

Colorado Geological Survey Special Publication 39

The Snowy Torrents

*Avalanche Accidents
in the United States
1980-86*

By Nick Logan and Dale Atkins

The Snowy Torrents

*“The snowy torrents
are like the deep sea;
they seldom return
their victims alive.”*

From *Kampf über die Gletschern*
(Battle over the Glaciers)
by W. Schmidkunz

Deep, drifted snow in central Colorado
as evidenced by this 16-foot avalanche
fracture line. Photo by Kevin Ahern.

The Snowy Torrents

Avalanche Accidents in the United States, 1980–86

By Nick Logan and Dale Atkins
Colorado Avalanche Information Center
Colorado Geological Survey

This compilation of 146 avalanche accident reports teaches by example, both good and bad. Commentaries will help those who spend wintertime in the mountains to avoid getting caught in an avalanche or if caught, how to survive.

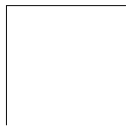
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Foreword

The National Avalanche Foundation is proud to sponsor the production of *The Snowy Torrents* and has provided funding to make it possible. This publication offers readers an opportunity to study actual

avalanche situations and glean from others' experiences.

*Brian McCartney, Treasurer,
National Avalanche Foundation*

Preface

On a sunny St. Valentines Day in Colorado, 1989, Tod Richards and two companions skied through a ski area boundary closure to a steep, deep powder chute named Temptation Gully. A few minutes later, a large and violent avalanche killed both of Tod's friends and trapped Tod for more than two hours before he was luckily rescued by passers-by. In a later interview Tod talked about his lack of avalanche awareness: "I think the problem with skiing Temptation is that it's such a challenging trail and it's so much fun that it's easy to fall into the trap that I did. You've never seen an avalanche, and you don't really know anybody that has been buried in an avalanche, and those kinds of things don't happen to you. They happen to somebody—I don't know—over in Europe."

Tod's statement likely reflects the attitude of many winter recreationists: "It won't happen to me." But a significant number of avalanche accidents and dramatic avalanche rescues occur in the United States each winter. Many such accidents are included here in the fourth volume of *The Snowy Torrents*. These are true-life adventures of those who have lived through, or died from, the wrath of an avalanche. The survivors tell it like it really is—a horrifying, and oftentimes detrimental ordeal. Scores of climbers, skiers, snowmobilers and others have fallen victim to the same trap as did Tod and his friends. Many have died needlessly in avalanches because they didn't know how to recognize, and thus avoid, the danger. With proper training, almost all of these accidents can be prevented. Had Tod's party possessed a higher level of avalanche awareness, that disaster might have been averted.

Also included are accident accounts of the seasoned veterans, the snow-savvy, and the well-trained. While their accidents usually result from errors in judgement, or from taking unnecessary risks, the end result is often the same: injury or death. Avalanches don't discriminate. Age, sex, occupation, nationality or experience; it makes no difference to the avalanche who its victim is. These stories are

published to serve as a record of significant avalanche events, and as examples from which we may learn from the experiences of others, both good and bad, so that we might not make the same mistakes.

With around 10,000 avalanches observed in the United States each winter (approximately 10 percent of the actual number of occurrences) it is inevitable that some will involve people and property. Records kept by the USDA Forest Service Westwide Avalanche Network reveal some interesting statistics. Based on current data, in an average winter 149 persons are caught by avalanches, 61 are either partly or wholly buried, 14 injured, and 16 killed. Also, 25 vehicles are struck by avalanches (10 damaged), and five buildings, one ski lift, and five miscellaneous structures. This accounts for an average of some \$558,000 in damage each winter.

For the 146 accidents included in this volume of *The Snowy Torrents* (1980–1986), 38 occurred within or near ski areas. Of these, 18 involved ski patrollers or snow rangers performing their duties, and five involved recreational skiers within the ski area. In 15 accidents lieft skiers left this ski area or skied into closed areas. Backcountry skiers were involved in 48 accidents; and in 20 accidents, climbers or hikers were caught in the churning snow. Also included are eight snowmobile-related accidents, and nine mishaps involving either motorists, miners, or other workmen. Finally, 13 avalanche incidents damaged houses, cabins, or buildings, bringing death to some of the occupants.

This publication of *The Snowy Torrents* follows in the tradition of volumes I, II and III. Dale Gallagher wrote the first volume. It was published in 1967 and documented 63 accidents that took place from 1910 to 1966. Knox Williams wrote the second volume. Published in 1975, Williams reported on 76 accidents that occurred from 1967 to 1971. The third volume, by Knox Williams and Betsy Armstrong, focused on 145 accidents that took place from 1972 to 1979. The current volume, by Nick Logan

and Dale Atkins, covers 146 avalanche accidents that took place from 1980 through 1986.

Each accident report contains the facts and details as provided by the survivors, witnesses, rescuers, or other individuals involved in the incident. All names used are real. Each report concludes with comments by the authors. Proper decisions and actions are praised; rash or unproductive actions are criticized. The authors also comment on risktaking, avalanche zoning, post-control releases, temperature releases, route-finding techniques, clues to instability, survival techniques, and remarkable examples of good and bad luck. Logan and Atkins have made sincere efforts to treat fairly all those persons involved in every accident and rescue effort. Author comments are made to point out lessons to be learned. There is no intent to embarrass any individual.

The accidents are identified by a number indicating the year and the sequential occurrence of the accident within that year. For example, number 80-5 designates the fifth documented accident for 1980. This is the same numbering system used in the previous three volumes of *The Snowy Torrents*. Occasional references to accidents in previous volumes are made in this publication.

Photographs or drawings are included with many of the accident reports. In the drawings, an "x" identifies the position of each person at the time of the avalanche release, an open circle indicates the final position of each person who escaped the avalanche. A half-shaded dot indicates who was partly buried. A solid dot indicates the final position of each buried victim.

Following the individual accident reports are chapters that contain additional information such as avoiding and surviving avalanches, avalanche statistics, a list of accidents contained in other volumes of *The Snowy Torrents*, an accident reporting form, glossary, list of

additional reading, and conversion tables for the metric-minded.

Readers of *The Snowy Torrents* can, through increased awareness, become safer backcountry travellers when navigating through steep, snow-covered terrain. In addition to reading enjoyment, the authors' foremost hope is that *The Snowy Torrents* will provide a means of reducing the number of avalanche accidents. To this end, "Evaluating Avalanche Risk and Avoiding and Surviving Avalanches", is provided. Safety measures and rescue techniques discussed here apply to all activity categories: downhill skiers, backcountry skiers, mountaineers, snowmobilers, ski patrollers, snow rangers, mountain guides, mountain rescue teams, highway personnel, hunters, and even occasional hikers who might find themselves in steep, snowy terrain.

This publication is only possible through the dedication of the many survivors, witnesses, and rescuers who originally documented these accidents. They are the people who recorded the details, took photographs, prepared maps, conducted interviews, and clipped newspaper stories to be included in the accident files from which *The Snowy Torrents* is based. The authors are indebted to those who have preserved the details of these accidents for posterity and the enlightenment of others. From these records other people might learn, and thus be spared from the fury of the "snowy torrents." We encourage persons involved in future avalanche accidents to use the accident reporting form to provide thorough and accurate documentation. This will further avalanche research and refine avalanche rescue and safety techniques. A copy of the report should be sent to the Colorado Avalanche Information Center, 10230 Smith Road, Denver, Colorado 80239.

*Nick Logan
Dale Atkins*

Acknowledgments

We want to express our sincere thanks to Knox Williams who made a large contribution to this publication. His expertise, guidance, support and encouragement were invaluable throughout the writing process, and he contributed countless hours in editing the manuscript. The following people have contributed to the many accident files used to write *The Snowy*

Torrents. By recording and sharing their experiences, whether from the viewpoint of a victim, rescuer or witness, these people have brought us a step closer to understanding the unique (and unpredictable) nature of avalanches, and of avalanche rescue techniques. Any omissions are purely unintentional.

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Don Bachman
Reid Bahnson
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Knox Barclay
Henning Bauer
Paul Baugher
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Ted Beck
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Jerry Divine
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James Eichler
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Rick Emarine
Roland Emetaz
Dan Ewert
Rodrigo Eyzaguirre
Doug Fesler
Liam Fitzgerald

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Sue Ferguson
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Norma Hight
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Bruce Tremper
Beat vonAllmen
Chuck Waggoner
Dick Walker
Wallace Watts
Walter Werner
Patti Whitcomb
Jim Whiting
George Whitlock
Onno Wieringa
Craig Wilbour
Dale Wilkins
Duffy Wilson
Dennis Wolf

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80-2	January 11, 1980	Brighton, Utah 8
80-3	January 12, 1980	Squaw Valley, California 9
80-4	January 12, 1980	Near Ketchum, Idaho 11
80-5	January 13, 1980	Cameron Pass, Colorado 12
80-6	January 13, 1980	Tucker Mountain, Colorado 13
80-7	January 18, 1980	Big Mountain, Montana 15
80-8	January 19, 1980	Red Mountain, Washington 17
80-9	January 19–22, 1980	Seward Highway, Alaska 18
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80-14	March 15, 1980	Crystal Mountain Resort, Washington 25
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81-2	January 31, 1981	Ketchum, Idaho 30
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81-4	February 2, 1981	Geneva Peak, Colorado 32
81-5	February 3, 1981	Berthoud Pass, Colorado 33
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Accidents by State and Date

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Alaska			Colorado continued		
80-9	1/19-22/1980	Seward Highway	82-6	1/23/82	Cumbres Pass
81-1	1/5/1981	Hatcher Pass	82-9	2/19/82	Aspen Highlands Ski Area
81-21	6/10/1981	Mt. St. Elias	82-10	3/13/82	Arapahoe Basin Ski Area
81-23	12/3/1981	Richardson Highway	82-17	11/13/82	Twin Lakes
82-11	3/18/1982	Mt. Alyeska Ski Resort	82-22	12/25/82	Montezuma
82-15	4/3/1982	Denali National Park	83-3	1/30/1983	Wolf Creek
83-2	1/2/1983	Hatcher Pass	83-4	2/2/1983	Ski Sunlight
85-10	3/2/1985	Hatcher Pass	83-7	3/3/1983	Eldora
85-12	3/10/1985	Eagle River	83-10	3/6/1983	Deer Creek, Silverton
California			83-11	3/9/1983	Crested Butte
80-3	1/12/1980	Squaw Valley	83-12	3/12/1983	Porphyry Peaks, Grand Lake
81-10	3/1/1981	Mt. Baldy	83-18	12/18/1983	Copper Mountain
81-26	12/29/1981	Sugar Bowl Ski Area	83-20	12/27/1983	Wolf Creek Pass
82-1	1/4/1982	Squaw Valley	84-4	2/18/1984	Ophir
82-3	1/5/1982	D.L. Bliss State Park, Lake Tahoe	84-5	2/21/1984	Berthoud Pass
82-14	3/31/1982	Alpine Meadows Ski Area	84-6	2/21/1984	Marble
83-13	4/2/1983	Mt. Shasta	84-7	3/15/1984	Silverton
83-19	12/23/1983	Alpine Meadows	84-8	3/17/1984	Vail Pass
85-23	11/29/1985	Sugar Bowl	84-9	3/19/1984	Dallas Divide
86-8	2/15/1986	Twin Lakes	84-10	3/31/1984	Aspen Highlands
Colorado			84-11	4/14/1984	Chair Mountain
80-1	1/7/1980	Copper Mountain Resort	84-15	10/17/1984	Mt. Kelso
80-5	1/13/1980	Cameron Pass	84-18	12/13/1984	Aspen
80-6	1/13/1980	Tucker Mountain	84-19	12/31/1984	Ashcroft
80-10	1/20/1980	Telluride Ski Resort	85-15	3/24/1985	First Creek, Berthoud Pass
80-12	2/18/1980	Red Mountain Pass	85-16	3/31/1985	Ski Sunlight
80-16	11/27/1980	St. Mary's Glacier	85-18	9/22/1985	Castle Peak
81-4	2/2/1981	Geneva Peak	85-20	11/17/1985	La Plata Mountains
81-5	2/3/1981	Berthoud Pass	85-21	11/21/1985	French Gulch
81-12	3/3/1981	Wolf Creek Pass	86-14	2/20/1986	Arapahoe Basin Ski Area
81-14	3/15/1981	Pyramid Peak	86-16	2/26/1986	Vail
81-15	3/15/1981	Telluride	86-18	10/6/1986	Quandary Peak
81-17	3/31/1981	Snowmass Ski Area	Idaho		
81-18	4/8/1981	Arapahoe Basin Ski Area	80-4	1/12/1980	Near Ketchum
81-24	12/20/1981	Turquoise Lake	81-2	1/31/1981	Ketchum
81-25	12/27/1981	Aspen Highlands	81-7	2/15/1981	Ski Schweitzer
82-2	1/5/1982	Telluride	82-12	3/22/1982	Sun Valley
82-4	1/6/82	Arapahoe Basin Ski Area	82-18	11/14/1982	Montpelier
			83-1	1/1/1983	Stanley
			85-4	2/9/1985	Lolo Pass Winter Recreation Area

No.	DATE	LOCATION	No.	DATE	LOCATION
Maine			Utah continued		
84-2	2/8/1984	Mt. Katahdin	83-9	3/6/1983	Big Cottonwood Canyon
Michigan			83-16	11/24/1983	Day's Fork, Big Cottonwood Canyon
80-13	2/19/1980	Sleeping Bear Dunes National Lakeshore	84-16	12/2/1984	Park City
82-5	1/10/1982	Sleeping Bear Dunes National Lakeshore	85-8	2/21/1985	Alta
Montana			85-9	2/22/1985	Powder Mountain
80-7	1/18/1980	Big Mountain	85-11	3/4/1985	Mineral Fork
81-19	4/12/1981	Red Lodge	85-13	3/15/1985	Big Cottonwood Canyon
82-19	12/7-8/1982	Big Sky	85-14	3/19/1985	Park City
82-20	12/19/1982	Philipsburg	85-19	11/13/1985	Sunset Peak
82-21	12/24/1982	Big Sky	86-2	1/6/1986	Provo Canyon
83-5	2/19/1983	Point Six Mountain, Missoula	86-3	1/16/1986	Steam Mill Canyon
83-6	2/19/1983	Hyalite Canyon, Bozeman	86-6	2/13/1986	Sundance
83-8	3/5/1983	Earnest Miller Ridge, Madison Range	86-9	2/17/1986	Brighton
85-1	1/3/1985	Bridger Bowl	86-12	2/19/1986	Alta
85-6	2/12/1985	Roberts	86-13	2/20/1986	Logan Canyon
86-1	1/3/1986	Mt. Blackburn	86-19	11/20/1986	Alta
86-4	2/4/86	Hell Roaring Mtn.	Washington		
86-5	2/7/1986	Mt. Ellis	80-8	1/19/1980	Red Mountain
Nevada			80-11	2/2/1980	Mission Ridge
81-8	2/15/1981	Lamoille	80-14	3/15/1980	Crystal Mountain Resort
New Hampshire			81-20	4/12/1981	Source Lake
82-7	1/25/1982	Tuckerman Ravine, Mt. Washington	81-22	6/21/1981	Mt. Rainier
New Mexico			83-14	4/16/1983	Granite Mountain, Snoqualmie Pass
80-15	11/15/1980	Taos Ski Valley	83-15	6/26/1983	Mt. Shuksan
Oregon			83-17	12/10/1983	Crystal Mountain
81-16	3/17/1981	Timberline Ski Area	84-12	5/18/1984	Granite Mountain
82-8	2/14/1982	Aneroid Lake	84-13	5/27/1984	Source Lake
82-16	6/20/1982	Mt. Hood	85-5	2/10/1985	Mt. Si
Utah			85-7	2/12/1985	Crystal Mountain Resort
80-2	1/11/1980	Brighton	85-17	5/12/1985	Whitehorse Mountain
81-3	2/1/1981	Doughnut Falls, Big Cottonwood Canyon	85-22	11/25/1985	Mt. Rainier National Park
81-6	2/9/1981	Logan Canyon	86-7	2/15/1986	Reflection Lakes, Mt. Rainer National Park
81-9	2/22/1981	East Fork of Mineral Fork Canyon	86-17	8/3/1986	Mt. Baker
81-11	3/1/1981	Porter Fork, Mill Creek Canyon	Wyoming		
81-13	3/8/1981	Day's Fork, Big Cottonwood Canyon	84-3	2/16/1984	Snow King Mountain
82-13	3/22/1982	Park West Ski Resort	84-17	12/11/1984	Teton Pass
			85-2	2/3/1985	Grand Teton National Park
			85-3	2/9/1985	Snowy Range
			85-24	12/2/1985	Jackson Hole
			86-10	2/17/1986	Jackson Hole
			86-11	2/17/1986	Teton Pass
			86-15	2/24/1986	Jackson Hole

Avalanche Classification

Avalanches are characterized by using the standard avalanche reporting system adopted in the United States as originally described in appendix D of the USDA Forest Service *Avalanche Handbook 489*. The following is a list of the abbreviations used to simplify avalanche reporting with some modifications by the Colorado Avalanche Information Center.

Five elements of an avalanche are covered: type, trigger, size, sliding surface, and airblast, in that order. The following are characteristics of each element.

Two principal **types** of avalanches are recognized: loose-snow and slab avalanches. Loose-snow avalanches are characterized by cohesionless snow: they originate from a point and fan outward as they flow downhill. Slab avalanches are characterized by cohesion between the snow grains; they originate from a well-defined line called a fracture line (or crown face). Slab avalanches are further subdivided into soft-slab and hard-slab avalanches, depending on the density and degree of cohesion of the snow. The distinction between soft slab and hard slab is often difficult to make. Usually, however, a soft-slab avalanche disintegrates into loose material while sliding downhill; a hard-slab avalanche contains large chunks or angular blocks of snow in the debris. The density of hard slab is usually greater than 300 kilograms per cubic meter. Both loose-snow and slab avalanches are classified as wet if free water is present in the snowpack or if the debris is obviously refrozen when inspected several hours after the event.

Some avalanches need an artificial **trigger** to get them started. Triggers can be anything that exerts enough stress on the snowpack to cause it to release in an avalanche. A skier, snowmobiler, animal, explosive charge, cornice fall, etc., can all be triggers. Some avalanches occur naturally. They can release from storm parameters such as wind-loading (drifting), rapid warming, or from the additional weight of new snow.

The size of the avalanche is conveyed by giving it a value of 1–5. This size classification

estimates the volume of snow transported down an avalanche path rather than the threat to life or property. Size 1 is based on running distance regardless of snow volume, and sizes 2 through 5 are reported relative to the individual slide path. That is, a “small” avalanche is one that is small (moves a small volume of snow down the path) for that particular avalanche path.

What the avalanche slides on is called the **sliding surface**, or **bed surface**, and can be either snow or ground. A surface avalanche slides on an old snow surface in the starting zone. A ground avalanche slides on the ground in the starting zone.

Some large avalanches have an associated airblast. An **airblast** is the potentially destructive, strong wind that may extend well beyond the visible dust cloud or moving snow front. An airblast occurs only with large, fast-moving avalanches and is the exception rather than the rule.

Use the following list as a guide to recording your own avalanche sightings.

Symbolic Avalanche Classification

Symbol	Type of Avalanche
HS	Hard slab
SS	Soft slab
WS	Wet slab
L	Loose
WL	Wet loose
I	Ice avalanche

Symbol	Trigger (initiating agent)
N	Natural
AC	Artificial, cornice
AA	Artificial, artillery
AL	Artificial, avalauncher
AE	Artificial, hand charge
AB	Artificial, air blast (suspended explosive)
AX	Artificial, Gazex
AS	Artificial, ski

	AD	Artificial, snowboard
	AF	Artificial, foot (walking: hiker, climber, snowshoer...)
	AV	Artificial, vehicle (snowcat, snowmobile...)
	AO	Artificial, other (snowplayer, animal, rockfall, earthquake...)

Symbol	Size (based on volume of snow relative to path)
1	Sluff (any slide running less than 150 feet slope distance, regardless of other dimensions)
2	Small (relative to the path)
3	Medium (relative to the path)
4	Large (relative to the path)
5	Major or Maximum (relative to the path)

Symbol	Running surface
G	Avalanche ran to ground in the starting zone
O	Avalanche ran on an old snow surface in the starting zone

Symbol	Airblast
J	Airblast was observed with the avalanche. Note: a powder cloud is not airblast. True airblast is a forceful wind beyond the visible dimension of the moving avalanche.

Some examples using this classification are:

HS-AA-2-G	Hard slab avalanche released by artillery. It was of small size and ran to the ground in the starting zone.
SS-AL-4-O	Soft slab avalanche released by an avalauncher. It was large in size, and ran on an old snow layer in the starting zone.
L-N-1-O	A loose-snow sluff that released naturally and ran on an old snow surface.

Avalanche Accidents

80-1

JANUARY 7, 1980

Copper Mountain Resort, Colorado

1 patroller caught, buried and injured

Weather Conditions

December 1979, was a warm, dry month in the Colorado Rockies: little more than 12 inches of snow fell all month at the Copper Mountain ski area. Late in the month, sunny weather caused a crust to form on south-facing slopes. One such slope at Copper Mountain is named Triple Zero. It is an out-of-bounds, southeast-facing slope that, although steeper than 30°, had not produced a significant avalanche since the ski area had opened in 1972. Nonetheless, the slope was treated with respect and periodically controlled with explosives or ski-cutting.

January 1–3 brought 7 inches of fresh snow, and another 12 inches fell by the morning of the 4th. Snowfall continued on the 5th, with 3 inches being recorded. Up until this time, the wind had stayed below 10 mph, but on the afternoon of the 5th, a strong west wind sprang up and continued through the 6th. Winds of 25–30 mph scoured the snow on the front side of the ski area and loaded slopes facing northeast through southeast. Light snowfall accompanied the winds: 2 inches were recorded on the morning of the 6th; and 5 inches on the 7th. In summary, about 30 inches of snow had fallen in 7 days, winds had caused about 24 hours of blowing snow on the 6th, and temperatures had remained cold, with highs reaching the mid 20s.

Accident Summary

January 7 was a cold, windy day with light snow falling. But it was also a good powder day, and two off-duty patrollers, Bill Murphy and Paul Greco, and ex-patroller Tom Schramm arrived at Copper Mountain for a little powder skiing. They learned that all potential avalanche slopes had been bombed or ski-

cut earlier in the morning, and there had been no releases. On-duty patroller Larry Schmidt joined these three for an out-of-bounds tour to Triple Zero to ski-cut the slope and then to ski it if it passed the test.

They all grabbed Skadi rescue beacons, but Schmidt had the only radio. No one had a shovel. Triple Zero is only a 150-yard walk from the upper patrol room, and the skiers arrived at the top of this slope at about 1100 hours. Minutes later Mickey Johnston, another on-duty patroller, joined them. The wind was kicking up ground blizzards, and the tracks of three skiers who had apparently sneaked into the area hours earlier had mostly filled in. They briefly discussed the stability on this and adjacent slopes, and Schmidt mentioned, "No problem. Triple Zero never slides" (compare casual attitude in accident 82-1).

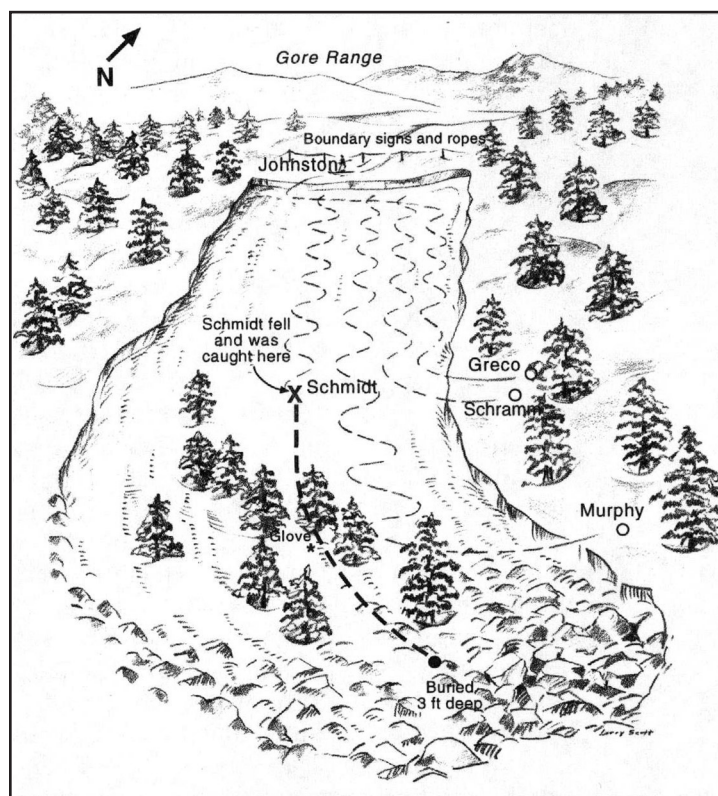


Figure 1. Accident 80-1, Copper Mountain Resort, Colorado, January 7, 1980.

Greco went first. He cut a traverse to the right (west) and then cut a "Z" back in the opposite direction, jumping on his skis as he went. No cracking or collapsing occurred, and the wind-drifted snow felt good and skiable, so Greco went for it. He skied the left edge of the slope, made about 10 turns, and stopped along the treeline. Schramm then made a set of knee-deep tracks just to the right of Greco's, and he too stopped along the treeline on the left. Murphy was next, skiing to the right of the previous tracks and stopping 100 feet lower on the slope. None of these skiers noted any sign of instability.

Schmidt was the fourth skier to start down, and he cut a set of turns right through the center of the slope. Halfway down, his ski tips dove, and Schmidt fell in a forward somersault. He stood up, dusted himself off, and began to look for his left ski which had popped off. Greco and Schramm were laughing and congratulating Schmidt on his fall when suddenly they heard the shout, "It's moving!"

Johnston had been last in line and was watching Schmidt ski down. A second or two after Schmidt fell, Johnston was astonished to see the entire slope slowly yawn open as a deep fracture broke just beneath his skis. The slab began to break into large, angular blocks, as if in slow motion. Johnston shouted, "It's moving, it's moving! Go left! Go to your left!"

All four skiers on the slope heard the shouts and saw the avalanche begin to move. Greco, Schramm, and Murphy moved deeper into the trees, but Schmidt could not move at all. He was pinned in position because his right leg, with ski attached, was buried in the snow. He tried to pop the binding but could not get enough leverage in the waist-deep snow. In this helpless position, Schmidt describes what happened next: "I relaxed and remained calm, waiting for the stuff to pop me out. I had hoped to stay on top and get a real slow ride. I was waiting facing downhill."

The avalanche had gained tremendous momentum in just a few seconds. When it struck, Schmidt knew instantly that the once slow-moving slide was now a churning killer. Again in his words: "It hit with such force, it blew my right ski off immediately. I attempted to swim in the only direction possible—downhill. It roared over me and sucked my body under for the first time. While I was under, I sucked in some snow. At this point, still mov-

ing head first, I bounced off two objects and absorbed the blows with my head.

"Realizing I had been making some errors in the world of the 'white blizzard', I consciously reviewed some of the procedures that would hopefully give me some extra time if I needed it. Things like swimming uphill if possible, keeping my mouth shut and covered, and creating an air pocket and trying to get one hand up when the snow stopped. As this was running through my head, I felt my body being spit out. For an extremely short period of time, I was on top and had a chance to clear my mouth of snow and take another breath. Then I was under again.

"Up to this point, I had been traveling head first. When I surfaced the next time, I did a head-under-heels somersault and landed on my back. The slide appeared to be slowing down. I opened my eyes and could see daylight through the snow. Immediately, I tried to scramble to the surface before the snow set up, or at least get one hand in the air and the other to my face to create an air pocket." But another wave of snow slammed shut any chance Schmidt had of reaching the surface.

He describes his situation: "With only one hand raised, the daylight I had just seconds ago vanished. We continuously hear of how the deposition sets up like concrete, and that is exactly what had happened before I could accomplish what I had intended to do. So there I lie under 3 feet of snow; pitch black; one hand up but not exposed; my gloves, hat, and goggles stripped from my body; my scarf still around my neck covering my mouth; not able to move as much as my toes in my boots.

"I immediately tried to cut down my oxygen intake by relaxing and slowing down my breathing. I still was not concerned with death because I had worked with these three patrolmen (Murphy, Greco, and Schramm) for 5 years. I respected and trusted their ability completely. Within 30 seconds after I had restricted my breathing, I passed out."

Rescue

The four eyewitnesses had watched Schmidt's progress as best as they could, but only Murphy, who was lowest on the slope, had a good idea where he might be buried. When the dust settled, Schramm, Greco, and Murphy moved out onto the debris and switched their beacons to receive. They were without a radio (it was buried with Schmidt) or shovels.

Schramm shouted up to Johnston telling him to go for help.

Murphy thought he had last seen the victim being carried through a small group of trees, so he headed for this point. He spotted a glove and then picked up a beacon signal below the trees, and shouted for Greco and Schramm to hurry down. There were large chunks of snow making travel over the debris difficult. Murphy skied down to where the signal was much stronger, took off his skis, turned down his Skadi, and bracketed the area. Greco and Schramm confirmed Murphy's area of the strongest signal, so they began frantically digging with hands and skis. About 2 minutes had elapsed since the avalanche had stopped.

About a foot beneath the surface they uncovered Schmidt's bare hand. Three more minutes went by before they uncovered his face. He was unconscious and shallowly breathing, and his face had a bluish tint. It was obvious from a swollen left eye and scratches on his head that he had suffered a head injury of some degree. At this point, Murphy was near exhaustion and suspected that Schramm and Greco might be feeling the same. Murphy instructed Greco to rest and save himself to give mouth-to-mouth resuscitation. Murphy and Schramm kept digging and removed the scarf covering Schmidt's mouth.

Meanwhile, it had taken Johnston about 3 minutes to return to patrol headquarters and set the rescue in motion. Within 1 minute, three patrollers were headed to the site with the hasty search pack containing probes and shovels. Other patrollers readied first aid equipment. The three rescuers arrived at the site just as Schmidt was regaining consciousness, and with the shovels, they quickly completed the job of digging him out. A few minutes later more rescuers arrived with a sled, backboard, and oxygen. They gave the victim oxygen and put him on the backboard since they were not sure of his injuries. After a long sled ride out, Schmidt was taken to the Summit County Medical Clinic in Frisco. There the doctor determined Schmidt's only injuries were facial cuts and a mild concussion. He was back on the job a few days later.

Avalanche Data

The avalanche was an HS-AS-4-O. The fracture depth was measured at 41 inches, and the frac-

ture line extended about 150 feet across the slope. It fell a little more than 300 vertical feet, or about 600-foot slope distance. This was a pretty good avalanche for a slope that never slides!

The slope faces southeast, with the starting zone just above timberline at 11,400 feet. The slab consisted of the snow that had fallen and blown in during the past 7 days. Winds had blown hard enough to produce hard-slab conditions at the top of the starting zone, though the snow softened considerably farther down-slope. The slab failed on a 1-centimeter-thick layer of developing faceted grains on top of a hard sun crust. The total snowpack was 82 inches deep in the starting zone.

Comments

Larry Schmidt was rescued from a 3-foot burial in 5 minutes only because he was wearing an avalanche transceiver, and his co-workers were skilled in their use. Rescue beacons save several lives each winter, and they are standard safety equipment for all ski patrols. It must be emphasized that frequent practice is required before a person can use one effectively.

There was, however, a serious omission from this group's safety equipment—shovels. Although no one in the group thought the slope would slide, they all knew it could slide. They were being cautious by skiing one at a time and favoring the edge of the slope, but without shovels, they were not fully prepared for the emergency that suddenly confronted them.

Finally, it is instructive to have Larry Schmidt's first-person perspective on being caught and buried. Especially interesting are his thoughts while being tumbled downhill in and out of the avalanche, his instant realization that he was not on a slow joy ride but in a life and death struggle, and his snap judgment on the techniques that could save his life. His training had sharpened his instincts and allowed positive actions in a panic situation (which is precisely the reason accidents are documented in *The Snowy Torrents*), but still he ended up helplessly buried. It was great comfort to him to know that he was wearing a rescue beacon and that his friends would find him quickly. Without these assurances, it would have been a terror-filled burial. (For other incidents where shovels were needed but not available see 90-10, 82-8, 82-13, and 85-24.)

80-2

JANUARY 11, 1980

Brighton, Utah

1 cross-country skier caught, buried and killed

Weather Conditions

A major storm struck the Wasatch Range on January 6, and by midday on the 11th, Brighton, at the head of Big Cottonwood Canyon, had received 63 inches of snow which contained 8.76 inches of water equivalent. At the 9,000-foot level, temperatures had been mild for January with lows in the mid teens and highs of 30–32°F. Winds during the storm had been strong from the west-southwest with gusts of 55 mph causing much blowing snow.

By the morning of January 10, the avalanche hazard was considered high to extreme and avalanche warnings were posted for the Wasatch Range. The roads up Big and Little Cottonwood Canyons were closed most

of the 10th because of heavy snow and avalanches. Many avalanches fell in the back-country.

On the 11th, snowfall was heavy and wet all day as temperatures hovered at the freezing mark. The avalanche warning was still very much in effect.

Accident Summary

At 1330 on January 11, a group of five skiers arrived at Brighton for a planned tour to Lake Solitude, a small lake 1 mile west of Brighton. The leader of the group was Jim Klem, 34, the most experienced of the five skiers. The group skied past Silver Lake, 1/4 mile west of Brighton, and here Klem was advised by another ski party of the extreme avalanche hazard on all slope aspects. Klem did not pass this information on to other members of his party. The group continued on its tour and soon came to Evergreen Ridge, a northward extension of 9,840-foot Mt. Evergreen. They climbed partway up the east side of the ridge and stopped for lunch on a level bench at about 9,200 feet in elevation.

At 1610 the group finished lunch and by consensus decided to return to the car rather than continue to Lake Solitude. Klem, however, mentioned to the last skier to leave the lunch area that he wanted to make a few runs on a nearby slope and that he would meet the group back at the car.

As the four skiers headed down the trail, Klem began to sidestep alone up the ridge. Within 5 minutes he came to the steep, north-east slope that he wanted to ski. It was an avalanche slope. Klem had skied perhaps 50 feet out onto the slope when it fractured above him 2–3 feet deep and 150 feet across. The avalanche caught its victim and carried him about 200 feet downslope into a small clump of trees. If Klem swam with the avalanche, he was unsuccessful. Debris piled up 10–12 feet deep, and Klem was buried 7 feet deep with both skis and one ski pole still attached. Death came swiftly.

Rescue

At 1745 the four skiers went to the Brighton Touring Center to report Klem as being missing. They were told to wait half an hour longer for him to return. When the missing man had not shown up after this time, personnel at the touring center organized themselves into two search groups and notified the Brighton and

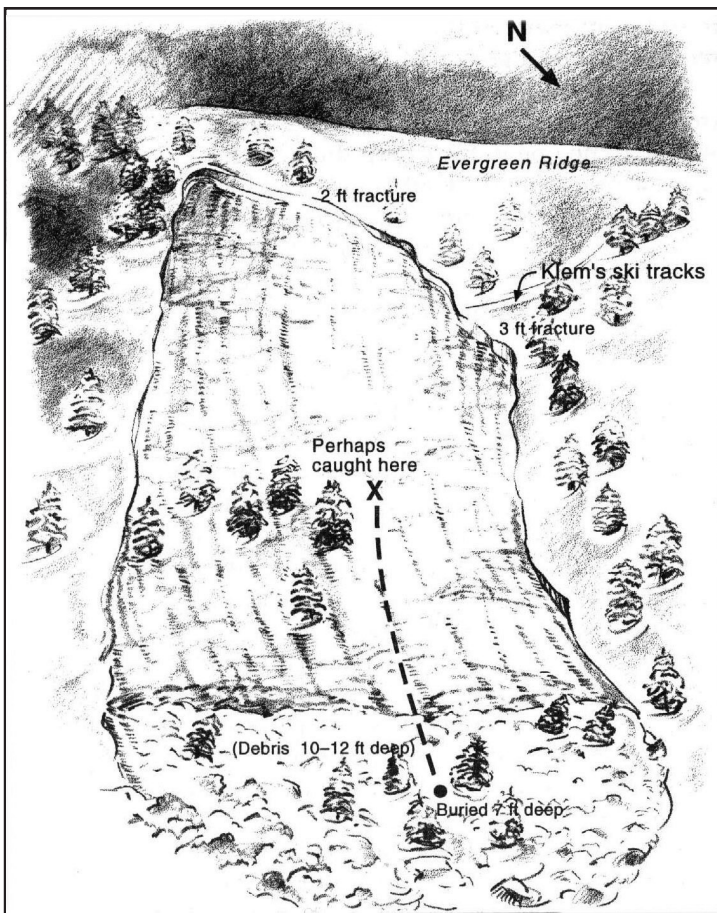


Figure 2. Accident 80-2, Brighton, Utah, January 11, 1980.

Solitude ski patrols that a search was beginning. At 1850 the first group of four rescuers, including two from the original touring party, headed out from the Brighton Touring Center with head lamps, a radio, and minimal rescue equipment. At 2015 they found the avalanche near the lunch site and radioed for the second rescue group to bring avalanche rescue equipment to the site.

A large-scale rescue was now set in motion with a call to Alta Central (a 24-hour emergency center at Alta, just over the ridge), which in turn notified the Salt Lake County Sheriff's Office and a local rescue team with two avalanche dogs. Meanwhile, rescuers at the site began a hasty search which produced no clues at all.

At 2158 a larger rescue team carrying rescue beacons, head lamps, shovels, probes, and explosives (in case they were needed for the safety of the rescuers) headed for the accident site. A half hour later, the rescue team from Alta, including Peter Schory and his dog, Naco, departed the Brighton Touring Center for the site. (Naco also performs in accident 81-3.)

The main mass of debris covered an area about 100 feet square. At 2256, Schory led Naco onto the slide area, and Naco alerted to a spot within 1 minute. Probers and shovelers began to work this spot while the dog was moved to other parts of the avalanche. After the shovelers had cleared about 4 feet of snow, Schory brought Naco back, and he alerted excitedly and began digging himself. Four minutes later, shovelers uncovered Klem's body in a face-down, prone position with both skis and one pole still attached. There were no life signs nor ice mask around the face or body. The victim had been buried 7 feet deep for 7 hours. Nonetheless, rescuers performed CPR for an hour, but there was no response. The toboggan carrying the victim and all rescuers returned to Brighton by 0100 on January 12. Death was later determined to be from suffocation.

Avalanche Data

The avalanche was classified as an HS-AS-3, released at an elevation of 9,200 feet, and fell 200 vertical feet. It ran on a slope facing north-northeast that was 42° steep at the fracture. This slope was to the lee of the prevailing storm winds that had blown strongly for several days. The fracture varied from 2–3 feet in depth along its 150-foot length. A fracture line

profile showed that the slab failed on a very weak depth-hoar layer near the ground. The avalanche then ran on a thick melt-freeze layer just above the ground.

Comments

Periods of extreme avalanche hazard are not the times to ski 42° slopes. A major avalanche cycle had begun in the Wasatch Range on January 10; it was no time for steep, backcountry skiing. The victim had been personally advised of the avalanche danger, but for reasons known only to him, he chose to ignore the advice. The lure of fresh powder was apparently too strong for Klem, although all the data available to him should have indicated this was a risk not worth taking.

80-3
JANUARY 12, 1980

Squaw Valley, California

1 ski lift damaged

Weather Conditions

A typically hard-hitting Sierra snowstorm struck the Lake Tahoe area on January 8. This meant heavy snow, which later changed to rain, and terrific winds throughout the storm. Weather data gathered at the Alpine Meadows ski area, adjacent to Squaw Valley, showed that 35 inches of snow fell on January 9–11. This was a wet snowfall which contained 4.60 inches of water. Southwest winds averaged 30–55 mph during these 3 days, and temperatures ranged from 20–34°F.

At mid morning on January 11, the freezing level jumped to 9,000 feet elevation, and the snow abruptly changed to heavy rain. By 0730 on January 12, Alpine Meadows had recorded 5.64 inches of rain. It was still raining heavily, the temperature was 45°F, and ridgetop winds were gusting to 105 mph.

Accident Summary

The ski patrols at Squaw Valley and Alpine Meadows battled a major avalanche cycle which began on January 9. Hundreds of avalanches fell on the 9th–11th. These were almost all soft slabs releasing in the new snow.



Figure 3. Accident 80-3, Squaw Valley, California, January 12, 1980. Photo by Chris Philips.

Most were controlled by explosives, but a generous number of natural releases were also observed.

With the onset of heavy rain on the 12th, the avalanche cycle changed to a wet-slab and wet-loose cycle. Several of the wet slabs were deep releases that ran to the ground. These were mostly natural releases, and fractures of 3–4 feet were common.

At about 0700 or 0800 hours on the 12th, the largest slide at Squaw Valley released in an area called the East Face. A large mass of wet snow, running down to the bedrock, rumbled downslope and devastated the Olympic Lady chairlift. (Several years earlier, the Olympic Lady chairlift had been built with its bottom terminal situated in the runout of the East Face avalanche.) The three lower towers were either knocked to the ground or bent at severe angles. The ramp area, bullwheel, and counterweight were completely overrun and heavily damaged. Damage was estimated to be \$60,000.

Avalanche Data

The avalanche was classified as a WS-N-5-G. The fracture depth was 7 feet, and the fracture line extended more than 1,000 feet across the starting zone. The avalanche fell 1,400 vertical feet. The debris was a mixture of snow, dirt, rocks, and small trees. The avalanche was triggered by heavy rain which had soaked and thoroughly weakened the snowpack.

Comments

The Olympic Lady chairlift was built despite words of warning from avalanche personnel



Figure 4. Accident 80-3, Squaw Valley, California, January 12, 1980. Photo by Chris Philips.



who vividly remembered a large avalanche overrunning the area in 1969. Following the 1980 damage, the chair was rebuilt in the same location, and it has since suffered minor avalanche damage in January 1981 and March 1982. A diversion dam could offer partial protection, but with or without a dam this chairlift will certainly be hit by future avalanches.

80-4

JANUARY 12, 1980

Near Ketchum, Idaho

1 person at work caught and partly buried, 3 vehicles buried and 1 building damaged

Weather Conditions

A vigorous storm moved into central Idaho on January 9. Over the next 6 days, the Sun Valley ski area recorded 52 inches of snow, and winds from the south through west averaged 20–35 mph for much of the storm. The heaviest snows fell on January 11 and 12. At the headquarters of the Sawtooth National Recreation Area, located about 6 miles east of the accident site, light snow became heavy at 2000 hours on the 11th. Strong winds had caused State Highway 75 to be closed at 8,700-foot Galena Summit, about 25 miles north of Sun Valley-Ketchum, and the road remained closed for the duration of the storm. Blowing snow had also caused a high avalanche hazard in backcountry areas, and numerous soft slabs with fractures of about 18 inches were observed. A backcountry avalanche warning was issued on the 10th.

Accident Summary

The accident occurred at 1130 on Saturday, January 12, at the Cathedral Pines Baptist Camp on Highway 75, about 14 miles north of Sun Valley-Ketchum. Camp manager Dale Wilkins, age 30, was standing outside the maintenance shop when he heard a rumble coming from the north-facing slope that loomed above the camp. A natural, soft slab avalanche had released in an avalanche path well-known to camp personnel. Wilkins noticed the bulk of the snow moving east of him, but then he picked out a hazy cloud of

white that appeared to be coming directly at him. He then noticed the rolling snow at the front of the concrete-block maintenance shop.

Seconds later, the avalanche struck with a force that startled Wilkins. He had no sooner closed the door when the avalanche slammed it open again. At the same instant, a wall of snow burst through the closed double-garage doors, ripping one from its hinges. The snow knocked Wilkins off his feet and threw him 10 feet backwards. He wound up being partly buried in 2 feet of snow, shaken but uninjured.

As the dust cloud settled, Wilkins stood up and looked around him. Two to six feet of snow filled the 15 by 25-foot space of the shop. One garage door had been flung to the rear of the shop. A snow machine that had been outside was now buried inside the shop. About 100 feet away, a jeep and tractor had been buried. Avalanche debris covered an area approximately 300 square feet and was 4–15 feet deep. The only serious damage was to the maintenance shop.

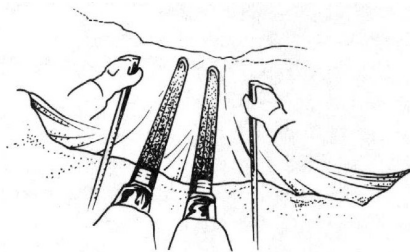
Avalanche Data

The avalanche was classed as an SS-N-4-O. Wilkins felt it was the force of the powder cloud that had knocked in the garage doors and him off his feet. A less substantial building would have sustained structural damage.

The fracture line was estimated to be only 18 inches deep and 300 feet long. The slide initiated at 7,600 feet elevation and fell 1,000 vertical feet. The starting zone is a north-facing, open slope of about 2 acres; the track is a confined gully.

Comments

This was not the first time the camp had been hit by an avalanche. Approximately 11 years earlier, the same building had been filled with snow by a similar avalanche. Given this history, it is certain that future avalanches will run during periods of heavy snowfall and strong southwest winds. The runout zone should be evacuated during such times.



80-5

JANUARY 13, 1980

Cameron Pass, Colorado

1 cross-country skier caught and buried

Weather Conditions

Early January brought light snows almost daily to the Front Range mountains of Colorado. Berthoud Pass had received 51 inches of snow from January 2–13, and winds had gusted to over 90 mph. Cameron Pass, situated at 10,276 feet at the northern end of the Front Range and about 70 miles west of Fort Collins, carried a snowcover of about 3 feet on January 13. The snow grains in the lower half of the pack were faceted, and therefore presented a weak, collapsible base. The new snow and wind had produced both soft- and hard-slab conditions. This, combined with a significant amount of depth-hoar in the snowpack, had caused forecasters to issue an avalanche warning on January 4. This covered the Front Range and was still in effect on the 13th. The weather by midday was overcast with snowshowers, blowing snow, and temperatures near 30°F.

Accident Summary

On Sunday, January 13, four Fort Collins skiers made the 1-hour drive to Cameron Pass for a day of touring. The group included Jayk Crill, 29, Debby Browne, 30, Rick Miller, 31, and Mike Moravan, 35. Crill and Browne were husband and wife. They were aware that an avalanche warning was in effect, but they did not plan on traveling in avalanche terrain.

A heavy snowshower was falling as they drove over the pass. About 3 inches of snow had accumulated by the time they arrived at their destination late in the morning. This was 7-Utes Lodge, a ski and snowmobile touring center. They followed a marked and maintained trail that headed south up a valley from the lodge. The trail ended after about 2 miles, so the group began following a stream bed, which entered a narrow, V-shaped gully. They followed the gully to timberline, at which point Browne decided she would turn back. She had tired because her wax was not holding. The trail had provided good skiing, but off-trail in the trees, the skiers broke through the sugar-snow to the ground. Once they had entered the gully, the snow had hardened

because of wind action.

The time was about 1500 when Browne and Crill started their traverse down the gully. Meanwhile Miller and Moravan had decided to continue a little further uphill, and they walked out on an open and more gentle slope above the gully. Suddenly, the entire area boomed like thunder as the depth-hoar beneath the hard slab settled and shifted. Miller and Moravan heard the sound, but felt no collapse. But in the gully, Browne, who was standing still at the time, felt the snow collapse beneath her. At the same instant, a 2-foot-deep fracture broke on the steep gully wall about 15 feet above her. The snow toppled her over so that she fell face down, arms outstretched. Her feet and skis had hardly moved. In a second, Browne was totally buried beneath 18 inches of snow. Only a ski-pole basket was left exposed.

Crill was about 30 feet away on the opposite side of the gully. He was untouched by the tiny avalanche, but watched in disbelief as it totally buried his wife. The avalanche had run so quickly and quietly that Miller and Moravan, several hundred feet away, were unaware that there had been a slide until they looked in the gully and saw only Crill standing where two skiers had been seconds earlier.

Rescue

Crill took off his skis and was at the burial site in less than a minute. He probed with a ski near the exposed pole tip and heard his wife's voice. With a few scoops of snow he uncovered her arm, then her head. She had been buried about 2 minutes, but it took a bit longer for the men to dig her out completely. The incident had fortunately produced only a close call and a scare.

Avalanche Data

This avalanche was an SS-AS-1-G. The fracture was 2 feet deep and 30 feet wide. The avalanche fell only about 20 vertical feet, yet piled up debris 3 feet deep in the gully. The slope faced west-northwest, was estimated to be 40° in pitch, and lay at an elevation of 10,600 feet.

The avalanche was probably triggered by the two skiers much higher on the flatter slope above. They had caused a collapse of the depth-hoar layer beneath hard slab snow. This collapse had then propagated to the steep gully wall where the soft slab released. The

small avalanche then scoured out the depth-hoar to the ground.

Comments

This tour group was aware of the avalanche danger and kept an eye out for obvious avalanche areas. However, in concentrating on avoiding large avalanche paths, they overlooked the danger in the small but steep-sided gully. The victim was fortunate to have had a ski pole break the surface and rescuers right on the spot. This is the type of avalanche that can be fatal to a lone traveler despite its small size (for example, see accident 82-6.)

80-6
JANUARY 13, 1980

Tucker Mountain, Colorado

3 backcountry skiers caught and buried

Weather Conditions

Tucker Mountain is a 12,337-foot peak situated immediately south of the Copper Mountain ski area in central Colorado. The early winter of 1979–80 had produced a deep and dangerous depth-hoar layer at the bottom of the snow-pack (see accidents 80-1 and 80-5). January brought almost continuous snowy weather to the Colorado Rockies. From January 2–13, Copper Mountain recorded 50 inches of snow, and the Breckenridge ski area, 5 miles east of Tucker Mountain, 82 inches. Winds gusting to 60 mph and more had created both hard- and soft-slab conditions and a high avalanche hazard. Warnings had been posted since January 4.

Accident Summary

Tucker Mountain is accessible to tourers by parking along Colorado Highway 91 and climbing up Tucker Gulch or Copper Creek, or by taking a ridge route from Copper Mountain. On Sunday, January 13, three Denverites—Geoffrey Ferguson, 28, David Williams, 29, and Marie Bernard, 30—parked on Highway 91 at the foot of Tucker Gulch. They had no particular destination in mind, other than wanting to take a tour to timberline.

They did not know the name of the mountain they were about to climb nor anything about the terrain.

The group headed out accompanied by Williams' dog, Poco, and did not follow a trail but made steep traverses in the trees. They were breaking trail through about 18 inches of unconsolidated snow, and they frequently heard the "whoompf" sounds as the snow collapsed around them. They had lunch in the trees, then continued upward and soon broke out above timberline. Here the snow abruptly changed to a hard-packed surface, and Bernard, without metal-edged skis, was having difficulty climbing.

The time was now 1530 and the group had been on the tour for 5 hours. The sky was partly cloudy and an occasional light snowshower drifted past. They were on an east-facing slope that was in the lee of the wind. The afternoon sun was casting long shadows, and the three skiers enjoyed the view of the Tenmile Range across the highway to the east. Then they started down, skiing the open slope and planning to rejoin their ascent trail at timberline.

Ferguson and Williams stopped beside a lone, scraggly tree to wait for Bernard to catch up. They heard Bernard scream, and they looked up. A hard-slab avalanche had cracked across the slope above them and was sliding silently in a jumble of large, angular blocks. It hit Bernard at the knees and knocked her down, head first, arms outstretched. She was dragged along with the avalanche, and mostly beneath the surface. The slide knocked off her skis and buried her in a prone position with her hands near her face. Her head was about 6 inches beneath the surface.

Ferguson and Williams had a second or two before the avalanche hit them. Ferguson reached out for the tree, but the snow hit his legs and pushed him away from the tree. He fell onto his side, face up, and the snow flowed over him. It buried him deeply, but the hard-slab blocks left a small air pocket around his face.

Williams grabbed onto the tree. "I could feel it starting to fill in around my knees, getting deeper and deeper," he recalled. "Then it was pouring in—huge chunks—just bending the tree over. Then after it came over the top of the tree and buried me, it stopped." Still hugging the tree in a standing position, Williams was totally buried, his head 2 feet beneath the surface.

Rescue

The protection of the tree and the blockiness of the snow had kept the avalanche from setting up. Williams was able to free one hand from his pole strap; he then could punch at the blocks of snow. In 5 minutes he had cleared a hole to the surface. He then began to move his shoulders, and in another few minutes he had both arms free. He was next able to slip off his pack over his head which gave him more freedom.

"I started digging down toward my legs, and all of a sudden I felt something moving against one leg, back and forth," said Williams. He thought it might be his dog, Poco. "I started digging down. I was yelling really hard. All of a sudden I heard this muffled yell, and I knew it was Geoff."

Ferguson had been buried 5 feet deep and was lying horizontally, his skis still attached. When first buried, he had struggled to get free, but quickly discovered that he was firmly imprisoned. Though he could breathe, it was pitch black, and he resigned himself to die, thinking both Williams and Bernard would most likely be in the same predicament. He was comfortable except for his left hand which was cold and hurting: the avalanche had ripped off his mitten and wristwatch.

