



# SNOW AND AVALANCHE

COLORADO AVALANCHE INFORMATION CENTER

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## **ANNUAL REPORT 1988-89**

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

**JUNE, 1989**

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DOI: <https://doi.org/10.58783/cgs.is29.lzgz2365>

STATE OF COLORADO



ROY R. ROMER  
GOVERNOR

JOHN W. ROLD  
DIRECTOR

**COLORADO GEOLOGICAL SURVEY  
DEPARTMENT OF NATURAL RESOURCES**

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DENVER, COLORADO 80203 PHONE (303) 866-2611

M E M O R A N D U M

TO:

FROM: John W. Rold, State Geologist

DATE: June 14, 1989

SUBJECT: CAIC ANNUAL REPORT

I am pleased to announce that the Colorado Avalanche Information Center has just completed its second successful year under the management of the Colorado Geological Survey. Enclosed is your copy of this year's Annual Report.

Snow avalanches are statutorily defined as a natural geologic hazard, so it is logical for the Avalanche Center to find its home within the Geological Survey. The purpose of the Center is to minimize the economic and human impact of snow avalanches on recreation, tourism, commerce, industry and the citizens of Colorado. It achieves this through a dual mission of forecasting and public education. The Center also serves as a focal point for writers and news media reporters seeking timely and accurate information on avalanches. The staff of four professionals is well suited to the task, for they bring more than 60 years of snow and avalanche experience to the Center.

The Avalanche Center is a cash-funded program (no Colorado General Funds) whose existence depends wholly on contributions from federal, state, county, and private organizations. This Annual Report is prepared primarily for this sponsoring consortium, whose belief in the value of an avalanche program for Colorado has made it a reality. We will continue to pursue additional and alternative funding to meet an expanding role for the Center and the needs of its customers.

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**COLORADO  
AVALANCHE  
INFORMATION  
CENTER**

**Colorado Department of Natural Resources**

**Colorado Avalanche Information Center**

10230 Smith Road  
Denver, Colorado 80239  
(303) 371-1080

**DIRECTOR'S STATEMENT**

To Our Sponsors and Patrons:

The Colorado Avalanche Information Center has completed six years of operation within the Department of Natural Resources and two years within the Colorado Geological Survey. Ours is a program of education and forecasting, with the goal of lessening the impact of snow avalanches on people who live, work, visit, or recreate in the Colorado mountains.

The Avalanche Center does not control avalanches but works closely with those who do -- the Colorado Department of Highways, ski areas, heli-ski operations, and mining companies. They help us by providing the field data that become a large part of our public forecasts, and we help them by providing real-time weather and snow stratigraphy forecasts, and consulting advice. The cooperative effort pays dividends for all in our common goal of increased public safety.

Some of our accomplishments/highlights of this year were:

- We have more sponsors than ever before, showing a broad base of support.
- Our hotline count has shown increases every year, and this year it was up 37% from last year.
- Serious avalanche incidents and deaths were down for the second year in a row.
- It was our second year of participation in Avalanche Back Country Safety (ABC'S) Week.
- We provided custom weather forecasts for the World Alpine Ski Championships at Vail and the Winter Nationals at Aspen.
- Two of our staff members worked on an outstanding educational video entitled "Avalanche Awareness: A Question of Balance" which was released in November.
- Our staff of four professionals has a total of 60 years of snow and avalanche experience.

The Colorado Avalanche Information Center is committed to providing the best possible service to the citizens of Colorado and our sponsors. It is your support that makes the Center possible. We thank you.

Sincerely,

*Knox Williams*  
Knox Williams  
Director

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# CONTENTS

Section	Page
I. EXECUTIVE SUMMARY . . . . .	2
II. FUNDING and BUDGET . . . . .	3
III. OPERATIONS . . . . .	5
IV. WEATHER and AVALANCHE SYNOPSIS . . . . .	7
Snowfall . . . . .	7
Avalanches . . . . .	10
Avalanche Hazard and Warnings . . . . .	10
Avalanche Accidents . . . . .	11
V. DETAILED WINTER SUMMARY . . . . .	16
VI. INFORMATION ACQUISITION . . . . .	29
Daily Weather, Snowpack and Avalanche Data . . . . .	29
Westwide Data Network . . . . .	29
VII. DISSEMINATION of HAZARD FORECASTS . . . . .	31
Public Hotlines . . . . .	31
Radio Broadcasts . . . . .	32
NOAA Colorado Weatherwire . . . . .	33
News Media . . . . .	33
VIII. PUBLIC EDUCATION . . . . .	34
Avalanche Awareness Talks and Field Seminars . . . . .	34
Avalanche Cards and Brochures . . . . .	34
Avalanche Information Packets . . . . .	36
IX. HAZARD GRADING . . . . .	37
Appendix	
A. SAMPLE AVALANCHE WARNINGS and ADVISORIES . . . . .	38
B. LETTERS and NEWSPAPER ARTICLES . . . . .	48
List of Tables	
Table 1. Monthly snowfall totals. . . . .	8
Table 2. Avalanches, hazard ratings, & accidents by month . . . . .	12
Table 3. Avalanche warning days by month. . . . .	13
Table 4. Avalanche warning days by region . . . . .	13
Table 5. Avalanches reaching highways . . . . .	14
Table 6. Accident statistics. . . . .	14
Table 7. Accidents by date, location, type. . . . .	15
Table 8. Avalanche courses taught . . . . .	35

## 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 88-89, total revenues were \$111,609 (compared with \$112,010 last year.)

Housing: The Center is housed at the National Weather Service in Denver, with an office 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 1,806 avalanches were reported to the Center this season (about 5% below normal). Avalanche Warnings were posted on 30 days (6 below normal). Four people died by avalanche (normal). There was negligible property damage.

Avalanche hotlines: The Center maintains avalanche message phones in seven Colorado cities and towns for the public to call for current conditions. Some 43,595 calls were made to the hotlines this winter, up 37% from last year.

Media contacts: The Center logged 169 contacts with broadcast and print media, once more achieving a timely and accurate dissemination of avalanche information and a high profile for the Center.

Public education: Center personnel presented 48 avalanche awareness talks and field seminars, reaching on a personal level some 1,949 people. We again participated in Avalanche/Back Country Safety (ABC'S) Week. 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 90% correct forecast, 5% over-forecast, and 5% under-forecast.

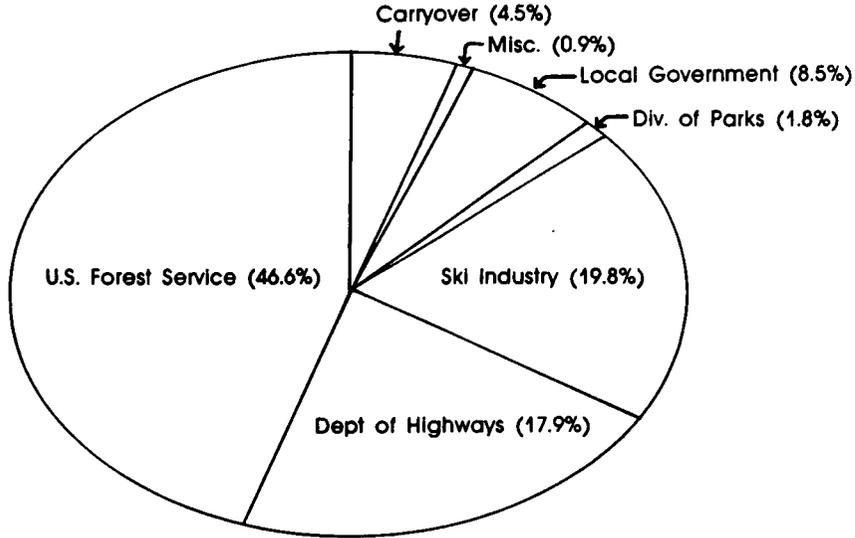
## FUNDING and BUDGET

The Colorado Avalanche Information Center is totally cash funded. A year ago funding was \$112,010. For FY 1988-89, total funding of \$111,609 came from the following sponsors:

Federal	
U.S. Forest Service	\$52,000
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
Ski Industry	
Colorado Ski Country USA	\$15,000
Winter Park Recreational Association	\$ 1,000
Breckenridge Ski Area	\$ 1,000
Vail Associates	\$ 1,000
Steamboat Ski Area	\$ 1,000
Snowmass Resort Association	\$ 1,000
Arapahoe Basin	\$ 500
Copper Mountain Resort	\$ 500
Telluride Ski Corp	\$ 500
Crested Butte Resort	\$ 250
Crested Butte Ski Patrol	\$ 200
Aspen Highlands Ski Patrol	\$ 100
Miscellaneous	
Colorado Mountain Club	\$ 370
U.S. West Foundation	\$ 250
Tenth Mountain Trail Association	\$ 250
Snow Sense Fund	\$ 189
Carryover from FY 87-88	\$ 5,000
TOTAL	<u>\$111,609</u>

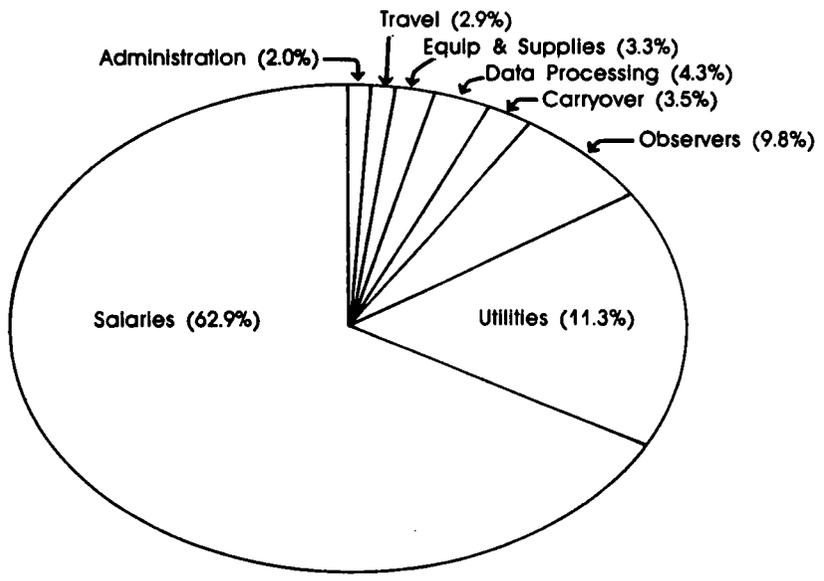
WHERE THE MONEY CAME FROM

**REVENUES**  
**\$111,609**



HOW THE MONEY WAS SPENT

**EXPENDITURES**  
**\$111,609**



## 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 (at 10230 Smith Road.) The space provided is shared with NWS Fire Weather operations. Secondary office space is also 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 (hotlines) (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);
- present educational avalanche awareness talks, seminars, and public service announcements (see Section VIII);
- be a focal point of avalanche information (in general or for specific events) for sponsors, news media, government or private agencies, researchers, writers, etc.
- provide specialized information to sponsoring agencies; 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 1988-89 winter were the same as last year: 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, from opening day on November 15, until closing on April 23.

The forecaster was responsible for:

- monitoring mountain weather, snow, and avalanche conditions;

- logging all incoming data from observers;
- evaluating field data and National Weather Service data;
- making daily snow stability evaluations and forecasts;
- updating recorded telephone messages (hotlines) twice daily;
- issuing and terminating avalanche warnings when warranted;
- handling special requests from sponsoring agencies; and
- initiating or responding to calls from the news media.

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 approximately 32 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: 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 of current avalanche conditions. Section VIII details our efforts toward public education and safety.

## WEATHER and AVALANCHE SYNOPSIS

The winter of 1988-89 was typical for the Colorado mountains in many respects. There were four sustained periods of storminess -- at Thanksgiving, at Christmas, in early February, and from late March into early April. Most avalanche activity and serious incidents occurred during or just after these stormy times. In between were periods of fair weather or light snows, and light avalanche activity. The mountain snowpack was unusually stable early in the winter (because depth hoar was slow to develop), in midwinter was typically unstable with a long-lasting threat of deep-slab avalanches, and was generally stable by spring.

Seasonal temperatures were below normal especially in the Northern and Central Mountains<sup>1</sup>, and only slightly below normal in the Southern Mountains. Seasonal snowfall for the four months of December-March was generally below normal, but these figures improve when the six-month period of November-April is viewed. 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 right on the long-term average. 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 fall season was exceptionally dry and mild.

