arriving by phone from 30 spotters scattered throughout three avalanche regions — the northern, central and southern mountains.

DATA INCLUDING cloud cover, temperatures, the weight of the snowpack and most importantly, the amount of new snow and the strength of the winds go into avalanche-danger forecasts.

Atkins said the increasing avalanche dangers in the backcountry stem from two key factors: more cross-country skiers, hikers and snowmobilers using the pristine backcountry for recreation, and slide-prone snow conditions. This year and last, weak, early snowpacks were covered with

later snows that formed "slabs" above the unstable layer.

"Whenever the stress of too much snow, or (the weight of) a skier or a snowmobiler is equal to or greater than the strength of the slab, you're going to have failure," said Atkins.

Individuals who venture into the backcountry, Atkins said, should be able to interpret "clues" that might indicate the threat of an avalanche. They include the presence of more than 12 inches of new snow, snowfall of greater than an inch and hour, wind-driven snow drifts, rapid changes in temperatures and slope steepness between 30 and 45 degrees.

"We're not going to keep them out of the backcountry," Atkins said. "But they need to be educated. The best way to be safe is to avoid avalanche areas. And look for those clues."

Letters

Think 'snow safety'

Editor:

I wish to thank Beaver Run Resort in Breckenridge for donating its conference center facilities for the free avalanche awareness seminar I held there on the evening of November 11. A "thank you" to K-Summit Radio and Television is also in order as they continue to air strong support for avalanche safety programs and related messages.

This provided an opportunity for 125 Summit County residents to learn more about the avalanche phenomenon, where and when avalanches are most likely to occur, how to avoid them and what to do in the event of an accident while enjoying a backcountry outing.

Upon signing in, almost everyone checked off that they would be interested in a more advanced avalanche course, including a field session, in the future. I will certainly do what I can to accommodate these desires.

The avalanche season is upon us.

Already, four backcountry skiers have been caught in separate accidents in Colorado. Three of the incidents had the potential to be quite serious. One of the victims was totally buried and not breathing when finally rescued by other members of his party (he lived); another

was buried up to his chin and had to be dug out of his vice-like entrapment; and the third sustained injuries when he was swept over a cliff by the moving snow.

The season has only begun and the snowpack, inherent to the Continental Climate Zone of the Colorado Rockies and Summit County, is exhibiting weakness in the form of a depth hoar layer (uncohesive sugar snow) near the ground. This layer may have a hard time supporting the weight of subsequent snowfall, or that of a backcountry skier, and may collapse and avalanche. We can only hope that the parameters that lead to this occurrence abate before the condition worsens.

The staff at the Colorado Avalanche Information Center want to instill a strong sense of "snow safety" thinking in the minds of backcountry users. This will ultimately lead to more fun in the snow and reduce the number of avalanche accidents--they can be avoided.

For local avalanche and weather information call 468-5434. This message is updated daily.

Nick Logan
Associate Director,
Colorado Avalanche
Information Center

We want your letters

The Summit Sentinel encourages your letters and will try to publish all letters in a timely fashion.

Letters should be no more than two double-spaced, typewritten pages in length, and must be signed by the author.

Clear, hand-printed letters will be considered for publication.

The letters will be edited for grammar, brevity and good-taste, but we will make every effort to retain the author's original meaning.

Send your letters to Editor, the Summit Sentinel, P.O. Box 709, Ft. Lisco, CO 80443.

Back-country ski advice: Stay out!

Forget all the blather about beepers and avvy cords. Knox Williams has just one bit of advice about skiing the Colorado back country these days: Stay the heck out.

In the wake of the most recent accident that claimed three skiers near Ashcroft Sunday, the director of the Colorado Avalanche Information Center has little else to offer in the vein of skier safety.

"This is the time to stick to established ski areas for a while until the back country heals itself," said Williams, who has been involved in avalanche forecasting since 1970.

As the headlines that screamed of the most recent tragedy — bringing to five the number of cross-country skiers who have been killed in snow slides this season — suggest, this is a dreadful period to be footloose in the steep mountain valleys. The current problem is one that, at one stage or another, repeats itself often in the Rockies.

A sparse early snowfall, just enough to establish a weak layer, was followed by a period of dry weather that caused this snow to become metamorphosed into the round crystals, much like ball-bearings, commonly known as sugar snow. Then, starting just before Christmas, there has been a continuing series of storms that have dumped from 50 to 70 inches over much of the high country.

The result is a snowpack ready to roll anywhere the slope is steep enough, whether there are skiers to dislodge it or not. Present conditions are so volatile that not even the most experienced avalanche-control experts can predict where or when the snow will break. There are stories of ski patrolmen climbing trees before throwing their explosive charges for fear that the slide will start above them rather than below. In many cases, the slides are breaking all the way down to the ground, unleashing a tremendous volume of snow.

When conditions are this treacherous a little knowledge can be a dangerous thing. To paraphrase the bumper sticker, stuff happens, even to experienced skiers.

"Snowfall and wind are the two main architects of avalanches," Williams said. "We've had plenty of both and right now there's a ma-



CHARLIE MEYERS

for hazard nearly everywhere. It just isn't safe to be anywhere where there are steep slopes."

Still, Williams doesn't believe things now are as dangerous as they were last spring, when a situation, unique for Colorado, conspired to create a hazard that resulted in 11 deaths between Jan. 8 and March 15. Then, it was a heavy October snowpack that sat drying out, rotting away to sugar, for all of November and December.

Williams thinks the present situation will improve in time, given the proper conditions.

"What we need is some warm, dry weather for a couple of weeks to allow the snowpack to settle, to form a strong mid-pack snow layer. If that happens, it would help the back country for the remainder of the season."

That eventuality would pave the way for what might be described as "normal" conditions under which the hazard increases with each major storm and then diminishes in between, a situation far preferable to that of last spring.

"Last year, we never had a period of lesser hazard," Williams continued. "It was bad all the time."

The best scenario now would be a period of respite from storms in which the snow settles, allowing the snow grains to bond together and the entire pack to gain strength. Only when this happens should skiers venture into the back country and then, Williams advises, they should do so gingerly.

For information on avalanche danger in various locations, phone the following numbers: Denver 236-9435, Fort Collins 482-0457, Colorado Springs 520-0020, Durango 247-8187, Aspen 920-1664, Dillon 468-5434, Vail 827-5687. ■