Digging below his waist, Williams uncovered his friend's face, and Ferguson beamed in relief. Williams' feet were still attached to his skis, so his movements were greatly restricted. Slowly and awkwardly he tried moving snow a chunk at a time without knocking snow onto Ferguson's face. Williams' head was still below the overall snow surface, and he had to toss blocks of snow up out of the hole he was excavation. He recalled, "I had myself uncovered to the thighs when I heard a yell. It was Marie."

Miss Bernard had been able to move the snow from around her face quickly, but it took 15 minutes for her to dig out completely. She looked around and saw neither of her companions, only a rubble field of snow. However, the dog Poco had apparently escaped the avalanche altogether and was sitting by her side. She began shouting the names of her friends. There was no response.

Williams tried shouting back, but he soon realized Bernard could not hear him. So he pushed a ski pole into the air from his hole in the snow and waved it back and forth. A moment later, Bernard's face appeared above

him. "I can't believe you're alive," he said.

Working as a team, Williams piled snow on the backpack and lifted it up to Bernard who dumped it. In half an hour, Williams had dug out his feet and skis, giving him some mobility. He then started digging out Ferguson, using his hands and ski poles. This took another half hour. Williams had tunneled around Ferguson's legs and popped his boots from his bindings. They decided it would take too much time and energy to dig out Ferguson's skis which were buried a full 6 feet deep.

It was after 1700 hours now, darkness had fallen, and they could see the headlights of cars on the highway far below. Between them, they had only one pair of skis and two pairs of poles. They decided to walk out together. Each shouldered a pack, they split up the ski poles, Ferguson placed his lightly frostbitten hand inside his shirt, and they started down, postholing through the soft snow in the trees. Again, they caused the snow to collapse audibly now and then, but released no further slides. Two and one-half hours later they reached the highway, about .5 mile from their car. Although exhausted, it was a treat to walk that distance on firm pavement. They were back in Denver before midnight. Ferguson was hospitalized for one day, and soon regained full use of his left hand.

Avalanche Data

The avalanche was an HS-AS-2-O. It released on an east-northeast-facing slope near an elevation of 12,200 feet and ran about 400 feet slope distance. The fracture was 1–3 feet deep, and debris piled up 8 feet deep. The slope had acted like a typically erratic hard slab: the skiers had traversed the slope twice before it released on their third pass. The wind-hardened slab was not especially deep, as numerous rocks were visible on the slope.

Comments

"It's phenomenal that we are alive," Ferguson remarked to a reporter about a week after the accident. "You know, three people don't get buried by an avalanche and just walk out. It's like we've been given a second chance." Indeed it is miraculous that three tourers were able to carry out a successful self-rescue after all were totally buried. And they did this without rescue equipment. Even after surviving the avalanche, they faced the ordeal of a long trek

through deep snow without their ski equipment, extra clothing, or survival gear. (Miss Bernard was wearing jeans without longjohns and got very cold on the walk out). A shovel would have permitted a quicker, less strenuous rescue and would have recovered at least one more pair of skis. Extra food and clothing, especially mittens, would have improved their comfort. In worse weather, these would have been indispensable for comfort and perhaps even survival. These people were indeed very lucky.

They were aware of the avalanche danger and that a warning was in effect. They had avoided the obvious avalanche paths on the way up the mountain and were seeking a safe route down when the slide occurred. They had noted the settlement sounds on the way up, but upon reaching timberline, the hard slab they encountered fooled them. Said Williams, "When we reached tree line, it didn't seem like the snow was more than a foot deep. And it was really hard and icy. You could hit it with your ski poles and not make a mark in it. So we felt really secure."

Hard slab is notorious for its unpredictability. Snow that hard seemingly should be bombproof, but it is not, as numerous accidents attest. (See accidents 83-8, 84-2, and 84-5, for example.)

The best precaution is to avoid hard-slab slopes that are steeper than 30°, especially if you know depth-hoar is present (as the collapsing sounds told these skiers). If you must cross or descend, do so one at a time. These three skiers got a valuable lesson in hard slab at the cost of two pairs of skis. That's a bargain compared to what some people have paid.

during the day. On the night of the 17th, snowfall and wind intensified. Winds of 20 mph blew from the northeast, moderate snow fell and the temperature slipped to a minimum of 3°F.

On the morning of the 18th, the ski area recorded 5 inches of new snow and an east wind of 23 mph. Quickly though, skies cleared and the wind abated to about 10 mph from the east. The new snow and sunny skies brought out the powder skiers on this Friday morning. The ski patrol released only two sluffs within the area. The avalanche hazard was rated moderate outside the area. On the morning of the 18th, the Forest Service and National Weather Service issued a weekend avalanche advisory warning backcountry skiers of a moderate danger due to newly fallen and wind-blown snow.

Accident Summary

FAA Hill, also known as the West Bowl, is an area beyond the Big Mountain ski area boundary that is easily reached from the top of the uppermost chairlift. The ski area boundary is well-marked by signs and rope line. It is not illegal for skiers to go out-of-area. The ski patrol makes every effort to let people know that no avalanche control is done out-of-area and that the people are on their own. Many skiers take this risk on good powder days.

At 1130 a ski party triggered a large soft-slab avalanche on the southwest side of FAA Hill. No one was caught in the avalanche, but it was visible from the ski area and did, therefore, alert skiers and the ski patrol to backcountry instability. South-facing slopes had become unstable because of the direct sun on the fresh, cold snow.

Skiers continued to ski the area, however. At about 1330, a party of four skiers—Marshall Mach, 25, Jay Ledbetter, John Daniels, and Andy Brown—headed down the West Bowl. About halfway down, the slope steepened a degree or two. Mach, in the lead, had just entered the slightly steeper slope when it broke. Not far behind were Daniels and Ledbetter. Ledbetter saw the slab crack, shouted a warning, and he, Daniels, and Brown avoided the avalanche.

Mach rode the avalanche in a sitting position for about 50 yards then disappeared in the dust cloud. Seconds after the first slide released, a second one broke loose about 50 yards higher on the slope, sending a second

80-7

JANUARY 18, 1980

Big Mountain, Montana

1 out-of-area skier caught, buried and killed

Weather Conditions

A small storm brought snow to northwest Montana on January 17–18. Big Mountain ski area recorded 3 inches of new snow on the morning of the 17th, and scattered snow fell



Figure 5. Accident 80-7, Big Mountain, Montana, January 18, 1980. Photo by Brian Kennedy.

wave of snow after the first. Mach may have survived one slide, but two were too many: the second wave of snow buried him deeply among scattered trees in the runout. When the

dust settled, there was no sign of Mach.

Rescue

Daniels, Ledbetter, and Brown skied to the

debris area and started a hasty search using their poles and skis to probe around trees and other likely burial spots. Meanwhile, their shouts had attracted the attention of other skiers, and within minutes the ski patrol knew of the accident. At about 1345, a patroller with several volunteers headed toward the area with probes and shovels. Minutes later a second group of rescuers started in, and by 1400 about a dozen rescuers were at the site, but things were chaotic at this stage. The patrol talked to the eyewitnesses, established a last-seen point, and organized the rescuers into two probe lines. Fifteen minutes later more rescuers with probe poles arrived. One rescuer approaching the site triggered another avalanche, but it buried no one.

At 1425 a ski was found by a tree at the toe of the debris. A group of probers concentrated on this area and minutes later struck the body. At 1440, 70 minutes after the avalanche, rescuers uncovered Marshall Mach from beneath 5 feet of snow. He showed no signs of life. Two patrollers immediately began CPR and continued this for more than 20 minutes. The victim did not respond, and it was determined later that he had died of suffocation.

Avalanche Data

The slide was classed as an SS-AS-3-O. The fracture was 16 inches deep and made a large arc which was 75 yards long. The avalanche released at an elevation of 6,300 feet and fell 700 feet slope distance. It ran down a slope that faced southeast, was 37° steep at the starting zone, and was mostly open with only a scattering of trees. A fracture line profile showed that the avalanche released because of a poor bond between the new snow and the hardened surface on which it had fallen. The strong sunshine on south exposures apparently increased creep in the new snow layer which caused the instability that led to all three avalanches.

Comments

The policy at Big Mountain is that skiers going out-of-area are given ample warning that they are heading into unpatrolled and uncontrolled slopes, and responsibility for their safety lies completely with them. It is a reasonable policy. In this accident, none of the skiers involved had any avalanche rescue equipment—rescue beacons, shovels, or probes. Had they been so equipped and practiced in their use, the sur-

vivors could possibly have effected the rescue and saved a life.

80-8

JANUARY 19, 1980

Red Mountain, Washington

2 snowshoers caught, partly buried and injured

Weather Conditions

Red Mountain is a 5,890 feet peak located 3 miles north of Snoqualmie Pass and 2 miles northeast of Alpental ski area. Heavy rain fell in the area on January 12, followed by 4 days in which 2 feet of snow fell. Winds were strong enough to produce a soft slab which lay on a rain crust. January 17 and 18 were pretty, clear days with temperatures ranging from the mid teens to mid 20s. Saturday, the 19th, too, dawned bright and clear as thousands of skiers streamed toward Snoqualmie Pass. Overnight the winds had been 10–30 mph from the east, the temperature had dropped to 17°F and would warm to 27°F by afternoon. The Forest Service had posted a high avalanche hazard for the backcountry above 5,000 feet elevation.

Accident Summary

On the morning of January 19, Ronald Thomson, 49, and his son, Duncan, 20, drove to Snoqualmie Pass for a backcountry snowshoe tour. They left their car at the parking area on Snoqualmie Pass and trekked north up Commonwealth Basin toward Red Mountain. It was a nice January day, and several ski and snowshoe parties were touring the area. The time was 1315 when the Thomsons entered an open slope at the 5,500-foot level on the southwest flank of Red Mountain. Traversing from west to south, they were in the center of the slope when it fractured 20 feet above them. It was a fast-moving avalanche that knocked them off their feet and carried them swiftly toward scattered trees. Ronald recalled, "There was no warning. It all happened so fast that you just go under. The whole slope moves down, all loose and powdery, and you just sink. It's like falling in a river, only you don't float."

Both men tried to swim with the snow, but their snowshoes handicapped their ability to maneuver. Ronald rode the avalanche about 120 feet, sometimes on top and sometimes underneath, with snow getting in his mouth. Then he slammed into a tree, breaking his left arm and leaving him partly buried. Duncan was carried another 150 feet downslope when he too crashed into a tree. The impact broke his upper right leg (femur), broke several ribs, and caused head injuries. He was left wrapped around the tree, his legs and torso buried, but his head and shoulders free. The avalanche rumbled another 500 vertical feet before stopping in the runout zone.

Rescue

Ronald Johnson, 23, was snowshoeing nearby and saw the avalanche and the victims. He also saw another snowshoe party close to the avalanche. He shouted directions to this group to guide them to the locations of the two victims. Following these directions, this group and Johnson gingerly walked into the avalanche area to find the victims.

Meanwhile, Ronald Thomson, hurting badly, was able to dig himself out of the avalanche debris and begin to search for his son. Duncan, hurting much worse, was unable to move. Within minutes though, Ronald Thomson and the other party came to Duncan's aid. They carefully dug him out and tried to comfort him while awaiting the rescue team. The day was turning colder and the wind was increasing, so they built a protective snow wall and put Duncan in a sleeping bag to guard against hypothermia. Another person began melting snow with his stove to make hot tea.

Once the victims were in good hands, Johnson raced down the 3-mile trail and notified the Forest Service and the Ski Patrol Rescue Team (SPART) of the accident. Blaine Price was on duty as rescue leader. He got the call at 1400 and immediately alerted the sheriff, ski areas, and Department of Transportation that personnel and equipment were needed for a backcountry rescue. Johnson led the first group of 10 rescuers back to the avalanche site. A total of 30 SPART members would eventually be involved.

The first SPART team arrived at about 1630 at the site where the Thomsons and the initial rescuers lay resting. They splinted the broken limbs, wrapped the victims in blankets,

and loaded them in toboggans. They had to rule out a helicopter evacuation because of darkness and the lack of a landing site. So they began the trip out which started with a difficult traverse along a narrow ledge. It was not until midnight that the victims reached the trailhead and the awaiting ambulance and paramedic teams. Duncan Thomson spent several days in the hospital, and he and his father eventually recovered from their injuries.

Avalanche Data

The avalanche was classified as an SS-AF-2-O, the AF indicating the artificial trigger by snowshoes. The slide released at an elevation of 5,500 feet and fell 700 vertical feet on the southwest slope of Red Mountain. The fracture was 1–2 feet deep and several hundred yards long. The slab consisted of snow that had fallen during the storm of January 13–16, and it released on a rain crust.

Comments

The route chosen by the victims across a steep, open snow slope would be safe only when the avalanche hazard was low—for example, when the surface was a hard-frozen crust, and then it might require crampons to cross safely. The slab conditions formed by the recent snows and winds made this slope far too dangerous on this day. The victims were, however, blessed with some good luck, despite their injuries. First, neither man was completely buried. Second, there were other people nearby who came to their immediate aid. These good fortunes saved their lives.

80-9
JANUARY 19–22, 1980

Seward Highway, Alaska

2 motorists caught, two vehicles damaged, plus damage to campground, powerlines, and train

Weather Conditions

A modest storm moved into the Anchorage and south-central Alaska region early on January 14. Light to moderate snow fell almost continuously for 4 days at Alyeska Resort, about 40 miles east of Anchorage. By the

morning of the 17th, 24 inches of snow, which contained 1.92 inches of water equivalent, had fallen at the 1,500-foot elevation study plot at Mt. Alyeska. Temperatures had remained below freezing during this part of the storm, and no significant avalanches had fallen.

With the passage of a warm front on the 17th, the freezing level jumped up, and mixed rain and snow began to fall heavily and steadily. Precipitation by 24-hour periods ending at 0600 hours for the next 5 days was as follows: on the 18th, 29 inches of snow with 3.22 inches of water equivalent; 19th, 24 inches and 3.84 inches respectively; 20th, 4 inches and .58 inches, respectively; 21st, 22 inches and 3.04 inches, respectively; and the 22nd, 8 inches and 1.82 inches, respectively. At the 1,500-foot level, temperatures held mostly in the low 30s, which meant that below 1,000 feet in elevation the precipitation fell as rain. Wind data was not available from the Alyeska site.

Accident Summary

The Seward Highway avalanche control team on January 18 shot down several avalanches along Bird Hill at milepost 92 between Anchorage and Girdwood. Early on the 19th, natural avalanches began running. One soft slab closed the Seward Highway at Bird Flats, and sometime before dawn on the 19th, a huge avalanche roared into the Forest Service Williwaw Campground just west of the Portage Glacier. It obliterated all improvements in the campground, caused some \$4,000 in damage, and killed two moose. Airblast from this avalanche flattened another 40 acres of timber.

Dozens of natural avalanches ran on January 19, 20, and 21 as the storm raged. Many of these hit the highway or the tracks of the Alaska Railroad, which parallels the highway along Turnagain Arm. One slide cut electrical power to Girdwood, and another dusted a highway crew putting up a closed sign. Others destroyed many acres of timber.

At 1100 on January 22, a large avalanche broke loose above Summit Lake at milepost 45. The fracture was 6 feet deep and extended for half a mile. The avalanche destroyed six spans of a Chugach Electric Association 115 kv powerline. Damage was estimated at \$250,000, and power was not restored to the nearby town of Moose Pass until 8 days later. The avalanche piled 10 feet of snow on the highway for 3,000 feet of its length. It then slammed down on

Summit Lake which carried a mantle of ice 1-foot thick. An observer described the lake as shattering on impact, "like a frozen bird bath hit with a hammer." The resultant wave threw ice on the far shore.

At 1730 on the 22nd, another avalanche hit the highway at milepost 94 on Bird Hill. This avalanche had released as a dry slab but then gouged out rain-saturated snow in the track. By the time it reached the road it was a slow-flowing wet slide. Earl Mansfield, 47, was driving toward Anchorage when he heard a rumble and saw a wall of snow oozing onto the road. The impact was gentle, but the snow flowed over the hood and slowly began pushing the car toward the embankment. Mansfield climbed out the window and scrambled over the moving debris to reach the safety of the roadway. The car ended up 30 feet below the highway, buried to the windows with its motor still running.

Mansfield was lucky. He had been caught by the edge of the avalanche. The main mass of the slide flowed another 200 feet downslope and put a mound of snow about 25 feet deep on the railroad tracks. Minutes later an Anchorage-bound freight train plowed into the bank of snow. The two engines penetrated about 120 feet into the avalanche, sending the two locomotives and 13 cars off the tracks. There were no injuries to the crew but damage was extensive—estimated at \$300,000—to the train and tracks. The line was blocked for 7 days as work crews had to remove snow, replace much rail, and rerail the engines and cars.

Later the same evening, another avalanche came down at milepost 93 and struck a pickup truck. Again, the driver was not injured, but the highway remained closed for the night.

Avalanche Data

The storm that began on January 14 and continued through the 22nd triggered a major avalanche cycle on the 19th–22nd. More than 70 miles of the Seward Highway were affected from mile 21 north of Seward to mile 94 where the car and train were struck along Turnagain Arm. Almost 8,000 feet of the road surface was covered by avalanches. Alyeska Resort also witnessed extensive avalanching, most of it resulting from artillery control. The starting zones for all the large avalanches were above the rain line and therefore produced soft- and hard-slab avalanches. However, many of these

struck a rain-saturated snowpack in the lower track and reached the runout as wet slides. The smaller avalanches had fracture depths of 1–4 feet, and the larger ones, 6–8 feet deep. On the Kenai Peninsula, fracture lines ran for extensive lengths of up to .5 mile.

Comments

Avalanches have always plagued the Seward Highway and the Alaska Railroad, which run parallel to one another along the north shore of Turnagain Arm. Transportation problems become acute during avalanche cycles when the highway and railroad can be closed for days at a time and the threat to life and property is high. The most intense avalanche cycle on record for this area occurred in March 1979, when 2.2 miles in a 3.8-mile stretch of highway from mile 93–97 were buried by avalanche debris 4–45 feet deep. Miraculously, no major damage occurred then, unlike the events of January 1980.

So far no lives have been lost to avalanches on the highway, but close calls have been frequent. The State of Alaska is trying to maintain its safety record with an improved avalanche forecast and control program.

80-10

JANUARY 20, 1980

Telluride Ski Resort, Colorado

1 ski patroller caught, buried and injured

Weather Conditions

Early season snowfall at the Telluride ski area had not been generous. Depth-hoar had developed near the ground and was beginning to strain under the weight of recent new snow. The January storm track finally became favorable for the San Juan Mountains and 49 inches of snow fell in 10 days, including 25 inches in the last 72 hours. On the morning of January 20, an additional 12 inches was reported at the midway snow study plot. Temperatures hovered in the teens, but there was little evidence of wind.

Accident Summary

The ski patrol, aware of potentially dangerous conditions, decided avalanche control measures were necessary before opening certain parts of the mountain to the skiing public. It was about 0745 when Jim Guest, 34, Greg Henzie and Jeff Campbell proceeded to a small, open area called “Sully’s Gully.” On their way there they encountered ominous collapsing and cracking under their skis. They threw one 2-pound explosive charge into the starting zone—it was a dud. The party decided to ski-cut the slope one at a time.

Campbell made the first ski cut across an open field above the starting zone. Henzie then followed to where Campbell was waiting in a safe location, turned back and made a lower cut, just above the starting zone. Guest was next. When he reached Henzie’s safe point, he turned back through a part of the starting zone with sparse trees. Just as he reached the timber on the opposite side, the snow fractured 75 feet above him. At the same time, Henzie yelled, “Here it comes!”

Guest was knocked down instantly and covered by a torrent of snow moving through the trees. Guest recounts, “And then I looked up, and I never saw it until it hit me. It felt like a giant had picked me up and tossed me through the trees, head first. Immediately it felt as if I had broken my femur. The next thing I felt was the snow setting up around me, like I was in a full body cast. My hands were above my head and I couldn’t move them.” As Campbell described it: “It broke way up in the saddle where I was standing, and boy, it was making noise. It was cracking trees and tumbling and roaring and throwing plumes of snow. We just lost sight of him (Guest) right away.”

Rescue

At 0810, Henzie radioed other patrollers of the accident. He and Campbell immediately switched their avalanche transceivers to receive and side slipped down the debris, listening for a signal. There were no clues on the surface to help the search. He knew the seriousness of the event was compounded by the trees: Both surviving an avalanche of this type, and searching for the victim under these conditions become increasingly difficult. Guest was now relying on his companions’ rescue skills, and a bit of luck.

They rushed down to the large deposition area and checked likely burial spots with their transceivers. But Guest's signal was not picked up on the first pass. When Campbell reached the toe of the slide he removed his skis and started to climb back up the middle of the deposition. He got a weak signal and yelled to Henzie. A quick grid-search led Campbell to the downhill side of a dense stand of spruce trees, some 50 feet below where Guest was caught. Henzie probed with his ski poles (specially designed to convert to avalanche probe poles) and verified Guest's position on the first try. But there's more.

They located Guest, but now had to get him out before he suffocated. It was then that they discovered the shovels had been removed from their route-packs. Frantically, they began digging with their skis and hands like wild dogs on a hunt. Four feet down they found the middle of his back. But which way was his head?

Fortunately they dug in the right direction and Guest's head was soon found wedged under a tree limb. This likely provided a small air pocket with less dense snow, and bought precious time. Even so, pressure of the avalanche debris was crushing his chest so tightly he couldn't get enough air. He later recounted being in and out of consciousness while under the snow. When found, he was semi-conscious and breathing, much to the relief of his rescuers.

By 0900, Guest had been completely extricated and loaded onto a snowcat for a ride off the mountain. He had just survived an avalanche that had strained him through the trees, causing significant injury to both knees and associated bruises and scrapes. He had been totally buried under 4 feet of dense avalanche debris for 12 minutes.

Avalanche Data

Sully's Gully has an estimated slope angle of 35° and faces west at an elevation of 11,400 feet. The 80-foot-wide avalanche was classified as an SS-AS-3. It had a fracture line of 24–30 inches deep, and ran 250 feet slope distance with a vertical drop of 150 feet. Avalanche debris piled up some 6–10 feet deep as the snow came to rest. On this day, the snow ran in an area where it had not slid before.

Comments

Jim Guest was lucky to come through this

avalanche with relatively minor damage. He could have easily died from the tons of moving snow pushing him through the trees. The area Guest was in when the avalanche struck did not have a history of sliding and they thought the trees to be safe. But the early season snowpack had developed into a weak, depth-hoar structure with little extra strength to withstand the stress of recent fresh snow. The slide climaxed to the ground. The slope was ski-cut by two skiers but it was the third skier who hit the weak spot in the slab and triggered the slide.

If this accident had not involved people with experience and training, it almost surely would have ended in death. Guest was found on the downhill side of a dense stand of spruce trees. This is not a likely burial spot and locating him without the use of transceivers would have taken a long time. It took two professionals almost 12 minutes to pinpoint and then clear an airway to their partner, even longer to fully extricate him. They never gave up hope of finding Guest alive, and a chance air pocket gave them the little extra time they needed.

As for the missing route-pack shovels, this points out the importance of checking all equipment each time it goes out. You can be sure this avalanche control team will perform regular checks in the future. Even professionals can make mistakes. Much skill and a little luck pulled them through this one. (For more incidents without shovels, see 82-8, 82-13, 82-21, 83-3 and 85-24.)

80-11
FEBRUARY 2, 1980

Mission Ridge, Washington

1 Snow Ranger caught and buried

Weather Conditions

The morning of February 2 found the Mission Ridge ski area in light rain, but there was only 1 inch of rain-soaked new snow with a 0.5 inch water equivalent. On the previous day, 3 inches of new snow fell with a 0.4 inch water content. The anemometer had rimed up the evening before the accident but a 15 mph wind was blowing out of the south the day before. The temperature was just above freezing so no one was concerned that the minimal amount of

new snow and light rain could seriously affect the snowpack at this time.

Accident Summary

Chester Marler, 34, Snow Ranger for the Leavenworth Ranger District, arrived at Mission Ridge at 0900 on this damp Saturday morning. He was joined by ski patrol leader Randy Betz to look at a site for a new ski run. While riding no. 2 chair to the top of the mountain, Betz received a radio call from Bob Kominski, an experienced volunteer patrolman, that he had noticed some snow instability in an area called the Bomber Chutes. They decided to check it out.

Shortly after 1100 hours, Betz took another patroller to look at the Bomber Chutes while Marler and Kominski headed for a nearby area called West Lip-Lip Face. Marler was confident that they would not encounter any problems and left behind a belay rope. Neither team carried avalanche rescue gear.

Upon reaching West Lip-Lip Face, they couldn't detect any unusual drifting from the recent snowfall, and the snow surface appeared quite firm. Marler made a traverse, jumping and testing the snow, while Kominski watched from behind. No results. He continued on his traverse across the face, planning to return to the main ski run, when suddenly a pocket of snow 25 feet wide fractured 10 feet above him.

He immediately twisted out of his ski bindings and found himself plummeting down the face. He tried desperately to keep on the surface, but the large blocks and speed of the moving snow made his efforts ineffective. Marler recalled, "I was tumbled several times, but was able to keep my mouth clear of snow. I was able to think of all the life-saving acts that I should be performing, but I was simply unable to swim and keep on top."

As Marler became immersed in the churning mass, he kept his mouth clear but could not thrust his arm up or make a large air space. "The snow became dense so fast!" He had a small air space with no snow in his mouth, but his body was now imprisoned face down under 1 foot of snow. He could not move. He felt helpless, and for good reason.

Realizing that he would probably die, he tried to relax and control his rapid breathing, and thought of his family and friends. "Surprisingly, my strongest emotions were anger and disgust at myself for getting into

such a predicament," he later recalled. But he also knew that Kominski had taken his "Circle-A" avalanche course the year before, and he hoped for the best. He was fairly comfortable and able to breath, but the air was becoming oxygen-poor. As he began to lose consciousness he heard the sound of Kominski's voice and digging above him.

Rescue

When the avalanche struck, Kominski watched Marler disappear under the snow. He skied down and found Marler's poles and a ski. He quickly probed around a clump of trees. Finding nothing he continued down slope searching for more clues. Near the bottom of the deposition he spotted Marler's boot sticking out of the snow and began digging frantically with his hands and a ski. He shouted several times before Marler answered.

By the time Marler was located and dug out (being buried about 5 minutes) Betz and his partner had skied over, unaware of what had just happened. They immediately radioed to close the chairlift and seal off the area. Avalanche control work was done with minimal results on the other chutes and faces threatening the area.

Avalanche Data

Lip-Lip Face is a north-northeast-facing slope of 40° steepness. The starting zone elevation lies at 6,200 feet, with a vertical drop of 340 feet. The avalanche, an SS-AS-2-O, was 20–30 feet wide with a 24 inch fracture line and comprised 20 percent of the slope. It initially broke apart in large blocks, but none remained intact in the deposition zone. The lubricating layer at the bed surface was likely deposited as a weak, cohesionless form, even though some early stage kinetic-growth grains (sugar snow) were found.

The top 6 inches of the dense slab were probably from the recent new snow and had drifted onto the leeward slope from the southerly wind. Nine-tenths of an inch of water, which was Mission Ridge's accumulation in the previous 24 hours, weighs 468 pounds on an area of 10 feet square. This weight, plus the sudden additional weight of Marler, was too much for the weak underlying layers of the snowpack to withstand.

Comments

When Marler and Betz got the radio call about

potential snow instability within the ski area, they decided to investigate immediately. It saved time by not skiing to the base area for avalanche beacons (Marler carried one in his fanny pack) and shovels and then riding back to the top of the mountain, but the men should not have compromised their personal safety in the interest of saving time. Neither thought the avalanche hazard to be that dangerous—evidenced by their ski-cutting a known avalanche area without the normal equipment. Situations can develop rapidly, and the cliché “be prepared” applies here.

It was fortunate no skiing public was caught on the slope. The spotter, Kominski, acted most efficiently and undoubtedly saved Marler’s life. We are also reminded of just how helpless one can be under just 1 foot of avalanche debris. But Chester Marler said it best: “I had obviously become too confident in my forecasting, and too complacent of potential hazard of the job. I hope this incident will be instructive for those who might be similarly lulled by over-confidence.”

Finally, avalanche instructors teach victims to swim with the avalanche and to create an airspace or thrust a hand to the surface. Despite his best effort, Marler was unable to perform any of these maneuvers. The lesson is that avalanche safety is best served by avoiding the avalanche altogether, rather than relying on survival maneuvers once caught. The avalanche is stronger than you.

ing again at 0200 on the 18th. By late afternoon the storm intensified. Some 8 inches of snow had fallen during the day, and 40–90 mph winds were howling across the ridgetops. White-out conditions prevailed as darkness fell over Red Mountain Pass.

Accident Summary

David Hartley and his wife Starla, both 19, were driving along U.S. 550 and descending the north side of Red Mountain Pass with all of their worldly possessions on a stormy Monday night. They were moving to Montrose, a sprawling farm and ranch community 40 miles farther north, but their plans would soon be suddenly altered when they and their car landed at the bottom of the Uncompahgre Gorge, packed in snow.

Shortly before 1930 hours, about half way down from the top of the pass, they stopped to talk with a Colorado Department of Transportation (CDOT) plow driver who told them to expect poor visibility from snow and blowing snow and bad road conditions. About 10 minutes later as they slowly forged ahead through the dimness of their headlights, David saw what he thought was just another ground blizzard. He stepped on the brake but released it and continued on as he could still see another 10 feet. All of a sudden he saw a big “puff of snow” and swirls of powder, but that was nothing new. This, however, was an avalanche, and the snow was pouring straight down. Before he could get his foot on the brake again, he felt the car run up on snow on the road and instantly felt the snow hit his car “like a baseball bat.” It hit the front first, spun the car around 180°, and shoved it over the edge of the road and into the Uncompahgre Gorge, 60 feet below. Starla, in the passenger seat, was pushed against her door and her head slammed into the passenger window, breaking it. David hung on to the steering wheel for dear life as the car rolled several times and finally came to rest right-side-up in the creek bed.

Rescue

All of the windows had been broken and the car was half filled with snow. Starla was pinned against her door but David was free to move. He soon got her dug out and they squirmed through the broken windshield. Once out of the car they began to climb back up the bank, but they were disoriented and

80-12 FEBRUARY 18, 1980

Red Mountain Pass, Colorado

*1 car caught and destroyed, 2
motorists partly buried*

Weather Conditions

From February 14–18, Red Mountain Pass, 6 miles south of the accident site, received 34 inches of snowfall with a 2-inch water equivalent. The light density snow (only 6 percent water) on the 14th–16th was subject to 20–35 mph winds, causing slab formation in avalanche starting zones. There was a break on the 17th with no snowfall, but it began snow-

went up the wrong side. The soft snow swallowed them to their waists and necks. After 20–30 feet of this they spotted the flashing light of a Department of Transportation pickup on the road behind them. They backtracked and went up the other side, noting that the snow there was like walking on concrete.

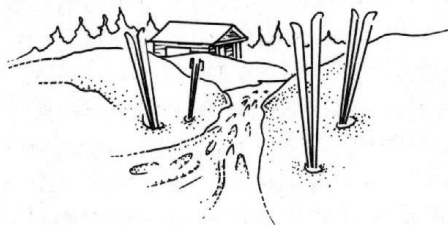
They hailed the CDOT pickup driver, who was startled to see two people climbing up over the edge of the highway. He helped the snow-covered and dazed couple into the warmth of the truck. They arrived in Ouray around 2000 hours where they were treated for minor cuts and bruises. They had lost all their possessions and their car was totaled, but they realized they were lucky to walk away from the notorious East Riverside slide.

Avalanche Data

The East Riverside avalanche has claimed five lives since 1963, and is referred to by locals as the “killer slide.” This avalanche was estimated to be an SS-N-2-O. Compared to its potential, it deposited only a small amount of snow on the road this time. It apparently released from mid track during the blizzard conditions.

Comments

In this type of avalanche, when the snow released naturally and without warning, there was nothing the Hartleys could have done differently. They tried to protect themselves as best they could when they were suddenly caught in the wrong place at the wrong time. If a motorist is not thrown out of the vehicle, he has a good chance of surviving an avalanche for three reasons. First, there is good protection from physical injury; second, there is a good chance for an airspace; and third, an automobile is easier to find in the snow. The Hartleys were fortunate to have not been thrown out of their car and buried. The East Riverside avalanche has claimed six lives. In 1985 an avalanche shed was built at this location to protect motorists and CDOT maintenance personnel from the East Riverside slide. (For a similar accident, see 83-20.)



80-13

FEBRUARY 19, 1980

Sleeping Bear Dunes National Lakeshore, Michigan

4 snow players caught, 1 buried

Weather Conditions

Sleeping Bear Dunes National Lakeshore is a dramatic stretch of the shore of Lake Michigan where sand dunes 300–400 feet high have formed. Some slope angles approach 30°. There had been some recent snow at Sleeping Bear Dunes, about 2 miles southwest of Glen Haven, Michigan, and strong winds the day before had drifted the snow onto the leeward side of the steeper terrain. Cornices were also created at the lip of the slopes. On Tuesday, February 19, the sun was shining and air temperatures were warm.

Accident Summary

Twelve-year-old Danny Culp was part of a group of 11 sixth-graders from Eastern Elementary School enjoying a 2-day field trip at Camp Innisfree. Today they were on an environmental outing to walk on and talk about the dunes. At about 1105, the group was standing at the top of a steep, snowcovered dune, looking for a place to sled down. They had been talking about how steep this slope was and whether or not to go down it when they heard a loud rumble and watched as the snow cracked around them. Culp, two of his classmates, and student teacher David Hoxsie were swept away in the moving snow. Camp counselor Bill Bradney was standing near the edge of the avalanche and grabbed something to keep him from going down too. The rest of the group was just far enough back from the edge to not get caught.

Hoxsie and two of the students ended up on the surface when the snow came to rest at the bottom of the hill. In the excitement and confusion, Culp was not discovered missing right away, as a subsequent head count wrongly accounted for everybody. It was not until after celebrating and picture taking that they realized Culp was not among them.

Rescue

Bradney ran more than a half-mile back to the

car and drove to the Leelanau District Ranger Office to report the accident. Authorities acted quickly to set the rescue in motion: A ranger responded immediately, the Glen Arbor Rescue Squad was alerted, as was a doctor, and plows were responding to open the road to a nearby campground. In the meantime, the student teacher and kids kept searching and digging with their hands.

When Bradney, along with two rangers, arrived back at the dune they marked the area where Culp was last seen and began digging with shovels in the most likely places to find the boy. Within five minutes more people arrived and dug or probed with shovel handles. A U.S. Coast Guard helicopter was soon shuttling manpower and equipment to the site. At 1304, rescuer Conley Addington found Culp's foot by digging in a deep hole. "I can't describe it," Addington said. "I just had the feeling that somehow I was at the right spot so I kept digging." In a short while they had him uncovered after being buried for nearly 2 hours.

Danny Culp was found semi-conscious lying face down under 6 feet of snow. His nose and mouth were not plugged with snow because he said he exhaled to clear them. The doctor still had to clear his airway of a mucous or water plug that was making it very difficult for Culp to keep breathing. He was stabilized and rushed to Munson Medical Center in Traverse City suffering from hypothermia with a body core temperature of only 89°. There were no other injuries and by the next day he had made a full recovery.

Avalanche Data

The avalanche was triggered by a cornice fall caused by people standing near, or on the overhang. A description of the snow breaking up in blocks, and rescuers moving chunks of snow while they were searching suggests that this was a hardslab avalanche. It measured 70 feet wide at the top, widened to 100 feet at the bottom, and ran about 250-foot linear distance. The fracture line was 4 feet deep.

Comments

Avalanches are not restricted to isolated, mountainous regions. They can occur wherever snow is resting on a steep incline. The rarity of avalanches in this part of the country does not keep people adequately aware of the potential danger. However, this was not the first avalanche accident in the area. A fatal

accident occurred in 1924 within a mile of this accident when a 16-year-old boy was buried for 9 hours. Danny Culp was more fortunate. He was wedged under three large blocks of snow which gave him the air space necessary to stay alive for that length of time.

Danny panicked at first and began screaming in his dark entombment. But Danny's father and brother were both active in the National Ski Patrol and had taught Danny some of the things to do if caught in a slide. This undoubtedly helped him calm down and kept his mind occupied by thinking of songs, books, and what his friends would be saying about him. Ironically, his father had just received his avalanche first aid card in the mail on the day he brought Danny home from the medical center. (See 82-5 for another lucky rescue on these dunes.)

80-14
MARCH 15, 1980

Crystal Mountain Resort, Washington

1 lift skier caught, buried and killed

Weather Conditions

The first week of March brought meager snowfall amounts to Crystal Mountain Resort. But on the 11th, skiers began to enjoy fresh snow again, and by the 15th, 22 inches of snow had fallen. Five inches of snowfall on the 12th–13th came in the form of loosely-bonded crystals, which were overlaid on the 14th–15th by 7 inches of light density (6 percent) snow. Prevailing winds were from the southwest at 15–25 mph, with some gusts reaching 50–80 mph on the 12th–13th. The ski patrol, however, reported minimal snow transport. Daytime temperatures in the 20s, and overnight lows in the teens had little effect on avalanche conditions.

Accident Summary

Steve Reynolds, 19, loved to ski and had developed a passion for untracked snow, steep terrain and jumps. On this Saturday, Reynolds and skiing partner Jim Parker, 18, were enjoying the recent fresh snow on the upper slopes of Crystal Mountain. At 1600, the two found

themselves on the Upper Exterminator ski run. Reynolds was beckoned by the powder as he looked over the steep edge of Exterminator Ridge. The chute he wanted to ski was clearly marked DANGER-CLIFFS-CORNICE, but he was up to the challenge with abundant confidence and skiing ability. Parker wisely declined to accompany Reynolds and they agreed to rejoin farther down the mountain. That was the last time Reynolds was seen alive.

Reynolds did not show up as previously arranged. The later it got, the more worried Parker became. Finally, at 1830, he reported Reynolds missing to the ski patrol.

Rescue

The initial search for Reynolds was routine. Phone calls were made to where he might have gone, and a search of the base area turned up no clues. It was almost 1900 when Parker led the patrol to Exterminator Ridge where he had last seen Reynolds. Closer examination of ski tracks leading into a steep chute named Rock Face revealed the 2-foot crown of a recent avalanche. The search for a missing person suddenly became an avalanche rescue.

To verify mounting feelings that this was an avalanche accident, the patrol called for probe poles and, with only the light of their headlamps, climbed down the forbidding chute with the aid of ropes. A ski pole was found and identified as Reynolds'.

Crystal Mountain's volunteer patrollers are in charge of mountain safety on the weekends, and up to now had been searching on their own. At 2000 Steve Hebard, the professional ski patrol director, was notified of the situation, and asked to bring in more manpower. Volunteer searcher Bob Anderson recognized the potential of more avalanches and at 2140 called for the professional patrol to use explosives to eliminate any further threat.

At 2157, search dogs were requested from the sheriff. They were told it would take almost two hours for the dogs to arrive, but the decision was made to wait on sending rescuers into the area for fear of contaminating the scent. Hand charges were thrown at 2335 while the searchers waited at a safe distance, but no snow was released. At the same time, rescuers were making plans for probing to commence at 0600 Sunday morning.

It wasn't until 0123 that four dogs began heading up the mountain in a snowcat. An

hour later they began working the avalanche debris, and within 2 hours had narrowed the most-likely burial sites to three. Fourteen searchers concentrated on these locations while the dogs and their handlers returned to the base area. It wasn't long before Anderson called over the radio that one of the probes had made a strike. At 0447, about 12 hours after the accident, Reynolds body was located under 2 feet of avalanche debris where he suffocated. His mouth and nose were packed with unmelted snow, and there was no ice mask around his face, which indicated little or no breathing after he was buried. The rescue was concluded at 0540 Sunday morning.

Avalanche Data

Rock Face is a northeast-facing chute of about 38°. It starts at an elevation of 6,930 feet and narrows sharply to rock cliffs a short distance down. The avalanche that engulfed Reynolds ran 800 vertical feet, and carried him some 600 feet down the slope. It was classified as SS-AS-3.

Avalanche control work was done on the 13th, producing only minor results. In two instances that day after explosives did not release an avalanche, two patrollers were caught but escaped the small slides they triggered while ski-cutting. On Saturday the 15th, after seven more inches of snow and fallen, the area was again evaluated and determined to be safe. Ski tracks and shot-holes from Thursday's control work could still be seen.

Comments

Steve Reynolds entered an open area on Crystal Mountain that was clearly marked as being potentially dangerous. The area had been controlled with explosives, without results, two days prior to the accident. In nearby areas ski-cutting was getting results where explosive testing wasn't. However, no ski-cutting was done on Rock Face because of its relative inaccessibility.

This accident clearly illustrates how long delays can develop during a rescue operation. Even for an organized rescue group, valuable time can be consumed quickly. There were no fewer than five major delays that kept rescuers from reaching Reynolds sooner. First, Parker waited almost 2 hours after Reynolds didn't show up to report him missing. Second, without evidence to the contrary, Reynolds was considered a missing person—not an avalanche victim. Third, most of the patrollers

had gone for the day causing an initial manpower shortage. Fourth, explosives had to be made up, the site cleared, and control work done (2 hours) before search teams could be sent in. Fifth, it took 4 hours from the initial call for dogs for them to arrive at the accident site.

At some point it was determined there was no chance for a live recovery, and probe lines were held back to wait for the dogs' arrival. People have been known to survive lengthy burials under the right circumstances (see accident 80-13). While taking measures such as avalanche control work to increase rescuers' safety is a legitimate delay, waiting for dogs is not when there is a chance for a successful rescue. In this instance, however, it would not have made a difference based on Reynolds' condition when found.

Steve Reynolds was working toward becoming an avalanche expert. He had read several books on the subject, and had plans to go to Europe that summer to work with an avalanche study group. However, his enthusiasm for steep slopes and powder snow clouded whatever he had learned about avalanches, for he skied alone into a steep chute with obvious avalanche potential.

80-15 NOVEMBER 15, 1980

Taos Ski Valley, New Mexico

1 backcountry skier caught, buried and killed

Weather Conditions

An early-season storm on November 3 brought Taos Ski Valley 18 inches of fresh powder. The next snowfall didn't come until the 14th when 10 inches fell on top of a thin ice crust that had formed on the surface of the old snow. Winds remained light. Taos Ski Valley had not yet opened for the season.

Accident Summary

Allen Cook, 23, was a familiar face around the ski area where he had spent much time during the last three years. Witnesses reported seeing him walking up a ski area road at 1400 on Saturday the 15th. He was carrying his skis and a backpack with a foam pad and sleeping

bag, apparently planning to spend the night out as he was known to do often. There were no witnesses to the accident, but it appeared from ski tracks that he had reached the upper part of the mountain and started to ski down a run called Blitz near the top of the Chief chairlift. He subsequently triggered, and was caught in a soft slab avalanche which carried him some 650 vertical feet, and buried him at the bottom.

At 0800 on Monday the 17th, the ski patrol arrived for work to begin pre-season ski packing to get the area ready for opening on Thanksgiving. They noticed Cook's van in the parking lot but were not concerned because they knew he liked to snow-camp, and was somewhat of a fanatic about ski mountaineering. At the top of the mountain they spotted an avalanche in the area of Blitz Rock, but noted several tracks that crossed the avalanche path and descended in a gladed area adjacent to the avalanche. They all felt that the avalanche had released naturally over the weekend and the tracks were those of skiers that were seen in the area on Sunday the 16th.

Rescue

It was 1325 Thursday the 20th when the ski patrol was ski packing over the old avalanche debris on Lower Blitz. Kevin Beardsley stepped over a hat lying on the surface. They recognized it as Cook's because it was very unique. Fearing the worst, half of the group began probing the area with ski poles while the other half went for avalanche rescue equipment and a toboggan. When they returned, a line was formed, and a fine-probe search worked its way downhill from where the hat was found. At 1350, Cook's body was located 25 feet farther down the slope.

Cook was found in a sitting position under 2 feet of snow. There were no signs of a struggle and no ice mask was found around his face. The only apparent injury was a bruise over one eye. One ski had come off but safety straps were still attached to his legs, and his ski poles had remained strapped to his wrists. His backpack was still on with its waist belt firmly buckled. It was later determined that he had died instantly of a broken neck suffered during the avalanche.

Avalanche Data

Blitz is normally a safe ski run with the benefit avalanche control work and skier com-

action. Since the ski area had not yet opened for the season, the run was no different than backcountry terrain. The 33° slope is narrow with a smooth track, and is flanked with gladed forest. It faces north-northwest at an elevation of 11,820 feet. The avalanche that trapped Cook was classified as an SS-AS-3-O. It had a fracture line depth of only 8 inches, but was 60 feet wide. As it funneled down the 45-foot wide track it gathered enough snow to pile up 7 feet of avalanche debris in the runout zone 650 feet down the mountain.

Comments

It was not unusual for Allen Cook to be out for a ski and camping trip. He was also known for skiing many local backcountry areas alone, and therefore not missed after the accident. He had attended an avalanche course and was aware of the dangers of backcountry skiing. These were addressed in an article he recently submitted to the local newspaper. In the draft he wrote: "Snow is potentially dangerous and extremely unsafe to ski off a peak high in the Sangre de Cristos during winter. A person on skis...may be enough to break the coherence of bondage between each snowfall, and that may be it for the skier."

Cook was learning about avalanches and gaining experience as a proficient skier, but had overlooked some of the most basic rules about travelling in steep, snowy terrain. Had he been able to free himself of his equipment, he could have actively fought the avalanche to stay on the surface. As it was, his skis, poles and backpack only hindered his movements and weighted him down. He was also skiing alone. Barring life-threatening injuries, this avalanche may have been survivable if he had a partner and they were carrying avalanche rescue gear.

80-16 NOVEMBER 27, 1980

St. Mary's Glacier, Colorado

*3 ski mountaineers caught and buried,
2 killed*

Weather Conditions

In Colorado, November of 1980 was not

known for abundant snowfall. St. Mary's Glacier, 45 miles west of Denver, lies just on the east side of the Continental Divide. Two weak and slow-moving storm systems on the 13th–15th and 23rd–27th produced 13 inches and 10 inches respectively at Berthoud Pass, 7 miles to the southwest. The snow was settling and nearby snow study sites were reporting less than 18 inches of snow on the ground. A cold front brought down frigid air from the north and temperatures for the previous four days hovered in the teens to low 20s during the day, and dipped to near zero at night. For 30 hours prior to the accident a steady north-west wind blew at 15–25 mph. On the morning of the 27th the weather was brutal at St. Mary's Glacier. Periodic ground blizzards with gusts 60–80 mph reduced visibility to less than 100 feet and the windchill factor plummeted to -40°F.

Accident Summary

Early on the 27th, three skiers from Denver drove to the popular, all-season recreation area at St. Mary's Glacier. Their objective this Thanksgiving Day was to climb and ski 13,294-foot James Peak, 2 miles northwest of the glacier. At 0830, Pierre Champel, 29, a Frenchman staying in the Denver area on business, and two acquaintances, Martin Currat, 41, and Richard Painter, 42, left their car at Fall River Road. They followed the trail to 10,690-foot St. Mary's Lake .5 mile away. Champel traveled on mountaineering gear while Currat and Painter used 3-pin bindings on cross-country skis. All carried packs with supplies for their day-long trip to the peak but no avalanche gear.

They donned climbing skins for the 350-foot climb through soft snow to the frozen lake, reaching it 45 minutes later. Instead of following the normal route around the east side of the lake, they crossed it. The weather was deteriorating and at times they could barely stand up in the howling wind and near-zero visibility. On the other side of the lake the snow changed to hard, wind packed conditions.

Champel was in front but did not know the way. Currat and Painter had both skied the area on previous occasions and thought they were going the right direction. After crossing the lake the trio began to climb a steep slope. Poor visibility prevented them from seeing the terrain ahead, but they could feel the slope

angle increase dramatically. Champel asked if this was a good route and Currat said he thought so. In fact, however, they had become disoriented and were traversing up the steepest pitch in the area.

By 0930, they had not climbed far when they stopped to deliberate their present course. Champel was 20 feet ahead of Currat and Painter who were standing close together. Suddenly the slope collapsed, triggering an avalanche that carried all three 150 feet back down the slope. Champel tried hard to swim in the moving snow but was hampered by his equipment. He was buried 1 foot deep with only a hand sticking out. Currat and Painter were less fortunate and buried deeply when the snow piled up at the bottom of the bowl.

Rescue

Champel was uninjured in the slide and able to breath. He could see light through the soft snow around his face. Thinking he was the only one buried, he waved his free hand to attract the attention of his companions but soon realized he was on his own. He began the slow process of digging himself out—one handful at a time.

Within a few minutes he freed himself from his pack but it took nearly 1.5 hours to break loose from the more dense snow encasing his lower body. To add to the problem, his skis had released but were still attached to his legs with safety straps. Once free he looked for Currat and Painter. Finding no sign of them he skied back down to the road where he caught a ride to the St. Mary's Glacier Summit House and summoned help. It was now 1130. Within 15 minutes the sheriff's department, two rescue groups and two volunteer fire departments were notified of the accident.

Champel, very cold and tired, managed to accompany three people from the Summit House back to the accident site. They had little equipment and could only scuff-search the area Champel pointed out. By 1230 the first rescuers began to arrive, and in 2 hours 35 people with avalanche rescue gear were searching the area. By now, the first people on the scene had to be evacuated because of the cold, and Champel was taken from the site hypothermic and in a state of shock.

It wasn't until 1540 that a probe line located Currat under 7 feet of snow. He was found face down with his feet arched over his back. One hand was over his face in an apparent

desperate attempt to clear an air space as the snow came to rest. Rescuers were very cold and tired but the probing continued. At 1640, Painter was discovered 10 feet from where Currat was found. He was buried the same depth, with his skis still attached and pole straps on his wrists but no poles. He was wearing a leather face mask and his hands too were covering part of his face, but it didn't do any good under the deep debris. They had been buried 6 and 7 hours respectively and there was no evidence that either had lived long after the avalanche. The coroner pronounced them dead at the scene and they were evacuated by a telephone company snowcat.

Avalanche Data

The snowpack in the vicinity of the slide consisted of 2 feet of wind packed, dense snow resting on 8 inches of depth-hoar. Strong winds had recently drifted deeper snow in lee areas, including the avalanche starting zone above St. Mary's Lake. The slide was most likely triggered by the three skiers traversing across the lower portion of the slab. Field data gathered the following day revealed a 2-foot-deep crown line that was 600 feet wide. When the avalanche broke in the 37° starting zone, it released to the ground, ran 50 vertical feet, and then back up onto old snow. As the snow descended 450 vertical feet down the 33° track, it was channeled into a 75-foot-wide deposition zone. This piled debris 15 feet deep and significantly reduced the victims' chances for survival.

Comments

What started out as a day of climbing and skiing soon turned into tragedy. The weather had deteriorated to the point that continuing was impossible, but it was already too late. In the poor visibility, the group had wandered 500 feet away from the standard route and directly under a steep, snow-loaded bowl invisible to the skiers. Currat was an experienced climber and had made several previous peak ascents, including Mt. McKinley in Alaska. It should have been obvious to an experienced back-country traveler that the avalanche danger was steadily mounting. However, the group did not evaluate or discuss avalanche conditions, and none carried avalanche rescue equipment. Normal visibility would have given them the opportunity to exercise good route-finding techniques. But given the whiteout conditions

in avalanche terrain, they should have turned back.

Avalanche accidents are not uncommon in this area. Its steep, high-elevation terrain near the Continental Divide is a popular attraction among Front Range recreationists. The last avalanche fatality here occurred in February 1957.

81-1

JANUARY 5, 1981

Hatcher Pass, Alaska

1 snowmobiler caught and buried

Weather Conditions

November snowfall and a dry, bitterly cold December (-15°F to -45°F) combined to form widespread faceted snow in the Hatcher Pass area north of Anchorage. A series of storms beginning on January 1 deposited up to a foot of new snow. On the afternoon of January 5, skies were partly cloudy with light winds. Avalanche warnings were in effect for the area due to a 40°F rise in air temperature over the previous two days.

Accident Summary

Bruce McLean, his wife and daughter, set out on a snowmobile outing from Hatcher Pass. Since the ridges were bare of snow, the McLeans restricted their activity to the gullies, where they found solid, wind-compacted snow, excellent for snowmobiling. At 1300, McLean was driving up the side of a gully when he saw the slope 90 feet above him break loose. McLean and his machine immediately parted company, as they both were engulfed and carried downslope 150 feet. McLean felt the snow coming to a stop and wrapped one arm in front of his face trying to create an air pocket, while thrusting the other hand up, searching for the sky.

McLean's wife and daughter were nearby but did not see the avalanche. When they heard the machine stop, they turned around to see only avalanche debris.