On the first of November, there was virtually no snow cover at all in the high country, but the first lasting snows fell on the 2nd. November brought a steady flow of moisture into the Colorado mountains, and monthly snowfall wound up 100-160% of normal.

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<sup>1</sup>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 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 from 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. 1988-89 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
<b>NORTHERN MOUNTAINS</b>										
ARAPAHOE BASIN		43	33	50	38		164	79		
BERTHOUD PASS	72	40	34	61	45	70	180	89	322	107
BEAR LAKE	35	42	32	58	24	30	156		221	
BEAVER CREEK		47	29	71	41		188			
BRECKENRIDGE	63	20	30	46	47	66	143	67	272	
COPPER MOUNTAIN	56	20	22	39	40	49	121	67	226	89
KEYSTONE		27	12	36	45		120			
LOVELAND		39	22	57	48		166	71		
MARY JANE		48	40	86	62		236			
STEAMBOAT		46	50	62	29		187	75		
VAIL	74	38	29	60	37		164	62		
WINTER PARK	54	25	27	52	35	43	139	91	236	105
<b>CENTRAL MOUNTAINS</b>										
ASPEN HIGHLANDS	52	32	23	58	41		154			
ASPEN MOUNTAIN		32	20	54	36		142	87		
CRESTED BUTTE		48	21	54	29		152	86		
GOthic	70	74	37	98	56	50	265	103	385	116
MONARCH	51	62	41	54	24		181	102		
SNOWMASS		23	20	41	42		126			
SUNLIGHT	50	50	27	58	31		166	84		
<b>SOUTHERN MOUNTAINS</b>										
RED MOUNTAIN PASS	64	36	38	61	29	16	164		244	
TELLURIDE	62	36	32	54	29		151	100		
PURGATORY		62	53	59	31		205			
WOLF CREEK		92	81	101	27		301	99		

December brought a sustained period of snowfall from the 19th-27th, and the monthly totals ended up with a strong bias favoring the Southern and Central Mountains. In the Northern Mountains, values ranged from 38-80% of normal; in the Central Mountains, 86-148%; and in the Southern Mountains, 98-153%.

January was a dry month without significant storms. All mountain areas were below normal for snowfall. In the Northern Mountains, amounts ranged from 43-70%; in the Central Mountains, 43-85%; and in the Southern Mountains, 90%.

February began with heavy snows throughout the mountains: by the 6th, 3-4' had fallen. Three other significant storms struck the mountains this month, ensuring above-normal totals at almost all sites. Amounts in the Northern Mountains were 96-170%; in the Central Mountains, 130-150%; and in the Southern Mountains, 158-170%.

March saw three short periods of snowfall (at the very first of the month, in the middle, and at the very end), but these were not enough to bring normal snows to any site. The Northern Mountains got 51-84% of normal; the Central Mountains, 44-83%; and the Southern Mountains, 29-66%. March also brought an extra-early warm-up and thaw which effectively ended for the season the deep-slab instability in the snowpack.

April began with five days of sustained heavy snowfall in the Northern and Central Mountains. Though this was the last major storm of the season, it was enough to carry all sites in the North and Central to 114-156% of normal monthly snows. The Southern Mountains were considerably below normal.

For the seasonal trend, note in Table 1 the percent-of-normal totals for December-March. A north-south bias in snowfall is clearly evident, as the Northern Mountains attained 62-91% of normal snows; the Central Mountains, 84-103%; and the Southern Mountains, 100%. (This north-south trend was in the opposite direction a year ago.) Also in Table 1, note that only four data sites (all in the Northern and Central Mountains) have long-term snowfall records for the six months of November-April. All four sites show that above-normal snows in November and in April greatly boosted the six-month seasonal averages.

## ***Avalanches***

A total of 1,806 avalanches was reported to the Avalanche Center from November through April. This number is roughly 5% below the average of 1,900 avalanches. Table 2 shows the monthly distribution of the avalanche total.

November produced few avalanches (110, as shown in Table 2), mainly because of little depth-hoar development in the snow cover. December was active (490 avalanches), because depth-hoar was developing into a significant layer at the bottom of the snow cover and because of the stormy period from the 19th-27th. January produced few avalanches because of subnormal snows, but the big storm in early February vaulted this month into the most avalanche-prone (597) of the season. In March, a cycle of wet avalanches from the 9th-14th produced at least 190 wet slides, more than half of the month's total. April saw avalanches during the storminess of the first week, but there was virtually no activity for the rest of the month.

Thaw instability and wet avalanches were limited to the warm-up in mid-March. Climatically, this was early for spring avalanches, which normally are observed in April and early May. This warm-up also had the lasting effect of producing a dense, strong snowpack that was incapable of causing deep-slab releases for the remainder of the season. Thus, there was no significant cycle of wet-slab avalanches in April.

## ***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. It is a typical result that the number of days with a widespread "high" hazard is greatest in December, January, and February, for these are the months that most often threaten backcountry travelers with deep-slab, delayed instability. "Extreme" hazard occurred on a few days in December and February during sustained periods of heavy snow and wind.

Table 3 shows a monthly summary of warning days for the 1988-89 season, plus the previous 14 seasons. (A warning day is one on which the hazard was rated high and an Avalanche Warning was issued.) Warnings were issued on 30 days, six days below average. In a rare occurrence, there were no warnings issued in January and

March. February, on the other hand, had almost 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. It is typical for the Southern Mountains to lead in warning days.

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 57 natural releases is above normal for the last six years. We have not been keeping accurate records of triggered events long enough to establish a meaningful average.

### *Avalanche Accidents*

The last part of Table 2 lists a monthly breakdown of avalanches involving people and property in 1988-89, while Table 6 compares these same statistics with long-term annual averages. The winter of 1988-89 was worse than normal in the number of people caught, partly buried, and totally buried, yet the number of people seriously injured or killed by avalanche was precisely on the long-term average. In fact, the number of people killed -- 4 -- was the lowest in two years. 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 three fatal accidents (February 5 and 14, and April 2).

This synopsis has presented a general and statistical overview of the 1988-89 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 2. 1988-89 winter summary of avalanches, hazard days and accidents.

	Nov	Dec	Jan	Feb	Mar	Apr	TOTAL
No. of avalanche warning periods	1	2	0	3	0	1	7
No. of days with warning in effect	3	11	0	13	0	3	30
No. of observed avalanches	110	490	186	597	317	106	1806
No. of days with 1 or more avalanches	18	24	27	24	18	14	125
Northern Mountains							
No. of days with:							
low hazard	4	14	9	1	19	9	56
moderate hazard	11	11	11	22	9	9	73
high hazard	1	6	11	5	3	5	31
extreme hazard	0	0	0	0	0	0	0
Central Mountains							
No. of days with:							
low hazard	5	16	9	1	19	10	60
moderate hazard	10	8	12	22	10	10	72
high hazard	1	6	10	2	2	3	24
extreme hazard	0	1	0	3	0	0	4
Southern Mountains							
No. of days with:							
low hazard	5	17	8	1	21	15	67
moderate hazard	8	5	15	19	8	8	63
high hazard	3	7	8	5	2	0	25
extreme hazard	0	2	0	3	0	0	5
Avalanche accidents							
people caught	5	20	11	11	4	5	56
people partly buried	2	3	2	4	1	4	16
people buried	0	2	3	5	0	1	11
people injured	0	0	2	1	0	0	3
people killed	0	0	0	3	0	1	4
vehicles caught	1	2	0	2	0	0	5
property sites damaged	0	0	0	0	0	0	0

Table 3. A 15-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
1988-89	3	11	0	13	0	3	30
<b>Total</b>	<b>41</b>	<b>108</b>	<b>115</b>	<b>111</b>	<b>121</b>	<b>38</b>	<b>534</b>
<b>Average</b>	<b>2.7</b>	<b>7.2</b>	<b>7.7</b>	<b>7.4</b>	<b>8.1</b>	<b>2.5</b>	<b>35.6</b>

Table 4. Avalanche warning days by region, 1988-89 (dates in parentheses)

Region	Nov	Dec	Jan	Feb	Mar	Apr	Total
Northern Mountains	(26-28)	(21-26)		(4-7) (27-28)		(4-6)	
Days	3	6	0	6	0	3	18
Central Mountains	(26-28)	(19-20) (21-29)		(3-8)		(4-5)	
Days	3	11	0	6	0	2	22
Southern Mountains	(26-28)	(21-29)		(3-10) (20-22)			
Days	3	9	0	11	0	0	23
<b>Total</b>	<b>9</b>	<b>26</b>	<b>0</b>	<b>23</b>	<b>0</b>	<b>5</b>	<b>63</b>

Table 5. Avalanches reaching Colorado highways, 1988-89

Highway	Location	Natural aval.		Triggered aval.	
U.S. 6	Loveland Pass	4	Nov. 16 Jan. 28 Feb. 1	19	Nov. 22, 29, 30 Dec. 27 Jan. 28 Feb. 1, 4, 21 Mar. 4, 30 Apr. 4, 2
U.S. 40	Berthoud Pass			2	Jan. 6 Apr. 4
U.S. 50	Monarch Pass	3	Jan. 28 Feb. 4		
U.S. 160	Wolf Creek Pass	2	Dec. 26 Feb. 4	2	Feb. 7
U.S. 550	Red Mountain Pass	22	Dec. 23, 25, 26 Feb. 5, 20 Mar. 11 Apr. 20	11	Nov. 25, 26 Feb. 6, 7
U.S. 550	Coal Bank & Molas	25	Dec. 26 Feb. 4		
Colo. 62	Guanella Pass			4	Jan. 4 Apr. 18
Colo. 82	near Aspen	1	Feb. 26		
Total: 95 avalanches; 57 natural and 38 triggered					

Table 6. Summary statistics of Colorado avalanche victims

	1970-88 Total	(18 winters) Average	1988-89 Total
People caught	631	35	56
People partly buried	176	10	16
People totally buried	120	7	11
People injured	57	3	3
People killed	71	4	4

Table 7. Colorado avalanche accidents, 1988-89 (\* indicates fatal accident)

Date	Location	Details
11/12	Rocky Mtn. Natl. Park	1 climber caught & partly buried
11/12	St. Mary's Glacier	1 ski tourer caught
11/26	North side of Carbon	1 ski tourer caught and ptly buried
11/26	E. Riverside (N. branch)	1 motorist caught, 1 vehicle caught
11/30	Loveland Pass	1 snowboarder caught
12/11	Breckenridge	1 patroller caught
12/13	Copper Mountain	1 patroller caught
12/15	Aspen Highlands	1 patroller caught
12/22	Crested Butte	1 patroller caught
12/23	Vail	4 patrollers caught, 2 ptly buried
12/23	Red Mountain Pass	1 motorist ct, 1 mailtruck ptly bur
12/24-26	Telluride	4 ct (4 events), 1 patrol, 3 skiers
12/25	Durango	2 hikers caught & partly buried
12/26	Vail	1 patroller caught & partly buried
12/26	Wolf Creek	1 worker caught, 1 snowplow caught
12/26	Beaver Creek	1 patroller caught
12/27	Aspen Highlands	1 patroller caught
12/29	N. Star Mtn (Hoosier P)	1 ski tourer ct (4 times)
1/7	Aspen Mtn	1 patroller ct, ptly bur, injured
1/7	Commando Run (Vail P)	3 caught, 1 ptly bur, 2 buried
1/9	Telluride	1 out-of-bounds skier ct & buried
1/12	Copper Mountain	2 patrollers ct, 1 w/minor injuries
1/12	Telluride	1 out-of-bounds skier ct & injured
1/13	McFarlands Bowl (Aspen)	1 snowcat skier caught
1/14	Loveland Pass	1 ski tourer caught
1/23	Telluride	1 out-of-bounds skier caught
2/3	Molas Pass	1 worker ct, 1 hwy truck caught
2/4	Powderhorn	1 out-of-bounds skier ct & ptly bur
2/5	Crested Butte (not SA)*	3 caught & buried, 1 killed
2/5	Aspen Highlands	1 patroller caught
2/5	Wolf Creek Pass	1 worker ct & bur, 1 hwy cat ct & pb
2/5	Berthoud Pass	1 snowboarder caught & partly buried
2/14	Telluride*	3 ob skiers ct, 1 pb & inj, 1 ptly buried & killed, 1 buried & killed
3/3	Telluride	1 out-of-bounds skier caught
3/4	Berthoud Pass	1 snowboarder caught
3/9	Monarch Pass	1 backcountry skier ct & ptly buried
3/13	Telluride	1 patroller caught
4/2	Loveland Pass	2 backcountry skiers ct & ptly bur
4/2	Loveland Pass*	1 backcountry skier ct, bur & killed
4/2	St. Mary's Glacier	1 climber caught & partly buried
4/6	Loveland Pass	1 ski tourer caught & partly buried

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## DETAILED WINTER SUMMARY

The following narrative is a detailed, month-by-month description of events and trends of the 1988-89 winter season and the avalanche activity that resulted as the mountain snowpack developed.

### Preseason

The summer of 1988 etched its place in history with a severe drought in the cornbelt and devastating wildfire in Yellowstone National Park and other regions of the Rocky Mountains. Colorado saw an exceptionally dry late summer and fall season. Only weak, sporadic storms moved into the Colorado mountains in October, and none left a lasting snow cover.

### November

The first lasting snows came to the Colorado Rockies on the 2nd. Mines Peak at Berthoud Pass recorded a wind gust of 113 mph on the 3rd, ushering in the first storm of the season. Mountain snows fell from the 3rd through the 4th, with accumulations of 20" at Vail, and 16" at Breckenridge and Berthoud Pass.

Dry weather returned for the 5th-7th, but the 8th brought another storm which, by the morning of the 9th, had dropped about 20" of snow at Aspen (1.90" of moisture in town) and 12" at Berthoud Pass. The first avalanche of the season was reported on the 9th: a natural release on the Seven Sisters on Loveland Pass put a small mound of snow on the road.

As this storm exited, another was poised to enter western Colorado and bring snow on the the 11th-12th. Red Mountain Pass got 9" and winds gusted to 80 mph, while the rest of the mountains varied from 4-8" of fresh snow. Two avalanche incidents -- the first of the season -- occurred on the 12th: a climber was caught and partly buried in Rocky Mountain National Park, and a ski tourer was caught at St. Mary's Glacier. The 13th-14th turned dry once more.

The Center opened on the 15th. This was a stormy day throughout the mountains with 6-12" of new snow reported in the morning and another 2-6" falling during the day and into the morning of the 16th. Snow continued on the 17th, with 3-8" additional falling.

On the 18th-19th, the storm center moved into southeast Colorado, which brought snow to the eastern slope but allowed the mountains to dry out. An increase in wind, though, on the 21st-23rd caused enough blowing snow to produce about 10 shallow, soft-slab avalanches -- both natural and controlled.

The next storm moved in on the morning of the 24th -- Thanksgiving Day -- and brought daily snows until the 27th. Sites in the Northern and Central Mountains got 6-14" of snow, while the Southern Mountains did far better -- typically 15-30" but with Wolf Creek totalling 39". This storm prompted the first Avalanche Warning of the season, which was in effect from the 26th-28th. Approximately 80 avalanches were recorded from the 25th-28th. Only two avalanche incidents occurred -- both on the 26th, both on Red Mountain Pass, and both to the same person! First, he was partly buried while ski touring, and then he was struck by a (fortunately) very small slide while driving home.

November ended with very light snows on the 29th-30th, and with several shallow, soft-slab avalanches being reported from the Northern Mountains. A total of 110 avalanches were recorded for the month.

Monthly snowfall totals were above normal at all data sites. Only a few of our sites have adequate data to compute long-term averages for November. These showed: Copper Mountain and Gothic, 160% of normal; Berthoud Pass and Winter Park, 157%; Wolf Creek, approx. 150%, and Vail, 100%.

By the end of November, snowpack depths were 2-3' in the Northern Mountains, 1-1/2 to 3' in the Central Mountains, and 2-4' in the Southern Mountains. The snowpack contained little depth hoar, because it had built up steadily in only 4 weeks. The severity of the avalanche season depended greatly on how this layer evolved: if it became stronger under the weight of deep December snows, there would be little depth hoar and little deep-slab instability; while on the other hand, if it deteriorated into large-grained depth hoar, we would likely have a deep-slab problem from January on.

## December

The first week of December brought mild, dry weather to the Colorado mountains. The mild weather was briefly interrupted on the 7th by an upslope storm

that brought 6-12" of snow to the Front Range and 1-4" to all mountain areas further west.

Fair weather returned on the 8th with split-flow aloft over Colorado; in the snow cover, this allowed temperature-gradient metamorphism to dominate. Observers reported the snowpack becoming very weak, with gradients exceeding 13 degrees per meter (while 10 degrees/meter is considered significant.)

Two weak storms on the 11th and 12th brought light snowfall and moderate winds mainly to the Northern Mountains, and increased the possibility of triggered releases. On the 11th and 13th patrollers were caught at Breckenridge and Copper Mountain, respectively, in small soft slabs. Neither was injured.

On the 15th another upslope storm brought 1-5" of snow to the Northern Mountains, but Lake Eldora received 9". The Central Mountains received 2-10" of snow, and the Southern Mountains went dry. Moderate winds on the 15th-16th loaded steep slopes in the 10 Mile and Front Ranges of the Northern Mountains and in the Sangre de Cristo's in the Southern Mountains, raising the avalanche hazard near and above treeline to moderate.

A series of small storms brought good orographic snows to all mountains from the 19th-27th. In the Southern Mountains observers reported 3-6" of new snow by morning on the 19th and a trace (T) to 5" for the Central Mountains, while the Northern Mountains were relatively dry. Snow continued to fall in all areas throughout the day. Monarch reported 10" of new snow during the day on the 19th accompanied by WSW'erly winds of 40 mph. These conditions required a Warning to be issued that afternoon for the immediate vicinity of Monarch Pass. Elsewhere the hazard increased to moderate near and above treeline. On the 20th, 3-9" of new snow was reported in the Northern Mountains, 2-12" in the Central Mountains, and 3-7" in the Southern Mountains. At Monarch, light winds and temperatures in the mid twenties allowed the new snow to stabilize, and the Warning was dropped on the morning of the 20th.

On the 21st another storm moved over the mountains bringing moderate to heavy snowfall during the day in the Southern Mountains. The new snow, accompanied by winds of 25-40 mph, necessitated an Avalanche Warning for the Southern Mountains to be issued late that afternoon. Elsewhere only light snow fell during the day, but

winds were increasing. On the morning of the 22nd, in the Northern Mountains new snows were 2-4" (with 7" at Steamboat); in the Central Mountains, 2-7" (with 12" at Gothic), and in the Southern Mountains, 4-12". Westerly winds blew at 20-30 mph and gusted to 50 for many areas. Mines Peak at Berthoud Pass reported gusts to 95, causing heavy blowing snow and creating both hard and soft slabs on top of the weak temperature-gradient snow. The Avalanche Warning was extended to all mountain areas early that morning as the hazard increased to high for all elevations. On the 22nd a ski patroller was caught at Crested Butte. Winds decreased on the 23rd, but maximum temperatures in the single digits and teens kept the snowpack brittle while light snowfall continued to add weight to the pack. On that day at Vail, four ski patrollers were caught and two partially buried, while a motorist was caught and partially buried by the Mother Cline slide on U.S. 550 over Red Mountain Pass.

Another 2-8" of snow fell in most mountain areas by the morning of the 24th, and light snow continued during the day. Temperatures reached only into the single digits and low teens during the day and dipped to the minus teens at night. The Warning remained in effect. The jet stream positioned itself over the Southern Mountains with a large fetch of available moisture to the west, creating a powerful orographic storm for the Southern Mountains. By Christmas morning the Northern Mountains had received only a T-3"; the Central Mountains, generally 3-6", but Crested Butte and Gothic reported 12" and 15", respectively. In the Southern Mountains 10-17" had fallen with strong winds. Telluride reported west winds of 50 mph, gusting to 100. The new snow and strong winds put more load on an already unstable snowpack, increasing the hazard to extreme in the Sawatch and Elk Mountains in the Central Mountains and in all of the Southern Mountains. In a Christmas-day incident that attracted national media attention, two very lucky hikers survived for 7 hours after being buried by a shallow slide that released within the city limits of Durango.

On the 26th, snowfall increased across the state; observers in the North and Central Mountains reported 5-11", while 8-14" fell in the Southern Mountains -- except at Wolf Creek, which got 24". Winds remained strong especially above treeline and the Warning remained in effect; however, we lowered the hazard from extreme to high as the number of natural releases decreased.

Moisture flowing through a weak ridge of high pressure on the 27th brought 1-3" of snow for all mountains, followed by clearing skies and dropping temperatures

as arctic air moved over Colorado. The natural cycle of releases was starting to wind down but the snowpack remained very tender to triggered releases. Early on the 27th the Avalanche Warning was dropped for the Northern Mountains, and finally on the 29th it was dropped for the Central and Southern Mountains.

During the Warning episode, 426 avalanches and numerous accidents were reported to the Center. At Telluride on the 24th, 25th, and 26th, four separate events caught one ski patroller and three lift skiers. Also on the 26th, at Vail a patroller was caught and partially buried, at Beaver Creek a patroller was caught, and on Wolf Creek Pass, U.S. 160, a snowplow was caught. On the 27th at Aspen Highlands two patrollers were caught in separate events. (Being a professional snow worker certainly has its hazards.)

The split flow aloft kept conditions mild with very light dustings of snow on the 29th through the 31st. Localized areas of high avalanche hazard persisted on lee slopes above treeline in all mountains. On the night of the 29th a lost, but lucky, mountain climber -- not even on his intended mountain -- was caught in four separate slides and escaped uninjured.

December snowfalls were quite variable. The Northern Mountains were below normal: Breckenridge, 38%; Copper Mountain, 41%; Vail, 54%; Winter Park, 63%; and Berthoud Pass, 80%. In the Central Mountains Aspen Mountain received 86%; Crested Butte, 102%; Sunlight, 110%; Monarch, 138%; and Gothic, 148%. In the Southern Mountains Telluride received 98%; and Wolf Creek, 153%. The snowpack was typically stable for all mountain areas early in the month, but prolonged fair weather allowed the pack to weaken as temperature-gradient growth dominated. The month did not begin with many avalanche releases -- only 48 were reported to the Center up to the 21st. But, by month's end 490 avalanches had been reported. Avalanche Warnings were issued for 10 days during the month. Sixteen avalanche incidents occurred during December: 20 people were caught, 3 were partly buried, 2 were buried, and 2 vehicles were caught.

### January

January began with split flow aloft, shunting storms to the north and south of Colorado. From the 1st-3rd the northern branch of the jet stream dipped over the Northern Mountains and brought a T-3" of snow each day. The Central and Southern Mountains remained dry.

On the 4th an upper-level low from the Pacific moved toward Colorado, with relatively warm air. That night, rain -- unusual in January -- fell below 8,000' elevation before turning to snow. On the 5th observers in the Northern Mountains reported 4-7" of new snow; in the Central Mountains, 2-6"; and in the Southern Mountains, 8-13". Westerly winds of 20-40 mph above treeline increased the hazard to high. On the morning of the 6th, 1-4" of snowfall was reported in the Northern and Central Mountains and 1-6" in the Southern Mountains. A second storm system quickly passed over the mountains that night, and on the morning of the 7th observers reported 1-6" in the Northern Mountains, 3-8" in the Central Mountains, and 6-10" in the Southern Mountains. An influx of arctic air dropped temperatures sharply: St. Paul Lodge on Red Mountain Pass reported an overnight low of -30F.

Also on the 7th two avalanche incidents occurred. First, a ski patroller at Aspen Mountain was caught, partly buried and slightly injured. Second, near Vail, three ski tourers (in a party of four) were buried in a slide they triggered. A gloved hand led to the quick recovery of the only member experienced in the use of rescue beacons. He in turn found the other two who were completely buried. All were uninjured, although one victim was unconscious when dug out.

Occasional light snow fell from the 8th-10th. On the 11th, a deep trough of low pressure formed over western Colorado. Observers that morning reported 2-5" in the Northern Mountains, but Steamboat excelled with 17". The Central Mountains received 3-11", and the Southern Mountains, 1-4". Snowfall continued throughout the day, with clearing that night as cold air settled in over the mountains. On the 12th the mountains saw clear skies and 1-6" of new snow, but Wolf Creek got 14". The coldest temperature of the month (-56F) was reported at Taylor Park Reservoir in the Central Mountains the morning of the 13th.

During this period five avalanche incidents occurred. On the 9th at Telluride an out-of-bounds skier was caught and buried 2-1/2 feet deep. Others in the party heard the victim's yells from beneath the snow and, acting quickly, dug him out. A few days later on the 12th, another out-of-bounds skier at Telluride was caught and slightly injured after being carried down 1,500 vertical feet. (One month later two skiers would be killed in the same path.) Also on the 12th two ski patrollers were caught at Copper Mountain while performing avalanche control work; both suffered slight injuries. On the 13th a snowcat skier was caught near Aspen, and on the 14th a ski tourer was caught near Loveland Pass.