Rescue

The McLeans quickly located the snowmobile, buried except for one handlebar. Mr. McLean

heard them talking and called out to them, even though his mouth was half-filled with snow. They heard his voice, located his position, and dug him out by hand. After an 8–10 minute burial, McLean was shaken but unharmed. He had been buried 2–3 feet deep, with his outstretched hand only inches below the surface.

Comments

Snow is an excellent insulator, and while buried avalanche victims can hear rescuers above them, it is not common that a voice can be heard rising up from below the snow. However, the nature of the avalanche debris, hard-slab chunks with air spaces between, is more conducive to sound transmission than homogeneous soft-slab or wet-slab debris with little air space.

McLean followed the correct procedure for self preservation—creating an air space and thrusting a hand towards the surface. A scuff search may have revealed his hand, which was only inches from the surface, if voice contact had not been effective.

81-2

JANUARY 31, 1981

Ketchum, Idaho

1 backcountry skier caught and partly buried

Weather Conditions

In the week prior to the accident, 34 inches of new snow was measured at Sawtooth National Recreation Area, 1 mile south of the accident site. Earlier though, between Christmas and January 23, no snow had fallen and a melt-freeze crust had formed on most east, south and west-facing slopes.

Accident Summary

A group of Twin Falls High School students, members of the Outdoor Living Association, were spending the weekend at Camp Sawtooth in North Fork Canyon. On January 30, the group rented touring skis at a shop in Ketchum and listened to a lecture on avalanche safety and hypothermia. The previous year the group had participated in an

avalanche seminar given by the Ketchum District Snow Ranger and the owner of the shop.

Tim Westerman, age 16, and Antonio Gomez, also 16 and a Mexican exchange student, left the camp and climbed 100 feet up the hill behind the camp. They were traversing a steep south-facing slope, with Westerman in the lead, looking for a good route to ski down. At 1145, a soft-slab avalanche released, carrying Westerman downslope through the trees and depositing him feet first in the North Fork of the Big Wood River, with snow up to his head. He was in a sitting position, unable to move. Gomez rushed down slope and dug Westerman out, cold, drenched and shaken.

Avalanche Data

Classified as an SS-AS-1-O, this avalanche was only 20 feet wide and fell 150 feet to the creek. The slab was 18 inches deep and consisted of new snow on a melt-freeze crust. The avalanche released in a 40°, east-facing, lightly timbered, narrow chute.

Comments

A combination of heavy load of new snow on the melt-freeze crust, plus the weight of the skier caused this avalanche. The quick rescue by Gomez saved Westerman's life. Although not totally buried, Westerman was helpless. He could easily have died from exposure and hypothermia due to the nearly freezing water running beneath the debris and soaking his clothes.

25–30 mph winds and 33 inches of fresh snow by February 1. Temperatures varied from the low teens to the mid 30s. An avalanche warning for extreme hazard was issued on January 29 and remained in effect through February 1.

Accident Summary

Three Salt Lake City men—Daniel LaFave, 30; Paul Clyde, 17; and Eric Brinkenhoff, 16—left the Big Cottonwood Road for a day's ski tour to Doughnut Falls. They took the summer road, the popular route, to the junction for the Cardiff Mine, then skied on the mine road before dropping down to the clearing just down canyon from the falls. At 1245, Brinkenhoff was in the lead, on foot. He felt more comfortable walking along the gully bottom and was carrying his skis. LaFave was next. He had skied up the side slope of the gully. Clyde was last and did not see the avalanche. Brinkenhoff heard a noise and turned around to see LaFave fall to his side and become partly covered as the snow moved downhill. Suddenly the snow above Brinkenhoff began to slide and he dove behind a rock outcrop at the base of the falls. The last time Brinkenhoff saw LaFave, he was about 25 feet above the gully bottom, sliding head first downhill.

Rescue

Brinkenhoff was the first to realize that LaFave was completely buried. Scanning the debris, he saw no clues on the surface. Nor was he exactly sure where the last seen area was. Crawling to a likely spot, he began to dig with his hands. At this time, Clyde came onto the accident scene. He began digging while yelling for help. Two other skiers heard the yells; one remained at the scene while the second skied out for help.

On reaching the road, he met a skier who then drove her car to Solitude Ski Resort to sound the alarm. Meanwhile, at the accident site, the three skiers continued to probe with their ski poles for LaFave.

The organized rescue got underway at 1310 when personnel at Solitude learned of the accident. At 1315, Alta Central, the central communications network for Big and Little Cottonwood Canyons, was notified and Brighton Touring Center began organizing a hasty search group. At 1407, the hasty party reached the accident site and found 20–25 people already randomly probing with ski poles.

81-3

FEBRUARY 1, 1981

Doughnut Falls, Big Cottonwood Canyon, Utah

1 cross-country skier caught, buried and killed

Weather Conditions

The winter of 1980–81 had been drier and warmer than average. The existing snowpack consisted of less than a foot of faceted snow with melt-freeze and rain crusts at lower elevations. On January 28, the first major storm of the winter hit the Wasatch Mountains with

The hasty rescuers organized those already at the site into two coarse probe lines, and probing continued. The first-stage rescue group arrived on the scene at 1415, and began probing likely burial sites.

At 1436, Naco, a trained avalanche dog from the Snowbird ski area, arrived at the accident site by helicopter. (For more of Naco's work, see accident 80-2.) Probers had been removed from the site a few minutes before the dog arrived to allow the human scents to clear. In 6 minutes, Naco had identified the burial spot. Two minutes later, shovelers hit a ski and one leg. The body was uncovered at 1500, after a burial of 2 hours and 15 minutes.

LaFave was found 5 feet below the snow surface, face down, with evidence of an ice mask around his head and face. Both skis were still attached. CPR was started, and LaFave was flown to a Salt Lake hospital by helicopter, where he was pronounced dead.

Avalanche Data

Classified as an SS-AS-1, this was a small avalanche. It was 55 feet wide, ran only 100 feet slope distance, and had a fracture of 5–24 inches deep. The avalanche released at an elevation of 7,800 feet on a west-facing, 40° open slope, which was on the east side of the gully. The snowpack in the starting zone consisted of only 40 inches of snow, all new snow except for the bottom 4 inches. The bottom layers were a melt-freeze crust at the ground, a few inches of intermediate faceted snow, and a sun crust. The slab released on the sun crust, although in some areas, the slab removed snow down to the melt-freeze crust.

Comments

Here is another example of a very small avalanche burying an unwary victim. LaFave triggered the slab by traversing the slope. Why he chose that route is unknown. It was just good luck and not good planning that the three skiers were so widely spaced; otherwise, more than one could have been buried.

It is interesting that the avalanche dog located LaFave's position in 6 minutes, when coarse probe lines missed him on at least two passes—a tribute to the effectiveness of trained avalanche dogs.



81-4

FEBRUARY 2, 1981

Geneva Peak, Colorado

1 helicopter ski guide caught

Accident Summary

Just north of Webster Pass in Colorado's Front Range, Whitney Guild and John Bass of Rocky Mountain Heli-ski were evaluating potential ski routes for their operation on the afternoon of February 2. This was during one of Colorado's drought winters, and snowcover was sparse. The two men had been walking on rock for 7 miles when they approached a lonely snowfield and put on their skis.

They traversed across the leeward slope, then onto the top of a cornice and discussed where to ski. Bass wanted nothing to do with the "boiler plate" snow or the cornice and skied down to the more shallow snow next to the rocks. Guild made about a dozen turns down the ridge line and stopped 8 feet from the lip of the cornice. The time was 1500 when Bass's dog ran down the slope, and instantly the slope and cornice released—the cornice breaking 2 feet above Guild. Guild was riding a very hard chunk of windslab and was able to release both 3-pin bindings. As soon as he got both skis off the avalanche stopped. After a 40-foot ride, Guild was above most of the avalanche and was able to gather up his equipment and go home.

Avalanche Data

Classified as a hard-slab avalanche, it was probably triggered by the dog. The fracture was 2 feet deep, stretching 250 feet across the slope. Chunks of cornice were 4 cubic feet in size. The starting zone, at 12,400 feet, faced southeast with a slope angle of 25°. This was a heavily wind-loaded slope—the only snowfield on the west side of the drainage for 9 miles. The windslab ran on a layer of 2- to 5-mm advanced kinetic grains, resting on a 4-inch-thick ice crust over 8 inches of depth-hoar to the ground.

Comments

Both men are very experienced skiers and guides, well trained in avalanche hazard evaluation. They agree they made some errors: not discussing more thoroughly their routes, not taking the same route and going one at a time,

and not digging snow pits. Guild said later: "Our perception of the weakness of the snow-pack was forgotten after walking on rock for 7 miles and 2 hours." It is also exceptionally rare for an avalanche to release on a 25° slope.

81-5

FEBRUARY 3, 1981

Berthoud Pass, Colorado

1 backcountry skier caught and buried

Weather Conditions

At Berthoud Pass, along the Continental Divide west of Denver, fresh snow fell daily from January 24 to February 2. During these 10 days, 26 inches of low-density snow (average 6% water) accumulated. Daytime temperatures ranged from 2 to 30 degrees while nighttime lows dipped below zero. This gave the new snow distinctive weak layers as it fell on a shallow base of only about 30 inches, much of which was weak, faceted snow. Moderate winds, sometimes reaching 30 mph, had drifted snow into lee pockets. The U.S. Forest Service Avalanche Warning Center issued an avalanche warning on January 30. By the 3rd, the storm had moved east onto the plains, leaving warmer temperatures and clear skies in the mountains. Fresh, untracked and unstable powder snow beckoned skiers to the high country.

Accident Summary

Nineteen-year-old Tony Hessner was one of those skiers. He left his Golden, Colorado home, telling his parents he was going to ski Loveland Pass. He hitch-hiked his way to the mountains, but since his ride was going over Berthoud Pass, that too is where he went. He decided to ski a small open area from the top of the pass, descending to a switchback in the highway below. Reaching U.S. 40, he saw an inviting-looking cut bank above the road with some old tracks and decided to ski it. As he climbed through the trees, he thought there was a 90 percent chance the slope would avalanche, but he thought he could ski out of it. Hessner began skiing down the steep open bank. The time was 1017 hours when, about halfway down, an avalanche fractured from

the top of the slope, knocking Hessner down. He tried to swim but the avalanche quickly stopped and he found himself buried on his back, arms out to the sides. He was able to move his head back and forth to make an air pocket, and he tried to remain calm. It was pitch dark, and absolutely quiet in his tomb. Despite his efforts to calm himself, when he noticed an ice mask forming around his air pocket he started to get hypoxic and hyperventilate.

Rescue

Dennis Wolf was driving along U.S. 40 when he saw the avalanche break above the switchback. He also saw the flash of an orange parka tumbling backward in the snow. Stopping his car, he climbed up the bank to see if he could see the person. He saw nothing and flagged down a Mountain Bell truck driver who radioed the local sheriff for help. The call came in at 1020, 3 minutes after the avalanche. The sheriff happened to be at the Winter Park ski area, so he notified the patrol who immediately gathered their rescue gear.

Within 10 minutes, about 30 people had parked their cars and were probing the site, using ski poles. At 1030, the rescuers from Winter Park arrived, and probing continued.

Hessner felt something hit his ski twice, then his arm, but the prober didn't feel his probe touch anything. On the next pass, they felt Hessner and started digging. The digging caved in Hessner's air pocket and he began to panic, but he was able to re-establish an air pocket and calm himself. At 1040, Hessner was uncovered, 4 feet deep, after a 23-minute burial. Unhurt, he walked away from his burial site. The patrol took Hessner to the Winter Park Clinic, where his only symptom was a body temperature of 95°F.

Avalanche Data

Classified as an SS-AS-1-G, this avalanche had a one-foot fracture, was 80 feet across and 100 feet long. The north-northwest-facing slope had an angle of 40° in the starting zone. The slab consisted of 14 inches of new and round-grain snow over a thin .25-inch layer of early faceted grains. The bed surface was a hard layer (.75-inch thick) over 11 inches of well-developed depth-hoar. The slab removed most of the old depth hoar. Evidence of an older avalanche just south of the one that Hessner released could be seen from the road.

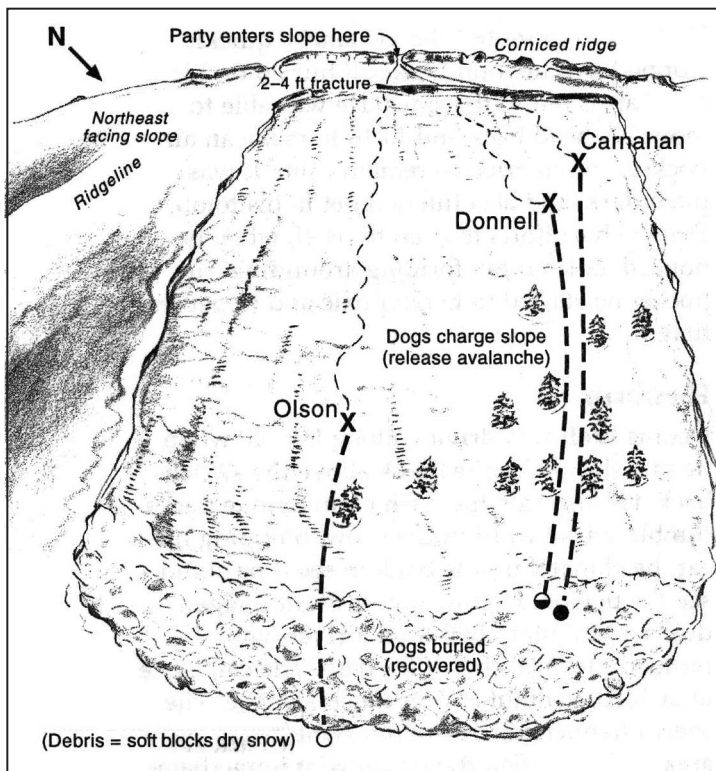


Figure 6. Accident 81-6, Logan Canyon, Utah, February 9, 1981.

Comments

This guy was lucky! He told his parents he was going to Loveland Pass when he actually skied Berthoud Pass. The sharp eyes of Dennis Wolf caught just a glimpse of Hessner's parka. The fast response of the Winter Park patrol, who reached the scene in less than 15 minutes, and the help of passing motorists, who used shovels and poles from the telephone truck, as well as skis and ski poles to probe for Hessner, all contributed to saving Hessner's life.

Avalanche warnings were issued on January 30 and were still in effect on the 3rd. Hessner's whole plan to ski alone, down a steep slope adjacent to older avalanche debris during high hazard conditions, with no one knowing his whereabouts, was a dangerous one. In the words of the sheriff: "That young man was very lucky. He was skiing alone. If he hadn't been spotted by Wolf, we'd have found out about it next spring."



81-6

FEBRUARY 9, 1981

Logan Canyon, Utah

3 backcountry skiers caught, 1 partly buried, 1 buried, 3 dogs buried

Accident Summary

An avalanche warning was in effect on Sunday, February 8, but on Monday morning the warning was lifted and the avalanche hazard was rated moderate on slopes facing northwest, north, and northeast.

Monday the 9th was the second day of a planned four-day trip for Bruce Olson, age 28, David Carnahan, 26, and John Donnelly, 22, and their three dogs. They left Logan Canyon the day before and had skied to the head of Bunch Grass Canyon. On Monday, they descended onto a lee slope beneath a cornice, planning to do some skiing in the new snow. The time was noon and it was snowing moderately with strong winds loading the slope with blowing snow. All three men were standing still when the three dogs charged onto the slope. At that moment, the slope released 8-10 feet below the cornice.

All three men were caught. Olson, who was standing a little downslope and towards the left, was getting ready to photograph the other two skiing. He was tumbled downslope and ended up at the bottom, not buried. Carhahan and Donnelly were also caught. Donnelly was only partly buried, with an arm and his head out of the snow. Carhahan was totally buried, feet downhill and head about a foot below the surface. All three dogs, who entered the slope above the skiers and probably triggered the avalanche, were buried.

Rescue

Olson walked up the debris and helped dig out Donnelly. Carhahan, totally buried, was able to yell, and yell he did. Donnelly, who was buried next to him, heard the yells and he and Olson uncovered Carhahan within 15 minutes of the avalanche. They never lost voice contact with him.

One dog dug himself out, another was recovered quickly, and the third was recovered 1 hour later from beneath 3 feet of snow. The first two dogs located the missing third dog, which had no lasting ill effects.

All three men lost ski equipment and had to walk out to Logan.

Avalanche Data

This was a soft-slab, skier- or dog-released avalanche, and was 300 feet wide and ran 625 feet slope distance. The fracture ranged from 2–4 feet deep on the 30° slope. The open, lightly timbered slope faces northeast and the starting zone was at an elevation of 9,000 feet. The debris was in soft blocks of dry snow, which probably accounted for Carhahan's and the dogs' survival.

Comments

This party consisted of competent nordic skiers who were familiar with the area. None carried rescue equipment—no beacons, probes, or shovels. None had received avalanche training. All three had previously signed up for an avalanche course, which was cancelled due to lack of interest.

The party knew of the Utah Avalanche Forecast Center, but since it is a toll call to Salt Lake City from Logan, they did not call for a forecast. After the accident, one of the party said that with an avalanche cord, he could ski anywhere. He was surprised to hear, via telephone conversation with one of the UAFC forecasters, of the grim survival statistics of buried avalanche victims. After the telephone conversation, he appeared convinced, for the first time, that he was lucky to have survived.

Idaho, with accumulations of up to a foot of new snow. On the 13th, temperatures warmed into the 30s and that night, several natural avalanches, small and large, released. The Idaho Panhandle National Forest issued a high avalanche warning to the public on the 13th, valid through February 15.

On the 14th, avalanche activity continued and snow turned to rain as temperatures reached the high 40s. On Sunday the 15th, it was snowing again and winds were strong. With the avalanche danger extremely high, the patrol at Schweitzer Basin was busy doing avalanche control on the mountain.

Accident Summary

Local skier Rick Metcalf, 28, failed to keep a morning appointment with some magazine photographers at the lodge of Ski Schweitzer. His wife Glenda, a patroller, was not concerned and she handled the appointment, showing the photographers around the area. Rick was an excellent cross-country and mountaineering skier and was probably just out enjoying the mountain and continuing snowfall.

A lift operator who knew Metcalf well saw him at 1400 hours getting on Chair 4. He was the last person to see him alive. When Metcalf didn't show up for dinner, Glenda began to worry. At 2300 she reported him missing to the sheriff and the ski patrol.

Rescue

The search began Sunday night, with snow machines combing the slopes in the fog, looking for Metcalf. The next morning, a full search effort was organized. At first light, the ski patrol, volunteer skiers, and sheriff's department personnel went into action. Avalanche deposition areas were probed, especially around trees and rocks. The patrol checked out one area in particular, near Chair 4, where debris from a small avalanche was spotted. Even though other patrollers were sure the slide had run before Metcalf disappeared, a crew probed the area since it fit the type of terrain Metcalf liked: steep and deep, and away from the main trails. They did a rescue beacon search since Metcalf's wife said Rick might have been wearing his. They found nothing.

By Tuesday evening, hope was waning for finding Metcalf alive. Snowfall had turned to high wind, rain, and sleet, and hypothermia threatened the multitude of rescuers. WOOF

81-7

FEBRUARY 15, 1981

Ski Schweitzer, Idaho

1 lift skier caught, buried and killed

Weather Conditions

Strong high pressure had dominated the weather picture in northern Idaho during the 1980–81 winter. Like everywhere else in the west, the snowpack was shallow. In the Idaho panhandle, the shallow snowpack consisted of faceted grains above 3,500 feet, and no snow below that elevation. For several days in early February, fog had deposited rime on the snow surface. On February 12 and 13, a low pressure system spread heavy snow into northern

Search dogs were called in from California, Canada and Alaska, and the local search efforts continued through Wednesday. Helicopters joined in the search; even psychics offered their advice, with no results.

The first group of dogs arrived and began searching Wednesday afternoon. The Royal Canadian Mounted Police dog team found nothing but deep, wet snow on the slope they searched.

On Thursday, seven dogs began a comprehensive search of the mountain. Poor weather, 90 mph winds and wet, heavy, deep snow pounded the dogs and their handlers. The patrol leader, John Pucci, requested that one of the teams check out the small avalanche he had probed several days ago. The WOOOF dog alerted sharply towards a tree in the debris and began digging.

Within a few minutes, Metcalf's body was uncovered from 5 feet of rain-laden snow. He was found pushed up against a tree, with no ice mask clutching his ski poles, both skis attached, and no sign of a struggle. He carried no rescue beacon.

Comments

The avalanche path where Metcalf was caught was rarely controlled and rarely ran. The avalanche was of medium size, about 300 feet by 225 feet.

Metcalf was the victim of a heavy storm, poor visibility, and the avalanche he triggered. His skiing ability and knowledge of avalanches was never questioned, though skiing alone always carries extra risk.

This rescue was a milepost in search-dog history, an international cooperative effort which proved that dog teams, trained to similar standards from different units can work effectively together. Seven teams were required to do the job of searching the entire Schweitzer Basin ski area.

Weather Conditions

Ideal temperature-gradient conditions existed for two months prior to this accident: a shallow snowpack and seasonal mountain air temperatures. On February 13 and 14, days were warm and nights were cool, with moderate winds. A windcrust was evident at higher elevations. No avalanche activity was observed in Lamoille Canyon.

Accident Summary

Lamoille Canyon, southwest of Elko, is a heavily-used four-seasons area. The road is not plowed in winter, making it an extremely popular snowmobile route. The road is about 15 miles long and resembles the Little Cottonwood Canyon road in Utah. The road has a minimum of 17 frequently-running, road-crossing avalanches, many of them capable of piling over 30 feet of snow on the road.

Lelia Koncher, age 20, grew up in Elko, had moved to Salt Lake City, and was visiting friends and family in Elko this weekend. When invited to go snowmobiling up Lamoille Canyon on Sunday, she readily accepted.

Koncher's party of about 25 snowmobilers was playing "high mark." To play the game, the snowmobilers race across Lamoille Lake and up the steep slopes at the edge of the lake. As their momentum slows, they turn and go back downslope, and it is the next person's turn. The tracks get higher and higher, as each snowmobiler tries to make the "high mark" of the day. If one doesn't turn the snowmobile around with enough speed, the machine stalls and the driver has to pull it around.

Koncher had borrowed a high-powered snowmobile and it was her turn to put a mark in the snow. She reached a high point about 500 vertical feet above the lake, but lacked the speed for her 180° turn. Getting off the machine, she began to turn it around. She was in the center of the avalanche path at 1245 hours.

At this point, two snowmobiles began a drag race across the lake and up the steep slope at a high rate of speed. A large slab avalanche released 500 vertical feet above Koncher. The two snowmobiles made 180° turns and outran the avalanche. Koncher took several steps downhill but was quickly engulfed by the wave of snow. The avalanche continued downslope and crashed onto the surface of the lake, cracking the ice and leaving a jumbled mass of snow, slush and slabs of

81-8

FEBRUARY 15, 1981

Lamoille Canyon, Nevada

1 snowmobiler caught, buried and killed

ice. Witnesses watched as the avalanche hit the machine and rolled it on top of Koncher. This was the last time she was seen.

Rescue

The rescue got into motion quickly, and by 1345, rescuers from the sheriff's department and from Ruby Mountain Heli-Ski Guides arrived at Lamoille Lake. They found about 10 people randomly probing the debris with ski poles or skis, and about 20 people on snowmobiles at the end of the lake observing. Joe Royer, a helicopter ski guide, organized people into a probe line, after handing out probe poles. An eyewitness described the accident to rescuers, and the probe line searched from the last seen area downhill to the lake. At 1445, a call to the Snowbird ski area was sent, requesting trained search dogs. A metal detector arrived at 1530, with the hope that if searchers could find the snowmobile, there was a better chance of finding Koncher. At 1630, with daylight fading, the search was called off for the day.

The dogs and their handlers arrived that Sunday evening, and on Monday morning a helicopter brought the dogs, their handlers and the rescue crew back to the avalanche site. The dogs searched from 0730 to 0920 with no results. The handlers had said it might be difficult for the dogs since the scent was cold. One of the dogs returned to a spot twice but after probing 12 feet through the snow, they only reached ice.

The dogs searched the slope, but the consensus was that the body was in the ice and water. At noon, the helicopter took the dogs and handlers out and brought another metal detector in. By 1345, with all efforts futile, the search was called off.

Koncher's family kept a vigil on the area until the ice melted. Her body was recovered in the summer.

Avalanche Data

This avalanche has a history of releasing and running onto the lake with tremendous power, tilting the entire lake surface and killing fish. Previous avalanches had released naturally when snowmobilers were not present, either during the week or at night.

The avalanche that killed Lelia Koncher was classified as SS-AV-4, with a fracture 2–5 feet deep and 900 feet wide. The starting zone, at an elevation of 9,740 feet, faces north with a

slope angle of 35°. The avalanche ran 1,000 vertical feet. The impact of the slide took the 2–to 4-foot-deep ice and placed it on the shore, about 200 feet away. Avalanche debris on the ice was 15–20 feet deep.

The snowpack in the area consisted of 3 inches of windslab on the surface, 18 inches of damp, faceted old snow, a 4-inch ice layer with thin layers of small faceted grains both above and below the ice layer, all resting on 2 feet of old, intermediate-stage faceted snow.

Comments

This avalanche path had been snowmobiled on, walked on, walked down, and slid down for several hours. What finally triggered this fatal avalanche was the combined stress of two machines speeding up the slope together and Koncher trying to release her machine. Lamoille Canyon is an area of potential severe hazard and it was only a matter of time until an accident of this sort happened. More avalanche accidents are certain here unless the high-markers choose their days very carefully. (See accident 82-20 for a similar risk-taking story.)

81-9
FEBRUARY 22, 1981

East Fork of Mineral Creek, Big Cottonwood Canyon, Utah

4 helicopter skiers caught, 3 partly buried and injured

Weather Conditions

By late February, the Wasatch snowpack was only 64 percent of average, with 55 inches of snow on the ground. On February 20, 13 inches of new snow fell. Mountain observers noted there were no heavily loaded slopes due to wind deposition, nor was there any sign of recent natural avalanche activity.

On February 22, skies were clear, the air temperature was 18°F at 1000 hours at 11,000 feet, with northerly winds of 8–15 mph. The avalanche hazard rating from the Utah Avalanche Forecast Center was generally low but on north and northeast slopes, the hazard was rated moderate.

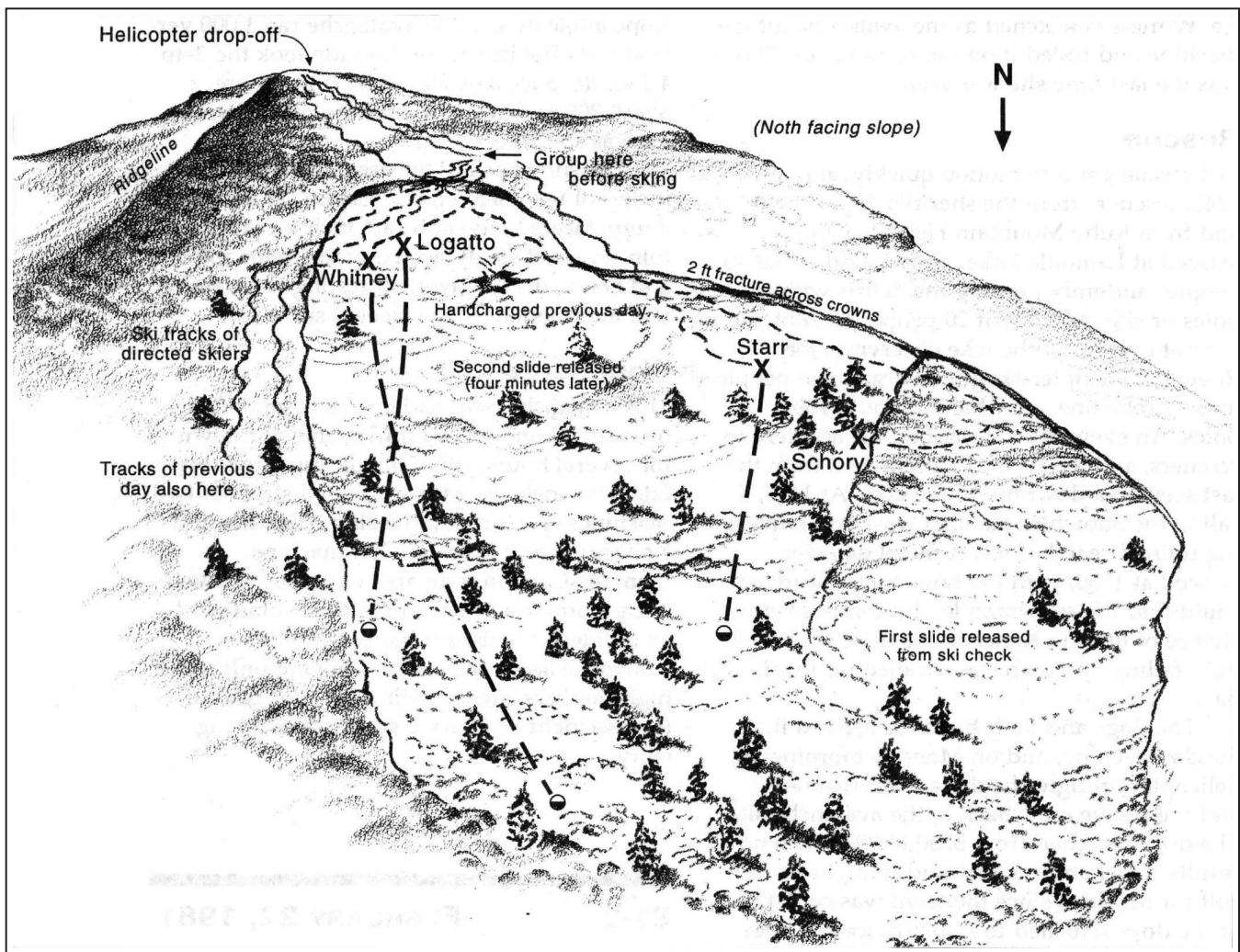


Figure 7. Accident 81-9, East Fork of Mineral Creek Canyon, Utah, February 22, 1981.

Accident Summary

At 0800 on February 21, about 11 miles from the mouth of Big Cottonwood Canyon, Wasatch Powderbird Guides bombed the north-facing slopes in the East Fork of Mineral Creek. There were no avalanche releases. The guides subsequently skied a portion of the bowl without incident. The same day, though, avalanche control at nearby Snowbird Resort produced a few avalanches that pulled out to the ground.

On the 22nd, helicopter ski guide Peter Schory took a party of seven skiers to the slope that had been controlled the day before. He told the group he would ski to the left through some large trees to ski-check the slope, and that they wouldn't be able to see him through the trees. He pointed out where he wanted them all to meet, and to ski down one-at-a-

time in one minute intervals to the designated spot. While Schory checked the adjacent area, two members of the group skied the slope per his instructions.

While ski-cutting to their left, Schory released a small, soft-slab avalanche, with a 2-foot fracture, at 1001. He yelled through the trees that he had just triggered a slide. Pam Starr, 45, had just started her run but stopped when she heard Schory yell. He told her to tell the remaining clients at the top of the slope to follow the traverse and tracks of the previous day. Two of them followed the old tracks and joined the first two skiers at the bottom. Lowell Whitney, 34, began the traverse and fell. Peter Logatto, 24, skied over to help him and as he did, a second avalanche released. This one ran between the old tracks on the skiers right, and adjacent to the slide released

by Schory on the left. The avalanche caught Whitney and Logatto near the top of the slope, and Starr and Schory farther down.

Schory grabbed a tree and was not buried, but lost some of his equipment. The three guests were partly buried and injured. They sustained broken ribs, tibias, a damaged knee and a back injury. The other four skiers in the party were east of the avalanche and were not caught.

Rescue

Schory immediately radioed the Powderbird Guides base area, notifying them of the accident. The radio call set the rescue in motion, and Alta Central, communications center for the Cottonwood Canyons, noted the call at 1012. At the accident site, a beacon and surface search was started immediately. After 2 or 3 minutes, everyone was accounted for: Starr was on her side, buried to the shoulders; Logatto was on his side wrapped around two small trees with his arm exposed; and Whitney was in a sitting position, facing downhill and buried to the waist.

At 1015, a helicopter deposited two Snowbird patrollers at the avalanche. At 1027 a medical doctor, equipment, and a third Snowbird patroller arrived by helicopter to treat the injured skiers. At 1046, another helicopter arrived at the accident site and flew one of the injured to the landing pad at the mouth of the canyon where the sheriff transported him to the hospital. By 1053, the Life Flight helicopter arrived at the accident site and took the second person to a Salt Lake City hospital. The third person was evacuated by helicopter at 1114, and the rescue was concluded by noon.

Avalanche Data

The first avalanche, triggered by Schory, was classified as an SS-AS-2 and was 150 feet wide by 300 feet vertical. The second avalanche, which shared a common flank and crown face with the first avalanche, was classified SS-AS-3. Both fractures were 2 feet deep. The second avalanche was 250 feet wide, running 400 vertical feet.

The starting zone faces north, lies at an elevation of 10,400 feet, and has a slope angle of 36°. The slope is concave with scattered trees.

The slab consisted of new snow, equilibrium (rounded) snow, and windslab. Underlying the slab were 2 inches of small-grained kinetic (faceted) grains, above a .5-inch layer of kinetic grains which had bonded

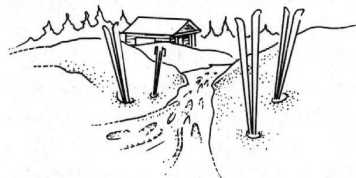
together to become a melt-freeze crust. Under the crust was a .5-inch thick layer of poorly bonded kinetic grains. The bed surface of the avalanche was below these thin layers, a 1-inch-thick layer of faceted grains, resting on 2 feet of advanced, moist depth hoar to the ground.

Comments

Even though Schory was an experienced guide familiar with the local snowpack and terrain, an avalanche accident occurred based on the assumption that the snow was stable. The avalanche hazard was rated low-to-moderate, but the presence of weak, faceted-snow layers in the snowpack contributed to deep slab instability. Although the slope had been shot with explosives the day before, the area that eventually avalanched had not been skied. The avalanche did, however, take out some of the tracks from the previous day.

Slope stability is not always achieved with explosives or ski pressure. Weaknesses within the snowpack are distributed randomly across the slope as a result of differences in snow structure and localized stresses from terrain and vegetation features. In this story, however, a small slab had just been released by ski-cutting which was a good clue to the avalanche potential in the surrounding area. Schory appropriately redirected the group toward the right where there had been ski pressure the previous day, and where the slope was presumably safer. It appears that when Logatto went to help Whitney, their combined weight was too much for the snowpack to bear. The slab failed and avalanched, which is not surprising given the weak snowpack structure on this steep slope.

Finally, all of the guests were wearing avalanche transceivers which was good. Their guide, however, was the only one carrying a shovel. Even though this is common practice with many helicopter and snowcat skiing operations, one can only speculate the outcome of an accident if the guide, along with the only radio and shovel, becomes buried too. Transceivers are of little help without a shovel to uncover the victim once located. (See related stories where shovels were not available: 80-10, 82-8, 82-13, 82-21, and 83-3.)



81-10

MARCH 1, 1981

Mt. Baldy, California*2 lift skiers caught and buried, 1 killed***Weather Conditions**

The dry conditions of this winter were particularly hard on the Mt. Baldy ski area. It had been closed for three weeks due to lack of snow, and had just reopened two days before the accident. Much of the area had received new snow on bare ground on February 26–27. Up to 12 inches of new snow was reported on top of an 8-inch base the morning of March 1. On this Sunday morning snowflakes the size of quarters were falling at the rate of 1 inch per hour.

Accident Summary

The area known as Sugarpine Run was test skied by a ski area employee on the morning of March 1, and closed with avalanche warning signs and bamboo poles at 0800 due to potential avalanche danger. Several hours later brothers Bozidar and Dragoje Govorcin, ages 32 and 31, entered the area between “Notch” restaurant and Lift No. 1. They apparently cut off of Sugarpine to an area called Ramp, a narrow path leading to Bentley’s Run.

As they came out onto Bentley’s Run, witnesses watched the event unfold. From the chairlift, a mere 40 feet away from the toe of the deposition, Debbie Semionyke and her niece Lisa saw the avalanche release at about 1155. They were directly across from the slide and watched the brothers get buried in 4–5 seconds. Ski patrolman John Mitchell, also on the lift, felt a blast of air pushed out ahead of the moving snow. When the snow settled, there were no clues on the surface. Dragoje later recalled that there were two waves of snow: the first one covered him to his thighs, and the second surge buried him very quickly. He and his brother had no chance of getting out of it.

As Dragoje went under he stuck his arm in the air and moved it around in an attempt to create an air hole. By doing so he was able to breathe. Bozidar was about 20 feet downhill of Dragoje and not so lucky. His head was buried some 4 feet below the surface and his mouth was packed with snow. Suffocation was imminent.

Rescue

The emergency call came in at 1159. Within 2 minutes a hasty search party consisting of seven patrollers was assembled and dispatched to the scene. They arrived at the site in 4 minutes and began their search. One of the team members thought he heard something. It was Dragoje Govorcin calling out from underneath the snow. They soon located him 2 feet under the surface at about 1210. He directed searchers downhill to look for his brother. Dragoje was found by probing about 5 minutes later. He was in a vertical position with his head under 4 feet of avalanche debris, his airway plugged with snow. Rescuers successfully performed CPR during evacuation, but he died in the hospital of cardiac arrest some 5 hours later.

Avalanche Data

The avalanche broke loose from the steep, rocky flank of a narrow gully at an elevation of 6,800 feet. Historically, Bentley’s Run is recognized as having the highest avalanche potential at the Mt. Baldy ski area. However, all previous avalanches have started at the top of the chute, the last major occurrence being in 1973. This particular avalanche came from a side slope near the bottom of the run and is the only known occurrence from this location. The avalanche appeared to start as multiple point releases from steep overhanging rock cliffs 300 feet above the deposition zone. It was classified as L-N-2-O. It widened to about 50 feet, and ran 400 feet slope distance. The debris was estimated to be 6–12 feet deep.

Comments

It is not known if the Govorcin’s saw the avalanche warning signs at the top of the mountain. Regardless, they ended up in an infrequent avalanche area at precisely the wrong time. Most avalanche victims trigger the slide that they are caught in. This appears to be the rare case in which a natural avalanche catches an unsuspecting victim. Avalanche accidents are likely to happen even in a lean-snow year. The recent new snow had been building up on a shallow base in the rocky cliffs above the trail. The avalanche released as multiple point releases, gathering enough momentum and volume on the way down to completely bury two people. One witness said he saw the skiers “ski right into” the

avalanche, indicating the skiers and churning snow intersected from two directions. (See accident 81-26 for a similar story.)

81-11 **MARCH 1, 1981**

Porter Fork, Mill Creek Canyon, Utah

1 backcountry skier caught, buried and killed

Weather Conditions

Near-drought conditions were not only affecting the west coast this winter (See accident 81-10). The Wasatch Mountains in Utah also had a shallow, weak and dangerous snowpack. This caused fragile depth hoar to develop more extensively than in normal intermountain-region winters. On February 26–27, nearby Alta and Snowbird recorded 22 inches and 20 inches of new snow respectively. It fell on a weak crust that had developed from several days of warm weather the week before. Several large backcountry avalanches released, some with fracture lines 3–4 feet deep. Also, following the storm north-facing slopes remained cold, and the new snow was reluctant to settle and stabilize. As a result, the Utah Avalanche Forecast Center (UAFC) had a high-hazard warning in effect for the steeper slopes facing NW-N-NE.

Accident Summary

A group of six people, all experienced backcountry travellers, eagerly anticipated an all-day tour in the Wasatch Mountains. They had already abandoned several other cross-country skiing trips this winter because of marginal snow conditions, and some were cancelled based on UAFC forecasts that warned of dangerous avalanche conditions. But this morning they were going to go. The group had called the Avalanche Center and knew about the warning, but figured their experience and route-finding skills would keep them safe.

The party left the Butler Fork trailhead in Big Cottonwood Canyon at 0930. Their destination was the Porter Fork trailhead in Mill Creek Canyon some 7 miles to the north. Bob Frohboese, 37, Joel Bown, 34, and Deborah Carlson, 28, were using downhill skiing equip-

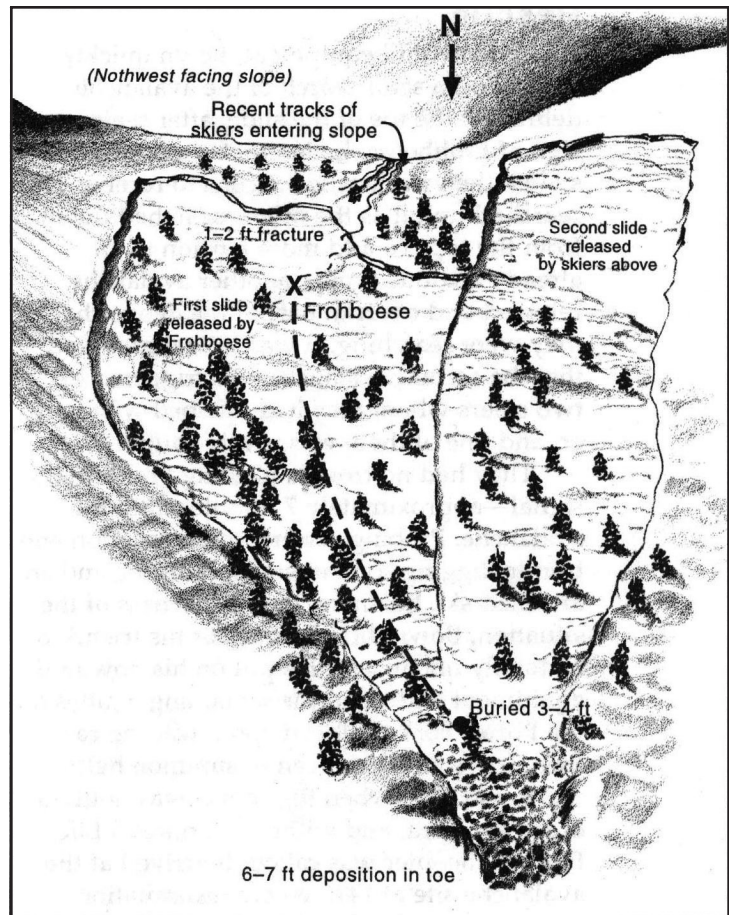


Figure 8. Accident 81-11, Porter Fork, Mill Creek Canyon, Utah, March 1, 1981.

ment and climbing skins while the rest of the group traveled on nordic gear. All carried avalanche beacons and shovels. Based on tender snow conditions following the recent storm and the avalanche report, they planned to use relatively safe south-facing slopes as an approach to the good skiing in the Porter Fork area.

Soon after lunch, Frohboese, Bown and Carlson were out ahead of the others when Frohboese, about 100 feet in the lead, skied down a moderately timbered north-facing slope and disappeared around a corner to their right. It was about 1300 hours. Bown was next to reach the corner and saw evidence of what he first thought to be an old avalanche because he had not heard anything. He became concerned when Frohboese did not answer his calls. As the others approached, he warned them of the slide and that he thought Frohboese had been caught in it.

Rescue

On his downhill equipment, Bown quickly conducted a scuff search of the avalanche debris. At the toe of the slide, after seeing no sign of Frohboese, he instructed everyone to switch their avalanche beacons to receive. He searched uphill as the others searched down from the top. To add more tension to an already anxious group, another avalanche released and overran part of the debris that they were searching. It was later discovered that the second avalanche was triggered by two skiers whom they had lunched with earlier, and one of them was nearly caught.

They had no trouble locating Frohboese's signal—approximately 7 minutes after the avalanche. Probing confirmed his location and frantic digging soon uncovered his leg and an attached ski. Realizing the seriousness of the situation, Bown did not wait for his friend to be totally uncovered. He put on his downhill equipment and skied the remaining 3 miles to the Porter Fork trailhead and a waiting car, then drove to Log Haven to summon help.

It was 1354 when the sheriff was notified of the accident, and within 5 minutes a Life Flight helicopter was called. It arrived at the avalanche site at 1423 where resuscitation attempts were being performed by Carlson and others in the group. After further attempts to revive him, the Life Flight crew pronounced Frohboese dead at 1440. He had been buried under 3–4 feet of snow for about 12 minutes and died of suffocation.

Avalanche Data

This was a skier-triggered, soft-slab avalanche (SS-AS-3-O) on a northwest aspect at 9,300-foot elevation. It released 60 feet below the ridgetop in a steep, timbered area with a slope angle of 37°. The 1- to 2-foot-deep slab broke on a weak layer of faceted grains resting on a thin crust. The slide was 150 feet wide at the top and travelled some 700-foot slope distance into a narrow gully. The second avalanche, which overran part of the first one, was evidence of the dangerous avalanche conditions in the Wasatch Mountains on March 1.

Comments

Robert Frohboese was an experienced mountaineer and a certified ski instructor. Members of his group were competent skiers with above-average ability, and they all had good

local knowledge of terrain traps and snow conditions. They were described as conservative, even turning back on occasion when snow conditions were too dangerous. We can only guess why Frohboese decided to enter such a steep slope on this high-hazard day. There are two plausible explanations. First, the area was, for the most part, heavily timbered. He knew that avalanches usually run on open slopes and gullies. Second, there were tracks in the area indicating the slope had been skied recently. Both could reinforce a false sense of security, especially if one is carrying avalanche rescue gear. In addition, the group had been frustrated with the generally poor touring conditions this winter and was eager to get into the fresh snow.

Barry Mathias, forecaster for the UAFC and personal friend of Frohboese, summarized the accident this way: "The outing represents a cautious, planned approach to the widespread unpredictability of this very weak snowpack—with a tragic end result. Exercising caution was not enough. It also serves to illustrate the limitations and false sense of security inherent in the rescue beacon-life jacket attitude." In other words, wearing a beacon only means that you will be found (in this case, quickly), but it won't necessarily save your life.

81-12
MARCH 3, 1981

Wolf Creek Pass, Colorado

1 backcountry skier caught, buried and killed

Weather Conditions

The San Juan Mountains of Colorado were among the many areas experiencing near-drought conditions this winter. Wolf Creek Ski Area, 1-mile southeast of the accident site at the top of the Wolf Creek Pass, had received only 90 inches of snow from November through February. (Wolf Creek Ski Area averages 244 inches of snow from November through February.) There were long periods of mild weather between the paltry storms that averaged a mere 5 inches of snow for any 24-hour period. The latest storm began on February 27, and deposited 5 inches of snow with strong winds that first day. By 0800

March 3, the ski area had a 5-day accumulation of 24 inches with a water equivalent of 2.8 inches.

Accident Summary

The afternoon of the 3rd found 38-year-old Dr. Larry Holle of Pagosa Springs, taking advantage of the fresh snow. He was accompanied by three friends from New Mexico—Dr. Dan Tandberg, Dr. Tom Parzyk, and Dr. Mike Davidson. They had driven 25 miles from Pagosa Springs up U.S. Highway 160 to the summit of 10,850-foot Wolf Creek Pass and, at noon, began skiing the rolling terrain west of the Continental Divide. This area is popular among ski-tourers and snowmobilers because of its accessibility and (normally) abundant snow.

After 2 hours of touring and skiing, they came out near the highway about a mile west of the summit of the pass, and some 550 feet lower in elevation. Here, Wolf Creek parallels the road 250 feet away and cuts a narrow, V-shaped swath in the terrain. It was 1435 when Holle was ahead of the group as they skied through the trees near the edge of the ravine. He was out-of-sight from the others when he reached the 50-foot breakover to the creek. Apparently, without hesitating, he skied over the lip and into the steep ravine and triggered an avalanche. The trailing skiers remember hearing Holle yell before they got to the pitch.

Rescue

When Tandberg, Parzyk and Davidson got to the edge of the slope they could see the avalanche that had carried Holle halfway to the creek. He was buried 18 inches deep but was easy to find with one arm exposed. They quickly dug him out with their hands and discovered he wasn't breathing and had no heartbeat. As they were performing CPR, a motorist on his way to Pagosa Springs saw the men and stopped. When he learned of the situation he returned to the ski area for more help. Four ski patrollers responded, but by the time they arrived Dr. Tandberg had pronounced Holle dead. The cause of death was later found to be a broken neck. Even though the accident was near the highway, it took several men another hour wading in chest-deep snow, sometimes using ropes, to get Holle's body back to the road.

No one witnessed the slide, but from the physical evidence it appeared that Holle had

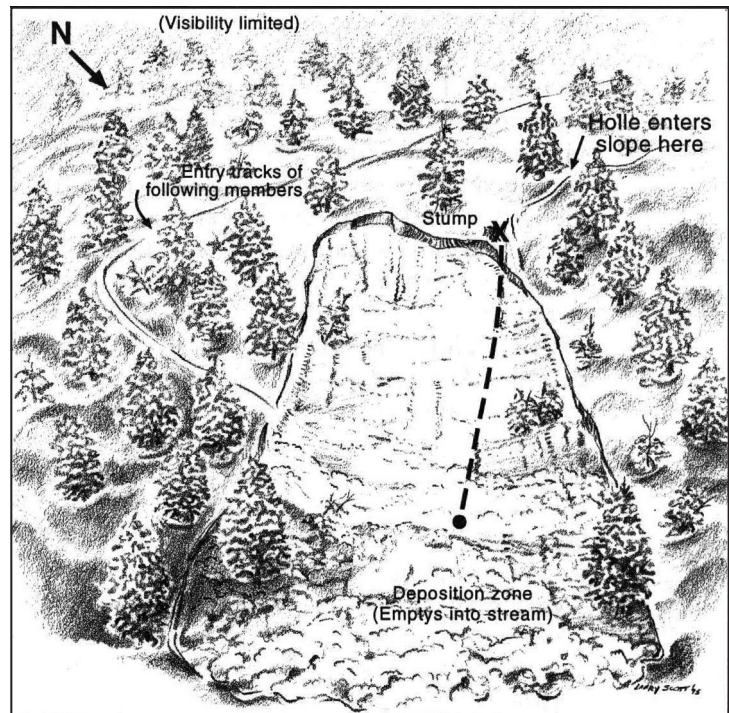


Figure 9. Accident 81-12, Wolf Creek Pass, Colorado, March 3, 1981.

fallen where a stump stuck through the snow. At this spot, his tracks and the avalanche fracture line intersected. Holle could have broken his neck tumbling with the moving snow, or possibly by hitting the stump. In either case, the avalanche caused his death.

Avalanche Data

This winter was plagued with puny storms and long periods of clear weather and cold temperatures. The inevitable result was a snowpack with generous quantities of depth hoar—a weak foundation with little strength to support the weight of subsequent snow (or a skier). On March 3, the ski patrol at Wolf Creek got favorable results with avalanche control work, including some size-3 and size-4 releases. A log entry for the Bonanza Cliffs area stated: "Every shot produced good activity." It was clearly a high-hazard day.

The avalanche that Holle triggered was classified as an SS-AS-1-G. It is a small opening among dense spruce and fir trees that runs some 90 linear feet at a 35° angle and ends abruptly in the creek bed. The 24-inch fracture line was 30 feet wide, and the avalanche widened somewhat at the bottom. The hillside faces north and lies at an elevation of 10,300 feet.

Comments

Driving up the pass, the group didn't notice any slides; however, by afternoon avalanches became obvious on the surrounding mountains. They heard the familiar "whoompf" sounds made by the collapsing snowpack along their route. The snowpack was stressed out. But people sometimes react differently when confronted with warning signs of dangerous avalanche conditions. This group was divided. Holle, described as an excellent cross-country skier with some 10 years experience, took a cavalier approach. He appeared overconfident. Tandberg and Parzyk knew little about avalanches but showed genuine concern for the hazard. Davidson had previous exposure to avalanches while climbing in Alaska, and suggested to Holle that they should be wearing avalanche cords. Holle replied with, "Avalanches are a fig-newton of your imagination." It was the last thing he said before the accident.

Tandberg felt that Holle really knew there was some avalanche hazard, but might have been trying to reassure the others. If this was true, that in itself was dangerous because of the group dynamics: Holle was the leader who displayed apparent knowledge of the local conditions; the other three were guests on "his turf." Instead of altering their route, Tandberg, Parzyk and Davidson continued to follow Holle even though they recognized a clear and present risk.

of weak depth hoar. A late-February storm on the 26th–27th brought 22 inches of snow to Snowbird and 20 inches to Alta. From March 1–8, Snowbird recorded an additional 12 inches of snow, while Alta got 8 inches. Wind for these periods was surprising light and there was little drifting. Temperatures reached into the 30s during the day, with upper teens and 20s for overnight lows. It looked like an early spring as snow temperatures 20 cm below the surface hovered between 0°F and -1°F in the first week in March. The morning of the 8th broke with sunny skies and a few scattered clouds; heavy fog and snow flurries developed by mid afternoon with a sudden drop in temperature.