A weak storm passed to the north of Colorado on the night of the 14th; most observers reported only a T-2", but Steamboat got 5". This would be the last snow to fall for more than a week as a ridge of high pressure moved in, pushing the jet stream to the north of Colorado. Through the 23rd, sunshine, light winds and mild temperatures were reported, though the mountain valleys remained quite cold with overnight low temperatures well below zero.

On the 24th an upper-level low over Arizona brought light snows, with a T-6" in the Central and Southern Mountains. The Northern Mountains remained dry except for Steamboat which reported 2". The 26th brought an additional T-6" to the Northern and Central Mountains (Irwin Lodge reported 8"), while in the Southern Mountains, Purgatory and Wolf Creek reported 11" and 15", respectively. The low retrograded to the southwest on the 26th, and once again light snow fell in all mountains before the system left the area. By the 28th the same upper-level low now moved northeastward over Colorado and brought upslope conditions (southeast winds). Thus, while most mountain sites received only a T-2", Monarch and Wolf Creek got 11" and 13", respectively.

January came to an end as a ridge of high pressure moved over the state with mild weather and unseasonably warm temperatures. High temperatures for many areas edged into the low 40's on the 30th and 31st. This was the warm before the cold as a deep arctic airmass was slowly migrating southward from Alaska.

January was a dry month with all mountain areas receiving less than normal snowfalls. In the Northern and Central Mountains, Crested Butte and Vail got 43%; Aspen Mountain, Copper Mountain, Gothic, and Sunlight, all 49%; Breckenridge, 51%; Winter Park and Berthoud Pass, 66%; and Arapahoe Basin, 70%. The Southern Mountains fared a little better: Monarch, 85%; Wolf Creek, 89%; and Telluride, 90%. The month was also very quiet avalanche-wise with only 186 reported to the Center, and no warnings were issued. Eleven people were caught in slides, two were partly buried, three were buried, and two were injured. Thus far, no avalanche fatalities had occurred. However, the snowpack continued to weaken as deep-slab instabilities developed due to the mild and dry conditions.

## February

The strong split flow in the jet stream, which kept January a dry month for Colorado, reunited during the first week of February and formed a deep trough over

Colorado. This brought deep new snows to the mountains from the 2nd-6th. Bear Lake in Rocky Mountain National Park received 36"; Purgatory and Crested Butte each accumulated 40"; and Wolf Creek, which reported 28" on the 5th, received 52" of new snow from the storm. The heavy snows diminished on the 5th and were replaced by record low temperatures as a deep arctic airmass moved into the mountains. Lake Eldora recorded a low temperature of -40F on the night of the 5th, and many other sites reported -30 to -35F. (Antero Reservoir dropped to -51F on the 7th for the month's coldest.)

Avalanches were also very prominent during this first storm of the month. A Special Avalanche Advisory was issued on the 2nd, and the month's first Avalanche Warning was posted by the 3rd. This Warning covered all mountain areas through the 7th, but remained in effect for the Southern Mountains until the 10th, with over 320 slides reported to the Center.

The first avalanche fatality of the 1988-89 winter was also recorded during this period. This incident occurred February 5th at Crested Butte. Three boys aged 4-6 years were playing in the snow next to their condominium when a natural avalanche released 300 feet above them. All three were buried. Almost immediately, rescuers were at the site. They found two of the boys in 15-20 minutes, buried under 3-4 feet of snow. Both were unconscious but quickly recovered. The third boy, aged six, was found under 8 feet of snow after a burial of 70 minutes. He did not survive.

The record cold temperatures continued until the 9th, when the second storm of the month brought much warmer temperatures to the Colorado mountains. This system produced snows until the 15th. Accumulations varied during this period, though most areas managed to get some snow each day. Several sites did quite well: 21" at Mary Jane, and 35" at Gothic. The remainder of the state averaged between 8-12" of new snow.

It was during this second storm of the month that Colorado recorded its second and third avalanche fatalities of the season. This incident occurred at Telluride on the 14th. Three out-of-bounds skiers ducked a rope and were in Temptation Gully (a permanently closed area) when an avalanche broke above and caught all three. They were swept through a narrow, twisting gully with a vertical fall of 1,800 feet, including a sheer 80-foot cliff. Surprisingly, one of the three men survived

without serious injury, though he was buried to the neck for two hours before being spotted by another skiing party. Rescuers recovered the bodies of the other two victims, aged 23 and 25, later that day.

For the next few days the mountains enjoyed warm clear weather with just a light wind. This was a welcome break from the record cold temperatures which had been recorded earlier in the month. However, things quickly turned stormy again as another weather system arrived in the state on the 19th. This storm lasted through the 22nd and provided variable snows to all areas of the state. Accumulations ranged from as little as 3" to as much as 40" (the latter at Irwin Lodge in the Central Mountains.)

As a result, an Avalanche Warning was posted for the Southern Mountains on the 20th and remained in effect until the 22nd. During this brief cycle, 85 avalanches were reported, but no avalanche incidents occurred.

The last storm of the month began on the 27th. This provided most areas with a few inches of new snow, though the ski areas along the Continental Divide fared the best by far: Arapahoe Basin reported 12"; Berthoud Pass, 19"; and Mary Jane, 24". February's last Avalanche Warning was posted the 27th and 28th for the Northern Mountains. Only 20 avalanches and no incidents were reported during this period.

All reporting sites had near or above normal snow for the month of February: Breckenridge, 96%; Vail, 111%; Copper Mountain, 113%; Crested Butte, 130%; Berthoud Pass, 138%; Monarch, 140%; Sunlight, 145%; Aspen Mountain and Gothic, 150%; Telluride, 158%; and Winter Park and Wolf Creek, 170%. Temperatures this month were well below normal.

During the month the backcountry snowpack received ample new snows. This snow quickly built into a slab which provided a significant hazard to backcountry skiers and snowmobilers. At the surface, this slab appeared to be quite strong, seemingly able to withstand the added strain of a skier or snowmobiler. In reality, though, the hard layer was bridging over a weak substratum, and often enough the snow bridge collapsed, creating large hard-slab avalanches. Approximately 597 avalanches were reported to the Center for the month, and several released with fracture lines of 8-12 feet. This deep-slab instability persisted throughout the month and into March.

## March

In the first week of March, a strong, fast-moving storm hit the Colorado Mountains. This storm began on the 3rd, lasted 2-1/2 days, and brought to all mountain sites deep snows and enough wind to load lee slopes. Backcountry skiers were caught in small slides on the 3rd near Telluride and on the 4th on Berthoud Pass. The heavier snowfall amounts recorded by the 7th were: Beaver Creek, 15"; Mary Jane and Telluride, 18"; Aspen Highlands, 20"; Gothic and Powderhorn, 22"; and Wolf Creek, 24".

Beginning on the 8th and for the next nine days, March brought above-normal temperatures and light winds to the mountains. During this warm spell, many observers recorded temperatures in the 40s and 50s, and an unusual March avalanche problem developed -- wet slides. This hazard began to manifest itself on the 9th as several wet-loose and slab avalanches were recorded.

Almost every year in Colorado there is a significant, wet avalanche cycle. Usually this is not until mid- to late-April. This year the cycle began in early March and continued until cold, stormy weather returned to Colorado on the 14th. Approximately 190 wet avalanches were recorded during this period, with many stations reporting 4-foot fractures. A Special Avalanche Advisory was issued on the 10th and repeated on subsequent days, alerting the public to the hazard. Luckily, only two minor avalanche incidents were reported to the Center during this wet cycle: on the 9th a ski tourer was partly buried on Monarch Pass, and on the 13th, a patroller was caught at Telluride.

The next storm entered the state on the 14th from the northwest. This system brought snow and gusty winds especially to the Northern Mountains. It produced lots of blowing snow, but due to the above-normal temperatures preceding this storm, few avalanches occurred as the new snow bonded well to the old snow surface. Typical accumulations of new snow for the storm were: 8-17" in the Northern Mountains (Mary Jane got 26"); 4-14" in the Central Mountains; and 1-9" in the Southern Mountains.

Another week of warm weather preceded the last storm of the month which began on the 29th. This storm lasted for the duration of the month and provided the Northern and Central Mountains with good snows. Sample accumulations from the 29th-31st were: Ski Cooper, 27"; Breckenridge, 21"; Mary Jane, 17"; Snowmass, 14"; Crested Butte, 9"; Telluride, 8"; and Wolf Creek, 2".

This storm period produced only 17 avalanches, with the majority of them running in the new snow and having fracture depths of one foot or less. (However, this storm would continue well into April and would eventually be the largest storm of the winter for parts of the Northern Mountains.)

March snowfalls were below normal at all sites. Some examples: Breckenridge, 84%; Gothic, 83%; Winter Park, 82%; Berthoud Pass, 80%; Copper Mountain, 75%; Crested Butte, 72%; Telluride, 66%; Arapahoe Basin, 61%; Aspen Mountain, 57%; Sunlight, 54%; Vail, 52%; Steamboat, 51%; Monarch, 44%; and Wolf Creek, 29%. Monthly temperatures at most sites were above normal by 5F or more.

The entire character of the backcountry snowpack changed during the mid-month period of hot weather and melt-freeze metamorphism. The widespread wet-avalanche cycle produced many deep releases that cleared the deep-slab instability from many areas. In those locations where deep slides did not occur, the snowpack settled into a dense, stable structure which would last for the duration of the winter. Of the 317 avalanches recorded for the month, only 40 occurred after this period of melt-freeze restructuring; and of the avalanches which did occur, only two had fractures deeper than a foot. No avalanche incidents occurred after this period.

April

April began with the storm inherited from March, and it now seemed to contain an endless source of moisture for the Northern and Central Mountains. From the 1st-5th snow fell on a regular basis at many sites. (The exception was the Southern Mountains where only an occasional snow shower was observed.) Here are some results of the 8-day tempest that was

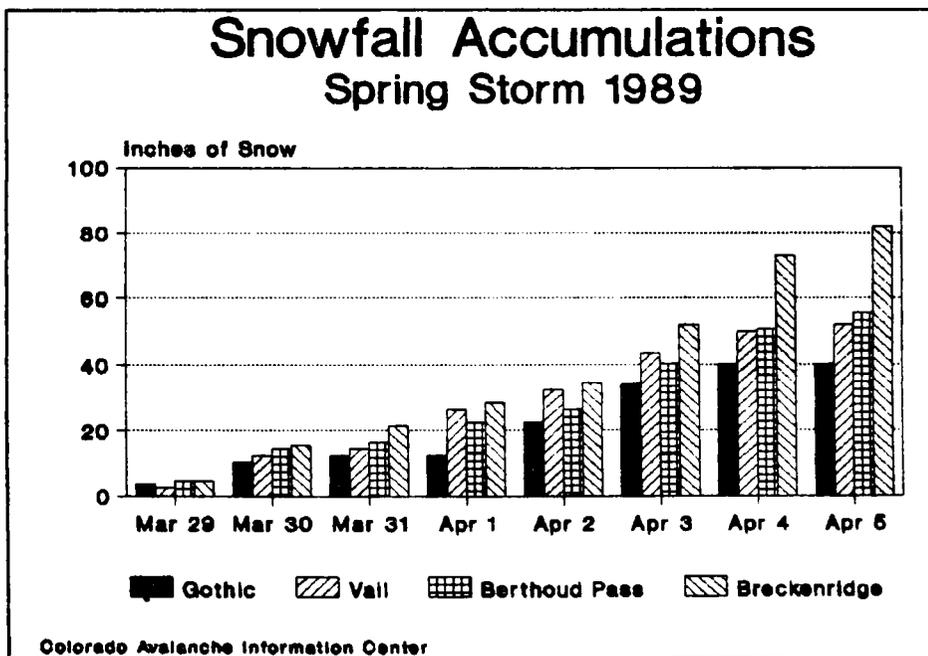


Figure 1

very selective in its distribution: Figure 1 shows some of these relationships. Bear Lake (in Rocky Mountain National Park), 24"; Snowmass, Aspen Highlands, and Gothic, all 37-40"; Vail, 53"; Berthoud Pass, 56"; Mary Jane, 61"; Copper Mountain, 66"; and Breckenridge (which is not usually noted as a snowfall leader, and which received 4 feet of snow in the final 3 days), a whopping 82"! This was to be the last major storm of the season.