Accident Summary

One mile north-northwest of Alta lies 10,530-foot Flagstaff Mountain, and the upper drainage of Day's Fork falls off to the northeast. On the afternoon of March 8, three groups of backcountry skiers were out to enjoy the snow on the steep slope. In the first party were Steve Conant and Wendy Beck. Conant had just made a run from the ridge above and was standing at the bottom of the pitch watching the others. At 1355, from Conant's vantage point looking up into the center of the cirque, he could see his partner, Beck, to the left. She had made some turns, had fallen, and was in the process of getting back up. The second party consisted of three skiers and two huskies. They had nearly completed their traverse back uphill to get their packs left on the ridge and make one final descent. Eight skiers were in the third party a few hundred feet to the right (looking uphill). They were also traversing back up to make another run but were separated from the others by a low shoulder of the mountain. It was a longer route, but easy and away from the slide path. Each group was aware of the other.

Creighton King was the leader of the third party. He was concerned about how the snow felt and the fact that it had gotten significantly colder in the last few minutes as low clouds and precipitation moved in. He and two others in his group were higher on the slope and told the five trailing skiers below that they didn't feel good about them being in an exposed and vulnerable position should an avalanche occur. King said they would stay put until the lower skiers moved off into the trees. At 1400, his group felt and heard the ominous collapse of

81-13
MARCH 8, 1981

Days Fork, Big Cottonwood Canyon, Utah

3 backcountry skiers caught and 1 partly buried; 2 dogs caught, buried and killed

Weather Conditions

The Wasatch Range had seen only sporadic storms from November through February. It had been a winter with mild temperatures, but periods of clear weather provided prime conditions for a temperature gradient to develop in the snowpack. This, in turn, created layers

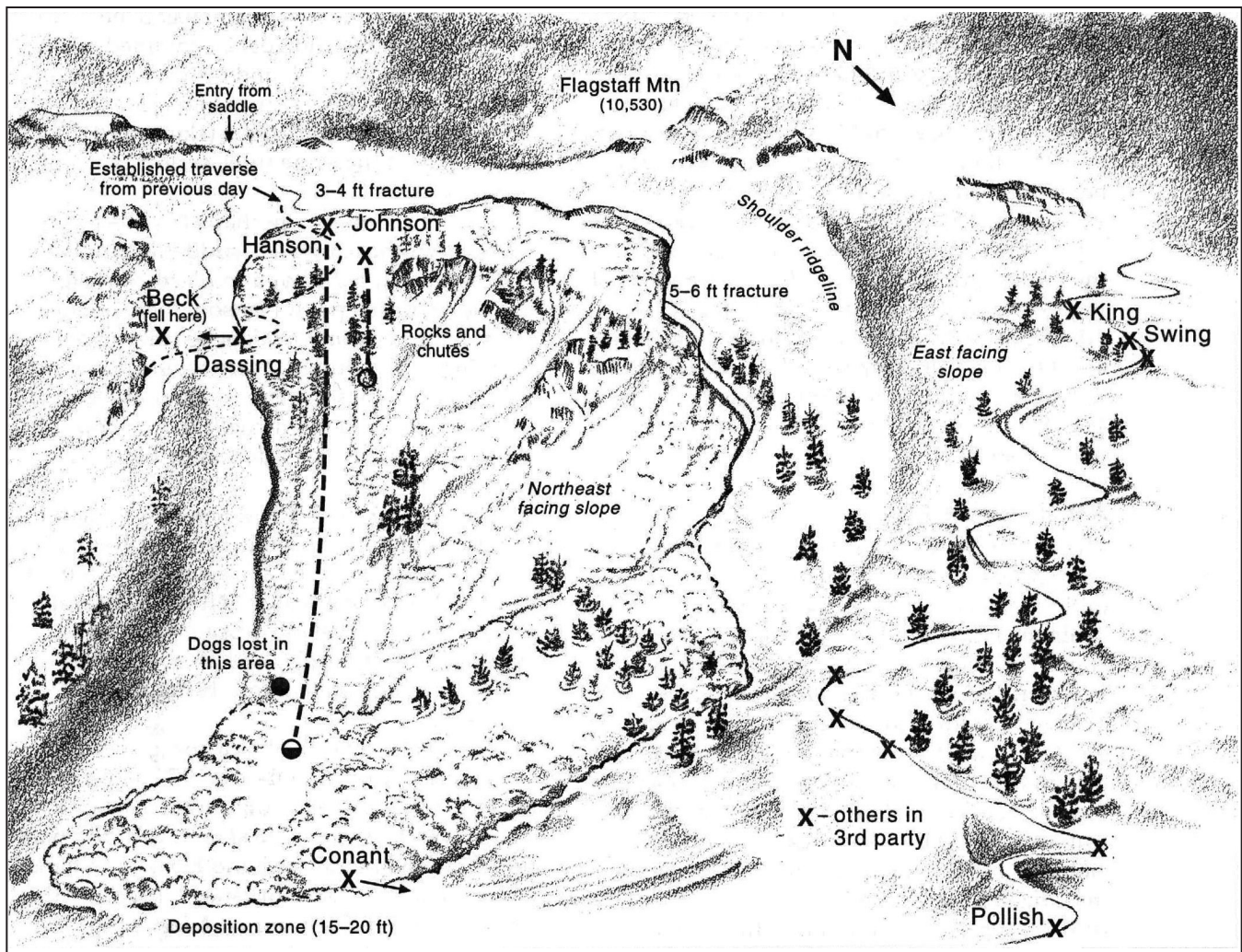


Figure 10. Accident 81-13, Day's Fork, Utah, March 8, 1981.

the snowpack around them. King looked uphill, fully expecting to see cracks widening in the snow above him, but they didn't materialize. Looking over toward the center of the bowl, he watched as an avalanche engulfed the three skiers and dogs standing near the starting zone. King's group was safe for now, separated from the avalanche by terrain features.

When the avalanche struck, the second party consisting of Steve Hanson, Mark Johnson and Rusty Dassing, along with Johnson's huskies, Smoke and Lady, were caught immediately and plunged downhill. Johnson grabbed onto a tree and the snow flowed around him, while Dassing had enough power, and luck, to ski out to the side of the avalanche seconds after it started. Only Hanson and the dogs were carried to the bottom. He fought to stay in a standing position

and was buried to his waist but unharmed when the snow came to rest.

King and partner Mike Swing watched intently as Hanson rode out the slide, and they saw Conant scrambling frantically to get away from the churning snow bearing down on him. He barely made it to the side in time. Beck had been just far enough to the side of the slide that she didn't get caught.

Rescue

When the snow finally stopped, communication between all three parties confirmed that indeed nobody was missing. This was done twice. King, Mark Pollish (also in the third party) and Conant skied to the half-buried Hansen to dig him out. Hansen was out in 5 minutes, but it took almost another 10 minutes to free his skis—which didn't come off in the

slide. At 1410, probes were assembled to search for Smoke and Lady. Since the dogs didn't have transceivers, the people who did left theirs on "transmit." A lookout was posted to watch for subsequent slides and warn those below should one occur.

At 1427, King skied out Day's Fork to report the slide, and others soon followed to the parking lot to catch a ride to the bottom of Big Cottonwood Canyon where they could take a bus to Alta. Pollish, Hanson, Johnson and Dassing said they would search for another half hour and then go out the same way. The dogs were not located and had perished in the avalanche.

Avalanche Data

The avalanche path has been appropriately named "Two Dog Slide" for Mark Johnson's faithful huskies, Smoke and Lady. The avalanche, triggered by the skiers on the slope, started at 10,250 feet on the northeast aspect of Flagstaff Mountain. The slide was an SS-AS-4 avalanche with a crown line 3–6 feet deep and 500 feet long. It ran down the 37° pitch some 500 vertical feet with enough velocity and volume to deposit 15–20 feet of debris in the runout zone. Onno Wieringa, avalanche specialist from Alta, was a member of an on-site investigation team the following day. In a fracture line profile, he found that the initial slab was comprised of 40 cm of recent snow overlying a 40-cm hard-slab. A thin layer of graupel was sandwiched in between. Together these collapsed on a 10-cm-thick weak layer of small, faceted ice grains. A thin crust, which had developed just above 90 cm of depth hoar, provided the sliding surface for the avalanche. The layering was strikingly similar to that of the slab that released in Porter Fork on March 1 (see accident 81-11).

Comments

This avalanche path had been skied numerous times in 2 days without incident. This created a false sense of security among the skiers in the area. While skiers in the three groups were conscious of avalanches and carried avalanche rescue gear (it's not known if all were similarly equipped, but unlikely if packs were left on the ridgetop while skiing), they ignored backcountry protocol of not exposing more than one person at a time to potential avalanche danger.

All the ingredients of an avalanche were

present: First, the snowpack contained multiple weak layers, a slab and a sliding surface. Second, the slope was steep enough. And third, there were 15 triggers (skiers and dogs) on the slab at the same time, seriously testing its weaknesses.

King's group was perhaps the most fortunate in that the snowpack suddenly cracked and collapsed, but stayed in place with eight people on the slope. If Hanson, Johnson and Dassing (all wearing avalanche cords) had been injured or buried, there would have been plenty of rescuers to increase their chances of survival. This is a rare benefit in most backcountry situations, and definitely better than skiing alone.

Actions taken by the skiers following the avalanche should be commended. Foremost, they quickly accounted for everybody in their groups. Transceivers were left on "transmit" should another avalanche occur from the slopes that didn't slide, and an avalanche guard was posted to sound the alarm if necessary.

This avalanche site has a special historic significance. On December 2, 1977, three well-prepared skiers were caught in a slide at this same location. One of the skiers was only partly buried and he rescued another whose hand was protruding above the snow. Together they found the third skier, buried 4 feet deep, with their Pieps avalanche beacons. It marked the first live recovery in the United States where the transceiver played a major roll in locating an avalanche victim. Day's Fork was the site of yet another dramatic avalanche accident in 1983 (see accident 83-16).

81-14
MARCH 15, 1981

Pyramid Peak, Colorado

1 backcountry skier caught and injured

Weather Conditions

Ski areas 7 miles away from this accident, Aspen, Snowmass and Aspen Highlands, had gotten little snow this season. Early March, however, brought two storms to the region. On the 2nd–4th, both Aspen and Aspen Highlands recorded 15 inches of light, new snow. Another storm system moved through on the

7th–9th that brought 10 inches to Aspen and 6 inches to Aspen Highlands. High temperatures for the first 2 weeks of March were seasonably in the upper 20s and 30s with overnight lows in the teens. Below timberline winds remained light except for short durations of velocities in the 20s on the 6th and 11th. Wind at high elevation ridgetops were likely much stronger. The weather was mild the weekend of the accident.

Accident Summary

On Saturday the 14th, four skiers from the Denver area toured up Maroon Creek, southwest of Aspen, to camp overnight at the base of 14,018-foot Pyramid Peak and do some backcountry skiing the following day. Sunday morning found Keith Engelman, Gill Murry, Dave Fulton and Butch Miconi, all 25, skiing up Pyramid Peak and traversing an avalanche path up the northwest side of the mountain. They gained about 2,000 feet in elevation and began a traverse across the mountain. Their route took them across the top of two other avalanche paths without incident. It was 1300 as they crossed the next open gully with Engelman 30 feet in the lead. All of a sudden a slab of snow broke 50 feet above him and swept him some 1,000 vertical feet down the rocky chute. He somehow managed to stay on the surface and was spit out to the side as the avalanche made a bend through the terrain. His companions were watching him all the way and saw him ejected from the avalanche.

Rescue

They climbed down to Engelman's aid and found him dazed, in much pain, and bleeding from his head. They sent for help and a rescue team consisting of nine people arrived at the site at 1730. Engelman was evacuated by 1930. He had suffered a dislocated shoulder and serious cuts: his left ear had to be reattached with 150 stitches.

Avalanche Data

The avalanche that Engelman triggered was an SS-AS-4. It started on a northwest aspect with a fracture line 16 inches deep and 150 feet wide. Soon after it released at 11,400 feet the snow was channeled to a 50-foot width and flowed 1,400 vertical feet down the mountain-side. It left debris piled 10 feet deep at the bottom of its path. Snowpack layering consisted

of 45 cm of low-density snow resting on a melt-freeze crust. The low-density snow was soft slab that had formed from the storms of March 2–4 and 7–9. Deeper in the pack was a very hard slab of snow sitting on top of 70 cm of rounding depth-hoar grains.

Avalanche control work at the nearby ski areas produced slides with explosives in each of the two previous storms. Ski-cutting had also been an effective means to trigger avalanches, and in 10 instances ski patrollers had been caught, though none seriously. It was evident that backcountry conditions were tender as well.

Comments

These four skiers ventured into the backcountry without prior avalanche training, and weren't aware of the danger surrounding them. Consequently they did not carry the standard rescue gear (avalanche beacons, shovels and probes) that could help save their lives should an accident occur. Had Engelman been buried, the outcome would certainly have been much worse. He was additionally lucky to have survived a fall of this magnitude without worse injuries.

The U.S. Forest Service Avalanche Warning Center, at that time in Fort Collins, had issued an advisory for the existing high hazard in the Aspen area, but the group made no phone calls to inquire about avalanche conditions. It was only luck that the skiers were spaced far enough apart that only one got caught in the slide.

81-15
MARCH 15, 1981

Telluride, Colorado

4 cross-country skiers caught

Weather Conditions

No one needed to look at snowfall data to recognize that the San Juan Mountains in southwest Colorado were starved for snow. But for those who like such things, here's some trivia from records kept at Red Mountain Pass, 5 miles east of where this adventure took place.

The rugged mountains surrounding the



Figure 11. Accident 81-15, Telluride, Colorado, March 15, 1981. Photo by Milt Carlson.

11,018-foot pass, including those towering above Bear Creek near Telluride, had seen few storms this winter. Snow had fallen on only 20 days from November through February. Storm systems that did find their way into the San Juans packed little punch, and only on two occasions did as much as 8 inches fall in a single 24-hour period. On November 30, the snowstake read 19 inches, and a mere 26 inches by the end of December. It took the next 2 months to reach the 44 inches measured at the end of February. The combination of a shallow snowpack and cold air temperatures (overnight lows often ranged from -10°F to $+10^{\circ}\text{F}$) transformed the snow into large, faceted grains with little cohesion or strength. High-altitude tanning became the pastime of choice during the extended mild weather because backcountry skiing was marginal at best.

Accident Summary

March 15th seemed like any other sunny afternoon in Telluride, but to Milton Carlson, 50, his wife Barbara, 47, their daughter Sherry, 23,

and her friend Michael Grazda, 28, it was a day they will never forget. It was about mid-day when they decided to go for a short ski-tour up Bear Creek. Bear Creek flows through a deep, incised valley flanked by steep slopes that reach more than 2,000 feet above the valley floor. The valley leads due south out of Telluride and terminates some 4 miles distant in two large basins surrounded by 13,000-foot peaks. The group had gone about 2 miles when they stopped to relax before heading back to town. They skied over to a large boulder and shed their equipment to enjoy the view of distant peaks and frozen Bear Creek Falls. They commented about how peaceful it was at that spot—a peace that was soon shattered as they were preparing for the return trip.

At 1330, Grazda heard a strange sound and looked to see what it was. His gaze focused uphill on the churning powder-cloud of a large, dry-slab avalanche plunging down the mountain. It was bearing down on their exact position and growing by the second. He

alerted the others, and after a few short remarks they determined the avalanche was indeed going to overrun them. They needed to get out of there fast but there was no time to make a run for it. Their skis were still laying on the ground and time was quickly running out. It was Grazda who finally broke into their personal thoughts of the moment: "Behind the rock!" he yelled.

Sherry, her mother, and Grazda ducked behind the 30-foot-high boulder, but Carlson was missing! Within a few seconds he too sought refuge, but only after snapping a picture of the oncoming mass of snow now only 300 feet away. Huddling all together they listened and waited for what might ever happen. They didn't have to wait long. Here is Sherry's first-hand account of what came next:

"At that point we had to yell to communicate; the roar of the avalanche was deafening. Just after all four of us were crouched together, the air blast encircled the rock. Trees were bent way over; branches and small objects flew by; the world around us was in motion. I tried to think of something to yell to my parents in those few seconds before the snow itself reached us. 'Try to keep an air pocket around your head! Swim with your arms!' As I was trying to hear what my parents were yelling, the avalanche hit the boulder with its full force. Snow flew past us on both sides of the boulder, and when I looked up I saw a wall of snow coming over the boulder as well. We squeezed together more closely and I alternated between shutting my eyes and watching the seemingly unending flood of snow. Looking at my mom once, we seemed to be thinking the same thing. I uttered, 'We might die.'"

The avalanche poured over and around them for some 30 seconds and it became difficult for them to breathe. Then suddenly it was over. It was again quiet in Bear Creek.

Fearing yet another avalanche, the group slowly and cautiously peered out from their shelter. They had not been buried, but were caked 2 inches thick with fine powder. As they climbed out over the dense debris they saw that where they had been standing a few moments before was now packed with cement-like snow 15 feet deep. Their equipment was nowhere in sight, but they were alive. After a few minutes of looking around and composing themselves, they began a slow walk back down the trail to town.

Avalanche Data

The avalanche that engulfed the Carlsons and Grazda released naturally some 2,000 vertical feet above them. (The nearby Telluride ski area recorded two other large, natural avalanches on the same day.) Debris at the boulder extended 300 feet wide, and it filled the creek bed as it stretched across the valley floor and 100 feet up the opposite side.

Comments

The group had been thinking "avalanche" when they started up the valley because of the obvious terrain features and their knowledge of the area. (Michael and Sherry lived in Telluride.) However, they determined that the snow in the valley was stable enough. And besides, this was only going to be a short tour that didn't include skiing radical terrain.

What happened to Milton, Barbara, and Sherry Carlson, and Michael Grazda can be most likened to fiction where the author conveniently provides an unforeseen way out of danger at the very last second. It was probably to the benefit of the skiers that they weren't wearing skis and packs when they saw the avalanche bearing down on them. They were able to move quickly and unhindered to the safety of the boulder. This was a rare event. Most people trigger the avalanche in which they're caught, but this one released naturally with the unsuspecting skiers standing right in its runout zone. Oh yes, did we say they were very LUCKY too?

81-16

MARCH 17, 1981

Timberline Ski Area, Oregon

3 lift skiers out-of-area caught, 1 buried and injured, 1 partly buried

Weather Conditions

Weather records for the Timberline ski area are not directly available, but here's what was happening at nearby Mt. Hood Meadows. It is a grim reminder of pitiful snow conditions for the region this particular winter. December started with a snow stake reading of 27 inches. Sunny skies, temperatures in the 40s and 50s, and rain at the end of the month battered the

snowpack down to a measly 8 inches by the 31st. The ski area was closed for lack of snow through most of January, but winter was slightly revived in February with 42 inches of snowfall. Conditions were again warm and dry for the first two weeks of March. On the 16th, a weak storm system moved in with snow and wind. By the 17th, 5 inches of snow had fallen on top of a sun crust, and by the afternoon it was warm and clear with only a light breeze.

Accident Summary

Shortly after 1600, three expert skiers and full-time ski instructors were looking for powder to ski for their last run of the day. This would be a rare find and they decided to look for it in White River Canyon just outside the ski area boundary. Melissa Fassold, 25, Kevin Smith and John (no last name given), also in their 20s, skied past the boundary signs and traversed onto steeper terrain. It was disappointing at first as they only encountered icy and crud-snow conditions. But a little farther on they found what they were looking for—a steep run with a foot of fresh snow.

It didn't take long for the trio to "point 'em down hill" for a few good turns. They didn't even get that many; at 1630, the slab released as soon as they started down the pitch. Fassold was 50 feet in the lead with Smith and John spread out behind. These trailing skiers were caught first, but were carried for only a short distance. Fassold saw the slab breaking loose and quickly decided that her only chance for escape was to outrun the avalanche by skiing straight down the fall-line. Her flight was short-lived when she was overtaken and knocked out of her skis. She began to sink in the grinding chunks of snow and was buried on a bench in the flank of the debris as the avalanche turned and continued down the mountain.

John's skis came off soon after the avalanche released. With swimming motions he was able to stay on the surface until the avalanche flowed around him. Smith's skis did not release so he couldn't actively fight the avalanche. He was dragged down and buried to his chest. They had lost sight of Fassold and thought she had been swept to the bottom.

Rescue

Smith couldn't move and John had to dig him out with a ski tip, which took some time.

Fassold was some 200 feet downhill, totally buried 12 inches deep following a bruising, painful ride. Blocks of snow were compressing around her and she had difficulty breathing. She later remarked that it was like being in a trash compactor. After a couple of minutes, she realized she could move one hand that was close to surface, and eventually dug herself out in 10 minutes. She had sustained bruises all over her body, especially around the rib cage, but was otherwise unhurt. When the three reunited, they climbed out the valley and walked to Timberline Lodge.

Avalanche Data

This avalanche path faces southeast at an elevation of 7,500 feet. Warm temperatures prior to the 17th created an icy-smooth surface for the new snow to fall on. When the skiers moved onto the 45° slope the slab released 1 foot deep, 300 feet wide and ran some 600 feet to the bench, depositing Fassold on the edge of the debris. From here the avalanche made a right hand turn and continued on for another 2,000 feet and piled snow 13–18 feet deep in the deposition zone. The avalanche was an SS-AS-3-O.

Comments

It is not uncommon for expert skiers to get caught in an avalanche. They have the expertise and usually the drive to ski the "steep and deep," which is most commonly found these days in the backcountry setting. Fassold, Smith and John didn't consider or discuss the potential hazard. They each had a solid skiing background, but lacked avalanche training that would have alerted them to the hazardous situation they were getting into. Two conspicuous warning signs here should have sent up a red flag shouting, "Think avalanche!" First, the slope was very steep, about 45°, and gravity was tugging hard on the recent snowfall. Second, the fresh snow was clinging precariously to the smooth, icy surface of the old snow. It took only slight ski pressure to tip the delicate balance and trigger the avalanche. A Forest Service warning was in effect at the time for high avalanche danger above 6,000 feet on southeast-facing slopes.

81-17

MARCH 31, 1981

Snowmass Ski Area, Colorado

2 ski patrollers caught and buried, 1 killed

Weather Conditions

The snowpack had been miserably shallow throughout most of Colorado. Dry weather, combined with little snowfall, produced ideal conditions for depth hoar formation. This fragile snowpack structure would not support much additional weight. In the week before the accident, fresh snow, and blowing and drifting snow, contributed to an ever-increasing avalanche hazard. On the 24th–25th, 4 inches of snow fell with light-moderate southwest winds. The wind increased to 40 mph on the 26th, drifting snow onto the lee slopes above timberline. From the 27th–29th, the area received another 8 inches of snow, and on the 30th, southwest winds of 30–60 mph again caused very heavy blowing snow. On the morning of the 31st, Snowmass reported 8 inches of fresh snow, partly cloudy skies and light wind.

Accident Summary

Throughout the month, the Snowmass ski patrol had produced numerous slides with avalanche control work. They were keenly aware of the avalanche conditions—four patrollers had been caught in small slides without serious consequences while ski-cutting in the previous weeks. Following the latest bout with new snow and strong winds loading snow into avalanche starting zones, they were again working to reduce the hazard that could potentially affect their ski runs.

On Tuesday the 31st, Roberto Gasperl, 40, John Erspamer, 37, and Loren Ryerson, 27, were working as a team on the Hanging Valley Headwall control route. Per procedure, Ryerson took a high traverse to watch from the main headwall while Erspamer and Gasperl descended to a bench above some short rocky cliffs to throw explosives into Small Chute (renamed West II). They armed the 4-pound explosive charge and Erspamer moved 150 feet to the other end of the bench to watch the results. Gasperl threw the charge onto the

slope below and joined Erspamer where they waited together. At 0942, within seconds after the explosion, a fracture line propagated up the slope some 40 feet behind the two patrollers. As the slab broke loose, Erspamer tried desperately to hang onto the rocks where he was standing but it was a futile attempt. This bought him a little time, but the avalanche swept them both over the edge to the steep slope below.

Rescue

Erspamer took a short, but rough ride down the steep path, sustaining lacerations and injuring both knees. He was shallowly buried and able to uncover himself to look around for Gasperl. When there was no sign of him, he immediately began a beacon search. Ryerson, watching from above, saw the avalanche rip his partners from their observation point. He quickly responded to the deposition zone and found that Erspamer had already homed in on Gasperl's signal near the toe of the debris. Ryerson dug a 3-foot-deep hole without any luck before Erspamer sent him for help. About the same time, Darrell Rankin and Stan Tenner were working a control route nearby and saw the avalanche. They tried to contact Erspamer by radio but without success because Gasperl was carrying the team's only radio when he was buried. Voice contact was made between the two and upon learning what had happened, Rankin radioed the Snowmass control desk (patrol headquarters on Sam's Knob) and advised them of the situation at 0950. He and Tenner joined Erspamer on the debris and continued digging.

Teams were quickly assembled and sent to the accident site with avalanche rescue gear and medical equipment. They located Gasperl under 8 feet of snow after being buried for 43 minutes. He wasn't breathing and had no heartbeat; he didn't have an ice mask and there was no snow found in his airway. Rescuers began CPR and transported him to the hospital where he was put on a life-support system and treated for extreme hypothermia (his body temperature had dropped to 72°). Gasperl never regained consciousness and was pronounced dead of respiratory failure in the early morning hours of Wednesday April 1. Erspamer was also admitted to the hospital for his injuries, and released on the 1st.

Avalanche Data

West II is a north-northeast-facing pitch that sits in a steep cirque at 11,790 feet in elevation. Its elevation and aspect make it susceptible to both depth hoar formation and deep drifting from the prevailing wind. The area is closed to skiers, but threatens an open trail below. This avalanche broke loose on a short, 37° slope, leaving a 4-foot-deep crown line 150 feet wide. It fractured 40 feet uphill and behind the patrollers. From there it travelled some 30 feet across the 10° bench where it overtook the men and flowed over a 15-foot-high cliff and onto the slope below. The avalanche ran 225 vertical feet and piled snow 15 feet deep in the runout zone. It was classified as an SS-AE-5-G.

The snowpack was made up of a lethal combination of three weak layers sandwiched between dense wind-slab. A fracture line profile revealed a 70-cm basal layer of 5-mm faceted grains. This was overlaid with a weak wind-slab 35 cm thick. On top of that rested a 60-cm weak layer that collapsed from the weight of a dense wind-slab about 40 cm thick, and new snow reaching up to 220 cm at the surface. The initial slab ran for a short distance before releasing to the depth hoar at the ground.

Comments

Ski patrollers that work at an area with avalanche terrain are responsible for maintaining safe skiing conditions in areas open to the public. Part of their job exposes them to avalanche hazards, but the risk is minimized through the use of proper equipment such as two-way radios, avalanche beacons, shovels, collapsible probe poles, and explosives. In addition, they receive ongoing avalanche training and extensive avalanche rescue practice.

This was a case where the control team was standing in an avalanche prone area. While the slope above them was relatively small, the volume of snow it released was enough to sweep the patrollers over the rocks. This pocket above the bench had been known to slide occasionally. Simply put, the patrollers were not in a safe location. A series of weather events prior to the 31st created conditions that were prime for an avalanche event. As a result of the accident, this avalanche control route has been modified to prevent a reoccurrence.

Ironically, Gasperl survived another avalanche while doing avalanche control work 2 weeks before this fatal accident. In that inci-

dent, he triggered a soft-slab avalanche while ski-cutting a slope in scattered timber. His partner, Patrol Director Rob Clark, watched from a safe location until the slide stopped, then skied down to the deposition and found Gasperl's hand sticking out of the snow. He dug down just in time as Gasperl was choking on snow packed in his mouth. In that instance a shallow burial with an exposed body part led to a quick rescue.

While it is uncommon for a ski patroller to be caught in an avalanche, these events can still occur. It generally happens on short slopes while test-skiing or ski-cutting. This procedure is a calculated risk, and done only when the chance of a serious accident is minimal should an avalanche occur. Two burials in 2 weeks was too much. Roberto Gasperl's luck ran out, and he became the second professional ski patroller to be killed while performing avalanche control work. An adjacent ski run now bears his name.

81-18
APRIL 8, 1981

Arapahoe Basin Ski Area, Colorado

*3 lift skiers caught out-of-area,
1 injured*

Weather Conditions

The Arapahoe Basin ski area sits on the west slope of the Continental Divide in central Colorado. Snow depths in the region had been below normal throughout the winter, and Arapahoe Basin was reporting a 44-inch base on April 1. (Near 80 inches is more the norm for this time of year.) The first week of April brought fresh snow much to the delight of skiers. On the 3rd–5th, 11 inches of snow fell with unseasonably cold temperatures. Daytime highs during this time ranged from 12°F to 22°F, with overnight lows of -9°F to 10°F. Eleven more inches of light-density snow (5 percent water content) fell in a 24-hour period on the 7th–8th.

Accident Summary

At about 1445 on April 8, low clouds were

moving in and the temperature was dropping when three lift-skiers decided to venture into an area called the Steep Gullies just outside the west boundary of the ski area. This is a rocky, steep hillside 1,000 feet wide with five narrow gullies running down its face. The slope gradually flattens out and terminates near the creek at the bottom. Two hundred feet up the opposite bank is U.S. Highway 6, winding its way over Loveland Pass.

Geary Dorsey, 28, Rick Emarine, 32, and Larry Ziruolo, 30, picked their way through shallow snow and partly covered rocks to reach the Second Steep Gully. Their intent was to ski down the wind roll as far as it went along the edge of the chute, thus avoiding the gully under the wind-roll and possibly triggering an avalanche. They would then drop into the gully, ski to the creek and climb up to the highway. From there they could either hitch a ride or walk back to their car in the parking lot a mile up the road. But here's what happened instead.

At 1500, Emarine and Dorsey skied one-at-a-time half way down the wind roll and stopped to watch Ziruolo ski down to them. Ziruolo had made only three turns when the snowpack suddenly collapsed with a loud "whoompf" sound. Emarine and Dorsey felt the snow settle several inches and knew immediately they were in trouble. They quickly jump-turned to face down hill and hoped to gain enough speed to ski off of the slab they were standing on. But the slab broke into pieces before they had a chance to get away. Dorsey was immersed in the churning snow and launched along with it over a large rock outcrop. He tucked into a ball while spinning through the air and landed hard at the bottom, destroying his skis in the process. He rode the avalanche a little further, going under once and then popping back up to the surface where he finally came to rest after an 800-foot vertical fall in just a few seconds.

Emarine and Ziruolo were more fortunate. Emarine was lucky enough to slide by one of the few trees in the gully and hooked it with his arm. This spun him around to where he could get a bear-hug on it from the lower side. Adrenaline from the fear of following Dorsey over the same precipice gave him enough strength to hold on as the snow flowed around him. At the same time, and to his relief, he saw Ziruolo traverse out of the flow. Ziruolo had been close to the fracture line when the

avalanche released and was able to escape before being carried too far downhill.

When the avalanche was over, Emarine had lost his poles and was shaken up from the ordeal. It was difficult for him to navigate down through the rocks and remaining sugar-snow. Ziruolo made it down the pitch to where he could make visual contact with Dorsey, who was badly beaten up but otherwise all right. Ziruolo reached him in about 10 minutes, with Emarine 5 minutes behind. After pondering their good fortune of all being alive, they switched skis to give Dorsey a full set to reach the highway. It took them nearly an hour to go the short distance to the road.

Avalanche Data

The skiers did not dig a snowpit; however, they did note 1-2 feet of fresh snow sitting on 2 feet of loose, sugar snow in the gully. The vertical wind roll was also resting on these weak, faceted snow grains. They couldn't feel any crusts or significant hardness variations when probing with a ski pole.

When these northwest-facing gullies are filled with enough snow, a channeled avalanche has the potential to run 1,400 vertical feet from its narrow beginning at 11,700 feet down to the runout zone near the north fork of the Snake River. Slope steepness in the upper starting zone ranges from 35–38°—contributing to rapid avalanche acceleration. In this case, the combined weight of the three skiers on the wind roll, which had little support underneath, was enough to collapse the slab and trigger the avalanche. It was classified as an SS-AS-4-G.

Comments

Rick Emarine, Geary Dorsey and Larry Ziruolo were all expert skiers, and had plenty experience skiing the local backcountry. Under "normal" conditions, their plan to stay on the wind roll was the reasonable choice. They didn't want to trigger an avalanche by skiing the compression zone at the toe of the pillow where the snowpack is shallower, weaker and stressed from above. However, this drought-winter produced a snowpack that threw many people off-guard. (See accident 81-17 for another example of this, but with a far worse outcome.) Places normally considered safe were avalanching.

It is good when backcountry skiers are thinking "avalanche" and plan their route

accordingly. But equally important is backcountry etiquette and safe-travel techniques. These skiers found themselves exposed to danger at the same time, and all were caught when the skier from above triggered the slide onto those below. Had the whole party been buried, there would have been no one to effect a rescue. Skiing one at a time puts only one person at risk at a time.

Snow conditions outside of a ski area are much different than where the snowpack has been heavily skied and compacted. This is precisely what lures some skiers and snowboarders past the ski-area boundary. The thrill of fresh, untracked powder "beyond the ropes" has enticed many a backcountry enthusiast into an avalanche. Being an expert skier is sometimes not enough, but having good avalanche sense is a must for thrill-seeker longevity. Another must is carrying avalanche rescue gear, with which this lucky trio was without. (For other accidents at this site, see 82-4 and 82-10.)

81-19

APRIL 12, 1981

Red Lodge, Montana

1 snowmobiler caught, buried and killed

Accident Summary

A Sunday snowmobile outing on April 12 ended in tragedy as an avalanche released above two Billings, Montana men about 15 miles south of Red Lodge near the Wyoming border. The accident happened at 1515 as the two riders were going up a draw. Gale Bush was in the lead when he noticed an avalanche come down behind him and bury his companion, 55-year-old David "Duke" Hall. Bush turned his machine around and went back to look for Hall. He searched for about 30 minutes without success, then snowmobiled back to his parked truck near U.S. Highway 212. From there he contacted the sheriff's office in Red Lodge at 1617 on his C.B. radio to report the accident.

Rescue

Upon receiving the call, Sheriff James Eichler

notified Snow Ranger Tom Alt of the U.S. Forest Service. The two went to Red Lodge Mountain ski area, 6 miles west of town, to solicit help from the ski patrol. A medical doctor was also at the ski area and offered his assistance. In the meantime, the sheriff's dispatcher notified the hospital in Billings, 60 miles away and apprised them of the situation. A helicopter with two flight nurses was dispatched with the misunderstanding that the victim was at the ski area. At Red Lodge, the pilot learned more of the rescue situation and elected not to fly to the site for safety reasons. Another source for air support was contacted, but he also did not have a helicopter that could perform adequately at high elevations with heavy loads. A group of local volunteers was finally assembled to take the ski patrol to the accident site by snowmobile. In addition, a ski-area snowcat was transported to the trailhead, but was never needed. Radios, electric lanterns, a snowmobile sled and food were obtained from the Custer National Forest to aid in the rescue.

The rescue operation was directed by radio from the sheriff's office in Red Lodge. Communication was relayed through personnel stationed on Highway 212 to rescuers on the scene. At about 2030, and almost 5 hours after the accident, rescuers located Hall under 4 feet of snow and requested a helicopter because they thought there might still be a chance to save Hall's life. The sheriff called for another helicopter from Billings. One flew to Red Lodge where the pilots got a weather briefing from the rescuers on-site. It was snowing but the pilots thought they could make a successful approach from the east. In the end, heavy snowfall kept them from reaching the site and they set down in Red Lodge for the night. It was 2139 when the rescuers relayed that Hall was deceased from apparent injuries suffered in the slide, and they would bring him out on the sled. It was about midnight when the rescuers finally returned to Red Lodge.

Comments

Very weak snowpack conditions were prevalent throughout the Rocky Mountains all winter and contributed to numerous avalanche accidents. It is likely that the snowmobilers triggered the small slide by undercutting a slope while going up the draw. Bush did the right thing by searching for a reasonable

amount of time before going for help. But without surface clues to guide him, and no avalanche rescue equipment, his efforts were futile. This rescue had sufficient trained manpower and appropriate equipment, but, as in most backcountry situations, transportation to and from the accident site was very time consuming. Air support is always severely limited by inclement weather, forcing the reliance on ground teams. Though slower, they are usually safer if rescuers don't have to travel through avalanche terrain. The pilots made sound decisions not to risk another accident for what was likely a body recovery. Initial rescuers should always presume an avalanche victim can be found alive, but Hall's burial time had far exceeded his statistical chance for survival, which is only fifty-fifty after the first 30 minutes if the victim is not killed outright or suffering from trauma.

81-20

APRIL 12, 1981

Source Lake, Washington

6 cross-country skiers caught, 4 partly buried, 2 buried, 1 killed

Weather Conditions

In November 1980, it looked like the beginning of a normal winter in the Cascade Range of central Washington. But at the Alpentel ski area, 50 miles east of Seattle, the 40-inch base at the end of the month deteriorated to a mere 10 inches by the end of December.

Temperatures in the upper 30s and 40s had prevailed through March, and precipitation came as much in the form of rain as snow. By the end of March, the snowpack at Alpentel was a scant 23 inches deep. The winter had brought near-drought conditions to a region where it is not uncommon to have 100 inches of snow on the ground this time of year. The first part of April brought much-needed spring snow and moisture. Alpentel and Snoqualmie Summit ski area, near the summit of Snoqualmie Pass, each recorded 51 inches of snowfall from the 1st–11th. Periods of 20–30 mph southwest to west winds caused blowing and drifting snow. Alpentel reported an additional 11 inches of fresh snow on the morning of the 12th. Deeper snow accumulated in

avalanche starting zones on the peaks and ridges. Moderate snowfall continued on the 12th, again with periods of blowing and drifting snow snarling traffic on Snoqualmie Pass. Several days of inclement weather prompted the U.S. Forest Service to issue an advisory for a high avalanche hazard above 4,000–5,000 feet.

Accident Summary

Brothers Robin and Kim Richards, 27 and 32 respectively, along with David Swenson, 33, and Glen Takagi, 26, left the Alpentel ski area parking lot about mid morning Sunday April 12, to ski the 2-mile-long trail into Source Lake, 3 miles northwest of the Snoqualmie Pass summit. The lake sits at the base of 6,238-foot Chair Peak. Four other skiers were already in the vicinity of the lake. In one party were James Garrett, 28, and Georgia Gerber, 26, along with Gerber's 6-year-old German Wirehaired Pointer, Joshua. Gerber recalls, "Jim and I just finished lunch and Joshua was sitting alongside of us. Suddenly there was a giant blast overhead and the pressure almost knocked us off our feet." They had felt the air-blast of an avalanche coming off of the slope above the lake, but the moving snow didn't reach them. They decided to leave, and, without wasting any time, headed down the trail with Joshua close behind. On their way out of the bowl, they met the Richards party coming up the trail. They told them what had just happened and that it might not be safe to go up to the lake. But the four skiers proceeded on. Garrett and Gerber had continued only a short distance when they heard another rumble and looked back to see an avalanche pour out of the bowl above the lake. They couldn't see the four skiers they had just talked to who were out of sight behind a knoll, but they feared the worst and turned back toward the lake. But there were two other skiers in the bowl that could see the Richards party.

At 1445, Nancy Lowe, 30, and Ronald Stein, 38, just started to eat lunch near the northeast shore of the frozen lake, and noticed the four skiers crossing it. At about 1500, Lowe saw a slab of snow break loose from the mountainside above the skiers, who had traversed a short way above the lake. She remarked to Stein, "I hope those people will be all right." Then, "Look at the snow. Let's move!" Lowe and Stein quickly sought shelter behind some trees but were overtaken by the powder cloud

and mostly covered in the swirling snow. It took several minutes to dig themselves out, and as they did, they could hear cries for help coming from the direction of the avalanche.

Rescue

Realizing what had happened, Lowe went for help while Stein rushed toward the victims. He was met by Garrett, Gerber and Joshua returning to the area. They quickly located Kim and Swenson who were buried up to their shoulders in the debris but otherwise unhurt. Within 20 minutes, Kim and Swenson were freed, and they all began the grim task of probing with skis and poles for Robin and Takagi. It was about 1530 when Gerber noticed Joshua some 30 feet away on another part of the debris.

"After a few minutes he began sniffing the surface quite intently, and started pawing the snow," Gerber recounted later. "I walked over and saw a ski he had partially uncovered." At that point, everyone was alerted to the discovery and focused their efforts in that area. After digging as best they could without shovels, they uncovered a hand. The fingers moved! It was Takagi, and he was alive and unhurt after being buried under 3 feet of snow for about 45 minutes. It took several more minutes for them to pry Takagi from the avalanche's grip, and by the time he was free, the chances of finding Robin alive had grown slimmer.

Now six rescuers resumed the laborious chore of probing and searching through the debris. At about 1615, some 7 feet away from where Takagi was found, Garrett struck a soft object with his ski pole a few feet below the surface. They dug down to find Robin's pack, and within 15 minutes uncovered Robin who was unconscious and not breathing. The group administered CPR but their continued efforts were unsuccessful. It was getting late, and it was snowing and blowing. The group decided that for their own safety the only thing to do was to leave Robin there and retreat back down the trail.

While the others were searching, Lowe made her way back to Alpental to summon help. Her efforts resulted in an all-out mobilization of available resources. She alerted Alpental Security who set the rescue in motion. The King County Police was notified of the accident at 1611. In turn, Chuck Waggoner of the U.S. Forest Service put together a rescue team with initial personnel obtained from the Snoqualmie Summit Ski

Area, which was the only ski area operating on the pass that day. SPART (Ski Patrol Rescue Team) was mobilized to perform the rescue, and the BEARS (Boeing Employees Amateur Radio Society) were called to help with necessary communications. The Alpental Day Lodge was made available if needed, and Jim Hilliker, Crystal Mountain Ski Patrol Director, offered his services from Crystal Mountain Resort.

At 1720, Bruce McKim lead the first SPART team toward Source Lake. In just over an hour they met up with the downcast survivors coming down the trail and learned that Robin Richards had not survived the avalanche. Shortly after 1900, McKim radioed the rescue leader that both groups were on their way out together due to weather and avalanche conditions. They could hear avalanches rumbling down behind them as they skied out. All were down and accounted for at 2055. In safer conditions, Richards body was brought out under clear skies the following afternoon.

Avalanche Data

The fatal avalanche was estimated to be 300 feet wide, running some 2,500 vertical feet before crashing onto the lake in the runout zone. The deposition was from 6–10 feet deep. Other avalanches also ran in the area from snow-drifted lee slopes, but luck held and these didn't reach the rescuers. A portion of the U.S. Forest Service Avalanche Advisory stated: "The recent snow is interspersed with thin layers of melt-freeze crusts due to intermittent solar radiation during the past week. The poor bonding between these crusts, and the subsequent new snow, has provided several weak layers within the snowpack resulting in the high avalanche hazard."

Comments

While this appears to be a rare case in which the victims were caught by a natural avalanche, it must be noted that the group was starting to traverse up the slope above the lake. It is not uncommon for avalanches to be triggered from the lower portion of the slab, or compression zone, which may have been the case here.

The best clue to instability is the presence of recent avalanches. A natural avalanche had just run in the immediate area of the victim's destination, but the group ignored this sign and continued on. Another warning of unsta-

ble conditions was the U.S. Forest Service snow and avalanche recorded telephone message for the weekend. It specifically mentioned dangerous avalanche conditions near Source Lake, and recommended backcountry travelers avoid that area, among others. An avalanche advisory for a high hazard was also posted in The Seattle Times on the 11th–12th. It is not believed that any of the parties in the bowl that day inquired about the avalanche conditions before venturing up the trail.

The accident site was relatively close to the highway, ski areas and available manpower. But this should not mislead people into believing there will be a speedy and successful rescue should an accident occur. In this case, some SPART members who were called out spent 2 hours trying to get up the pass in snarled traffic; others didn't make it at all. There were some problems with radio communications because a previous night's aurora was causing difficulties in reception, and inclement weather hampered the SPART rescue team going to the site.

The best chance to recover a buried avalanche victim alive comes directly from his companions, provided they have the right equipment and know-how to use it. Kim and Swenson had avalanche transceivers, but Robin and Takagi (both buried) did not. No one carried the most essential tool—a shovel. Obviously, a stroke of good fortune occurred when Joshua, though untrained in avalanche rescue, located Takagi's position. This prevented his almost-certain death as the party said later that they would not have probed that area for another 15–25 minutes. Takagi was lucky to have lived long enough (about 45 minutes) to be found alive under 2–3 feet of snow. Statistically, an avalanche victim has only a 50 percent chance of surviving after being buried for 30 minutes. Kim had the presence of mind to put his hand in front of his face to form an air pocket, then thrust his arm up through the surface to clear a large air space to the outside world. He would not have been so fortunate had he been deeper or upside-down.

Fatal avalanche accidents are devastating to all involved. Not only does the victim lose his life, but family members are profoundly affected as well—Robin Richards was a soon-to-be-father of his first child. The Source Lake area is not a stranger to tragedy. Two girls, ages 10 and 14, perished in an avalanche while

snowshoeing with relatives in the same area in January, 1974. Their bodies were recovered 7 months later.

"If you can warn people about being prepared for avalanches, maybe something good can come out of this tragic situation," said Robin's brother, Kim. "It's really important to have probes, beepers (avalanche transceivers) and shovels."

81-21

JUNE 10, 1981

Mt. St. Elias, Alaska

2 climbers caught, 1 partly buried and injured, 1 buried and injured

Weather Conditions

"Picture perfect." Southeastern Alaska in early June is bathed in abundant sunlight (1 hour of complete darkness between 0000 and 0100), provided no storms are moving on-shore, which is more often the case.

Accident Summary

The climbers, Charlie Campbell and companions Mack Ellerby, Ted Handwerk and John Iltis, had a goal few men ever aspire to—climb to the summit of 18,008-foot Mt. St. Elias, Alaska's second highest peak. (Only Mt. McKinley at 20,320 feet is higher.) To decrease their chances of being caught in spring avalanches dropping from thousands of feet above them, the team climbed at "night" when the sun was at its lowest point. This also kept them cooler as they ascended to Russel Col, the start of the North Ridge route.

On June 10, the group began another evening of moving supplies up to their next camp. They could hear avalanches running in the distance, "...as commonplace as passing automobiles back in downtown Denver." Campbell separated the team into two groups to keep the four climbers from all being caught in a slide should one come down from above them. Iltis and Handwerk followed some 600 feet behind the roped-up leaders Campbell and Ellerby. Their immediate goal, Russel Col, loomed directly ahead as terrain features began to lose their shape in the dimming light.



Figure 12. Accident 81-21, Mount St. Elias, Alaska, June 10, 1981.

For additional safety, they chose a route that skirted the more dangerous North Wall of Mt. Saint Elias by about a mile. Campbell and Ellerby heard an avalanche release near the summit and stopped to assess their position in relation to the slide. This had become second nature during the expedition. They figured the avalanche was larger than most coming off the peak, but that it would stop at the base of the face and short of their location. They continued on for another 10 minutes when they heard another slab break loose from near the summit. They soon realized this avalanche was much larger and skied away from it as fast as they could.

On its plunge from the peak, the avalanche struck a large, prominent field of ice, bringing

everything down onto the glacier where the climbers scrambled for safety. The two leading climbers skied recklessly across the smooth, hard ice of the glacier to get out of the path of the roaring snow. Campbell felt a tug on the rope linking him to Ellerby and turned to see his partner struggling with one of his ski bindings. The huge snow and ice avalanche was bearing down on them with tremendous speed and they were struck almost immediately. Campbell was knocked unconscious and Ellerby was tossed and hammered violently by the churning mass. Survival techniques, such as swimming to stay on the surface, were impossible.

When the avalanche stopped, Ellerby was alive with his head and shoulder above the

surface; Campbell was nowhere to be seen. When he regained consciousness, he could see the pail blue color of faint light, but couldn't move. Breathing was very difficult with his mouth packed with snow, and his chest compressed from the weight of the crushing snow around him. "I gave in to what I knew faced me," Campbell said later of his experience.

Rescue

Iltis and Handwerk were near the edge of the avalanche and were only struck by the airblast, which nearly knocked them off their feet. They dropped their packs and, with ice axes and shovels, rushed to the aid of their companions. When they got close, they could hear Ellerby shouting and found him easily in the rubble. Though he wanted to be dug out, Iltis and Handwerk took only enough time to assess his condition and turn off his avalanche beacon. They had to find Campbell as fast as possible.

The rope between Campbell and Ellerby had been completely buried; there were no surface clues. The rescuers switched their transceivers to "receive" and spread out to look for Campbell. In a short time they picked up his signal and closed in on his location. Suddenly, Iltis spotted a tiny piece of yellow webbing in the snow. It was part of Campbell's pack which he was still wearing. They soon found that their plastic shovels were useless in the hard debris and resorted to ice axes to frantically chip away with at the ice encasing Campbell. He was eventually found 3 feet below the surface, blue in color and not breathing. Blood oozed from injuries he sustained during the grinding ride. As they dug to expose his chest, Campbell coughed out the plug in his mouth and began the painful but glorious chore of breathing. He had been buried in the ice and snow for some 15 minutes, and it took another 10 minutes for him to gain his senses. Iltis continued to free Campbell while Handwerk ran back for a sleeping bag. Ellerby, in the meantime, was busy digging himself out. They placed Campbell in the sleeping bag and dragged him back across the glacier to camp where he could recover from his violent shaking and hypothermia. Ellerby had lost all of his equipment but was able to use Campbell's skis to painfully follow the others back to camp.

Ten days after the accident, per previous plans, a glacier pilot flew over to check on the climbers. They radioed their plight, and he

summoned a helicopter to pick them up. They later received medical attention in Seattle which revealed that Ellerby had suffered only severe bruises with no broken bones. Campbell had a sprained back and sustained various cuts and bruises.

Comments

As do many adventurers, Charlie Campbell and his fellow climbers knowingly put themselves in a potentially hazardous situation. They were far from immediate help and without direct communication to the outside world should an emergency arise. The team relied on their experience, training and physical ability to get them through tough situations, and they accepted avalanches as a calculated risk in pursuit of their love for climbing.

This accident could have ended in tragedy with four lives lost. It reminds us that even the most-experienced people can suddenly find themselves in a life-threatening situation with little time to react. Campbell and Ellerby were lucky to have been caught near the edge of the avalanche where it had less energy—the center of the slide deposited debris 6 feet deep for 2 miles. These were Campbell's observations regarding the outcome of the event:

"The only explanation of our miraculous survival, aside from pure luck, was that we had faithfully taken every possible safety precaution. On my eight previous climbing expeditions none of us ever used avalanche beacons. It was at my insistence that everyone had to wear one on this trip. I guess I got smart just in time! Our choice of route, the intentional separation of our party, our avalanche beacons and the fact that we were trained to use them, all helped stack the deck in our favor against the 'white death.'"

The group did all they could to prepare for an avalanche accident, but it hardly seems that the deck was "stacked in their favor" with avalanche activity "as commonplace as passing automobiles." In light of this fact, it would have been wiser to wait for conditions to stabilize, or abandon the peak ascent altogether. Turning back is a very difficult decision to make after significant time and money have already been spent on an expedition.

Note: This accident was taken from the story, "You Only Live Twice" by Charlie Campbell, in the *Journal of Unconventional Skiing*, pub-

lished in 1981 by Paul Ramer of Golden, Colorado.

81-22

JUNE 21, 1981

Mt. Rainier, Washington

22 climbers caught, 11 buried and killed

Weather Conditions

From the observations by Bruce Hevly, a professional mountain guide on Mt. Rainier, spring climbing had been precarious because of the light winter and heavy spring snowfalls. He said that there was "an awful lot of snow up here on an unstable base." The weather was cloudy before dawn as the climbers left Camp Muir, but mild at the time of the avalanche with no wind and clear skies. They had climbed above the cloud tops.

Accident Summary

On Saturday, June 20, an organized group of 29 climbers, ages 21–42, set out on a two-day expedition to climb Mt. Rainier, the highest peak in Washington at 14,410 feet. Mt. Rainier National Park surrounds the now-extinct volcano that lies some 50 miles south-southeast of Seattle. Hikers, climbers and skiers are attracted to this popular area throughout the year.

The group took the Camp Muir route and was led by six Rainier Mountaineering, Inc. (RMI) guides. RMI, a concessionaire of the park, is a reputable guide service co-owned by veteran climber Lou Whittaker (Lou's twin brother, Jim, was the first American to reach the summit of Mt. Everest) and Gerald Lynch. Lou Whittaker's son, Peter, was on the fatal climb. (See 85-11 for another accident involving Peter Whittaker.)

The group's goal on Saturday was to reach Camp Muir and spend the night in stone cabins at 10,000 feet. From there they would make a summit attempt early Sunday morning. Their route would take them across the Cowlitz Glacier and over Cathedral Rocks to Ingraham Flats at the base of Disappointment Cleaver, a prominent, rocky ridge on the southeast flank of Mt. Rainier. From there they would climb along the rugged, 12,300-foot-high Cleaver to

gain access to the steep, crevasse-laced snow fields leading to Columbia Crest, the highest of three points on the rim of the crater.

In the pre-dawn hours of Sunday, 29 people started their climb toward the summit. They traversed the Cowlitz Glacier and scaled Cathedral Rocks. Larry St. Peter, 40, recalled that the party climbed 1,000 feet above Camp Muir and crossed a 45° slope approaching Disappointment Cleaver. The going was difficult because of the recent, deep snowfall, and upon reaching Ingraham Flats at about 0600 the group took a break. Three guides scouted the route ahead for avalanche conditions while the climbers casually visited in the rising sun, ate snacks, and took pictures of the magnificent view from their position some 2,000 feet above the cloud level.

As the group prepared for the next leg of the ascent, Paul Kulhanek, Jim Byrne and Robert Hammon decided not to go on and headed back to Camp Muir with one of the guides. A short time later there was the sound of a loud crack from above, and the roar of tons of falling ice and snow filled the air. St. Peter looked up to see the wall of frozen rubble rushing down on them. He yelled, "Avalanche," and the remaining two guides yelled, "Run!" People dashed for cover as best they could.

St. Peter was roped to two other climbers, Ted Fensetter and Robert Mullen, which made running difficult if not impossible. After a few strides, Fensetter was struck by the avalanche, which immediately stopped his tethered partners. In the next few seconds, 22 people were being swept toward a crevasse 200 feet down the mountain. St. Peter, thinking he would surely be buried, curled up in a ball for protection and to create an air pocket. But his small party was near the edge of the slide and only carried 50 feet. The three had survived the avalanche, but Mullen sustained broken ribs in the process. Eight other climbers stopped just short of being carried into the chasm; but 11 people were pushed over the lip and covered some 70 feet deep by wet, spring snow and chunks of ice, "some as big as cars," witnesses said.

Another survivor, Cordell Berge, 40, described the initial sound of the ice fracturing from the glacier as "louder than an explosion," and said, "you could hear a tremendous roar, just like a train." That was just before he and four others, all tied together with 15-foot lengths of rope, were hit by the onslaught of

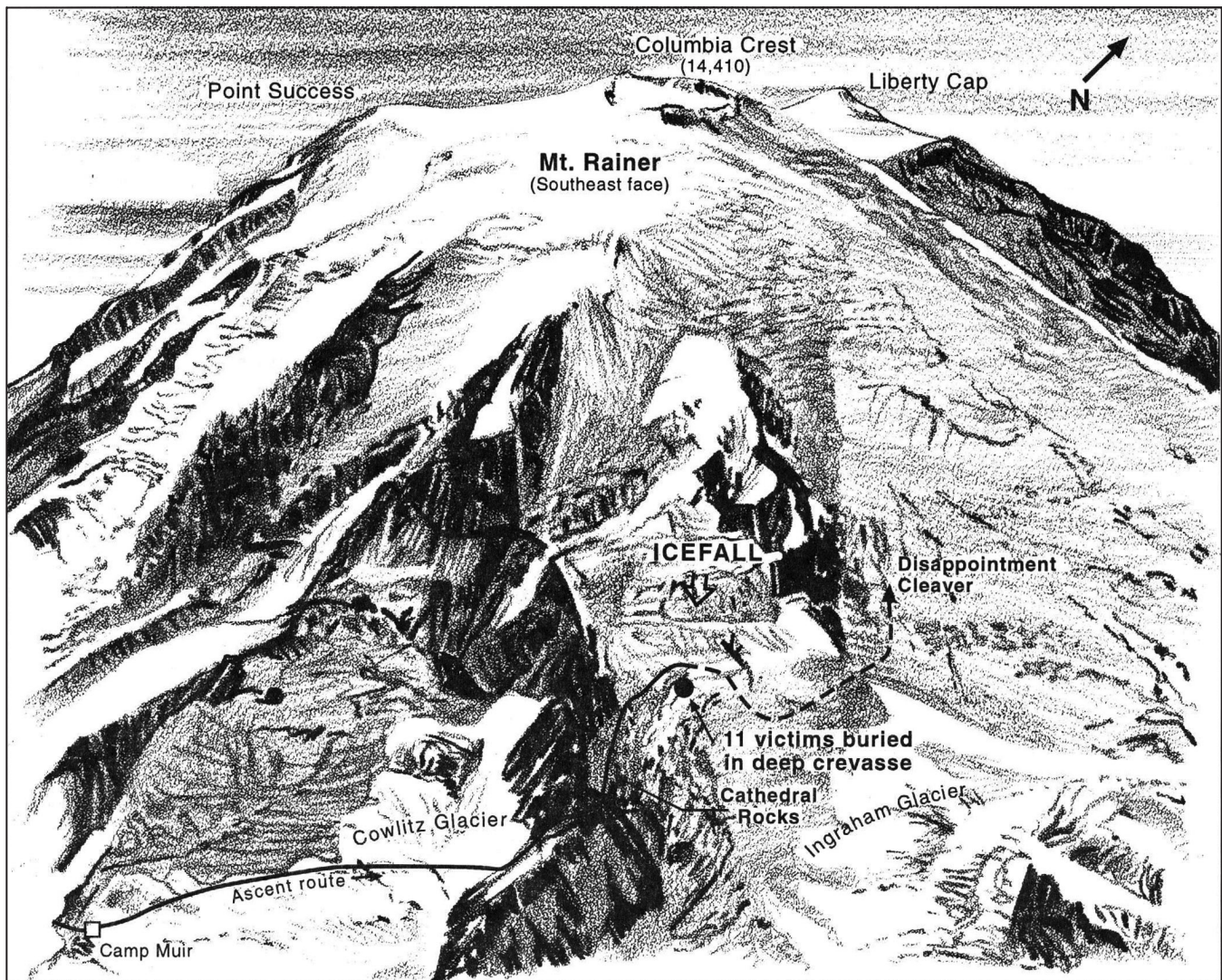


Figure 13. Accident 81-22, Mount Rainier, Washington, June 21, 1981.

ice and snow. They tried to run, but sank into the fresh snow with each step. "It was like standing in the ocean and getting hit from behind by a tremendous wave." Four groups were sitting near each other and three were swept into the crevasse. Like St. Peter's group, Berge's small party of five survived. He said that "it was the few feet (separating the groups) and split seconds that made the difference between survival and vanishing."

Rescue

All of the survivors were able to dig themselves out easily. Quiet had again returned to the glacier as they gathered their thoughts and surveyed the altered landscape. But there was no sign of their gear, nor 11 mountaineers that

had been there just 30 seconds before. They quickly moved off to the side of the glacier to avoid any more avalanches. The guides posted an avalanche-guard to warn them if more snow broke loose from above while they searched the debris for more survivors. None had been found after searching for nearly an hour and the remaining group descended to Camp Muir.

By turning back early, Kulhanek, Byrne, Hammon and their guide avoided the tragedy. They didn't see or hear the avalanche but learned of the accident from park ranger Gary Olson, who received a radio call from the guides at 0630. Olson, the guide and Kulhanek returned to the site to help with the search while Byrne and Hammon stayed at Camp

Muir to prepare hot drinks for the survivors. Without any success at finding more victims, the entire party later descended to the Paradise Visitors Center in white-out conditions with visibility a mere 30–50 feet. There they were treated for minor injuries and comforted at the loss of their friends.

Upon learning of the accident, Lou Whittaker assembled a 10-man rescue team Sunday afternoon and began the climb to Camp Muir. They were joined later by another team of 12 rescuers battling the elements to get to the camp, and all spent the night in the two stone huts. Bad weather on Monday kept the rescuers pinned down most of the day, and helicopter air support from nearby Fort Lewis in Tacoma was unable to reach the accident site. By late afternoon, conditions improved and the team proceeded to the avalanche. They searched 2.5 hours using shovels, probes, and ice saws but found nothing. Another attempt on Tuesday failed to turn up any sign of the missing climbers and the search was abandoned with virtually no hope of their ever being found.

Avalanche Data

The 500-foot-wide wall of snow and ice that broke off the glacier was a natural occurrence and not triggered by the climbers below it. It fell some 1,000 feet before smashing into the mountaineers. Recent heavy snows and warm spring temperatures were the likely causes of the avalanche. Lou Whittaker recalled a recent climbing party trudging through snow “up to their armpits.” A guide for another climbing concessionaire on the peak, Bruce Hevly, said he had noticed a lot of avalanches that spring, “probably due to the light winter and heavy spring snowfalls.”

Comments

Prolonged exposure to avalanche danger increases ones chances of getting caught in a slide. A skier’s risk-time is relatively short while making turns down a slope. Climbers, on the other hand, are exposed to the hazard for much longer intervals.

Former guide and ranger at Mt. Rainier National Park, Dee Molenaar, said that he had never seen avalanches in the Ingraham Flats area, and that the Ingraham Glacier route is popular because it is generally the easiest and safest. Avalanches in that area usually get stopped by terrain features far above the acci-

dent site. He also added, “the mountain is always unpredictable.”

Gary Gregory, a park officer, described the RMI guides as “the best around.” Indeed, they were alert to the snow conditions and avalanche potential, and based their actions accordingly. Two of them stayed with the climbing party in a normally safe place while three others went ahead to evaluate the hazard. Ironically, those waiting behind were the ones struck by the avalanche.

Though unsuccessful, the survivors and guides did all they could to locate the buried victims. This was a rare incident because of Ingraham Flats’ history of being safe, and the fact that the avalanche terminated in a deep crevasse. Once the victims were pushed over the edge, there was little hope of their being rescued. Their bodies will probably never be recovered from this climbing accident, the worst in U.S. history. A similar incident occurred almost 1 year to the day from this one on Mt. Hood in Oregon. (See accident 82-16 for details.)

81-23
DECEMBER 3, 1981

Thompson Pass, Alaska

1 motor home and 6 occupants caught and partly buried; 1 person buried outside vehicle; 1 snowplow and driver caught and partly buried

Weather Conditions

On Thursday, December 3, a strong storm moving through southeast Alaska brought heavy snow and strong winds to the region. At 0400, George Levasseur, acting Superintendent of the Alaska Department of Transportation (DOT), reported 18 inches of new snow and poor visibility at the Valdez Airport. Nineteen miles north on Richardson Highway over storm-battered Thompson Pass, conditions worsened with periodic whiteouts and poor driving conditions.

Accident Summary

Shortly after 0800, Levasseur drove to Thompson Pass to check on the situation. At Mile 38 (term used for locations along the

highway north of Valdez), he met a tired Jack Townsend who had been plowing the Richardson Highway throughout the night. They talked about the plowing schedule, available equipment, and parts needed for Townsend's plow. Levasseur said he would retrieve the plow parts from Valdez after he checked out the rest of road. He later notified the DOT office in Valdez that the weather was deteriorating. On his return down the pass he advised drivers going up that conditions ahead were very poor. Some turned around while others proceeded on.

Also on the highway that day was Joe DeMattia. He was on his way to Anchorage with his two sons and three other teenagers to watch a high-school sports competition that weekend. Travelling with them in his motor home were Harry and Jane Barnum who planned to visit relatives and do some Christmas shopping. It was very slow going but the motor home was equipped with chains and was able to break through the drifts. It got stuck, however, trying to push through a pile of avalanche debris blocking the road at Mile 39.

DeMattia's son, Tom, left the vehicle to get help and caught a ride back south with one of the cars that had been following them. At about 1700 hours, Townsend pulled up behind the motor home in his plow. DeMattia got out and was walking toward the plow when he was engulfed in a whiteout. Townsend recalled watching him put his arm up to protect his face and then lost sight of him in the swirling snow. Within seconds, his cab windows shattered and snow poured in around him. Townsend realized this wasn't just another burst of driving snow. It was an avalanche!

When the dust cloud settled, the big truck was upright but buried up to the hood. With only minor injuries, Townsend crawled out of the plow and found the motor home some 100 feet away. It had been pushed over the road bank and partly buried, but he couldn't get to it because he was sinking too deep in the fresh avalanche debris. After yelling to the people inside to stay where they were, he made his way back to the plow and radioed the Thompson Pass shop to tell what had happened. He was instructed to walk back about 2 miles where he would be picked up at the Tsaina bridge. He left not knowing DeMattia's fate.

When the avalanche struck, DeMattia had just enough time to dive behind the blade of the plow, where he was buried. He could bare-

ly move and was dressed in only light clothing, but he began the slow, arduous process of digging himself out. The plow was left running and DeMattia, not knowing Townsend had left, feared the driver would try to move the truck and he would be crushed.

Rescue

Late in the afternoon, after getting the parts in Valdez for Townsend, Levasseur drove back up the pass only to be turned back by impassable road conditions at Mile 16. He soon learned over his DOT radio about an avalanche accident involving a snowplow and motorhome at Mile 39. He also heard colleague Dick Walker call to evacuate the area because of the avalanches coming down nearby. Levasseur closed the road at Mile 12 and called for a plow to clear out a turnaround for traffic and a staging area for the rescue. He was joined by a Valdez police officer and they prepared for the rescue.

Rescuers from Valdez met at Mile 12 and they started up through the canyon, led by a DOT snowplow. They were soon blocked by an avalanche across the road and forced to return to Mile 12 while a front-end loader from the other side cleared a path through the debris. After some 45 minutes the route was reopened and the convoy again headed north for the building at Thompson Pass. In the meantime, Levasseur returned to Valdez with two other men to get warm clothes, rescue gear, and medical supplies. They arrived back at the pass at midnight with the equipment. At about 0100, two vehicles set out for Mile 38 through heavy falling snow on a drifted road. Among the occupants were Corporal Ron Polk, Alaska State Trooper; Lynn Harkins, director of Valdez Emergency Medical Services; Mark Lewis, Valdez City Manager; and George Levasseur. In the dark, Levasseur listened for more avalanche activity but couldn't hear any. (The slide that buried DeMattia was silent.)

At 0230, the weather began to clear. Jack Morrow, lead avalanche coordinator for DOT, called Levasseur on the radio and said he was en-route to the pass. A multi-passenger snowcat, trucked in from Alyeska Pipeline Service company, arrived at the pass as did Morrow about an hour later. The stars were out and the temperature had dropped 10°F. After some discussion, Morrow and Levasseur decided it was safe to proceed to the accident site.

About the same time, avalanche expert Doug Fesler of the Alaska Division of Parks, called the Thompson Pass building by phone from Glennallen which was north of the accident. He talked to Corporal Polk and Levasseur and explained that he had been appointed Site Commander by Trooper Sergeant Cockrell and put in charge of the rescue operation. By state statute Alaska State Troopers are in charge of all rescues, and Trooper Cockrell was acting within his authority.

During their conversation, Fesler learned of Levasseur's plan to go the accident site. Fesler said that it was too dangerous and that no one would be authorized to move until daylight when an assessment of avalanche danger could be made from a helicopter. The Alaska Mountain Rescue Group, Valley Alpine Resue Team, National Ski Patrol, Dogs Organized for Ground Search, a helicopter, and a 105 millimeter howitzer with 48 rounds of ammunition were all being coordinated into the rescue operation. But Levasseur argued that those on the south side of the avalanche considered the conditions to be safe and that they were prepared to go in. After further discussion, he reluctantly agreed to await further orders. Fesler then left Glennallen for the road-block and rescue staging area at Stuart Creek and arrived in a little more than 1 hour.

It was still pitch black at 0700 when a faint call came over the radio. "Can anybody hear me?" uttered a voice in the dark. It was DeMattia. He had dug his way free from beneath Townsend's plow, and had crawled into the cab through the broken window. He supported the microphone in one frozen hand and pushed the transmit button with the other. Deputy Commissioner Ryan, on the north side of the avalanche, responded and told DeMattia to stay where he was and that they would get to him at daylight. Morrow, still anxious on the south side of the avalanche, radioed Ryan that they were ready to go. DeMattia radioed again asking for help. In a few moments, Ryan called Morrow and gave him to go-ahead. Fesler, however, did not hear this conversation because the only radio he had was malfunctioning.

Corporal Polk allowed Morrow, Harkins, Lewis, and Levasseur to pass through the road block, but no one else. They drove as far as they could (less than 1 mile) before they started to walk through the deep snow and over avalanche debris piled across the highway. In

about half-an-hour, Levasseur and Morrow were close enough to see the flashing lights of the snowplow. Harkins and Lewis were having a hard time in the deep snow and followed farther behind. They reached the plow and found DeMattia. Levasseur, on showshoes, easily found the partly-buried motor home and assessed that the occupants were allright. DeMattia, however, suffered from hypothermia, frostbite and back pain, and would require evacuation soon. They called for the snowcat to come in and start bringing out the victims.

Fesler was apprised of the recent events upon reaching the Stuart Creek Staging area. He said he didn't recommend using a snowcat because of the avalanche danger, but wanted them to wait for the helicopter which would be there shortly. It arrived at first-light but flew over the staging area without stopping. Fesler scrambled to find a radio to communicate with the pilot. Eventually he returned, picked up Fesler, and they assessed the area for further avalanche danger. From aerial observations, Fesler estimated that only 20 percent of the starting zone above the accident site had actually released.

After widely skirting the avalanche starting zones to avoid triggering another slide, the helicopter set down at the accident site but stayed under power to keep from sinking in the soft snow. Fesler, Morrow, and Levasseur discussed the situation, including equipment and manpower needed. Fesler flew back to Stuart Creek (a 2-minute flight) and sent the helicopter back with three men and rescue equipment. They established an avalanche guard and a safe area to retreat to should another slide release. One by one the motor home occupants were were brought up to the road and, after 20 minutes and several shuttle trips, seven avalanche survivors and seven rescuers were evacuated from the area.

Avalanche Data

The snowpack was very unstable on December 3. Several avalanches reached the highway as a result of this strong storm. The second avalanche at Mile 39 was much larger than the one that DeMattia got stuck in. It had enough energy to both move and damage vehicles. It is interesting to note that, in contrast to most avalanches, the debris remained soft for a long period of time following the avalanche. Following the rescue, five artillery-triggered

slides were released above the road, but did not reach it.

This was not the first time for this avalanche path to act in a similar manner. A fatal accident occurred here on January 8, 1958, when a tractor-trailer rig was blocked by an avalanche across the highway. It could neither proceed nor back up, so the driver waited for the road to be cleared. A second avalanche struck and carried the truck to the Tsaina River below, killing the driver.

Comments

This was a complicated rescue, fraught with problems from the beginning. A number of circumstances made it difficult to effect a smooth operation. Here are a few:

- 1) The accident occurred many miles from the nearest source of help.
- 2) Access to the site was blocked by subsequent avalanches across the highway, which also signified the avalanche danger was high.
- 3) Darkness prevented an assessment of the avalanche danger to rescuers or the victims, and thus held up the rescue for more than 12 hours.
- 4) Some radio equipment malfunctioned, and at times there was not a radio available to reach a specific party.
- 5) Rescuers came from two directions, and there was no central staging area from which to coordinate. This contributed to a breakdown in communication between Fesler, who was in charge of the rescue, and other officials who eventually overrode standing orders to stay put until daylight.
- 6) To make matters more trying, there were multiple victims and no one was sure of their condition.
- 7) When the rescue was over, the pilot was instructed to return to the staging area and pick up Fesler to do another inspection of the road to see if there might be other vehicles trapped. But the pilot didn't come back and the Trooper with the only radio capable of communicating with the helicopter had left without notifying Fesler.

Surely, hearing DeMattia's pleas for help over the radio reinforced the sense of urgency to reach the accident site. In this case very little time was saved when four people overrode judicious safety decisions and risked unknown

avalanche danger in the dark to reach DeMattia. Where several "official" entities are involved, especially when complicated by the difficult logistics mentioned above, it is imperative that only one person be in charge and the chain of command not be broken. The primary responsibility of any rescue leader is for the safety of his people, and the safe recovery of the victim(s). It was fortunate that another slide did not come down on Levasseur's party causing injury or death, both for them and for the legal ramifications that surely would have followed such an incident.

Much to his credit, Joe DeMattia fought hard to stay alive and won out over the avalanche that almost took his life. He had the perseverance, determination, and will to overcome his burial.

81-24

DECEMBER 20, 1981

Turquoise Lake, Colorado

2 hikers caught, 1 partly buried, 1 buried and killed

Accident Summary

On the afternoon of December 20, Vernon Westbrook, 24, and friend Paul Drobnik, set out to do some rock climbing. On the west side of Turquoise Lake, 3 miles west of Leadville, they left their car at about 1630 to climb some nearby cliffs. To reach their destination they had to cross a steep bank above the road. At some point during their traverse Westbrook felt the snow moving and yelled, "Avalanche!" The slide swept both of them back toward the road. Drobnik tried to swim out of it and was only partly buried. Westbrook was less fortunate. He was carried to the road and buried under 4 feet of snow.

Rescue

Drobnik searched the debris for about 20 minutes but could find no sign of his friend. He then drove to a phone at a nearby campground and notified the sheriff's office of the accident. The local search and rescue group was alerted, and by 1730, some 15 volunteers had responded to the staging area. An ambulance also

stood by, ready to care for the victim when he was found.

By 1800, rescuers were at the accident site and probing for Westbrook. It took an hour and 45 minutes of probing before the victim was found. He was transported to the awaiting ambulance, and rushed to the hospital where he was pronounced dead of asphyxiation at 2024.

Avalanche Data

Little is known about the physical properties of the avalanche. The snow was described as being "rotten," and was probably comprised of depth hoar near the ground due to the lean snow year, and heavier, damp snow near the surface from the recent warm temperatures in the area. It was likely a shallow snowpack, less than 2 feet deep, and ran on the ground. The small slide, an SS-AF-3, ran only about 150 vertical feet.

A sympathetic avalanche ran just west of the fatal slide. It released a little lower than the first one, but ran farther down slope and well into the trees. This is a good indication of the overall weak snowpack conditions in the area at the time of the accident.

Comments

This accident points out that one does not have to be deep in the backcountry to find dangerous avalanche conditions. Nor does the avalanche have to be large. These two young men were merely looking for some rocks to climb. They were not pushing the limit as some do in pursuit of extreme skiing or mountaineering. Instead, they found conditions that were right for an avalanche: a weak snowpack clinging to a steep slope. They simply provided the trigger that set the slab in motion.

Without avalanche rescue gear (transceiver, shovel and probe) Drobnik could do little more than look for surface clues on the debris. However, he did the right thing by searching as best he could before going for help. Westbrook did not die from injury, but from suffocation. Proper equipment, rescue training and practice could have made the difference in this accident, resulting in a more favorable outcome. The following accident (81-25) that occurred at Aspen Highlands clearly shows how this can pay off.



81-25

DECEMBER 27, 1981

Aspen Highlands, Colorado

1 ski patroller caught and buried

Weather Conditions

Snowfall at Aspen Highlands had been about average for the month of December. In the 5 days leading up to the accident, a slow-moving cold front gripped the Colorado mountains. The ski area received 13 inches of light density snow, with an additional 7 inches new on the morning of the 27th. Prior to this cold snap temperatures were in the upper 30s to low 40s. But these quickly dropped to -11°F at night and only single digits to low teens for daytime highs. Winds had been generally light but increased to 25 mph on the 27th.

Accident Summary

An avalanche control team was working in an area called Hot Meadow No. 27, a permanently closed area that threatened Park Avenue below. Park Avenue is an open traverse between the runs Upper Jerome and Arthur's. At 1055, Chris Kessler and Larry Lembke, both 25, had just thrown a 2-pound explosive charge onto the slope. It produced no results. To test the slope further, Kessler made a ski cut just below the bomb crater. As he did so, he took a hard fall that stressed the snowpack to failure and an 18-inch-deep fracture developed 15–20 feet above him. The avalanche broke loose, carried him some 250 feet down the steep, sparsely-treed slope and buried him. As the avalanche came to rest, and just before it immobilized Kessler, he made a small air pocket around his face. This bought him a little precious time while waiting to be found.

Rescue

Lembke lost sight of his partner in the churning snow. He immediately radioed patrol headquarters to notify them of the accident, then began to search for his partner. He found Kessler's skis and one pole on the surface, and a beacon search located Kessler in 2 minutes. He was buried in the upper end of the debris where the snow piled up on the road cut (Park Avenue) that traverses the slope.

Lembke found Kessler's foot just below the surface, but Kessler was nearly upside down with his head 4 feet deeper. He dug frantically

and reached Kessler's air pocket in another 2 minutes. Kessler was alive, but hypothermic and hypoxic. Help arrived and Kessler was freed from his icy encasement. He was given oxygen and transported to Aspen Valley Hospital for observation. No worse for the wear, he was back at work the next day.

Avalanche Data

This is not a large avalanche area, but it does pose a problem for the open ski run below and needs to be monitored closely. It is below timberline at an elevation of 9,000 feet, and is about 45° in steepness. The avalanche was 18–24 inches deep, 150 feet wide and ran about 300 feet. The debris was piled 5 feet deep on the road where Kessler was found.

Examination of the snowpack showed it to have all the ingredients necessary for an avalanche release. It was made up of depth hoar near the ground which supported a thin ice layer created by warm weather earlier in the month. On top of that was a fragile layer of surface hoar that tenuously held the recent new snow in place.

Comments

Kessler and Lembke were following normal avalanche control procedures at the time of the accident. Only one of them was exposed while the other watched from a safe location. In retrospect, a snowpit may have shown them just how weak the snowpack was. This might have prompted them to throw another bomb before going out on the slope, or kept them from doing any ski cuts until a further assessment was made.

This accident has similarities to the fatal accident at Turquoise Lake 7 days earlier (see 81-24 above). Neither avalanche was large or destructive, the primary threat was suffocation and not major injury, and both victims were found about 4 feet deep where snow piled up on a road. However, the people involved in this incident had a distinct advantage. Chris Kessler's own comments following the accident say it best:

"I'm alive because of the training of the patrol. Without that extensive training, they could never have dug me out so fast. If I had been alone without a beacon, or in the backcountry, I would have been dead. Luckily, it was a controlled situation." Sadly, less than 3 years later, Kessler would die in an avalanche (see accident 84-10).

If risks are taken, either by a professional or a backcountry recreationist, they should be taken only under the best conditions possible for a favorable outcome should an avalanche occur. This accident shows there is no substitute for having the right equipment and proper training when travelling in avalanche-prone terrain.

81-26

DECEMBER 29, 1981

Sugar Bowl Ski Area, California

1 out-of-bounds lift skier caught and buried

Weather Conditions

Very little snow fell at Sugar Bowl during the month of December. In fact, only 17 inches had fallen up to the 29th when 8 inches was recorded that morning. Heavy snow continued to fall during the day with up to 24 inches accumulating on the upper mountain. Winds increased to 25–35 mph for most of the day. This produced fast and heavy drifting on lee slopes. Temperatures during this time were mild. At about 1430, the temperature rose from 27°F to 30°F and remained there for the rest of the afternoon.

Accident Summary

It was a snowy day when Edward Marsh, 23, and his friend Martin Bauer, 20, strapped on their skis to enjoy some of the first fresh powder in almost 2 weeks. Near the end of the day while riding Lincoln Lift No. 2, Marsh dropped his glove into the snow below. To retrieve it, they skied back down Lincoln Road and traversed to the Waterfall area where the two separated. Marsh continued into the closed area to get his glove and Bauer skied back to the lift. Bauer rode the lift two times above Marsh as he looked for his glove. Both times he yelled at him to forget it and get out of the area.

Volunteer ski patrolman Ed Oda was riding the lift at 1525 and noticed Marsh, with no skis on, crawling and searching in the snow below. He called out to Marsh and told him that he shouldn't be in that area because of the avalanche danger. Marsh did not respond.

After riding a short ways farther, Oda saw what appeared to be a natural avalanche release in the upper Waterfall area. He turned in the chair and yelled, "Avalanche!" but could not see anything through the heavy snowfall. He immediately called the patrol and alerted them of the slide and that there was a skier in the vicinity. This area was closed to the public at the time of the accident.

The next time Bauer arrived at the bottom of the lift, the operator informed him of the accident. Realizing what must have happened, Bauer told him of the approximate location of his friend. Being a witness, he was told to stay put until someone could take him to the accident site.

Rescue

It was 1525 when the call came into the patrol at the Lincoln Blockhaus. The Lincoln Hill boss, Ken Kirschenman, organized a hasty search team and led the party to the accident site. At about the same time, six rescuers started toward the scene in a snowcat, including two witnesses, one of which was a doctor.

Manpower, witnesses and equipment converged on the accident site. The situation was well in hand, with patrol leader Bernard Scherrer stationed at Lift Operations as Incident Commander and assistant patrol leader Rich Bailey on the scene as Accident Site Commander with 12 rescuers.

A probe line was formed, and Marsh was quickly found under about 4 feet of debris on the third probe of the first pass. The time was 1555, and Marsh had been buried 30 minutes. Professional ski patroller and rescuer Michael Quinones remembered when Marsh was located: "We cleared his head of snow and I checked for breathing. The victim began to move. He was alive and well with no injuries except for being cold. His speech was slow and his motor ability was also slow. We finished digging the victim out and treated for shock and administered oxygen until he was able to walk out on his own...."

Avalanche Data

On the morning of the 29th, fresh snow and strong winds gave cause for the ski patrol to do avalanche control work and restrict the public to safe skiing areas. Their efforts with explosives and ski cutting were rewarded when several 2- to 3-foot-deep slides released

in the freshly drifted snow. Warm weather earlier in December created an ice layer that the new snow couldn't bond to. This was the bed surface of the morning's activity and the slide that caught Marsh. The avalanche was likely an SS-N-3-O with an 18-inch crown that failed when the slab, stressed from gravity tugging it downhill, simply couldn't maintain its grip on the slick, old snow surface.

Comments

For the skier's safety, most ski resorts have at least some terrain closed within their boundaries. The potential avalanche danger was one reason the Waterfall area was closed at Sugar Bowl when Marsh violated the closure. But this was Edward Marsh's lucky day. He beat the odds of dying from a burial of 30 minutes. Statistically, he had only a fifty-fifty chance of living through the ordeal.

Quick action on the part of witnesses and the ski patrol undoubtedly played a major roll in this live recovery. Without avalanche rescue gear and proper training, the same accident in the backcountry would have almost certainly resulted in death.

In an interview with Marsh by Sandy Bryson of WOOOF Search Dog Unit, Marsh said that he blacked out. This probably helped his survival by conserving oxygen. When Bryson asked him what he remembered of the avalanche he replied, "At first I wasn't aware that it was an avalanche. It was just like powder falling and building up around my shoulders. Then I realized that I couldn't move my body, couldn't see anything, that I was breathing very fast. I could move my arm a little bit and tried to dig out with that arm. I tried to slow down my breathing, I couldn't move," he said. By moving his arm, even a little bit, Marsh may have created a small air pocket. Trying to slow his breathing also helped buy time until rescuers reached him.

Marsh also indicated that he had no prior avalanche training and said, "The thing that shocked me the most about the whole experience is that I didn't know what to do!" When Bryson asked him about advice to other skiers who might end up in the same type situation, Marsh replied with a sound recommendation: "Learn about avalanches. Learn what to do if you are caught in one." We might add here that learning how to avoid avalanches through good route-finding techniques is just as important. In many cases, simply knowing

what to do if you're engulfed in a slide may not be enough to save your life. (A similar but less fortunate case can be found in 81-10.)

82-1

JANUARY 4, 1982

Squaw Valley, California

2 ski patrollers caught and buried

Weather Conditions

By California standards, the Squaw Valley ski area saw only sparse snowfall this fall and early winter. But to the skier's delight, winter returned when a strong and persistent storm pummeled the west coast at the end of December. Motorists were not so happy, though, as the storm closed Interstate 80 and numerous other highways, and also flooded lowland areas from heavy rain. The rain turned to snow in the Sierra Nevada where temperatures slowly dropped from the mid 30s to the 20s, and overnight lows dipped to 10°F by January 3.

Squaw Valley recorded 70 inches of new snow with 5.68 inches of water between December 29 and January 4. Even deeper snow accumulated in drifts and at the higher elevations. Ski Patrol Director Mark Mueller commented, "January 4, 1982, was the hardest I have ever seen it snow." An additional 34 inches of snow fell by the following morning. Only two of some 30 ski lifts were running due to blizzard conditions.

Accident Summary

It was near the end of the day when Jim Mott, 34, Assistant General Manager of Squaw Valley and also the director of avalanche control, along with patrol supervisor Sam Davis, 23, were finishing another extensive day of avalanche work at about 1500. They were returning to the base area and checking the clearance between the deep snow and a chairlift. The chair was closed at the time and the area they were in was closed to the public. Mott was in the lead with Davis following about 75–100 feet behind.

Mott heard his partner yell, "Here it goes!" Initially he thought Davis had triggered a

small slide somewhere behind him. But this was quickly dispelled as he was overrun by a wave of snow. He tried to grab a tree but it failed to hold him, and he was quickly carried down the slope. In seconds Mott was pushed up against a small tree and completely buried. He was conscious and able to breathe in a small air pocket around his face but was pinned tight in his icy encasement. Davis, too, was totally buried. Both men were beneath the snow and even worse, there were no witnesses to the accident.

Rescue

A successful rescue seemed highly unlikely for two reasons. First, no one knew where they were or that an accident had occurred. This would significantly delay the start of any search. Second, the area they were in was considered to be safe. No avalanches had ever been observed here and it would be one of the last places rescuers would look once Mott and Davis were discovered missing.

From his buried spot pinned against a tree, Mott could move his wrist a little. With considerable effort he was able to dig and extend his arm toward faint light above. In about 15 minutes, he finally broke through the snow surface with his fingers. This gave him some air but he was still trapped and getting very cold. He called out for Davis without success and feared the worst. Without quick help, he knew they both would perish. He had to alert the patrol of their plight.

There was only one way to let them know what had happened and where they were—radio for help. With all his strength and will to survive, Mott slowly dug toward the radio strapped to his chest. This took another 15 minutes and he knew hope was fading fast for Davis. As he was about to make the call, Ski Patrol Director Mark Mueller radioed to him asking how much explosives would be necessary for the following day. Mott responded that they would need 12 cases, and, by the way, he desperately needed help. He explained what had happened, where they were, and that he had enough air so look for Davis first. The time was 1530.

Mueller quickly organized the limited personnel available at patrol headquarters and requested search dogs from WOOOF, a California-based rescue organization. Rescuers loaded into snowcats that were idling outside and about to begin their evening of snow

grooming. Within 10 minutes, six ski patrollers and a dozen mechanics and snowcat operators reached the site of the avalanche.

Using his avalanche transceiver, Mueller successfully located Davis who was dug out from under of 3 feet of snow. He was shaken but all right. Mott was found moments later. He was extricated from an upright position with his feet about 7 feet deep packed in firm avalanche debris. The men had been under the snow for nearly 45 minutes. They were taken to the base area where they were warmed with blankets and warm drinks. They were in good condition despite their terrifying ordeal.

Avalanche Data

Abundant fresh and drifting snow in avalanche starting zones created a considerable avalanche danger at Squaw Valley. More than 160 slides were released by the patrol since the storm began late on December 28 up to the time of the accident, and many parts of the mountain were still closed for weather and safety reasons. During this time, another ski patroller was caught and injured while doing control work, and one ski lift was hit.

The avalanche slope faces southeast at 6,800 feet in elevation, and is about 27° in steepness. The slide was classified as an SS-AS-3-O. It was 500 feet wide and ran 200 vertical feet to the runout zone.

Comments

The avalanche that trapped Mott and Davis was an anomaly for this area. Perhaps due to its shallow angle (less than 30°) the slope had no prior avalanche history in some 40 years of observation and had thus never been controlled. Use of explosives and ski-cutting since the accident has yet to release another avalanche in this location.

Ironically, earlier in the day while on a control route, Mott noticed that his radio wasn't working. He decided to finish the route anyway but his team was out of contact with the rest of the mountain. His colleagues became concerned and were just putting together a search party when he arrived at the bottom of the mountain. Upon seeing the relief of his would-be rescuers he said jokingly, "I don't get caught in avalanches." (Compare this casual attitude with 80-1.) As a result of the accident that nearly killed Mott and Davis, avalanche control teams are now called on the

radio every 15 minutes to check on their status.

Jim Mott drew upon all his 15 years of experience to remain calm and do the right thing in this life-threatening situation. He kept a cool head and ultimately saved two lives. This incident also strongly reinforces the fact that regardless of a site's history or a person's knowledge and experience, avalanches remain unpredictable. Had this been a similar accident in the backcountry the victims most surely would not have survived.

82-2
JANUARY 5, 1982

Telluride, Colorado

1 Snow Ranger caught and buried, 1 ski patroller caught

Weather Conditions

Light snow totalling 32 inches fell over a 7-day period prior to January 5. Winds increased from the southwest causing snow to drift in lee areas and cornices to grow along the ridgetops. Some gusts were estimated to be 50 mph. Daytime temperatures dropped from the low 30s to low 20s and overnight lows reached below 0°F on the 2nd, 3rd and 4th. Light snow continued to fall on the morning of January 5.

Accident Summary

It was 0945 when Judd Wiebe, 33, Snow Ranger for the Uncompahgre National Forest, and ski patrollers Jim Gowdy, 42, and Jerry Wilcox left patrol headquarters. They hiked to an area called Mammoth Slide to investigate an avalanche that released a few days earlier. Traversing above the old fracture line, they came to an area that had not yet released.

Gowdy knocked several large chunks of cornice onto the narrow, tree-lined slope below called Mammoth Third Finger. This produced no activity so he proceeded to ski cut the starting zone and ducked into the safety of the trees. Wilcox followed with two ski cuts and then skied down and out of the path. It was now Wiebe's turn; the time was 1025. He made a cut and had just started to ski down when the avalanche broke loose. He was about 60 feet below the fracture line when the slab released and was immediately submerged in

the churning snow. He desperately fought to get back to the surface, but his efforts were useless and he remained buried when the snow came to rest. The slide fractured far enough back into the trees to knock Gowdy off his feet but he was not carried far.

Rescue

Gowdy immediately radioed the patrol to tell them of the accident, then joined Wilcox to do a beacon search of the debris. They soon determined Wiebe's general location, and within 2 minutes the search area was narrowed down to a few feet. They shoveled snow as fast as they could and found Wiebe at 1033 under 3 feet of snow.

When Wiebe was discovered, he was lying face up but unconscious and blue in color. Much to his rescuers relief, he began breathing on his own, but it took several minutes of administering oxygen before he was completely revived.

Avalanche Data

This avalanche was an SS-AS-3-O. It released on a north-facing, 35° slope at an elevation of 11,800 feet. The slide had a 4-foot-deep crown line and ran 400 vertical feet through a narrow opening in the trees.

Comments

Judd Wiebe survived this avalanche because of the quick action of his comrades. The group was carrying avalanche rescue gear and was trained in its use. Also, luck was with him as he suffered only scratches and bruises when he could have just as easily been swept into a tree on this narrow path.

Even though Wiebe tried to swim out of the avalanche, it was ineffective when he got wrapped around small trees. This also prevented him from bringing his hands over his face to form an air pocket as the avalanche slowed down. It is always worthwhile to try these lifesaving maneuvers, but as in this case, they don't always work.



82-3

JANUARY 5, 1982

D. L. Bliss State Park, Lake Tahoe, California

2 snow-campers caught, 1 buried and killed

Weather Conditions

D. L. Bliss State Park, on the southwest shore of Lake Tahoe, received copious amounts of snow from the end of December to the first week in January. Data from Alpine Meadows Ski Area, some 15 miles to the north, shows what the weather was like in the Lake Tahoe region around the time of this accident.

In a span of 7 days, December 29–January 4, the ski area endured very heavy snowfall, strong winds and cold temperatures. In short, blizzard conditions prevailed for much of this time. Records show 84 inches of snow fell, containing 8.47 inches of water. An additional 40 inches of snow fell on the 5th with over 4 inches of water. Winds were strong out of the southwest, averaging 20–40 mph with gusts of 60–90 mph. This made conditions quite inhospitable when accompanied with falling temperatures from 34°F on December 29 to 16°F for a high reading on January 3. Overnight lows reached as low as 11°F on the 3rd. (Compare nearby Squaw Valley Ski Area weather data for the same time in 82-1.)

Accident Summary

Everett Piner, 22, and his friend Keith Lawcock, 27, were tent camping in D. L. Bliss State Park above Emerald Bay on Lake Tahoe. Sometime in the early morning on January 5, while the storm still raged and the two men slept in their tent, a large avalanche broke loose on the mountainside far above. It set a large amount of snow in motion that easily snapped large, mature trees as the avalanche flowed through the forest below. The wall of snow overran the tent site and even buried Piner's truck which was parked farther downhill. It threw Lawcock from the tent, carried him downslope, and took him over the 10-foot road embankment of Highway 82. He awoke lying face-down in the snow, but on top. The avalanche also pulled Piner from the tent and tumbled him, still in his sleeping bag, down the slope, and buried him deeply. It was like being in a straight jacket. He had virtually no

chance of fighting the slide or getting an airway while entangled in the sleeping bag.

While looking for the source of a power failure, a State Park Ranger found Lawcock the next day wandering around on the debris. Lawcock told him of the avalanche and that his friend was buried somewhere beneath the snow.

Rescue

The initial search for Piner couldn't locate him, and WOOF teams were called in on January 7 to help locate the missing man. (WOOF Search Dog Unit is a volunteer, nonprofit corporation based in South Lake Tahoe, California.) But the dogs could only locate their tent which was buried under 4 feet of debris.

Another search was conducted on the 17th. To avoid scent contamination, one dog thoroughly inspected the locality where Lawcock was found before eight other teams were allowed into the area. This time the search area was extended beyond the avalanche perimeter with the thought that Piner may have survived the avalanche but wandered off in a state of shock and collapsed somewhere nearby. The area above the identified tent site was also searched in case Lawcock had been mistaken about its original location. The nine WOOF teams looked for 4 hours without success. Later in the afternoon another team rechecked the site, but Piner still could not be found.

With the help of spring snow melt and coyote diggings, Everett Piner's body was discovered by skiers on March 5. It was still inside the sleeping bag, and in the avalanche flow line between the tent site and his truck.

Avalanche Data

This avalanche released from a starting zone on the mountainside far above the fateful campsite. As it descended and entrained more snow, its volume swelled tremendously. The avalanche was narrow but nearly a mile in length. It packed enough energy to destroy many mature trees as it plunged through the forest below. The avalanche was classified as an SS-N-4. At Alpine Meadows, more than 300 avalanches were recorded from the onset of the storm to January 4.

Comments

Lawcock and Piner picked a poor campsite that greatly increased their exposure to avalanche danger. Campers are in the same

location for many hours or days, as compared to a skier who is exposed to the danger for generally less than 1 minute. It is vitally important that campsites be located in an area with absolutely NO chance of an avalanche overrunning the site.

It remains a mystery why experienced search dogs could not locate Piner under the snow when they were able to find the camper's tent, buried 4 feet deep, and other articles that gave off much less scent than a human being. To increase the chance for a live recovery in avalanche rescues, the dogs are generally taught to ignore personal items and concentrate on finding people. Sandy Bryson wrote in the March 1982 issue of WOOFNEWS: "The discovery leaves WOOF handlers in a quandary. Four of our most experienced dogs searched that area thoroughly at different times under different conditions. Why we had no alerts, we cannot explain. Obviously, the dogs were working since they found other scent-bearing objects buried in the snow, including some clean cooking pots carried hundreds of meters downhill in the toe of the avalanche!"

82-4

JANUARY 6, 1982

Arapahoe Basin Ski Area, Colorado

1 lift skier out-of-area caught, partly buried and killed

Weather Conditions

A strong cold front moved into Colorado during the first week in January that brought fresh snow, powerful winds and frigid air to the region. On the 6th, the Arapahoe Basin ski area recorded 10 inches of fresh snow. This fell on top of 28 inches of snowfall from the 1st-5th. Winds in the area averaged 15-35 mph over the higher elevations for 6 days. As the cold air penetrated deeper into the Rocky Mountains, daytime temperatures fell into the low 10s and overnight lows dropped below 0°F.

Accident Summary

It was a cold morning when Jeff Slames and

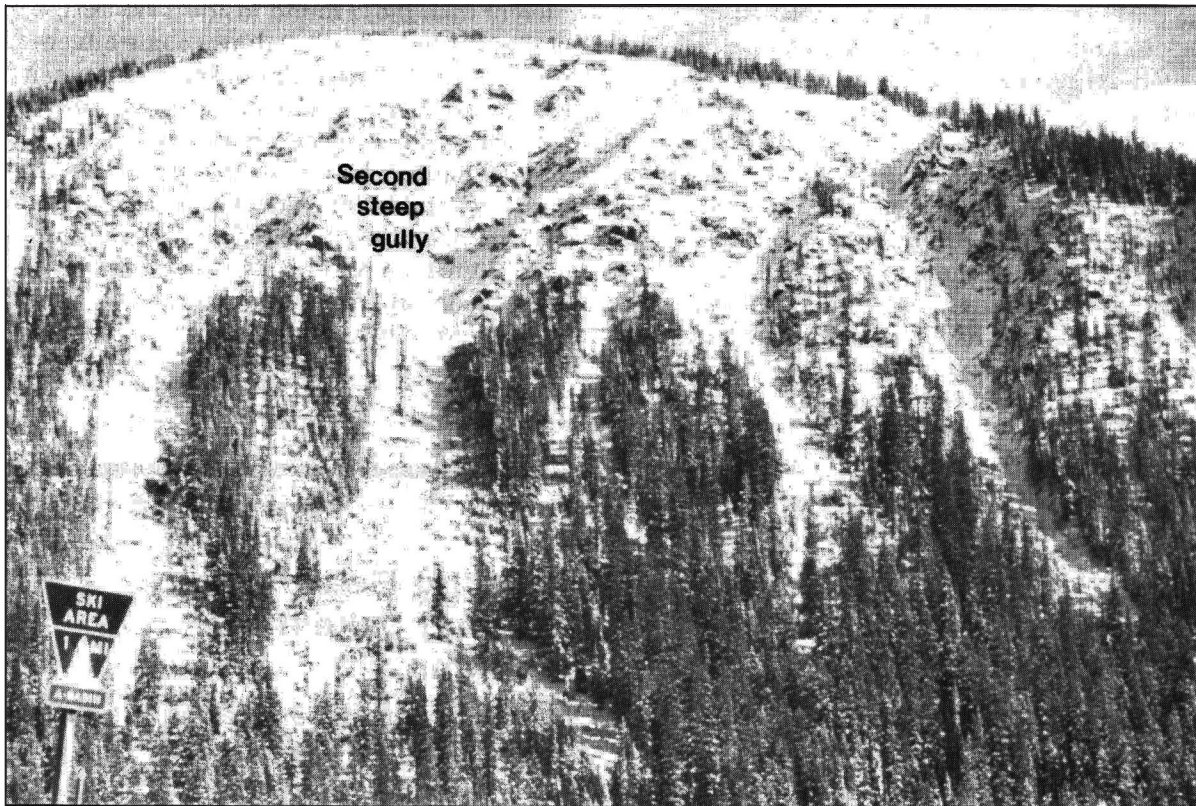


Figure 14. Accident 82-4, Arapahoe Basin Ski Area, Colorado, January 6, 1982.

good friend Frank Maes, both 25, drove up the west side of Loveland Pass to ski fresh powder at the Arapahoe Basin ski area. They skied together that morning and sometime early in the afternoon they separated. Slames decided to ski the powder outside of the marked ski area boundary. Alone, he skied a short traverse into an area known as Steep Gullies adjacent to the ski area. This exposed area consists of several steep, narrow chutes that drop through a series of low rock outcrops. They terminate at the bottom in mature timber and a small creek below U.S. 6 on Loveland Pass. Typically, out-of-area skiers get to the bottom, cross the creek and hike the steep road bank to U.S. 6 where they catch a ride or hike up the road back to the ski area.

Slames inched his way out to look beyond the breakover of Second Steep Gully. The deep powder looked inviting and, in anticipation of a great run, he savored the moment. Slames could wait no longer. He jumped into the gully and started to make turns in the powder. An instant later an avalanche broke loose and began pulling Slames down the rocky, narrow gully. Its violent energy ripped off his hat, gloves, ski poles and a ski. The wild ride car-

ried him over rocks and down the path where he was partly buried near the toe of the debris.

The avalanche left him dazed and in pain, but he could move well enough to eventually free himself from the clutches of the snow. He was cold, tired and alone. He knew he had to make it to the highway and get help, but the creek proved too formidable a barrier. Without skis, he kept falling through the weak snow cover to the water below. Now wet and exhausted, he sat down to rest next to a tree in the plummeting temperature—never to get up again.

Maes left the ski area at about 1430. On his way down the pass he stopped to look at the avalanche in Second Steep Gully. He saw no tracks or other signs to indicate someone was in that area, so he continued on home to Dillon about 10 miles away. Later in the evening, Slames' girlfriend and Maes reported that Slames hadn't come home from skiing, and subsequently, the Summit County Rescue Group was called out to look for him.

Rescue

That evening, Slames' car was found in the ski area parking lot and a search was initiated in

the dark. Despite their efforts, they had no luck in finding him. As the temperature continued to plummet, the search was called off until daylight when it would be much safer to further inspect the avalanche site.

The following morning, Arapahoe Basin ski patrollers joined in the search. They found Slames' tracks going into the Steep Gullies area, and followed them to the avalanche. Within a few minutes they located the waist-deep hole Slames' had apparently dug himself out of the previous afternoon. They also found some of Slames' equipment in the avalanche debris which led them to believe he was still in the vicinity. Upon further exploration of the area, and following tracks in the snow, rescuers found him at 1030 sitting against a tree some 200 yards from the avalanche. He apparently froze to death overnight in the -20°F temperature. His condition was probably compromised from injuries he suffered in the slide, thus preventing him from climbing out of the creek bottom to the highway above.

Avalanche Data

This SS-AS-4-O avalanche fractured 3–5 feet deep at 11,600 feet in elevation and ran 1,000 vertical feet. The northwest-facing, 35° mountainside typically harbors depth hoar near the ground which is overlaid with wind-drifted snow in the lee gullies.

Comments

Jeff Slames was known to take risks. He skied this and other avalanche paths alone and with little regard for his personal safety. The ski patrol spotted him a few days earlier in an avalanche-prone area near the Continental Divide. When asked what he was doing there he replied, "I like skiing unstable snow." In an interview following the accident Maes remarked, "He was skiing out-of-bounds—alone—and there was supreme avalanche danger and he was aware of that fact."

Ski areas that have avalanche problems within their boundaries take every precaution to minimize the danger. This can be done effectively with a combination of explosives, ski cutting and ski pressure from the public to compact and stabilize the snow. If this is not feasible, the slope is left closed altogether and marked accordingly.

A skier who ventures outside of the ski area boundary leaves this kind of security behind. Backcountry snow conditions are far

different than those found inside a ski area, but that is precisely what draws some adventure skiers out-of-area. Untracked powder can be a powerful lure. Jeff Slames survived the avalanche but not the aftermath. Skiing alone and then injured, he was unable to survive the deep snow and bitter cold. Had he been with a companion, and used the technique of skiing one-at-a-time, he could have lived to tell about his escapade, and ski another day. (See 81-18 and 82-10 for other accidents at this location.)

82-5

JANUARY 10, 1982

Sleeping Bear Dunes National Lakeshore, Michigan

3 cross-country skiers caught, 2 partly buried, 1 buried

Accident Summary

One would not normally associate Michigan with avalanches. However, Sleeping Bear Dunes National Lakeshore has been the site of more than one avalanche accident (see accident 80-13). Steep sand dunes some 300–400 feet high lie along this stretch of the east shore of Lake Michigan. The National Lakeshore lies about 2 miles southwest of Glen Haven, Michigan, and is popular in both summer and winter.

On January 6, Randy Winowiecki, 21; Jim Williams, 20; Peter Taylor, 22; and Kirsten Karlstrom, 21, were enjoying an evening of cross-country skiing. Winowiecki, who had lived in the area all his life, was taking the others on a short tour of the dunes. It was already early evening and he planned to be out for only a short time. These plans were soon altered by a near-disaster.

As the group skied over the dunes, they eventually came to the crest of a steep slope and began to traverse along it. Suddenly the hillside avalanched and all but Karlstrom, who was bringing up the rear, were caught and carried some 100 feet downhill and into a wooded swamp below. When the snow stopped moving, Williams and Taylor were only partly buried but Winowiecki was totally covered. In his struggle to get free, Winowiecki was able to stick one hand out of the snow, but could

do little else to rescue himself. He was firmly trapped by the snow pressing in on him. It was already dark when the accident happened at 1800, and not knowing if the others were buried too, he sensed a degree of urgency about his situation.

Rescue

Williams was able to free himself and then help Taylor get out. Fortunately, Williams spotted Winowiecki's hand protruding through the snow a short distance away. Williams and Taylor used their hands to dig snow from around Winowiecki's head but could not free him without a shovel. There was little left to do but go for help a mile away where they were visiting in Glen Haven. Winowiecki was reasonably comfortable, and he settled down to await his companions' return, thinking at the time that he would be rescued soon.

Back in Glen Haven, his friends alerted the authorities and got help from neighbors where they had been staying. The search was led by sheriff's deputies and rangers from the National Lakeshore. Two snowmobiles were donated and several volunteers joined in the search. But, there was a problem. Williams, Taylor and Karlstrom were only visitors to the area. In the dark and unfamiliar expanse of the dunes, they could not find the avalanche where Winowiecki remained buried in his icy surroundings.