On the 2nd, three separate accidents occurred involving four people; one accident was fatal. First, two skiers were caught and partially buried across the highway from the Arapahoe Basin ski area. At approximately the same time, a party of four skiers was leaving the Loveland Pass summit parking lot to find fresh "steep and deep powder." Their venture left one member dead when he was caught and buried under four feet of snow in an avalanche which he triggered. He was found unconscious and not breathing by his friends in about 45 minutes. He did not respond to resuscitation efforts. Later that day, a climber was caught and partly buried in a slide he triggered on St. Mary's Glacier.

Although few avalanches had been reported (one unfortunately being the fatal incident), new snow continued to fall and an Avalanche Warning for the Northern and Central Mountains was issued on the 4th. This Warning, the last of the season, ran until it was terminated in the afternoon of April 6th as temperatures began to climb back into the upper 30's and 40's. Forty avalanches were reported during the warning period, and one accident occurred on the 6th near Loveland Pass when a ski tourer was caught and partly buried without injury.

On the 8th, following three days of settlement of 4-7" per day in the new-snow layer, the hazard was lowered to moderate. Alamosa set a record high temperature of 73F as warm air enveloped the state. Snow conditions were such that another heavy snowfall or thaw situation would not bring any more Avalanche Warnings.

For the remainder of spring only minor short-wave weather systems moved through the mountains. These brought a scant few inches of snow occasionally to the Northern and Central Mountains, and none to the Southern Mountains. Infrequent afternoon wet avalanches were reported as the winter season wound down quietly.

There were 106 avalanches recorded for the month, and no major wet avalanche cycle occurred this spring. There are three reasons for this. First, the snowpack

in the Southern Mountains was becoming very thin on sun-exposed slopes, and there was little, if any, new snow to replace it. Second, the snowpack in all mountain areas gained considerable strength following the warm spell that produced many wet slides during the second and third week of March. And third, daily maximum temperatures were not overly warm in the mountains in April because periodic short-wave weather systems moving through the northern half of Colorado did not allow prolonged heat flow into the snow layers.

The storm at the beginning of April helped to raise snowfall averages for the month in all areas except the Southern Mountains. Northern and Central Mountain averages were well above normal: Gothic, 156%; Berthoud Pass, 130%; Copper Mountain, 120%; and Winter Park, 114%.

The Avalanche Center recorded its last public message on Sunday, April 23rd and closed for the 1988-89 season.

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## 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 32 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 sites are highway, heli-ski, and backcountry sites, from which volunteers or contract observers report to the Center. An additional backcountry observation site was in place for the 1988-89 season. Irwin Lodge, located eight miles west of Crested Butte in the Elk Mountains, provided valuable data from the central Colorado mountains.

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.

### *Westwide 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 events, 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 on a real-time basis 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.

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## 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*

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 some 43,595 calls were placed to the hotlines this season. Although usage fluctuates on the phones from year to year, we witnessed another escalation in the overall call count. This represents an increase of 37% over last year when using the same parameters; i.e., not including Eagle County's estimated call count or Summit County's count prior to January. This is explained further in the ensuing narratives for these individual hotlines. 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 24,183 calls were made to this phone (236-9435) this winter from the Denver/Boulder area, an increase of 46% 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 2,588 calls were made to the 482-0457 number this winter. This is a decrease of 9% from last winter.

Colorado Springs: This is the fourth year of operation for this phone. Call counts were down by 8%, but 2,862 calls were made to the 522-0020 number. 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 enjoyed the second season of their new message phone (668-0600). This phone came online in January of 1988 when 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 is now being dispensed to listeners in this high-use area located amidst much avalanche terrain. Call counts were not available prior to January of last winter, but the count comparison of January through April from last season and this year shows an increase of 27%. This area has shown overwhelming support for this new system as 4,798 calls were made to the hotline this winter. The phone is housed by the county.

Eagle County: The public message phone, housed and maintained by the U.S. Forest Service in Minturn has no call counter, so the actual volume of use is not known. Conservative monthly estimates show a call count of 2,310 this season. No estimate was provided last year so this number was not included when figuring the overall 37% increase of all hotline usage over last season. 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 1,890 calls were made to this phone this winter.

Durango: This weather and avalanche hotline operated in the Southern Mountains for its second season. The first call count comparison reveals a whopping increase of 80% over last year! Enthusiasm for the service has spread quickly as 4,964 calls were made to the hotline this winter.

### ***Radio Broadcasts***

We are pleased that several radio stations in various mountain communities air our daily messages. This has given us access to a large listening audience not previously reached. Listed here are stations conveying our bulletins.

For its fourth 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 serves 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 has continued to be a benefit for residents and tourists in an area that has a potentially high risk for backcountry enthusiasts.

In Summit County, K-Summit Broadcasting (television and radio) continued to support the Center's efforts in reaching the public with timely weather and snowpack information. They aired our messages and provided live talk-show time to increase avalanche awareness in a community that is no stranger to dangerous avalanche conditions.

#### *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 169 contacts in 1988-89.

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 12 inquiries came from outside Colorado including calls from USA Today, NBC, UPI, Associated Press, International Snowboard Magazine, WEBC Duluth, Readers Digest, CRN (CT Radio Network), The Boston Globe, and KMGC in Dallas.

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## 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 November 4th. By the time the last talk was given on May 5th, the Center staff had spoken on 48 different occasions, with a total of 1,949 persons attending 1-hour seminars to multi-day field sessions. While attendance was down 27% from last season, we must realize that the astounding 68% increase recorded last year could not be sustained. Betsy Armstrong, formerly a full time Center staff member, remains an associate of the CAIC and continues to educate the public about avalanches. Her classes are listed among others in Table 8. Course 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.

To monitor our efforts in providing avalanche education, Center personnel logged the time spent in course preparation, driving time and presentation length. The outcome was: preparation - 44 hours, driving time - 84 hours, and 202 hours spent teaching the various courses.

### *Avalanche Cards and Brochures*

Printed material in the form of brochures and wallet-size avalanche cards 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.

Table 8. Scheduled contacts with organized groups by Avalanche Center personnel, 1988-89

Date	Personnel	Group	Attendance
11/4	K. Williams	Breckenridge Ski Patrol, Breckenridge	65
11/5	KW & D Atkins	Mountain Rescue Assn., Loveland	40
11/5	D. Atkins	National Ski Patrol, Boulder	22
11/11	N. Logan	Summit Co. Awareness, Breckenridge	115
11/13	K. Williams	Outdoor Recreation Conf., Cameron Pass	15
11/15	K. Williams	Eastern Mtn. Sports, Wheatridge	40
11/16	K. Williams	Public Library, Ft. Collins	40
11/20	B. Armstrong	Eastern Mountain Sports, Boulder	62
11/22	N. Logan	Keystone Science School, Hoosier Pass	9
12/6	D. Atkins	ABC's Week, Arapahoe Community College	52
12/6	A. Loving	Flatiron Ski Club, Boulder	115
12/8	A. Loving	AMS Chapter, Arvada	20
12/9	N. Logan	Copper Mtn. Ski Patrol, Copper Mtn.	12
12/10-11	Logan, Atkins	Colo. S & R Board, Breck./Webster Pass	70
12/13	K. Williams	Rocky Mtn. Experiment Sta., Ft. Collins	50
12/13	K. Williams	The Mountain Shop, Ft. Collins	32
12/17	N. Logan	Aval. Rescue Seminar, Breckenridge	12
1/5-8	K. Williams	Paragon Guides/TMTA, Shrine Pass	17
1/10-11	Logan, Loving	Summit Co. Pro Course, Breckenridge	56
1/11-12	K. Williams	REI Clinic, Denver	30
1/14	D. Atkins	National Ski Patrol, Boulder	37
1/13-14	N. Logan	Vail Public Awareness, Vail/Shrine Pass	12
1/16	A. Loving	Colorado Mtn. College, Aspen	15
1/18	N. Logan	Rocky Mtn. Rescue, Boulder	22
1/18	D. Atkins	AT&T Mountain Club, Westminster	52
1/19-20	D. Atkins	Griffith Center/AAI, Brainard Lake	14
1/20-21	B. Armstrong	Silverton Avalanche School, Silverton	88
1/25	N. Logan	AAI Course, Berthoud Pass	17
1/28-29	D. Atkins	NSP Patch Course, Copper Mtn.	27
1/30	K. Williams	Ft. Lewis College, Durango	27
2/1	B. Armstrong	Mountain Sports, Boulder	35
2/3	B. Armstrong	Keystone Science School, Keystone	38
2/6-7	K. Williams	REI Course, Denver	20
2/6-7	N. Logan	Breckenridge Ski Patrol, CMC Breck.	6
2/11-12	K. Williams	Western State S & R, Irwin Lodge	60
2/14	N. Logan	Summit High School, Frisco	8
2/22&24	N. Logan	Breckenridge Ski Patrol, CMC Breck.	7
2/28	N. Logan	Breckenridge Elementary, Breckenridge	33
3/2	N. Logan	Colo. Dept. of Highways, Silverthorne	40
3/4	D. Atkins	Adolf Coors Co., Golden	237
3/4-5	N. Logan	NSP Patch Course, Powderhorn	22
3/6-9	N. Logan	Breckenridge Ski Patrol, CMC Breck.	13
3/14	A. Loving	Boulder Mountain Club, Boulder	85
3/21	K. Williams	Eastern Mountain Sports, Lakewood	25
3/27	N. Logan	Spring Awareness Seminar, Breckenridge	10
4/24	B. Armstrong	Univ. of Colo. Climatology, Boulder	65
5/2	K. Williams	CSU Snow Hydrology, Ft. Collins	12
5/5	D. Atkins	Evergreen Jr. High, Evergreen	48
TOTAL			1949

The Summit County Rescue Group printed special cards similar in nature but designed specifically for the Summit County area. This is in conjunction with their sponsoring the local hotline installed in this area last season. Rescue group members distributed and maintained avalanche poster/card holders in Summit County which generated much use of the phone.

#### *Avalanche Information Packets*

For the first time, the Avalanche Center this winter provided a free information packet to anyone requesting one. Our public message phones conveyed the announcement that callers had only to provide a self addressed stamped envelope to receive their own. The packet contained a CAIC brochure and wallet-size card, information about the Center's mountain weather and avalanche forecasts, and a glossary of related terms commonly used in hotline recordings and avalanche courses. Although no count was made of requests, the response was good. We will continue the service again next season.

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## HAZARD GRADING

For the fifth 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. (These categories have written definitions.) Forecasters previously had the freedom to combine two of these terms to describe the current hazard rating; e.g., "moderate-high." This option was dropped this year, though, because it was felt that the listener was getting too general a forecast. Now each forecaster must 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>1988-89</u>	<u>1987-88</u>	<u>1986-87</u>	<u>1985-86</u>	<u>1984-85</u>
Correct forecast	90%	86%	95%	92%	81%
Over forecast	5%	8%	2%	5%	12%
Under forecast	5%	6%	3%	3%	7%

We remain 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 continue to be pleased with accuracy figures greater than 80%. Second, the "under" forecast rate does not exceed "over" forecasts. It is more desirable to err on the side of overestimating the danger rather than underestimating.

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## **SAMPLE AVALANCHE WARNINGS and ADVISORIES**

This section shows examples of products that Avalanche center forecasters issued via the NOAA Colorado Weatherwire. This includes a Special Avalanche Statement and Avalanche Warning Bulletins. Page 39 is an example of a Special Avalanche Statement, pages 40-43 represent bulletins selected from December 21-29 (the longest-running warning period of the season), and pages 44-47 are selections from a warning period that ran from February 3-10.

SPECIAL HOLIDAY AVALANCHE STATEMENT  
COLORADO AVALANCHE INFORMATION CENTER  
NATIONAL WEATHER SERVICE DENVER CO  
4:00 PM THURSDAY NOVEMBER 23, 1988

... ALL COLORADO MOUNTAINS ...

A PACIFIC STORM IS MOVING TOWARD COLORADO AND WILL BRING STRONG WINDS WITH MODERATE SNOWS TO THE MOUNTAINS IN THE NEXT FEW DAYS. THIS WILL INCREASE THE AVALANCHE HAZARD IN ALL MOUNTAIN AREAS. RECENT WEATHER PATTERNS HAVE CAUSED THE SNOWPACK TO GRADUALLY LOSE INTERNAL STRENGTH DURING THE LAST WEEK. WINDBLOWN SNOW WILL CAUSE FURTHER STRESS ON THE SNOWPACK THUS INCREASING THE AVALANCHE HAZARD. SIX AVALANCHES..ALTHOUGH SMALL IN SIZE..HAVE BEEN REPORTED TO THE AVALANCHE CENTER IN THE LAST 24 HOURS. THIS IS AN INDICATION THAT SNOW STABILITY IS DECREASING.