They searched for 2 hours and were about to return for more help when searcher Brian Timko spotted ski tracks heading toward a likely area. He followed the tracks to the accident site and heard Winowiecki calling out. In a short time other rescuers arrived at the scene and had Winowiecki dug out in less than 10 minutes. The time was 2030. They transported him back to Glen Haven where he was re-warmed with a hot shower and he recovered fully.

Comments

An avalanche can occur wherever the right ingredients combine to create dangerous conditions. Whether on a steep mountainside in Colorado, or a sand dune in Michigan, all that is needed is a slab of snow, a weak layer and terrain steep enough for the snow to slide on. There is a good chance that Winowiecki would have died had he not been able to create a hole

to the surface with his arm. It gave him the opportunity to breathe and be seen.

Winowiecki's party was not anticipating or prepared for this emergency. Darkness and unfamiliarity with the area further complicated the situation. Even though Winowiecki was not in an immediate life-threatening predicament, time was not on his side. Hypothermia had already begun to set in by the time he was found the second time. The delay could have been easily avoided by leaving one person at the accident site who could have comforted Winowiecki, and attracted rescuers when they got close. In this case, sending two people to get help would have been both safe and prudent. (See 80-13 for another accident at Sleeping Bear Dunes.)

82-6
JANUARY 23, 1982

Cumbres Pass, Colorado

1 cross-country skier caught, buried and killed

Weather Conditions

In the 5 days that led up to the accident, snow fell across parts of southern Colorado, with periods of strong southwest winds. Wolf Creek Pass, 35 miles northwest, recorded a total of 31 inches of fresh snow from the 18th–22nd. On January 23, it was mostly sunny but cool with a light breeze.

Accident Summary

Saturday the 23rd was James Harshman's day off. To take advantage of the first good weather in several days, the 27-year-old cross-country skier drove from his home in New Mexico to Cumbres Pass in southern Colorado. He parked his car at the side of the road, donned his pack and skis, and traversed in a northerly direction for about 1.5 miles. The brisk air felt good on his face as he plowed through the fresh snow. At about 1600 hours, his route brought him to a steep, open gully. As Harshman traversed across the lower portion of the northeast-facing hillside, he triggered an avalanche above him that released like a snare. It quickly trapped him under 3 feet of heavy snow.

Completely buried, Harshman was helpless to dig himself out. He struggled with all his might to gain freedom. He had a small air space around his head, but his desperate fight to get loose soon used up all the available oxygen. An ice mask formed to seal the air space, as well as his fate. He died of suffocation.

Rescue

Harshman was reported missing Monday morning when he didn't show up for work. Conejos County Sheriff Department was notified at 0915 Monday the 25th by authorities in New Mexico that Harshman had apparently disappeared while on a cross-country skiing trip in southern Colorado. They offered to send a rescue team from Chama, New Mexico, since it was close to where they believed Harshman would be. Relatives found Harshman's car and search efforts concentrated on ski tracks which led rescuers to the avalanche. After about 1 hour of searching the debris, one rescuer was poking holes into the snow and collapsed a small, melted-out cavern around Harshman's head. He could be seen through the hole. They dug Harshman's body out from under 3 feet of avalanche debris at 1515, January 25, nearly 48 hours after the accident.

Avalanche Data

This avalanche was an SS-AS-1-O. It was 100 feet wide and ran 75 linear feet into the bottom of the gully. The snowpack was approximately 70 inches deep in the area, and the avalanche, consisting of soft powder about 2 feet deep, ran on a hard surface. This was on a northeast-facing slope above a gully at 10,400 feet in elevation.

Comments

This accident didn't have to happen. With 8 years skiing experience, Harshman was probably good at his sport, but had little knowledge of avalanches. Basic avalanche awareness and route-finding skills would have kept him from entering this terrain trap—a steep-sided, narrow gully. It was especially dangerous so soon after the storm because the new snow had little chance to settle and stabilize.

By touring alone, Harshman had virtually no chance of surviving an avalanche if he became buried, which is precisely what happened. The melted space that formed around his head indicated that he was alive and breathing for some time before an ice mask

formed, sealed off his air supply, and suffocated him. Also, his glasses were still on and not out of place when he was found, indicating that he did not, in all probability, suffer any major physical trauma in the small avalanche. In short, avalanche rescue gear in the hands of a trained companion would have saved his life. (See 80-5 for another small-avalanche burial, but with rescuers on hand.)

82-7

JANUARY 25, 1982

Tuckerman Ravine, Mt. Washington, New Hampshire

2 searchers caught and buried, 1 killed

Weather Conditions

The northeastern United States had been locked in a period of extremely cold weather with periodic light snowfall. Two days prior to the accident, the area around Mt. Washington in New Hampshire saw 8 inches of fresh snow followed by winds up to 70 mph higher on the mountain. At the avalanche accident site on January 25, winds were 20–40 mph with bitterly cold temperatures of -12°F. Mt. Washington has experienced some of the stormiest weather in the world, and can be a brutal place in the middle of the winter. On April 12, 1934, winds were clocked at 231 mph—the strongest ever recorded on the earth.

Accident Summary

This story is of both triumph and tragedy. Here's how it began. Two ice climbers spent Friday night January 22 at the Harvard Cabin near the base of Huntington Ravine on Mt. Washington. The following morning, Jeffrey Batzer, 20, and Hugh Herr, 17, set out to climb 750-foot O'dell's Gully in Huntington Ravine. This was against the recommendations of the cabin caretaker, Matt Pierce, because a storm was forecast for the area. The two climbers left the cabin just as the snow began to fall, and by noon winds had increased to a steady 60 mph with gusts to 80 mph. Visibility was poor.

That evening when the climbers failed to return, Pierce made a visual search of the ravine and called out, but there was no sign of the pair. Recognizing a potentially dangerous

situation, he radioed the Appalachian Mountain Club's (AMC) Pinkham Notch headquarters and told them of the overdue climbers. The AMC then notified Mountain Rescue Service (MRS), a volunteer organization that specializes in such matters. On Sunday morning, some 20 searchers from MRS, AMC, U.S. Forest Service and the New Hampshire Fish and Game Department began their search for the missing climbers. But whiteout conditions, in winds gusting to 60–75 mph, and temperatures near 0°F forced a halt to their efforts early that afternoon.

Monday was even colder and windier but visibility had improved. Among the rescuers that morning were Albert Dow, 28, and Michael Hartrick, 30. Avid climbers themselves, they were chosen to search O'Dell's Gully. They reached the top at about noon after a tough 5-hour climb in severe conditions. Here they noticed tracks leading in the direction of the Lion Head trail, considered one of the safer routes off this above-timberline plateau. Hartrick radioed their intent to follow the tracks. Some other members of the search team regrouped below Huntington Ravine and headed toward the bottom of the Lion Head trail to meet Dow and Hartrick when they came out.

Relentless winds blew Dow and Hartrick off their feet several times as they crossed the exposed terrain leading to the trail, and it was bitter cold. As they started down the steeper part of the trail they consciously avoided avalanche-prone areas that were drifted with snow. At about 1345, much farther down the trail, they entered a glade of trees. Suddenly they felt the snow move under their feet as a fracture developed 40 feet above them. While walking across this snow-covered slope, they had triggered a small but deadly avalanche that dragged them swiftly downhill through the maze of trees.

Hartrick later described the avalanche. "There was no time to yell." He remembered being on his stomach and doing everything he could to stay on the surface. Near the end of his short ride he was pulled under the snow. "As the slide stopped," said Hartrick, "the weight of the compacted snow immobilized me." He had no idea of Dow's whereabouts or his condition.

Rescue

Hartrick was buried in a vertical position and

luckily his head was up. He could move one arm that was close to his chest and tried to push the snow away to give himself room to breathe. He poked his hand through the snow surface just 6 inches above his head which gave him a good supply of air, but he was still trapped. At 1400, he was able to reach his radio and alerted his comrades: "Emergency, emergency. We've been avalanched!"

Two searchers were nearby and responded immediately to the location given by Hartrick, who knew he was somewhere between the summer and winter trails close to Tuckerman's Ravine. Ten other rescuers in a snowcat were already on their way up the Tuckerman Ravine trail when Hartrick's frantic call came over the radio. Nearing the area, one of the rescuers heard yelling some distance away which led them to the accident site. At 1425, a full contingent of rescuers were on the scene.

Hartrick was found immediately, but random probing for Dow in likely burial spots produced no results. A coarse-probe line was set up and Dow was located 5–10 minutes later under 3 feet of snow and less than 5 feet from where Hartrick was found. Resuscitation efforts failed to revive him. He was dead of a broken neck, probably from hitting a tree on the way down, and had been buried for about 90 minutes.

Avalanche Data

The avalanche, classified as an SS-AF-3, released on an east-facing slope 30–35° in steepness. It started at an elevation of 4,000 feet, and ran about 350 feet through mixed birch and young fir trees that were 10–20 feet apart in a shallow gully. The crown line was 2–3 feet deep and 100 feet long.

Comments

Albert Dow and Michael Hartrick were proficient climbers and dedicated rescuers on a mission in extreme weather conditions. While they managed to avoid the more obvious avalanche areas higher on the ridge, they let their guard down on a less-ominous-looking slope lower down. They were travelling too close together and both were caught. Inclement weather conditions and fatigue may have played a part in their assessment that this

was a safe slope to cross; it had trees on it and was not extremely steep.

On the brighter side of this story, the two ice climbers that had been missing since Saturday were found alive by a snowshoer the day after the avalanche accident. Jeffrey Batzer and Hugh Herr were several miles from where Dow was killed while searching for them. Search coordinator Dave Warren noted that the experience was bittersweet. "One man is dead and two were found alive." Although Batzer and Herr triumphed over the mountain for three days and lived, being spared was not without its price. Batzer lost his thumb and fingers on one hand, left leg below the knee, and a portion of his right foot. Herr lost both legs below the knee.

82-8

FEBRUARY 14, 1982

Aneroid Lake, Oregon

2 backcountry skiers caught, 1 buried and killed

Weather Conditions

Warm weather a month before the accident formed a melt-freeze crust on the snow surface. This was later followed by a very cold period and a dry powder snowfall. Two days prior to the accident, 18 inches of warm, heavy snow fell on top of the drier snow underneath.

Accident Summary

On Saturday February 14, a party of eight people set up camp near Aneroid Lake in north-east Oregon. They settled into two igloos, a tent and a U.S. Forest Service cabin, surrounded by the Eagle Cap Wilderness, with plans to do some skiing in the local area. All members of the party agreed not to go on steep slopes that weekend because of dangerous avalanche conditions, and all were equipped with beacons and shovels.

On Sunday afternoon the 15th, Judith Scott, 35, and Richard Easter were looking for a place to practice telemark turns about 200 feet above the trail in the valley, and some distance from the rest of the group. Everyone wore beacons but had inexplicably left their shovels back at camp. To avoid a potentially

dangerous slope, the pair traversed around the hillside on gentler terrain and came to a gladed opening in the trees about 40 feet wide and 130 feet below the leeward crest of the slope. At about 1445, Easter told Scott to wait where she was in the thicker timber while he skied ahead. He gently edged his way out onto the gladed slope. Without warning, the snow cracked and collapsed. It broke near the ridge crest above them, and both were caught by the avalanche. Scott saw it coming and tried to warn Easter but the avalanche quickly swept through the glade and spread into the thicker timber where Scott was standing. Easter was pushed 100 feet downhill but managed to stay on top of the moving snow. Scott was less fortunate. Before she could move out of the way, she was covered and pinned against a tree close to where she had been standing in relatively flat terrain. Easter, now alone in his quiet surroundings, knew he had to act quickly to save Scott's life.

Rescue

Easter was unhurt in the slide and began a beacon search without delay. He located an area where he thought she was and probed the snow with the tail of his ski—no luck. He dug with his hands hoping to find some sign of her but it was useless. Realizing she was buried pretty deep, he ran to the top of a small knob and yelled for help—and silently wished for a shovel.

It took other group members only 15 minutes to get to the site. Scott's position had been narrowed down with a beacon, and pinpointed with a pair of special avalanche-probe ski poles, the only probe the group had. But without shovels, nearly an hour passed before they finally reached Scott under 6 feet of snow. They cleared her snow-clogged airway and administered CPR but it was too late; she had died of suffocation.

Avalanche Data

This was not a large avalanche but contained enough snow to bury its victim 6 feet deep. It was at 7,800 feet in elevation on a northwest aspect, and estimated to be 75 feet wide at the top with a 2-foot-deep fracture line. The slide narrowed to 25 feet in the runout zone some 150–200 feet below. It was classified as an SS-AS-2-O. The snowpack was comprised of three distinct layers. The lower, and thickest, layer of snow near the ground was capped with an

ice crust. On top of that was a layer of dry powder some 6 inches thick which was overlaid by 18 inches of recent heavy snow.

Comments

There is much to be learned from this accident. From the beginning, this party focused on the correct procedures to insure the groups' safety. First, and perhaps most ironic, was that their initial plan for a ski trip to Canada was cancelled when informed that the avalanche danger would be high. They opted for northeastern Oregon instead. In the week before their departure, they called the sheriff's office to follow local weather conditions; they acquired avalanche rescue equipment and took training sessions in preparation for the trip; they secured a wilderness permit which included a brochure about avalanche safety and survival; the party agreed not to attempt steep slopes for fear of being caught in an avalanche.

Yet, in spite of these preparations and safeguards, some fundamental mistakes were made. One might first think that they weren't thinking "avalanche" while skiing in backcountry conditions; or that they were too close together for travelling in avalanche terrain; or that they should have dug a snowpit to look for weak layers in the snowpack. Certainly, these are important factors to be considered in the decision-making process. But leaving their shovels in camp was a crucial and, for Judith Scott, fatal error. Rescuers with shovels would not have guaranteed that Scott would survive, but it would have saved more than 30 minutes of her burial time. (See 80-10, 82-13, 82-21, 83-3 and 85-24 for more accidents where shovels were needed but not available.)

These skiers were thinking "avalanche" when they recognized and skirted steeper terrain for a less steep slope. They were thinking "avalanche" when Easter suggested that Scott stay in the thicker trees while he crossed the gladed slope alone. But their best intentions were all for naught as soon as the slab released above them. The only sure way of never getting caught in an avalanche is by using well-honed route-finding skills to steer clear of any potential avalanche terrain—from starting zone to runout zone.



82-9

FEBRUARY 19, 1982

Aspen Highlands, Colorado

1 backcountry skier caught, partly buried and injured

Weather Conditions

The Aspen Highlands ski area received only 30 inches of snow during the month of February, and those came in sporadic increments ranging from 1–4 inches at a time. The only exception was 7 inches of new snow on the morning of the 10th. There had been no major storms and winds had been light. During the first week of February, temperatures were cold. Highs reached only into the teens, overnight lows were 7–15°F below zero. There had been a gradual warming trend after the 8th up to the time of the accident on the 19th.

Accident Summary

At 0400 in the morning of the 19th, Lou Dawson and John Isaacs, both experienced mountaineers and expert skiers, began their ski-trek up the Aspen Highlands ski area. Their goal was to put first tracks in Highlands Bowl on the east side of 12,381-foot Highlands Peak. The bowl was within the ski area's permit boundary but closed to skiers except in organized groups guided by a ski patroller. Dawson and Isaacs were hiking early not only to have the bowl to themselves, but to avoid getting caught and possibly fined for violating a posted, closed area. This practice was becoming popular enough to be known as the "bandit ski" down the 3,000 vertical-foot Highlands Bowl.

It was a beautiful, clear morning and the skiers made good time. The first rays of sunlight were striking the surrounding peaks as they passed the top of Loges lift and the signs that marked Highlands Bowl as a closed area. They reached the peak at about 0720, in plenty of time to not be seen by the Highlands ski patrol if they didn't waste time on the peak.

After a brief, 10-minute rest Dawson skied a short way down from the peak to the breakover of B-1, a steep gully just below the peak. He skied over to some rocks and called for Isaacs to follow. Isaacs joined him, then waited and watched as Dawson descended B-1 into the main part of the bowl. Dawson got in several good turns and stopped just below an

old avalanche fracture line. It had been filling in with fresh snow, but the new snow was much different than the older slab. Instead of being firm and skiable, it was deep, cohesionless snow, weak with depth hoar. Knowing this was an ominous sign, he yelled back up to Isaacs what he found. He wanted to get off of the weaker snow, and started for the side of the gully about 50 feet away.

He was too late. As he turned toward the side, a fracture line suddenly cracked and widened between him and his goal. He had triggered an avalanche that instantly knocked him off his feet. He fell uphill and tried to dig his pole grips into the bed surface to slow his ever-increasing speed. But the near-40° pitch only accelerated him, along with tons of snow, toward the bottom of the bowl. He rolled onto his back and his skis came off. In an effort to minimize physical injury, he tried to roll into a ball by bringing his arms and legs in. But it was no use. The violent forces inside the avalanche made this an impossible task as he tumbled and spun down the mountain. For a brief moment there was quiet as he and chunks of snow were hurled through the air. It was a rough landing as he slid across the tops of coarse debris and came to a grinding halt about 1,300 vertical feet below where he had been caught. Dawson was not buried deep and quickly brushed away the snow that covered his face. He was trapped and in pain, but alive.

From above, Isaacs saw only the churning powder-cloud that engulfed his companion. But unknown to the skiers, from his home on Red Mountain Bob Limacher watched the event unfold through his telescope. At about 0740, Limacher was actually looking for his own tracks he had left in the bowl the day before while on a patrol-guided tour. But instead of admiring his tracks, he watched Dawson appear and disappear in a turbulent mass of snow as it rumbled down B-1 gully.

Rescue

Isaacs knew he had to act fast if he were to save his friend. He switched his avalanche transceiver to “receive” and, with skis off, descended the avalanche path searching for a signal from Dawson. He finally spotted Dawson near the bottom of the avalanche, but upon reaching him, he could do little more than dig the tightly-packed snow away from Dawson’s painful body. Dawson had broken

both legs in the violent ride, and shock and hypothermia would soon set in.

They quickly decided that Isaacs should get help as fast as possible, and not waste time trying to splint the broken femur. He climbed back up out of the bowl to summon help from the ski area. At the top he was surprised to meet four Aspen Highlands ski patrollers already on their way in. Limacher had alerted the sheriff’s department and ski patrol right after the accident happened. At 0800, Patrol Director Mac Smith and Highlands Bowl guides Tom Hicks, Tom Snyder and Kelly Klein gathered at the ski area. They were towed part way up the mountain on a snowmobile, and rode the Loges chairlift the rest of the way to the top of the ski area. They met Isaacs at the top of Loges lift, coming out of the bowl for help. Together they descended a safe route into the bowl and reached Dawson by 0815.

The rescue team stabilized Dawson with oxygen and a traction splint for the long and painful ride to the bottom. It was rough going as they negotiated through tight trees and poor snow conditions, but they got him to a waiting ambulance at the bottom by 1110. He was transported to Aspen Valley Hospital where he arrived about 10 minutes later.

Avalanche Data

This was a skier-triggered avalanche at 12,000 feet on an ENE aspect. It was 50–100 feet wide with an 18– to 24-inch crown line, and ran 1,300 vertical feet from a 40°-steep starting zone. This area had seen avalanche activity three times already this winter. Very cold temperatures, and a shallow snowpack because of previous avalanches, combined to form a layer of faceted, cohesionless snow. On top of this was a shallow weak layer of soft slab, wind-blown snow that accumulated from periods of light snowfall prior to the accident.

Comments

Dawson and Isaacs knowingly entered closed terrain within the ski area boundary. Even though the area had been shot with explosives and skied periodically, snow conditions in Highlands Bowl were much more like the backcountry than a ski area. But this was an acceptable risk to these two skiers who both had extensive backcountry skiing experience in radical terrain.

Fortunately, prior mountaineering experience and avalanche-savvy led them to take

precautions to lessen their risk. They carried avalanche beacons, collapsible probe poles and shovels, and they planned to ski one-at-a-time with one ready to rescue the other should an avalanche occur. They also took the right steps following the avalanche. Isaacs' beacon search would likely have found Dawson had he been buried, and their decision to seek immediate help instead of spending excess time at the accident site was a wise choice under the circumstances.

They were, however, in too much of a hurry to beat the ski patrol and avoid getting caught in a closed area. To save time, they didn't dig any snowpits that would have revealed structural weaknesses in the snowpack.

Dawson not only paid a physical price for this adventure, but a monetary price as well. He was found to be in violation of Colorado's Skier Safety Act of 1979 and fined \$350, and he was charged \$600 by Aspen Highlands for the rescue. He was just happy to be alive, and out of gratitude for his rescue he later became an active member of Mountain Rescue Aspen.

82-10

MARCH 13, 1982

Arapahoe Basin Ski Area, Colorado

1 out-of-area lift skier caught, buried and killed

Weather Conditions

In January, 78 inches of snow had fallen at Arapahoe Basin, which was far above normal. February was dry and disappointing in comparison with only 15 inches of new snow recorded at the ski area. The snowpack was shallow in many locations and the cold temperatures provided fertile conditions for depth-hoar growth in the surrounding backcountry. By the first week of March light snow began to fall again and the ski area picked up 18 inches of snow by the 10th. Southwest winds increased to 20-45 mph. Moderate snowfall brought another 9 inches of snow on the 12th, accompanied by strong winds. The morning of the 13th dawned clear with 3 more inches of fresh snow, bringing the total to 30 inches since March 1. For lee gullies and

chutes in the backcountry this translated into soft windslab resting on a foundation of cohesionless, faceted snow grains.

Accident Summary

The Arapahoe Basin ski area lies on the Continental Divide 2 miles south of Loveland Pass. With its 12,450-foot-high top elevation and plenty of advanced terrain, the ski area draws its share of expert skiers—and risk-takers.

Adjacent to the west ski area boundary lie the Steep Gullies. These narrow chutes, which cut through a series of rock outcrops, attract adventurers seeking steep, untracked powder. Mark Frieze, 30, was one of those skiers, and on Saturday the 13th, the fresh, untracked snow from a recent storm beckoned him out-of-area.

Early that morning, Mike Kopicky, 30, John McDonald, 24, and Frieze rode the lifts and skied out-of-area terrain called Montezuma Bowl, just south of the ski area. They picked up a waiting car at the bottom and drove back to the ski area. They planned to ski the Steep Gullies next, and during the lift ride up they talked about skiing the Gullies "safe" to avoid avalanches. At about 1100, they again left the ski area through well-signed ropes, and traversed west toward their objective.

When they reached the top of Second Steep Gully, Frieze tested the snow while Kopicky and McDonald waited in a safe area on some nearby rocks. For the first 50 feet, he made four ski-cuts and jumped on the snow to test its stability. Nothing happened. Feeling either safe or lucky, he determined that the slope was stable and began his ski down.

After making three turns, Frieze forced the upper snowpack to collapse into the granular snow near the ground. This triggered an avalanche which took Frieze on a torturous ride down a steep, rocky chute—gnashing him for 1,200 vertical feet. From their vantage point, Kopicky and McDonald tried to watch Frieze on the way down, but quickly lost sight of him.

Rescue

At 1120, ski patroller Carl Oldham noticed a fresh avalanche in Second Steep Gully and two people standing at the bottom of it. Oldham radioed patrol headquarters of the incident and set rescue operations in motion. Ski Patrol Director Jim Gentling and patroller Terry

Pfeifer were dispatched as the hasty search team to investigate. They reached the site in about 10 minutes, confirmed that a skier was indeed buried, and began probing likely burial spots.

Before Gentling and Phiefer got to the avalanche, one of the skiers Oldham had seen standing on the debris skied over to U.S. Highway 6 (Loveland Pass) and hiked up the steep road bank to get help. Kopicky met Oldham on the highway and displayed a ski pole thought to belong to Frieze. After further questioning as to where the pole was found, Oldham radioed Gentling and told him to concentrate his search down the center of the debris.

Gentling and Pfeifer continued their search and found Frieze at 1152. His hand was spotted sticking through the snow underneath a tree branch. They dug Frieze out from under 2 feet of snow and performed CPR for 45 minutes but to no avail. Frieze was dead from the severe trauma he suffered when he was dragged over rocks in the chute and then wrapped backwards around a tree near the bottom of the slide. Patroller Rick Sandstrom arrived with additional help and took over as Accident Site Commander. With the help of the Summit County Rescue Group, he transported the body out to the highway, secured the site, accounted for all personnel and equipment at 1250, thus ending the 90-minute operation.

Avalanche Data

This was the second fatal avalanche in Second Steep Gully this winter (see accident 82-4). The SS-AS-5-G released at 11,600 feet on a north-west-facing slope of 38°. It slid the width of the gully, 50–75 feet, and ran full depth to the ground. Debris piled 6–8 feet deep in the runout zone after plunging some 1,100 vertical feet. The snowpack was comprised of a wind-slab resting on unconsolidated, granular snow—a deadly combination all too familiar in this region. New snow following the fatal avalanche on January 6 was subject to a strong temperature gradient and turned into depth hoar.

Comments

Two things could have expedited this search and saved valuable time. First, articles such as skis, poles, and hats that are found in the avalanche debris must be marked and left in place after showing other rescuers. They are

valuable clues that may lead to the buried victim. Second, these people were skiing obvious avalanche terrain and should have carried avalanche rescue gear (avalanche transceivers, collapsible probe poles and light-weight shovels) for each other's safety. When used effectively, these tools give the avalanche victim a much greater chance of being found alive by decreasing the burial time. Though in a case involving massive trauma such as this, the outcome would have probably been the same.

This accident came as no surprise to avalanche forecasters. The Avalanche Warning Center had issued a warning that included the backcountry around Loveland Pass. The recent snowfall (30 inches since the 1st) and strong winds created dangerous avalanche conditions by forming a fresh, brittle wind-slab on top of depth hoar. The Arapahoe Basin ski patrol had no problem releasing seven slides during avalanche control work on the 12th.

Mark Frieze was an expert skier and liked to ski the backcountry. But he was a risk-taker and possessed a casual attitude about avalanches. "Crazy Mark" was well known by Summit County ski patrollers for ducking ropes and skiing closed areas at the local ski resorts. They knew it was only a matter of time until he became involved in a serious avalanche accident. If his avalanche skills had matched his skiing ability, he may very well have been alive today, skiing the powder he loved.

82-11
MARCH 18, 1982

Mt. Alyeska Ski Resort, Alaska

1 U.S.F.S. Snow Ranger caught

Weather Conditions

From March 16–18, moisture on a strong southerly flow brought 10 inches of snow to the 2,700-foot elevation of the Alyeska ski area. The freezing level fluctuated between 1,500–2,500 feet with intermittent drizzle on the lower part of the mountain and snow at the top. Winds for the period were from the southeast at 10–20 mph, gusting in excess of 35 mph. On the afternoon of the 17th, there were

heavy graupel showers accompanied by strong winds. Lee pockets and low-lying areas accumulated the most snow while the ridges remained relatively free from significant accumulations. This all fell on a hard, old snow surface.

Accident Summary

On Thursday morning the 18th, Reid Bahnson, Assistant U.S. Forest Service Snow Ranger, was doing avalanche control work with the Alyeska ski patrol. Shots from the 105 mm recoilless rifle produced numerous small avalanches in the new snow. Each chute in the Shadows area ran when shot and put debris on their respective alluvial fans at the bottom. Most of the ski runs were then opened to the public.

Since all of the chutes above a high traverse leading to good powder skiing had avalanched, it was decided to inspect the traverse and, if all looked well, open it to provide

access to the bowl below. The following first hand account by Bahnson tells the whole story.

"I led the party of three traversing across the debris fans in the bowl. Although the snow surface along our route had been disturbed by the action of slides from above, it felt slabby even in places with fresh debris. I kept the team well separated as we worked across the bowl without stopping. I sensed an urgency to keep moving to someplace safer. The snow just didn't feel right to me. Probing with a ski pole indicated 6-12 inches of moderately stiff snow bonded to a hard crust.

"I crossed high on the alluvial fan of Sleeping Lady chute and waited for the others. The snow here was very hard because the slide which exited the chute hours earlier pummeled the fan after falling 100 feet over cliffs. The same situation existed on the next fan, Little Sleeper chute, some 100 feet ahead. But between the two fans the snow was undisturbed. I moved forward cautiously into this

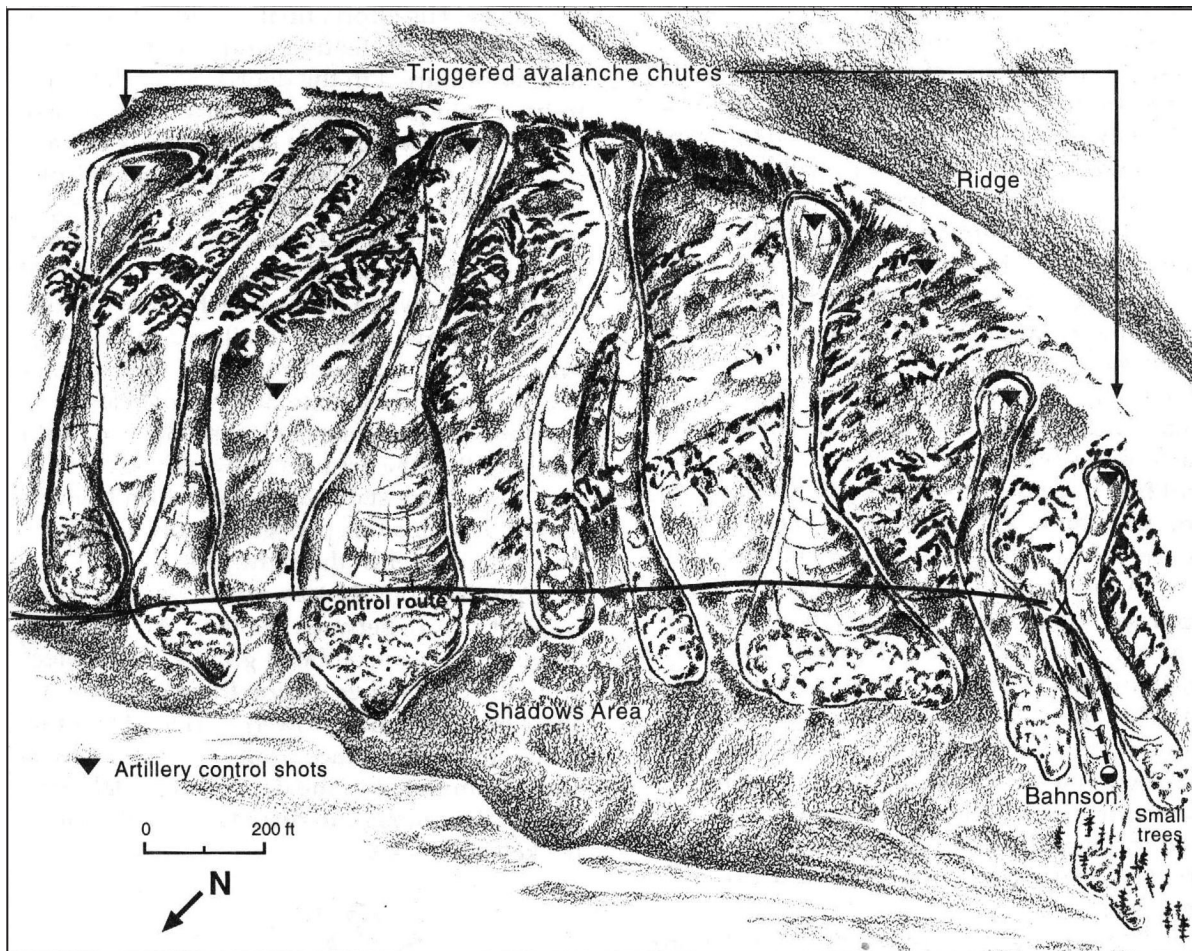


Figure 15. Accident 82-11, Mt. Alyeska Ski Resort, Alaska, March 18, 1982.

soft, slabby snow. It felt like it should slide so I decided to jump on it, hoping it would fracture below my line. As I down-weighted, preparing to jump, the entire area of soft snow silently began moving. I glanced up to see that the slope had broken loose almost 2 feet deep from the base of the rock face about 50 feet above me. I knew I was in the center of the slab, and in trouble. Instinctively I yelled 'Avalanche!' and my route partners helplessly watched me go down.

"I turned my skis downhill in a steep traverse in an attempt to get to the edge of the slide but the snow gained momentum so rapidly, I had no directional control. Next, I tried to push off with my left pole to regain my balance but a large block overran my left arm, pulling me down between the sliding blocks of snow.

"I was partially submerged, head uphill, on my left side and going downhill faster than I felt comfortable with. The tip of my right ski caught on something, pushing the tail up and torquing my leg. I consciously twisted out of the binding and the pressure immediately ceased. But then my left ski went to the bottom of the moving mass, pulling me with it. I was able to twist out of this binding also but was then somersaulted headfirst downhill. 'Time for water sports', I thought.

"I began swimming motions while face down, body slightly across the slope and started slowing somewhat relative to the moving snow. By this time, the blocks had broken into a churning, fluid-like mass about 3 feet deep around me and was still accelerating. I tried digging the toes of my ski boots into the bed surface to slow down but was unsuccessful. I still had one pole (no straps, just a death grip) and tried an upstream brace. This move rotated me into a sitting position facing downhill.

"A group of small trees was rapidly approaching so I tried digging in my heels. I was able to slow down as I gained purchase on the hard bed surface. Slowing further, waves of debris flowed around and over me continuing down toward the group of small trees. I stopped in a sitting position about 100 feet above the trees as the last of the slide continued through the trees, channelling into a gully 300 feet below where it deposited debris 4-7 feet deep.

"Unhurt and very relieved, I collected my equipment and waited for the other team members to join me. From their safe location

on the fan, they had been able to see me more than half the time above the surface of the slide. They congratulated me on my tumbling routine and we skied down, deciding to leave the trail closed."

Avalanche Data

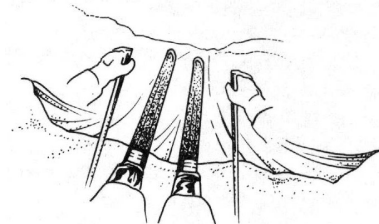
The avalanche, an SS-AS-2-O, released in undisturbed snow between two alluvial fans covered with the morning's avalanche debris. This northwest-facing terrain has a slope angle of 31°. The crown line averaged 18 inches deep over its 80-foot length and the slide ran 400 vertical feet. A 12-inch-high stauchwall was discernible after the avalanche released: only the heavy, new snow had slid on a hard bed surface.

Comments

This accident teaches us two important lessons. First, never give up! Bahnson used every method he could think of to keep himself from being carried to the bottom of the avalanche. His efforts finally paid off when he stopped short of the trees and avoided being injured or buried in the debris. Second, learn to trust your gut feelings. Bahnson felt uneasy about the snowpack that day and took extra precautions accordingly. He kept the control team spread out and moving to avoid being exposed to potential avalanche danger longer than necessary, and he was mentally prepared to act swiftly when the avalanche caught him.

It is always prudent to allow new snow time to settle and stabilize. But in this instance, several avalanches came down quite close together. This may have swayed Bahnson into thinking that the areas in between the alluvial fans were more stable since they didn't release earlier. It seems this pocket of snow simply needed a trigger in the right spot.

Another contributory factor was the weak snow structure between the fans. An abundant amount of unconsolidated graupel had collected in the concavities during the recent heavy showers. The pellets flowed in rivulets on the hard, old snow surface from the chutes above and accumulated in the depressions. Bahnson's weight was enough to dislodge one of these pockets of weak snow.



82-12

MARCH 22, 1982

Sun Valley, Idaho

1 helicopter skier caught and injured

Weather Conditions

March did not produce significant snowfall for the Sun Valley ski area, but the most significant storm amounts came on the 17th–19th when 23 inches of snow fell with 1.90 inches of water equivalent. This brought the ski area's base up to 95 inches. South-southeast winds during the storm ranged from 15–35 mph, and temperatures were mostly in the 20s during the day, dropping into the single digits overnight. Wind speeds dropped significantly and veered to the NW between the 20th–22nd, and temperatures returned to the upper 20s.

Accident Summary

In the days leading up to the accident, Greg Morrison, owner of Sun Valley Helicopter Ski Guides, and two of his guides did avalanche control work with explosives and test skied numerous slopes in the area. Snow safety work with the Sun Valley ski patrol on the 18th, and similar work through the 21st, showed no major instability. They felt that the new snow still needed time to settle and stabilize before taking clients into some areas, and corn-snow skiing on southerly aspects would improve too.

On Monday, March 22, the heli-ski operation was open for spring skiing. It turned out to be a busy morning with nine guests, all eager to ski untracked powder. At 0925, the first of three groups, consisting of one guide and three guests each, began the 8-minute flight from Sun Valley to Morgan Ridge which is above Wilson Creek. Groups two and three followed in 15-minute intervals. The first run was superb in 18–24 inches of powder.

Group one, guided by Morrison, started its second run at 1015. Group two, with 33-year-old guide Bill Gehrke, began its second run shortly afterward from another point on the ridgetop, a little farther northwest and higher in elevation. This gave them terrain that was more open, but less steep than their first run. Guide Carl Rixon, in group three, noticed a small avalanche that was triggered by Morrison's party in some steep rocks. He radioed Morrison and it was determined that the event was small and insignificant.

Gehrke heard this radio call too, and again cautioned his group to go one-at-a-time and ski close to his tracks. He skied down to a group of trees and they soon joined him. Gehrke pointed out the route to the next meeting place, saying he would bring up the rear. It was about 1030 when guest Patti Whitcomb, 32, skied down first. Next was Elliot Miller, 37, followed by Mark Baumgardner, 31. Just as Baumgardner began his descent he heard the cries, "Avalanche!" and "He's going!" He stopped just in time to watch the slope below fracture and avalanche. He tried to spot Miller and Whitcomb but the swirling snow blocked his view.

When Miller was caught, he yelled, "Avalanche!" and tried to pull out of it. He lost his ski equipment and fought with swimming motions to stay on the surface. Part way down he was crushed against a clump of trees, but only partly buried. Excruciating pain shot through his leg.

Rescue

Gehrke radioed the helicopter but got no response. Hearing Miller's cries for help, he sent Baumgardner to check on Whitcomb at the bottom then skied straight to Miller, reaching him in less than a minute. He found him partly buried next to a tree and in great pain. He dug him out and made him as comfortable as possible, then called down to Baumgardner, who had not yet found Whitcomb. Thinking she could be buried, there was little left to do but reassure Miller that help would arrive soon, and ski down to look for Whitcomb. He reached Baumgardner and told him to begin a transceiver search, then noticed a set of tracks farther down, leading toward the pickup point. He followed them and found her safe at the lower landing zone.

Whitcomb had been near the bottom of her run and about to stop below a tree island when she heard Miller shout, "Avalanche!" Looking over her shoulder, she saw a powder cloud and wall of snow descending toward her. She dropped into a tuck and quickly skied farther down and off to the side. When she looked up, the avalanche had stopped and could see Gehrke and Baumgardner, but Miller was missing.

Group three had been flying to their second drop-off point at the time of the accident. Rixon noticed a slide in the area of Gehrke's party and called him on the radio; this time

contact was made. Upon learning that Miller had been caught, Rixon had the pilot land where Gehrke's group had been dropped off. Further radio conversation revealed Miller was indeed injured and that Gehrke was going to look for Whitcomb. Rixon's party skied a safe route down to the avalanche. Fortunately, Sun Valley ski patrollers Knox Barclay and John Matteson were in Rixon's group, and together they got Miller ready for transport.

Morrison, in the meantime, had been monitoring the events on his radio. It was collectively agreed that he would fly his group back to the heli-pad and return with a sled and extra equipment. Upon their return, pilot Brad Martin released the slung toboggan some 300 feet uphill of Miller's location, then took Morrison to the top and let him out. Morrison retrieved the toboggan and skied it down to the site. They loaded Miller into the sled and dragged him just far enough down to where the helicopter could safely land. He was flown to nearby Moritz Community Hospital, and arrived there some 90 minutes after the accident. He had suffered a dislocated hip in the mishap.

Avalanche Data

The slide released on a steep west-northwest aspect at 8,800 feet in elevation. The debris spread out 3 feet deep some 900 feet below. It slid on a sparsely-treed, narrow slope about 40° in steepness, which channeled into a narrow gully below.

Further examination of the snowpack revealed 18 inches of new snow resting on a .5-inch-thick layer of faceted grains. These loose grains, in turn, sat on top of an old rain crust. From there to the ground was some 40 inches of firm, old snow. The SS-AS-3-O avalanche released 18 inches deep to the crust, and propagated 450 feet wide. The faceted grains of recrystallized snow were formed by a local temperature gradient between the new snow and crust, thus providing the required weak layer between the slab and bed surface.

Comments

Elliot Miller had two things going for him that day. First, he was lucky that it was his hip, and not his head, that hit the tree. Second, he was fortunate that this was an organized group with trained professionals and quick transportation (only 4 minutes) to secondary care. All parties agreed that following the accident,

the rescue was carried out in a safe, smooth and timely manner. Gehrke's decision to leave Miller and search for Whitcomb was easily justified. Even though Miller was badly hurt, he had no apparent life-threatening injuries. If Whitcomb had been buried she may have suffocated.

The guides performed avalanche control work in the days prior to the accident without significant results, and the accident occurred after some 14 runs had been made on similar aspects and elevations on the 22nd. These point to a generally stable snowpack, yet an avalanche accident still occurred. The minor avalanche activity triggered by Morrison's group, coupled with snowpit data which could have revealed the slab, lubricating layer and slick bed surface, should have directed the skiers to more shallow-angled terrain, or slope aspects with stronger snowpack features.

Witness accounts show that Whitcomb was at the bottom of the run, but still in motion when the avalanche released. Additionally, Baumgardner had already started skiing when Miller was caught. It appears that the group was not quite skiing one-at-a-time per Gehrke's instructions. The recommended technique is to wait until the previous skier gets in a "safe" location and signals by voice or pre-arranged arm gestures that they are ready and watching for the next person.

82-13
MARCH 22, 1982

Park West Ski Resort, Utah

2 out-of-area lift skiers caught, 1 partly buried, 1 buried and killed

Weather Conditions

March brought warm weather to the Park West ski area. Daytime temperatures ranged mostly in the 40s but overnight lows were still below freezing. Light rain, and rain mixed with snow fell on three occasions. From the 12th–14th, sunny skies prevailed and formed a thin melt-freeze crust on the snow surface. Twenty-five inches of snow fell over the next 3 days, and on the 18th, winds of 40–60 mph rearranged the fresh snow into denser slabs. Another burst of snow came on the 19th–20th, leaving 19 inches of fresh powder before the

storm moved out. This brought the new snow total to 44 inches in 6 days. The 21st–22nd were mild with light wind.

Accident Summary

Park West Ski Resort lies about 25 miles east of Salt Lake City in the Wasatch Mountains. Like many ski areas, Park West has appealing, untracked snow on steep terrain just outside the ski area boundary. It was this allure that led Gus Mora, 28, and Rick Cannard, 29, to leave the ski area for the short hike to 9,602-foot Murdock Peak.

It was clear and calm on the morning of March 22. Mora and Cannard looked forward to a day of skiing in the recent new snow and setting some tracks in un-cut powder. They skied in the ski area for a while but a lot of their favorite runs were getting tracked up. Todd's Bowl, however, on the northeast face of Murdock Peak had just what they were looking for—untracked powder. They rode the Ironhorse chairlift and, on their telemark skis, left the ski area for the peak and the bowl just beyond.

From the peak, the duo skied north down the ridge, dropped off of it to make a few turns and traversed back to the ridge-line, and within a few minutes they reached their objective. From the top of Todd's Bowl they surveyed the steep slope below and discussed the route they should take. They even talked about the avalanche danger, and the fact that Mora wasn't carrying the shovel that he usually did in areas like this. They were, however, wearing avalanche beacons.

Cannard, an intermediate skier, went down the less-steep, left side first to check out the snow conditions. About two-thirds of the way down, Cannard fell and called back up to Mora that the snow was a little crusty. Mora, who had the skiing ability to handle the steeper pitch down the middle, began his run. At 1355, Cannard got back up and was standing with his skis pointing downhill and slightly to the left when he heard a loud boom, "like dynamite." It was the sound of a slab avalanche releasing around them.

When he looked up, Cannard saw snow breaking loose above him. He tried to ski out to the side, but was quickly overcome and the slide carried him along in a sitting position. On the way down he looked to his right and there was Mora, riding down on his chest with outstretched arms as if body surfing. They

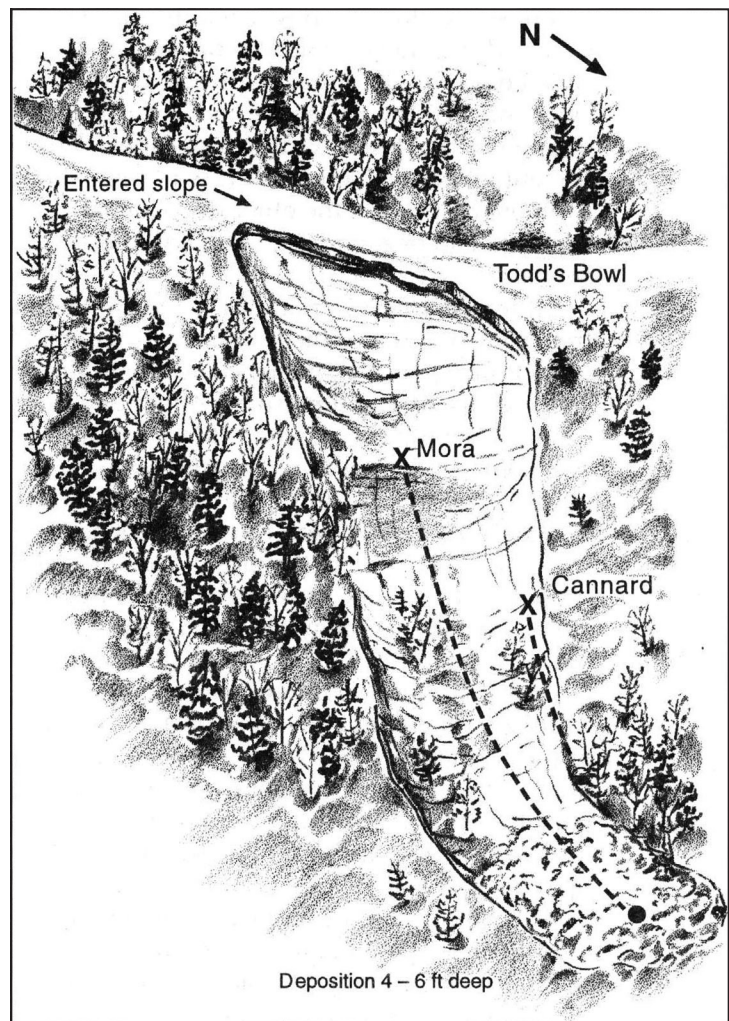


Figure 16. Accident 82-13, Park West Ski Resort, Utah, March 22, 1982.

made eye contact but said nothing to each other as they descended in the churning snow. It was the last time Cannard saw his friend alive.

Rescue

When the snow came to rest, Cannard was only partly buried and dug himself out in about a minute. He looked for Mora in the debris pile but there were no clues to where he might be. Cannard searched with his avalanche transceiver and in 10 minutes, narrowed Mora's location to a 6 square-foot area that he marked with his poles. About that time he heard a "muffled moaning sound" from underneath the snow and shouted for Mora to hold on.

He began digging with his hands, and in 10 minutes found a ski and one foot under 2

feet of snow. But which way was his head? Cannard then heard voices in the area and called out for help. From nearby, four other skiers noticed the avalanche and saw Cannard digging in the debris. It didn't take long to figure out what had happened. One person went for more help while the other three joined Cannard and began to dig—still without a shovel.

It took another 15 minutes to release Mora from the packed avalanche debris. He still had his skis and poles on, which complicated the chore of dislodging him from a 4-foot-deep burial. They put sunglasses to Mora's mouth and nose but there was no fogging on the glass. He wasn't breathing and they couldn't find a pulse, so they performed CPR as best they could. (No one in the group had any prior training for this type of rescue.) These efforts were stopped in 15 minutes when Mora did not respond.

At 1435, some 40 minutes after the avalanche, the Park West ski patrol got word of the accident. Within 2 minutes they had help and equipment headed to the site. The ski patrol at Alta was notified, as was Wasatch Backcountry Rescue (WBR). A nearby heli-ski operation, Wasatch Powderbird Guides (WPG), was called too, but didn't get the message until 10 minutes later when they landed to refuel. WPG reached the accident by 1500 with avalanche rescue gear and trained personnel.

Jim Wilder of WPG assumed the position of Accident Site Commander. He confirmed there was only one victim and CPR was initiated again. Within 30 minutes, they had been joined by Park West ski patrollers, WBR, a doctor, an avalanche rescue dog, and Life Flight from Salt Lake City. Together they worked to save Mora at the accident site until 1545 when he was flown to Latter Day Saints Hospital by the Flight Life helicopter. There he was pronounced dead of asphyxia at 1620 hours.

Avalanche Data

The local avalanche danger increased from the 15th–20th when 44 inches of fresh snow fell with strong winds. During this time, Park West ski patrollers brought down 11 size-2 or larger avalanches (plus many small ones) with explosives and ski-cuts. But it was spring and warm temperatures slowly helped the new snow settle and stabilize. On the 22nd, two

days after the storm, the Utah Avalanche Forecast Center's public forecast called for a low hazard on most slopes, but moderate danger still existed at the ridgetop locations where wind-slabs had formed in lee areas. Slopes that faced north through east were considered most dangerous, and backcountry travellers were advised to use extra caution wherever cornices and wind-slabs had formed.

Mora triggered the avalanche, an SS-AS-3-O, as he began skiing the steep, 43° pitch at the top of Todd's Bowl. The slide released at an elevation of 9,375 feet and ran into the runout zone some 500 vertical feet below. The crown line measured 2 feet deep and 180 feet long.

Investigators from Park West, Snowbird, U.S.F.S. and the Utah Avalanche Forecast Center returned to the site. Before they dropped into Todd's Bowl, they tested the area with two explosive charges. One released an additional avalanche next to the slide that trapped Mora, and this one was more than twice the size of Mora's. They believed that excessive tensile stress due to gravity on the steep slope had brought the slab to near-failure before Mora started skiing it. His weight simply tipped the delicate balance near the terrain breakover where the stress was concentrated.

Comments

This accident resulted from poor judgment in light of some obvious warning signs, which were: very steep terrain (43°), a recently-formed slab on top of a smooth crust and, perhaps most significant, recent avalanches triggered by the patrol in the ski area. Todd's Bowl also had all the necessary ingredients for an avalanche and simply needed a trigger.

Even though the skiers had avalanche transceivers, these were practically useless without shovels. Once located, it took almost 30 minutes for four people to uncover Mora who was just 2–4 feet deep. This was too long, and he ran out of oxygen before they could reach him.

Cannard's decision to stay at the site and search was a good one and provided Mora with his best chance of being found alive, even though help from the ski area was reasonably close by. This is always recommended unless there is imminent danger to the rescuer. The odds, however, were not in Mora's favor. He was totally buried, and precious time slipped away without a shovel to expedite the rescue.

Mora and Cannard were thinking “avalanche” but didn’t act accordingly. Both skiers were exposed to the hazard at the same time and, consequently, both were caught when the avalanche released. Fortunately for Cannard the slide only partially buried him. Also, the steep terrain down Todd’s Bowl was too dangerous to attempt so soon after the storm, especially without shovels. (For other accidents where lack of equipment was critical to the outcome, see 80-10, 82-21, 83-3 and 85-24.)

82-14

MARCH 31, 1982

Alpine Meadows Ski Area, California

12 people caught, 10 buried, 7 killed, 2 ski lifts damaged, 3 buildings destroyed or damaged, 21 vehicles caught with 9 damaged

Weather Conditions

Following a slow start in December with 65 inches of snowfall, January brought a copious amount—175 inches—to the Alpine Meadows ski area. One storm alone dumped 125 inches of snow from December 30 to January 6. Periods of strong winds gusting to 70-100 mph accompanied much of the snow. February, in sharp contrast, was dry and warm. A paltry 7 inches of snow fell during the month, along with some light rain.

That changed in March when the storm track again took aim on the Sierra Nevada. A total of 163 inches of snow fell during the month, 86 inches of which came from a fierce storm that battered the region from the 27th-31st. Howling winds of 40-80 mph (a gust of 120 mph was recorded at the nearby Squaw Valley ski area on the 31st) drifted snow into avalanche starting zones for 5 days. Snowfall at Alpine Meadows was 300% of normal for March.

In addition to the excessive snowfall amounts, temperature changes during the storm also contributed to the avalanche danger. Temperatures dipped into the teens on the 29th-30th, then climbed into the upper 20s on the 31st. This influenced new snow densities:

snowfall on the 29th-30th contained 7 percent water while new snow on the morning of the 31st measured 10 percent water. Weak, low-density snow was sandwiched underneath a heavy slab above. During the day even more snow fell at a vigorous rate of 2-3 inches per hour, coupled with continued strong winds. Conditions were prime for extreme avalanche danger.