THE BACKCOUNTRY AVALANCHE HAZARD IS CURRENTLY RATED LOW BUT WILL INCREASE TO A MODERATE HAZARD WITH AREAS OF HIGH HAZARD NEAR AND ABOVE TIMBERLINE IN THE NEXT 24 HOURS. THIS MEANS TRIGGERED AVALANCHES BY BACKCOUNTRY SKIERS AND SNOWMOBILERS ARE POSSIBLE THIS HOLIDAY WEEKEND.

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.

LOGAN  
COLORADO AVALANCHE INFORMATION CENTER  
8889

AVALANCHE WARNING BULLETIN NO 1  
COLORADO AVALANCHE INFORMATION CENTER  
NATIONAL WEATHER SERVICE DENVER CO  
4:15 PM MST WEDNESDAY DECEMBER 21, 1988

...SOUTHERN COLORADO MOUNTAINS...

AN AVALANCHE WARNING IS IN EFFECT IMMEDIATELY FOR THE SAN JUAN MOUNTAINS OF SOUTHERN COLORADO. THIS WARNING COVERS THE MOUNTAINS SOUTHWEST OF A LINE FROM ALAMOSA TO MONTROSE. THE WARNING IS VALID THROUGH THURSDAY DECEMBER 22.

SNOWFALLS OF 8 TO 10 INCHES AND WINDS OF 25 TO 40 MPH HAVE CAUSED A HIGH AVALANCHE HAZARD IN BACKCOUNTRY AREAS OF THE SAN JUAN MOUNTAINS. THE HEAVIEST SNOWS SO FAR HAVE FALLEN AROUND PURGATORY ... MOLAS PASS ... RED MTN PASS ... AND WOLF CREEK PASS. HEAVY SNOW HAS NOT YET FALLEN IN THE TELLURIDE AREA.

BOTH NATURAL RELEASING AND SKIER TRIGGERED AVALANCHES ARE LIKELY ON SLOPES OF 30 DEGREES AND STEEPER THAT HAVE BEEN LOADED WITH WINDBLOWN SNOW. BACKCOUNTRY SKIERS SHOULD LIMIT TRAVEL TO GENTLE TERRAIN ONLY.

MOTORISTS SHOULD CHECK ON ROAD CONDITIONS. THERE COULD BE SOME DELAYS AS SMALL AVALANCHES BLOCKING HIGHWAYS ARE POSSIBLE.

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.

THE NEXT AVALANCHE BULLETIN IS SCHEDULED FOR 11 AM THURSDAY.

WILLIAMS  
8889 3-1

AVALANCHE WARNING BULLETIN NO 7  
COLORADO AVALANCHE INFORMATION CENTER  
NATIONAL WEATHER SERVICE DENVER CO  
4:30 PM MST FRIDAY DECEMBER 24, 1988

... ALL COLORADO MOUNTAINS ...

THE AVALANCHE WARNING REMAINS IN EFFECT FOR ALL BACKCOUNTRY AREAS IN THE COLORADO MOUNTAINS. THE HAZARD REMAINS AT HIGH BOTH ABOVE AND BELOW TIMBERLINE FROM THE NEW SNOW AND STRONG WINDS SINCE TUESDAY.

TWO BACKCOUNTRY SKIERS WERE CAUGHT IN THE NORTHERN MOUNTAINS AND A VEHICLE WAS CAUGHT IN THE SOUTHERN MOUNTAINS ON FRIDAY. ALL ESCAPED UNINJURED. MODERATE WINDS TODAY AND NEW SNOW CONTINUE TO LOAD AVALANCHE STARTING ZONES ABOVE AND BELOW TIMBERLINE.

SINCE THE WARNING WENT INTO EFFECT WEDNESDAY MORNING 69 AVALANCHES HAVE BEEN REPORTED TO THE CENTER. POOR VISIBILITY IN THE BACKCOUNTRY HAS NOT ALLOWED FOR MORE OBSERVATIONS BECAUSE OF THE BLOWING SNOW.

MORE NATURAL RELEASING AND SKIER TRIGGERED AVALANCHES ARE LIKELY ON BACKCOUNTRY SLOPES OF 30 DEGREES AND STEEPER BOTH ABOVE AND BELOW TIMBERLINE. BACKCOUNTRY TRAVELLERS ARE URGED TO AVOID STEEP SNOWLOADED SLOPES AND TO LIMIT TRAVEL TO GENTLE SLOPES ONLY AT THIS TIME.

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.

THE NEXT AVALANCHE BULLETIN IS SCHEDULED FOR 11:00 AM SATURDAY

ATKINS  
COLORADO AVALANCHE INFORMATION CENTER  
8889 3-7

AVALANCHE WARNING BULLETIN NO 13  
COLORADO AVALANCHE INFORMATION CENTER  
NATIONAL WEATHER SERVICE DENVER CO  
11:20 AM MST TUESDAY DECEMBER 27, 1988

... BACKCOUNTRY AVALANCHE HAZARD REMAINS HIGH AND AVALANCHE WARNING CONTINUES IN CENTRAL AND SOUTHERN MOUNTAINS OF COLORADO ...

A HIGH BACKCOUNTRY AVALANCHE HAZARD AND AN AVALANCHE WARNING REMAIN IN EFFECT FOR THE CENTRAL AND SOUTHERN MOUNTAINS ... SOUTH OF A LINE FROM DENVER TO BRECKENRIDGE TO GLENWOOD SPRINGS. THIS WARNING IS VALID THROUGH WEDNESDAY DECEMBER 28.

THE AVALANCHE WARNING FOR THE NORTHERN MOUNTAINS ... NORTH OF THE DENVER TO GLENWOOD LINE ... HAS BEEN DROPPED AS THE DANGER HAS DIMINISHED TO AN OVERALL MODERATE HAZARD BUT WITH POCKETS OF HIGH HAZARD ON STEEP SLOPES FACING NORTHEAST TO SOUTHEAST.

THIS MORNING 75 FRESH AVALANCHES HAVE BEEN REPORTED TO THE AVALANCHE CENTER. MOST HAVE BEEN IN THE BACKCOUNTRY AROUND ASPEN ... GOTHIC ... AND CRESTED BUTTE IN THE CENTRAL MOUNTAINS ... AND AROUND RED MOUNTAIN PASS IN THE SOUTHERN MOUNTAINS. THE TOTAL NUMBER OF AVALANCHES REPORTED SINCE CHRISTMAS DAY IS 182 ... AND 250 SINCE WARNINGS WERE FIRST POSTED ON DECEMBER 21.

TWO AVALANCHES HAVE CAUGHT PEOPLE IN THE LAST TWO DAYS. ON CHRISTMAS DAY NEAR DURANGO TWO MEN WERE BURIED IN A SMALL SLIDE ... WERE ABLE TO CLEAR AN AIRSPACE TO THE SURFACE ... AND THUS WERE ABLE TO SURVIVE A 7 HOUR BURIAL. ON MONDAY A SKI PATROLLER WAS BURIED TO THE SHOULDERS IN A SMALL SLIDE.

PEOPLE TRIGGERED AVALANCHES IN THE BACKCOUNTRY REMAIN A THREAT ON SLOPES OF 30 DEGREES AND STEEPER. THEREFORE BACKCOUNTRY TRAVELLERS IN ALL MOUNTAIN AREAS ARE URGED TO AVOID STEEP SNOWLOADED SLOPES AND TO LIMIT ACTIVITIES TO GENTLE SLOPES WELL AWAY FROM AVALANCHE STARTING AND RUNOUT ZONES.

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.

THE NEXT AVALANCHE BULLETIN IS SCHEDULED FOR 4 PM TODAY.

WILLIAMS  
COLORADO AVALANCHE INFORMATION CENTER  
8889 3-13

AVALANCHE WARNING BULLETIN NO 16  
COLORADO AVALANCHE INFORMATION CENTER  
NATIONAL WEATHER SERVICE DENVER CO  
4 PM MST WEDNESDAY DECEMBER 28, 1988

... AVALANCHE WARNING EXTENDED FOR CENTRAL AND SOUTHERN MOUNTAINS ...

A HIGH BACKCOUNTRY AVALANCHE HAZARD AND AN AVALANCHE WARNING REMAIN IN EFFECT FOR THE CENTRAL AND SOUTHERN MOUNTAINS ... SOUTH OF A LINE FROM DENVER TO BRECKENRIDGE TO GLENWOOD SPRINGS. THIS WARNING WAS EXTENDED IN THIS MORNINGS BULLETIN AND IS VALID UNTIL THURSDAY MORNING DECEMBER 28.

IN THE NORTHERN MOUNTAINS OF COLORADO NO WARNINGS ARE IN EFFECT. HOWEVER THE BACKCOUNTRY HAZARD IS RATED LOCALLY HIGH ON SLOPES OF 35 DEGREES OR STEEPER THAT FACE NORTHEAST TO SOUTHEAST.

AVALANCHE ACTIVITY HAS DIMINISHED DRAMATICALLY TODAY. 16 AVALANCHES HAVE BEEN REPORTED TODAY ... COMPARED TO APPROXIMATELY 235 REPORTED YESTERDAY. THE TOTAL NUMBER OF AVALANCHES REPORTED SINCE CHRISTMAS DAY IS NOW 348 ... AND 426 SINCE WARNINGS WERE FIRST POSTED ON DECEMBER 21.

SO FAR NO SERIOUS INJURIES OR PROPERTY DAMAGE HAVE BEEN ATTRIBUTED TO AVALANCHES.

THE DECLINE IN AVALANCHE RELEASES INDICATES THAT THE MOUNTAIN SNOW COVER IS STABILIZING. NO ADDITIONAL NATURAL RELEASING AVALANCHES ARE EXPECTED. HOWEVER ... PEOPLE TRIGGERED AVALANCHES IN THE BACKCOUNTRY REMAIN A THREAT ON SLOPES OF 30 DEGREES AND STEEPER. THEREFORE BACKCOUNTRY TRAVELLERS SHOULD AVOID STEEP SNOWLOADED SLOPES AND LIMIT ACTIVITIES TO GENTLE TERRAIN THROUGH THURSDAY.

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.

THE NEXT AVALANCHE BULLETIN IS SCHEDULED FOR 11 AM THURSDAY.

WILLIAMS  
COLORADO AVALANCHE INFORMATION CENTER  
8889 3-16

(This avalanche warning was terminated the following day, 12/29/88.)

AVALANCHE WARNING BULLETIN NO 1  
COLORADO AVALANCHE INFORMATION CENTER  
NATIONAL WEATHER SERVICE DENVER CO  
4:15 PM MST FRIDAY FEBRUARY 3, 1989

... CENTRAL AND SOUTHERN MOUNTAINS OF COLORADO ...

AN AVALANCHE WARNING IS IN EFFECT IMMEDIATELY FOR THE CENTRAL AND SOUTHERN MOUNTAINS OF COLORADO ... SOUTH OF A LINE FROM GRAND JUNCTION TO ASPEN TO LEADVILLE. IN THIS AREA THE BACKCOUNTRY AVALANCHE HAZARD IS RATED HIGH FOR ALL MOUNTAINS NEAR AND ABOVE TREELINE.

THIS WARNING IS VALID THROUGH SATURDAY FEBRUARY 4.

WINDS OF 30 TO 45 MPH HAVE CAUSED HEAVY DRIFTING SNOW NEAR AND ABOVE TIMBERLINE. THIS IS THE CAUSE OF THE HIGH BACKCOUNTRY AVALANCHE DANGER.

BOTH NATURAL RELEASING AND SKIER TRIGGERED AVALANCHES ARE LIKELY ON SLOPES OF 30 DEGREES AND STEEPER. STEEP SLOPES FACING NORTHWEST TO EAST ARE MOST PRONE TO AVALANCHES AT THIS TIME.

BACKCOUNTRY SKIERS AND SNOWMOBILERS SHOULD LIMIT TRAVEL TO GENTLE TERRAIN UNTIL THE HAZARD MODERATES. ITS ACTUALLY A GOOD WEEKEND TO SKI AT A SKI AREA. MOTORISTS PLANNING TO TRAVEL US 550 AND US 160 IN THE SAN JUAN MOUNTAINS SHOULD CHECK ON ROAD CONDITIONS BEFORE HEADING OUT.

THE AVALANCHE HAZARD FOR BACKCOUNTRY AREAS OF THE NORTHERN MOUNTAINS IS CURRENTLY RATED MODERATE ... BECAUSE OF LACK OF NEW SNOWFALL.

THIS MESSAGE 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.

THE NEXT AVALANCHE BULLETIN IS SCHEDULED FOR 11 AM SATURDAY.

WILLIAMS  
COLORADO AVALANCHE INFORMATION CENTER  
8889 4-1

AVALANCHE WARNING BULLETIN NO 5  
COLORADO AVALANCHE INFORMATION CENTER  
NATIONAL WEATHER SERVICE DENVER CO  
3:30 PM MST SUNDAY FEBRUARY 5, 1989

... AVALANCHE WARNING CONTINUES ALL COLORADO MOUNTAIN AREAS ...

AN AVALANCHE WARNING REMAINS IN EFFECT FOR ALL BACKCOUNTRY AREAS OF THE COLORADO MOUNTAINS. IN THE CENTRAL AND SOUTHERN MOUNTAINS OF COLORADO ... SOUTH OF A LINE FROM GRAND JUNCTION TO ASPEN TO LEADVILLE ... THE AVALANCHE HAZARD IS EXTREME. IN THE NORTHERN MOUNTAINS THE AVALANCHE HAZARD IS RATED AS HIGH.

THIS WARNING IS VALID THROUGH MONDAY FEBRUARY 6TH.

APPROXIMATELY 145 AVALANCHES HAVE BEEN REPORTED TO THE CENTER DURING THIS PERIOD OF STORMY WEATHER THOUGH THE POOR VISIBILITY IN MANY BACKCOUNTRY AREAS HAS PROHIBITED ACCURATE COUNTS OF NATURAL AVALANCHES.

RED MOUNTAIN PASS AND WOLF CREEK PASS REMAIN CLOSED TODAY. SEVERAL PEOPLE HAVE BEEN CAUGHT DURING THIS STORM CYCLE IN THE CENTRAL MOUNTAINS. ONE PATROLMAN WAS CAUGHT AND CARRIED APPROXIMATELY 100 FEET AND NEAR CRESTED BUTTE THREE BOYS WERE CAUGHT AND TOTALLY BURIED ... ALL WERE RECOVERED ALIVE BY PROBE LINE ... TWO ARE REPORTED TO HAVE MINOR INJURIES THOUGH THE CONDITION OF THE THIRD IS UNCERTAIN. IT IS HIGHLY RECOMMENDED THAT SKIERS AND SNOWMOBILERS STAY OUT OF THE BACKCOUNTRY AT THIS TIME.

THE NEXT BULLETIN WILL BE AT 11:00 AM MONDAY THE 6TH.

THIS MESSAGE 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  
8889 4-5

AVALANCHE WARNING BULLETIN NO 10  
COLORADO AVALANCHE INFORMATION CENTER  
NATIONAL WEATHER SERVICE DENVER CO  
11:30 AM MST THURSDAY FEBRUARY 9TH 1989

... AVALANCHE WARNING CONTINUES LOCALLY IN THE RED MTN PASS AREA ...  
... WARNING DROPPED FOR REST OF SOUTHERN MOUNTAINS ...

THE AVALANCHE WARNING REMAINS IN EFFECT FOR THE BACKCOUNTRY AREA ABOVE 11,000 FEET IN THE IMMEDIATE VICINITY OF RED MOUNTAIN PASS ENCLOSED BY THE TRIANGULAR AREA FROM OURAY TO SILVERTON TO TELLURIDE TO OURAY. THE AVALANCHE HAZARD IS PRESENTLY RATED HIGH ABOVE 11,000 FEET AND MODERATE WITH LOCALIZED AREAS OF HIGH AVALANCHE HAZARD BELOW. WARMING TEMPERATURES AND LIGHT WINDS ARE HELPING EASE THE HAZARD IN THE SOUTHERN MOUNTAINS ... BUT THE RED MOUNTAIN PASS AREA DID RECEIVE LOCALLY GREATER SNOWFALL OVERNIGHT OF 5-8 INCHES ADDING WEIGHT TO AN ALREADY TENDER SNOWPACK AND SIMILAR AMOUNTS ARE LIKELY BY FRIDAY MORNING. TRIGGERED RELEASES ARE LIKELY BY BACKCOUNTRY TRAVELLERS ON SLOPES 30 DEGREES AND STEEPER IN THIS AREA.

THIS WARNING IS VALID THROUGH FRIDAY FEBRUARY 10TH.

FOR THE REST OF THE SOUTHERN AND CENTRAL MOUNTAINS THE AVALANCHE HAZARD IS RATED MODERATE WITH LOCAL AREAS OF HIGH AVALANCHE HAZARD WHICH MAY BE FOUND AT ALL ELEVATIONS ... IN STEEP SNOWLOADED AREAS WHICH ARE 30 DEGREES AND STEEPER. IN THE NORTHERN MOUNTAINS THE HAZARD IS ALSO RATED MODERATE ... BUT WITH LOCALIZED AREAS OF HIGH AVALANCHE HAZARD WHICH MAY BE FOUND NEAR AND ABOVE TIMBERLINE .. IN STEEP SNOWLOADED SLOPES 30 DEGREES AND STEEPER.

APPROXIMATELY 328 AVALANCHES HAVE BEEN REPORTED TO THE CENTER SINCE LAST FRIDAY WHEN THE WARNING WENT INTO EFFECT.

THE HIGH AVALANCHE HAZARD MEANS THAT TRIGGERED RELEASES BY A SKIER OR SNOWMOBILER ARE LIKELY ON BACKCOUNTRY SLOPES 30 DEGREES AND STEEPER. BACKCOUNTRY TRAVELLERS IN THE RED MOUNTAIN PASS AREA SHOULD LIMIT TRAVEL TO GENTLE TERRAIN. BACKCOUNTRY TRAVELLERS SHOULD AVOID ALL SNOWLOADED SLOPES 30 DEGREES AND STEEPER IN ALL MOUNTAIN AREAS ... AND CONTINUE TO USE EXTRA CAUTION AND BE ALERT FOR CHANGING AVALANCHE CONDITIONS.

THE NEXT BULLETIN WILL BE AT 4 PM MST THURSDAY THE 9TH.

THIS MESSAGE 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  
8889 4-10

AVALANCHE TERMINATION BULLETIN NO 12  
COLORADO AVALANCHE INFORMATION CENTER  
NATIONAL WEATHER SERVICE DENVER CO  
11:00 AM MST FRIDAY FEBRUARY 10TH 1989

... RED MOUNTAIN PASS AREA...AVALANCHE HAZARD MODERATES ...

THE AVALANCHE WARNING FOR THE RED MOUNTAIN PASS AREA IS NOW TERMINATED. ALTHOUGH NEW SNOW IS FALLING IN THE SOUTHERN MOUNTAINS ACCUMULATIONS ARE LIGHT ... BUT WARM TEMPERATURES AND VERY LIGHT WINDS ARE ALLOWING THE SNOWPACK TO STABILIZE.

THE AVALANCHE HAZARD IS RATED OVERALL MODERATE FOR ALL MOUNTAIN AREAS OF COLORADO. HOWEVER LOCALIZED AREAS OF HIGH AVALANCHE HAZARD MAY BE FOUND ABOVE 10,500 FEET ON WIND LOADED SLOPES AND GULLIES 35 DEGREES AND STEEPER. BACKCOUNTRY SKIERS AND SNOWMOBILERS SHOULD USE EXTRA CAUTION IF THEIR TOUR VENTURES INTO STEEP TERRAIN AS TRIGGERED RELEASES ARE CERTAINLY POSSIBLE.

THIS MESSAGE 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.

THIS IS THE LAST BULLETIN ON THIS AVALANCHE SITUATION.

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  
8889 4-12

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## LETTERS and NEWSPAPER ARTICLES

This appendix includes two 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.



ASPEN/SNOWMASS EVENTS, INCORPORATED

POST OFFICE BOX C-3

ASPEN, CO 81612

303-925-2720

March 1, 1989

Knox Williams  
Colorado Avalanche Information Center  
10230 Smith Road  
Denver, Colorado 80239

Dear Knox, Andy, Nick, and Dale:

Thank you very much for your weather forecasts during the 1989 SUBARU ASPEN WINTERNATIONAL. The reports were accurate, timely, and very much appreciated by all the captains, coaches, and organizing committee. Your extra effort added immensely to the overall success and professional quality of the event.

Please accept the hats and key rings as a token of our appreciation.

Again, thank you.

Sincerely,

Cindy Griem, Director  
Aspen/Snowmass Events, Incorporated



Adolph Coors Company  
Brewing Division  
Golden, Colorado 80401

March 17, 1989

Mr. Dale Atkins  
COLORADO AVALANCHE INFORMATION CENTER  
National Weather Service  
10230 Smith Road  
Denver, CO 80239

Dear Dale:

Thank you for "rescuing us" on our "Ski Track" show on Sunday, March 4, 1989. I appreciate you stepping in on such a short notice, you have to a pro to do that. We had nothing but compliments about your presentation from the approximately 175 guests.

We are planning on having another ski show on Sunday, October 1 or October 8, 1989. I am hoping you will be able to participate again. In the fall we are planning an appreciation party for all our "volunteers", so you will be hearing from us as soon as all the plans are finalized.

In the meantime, if we can be of any service to you, maybe a V.I.P. tour of our Brewery, please call me at 277-3709.

Thanks once again!

Sincerely,

A handwritten signature in black ink that reads "Maridale Powell". The signature is written in a cursive, flowing style.

Maridale Powell  
Special Programs Planner  
Guest Relations Department

MP/db:EP/T08B

# Fewer accidents is avalanche center goal

The Colorado Avalanche Information Center opened Tuesday with an important goal — saving lives.

"We're working hard to reduce the number of avalanche accidents," said Nick Logan, associate director of the center.

The center provides up-to-date avalanche and weather information through recorded messages 24 hours a day on seven hotlines throughout the state. The messages include mountain weather and snowpack details along with special avalanche advisories and warnings.

"Last season, attendance at avalanche seminars reached an all-time high of more than 2,870 people, and more than 29,300 calls were made to our avalanche hotlines for an increase of 25 percent," Logan said.

Five people died in avalanches last season in Colo-

rado. That number is down from 11 deaths in 1986-87, but it is still higher than the average of four over the last 17 winters. Of the 42 people caught in avalanches last season, 20 were partially buried, six totally buried.

"We don't discourage winter travel in the backcountry, but it's imperative that some areas be avoided in times of higher avalanche hazard," Logan said. "Even during these periods there are safe places to have fun if one knows what to look for."

He said mountain travelers are encouraged to call the weather and avalanche hotlines on a regular basis to monitor conditions for several days prior to their outing. In addition, some local radio stations air the recorded messages during the day. The avalanche center does not forecast conditions within developed ski area boundaries since ski areas employ

their own snow safety personnel.

"One of our main objectives is to provide information to the public to help make their mountain experience more enjoyable and safe from the threat of avalanches," he added. "The end result will be a reduced number of avalanches involving people."

To obtain information on conditions, call 827-5687 in Vail, 668-0600 in Frisco or 920-1664 in Aspen.

Although the Avalanche Center is administered by the Colorado Geological Survey, funding comes entirely from grants and donations. Major contributors this year include the U.S. Forest Service, Colorado Department of Highways, Colorado Ski Country USA and several individual ski areas, Eagle, Summit and Pitkin counties, Rocky Mountain National Park, Colorado Division of Parks and Outdoor Recreation, Colorado Search and Rescue Board, Tenth Mountain Trail Association and the US WEST Foundation.

DELTA COUNTY INDEPENDENT 11-16-88

## Avalanche center opens to provide safety info

With winter bearing down on the high country this week, cross country skiers, snow mobilers and other winter outdoorsmen are getting ready to enjoy outdoor activities.

Before going out into the high country, plan for a safe outing with essential mountain weather and snowpack details from the Colorado Avalanche Information Center.

The center, managed by the Colorado Geological Survey, opened for the season Nov. 15. The public can obtain up-to-date avalanche and weather information by calling any one of seven avalanche hotlines for a recorded message 24 hours daily. This service will extend through April. Special avalanche advisories and warnings are also issued by the center when necessary via the NOAA Colorado Weatherwire.

"We're working hard to reduce the number of avalanche accidents," said Nick Logan, associate director of the Avalanche Center. Last season more than 29,300 calls were made to the avalanche hotlines.

Five people died in avalanches last winter. That number is down from 11 the previous season, but is still one more than the 17-winter average of four, according to Avalanche Center records. Of the 42 people caught in avalanches last season, 20 were partially buried. Six were totally buried, and only

one of these lived to tell about it.