The Alpine Meadows ski area, 5 miles north of Lake Tahoe on the east side of the Sierra Nevada, is no stranger to avalanches. In many years it records more avalanches than any ski area in the United States. This March had been especially active with more than 420 slides recorded.

The storm at the end of March persevered for several days with heavy snow and howling winds. The US Forest Service issued a warning for extreme avalanche danger. The ski patrol and USFS Snow Rangers at Alpine Meadows fought valiantly to stabilize avalanche-prone slopes that threatened the ski area and the road leading to it. Their main weapons against this familiar enemy were hand-thrown explosives and artillery, including a 75mm recoilless rifle and a 75 mm pack howitzer.

On the 27th-28th, the ski patrol braved the elements on exposed ridgetops to throw hand charges into avalanche starting zones and ski-cut some of smaller slopes. On the 29th, control work included 26 artillery shots in the morning and 14 shots in the afternoon. Hand charges were placed from the ridgetops by ski patrollers who fought strong winds and poor visibility. There was no letup in the storm, which meant no letup in the defense. On the 30th, 12 more shots and additional hand explosives were placed in strategic locations both high and low on the slopes. The strong wind was drifting snow into lee areas lower than normal.

Also on the 30th, four Alpine Meadows ski patrollers rode a chairlift at neighboring Squaw Valley, just north of Alpine Meadows, to gain access to avalanche paths that threatened the road to Alpine Meadows. The lift took them to a point near the summit of 8,070-foot KT-22. From there, through heavy snowfall and howling wind, they worked their way around the mountain, and to the steep snow fields poised above the road. During their mission they saw a very different avalanche-release pattern: both delayed and sympathetic avalanches (indicators of a very treacherous

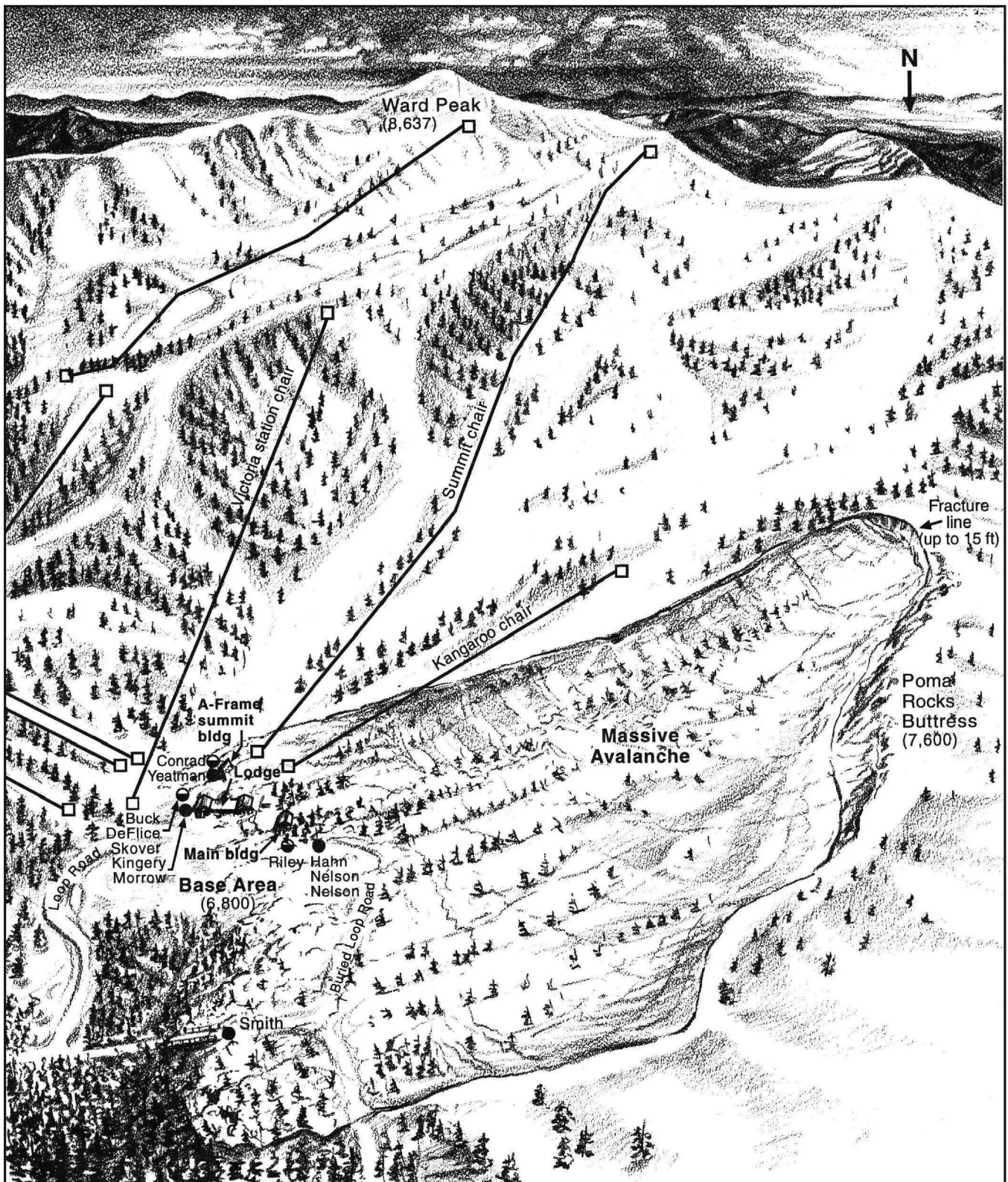


Figure 17. Accident 82-14, Alpine Meadows Ski Area, California, March 31, 1982.

snowpack) resulted from their hand charges. Some of the avalanches buried the road 1,000 feet below. These avalanche hunters knew that

only cautious maneuvers and excellent route-finding would bring them down to the road safely.

Accident Summary

On the morning of the 31st, the blizzard raged on. Alpine Meadows and Squaw Valley were both closed because of the storm. The Mountain Manager at Alpine Meadows, Bernie Kingery, 49, was coordinating the avalanche control efforts. He and his crew of avalanche workers knew that the intense storm had stressed the snowpack to its limit in many locations. The Snow Rangers at Alpine Meadows sensed even more urgency in their work and continued to blind-fire at avalanche paths through the heavy snowfall. Thunderous blasts from 35 artillery shots vibrated the ski area.

Although poor visibility prevented the crews from seeing much of the time, they did spot some results in the Buttress above the resort's base area. The Buttress and Poma Rocks area is an extensive slope that lies above several buildings, chair lifts, and parking lot. This slope is steep, has about 800 vertical feet, and is routinely controlled for avalanches. Two important buildings lie at the foot of the Poma Rocks-Buttress slope: the Summit Building and the Day Lodge.

The Summit Building was situated just uphill of the lodge. It housed the drive terminal of the Summit Chairlift and was the hub of mountain operations. This A-frame-style building accommodated offices and locker rooms for the ski school on the first floor, the ski patrol and lift crew on the second floor, and trail crew and ticket personnel on the third floor. It also housed crucial avalanche rescue equipment.

At 1530 on the 31st, there were seven people in the Summit Building, and all were on the second floor. Five people were in the patrol office on the downhill end of the building. These included Bernie Kingery; Beth Morrow, 22 (lift operations); Randall Buck (lodge maintenance) and Jeff Skover (night security), both early 20s; Theodore "Tad" DeFelice, 25 (lift operations); and Jeffery "Jake" Smith, 27 (trail crew). Anna Conrad (lift operations) and Frank Yeatman, both 22, were in the lift crew locker room on the uphill side of the building. Kingery had sent a team of patrollers to Squaw Valley to run another KT-22 avalanche control route. On this team were assistant patrol director Larry Heywood, Alpine Meadows' avalanche technician Jim Plehn, and patrollers Igor Goulaevsky, Tom Kimbrough and Casey Jones.

At about 1535, only a handful of people were outside. Visitors David Hahn, 46, Dr.

LeRoy Nelson, 39, and his 11-year-old daughter Laura, shielded themselves from the driving storm while they walked across the parking lot toward the base area from nearby condominiums. At about the same time, Jake Smith donned an avalanche transceiver, bundled up against the elements, and took a snowmobile to close the Alpine Meadows road so the KT-22 control team could proceed with avalanche control work on the slopes above it. John Riley, 74, was snug in his motor home parked in the employee's lot near the lodge. (Riley was one of the original developers of the Alpine Meadows ski area.)

The situation grew tense. It was about 1540 when Kingery got a radio call that a slide had just blocked the road near the parking lot. A few minutes later, Smith's strained and excited voice broadcast something over the radio about an avalanche but the message wasn't clear. Kingery tried to get more details from him to see if he was all right, but he never got a response. What Smith had witnessed and was trying to report was an enormous avalanche release in the Buttress area. His brief radio alert was summarily interrupted when he was struck by the avalanche.

A moment later the lights in the base area flickered a few times and then went out. In the next instant the Summit Building exploded as the avalanche tore into it with tremendous force. The people in the Summit Building were struck down with little warning: They saw arcing lights, felt shaking beams, and heard a roar that heralded the onslaught of the avalanche. Within seconds, Conrad and Yeatman were buried in the collapsed locker room and DeFelice and Buck were trapped in what was left of the patrol room. Skover, Morrow and Kingery were blown out the back of the building and buried among the avalanche debris and wreckage.

The Day Lodge was also struck but sustained only light damage. Only a few employees were in the lodge at the time, and they luckily escaped injury when windows shattered and snow poured into the cafeteria and lounge. The nearby maintenance building was also hit, but trees on the uphill side provided enough protection so that damage was minor. The Kangaroo Chairlift was hit and heavily damaged.

When David Hahn and LeRoy and Laura Nelson in the parking lot noticed the wall of snow bearing down on them, they bolted

toward the lodge in a desperate attempt to save their lives. Mike Alves of the road crew was standing near the maintenance building. He watched through the storm in disbelief as the three people were overrun by the onslaught of snow. At the same time, Riley was suddenly trapped in his motor home but otherwise unhurt.

When the powder cloud settled, people emerged to gaze over the destruction and a vastly different landscape than what had been there a minute earlier. Much of the parking lot was filled with 15 feet of snow. Vehicles were either rearranged or buried, two buildings had sustained heavy damage and debris from these buildings was scattered about, snapped trees littered the debris, the lower terminals of the Kangaroo and Summit chairlifts had been demolished, parked snowcats and grooming equipment were buried or scattered, and power and communication lines were ravaged.

Rescue

Snow continued to fall heavily. Buck had been buried in what was now the rubble of the Summit Building. He freed himself from under 18 inches of snow and discovered DeFelice partly buried next to him. DeFelice said he was all right so Buck searched through the debris for the others. He had no luck and returned to dig out DeFelice.

News of the disaster spread fast over ski-area and snowplow radios. The control team of five Alpine Meadows patrollers that had gone to Squaw Valley had talked to Bernie Kingery by phone at about 1540. Within minutes of that conversation, news reached them of the catastrophic avalanche that had struck their ski area at 1545.

The Alpine Meadows patrollers at Squaw Valley quickly changed their concerns from avalanche control to avalanche rescue of their friends that might be buried or injured. As fast as possible, this team drove back toward Alpine Meadows. They followed a snowplow as it cleared a path through the heavy snow on the road. Jim Mott, Assistant General Manager and director of avalanche control at Squaw Valley, and a crew of rescuers were also in route to the accident. They didn't know how close they would be able to get to the accident site or what they might find when they got there.

The people who would normally take over in this kind of situation were either victims of the avalanche or were not at the ski area. For

now, it was up to the others to fend for themselves. When they realized what had just happened, three employees from the maintenance building, and some from the lodge, rushed to the steel-beam skeletal remains of the Summit Building. They brought long tubing from the shop and probed the area around the demolished structure. Skover was found by random probing within a few minutes. He had sustained a bad head laceration and concussion. DeFelice and Buck suffered from minor injuries too, but all three helped in the initial search efforts until they were transported by ambulance to the hospital some 90 minutes later. (Skover didn't remember any of the search.)

People from the maintenance building, day lodge and nearby condominiums also quickly converged on the parking lot. They too used makeshift probes from shop tubing. Some set up probe lines while others scuffed the surface of the snow for clues, and randomly probed likely burial spots where the victims were last seen. Riley was freed from his motorhome and Hahn's body was found by a probe line at 1715. But Nelson and his young daughter were still missing.

Ski Patrol Director Bob Blair was at home when the power went out. He turned on his two-way radio to see if he could learn more about the problem and picked up something he never expected: excited voices and dialogue about an avalanche at the ski area. He knew immediately he wouldn't be able to drive to the area, so he contacted snowcat drivers and told them to pick up him, the KT-22 team and other rescuers at the spot the road was buried by avalanche debris. When all were assembled, two snowcats pulled and carried about 20 rescuers to the ski area.

On the way in, Blair's party spotted Smith's mostly-buried snowmobile on the Gintzon Road bridge, some 1,500 feet from the parking lot. This prompted a beacon search of the area, and Smith's signal was detected under the bridge. He was dug out at about 1715, close to the time Hahn was found in the parking lot some 1,500 feet away. They tried to revive Smith, but even the most persistent resuscitation efforts failed. He had been buried for 90 minutes. Blair continued to the base area where he set up a command post at the day lodge.

Probe lines in the parking lot and around the Summit Building worked into the night,

and WOOF search dogs combed the debris. Both weather and search conditions were less than ideal: it was wet and cold in the ongoing storm, buried building debris made it difficult if not impossible to probe, and scattered locker-room clothing and other personal items confused the dogs who were alerting constantly. One more victim was found that night. The body of LeRoy Nelson was found in the parking lot by a probe line at 1900 hours. The search was finally called off at 2300 due to inclement weather, darkness and the threat of more avalanches.

The weather broke the following morning, April 1, and artillery shots and hand charges dropped from a helicopter tested the slopes above the base area. Many natural avalanches were spotted from the air, and explosives produced additional slides. About midday, rescuers were allowed back into the area to begin the grueling task of digging and probing through the rubble. Later that afternoon, they found Yeatman's body in the rubble of the A-frame, and Morrow was found buried 100 feet downhill of the building. Laura Nelson's body was discovered in the parking lot that same afternoon.

As snow again moved into the area, rescuers made one live recovery. Patrolman Jim Plehn's dog, Mariah, was found in the wreckage of the ski patrol room at the Summit Building. She was cold and dehydrated but otherwise all right. The German Shepherd had been in training with WOOF for avalanche rescue.

Rescuers assembled again on the 2nd and searched through the debris as the storm regained its strength. They dug trenches and random holes in the snow in search for Kingery and Conrad but had no success. Roberta Huber was working her WOOF search dog, Bridget, through the wreckage of the Summit Building. As Bridget was nosing around the upper end of the building she suddenly alerted at a small opening under a pile of snow, lumber and other debris. Huber watched as Bridget gave strong signals that a person was down there, either alive or dead. People with chainsaws and shovels converged to carefully widen the opening without collapsing the fragile "house of cards" stacked some 15 feet high.

When the opening was wide enough, they lowered the dog into the space to find out in which direction the victim might be. Bridget indicated "left," but before they could expand

the search, rescue efforts were called off at 1300 due to the storm and ever-increasing avalanche danger. The storm's intensity prevented any further rescue efforts for the next 2 days.

Following more avalanche control work on the morning of the 5th, search teams returned to the accident site under clear skies. At 1300, rescuers worked on the hole leading down into the twisted wreckage of the building and widened the gap. They slowly made their way into the void where, to their astonishment, they saw a hand reaching out from under a tight space to grab a fist full of snow. It was Anna Conrad and she was still alive! Ski patroller Lanny Johnson called down to her, "We love you and we're coming to get you!"

Conrad survived amazingly well for her 5-day ordeal. She had no major trauma injuries, and her body temperature was close to normal when she was taken to the hospital. Her feet, however, were severely frostbitten. She eventually lost all of her toes on one foot and had to have her other leg amputated below the knee. She survived on willpower and luck. When the building collapsed, she was protected from being crushed when she was thrown under lockers that had fallen over against a bench. In the tight space, she was able to move a little and pull some clothing around her to help fight the cold. She ate snow and patiently waited for rescuers to find her. "I slept a lot—there wasn't much else to do," said Conrad.

Two hours after Conrad was found, Bernie Kingery's body was located some 100 feet from the Summit Building. He had died under several feet of snow soon after the avalanche had thrown him out the back of the building. Kingery was the last victim to be found, though the search wasn't officially terminated by the sheriff's department until April 7 when it was determined that there were no more victims buried in the slide.

Avalanche Data

Many of the avalanche occurrence records for Alpine Meadows for March were destroyed by the avalanche on the 31st, but activity during the storm was extensive. The fatal avalanche originated in the Poma Rocks and Buttress area just outside the ski area boundary. It had been shot repeatedly both before and on the day of the accident. Some small results were noted but there were no large releases in that area. The natural avalanche released on a 38-

degree, east-facing slope at 7,600 feet in elevation, and ran almost 800 vertical feet to the base facilities below. The fracture line was up to 15 feet deep and some 2,950 feet in length. It was a post-control release.

The intense storm (up to 14 feet of new snow in some locations) and a steady rise in temperature escalated notable slide activity on the 31st. In addition to the fatal avalanche at Alpine Meadows, there were other accidents on the same day. A slide at Squaw Valley destroyed two houses, but luckily the five occupants were spared. Another avalanche covered the road near the junction of Alpine Meadows Road and State Highway 89. That avalanche caught five people including California Highway Patrol Officer Doug Diamond. Diamond had parked briefly to make room for a snowplow and was talking to four people outside his car when the avalanche struck. The officer was trapped in his vehicle, and the people outside were buried. Two women were pinned partway under the car, but the two men were able to dig themselves out and then free the women. Later that evening, an avalanche at Squaw Valley damaged the Olympic Lady Chairlift, and 9 miles north at Donner Lake, four houses were struck and damaged.

Comments

At 1545, a mountainside of snow released above the Alpine Meadows ski area, culminating in the most destructive and deadly ski-area avalanche in the United States. Seven people were killed and property damage reached \$1.6 million.

Given the severity of the storm, one of the most severe on record, it would have been prudent to evacuate the ski area until the storm was over and the avalanche paths were tested extensively. Artillery and hand-thrown explosives minimized the danger for a short time, but the storm was simply too intense to keep up with. With no prior history of a slide of this magnitude at this location, avalanche workers weren't prepared for this worst-case scenario. They observed some avalanche debris from the paths above the base area and believed the danger had been minimized. Poor visibility, however, prevented them from seeing the avalanche starting zones where thick slabs of snow had defied their control efforts. This accident reminds us that explosives are not always a reliable test of snow stability.

Rescue operations were a logistical nightmare for several reasons: communications were knocked out, access to the site was blocked, building debris and other items were mixed in the rubble, an undetermined number of people were missing, and the storm raged on with the threat of more avalanches.

Fortunately, all of the personnel at Alpine Meadows had been trained in search and rescue techniques. The survivors were able to initiate immediate action after the accident even though the rescue cache was destroyed and there were no experienced rescue leaders. This saved Skover's life, but the other victims were buried too deeply for a quick find.

Anna Conrad was the miracle of the accident. Her fortitude and luck allowed her to survive being buried for 5 days (115 hours) making this the longest avalanche survival in the United States. Conrad was also the first avalanche victim found alive by a trained rescue dog in this country. This should give inspiration to avalanche rescuers (and victims), and points out that even though survival may seem hopeless, the victim should always be given the benefit of the doubt.

In 1992, the Bernie Kingery Award was established by the American Association of Avalanche Professionals to honor Kingery's long and dedicated service to avalanche safety. Anyone who has shown life-long commitment and dedication on the front lines of avalanche safety is eligible to receive this distinguished award. Kingery had been with Alpine Meadows for 18 years, and was well respected in the avalanche community.

The accident resulted in several procedural changes. A ski area evacuation plan was developed, and the parking lot was secured with a fence to prevent people from entering the area under extreme avalanche conditions. An avalauncher was installed to shoot explosives into the paths above the parking lot, and a 106 mm recoilless rifle was purchased to deliver more powerful explosives into the avalanche starting zones when necessary. Permanent earthen barriers were built in some locations, and additional barriers are built out of snow during the winter. The record-keeping system was improved to keep closer track of weather data, avalanche control work and avalanche occurrences.

Several lawsuits were filed as a result of the accident. Some were settled out of court, and some were dropped. The only one that

went to trial was settled in December, 1985 in the Superior Court of the State of California in Placer County. The jury ruled in favor of Alpine Meadows and absolved the ski area of negligence in the disaster.

82-15

APRIL 3, 1982

Denali National Park, Alaska

2 backcountry skiers caught, 1 partly buried, 1 buried and killed

Weather Conditions

For the most part, the winter had been exceptionally clear, dry and cold. The early winter snowpack remained shallow and kinetic metamorphism dominated to form depth hoar grains. About 2 weeks before the accident, a 2-day storm deposited 36–48 inches of dry snow on top of an old rain crust. This was followed by strong, northerly winds for a week. On April 3, the day of the accident, the weather was clear and mild.

Accident Summary

Two Fairbanks residents, James Stelmock, 26, and Cortland Zachel, 23, set out at 0630 on April 3 to do some backcountry skiing and camping in the Savage River Canyon in Denali National Park. But their plans were thwarted by a Park Ranger as they started up the park road on foot. Stelmock had his dog with him and they weren't allowed to take him into the backcountry. They left the park and drove to Cantwell to ski in the Windy Creek area, a familiar place to Stelmock who had worked in the area.

At 1100 hours they left their car in Cantwell and skied toward Windy Creek, enjoying the sunshine and views along the way. In 2 hours they reached their destination and set up camp on the side of a ridge at about 2,600 feet in elevation. They were about one-quarter-mile inside the park boundary. At 1400, they were anxious to get to the skiing they had come here for and skied a gradual ascent to the top of a small peak, known as Hill 3330, some 400 vertical feet above their camp. From there they skied east along the ridge and intended to drop back down to the flats below and return to camp.

It was about 1630 when they began their descent and were traversing across a moderately steep bowl just below the ridgetop. They were about half way down the bowl and one-third of the way across it when Zachel, some 30 feet ahead of Stelmock, heard and felt the snow starting to slide. It acted like it was going to stop, but after a brief hesitation the slab beneath him quickly gained downhill velocity. There was nothing he could do but try to stay on top of the hard chunks of snow as they slid down the pitch. When his balance and tenuous grip on the chunks failed, he was thrown off, tumbled, and buried up to his thighs when the avalanche came to rest after sliding some 120 feet. Stelmock was nowhere to be seen.

Rescue

Although only Zachel's legs were buried, he was trapped by the vice-like pressure of the avalanche debris surrounding him. It took 30 minutes of hand digging and moving heavy blocks of snow to free himself, and another few minutes to recover from the shock of what had happened. He then began to search for Stelmock by scuffing the snow and looking for clues. After 20 minutes he found a ski pole and dug down to find one of Stelmock's legs. It took Zachel nearly 1.5 hours to uncover Stelmock from 2 feet of snow by digging with the tail of his ski. He attempted CPR for a couple of minutes but could detect no signs of life for his efforts.

It was beginning to get dark when Zachel started out to report the accident. He reached a telephone in Cantwell and contacted State Trooper Headquarters at 2036, and park officials were notified shortly afterward. Since this was an obvious fatality, it was decided to delay recovery efforts until morning when it would be safer to travel in avalanche terrain. After nearly 9 hours of work, Stelmock's body was brought out to Cantwell by a rescue team on the 4th.

Avalanche Data

This avalanche was an HS-AS-3-O, although it ran to the ground in several places. The hard-slab had been clinging to a south-southeast facing slope at an elevation of 3,000 feet, on a 40–45° slope at the top. The 200-foot-wide avalanche slid 180 vertical feet to the transition, and the fracture line ranged from 2–7 feet thick. The snowpack was comprised of a deadly

combination of hard wind-slab poised on depth hoar. A number of dense snow blocks remained in tact, the largest being the size of a car.

Comments

Both men were reasonably experienced cross-country skiers. Zachel had done some reading on avalanches, but had no formal training. Stelmock was said by his widow to be “aware of the dangers of avalanches and mountaineering,” and “well informed on both subjects.” But Zachel reported they did not recognize the potential danger they were in, and the subject of avalanches had not come up.

In this case, basic avalanche knowledge should have alerted these skiers to the danger they were in: They were on a heavily-drifted, leeward slope which was obviously steep enough to avalanche. Also, the snowpack structure held no secrets. Had they dug a snowpit they would have found a very hard layer of snow resting on unconsolidated, granular snow—an easily recognizable, lethal combination to the trained eye. Good route-finding skills would have then led them away from this potential avalanche path.

Even though Zachel had no formal avalanche rescue training, he did the right thing by staying at the accident site and looking for Stelmock instead of immediately going for help. This gave Stelmock a reasonable chance of being found alive, but the circumstances in this case were against it. The party did not have the advantage of avalanche transceivers to quickly locate the victim, and the lone rescuer did not have a shovel to expedite digging once the victim was found. It is interesting to note that Stelmock’s dog survived the avalanche but had no apparent interest in finding his master.

June 19, afternoon rain saturated the snowpack and evening temperatures cooled enough to form a crust on the snow surface. On the 20th, the weather was warm with mostly clear skies and only a light breeze was blowing.

Accident Summary

On Sunday, June 20, a party of nine climbers began their ascent of Mt. Hood at midnight. They planned a route that would take them to the summit via the Leuthold Couloir on the southwest side of the mountain, and they expected to be off of the mountain by 1000 hours. Two members of the party decided not to complete the climb and separated from the group at dawn. The remaining seven climbers continued in two roped groups. The more experienced climbers were in the first group, including group leader Dean TeeHee, 26; Hugh Hakes, 45; and Charlie Hysmith, 31. On the second rope were assistant leader Ken McMahon, 34; Tom Kredlo, 30; Rhonda Rundquist, 29; and Dave Fielder, 34.

They made good progress during their ascent on this warm Sunday morning. The second group took a rest off to one side of Leuthold Couloir while the first group continued their climb some 200 feet higher in the chute. It was about 0730 when the lead group was approaching the top of the Hourglass, a narrow portion of the couloir, when suddenly they were overcome by a roaring avalanche of ice, snow and rock plunging down through the chute. There was no place to take cover even if time allowed.

Fielder’s group on the second rope heard the avalanche coming before they saw it. They looked up just in time to see their companions overrun, not being able to self arrest against the torrent. Then they watched unbelieving as the mass pushed the climbers down past them with increasing velocity toward Reid Glacier. Fielder later wrote, “What we heard, and probably will continue to hear, were the cries of grown men certain they were about to die.” They watched the avalanche descend into the constricted ravine that they all had cautiously climbed only 30 minutes earlier.

During their wild fall, the three climbers were at the mercy of the vigorous avalanche. They were helpless victims who had no control over their fate. Hakes was buried in the debris, and died quickly under the crushing pressure of wet snow, ice and rocks. Hysmith was lucky to stay on the surface, and TeeHee was only

82-16

JUNE 20, 1982

Mt. Hood, Oregon

3 climbers caught, 1 partly buried, 2 injured, 1 buried and killed

Weather Conditions

June had been quite warm in the Mt. Hood area east of Portland, Oregon. On Saturday,

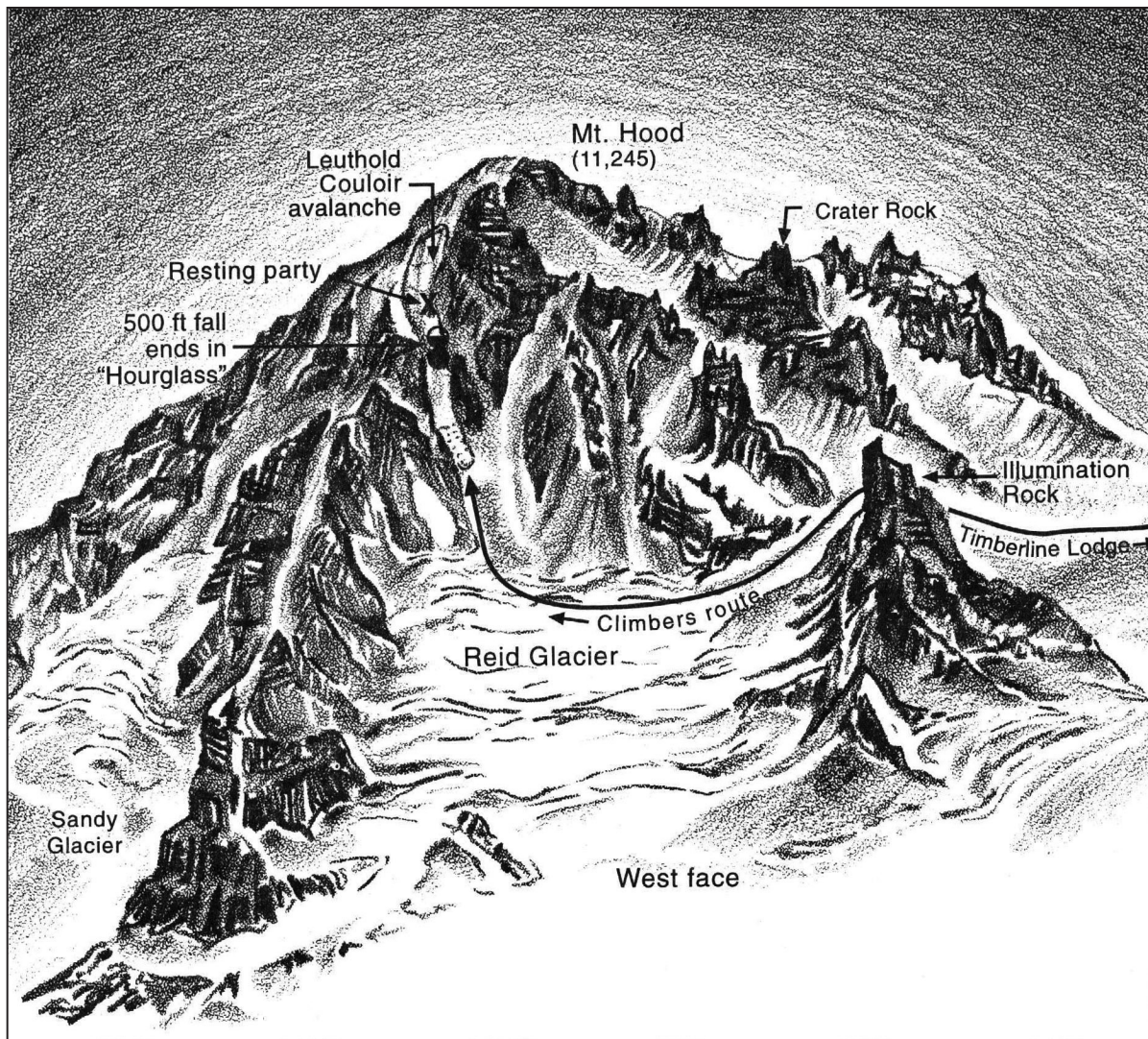


Figure 18. Accident 82-16, Mount Hood, Oregon, June 20, 1982.

partly buried under Hysmith. The ordeal left both of the men injured and in great pain.

Rescue

McMahon, in the lead position on the second rope, acted quickly to organize his group for the down-climb. They descended as fast as possible on the 60° incline and reached two of the climbers, some 300 feet below, in 15 minutes. They were glad to see that their friends had stopped in the Hourglass, which was the only terrain feature capable of stopping them for the next 1,000 feet.

There was no sign of Hakes who had obviously been buried in the wet debris for at least 15 minutes before McMahon's group arrived at

the site. There was little chance he was still alive. Hakes was found later by McMahon, but it is not known how. Following the tether rope would have been the most likely method. They focused their attentions on Hysmith and TeeHee. Both were in agonizing pain and shock, but had to be gotten out of the 6-foot-deep channel with near vertical sidewalls because another avalanche could come down at any time. To complicate matters, 300 feet of rope and climbing equipment was tangled among the debris and bodies. As they worked to free the men, they could see and hear rocks and small ice slides coming down around them, but most of this was routed down adjacent chutes.

While McMahon and Fielder worked in the

couloir to stabilize the victims, Kredlo and Rundquist untangled ropes and devised a pulley system to get the injured men out and relocated in a safe place. Within 45 minutes, they had Hysmith and TeeHee secured on a small rock outcrop where all but a large avalanche would be channelled around them. Both appeared to have suffered broken bones, and TeeHee had obvious head and facial injuries.

Now came the task of getting more help for the evacuation. Since this was the first climb on the Leuthold Couloir route for all of the uninjured, they decided not to attempt the peak even though descending from the summit on an easier route would be safer. They contended that to continue to the peak meant additional route-finding challenges in unfamiliar and dangerous terrain. It increased the chance of another accident and could, in fact, take much longer to reach help. Instead, Fielder and Kredlo were elected to back-track down the couloir, cross Reid Glacier and try to find some climbers they had seen camped earlier in a saddle near Illumination Rock.

They took only bare essentials (ice axes, crampons and 50 feet of rope) and began their descent at about 0830. The going was tough as the snow on the glacier had softened considerably in the sun since their crossing 2 hours earlier. They each took falls getting across three avalanche chutes, but their belays held. After an hour of arduous work, they crossed the last big crevasse and arrived at Illumination Rock. Kredlo was near exhaustion and couldn't keep up so Fielder untied the rope and climbed up 300 feet to the saddle where they had seen the climbers. By now the whole hillside was mush under the warmth of the sun.

As Fielder neared the saddle he could see the climbers, Craig Henry and Mark Seder, were still in camp. Henry filled out an accident report card (carried by most climbers) while Fielder explained what had happened. Seder skied it down to the Timberline Ski Area and alerted the authorities at 1030. By mid afternoon, a helicopter from the 304th Aerospace Rescue and Recovery Squadron was shuttling rescuers up the mountain. They were dropped off some 800 feet above the injured climbers, and two of the rescuers down-climbed to the accident site to prepare TeeHee and Hysmith for evacuation up the couloir. It took 4 hours just to get TeeHee up to the pickup point, and within 10 hours after the accident all of the climbers were safely

evacuated.

Avalanche Data

This avalanche was triggered from the warming temperatures of spring conditions. It descended toward the climbers without warning until it was almost upon them, and could have started several hundred feet above the group. It caught the climbers at about 9,800 feet in elevation, and carried them down the chute another 500 feet. The Leuthold Couloir faces west and approaches 60° in steepness.

Comments

Climbers are at much greater risk to avalanche danger than are skiers simply because of their prolonged exposure time in avalanche- or ice-fall-prone terrain. Henry and Seder said they watched slides come down the couloir about every 15 minutes the previous afternoon. The accident could have had much worse consequences because of the violent nature of this type of avalanche. Also, it was only by chance that McMahon's group was resting and out of the way when the avalanche struck.

The avalanche danger was high on June 20 because of the very warm temperatures and from the rain that saturated the snowpack the day before. These danger signs should have been recognized by the more experienced mountaineers of the group, and a new route taken to avoid avalanche paths and steep couloirs. If this was not feasible (or possible), then the climb should have been postponed until conditions stabilized by a hard freeze—unlikely this time of year—or until the avalanche potential had been considerably reduced by having less snow on the ground later in the year.

This accident happened a day before the one-year anniversary of a very similar event that occurred on Mt. Rainier in Washington on June 21, 1981. That ice avalanche killed 11 of 25 climbers (see accident 81-22).

82-17

NOVEMBER 13, 1982

Twin Lakes, Colorado

1 hunter caught, buried and injured

Weather Conditions

This was a typical fall in Colorado: warm days, cold nights, brisk winds through the higher elevations, and intermittent light snow storms. An early-fall snowstorm brought light density snow to the high country, and little melting occurred on cold, northerly aspects. This was later followed by two storms that brought some 18–24 inches of new snow and strong winds to the ridges near and above timberline.

Accident Summary

Early Saturday morning, November 13, elk hunter Don Shake, 35, and his 10-year-old son Shawn, left their home in Buena Vista to hunt in the Sawatch Range. They drove toward the old mining towns of Vicksburg and Winfield, 25 miles to the northwest. They arrived in the area at 0630 and met their hunting companion Warren Cureton, 59, from nearby Twin Lakes.

The trio set out on a trail leading up the mountain just north of Vicksburg. It brought them to a 12,500-foot saddle between two peaks and from there, Cureton took a high traverse out of the saddle while Shake and his son chose a lower route onto a north-facing ridge. They had dropped about 500 feet in elevation when Shake spotted some deer tracks and began following them. He slipped and fell on the hard snow surface as he crossed a steep, open chute, and slid some distance down to softer snow where he stopped. When he got up, he was standing knee-deep in the snow and realized he was in prime avalanche terrain. He didn't want to traverse the gully because, he said, "It was like slicing the snow with a knife." Suddenly, he was engulfed by a hard-slab avalanche and swept down the mountain.

Shake's son had been following behind but was closer to the edge of the snow field. Shawn remembered his dad being farther out in the middle of the snow when he too slipped on the hard snowpack, but did not slide very far. Then he heard a loud boom as the avalanche broke loose. Fortunately he was able to scramble off of the snow before it carried him away.

Rescue

Shawn lost sight of his dad and called out to Cureton who was farther up the ridge. Then he ran down the slope to find his father. While looking over the coarse avalanche debris, he

saw a movement of blaze orange. It was Shake, waving his arm through the snow. He was buried but able to push his arm it out to make an airway.

Shake's son began to dig him out and found his head buried under 2 feet of hard snow. He continued to dig and was joined about 15 minutes later by Cureton. They used their hands and Shake's broken rifle stock to dig him out of the concrete-like snow.

Shake had an injured knee, and he was very cold and wet. Instead of trying to climb back up through the saddle and hike down to their vehicles to the south, they decided to continue down the north side of the ridge toward the little town of Twin Lakes, about 4 miles distant and 2,800 feet lower.

When they got down to timberline they made a fire to dry and warm Shake. A short time later they resumed their descent until they again stopped to rest and make a large fire to stave off the sub-zero cold. Cureton left the Shakes there and continued on for help, still almost 3 hours away. After about 8 hours, the Lake County rescue team found the Shake's make-shift camp and began the process of evacuating the injured hunter the rest of the way down to the road. They dragged Shake down in a sled and reached a waiting ambulance at 0130 on the 14th.

Avalanche Data

The avalanche that caught Shake was an HS-AF-3-G. It was on a north-facing slope estimated to be as steep as 45°. The 150-foot wide slide released around 12,000 feet in elevation and travelled about 1,000 feet slope distance. Shake was tumbled some 500 feet before he was buried under 2–4 feet of hard snow.

An avalanche advisory had been issued by the Avalanche Warning Center in Fort Collins. The primary concern was for north-facing slopes above 10,000 feet in elevation.

Comments

Don't let the season fool you. Avalanches can occur any time of the year when the conditions are right. Early snow had turned to granular, sugar snow (depth hoar) and was subsequently covered with a layer of hard-slab. This is a dangerous combination any time of the year.

Young Shawn Shake should be commended for his actions following the accident. He quickly summoned help, then began to search the deposition zone for clues. This is an excel-

lent example of the benefits of even minimal avalanche training. Shawn learned about avalanches and rescue techniques through a snowmobile safety course. "I had to take it if I wanted to ride a snowmobile," he said. Shake was an avid outdoorsman and familiar with the avalanche phenomenon through his association with the local search and rescue team.

Shake analyzed his own mistakes after the accident and used this as a valuable learning experience. He said when he tried to swim out of the avalanche, the rifle he had slung over his shoulder kept dragging him under (as can skis or a snowboard.) Also, the weight of his small backpack made it harder to stay on the surface.

Additionally, he could have crossed the gully higher on the slope, but he thought he would be all right where he was. We believe there is no substitute for good route-finding techniques. When strictly adhered to, this essential skill will keep the backcountry traveller well away from avalanche hazards.

A similar accident, but with a more tragic outcome, was repeated the next day in Idaho. (See accident 82-18 to learn more about it.)

82-18 NOVEMBER 14, 1982

Montpelier, Idaho

1 hunter caught, buried and killed

Weather Conditions

Following some early-season snowfall, 2–3 inches of fresh snow fell with strong winds the day before the accident.

Accident Summary

On Sunday the 14th, Lewis Robison, 32, was hunting deer with fellow hunters. He separated from his companions at 1100 and rode his horse to the top of a ridge. There he tied his horse to a tree, took his rifle and proceeded down across a steep snow-covered slope to look for game.

Robison slogged his way through the drifted snowfield some 20–30 inches deep. The walking, however, wasn't particularly difficult because under the soft slab snow on the surface was weak, granular snow that offered lit-

tle resistance to his legs. In mid stride, the snowpack suddenly collapsed around him and swept him off his feet. He was part way across the slope when the avalanche released and there was no escape. The slide carried him some 600 feet, but it wasn't a rough ride. He fought to keep his head above the snow but it was impossible to stay on the surface. The flow deepened when it reached a gully, turned a corner, and trapped him under 3–5 feet of snow. Robison was in a horrifying situation. He was buried in an avalanche, and no one knew where he was.

Rescue

Later in the day, Robison's friends became concerned and began to look for him. They located his horse and followed his tracks over the ridge to the avalanche. It was now obvious what had happened, and with no exit tracks from the debris, they knew he was still buried somewhere beneath their feet. But it was getting late, and without any surface clues, nor shovels or probes to search with, there was little they could do but go back and report the accident.

At 0730 Monday morning, Dick Epley, a member of the Utah-based Rocky Mountain Rescue Dogs, Inc. and the avalanche advisor for the Intermountain Division of the National Ski Patrol, received a call from the Bear Lake County Sheriff in Idaho. Upon hearing what had happened, Epley arranged for a helicopter from Hill Air Force Base to fly him and his rescue dog, Beau, some 80 miles north to the accident site, just northeast of Montpelier, Idaho. They set down near the site and met Leroy, a Bear Lake Search and Rescue Team member who took Epley and Beau to the top of the avalanche.

Feeling uneasy about some of the remaining snow in the starting zone, Epley positioned Leroy as an avalanche guard and gave the "Search" command to Beau. It was 1025 when Beau put his nose to the snow and went to work. They searched down through the debris and Beau gave a weak alert about 60 feet below the bend in the path. They covered the remainder of the narrow avalanche debris in a few minutes and started back up. At 1045, Beau alerted again in the same spot, but this time he began to dig wildly. This was good enough for Epley. He got out his shovel and helped Beau dig down 3 feet where they found Robison's frozen body. He had died of suffocation.

Avalanche Data

Avalanches don't care if you are a hunter, skier or an elk. If the snowpack is weak enough and the terrain is steep enough, any suitable trigger will do to set the snow in motion. This SS-AF-3-O avalanche was triggered by a hunter walking across a steep (45–50°) snow-loaded slope. Conditions on this north-northwest aspect at 8,600 feet had been perfect for the formation of faceted snow in the shallow snowpack. Snow had drifted 1–3 feet deep in some lee areas, and much of it had turned into fragile depth hoar.

The slide released 18 inches deep and 120 feet wide, some 60 feet above Robison. It ran 600 feet to where it narrowed into a gully and made a bend to the left, then continued for another 600 feet down the 20–30° trough. The debris piled up to 25 feet deep in one place and was 10 feet deep where Robison was found.

Comments

Robison was hunting alone; there was no one to try to save his life after the avalanche. He was found with an ice mask around his head which indicates he may have been alive for some time under the snow. There were no indications of trauma from a wild avalanche ride; his mouth was not packed with snow and his glasses remained on his head.

This was the second hunter caught in an avalanche in 2 days (see accident 82-17). While more backcountry skiers are starting to carry avalanche rescue gear, it is doubtful that hunters are. Avalanches don't discriminate as to the activity category of their victims. A person on foot can trigger a slide just as easily as a person on skis. Avalanche skills and rescue gear are recommended for hunters, too, whenever they pursue their prey into steep, snow-covered terrain.

Where depth hoar tries to support a fresh soft-slab, there is a high probability of triggering an avalanche if the slope is steep enough. Many people discount the avalanche potential in the fall because it is not winter yet. Avalanches are not dependent on the time of year but can occur whenever the ingredients are present: a steep slope, a snowcover, a weak layer, and a trigger. Fall can be a dangerous time for avalanches because a shallow snowpack often turns into weak, faceted grains that don't bond well to each other. This makes a poor foundation for subsequent snows. There

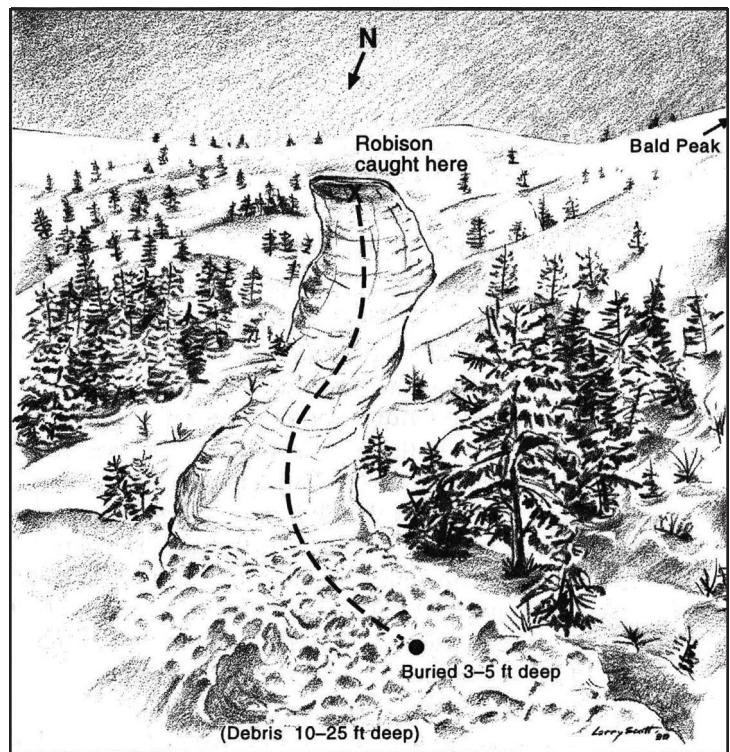


Figure 19. Accident 82-18, Montpelier, Idaho, November, 14, 1982.

are several "bad" snowpack-structure scenarios, almost any of which can be found somewhere in the mountains at a given time.

82-19 DECEMBER 7 AND 8, 1982

Big Sky, Montana

3 lift skiers and 4 ski patrollers caught (three incidents), 3 partly buried, 2 buried, 3 injured

(Because of the continuity of two incidents here in 2 days, both are included as one narrative.)

Weather Conditions

November 1982 produced no major storms for the Big Sky ski area in southwest Montana, some 45 miles south of Bozeman. The snowpack was shallow, about 20 inches deep, until more fresh snow moved into the region November 30 to December 2. This was followed on the 5th by another storm depositing up to a

foot of dry (5 percent water content) snow by the morning of the 7th. Cold air followed the front and dropped temperatures into the single digits for a brief period. Moderate winds reshaped the new snow into soft-slab conditions in avalanche starting zones.

Accident Summary

On the morning of the 7th, avalanche control work was conducted around the top of Lone Peak chairlift using a 75 mm recoilless rifle. This produced two small slides in First Chute and Second Chute, and one SS-AA-4 in Third Chute. When the gun crew finished, patrollers Jon Ueland and John Paquette set out on a high traverse to throw hand charges into additional chutes along the North Face. These produced some small, shallow releases in the new snow but nothing major. When they completed their route, another control team commenced their route on a lower traverse with more hand-thrown explosives. This resulted in one full-depth avalanche on Forested Knoll, but the rest of the route went without incident. Based on the considerable explosive (12 charges) and ski-cut tests that did not produce results that morning, the two teams felt the bowl was safe to open to the public and the chairlift began loading passengers at 1020.

At 1100, while skiers tracked up the main cirque, Paquette, along with patroller Rich Bearwald and snow safety director Doug Kremer broke trail to an area called South Wall. Bearwald kicked off a 20-inch-deep avalanche that slid on depth hoar to the ground. Other ski cuts produced no results, but Kremer and Bearwald did not feel good about the area and returned to check it again. They traversed higher this time, got more collapsing and decided to discuss closing the bowl with their comrades on duty. Kremer skied down Black Rock first, which had been skied previously by two other people, and turned to watch Bearwald coming down close to his tracks. Suddenly the slope collapsed and released an avalanche that carried Bearwald down 100 feet before he was able to get out of it. Recognizing that considerable danger still persisted in the area, Kremer and Bearwald proceeded down to tell the patrol to close the bowl.

About the same time, three people entered the same area and began to ski another slope that had already been skied. Part way down they triggered an avalanche that carried them

200 vertical feet to the bottom where they were partly buried. Two of the skiers were unharmed, but it was a different story for 25-year-old David Kelleher, a ski area dining room manager. He suffered a compound broken femur when he was ground through the rocks on the way down. The bowl was closed immediately and the ski patrol transported Kelleher to the bottom of the mountain where he was stabilized and transferred to Bozeman Deaconess Hospital. Kelleher was the first person ever to be injured in an avalanche at Big Sky, but he was soon joined by two fellow employees.

On the following day, December 8, the Lone Peak chairlift remained closed to the public. Once again, avalanche control teams tested the cirque bowl areas for unstable snow. Fourteen rounds from the recoilless rifle produced few results, and control routes on the high and low traverses did no better. The snowpack appeared to have stabilized somewhat in the last 24 hours.

About mid afternoon, Kremer, along with patrol director Sean Monahan and patroller Bob Dixon, proceeded farther north and on the other side of Lone Peak chairlift to an area called Little Rock Tongue. Of the twelve charges thrown (some simultaneously) they got three avalanches to run to the ground, including one sympathetic release. In an adjacent area the team threw four additional charges without results, then ski-cut a starting zone where the third patroller got it to collapse but not slide.

The next shot was thrown into High Clearing, but it hit a tree branch and fell short. Uncomfortable with where they were standing, the team started to traverse one of the slopes that had already been controlled. As Monahan started across, the entire slab released and all three were caught in a torrent of churning snow. Kremer's skis were ripped off but he was able to grab a nearby tree where he hung on for his life as chunks of snow swept around him. Monahan and Dixon were less fortunate. They were dragged down 400 vertical feet over rough terrain and totally buried.

Rescue

Kremer got up and called out for his companions but he got no answer. He immediately radioed patrol headquarters for help, asked for a helicopter and an ambulance, and told them

he was starting a Skadi (brand of avalanche transceiver) search.

About 300 feet down the slope he picked up a signal and homed in on one of his partners. He heard a muffled yell from under the snow and uncovered Dixon's face which was about 1 foot below the surface. To avoid getting confused with two signals, he turned Dixon's Skadi off and told him he was going to search for Monahan.

Some 60 feet farther down the debris he picked up a strong signal and discovered Monahan's hand just under the snow surface. By that time Jon Ueland had arrived with more equipment, including a larger shovel, and together they dug 3 feet down to Monahan's head. He was barely breathing but responded better after they loosened the tightly-compacted snow from around his chest. Kremer then went back to dig out Dixon while Ueland tended to Monahan. Additional help reached them shortly, and the helicopter arrived at 1700. Monahan was flown directly to Bozeman Deaconess Hospital, and Dixon was transported to the bottom of the mountain where he was taken to the hospital by ambulance. Both were treated for cuts and bruises, and Monahan was held overnight for additional observation.

Avalanche Data

Early in the season in southwest Montana, the shallow November snowpack was subject to a temperature gradients that formed depth hoar near the ground. Snow at the beginning of December fell on this weak base (16–20 inches thick), creating the dangerous combination of a slab resting on a weak foundation of granular, unconsolidated grains. After the accidents, investigators noted that it was difficult to isolate and test a column of snow because the depth hoar in the lower portion of the pack kept collapsing.

Many of the avalanches from control work on the 7th–8th slid to the ground and had crown lines 2–8 feet thick in drifted areas. The slide that injured Kelleher on the 7th was classified as an SS-AS-2-G. It took out 50 percent of the path and ran 225 vertical feet. The slide that caught the three patrollers on the 8th was also an SS-AS-2-G of about the same size. Both avalanches released in areas that had been previously skied, or controlled with explosives and ski cuts and were post-control releases.

Comments

Avalanche control results on the 7th led the ski patrol to believe that the snow that did not slide with explosive and ski-cut tests was stable and safe to open to the public. But further checking after the area had been opened proved this was not the case; Bearwald was caught by a small slide in a previously-skied area.

It is sometimes difficult to assess the avalanche danger in a snowpack comprised, in part, of depth hoar. In some locations the slab above this fragile layer may be strong enough to "bridge over" the weakness. But a short distance away, the overlaying slab might be easily collapsed by the weight of a skier or an explosive charge. Variations in snow depth and temperature patterns across a slope promote differences in snowpack strength from one location to another. Therefore, the position of the trigger becomes crucial. There is a good chance the areas that didn't slide during control work, but slid later with ski pressure, would have released with different shot placement or ski cut locations.

While it appeared that there was sufficient use of both explosives and ski-cutting to stabilize the area, in retrospect the cirque and the North Face should not have been opened to the public until more complete testing had been done. Snowpack stability was still under suspicion; Kremer and Bearwald didn't feel good about it and returned to have another look. Their additional findings prompted the area to be closed, but not before an avalanche caught three skiers.