"We don't discourage winter travel in the backcountry, but it's imperative that some areas be avoided in times of higher avalanche hazard," Logan said. "Even during these periods there are safe places to have fun if one knows what to look for."

Mountain travelers are encouraged to call the weather and avalanche hotlines on a regular basis to monitor conditions for several days prior to their outing. Residents on the Western Slope can obtain information on mountain conditions by calling (303) 668-0600 in Frisco, (303) 827-5687 in Vail and (303) 920-1664 in Aspen. For those near the southern Colorado mountains, call 247-8187 in Durango.

Although administered by the Colorado Geological Survey, the Avalanche Center is funded entirely through grants and donations. Major contributors this year include the U.S. Forest Service, Colorado Department of Highways, Colorado Ski Country USA and several individual ski areas, Eagle, Pitkin and Summit counties, Rocky Mountain National Park, Colorado Division of Parks and Outdoor Recreation, Colorado Search and Rescue Board, Tenth Mountain Trail Association and the US WEST Foundation.

# Avalanche safely: common sense

By NICK LOGAN

(Editor's note: The following informative article was sent to us by Nick Logan, associate director of the Colorado Avalanche Information Center. Our thanks to Nick for his expertise and interest in making the public aware of an all-too common and deadly occurrence in the Colorado high country.)

Summit County enjoys clean mountain air, beautiful mountains and an abundance of snow throughout the winter season. This entices many winter visitors to our area in pursuit of a wide variety of outdoor winter activities.

Unfortunately, these same inherent conditions of steep mountains and plenty of snow contribute to avalanche formation.

Winter enthusiasts who venture into the backcountry should not expect to have the

same feeling of well-being as those who utilize terrain within the confines of a developed ski area.

Avalanche avoidance, by using sound judgment and good route finding techniques, is the only guarantee of not becoming a victim of the "white death."

There are plenty of safe trails and gentle terrain areas that cross-country skiers and snowmobilers can enjoy without ever having to worry about the threat of avalanches.

For those who can't resist the lure of the "steep and deep," let me offer this information. First, while the early season snowpack had the prospect of being a strong and cohesive substructure for the future snow to rest upon, it soon became evident that this would not be the case for long.

The Colorado mountains have since experienced weather patterns that have transformed a

relatively stable and strong snow structure into one comprised of large, angular grains known as depth hoar, or sugar snow. This unconhesive formation can lead to an overall collapse of the snow layer, and avalanching, when more weight is added to it.

This can be in the form of new snow or a person traveling across it.

Secondly, while we were savoring the mild and warm weather between light snowfalls in November and December, slopes on sunny aspects were developing melt-freeze crusts. Sandwiched in between this framework of firmer layers is lighter-density soft snow, and sometimes sugar snow. This type of structure offers little strength to bond the layers together.

Given a steep enough angle, say 30 degrees or steeper, these layers want to shear away from one another.

So far this season the Colorado Avalanche Information Center has recorded 315 slides in the northern and central mountains of Colorado. This is perhaps 10 percent of the actual number of occurrences as most go unobserved.

Summit County lies on the border between these regions.

There have been 14 people caught in slides across the state; four partly buried, two totally buried and two vehicles caught. Fortunately, no deaths have resulted from these incidents.

The Avalanche Center wishes everyone a safe and fun winter. Follow the basic rules of backcountry such as never traveling alone, be properly equipped for your outing and plan your routes around avalanche-prone terrain.

In Summit County, the avalanche hazard report number is 668-0600. Always call before heading out.

THE QUANDARY TIMES

JANUARY 3, 1989

# Colo. top state in snowslide deaths

By Kit Minicler  
Denver Post Staff Writer

More people are killed by avalanches in Colorado than in any other state in the Union.

An often-treacherous snowpack, an abundance of steep slopes and easy road access to avalanche areas combine to place a lot of people in potential avalanche danger in the state, says Knox Williams, a nationally recognized avalanche expert and director of the Colorado Avalanche Information Center.

Two winters ago, Colorado avalanches took 11 lives, nearly half the national total of 23. Last winter, Colorado accounted for five of the eight avalanche

deaths nationally.

This winter, three people have been killed by avalanches in Colorado. The only other reported U.S. avalanche death this winter was in Alaska.

Colorado has recorded 103 avalanche deaths from 1950 through last winter — more than twice the number of second-place Washington state, with 50 deaths in the same 37-year period, said Williams, a co-author of "The Avalanche Book" and "Snowy Torrent."

Colorado has the "shallowest and weakest snowpack compared to any other state," because of its distance from major moisture sources and its altitude,

with more than 52 peaks higher than 14,000 feet. The result is a snowpack "much lighter and more prone to avalanches."

A total 1,277 avalanches have been reported in the Colorado Rockies this winter through the end of last week, said avalanche center spokesman Nick Logan. But experts say only one in 10 avalanches are reported, meaning there may have been 12,000 avalanches in the state this winter.

The 90 percent that aren't reported also aren't seen, because they are in the vast back country or occur during storms. An average of 1,900 avalanches are reported in Colorado each winter.

D Post 12/31/98

88 \*

## ROCKY MOUNTAIN SKI REPORT



THE DENVER POST

SPONSOR OF THE 1989 WORLD ALPINE SKI CHAMPIONSHIPS

SKI REGISTRY

INSIDE SPORTS TODAY

# Series of clinics will interest nordic skiers

By Steven Weinmeister  
Denver Post Sports Writer

A series of clinics next month at a local outdoors specialty store should be of interest to both the beginning and advanced nordic skier.

Recreational Equipment Inc., a chain with 20 stores nationally, will present three clinics in January. They will be part of an expanding clinic program at the local store, at 2200 W. Alameda Ave.

"I intend to have at least one clinic program per week throughout the year," said Bruce Ward, outreach coordinator at REI.

The first clinic, at 7 p.m. Wednesday, will be on the art of cross-country ski waxing. Presented by REI's Jeff Jadel, the clinic will cover everything about waxes and their application.

The second clinic, from 6:30-9 p.m. Thursday, will be a two-day clinic on cross-country ski waxing with world-

renowned avalanche expert Knox Williams. Cost for the seminar is \$5.

Knox co-authored "The Avalanche Book" with Betsy Armstrong, a text considered the definitive book on avalanches. Knox is the director of the Colorado Avalanche Information Center and former director for the U.S. Forest Service's National Avalanche School.

The final event will be a cross-country ski clinic. This is also a two-day seminar. The first part is at 7 p.m. Jan. 26 and will include a comprehensive overview of equipment, clothing and technique.

The second part of the clinic will be Jan. 29. It will be an on-snow instruction at Eldora. Both days are presented in conjunction with the Eldora Rossignol Nordic Center. Cost is \$20 and includes REI rental and trail pass.

For further information, call 937-0536.

## Avalanche safety comes first

**EDITOR'S NOTE:** Knox Williams, director of the Colorado Avalanche Information Center, was interviewed on Monday by John Feeley, editorial page editor and associate editor.

**Coloradoan:** What is the Colorado Avalanche Information Center?

**Williams:** The Colorado Avalanche Information Center is managed by the state Department of Natural Resources.

We are an organization that was founded in 1983 with two broad purposes. One would be to provide avalanche education services to any and all comers. And secondly, we try to provide a series of hotlines around Colorado for the public to call to get current information on what the snowpack is doing and where they might more safely tour the back country.

**Coloradoan:** What causes an avalanche?

**Williams:** Gravity puts the snow under stress. Gravity is all the time stretching the snow, wanting to pull it off the mountainside. It is held in place by the bonds, the knitting between individual grains of snow.

When the pull of gravity gets to be too much, or when an outside force such as the weight of a person, overloads the snowpack, the stress exceeds the strength. It pulls away in an avalanche.

**Coloradoan:** How many avalanches are there in a season?

**Williams:** That's a question we can't answer very directly, but I can give you some indirect information.

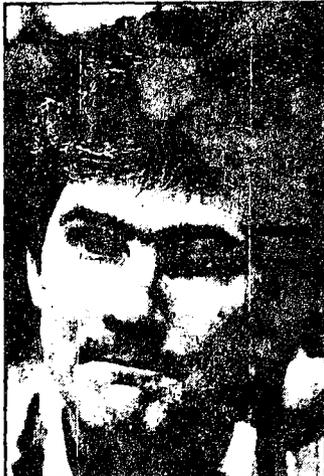
Every year reported to the center in Colorado are about 2,000 avalanches, and about 10,000 in the United States. We make a rough guess that maybe we're getting one out of 10 reported to us. So if we get reported 2,000 in Colorado, we are thinking that somewhere around 20,000 are falling each winter.

We have observers who see a limited amount of the mountain environment. Therefore, we just know that if they see so many in their small area, we can spread this out to a larger area and get perhaps 20,000 a year in Colorado.

**Coloradoan:** Early-season snow conditions are important. What sort of snow are we getting?

**Williams:** This year started out to be potentially a very safe year. It may not turn out that way.

By the first of November, there was virtually no snow cover to speak of in the mountains. On about Nov. 2, snow started to come. It fell fairly



Blair Godbout/The Coloradoan

◀ This year started out to be potentially a very safe year. It may not turn out that way. ▶

smaller or missing altogether. That would be evidence of an avalanche path. Gullies, bowls — anything where the slope steepness is 30 degrees or greater is a potential avalanche path.

And then pay attention to the signs that nature is giving you. If you see fresh avalanches, that's your best single sign that more may occur. But also,

avalanche during a low hazard.

I think if we really looked at our data closely, we would find that a lot of accidents occur when the hazard is moderate. This bothers some people. When they think of moderate, they think that's not bad, I can ski most places. When the hazard is moderate, you have to be careful where you ski.

A moderate hazard means

This makes the back country the spot where avalanches occur almost exclusively.

**Coloradoan:** It's also the place people find so enticing.

**Williams:** Hey, it's great. It's fun. It's a challenge. We don't tell people not to take risks because we know the fun that can be had by successfully tackling a risk and making things work.

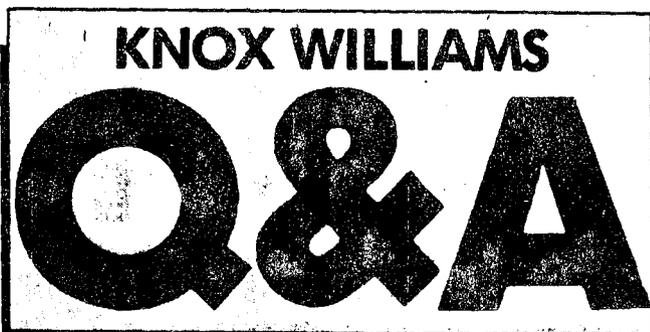
What we try to do in our public messages is to tell people what conditions are like, but we're not going to tell them to go or not to go. We feel that's a decision that people ought to make. It's your right to go into the back country and take whatever challenges you want to take on. Be smart about it. Choose the time and the place to ski that 40-degree bowl.

**Coloradoan:** Is funding for the Avalanche Information Center on firmer ground?

**Williams:** It's a little bit better right now. The reality is that we live on a year-to-year basis regardless of whether times are good or bad. I spend the summer raising money. There are some 18 to 20 different sponsors who contribute toward the cost-sharing of the Avalanche Center. I have to do this every year.

The funding situation has settled down, and we're feeling pretty comfortable, at least for the short term. Certainly any major recession would hurt our funding opportunities drastically, and it could put the center under. Until that time, I'm feeling pretty good.

The public has been using the



there are other signs, such as the snow collapsing underneath your feet when you're on level ground. That's a real good danger sign.

So we teach people to recognize where avalanches are likely to occur and avoid those areas if they're truly safety-conscious.

If they're the type person who likes to take risks — and a lot of us do — by skiing slopes of 30, 40 degrees because it's fun if you can do it, then we ask those people to pay attention to what the snowpack is telling them about how safe it is, and to choose the day they ski those degree chutes fairly care-

we're not going to see avalanches running by themselves, that most avalanches that a person would trigger would be rather small, that nonetheless there are going to be areas and pockets of snow which could prove very dangerous if somebody gets into it.

**Coloradoan:** There must be some things you think you can do.

**Williams:** In our avalanche awareness talks, we give a few tips. These tips are derived from what survivors have done to help themselves.

The first thing we suggest is that people, if they are skiing a slope or climbing up it, that

### Bhutto dispel

Editor Benazir Bhutto election being a ment is the entire of, and world. the re democr the elec state in

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