The avalanche that caught Monahan, Kremer and Dixon on the 8th could have resulted in a double fatality—statistics show that only 33 percent of totally buried avalanche victims survive. Kremer can be credited for performing a textbook rescue and saving the lives of his partners. Here are some of the key points. First, he sounded the alarm to get help moving his direction. Second, after finding Dixon he turned Dixon's transceiver off to avoid confusing signals. And third, after ascertaining that Dixon was all right, he didn't waste time digging him out, but immediately continued his search for Monahan who wouldn't have lasted much longer under 3 feet of constricting, suffocating avalanche debris.

The control team members were positioned in a safe treed area near a slope that had already been shot and protective skied.

But they were forced to leave their protection when the thrown charge hit a tree branch and fell short of its mark. When they started to cross the previously-controlled slope toward a safer spot on the other side, it collapsed and avalanched.

Good fortune on the 7th (Kelleher could have just as easily hit his head, not his leg, on the rock), and avalanche rescue skills on the 8th averted worse disaster. On both days the avalanche potential was underestimated. The ski patrollers, however, were relying on their control route observations, which indicated in several locations that the snowpack could hold up to the stress of explosive testing. Should it, therefore, have the strength to support the weight of skiers? That difficult question requires much more input than control results alone, such as the recent history of the path, snowpack and terrain data, and recent weather data. It is a dilemma that faces every ski area avalanche forecaster: open an area or leave it closed? If your feelings are borderline, go with the latter.

Before the end of December, the Big Sky ski patrol would suffer another blow. That story can be found in 82-21.

82-20

DECEMBER 19, 1982

Philipsburg, Montana

1 snowmobiler caught, buried and killed

Weather Conditions

Recent rain and freezing temperatures created a slick base for subsequent snow. Much of the early-season snowfall had not melted on this north-aspect accident site, and the cold temperatures above 8,000 feet gradually turned the old snow into depth hoar.

Accident Summary

New snow in western Montana attracted many snowmobilers to the mountains to experience the thrill of riding in deep powder. Among those who wanted to test their machines and skills were Paul McDermott, 39, of Anaconda, Montana, and Ted Beck, 29, Jody Neubauer, 24, and Dave Haviland, 30, all from Deer

Lodge, Montana. Full of anticipation for a great day of riding, they hauled their snowmobiles to nearby Philipsburg and a trailhead on Warm Springs Creek.

The group's objective was to ride a large circle from Warm Springs Creek toward Fisher Lake, then cut off to a pass near Twin Peaks and come out again on Warm Springs Creek for their return to the trucks. The powder was deep and they got stuck several times on the road to the lake. When they turned off of the road, the task of breaking trail to the pass was even more difficult because of the steep grade on the north side of Twin Peaks.

In turn, each snowmobiler took a run at the hill until he got bogged down, then he came back down the compacted path and waited for the next person to take a shot at it. Several passes were made but progress was slow. The only rider to make a slight deviation on the return to the bottom was McDermott. Part way down he veered off to an adjacent steep slope, then turned back to the packed trail and rejoined his comrades for the next round. When his turn came again, he shot up the hill as high as he could get, turned around, and again cut off onto the adjacent slope but this time a little higher.

At 1500, McDermott's friends watched as he cut across the steep hillside, throwing a wake of powder as he went. Neubauer was the first to see the snow fracture some 600 feet above McDermott and shouted, "Avalanche!" He and Haviland made a dash to the side, while Beck turned downhill and tried to outrun the onslaught of cascading snow. But, in movie-script style, his machine got hung up on a log after going only 30 feet. Beck looked over his shoulder and watched as the avalanche bore down on him, then faced downhill again and hung on tight to his immobile sled. The churning snow rode up over the back of his seat and flowed around him on each side for another 10 feet before it stopped.

From the toe of the vast debris, Beck heaved a sigh of relief and jumped up on the snowmobile seat to look for McDermott. He was nowhere to be seen. Neubauer and Haviland soon joined him and reported no sighting of McDermott. Their Sunday outing had turned into a horrible tragedy.

Rescue

They decided that Beck should skirt the avalanche and look for a track coming out. If

he didn't find any encouraging signs, he would go back down the trail in search of help. Neubauer and Haviland would search the debris below the spot where they last saw McDermott.

Beck found no evidence to indicate that McDermott made it out of the avalanche. He set out for the trailhead, some 12 miles distant. Though they had seen 15–20 snowmobilers on the road on the way in, this time he found no one until he reached the end of the road.

At Cable Mountain Campground he met state Game Warden Steve Magone, who radioed the Granite County Sheriff Office to organize a rescue. The initial call came in at 1547, and over the next few hours, 50 volunteers responded from the Discovery Basin Ski Patrol, Anaconda Search and Rescue, Lost Creek Search and Rescue, and the Georgetown V.F.D. among others. All of them had to be taken in on snowmobiles as it was some 12 miles to the accident site from the staging area at the campground.

They worked into the night probing the avalanche, and only had half of it covered by 0200 on the 20th. But the rescuer's efforts were fruitless and a fresh crew replaced them the next morning. More than 80 people combed the accident site on the 20th, and at 1420, McDermott was located under 6–8 feet of snow, and about 100 feet uphill of the toe of the debris. He had been buried for more than 23 hours. He had no apparent injuries and the coroner attributed his death to suffocation.

Avalanche Data

One witness said of the snowpack at the accident site, "...a fairly deep depth hoar layer was observed with approximately 2 feet of heavy snow on top. It was too hazardous to excavate a snowpit close to the avalanche starting zone."

The starting zone was at 8,800 feet in elevation on the north face of Twin Peaks. The avalanche poured down the 35° pitch after the 1,200-foot-wide, and 30-inch-deep slab collapsed under the weight of McDermott's snowmobile. Terrain features squeezed the avalanche to half that width at the toe after it dropped 500 vertical feet, and contributed to more than 10 feet of debris in many areas.

Comments

We don't know how much avalanche training these snowmobilers had, if any. But much can

be learned from the accident. First, all of the riders were exposed to the avalanche danger at the same time. Had it not been for their quick actions, the people below could have also been trapped. Second, the snowpack was very weak. The snowmobiles could barely stay afloat and repeatedly collapsed into the lower layers. This should have sent warnings that the snowpack was in a fragile state. Third, an avalanche transceiver would have shortened the search time immensely and spared many people a miserable night out on the mountain. Even had McDermott carried one, the odds of a live recovery were slim because of his deep burial. To date, no one has been found alive buried deeper than 7 feet in direct contact with the snow.

Snowmobilers are inherently at a disadvantage in that they cannot hear the snowpack around them. Subtle collapsing noises and cracking in the snowpack communicates valuable information to the trained backcountry traveller. In addition, the weight of a snowmobile and rider places significant stress on the snowpack. While it may hold up under one or more skiers, it might fail beneath a snowmobile.

On the other hand, a snowmobiler has the advantage of speed, which would be handy to get away from an avalanche. Also, if caught in a slide the rider would not be encumbered by skis, poles and a pack, thus making swimming motions easier in the battle to stay on the surface.

Snowmobilers, as well as climbers or backcountry skiers, need to learn basic avalanche awareness. They are the fastest growing group for recreational avalanche accidents. (See accident 81-8 for a similar snowmobile incident.)

82-21
DECEMBER 24, 1982

Big Sky, Montana

1 ski patroller caught, buried and killed

Weather Conditions

Following a mild November, December 1982 brought consistent light snow to the Big Sky ski area in southwest Montana, 45 miles south of Bozeman. From the 1st–24th, 60 inches of snow fell with an average density of 6 percent.

Forty inches of this came in the 10 days leading up to the accident. Periodic winds of 15–30 mph drifted some of this light snow into lee areas to form soft-slab conditions. While day-time temperatures were mostly in the 20s, it became very cold at night, ranging from the teens to minus 18°F.

Accident Summary

In the afternoon on Friday, December 24, professional ski patroller David Stutzman, 31, and Lynn Broughton, a former Big Sky ski patroller of 3 years, were skiing together in the recent fresh powder. The skiing had been good on the runs but they wanted to try some untracked snow in a permanently closed area called the Snake Pit which lies between the Big Horn ski run and the Mad Wolf chairlift. At 1400, Stutzman borrowed a Skadi (brand of avalanche transceiver) from fellow patroller John Paquette to give to Broughton. Stutzman told him where they were going, and the pair skied down Big Horn.

Part way down Big Horn, Stutzman and Broughton turned off the trail, skied past the closure signs and through timber to a steep, open hillside known as the Snake Pit. Stutzman skied a short way out onto the slope while Broughton waited. The snow felt good as he carved through the soft snow, but the delicate snowpack failed when he encroached the near-40° pitch. Stutzman's skiing was suddenly interrupted as the serpentine slope fractured into a soft-slab avalanche that swallowed him in his tracks. The narrow, soft-powder avalanche ran some 275 feet into a narrow draw and dumped debris, and Stutzman, onto an old access road in the runout zone. He was totally buried and tightly encased in the dense snow that piled up on the bench. Broughton, who watched from a safe spot, was not caught in the slide.

Rescue

The avalanche stopped almost as quickly as it began. Broughton went straight to the debris pile and began to search for Stutzman. She spotted the tail of his ski sticking out of the snow, and dug far enough to find Stutzman's boot attached to it. But she didn't have a shovel! Stutzman carried the only one in the party. She frantically dug with her hands until she realized it was futile in the dense debris. She decided to go for help. About a half-mile away she reached the lower terminal of the Mad

Wolf chairlift and reported the avalanche. The operator called patrolman John Paquette who was stationed at the top of the lift.

Paquette and a fellow patroller were the first on the scene. They found Stutzman's ski tail sticking out of the snow and, together, dug him out as fast as they could. When they reached his head under 5 feet of snow, they found him to be significantly bent forward with his chin pressed into his diaphragm. His lips were blue and there was no ice mask around his head. He had been buried in dense avalanche debris for some 30 minutes but they still attempted CPR hoping to kindle any spark of life. They never got a response, and Stutzman was flown to Bozeman Deaconess Hospital where he was pronounced dead at 1800 hours. He was the fifth avalanche victim to be taken there from Big Sky this month. (Three lift skiers and three patrollers were caught in separate slides at Big Sky on the 7th and 8th of December. You can review these incidents in accident 82-19. Also, a similar event [no shovels] occurred in Colorado in 1980. See accident 80-10 for that story.)

Avalanche Data

The SS-AS-2-O avalanche that killed Stutzman was a small avalanche involving only 10 percent of the snow that could have slid. The avalanche ran 150 vertical feet from a fracture line 12–16 inches deep and 40–50 feet wide. The soft-slab consisted of 12–16 inches of recent new snow resting precariously on an old crust. Between the two was a layer of buried surface hoar, and supporting it all was a fragile foundation of 1- to 2-millimeter faceted grains 10 inches deep. The northeast-facing slope was 35–40° in steepness.

Comments

When the avalanche came to rest, Stutzman was deeply buried on the road. Like any terrain bench in an avalanche path, this one collected snow as the avalanche flowed over it. If he had been carried for a shorter or longer distance, placing him in a different part of the debris, Stutzman would not have been buried as deep as he was. This decreased (but didn't eliminate) his chances of surviving, even if Broughton had carried a shovel.

An avalanche beacon is incomplete without a shovel; it is virtually useless if the victim is buried at any significant depth. What could be more frustrating (and painful) than know-

ing your companion was right beneath your feet, but there was no way to reach him in time?

Should Paquette have loaned his Skadi to Broughton? Probably not. He was an on-duty patrolman, responsible for the skiing public. By giving his transceiver to Broughton, he disabled himself to fully participate in a rescue elsewhere, or if there had been no protruding ski to signal Stutzman's location. It also gave tacit approval for these two skiers to enter a permanently closed area.

It was a hollow Christmas Eve for the ski patrol and friends of David Stutzman. He was well respected in the community, and talked of highly. Stutzman was an experienced ski patroller and mountaineer. He had just returned from China where he made the first ascent of 21,457-foot Jiazi Peak in western Szechwan province. He was planning a public slide show to share his adventures with the Big Sky community. The Snake Pit must have looked very innocuous compared to the demanding mountaineering challenges he had recently faced on Jiazi Peak. (See accidents 80-10, 82-8, 82-13, 83-3 and 85-24 where shovels were needed but not carried.)

82-22

DECEMBER 25, 1982

Montezuma, Colorado

1 backcountry skier caught, buried and killed

Weather Conditions

It was 2 days before Christmas, and the mountains around Loveland Pass, some 45 miles west of Denver, were getting fresh snow. By the morning of the 25th, new snow totals from two nearby ski areas, Arapahoe Basin and Keystone Resort, were 14 inches and 11 inches, respectively. Winds of 20–35 mph created long snow plumes off of the high ridges above timberline. A brief notation in the Arapahoe Basin daily weather log told the whole story: “windier than s____.” Temperatures were seasonably normal, in the teens and low 20s.

Accident Summary

A party of two, Doug Sheldon, 38, and Harry Baum left the small town of Montezuma on

their skis to do some above-timberline powder skiing in the fresh snow. Their plan was to ski up Saints John Gulch, past the old Saints John townsite and mine, to the upper end of the drainage. From there they would traverse back above timberline to a point far above Saints John for a 1,200-vertical-foot powder run down to the townsite. But they never completed their loop. Here's what happened instead.

They left Montezuma at 0900 under a clear sky and a temperature of 0°F. They skied 2-3/4 miles up the Saints John drainage to a point where they cut back and began their gradual climb up the hillside. It wasn't long until tragedy struck. Sheldon was skiing behind Baum at a distance of about 150 feet. The snow had been collapsing locally around them since they broke out above the tree line, and Baum was concerned enough to have his avalanche cord deployed behind him.

At 1325, Baum looked around and saw Sheldon start to ski a short pitch that gradually channeled into the trees some 80 vertical feet below. Sheldon made only two turns when he fell in the drifted powder. As he was getting up, the slope fractured and started to slide. Baum yelled, “You're in it!” He watched Sheldon point his skies downhill and get into a low crouch with his feet in a wide, stable stance to ride out the small avalanche. After all, it was only a small slope. He descended in this position until Baum lost sight of him in the churning snow.

Rescue

Baum was less than 100 feet from the flank of the slab when it broke loose and had no trouble getting to the deposition zone quickly. There were no clues on the surface to guide him to his friend, and they weren't wearing avalanche transceivers. The only thing Baum could do was probe what he thought were the most likely areas with his ski pole. With handle end down, he could easily push the pole full depth into the snow and not hit bottom. He searched for 20 minutes without success before he skied back to the Montezuma Inn and reported the accident.

The Summit County Rescue Group was notified of the avalanche at 1435 and began arriving at the Montezuma Inn at 1530. The first team of four people, including Harry Baum, left for the accident site at 1545. They were followed in 30 minutes by seven more rescuers for the 1 hour trek to the accident site.

Volunteers from the Arapahoe Basin ski patrol and employees from the Montezuma Inn also helped in the search. After probing the debris for 4 hours, Sheldon was found under 3 feet of snow, just 6 feet from the flank of the debris in the transition zone. He had been buried for 8 hours and had died of suffocation. They evacuated him to Montezuma under bright moonlight and headlamps, arriving there at 0018 on the 26th.

Avalanche Data

This avalanche had enough volume to bury a skier at the bottom where debris piled up some 5–10 feet deep. The fracture line was 30–60 inches high and propagated nearly 200 feet wide. The avalanche ran on a 32° slope on an east-southeast aspect at 11,680 feet in elevation. The vertical drop was little more than 75 vertical feet. The avalanche site is a comparatively small terrain feature near the toe of a large mountainside rising sharply above it. Since the avalanche involved most of the drifted snow this terrain could hold, it is classified as an HS-AS-4-O.

The snow on this high elevation, lee slope was drifted over 5 feet deep. More than 20 inches was recently wind deposited with a strong slab underneath. This, in turn, was weakly supported by 12 inches of depth hoar at the bottom, and all gave way after Sheldon fell and was struggling to get up in the deep snow.

Forecasters at the Colorado Avalanche Information Center had been carefully monitoring the storm and the results from wind-loading in the higher elevations. An avalanche warning had been issued for this area and was in effect at the time of the accident. It is unknown if these skiers called the local avalanche hotline before they started on their tour.

Comments

Doug Sheldon and Harry Baum had been skiing together in the backcountry of Summit County (the deadliest county in the United States for avalanche accidents) for over 12 years. Sheldon had been a professional ski patroller at the Breckenridge Ski Area, and both were familiar with avalanches and rescue techniques. They knew the danger, yet by skiing without beacons and shovels, they did nothing to minimize their risk. Avalanche rescue beacons would have likely saved Sheldon's life. He had not been injured in the short ride and was buried less than 4 feet deep.

They had both skied steeper and much larger slopes many times. This particular pitch must have looked benign, and good for a few easy turns in the fresh powder on that sunny, Christmas afternoon. They were avoiding the more challenging and obviously more hazardous terrain, only to have their tour still end in tragedy.

This accident tells us to be suspicious of any steep, wind-drifted slope, regardless of its size, so soon after a storm. The snow was collapsing under their weight as they toured near timberline, which was a clear warning that the snowpack was in a very fragile state and steep terrain should be avoided. This was evidenced by a second avalanche that ran between the time Baum left for help and returned with the rescue party. It was an HS-N-4-O, 600 feet wide and ran 500 vertical feet on the slope above the accident site. Had it been a little larger it would have overrun the debris where Sheldon was buried.

83-1
JANUARY 1, 1983

Stanley, Idaho

1 snowmobiler caught, buried, and killed

Weather Conditions

Weather records taken at Sun Valley ski area, about 40 miles south of this accident site, show that the Sawtooth Range received light snow daily from December 15–20, 1982, and then moderate snow fell on the 21st–23rd. Sun Valley recorded 40 inches of snow that contained 3.55 inches water equivalent on those three days. This storm produced widespread slab conditions in the Sawtooth Range. Dry weather prevailed from December 24–31.

Accident Summary

Dawn Aldous, 32, of Clayton, Idaho, and his brother Lynn had planned a snowmobile trip for New Year's Day. On the morning of Saturday the 1st, the two men rode their snow machines into the White Cloud Mountains southeast of Stanley. The area of their day-trip was in the Sawtooth National Recreation Area

and about 18 miles from Stanley. They reached the Crater Lake area at 1100 hours.

A short time later the two men had ridden part way up a steep, high cirque above the lake and were traversing the slope with Lynn in the lead. Lynn came to a stop, turned around, and was stunned to see a huge avalanche running down the bowl behind him. He had not heard the avalanche over the sound of his snowmobile, and instantly feared for his brother's life. When the powder cloud settled, he saw no sign of him.

Lynn rode his machine onto the debris and searched for visible clues, but the area was enormous, the debris was deep, and there were no clues. Eventually he turned his snowmobile down the trail and rode out to summon help.

Rescue

The Custer County Sheriff responded to the call for help. Lynn Aldous led a group of rescuers by snowmobile back to the site. The group included the deputy sheriff, members of the Custer County Search and Rescue Team, and Idaho Fish and Game Officers. Their search that afternoon found nothing, and they spent the night in a small cabin near Crater Lake huddled around a wood stove as temperatures outside fell to 20°F below zero.

The next day, Sunday, these rescuers were joined by the Galena Nordic Ski Patrol, flown in by U.S. Air Force helicopter. About 30 searchers formed into probe teams, but again they found no trace of Dawn Aldous or his snowmobile. Some of the debris was estimated to be 30 feet deep, far deeper than the 12-foot probe poles being used. Additional searchers used bloodhounds and metal detectors, again to no avail.

The next day, Monday, winds of 50 mph were building the cornice above the searchers and filling in the fracture line with blowing snow. The sheriff called off the search because of the threat of a second avalanche and the zero chance that the victim could be found alive.

In the spring, the sheriff began periodic flights over the area. In early June, the victim and his snowmobile had melted out and were spotted from the air. A ground team evacuated the body.

Avalanche Data

This avalanche was classified as an HS-AV-4,

which means a large hard-slab triggered by a vehicle (snowmobile.) The fracture was 350 yards wide and up to 8 feet deep. The avalanche released on a north-facing slope at an elevation of 9,900 feet and fell 600 vertical feet. One rescuer described the snow structure as "a sheet of glass on ball bearings," which is a classic description of hard snow on top of depth hoar.

Comments

The Aldous brothers had given no thought to avalanche dangers when they traversed a large, steep, open bowl. The snow structure was decidedly dangerous this day, and when the snowmobiles caused local collapse, cracks easily propagated long distances to produce a large avalanche. The only safe measures on such days is to have and use the skills to identify the problem, by digging snowpits and making stability tests, and then avoid avalanche areas.

The victim and survivor had taken no safety precautions prior to the accident (no rescue gear), had not looked for clues of unstable snow, and had used poor route selection in avalanche terrain. Collectively, these were three errors that led to tragedy. Education tailored specifically for snowmobilers is key to saving their lives in avalanche terrain.

83-2

JANUARY 2, 1983

Hatcher Pass, Alaska

2 backcountry skiers caught, 1 partly buried, 1 buried

Weather Conditions

Hatcher Pass is located about 60 highway miles northeast of Anchorage and is a popular ski touring area. Situated wholly above timberline, this area offers a wide variety of skiing from maintained tracks across an undulating valley to steep bowl and chute skiing far above the valley. The snowpack usually has a depth-hoar base, and avalanching is widespread following storms.

There is no data on preceeding weather, other than a storm that brought about a foot of fresh snow to Hatcher Pass the last few days of

December. Daylight is a rare commodity around the first of the year this far north, but Sunday, January 2, brought clear skies with good light, temperatures in the mid 20s, and calm wind.

Accident Summary

Tim Flynn and three companions had parked at the Hatcher Pass Nordic Center. Equipped with shovels but no beacons, they skied across the flats to the foot of a steep mountainside that they would climb and ski. They put skins on their skis and started up the edge of the slope they intended to ski, an ascent route that kept them beneath a large pinnacle of rocks.

Flynn climbed faster than his companions and was the first to reach the top. On his ascent he kept looking at the slope he wanted to ski. Based on the new snow covering the slope, he guessed "it was fifty-fifty it would avalanche" when he skied it. The slope rolled from an angle of 20° at the top to 38° in mid track.

Flynn started his descent from the top, while a second skier who had not made the top entered the slope from the side. The other two skiers in the party were still climbing the

edge of the slope. After several turns Flynn fell, and he instantly felt the slab collapse. The fracture broke 50 feet above him, and he was on his way. He tossed his poles and started swimming; he briefly watched his poles slide down on top of a block of slab near the edge of the avalanche.

He rode on the surface for several hundred feet and could breathe fine. Then the slope steepened to 45°, and he accelerated and suddenly felt himself getting launched. He was airborne for about 20 feet and tensed for the landing he could not see. He hit hard, bounced up, and tumbled forward, fast and helpless.

Quickly though, Flynn felt the avalanche slow down. Before he could maneuver at all, he came to a stop buried in a standing position. It took some effort but he managed to punch his right hand upward which broke the surface and made a small airspace. He tried to move his left arm in front of his face, but the snow kept that arm at an awkward angle to the side. He could see daylight above. He struggled to control his breathing and keep from hyperventilating, and hoped his hand was visible on the surface.

The second skier on the edge of the slope had also been caught by the avalanche. He too was carried over the steeper section and was briefly airborne. He came to rest buried to the chest.

Rescue

Joe, one of the two skiers still climbing the edge of the slope, saw the avalanche break in front of him and watched it carry his two friends down. He lost sight of Flynn in the moving snow, but when the avalanche stopped, he made a guess where Flynn might be. He skied onto the debris looking for clues. Five minutes of searching finally paid off: he spied Flynn's hand sticking from the snow.

He skied to the spot and saw there was an airway to Flynn's head. He made voice contact, then took his shovel off his pack and started digging him out. Tim Flynn had suffered no injuries in an avalanche that had carried him on a ride of 600 feet. The second skier, too, had escaped without injury.

Avalanche Data

This avalanche was classified as an HS-AS-3. The crown was 1.5 to 3 feet deep and about 150 feet wide. The avalanche released on a 38° starting zone which steepened to 45° in mid-

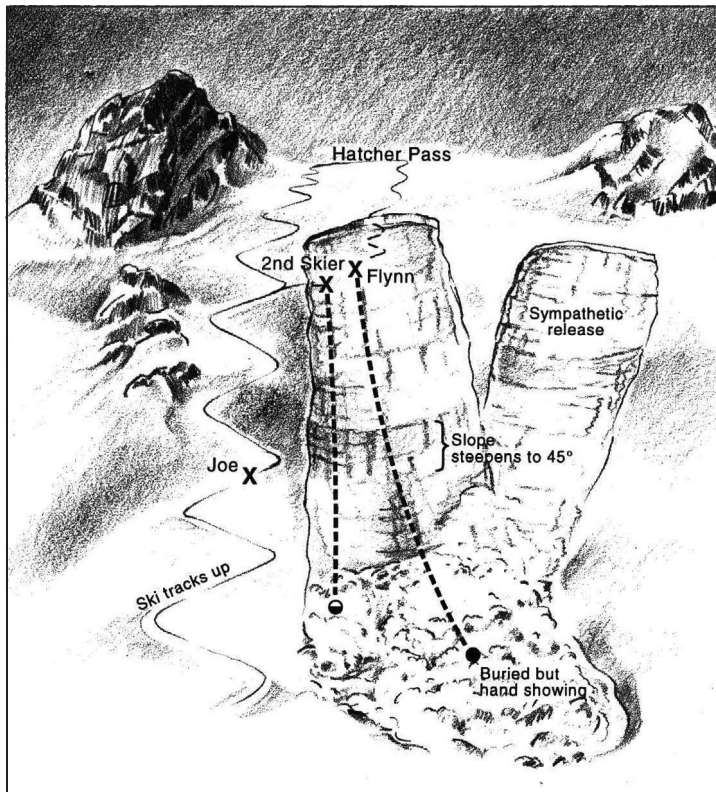


Figure 20. Accident 83-2, Hatcher Pass, Alaska, January 2, 1983.

track. It fell 1,000 feet down a slope that averaged 35°.

Comments

Tim Flynn knew the avalanche danger was high, for he had estimated there was a 50 percent chance of triggering an avalanche. It takes a cavalier attitude to proceed in the face of such odds. And Flynn compounded his risk by proceeding even though he had no beacon. To his credit Flynn had a change of attitude following this accident and enrolled in the Alaska Avalanche School to improve his knowledge and skills. We commend him for a smart move after a close call.

83-3
JANUARY 30, 1983

Wolf Creek, Colorado

1 out-of-area skier caught, buried, and killed

Weather Conditions

Wolf Creek ski area lies in the San Juan Mountains of southern Colorado. It's an area famous for heavy snowfall as it benefits from orographic lifting from storms approaching from the southwest. Strong winds that frequently accompany these storms create hard slab conditions above timberline, especially in the Alberta Peak area just southeast of the ski area boundary.

In 1983 the Wolf Creek ski patrol was leading guided tours in the area of 11,900-foot Alberta Peak, especially in Montezuma Bowl which was easily accessible beyond the ski-area boundary. This bowl offered excellent skiing down its steep pitches, some of which reach 45°. Because of the guided tours, the patrol routinely carried out avalanche control in Montezuma Bowl. On Saturday, January 29, nine 2-pound charges produced no results. Two of the blackened craters were in the immediate area of the avalanche that broke the next day.

On the morning of the 30th, 5.5 inches of new snow had fallen, but in Montezuma Bowl winds had scoured out the new snow, leaving the hard-slab surface exposed all across the top of the bowl. Almost 10 feet of snow lay in the

roll at the top of Montezuma Bowl, and it was a fairly uniform hard slab, a product of the strong winds that were so common to the area.

Accident Summary

At 1330 hours a group of three skiers—Mark DeLaney, 29, Joni Dorsey, 22, and Ron Wedemeyer—headed out of the ski area to ski Montezuma Bowl. All were locals and good skiers. Their guide was Grant Weidenbach, 27, a patroller and boyfriend of Joni Dorsey.

Even though the slope had been bombed the day before, the group was wary of potential avalanche danger. They had been briefed on this and agreed to ski one at a time. However, they were not fully prepared for an avalanche, for only patroller Weidenbach carried a beacon, shovel, and rescue pack.

DeLaney skied first and found the snow to be hard, crusty, and difficult to ski on the top part of the bowl. Farther down the snow was softer and more fun to ski. Wedemeyer picked a different line of descent and found the same type of snow—hard and difficult at the top, soft and easy below. Both men stopped in a stand of trees.

Dorsey traversed left (west) in search of softer snow at the top. She picked a slight gully that had held snow a little better. On the left edge of the gully was a rock rib sticking

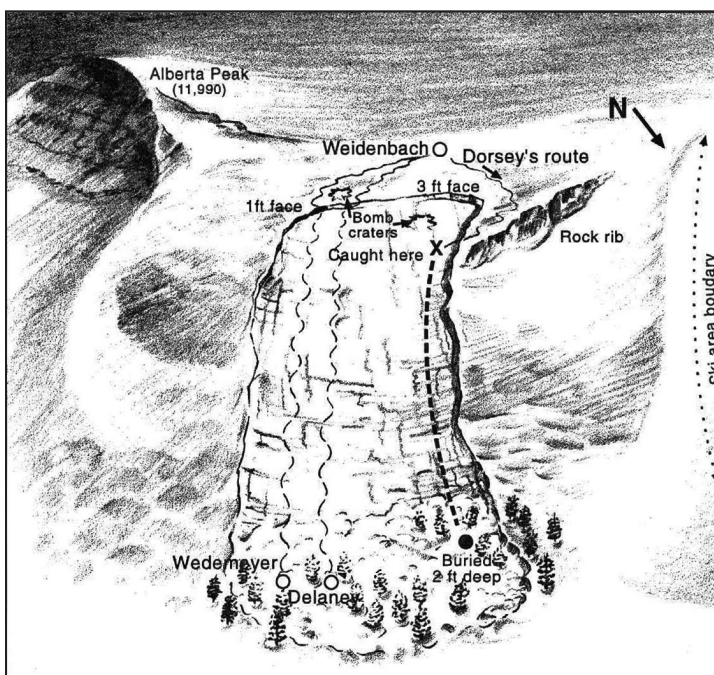


Figure 21. Accident 83-3, Wolf Creek, Colorado, January 30, 1983.

from the snow. She skied around the rocks and made about four telemark turns in the shallow gully before dropping into the steeper Montezuma Bowl. Seconds later the snow fractured 50 feet above her and then all around her. Weidenbach, standing on the ridge above, shouted to her, but she quickly disappeared from Weidenbach's view as the avalanche gained momentum. DeLaney and Wedemeyer also saw the avalanche, but they never saw Dorsey on her descent.

The avalanche was about 200 feet wide, and the fracture was deepest—about 3 feet—in the small gully above Dorsey. The fracture was shallower further east, where the avalanche wiped out the tracks made by DeLaney and Wedemeyer minutes earlier. The two men ducked behind trees as shallow debris from the avalanche flowed into the trees where they were standing.

The avalanche flowed 600 feet down the slope. Dorsey had been on the extreme left edge of the avalanche, and Weidenbach could see no sign of her after it stopped. He shouted Joni's name: no response. He reported the avalanche by radio to patrol dispatch and then skied down the slide path.

Rescue

Patrol Director Jim Whiting had been watching the group through binoculars from the summit patrol building. He saw the avalanche break above Dorsey but could not tell if she had been caught. Seconds later his radio crackled with Weidenbach's alert.

The time was 1350.

Whiting radioed to initiate the avalanche rescue plan, then he and patroller Travis Lester were out the door and in seconds were equipped with rescue packs and probes and were skiing toward the avalanche site. The radio alert had begun the stage-two rescue. Patrollers and lift operators put all competent volunteers from the public on the chair, to rendezvous at the top and be led to the site by patrollers.

Weidenbach was first to arrive at the lower debris area where he was certain Dorsey must be buried. He was quickly joined by DeLaney and Wedemeyer coming from the east and Whiting and Lester coming from the west. These five began a hasty search and were soon joined by several others. Some were spot probing in an area dotted by small trees, and four had formed up in a coarse probe line.

Before the main party of rescuers had arrived, one of the probe-line members shouted, "We found a ski!" This was quickly followed by, "We found her!"

The rescuers shoveled away 2 feet of dense, blocky, hard-slab snow and uncovered Dorsey's face. She was unconscious and not breathing. One patroller began mouth-to-mouth resuscitation while others continued to dig her out. Her skis were still attached and she was in a kneeling position, face down and head uphill. The dense snow was packed tightly around her which hampered rescue efforts.

A toboggan and oxygen arrived just as she was completely dug out. Resuscitation efforts continued until after she reached the hospital, but Joni Dorsey never responded. She had died of suffocation.

Avalanche Data

This avalanche was classified as an HS-AS-3. The fracture line was 200 feet wide and varied from 35 inches deep near the trigger point to 12 inches deep near the far eastern flank. It released at an elevation of 11,740 feet and fell 350 vertical feet, or about 600 feet slope distance. The north-facing slope was above timberline and varied from 40–45° in steepness.

The avalanche pulled out one of the shot holes from the day before, while a second shot hole lay just above the crown. Clearly the victim had hit a localized weak layer and triggered the avalanche in the shallow gully on the far west side of the slope. This was a weak layer that did not react to the bombs the day before. Once triggered, the hard-slab fracture drove into the stronger snow that had been bombed to produce a wide avalanche. This was not a post-control avalanche since the control occurred on the previous day.

A fracture-line profile revealed no discernable weak layers. All shear layers found, even at the bed surface, were hard and required a strong pull on the shovel. But, then, fracture-line profiles frequently fail to find the failure plane. In this case, the profile was taken at least 50 feet above the point at which the avalanche was triggered.

A best guess is that a thin layer of surface hoar had formed in the shallow depression of the gully, had not been destroyed by wind, and had been buried by drifting snow. (Another possibility is that depth hoar had formed next to the rocks and had failed as Dorsey skied by.) A bomb thrown in this area

may have been more effective than the one about 50 feet away.

Comments

The rescue was a textbook case in efficiency. Five rescuers, including two patrollers who arrived with probes and shovels, were at the site within 3 minutes. They located the victim with a probe 9 minutes after burial and dug her out 1 minute later. Still, a 10-minute burial in dense snow proved fatal.

Why no beacons? That is the burning question. None of the guided skiers wore a beacon (or shovel), only the patroller. Skiers should not be guided in avalanche terrain without beacons and shovels for all. Rescue beacons properly used in this case would have cut the burial time in half and Joni Dorsey may have

survived a 5-minute burial. (See accidents 80-10, 82-13 and 82-21 for want of equipment.)

83-4

FEBRUARY 2, 1983

Ski Sunlight, Colorado

1 patroller caught, partly buried and injured

Weather Conditions

January had been a cold, dry month in the mountains of central Colorado. Much of the backcountry snow cover had turned to depth hoar. Lower-elevation slopes, where winds

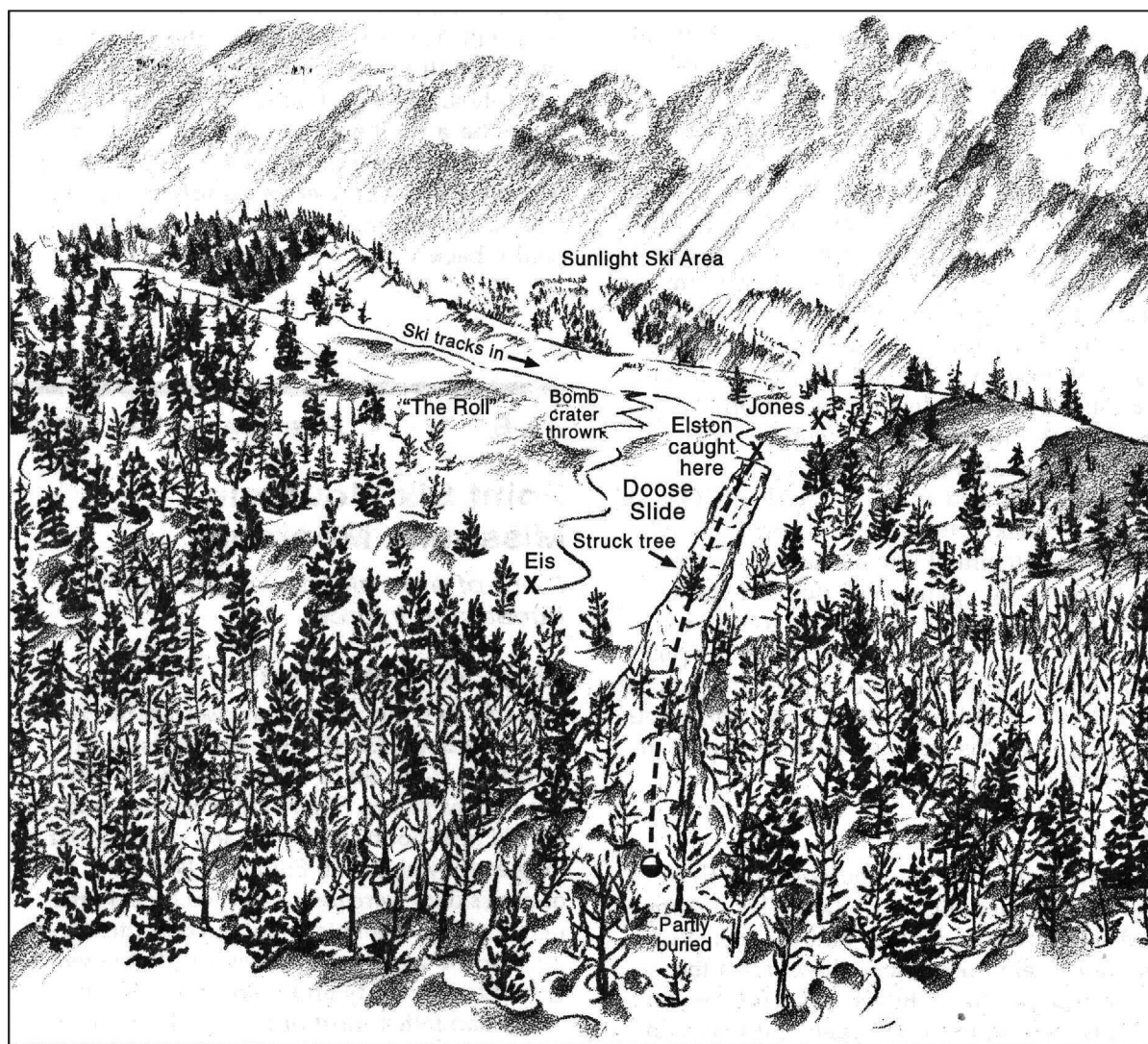


Figure 22. Accident 83-4, Ski Sunlight, Colorado, February 2, 1983.

had not created slab, carried a snow cover composed of mature to early-growth depth hoar from bottom to top. This was the snow condition around Ski Sunlight, located 10 miles south of Glenwood Springs.

A total of 26 inches of snow had fallen at Sunlight in January, and this had come in very small daily doses of 1–4 inches. Another 1 inch fell on the morning of February 2. The accumulated effect of these snows was negligible on avalanche conditions. There was no slab formation, and the new snow layer was being weakened by faceting almost as fast as it accumulated.

Accident Summary

Patrollers Randy Eis, 28, Tod Elston, 58, and Janie Jones were running a control route in an outlying area that had not been opened all year. The area is called the East Ridge, and the snow cover was bottomless depth hoar, about 4 feet deep. They threw a bomb in the Roll: no results. They then decided to protective ski an adjacent slope called Doose Slide. Eis made several Z-cuts, then a few turns, and stopped in trees at the lower edge of the slope.

Elston went next. The time was 1230. He made one turn, got caught up in the bottomless, cohesionless snow, and it pitched him head first. As he rolled over to get his skis downhill, the snow around him started moving as a loose-snow avalanche. The avalanche was about 8 feet wide and 3 feet deep and made a hissing sound as the cohesionless grains accelerated downhill.

Elston shouted as he started down. One ski came off quickly, then after sliding about 60 feet Elston slammed into a small aspen tree. He felt a sudden pain in his ribs and chest, then he slid around the tree and continued downhill. His other ski came off and his poles were gone, and he stopped after sliding another 60 feet. He had been alternately submerged and on top on his ride down, and he came to rest buried to the waist.

Rescue

All three patrollers wore beacons, but they were not needed. Eis saw where Elston stopped and skied over to dig him out. He was in considerable pain. Jones came down from the ridge and picked up Elston's skis on the way.

Eis radioed for a toboggan, but Elston insisted on skiing out. He had lost one pole but skied to the first-aid room, then traveled to the

Glenwood Springs hospital. He had suffered four broken ribs and a collapsed right lung.

Avalanche Data

This avalanche was classed as L-AS-2. It ran 120 feet slope distance down a slope that was 34° at the top. The loose-snow avalanche barely got wider than 10 feet on its descent, but it was 3 feet deep and pulled out the cohesionless, faceted snow almost to the ground. It was the classic all-depth-hoar avalanche, sliding as a river of sugar snow. The bed surface was a hardened, well-sintered layer of depth hoar 10 inches above the ground. The avalanche released on an ENE-facing slope at an elevation of 8,700 feet.

Comments

Loose-snow avalanches account for less than 5 percent of all accidents, mostly because they are small. This accident shows the harm that even a small avalanche can bring. An all-depth-hoar snowpack seldom propagates cracks because there is no slab to store strain energy. But once a deep layer of depth hoar is triggered, it can accelerate rapidly as a point-release avalanche, for there is no resistance to hold it back.

83-5

FEBRUARY 19, 1983

Point Six Mountain, Missoula, Montana

2 out-of-area skiers caught, partly buried and injured

Weather Conditions

Point Six is a mountain that rises north of Montana Snow Bowl, a ski area outside of Missoula. Point Six is a destination for some out-of-area skiers. Skiers are welcome to leave the ski area boundary at the top of the T-bar as long as they sign out. For all of February, out-of-area skiers were being warned by ski-area personnel of unstable snow beyond the ropes.

For the week of February 13–19, the weather had been cloudy and warm for February. Snow had fallen most of this week, so that by the 19th, a foot of heavy, new snow lay atop a firm crust.

Accident Summary

On Saturday, February 19, Kambel Wyse, John Porterfield, and Eric Kettenering, all students at the University of Montana, signed out and left the ski area boundary around noon. Their destination was Wyse's tepee which was located near an unnamed lake southeast of the summit of Point Six. They reached the tepee at 1330 hours and spent the afternoon building a ski jump near the tepee. They were also awaiting two other friends, Mike Macke, 16, and Kurt Feiler, 20, who were to arrive later in the afternoon.

Macke and Feiler left the ski area around 1600 hours. They hiked to the top of Point Six and then began their ski descent toward the tepee. They were working their way down and across an east-facing bowl through widely-spaced trees when they heard a loud boom followed by the snow fracturing all around them. The avalanche grabbed both men and pulled them down the mountain. Feiler told himself to grab a tree but was submerged before he could do so. He hit a tree or two and later recalled that "it got dark real fast." He was totally buried with his head up and an arm near his head. He punched through with his fist and cleared a hole to the surface.

Macke hit a tree hard and felt his leg break. He ended up partly buried but hurting too badly to dig himself out. It was 1700 hours and getting dark.

Rescue

Wyse, Porterfield, and Kettenering had climbed to the top of a nearby ridge to get one last run before dark off the ski jump they had built. They were not sure that Macke and Feiler would even come to the tepee, so their absence caused no alarm. But as the three men were on the ridge they heard shouts for help. Looking in that direction they noticed the fresh avalanche.

The three men skied over to the avalanche and saw Macke first, partly buried in the debris. As they got closer they heard more shouts and saw a hand sticking from the snow. The hand was waving and a hat that Feiler had thrown out of the hole lay on the snow. The rescuers dug out Feiler, brought him down to where Macke lay, and then assessed the situation.

Feiler's leg was hurting but he appeared to be all right. He said he could ski, so the three

rescuers sent him to the tepee, which was half a mile away, to warm up. Macke, however, was in great pain with what appeared to be a broken femur. Moving him was going to be a problem.

The rescuers started a fire on the snow and tried for the next few hours to make a sled. It was cold and dark, and the sled did not work out. Porterfield later recalled his thoughts: "Macke kept asking me if he was going to live. I told him 'sure,' but I was scared for my own life, let alone his. We were all praying, that's for sure."

The three able-bodied rescuers eventually brought back some gear from the tepee and wrapped Macke in a space blanket and sleeping bag. Next they placed him on a tarp and dragged him the half mile to the tepee. It was a slow trip, but they made it and soon had Macke inside and warmer.

It was now well into Sunday morning. Kettenering stayed with the injured skiers, while Porterfield and Wyse put on their skis and headed for the ski area. It was a long trip out, breaking trail and being certain to avoid further avalanche encounters. They arrived at the ski area at 0900.

David Malasky, manager of Snow Bowl, contacted the Missoula County Sheriff and then called St. Patrick's Life Flight helicopter. In addition, five patrollers put on rescue packs and skied to the tepee, using the track that Porterfield and Wyse had broken. They wrapped both victims in sleeping bags and dragged them to the lake where they packed out a landing pad for the helicopter.

At the hospital, Macke underwent surgery for a broken femur. Feiler had suffered a bruised and pulled thigh muscle and was treated and released.

Avalanche Data

The avalanche was classified as an SS-AS-3. The fracture was 12–18 inches deep and 100–150 yards wide. It fell 300 yards slope distance down an east-facing slope with an estimated angle of 30°. Two other avalanches of similar size released sympathetically and were separated by bands of trees. The east face of Point Six is slightly concave with broad open slopes dotted with a few trees.

Comments

Lucky men.

83-6

FEBRUARY 19, 1983

Hyalite Canyon, Bozeman, Montana

2 backcountry skiers caught, 1 partly buried, 1 buried and killed

Weather Conditions

A storm system moved into the Gallatin Range on February 16, and by the 18th it had dropped 10 inches of snow at both Bridger Bowl ski area north of Bozeman and Big Sky southwest of Bozeman. By Saturday morning, the 19th, Bridger Bowl had received another 14 inches of snow with 1.20 inches water equivalent, while Big Sky got 6 inches of snow with 0.48 inches of water. On these 4 days, winds had been from the southwest and had varied from 15–50 mph, causing widespread slab formation. On the 19th, Bridger Bowl had a high avalanche danger with a full morning of explosive control and released 70 avalanches. Big Sky experienced moderate avalanche activity with 12 avalanche releases. The storm had created a high avalanche danger in the surrounding backcountry, and the Forest Service issued an avalanche advisory. (The next day, February 20, two class-5 avalanches that fell 2,000 feet were triggered by explosives outside the Big Sky boundary.)

Accident Summary

Hyalite Canyon is located 20 miles south of Bozeman in the Gallatin Range with peaks rising to 10,000 feet above Hyalite Reservoir. On Saturday morning, Montana State University students Leland Howe, 21, and Tim Madsen parked near the reservoir and headed off for an overnight ski tour. They skied 3.5 miles up a logging road and set up camp on the upper slopes of Hyalite Canyon. After making camp, the two men set off on a ski tour that took them to the top of a prominent east-west oriented ridge. They decided to ski the north side of the ridge, which dropped them into Lick Creek. Since storm winds had been from the southwest, this was the leeward side of the ridge. A large cornice had formed the entire length of the ridge, and blowing snow had heavily loaded the north-facing avalanche slope below.

It was 1500 hours when Howe and Madsen skied off the cornice and then traversed direct-

ly beneath it, apparently seeking a line for their descent. They started skiing down together and had made about three turns when the snow fractured around them. The area of fracture extended upslope to just below the cornice, and the crown followed the line of their ski traverse moments before.

Madsen was slightly ahead of Howe and closer to the edge of the avalanche when it began. He managed to stay on his skis, sat back, and rode down the edge of the moving snow. He was never buried on his descent and ended up being partly buried to the knees.

Howe was knocked down by the avalanche and was swept toward a lone cluster of pine trees in the runout. Apparently he was carried just below the trees and was buried deeply where the snow converged after splitting around the trees.

Madsen searched for several hours, skiing over the debris, shouting, and probing with his ski poles. At dark, he gave up the search and skied out to the road and to the parked car. He drove down the canyon to a home and phoned the sheriff.

Rescue

The Gallatin County Sheriff notified the Nordic Ski Patrol at 1930. The patrol agreed that a night rescue should be attempted, so patrol members met members of the Gallatin Snowmobile Club at the trailhead. The skiers were taken by snowmobile to a second staging area high in Hyalite Canyon. From there they skied to the ridge, but the avalanche area seemed too big and the avalanche danger too great to proceed. At 0230 on Sunday, the 20th, they postponed the rescue until daylight.

At 1000 Sunday morning, a helicopter bombing mission dropped six hand charges. No additional avalanches released, so the ground team entered the area. Rescuers used spot probing and coarse probe lines all day, and finally found the victim at 1630. Leland Howe was found below the island of trees under 4 feet of snow. He had not suffered injury, but was dead from suffocation. The victim was evacuated by helicopter sling, and all rescuers were back in Bozeman by 1800.

Avalanche Data

The avalanche was an SS-AS-4. It was 250 yards wide and 250 yards long, so that about 8 acres of area was involved. The fracture was 3–4 feet deep, and the slab consisted of the

new snow plus 2 feet of old snow. The failure plane was a mid-pack ice layer. The slope faced north.

Comments

Avalanche safety was not on the minds of these two skiers. They had no beacons, they performed no stability tests, and they skied together down an obvious avalanche path during high-hazard conditions.

The rescue was a perfect opportunity for an avalanche dog. A trained dog would have found the victim within minutes, thereby saving 6 hours spent in probing.

83-7

MARCH 3, 1983

Eldora, Colorado

1 backcountry skier caught and buried

Weather Conditions

March 3 was a fine, spring-like day in the Front Range of Colorado. Skies were clear, winds were light, and afternoon temperatures reached 35–40°. Light snows and winds from several small storms the previous 2 weeks had created a layer of soft-slab snow on north and east aspects above 10,000 feet. Though there was no widespread avalanche danger, pockets of instability persisted where the snow cover remained cold and unsettled from recent mild temperatures.

Accident Summary

Eldora is situated on the east slope of the Front Range, about 20 miles west of the city of Boulder. A ski area and endless miles of touring terrain make it a high-use winter recreation area. On the morning of March 3, John Neiley, 24, Errol Frank, 30, and John Gambardella, 24, left the Eldora townsite for a ski tour up the Devil's Thumb trail. About 3.5 miles up the trail, they stopped for lunch at the foot of a steep but inviting east-facing slope. During lunch Neiley decided he would ski the slope, and while Frank and Gambardella watched, Neiley side-stepped up the slope.

He climbed to a point where his way was blocked by a band of rocks. Above the rocks was a 4-foot cornice that defined the ridgeline.

Neiley traversed onto the slope and realized that "this was steeper than I thought." He decided to go for it. He pushed off, made two nice telemark turns, then fell. Instantly the slab fractured. Neiley started sliding down on top of the snow but was quickly overtaken by a wave of snow that had released above him. He was buried and sliding down inside the moving snow. He had the sensation of being caught in a large ocean wave; it felt as though he was floating beneath the surface on his back.

He could not breathe, so he thrust his left arm forward and upward near his face, trying to break through to the surface. Very quickly then, he felt the avalanche come to a stop. He was buried on his back, lying across the hill with his feet slightly lower than his head. His skis and right ski pole were still attached, which had forced him into a spread-eagled position. However, his left hand had broken the snow surface. He was able to move that arm and hand to make an air passage. Once he realized he was not going to suffocate, Neiley was able to relax and let his panic subside.

Rescue

Frank and Gambardella saw the avalanche break but quickly lost sight of Neiley. They put their skis on and hurried to the toe of the debris. The avalanche was about 200 feet wide, but they remembered where they had last seen Neiley, so they went to the debris below that point. In about 1 minute they saw Neiley's hand sticking out of the snow and started digging him out. His head was 2 feet under, and his legs, 3–4 feet under. He was buried 10 minutes and was not injured.

Avalanche Data

This avalanche was classified as an SS-AS-2. The crown was 2 feet deep and 200 feet wide, and followed a zigzag pattern from one rock to another. The avalanche fell 175 feet slope distance and piled up debris that was 7 feet deep. Neiley had been buried in the area of deepest deposition. The avalanche released on a treeless, east-facing slope at an elevation of 10,120 feet. There is no data on slope angle.

The slab consisted of wind-blown snow that had accumulated on a leeward slope. A sharp, prominent cornice had formed at the ridgeline above the slope. The bed surface was a firm crust. It was likely that small surface hoar had formed on the crust and been buried.

The next day Neiley returned to photograph the slide. When he got to the site, he saw that a much larger avalanche (SS-N-3) had released just to the south of the avalanche he had triggered.

Comments

In his written report, Neiley states: "The slide occurred due to ignorance and recklessness. I didn't even consider the potential danger. My friends were watching not for concern about danger but simply to observe my descent. The slope is extremely dangerous, but I had no awareness of that potential. I was extremely lucky." The next winter, Neiley took an avalanche course.

83-8
MARCH 5, 1983

Earnest Miller Ridge, Madison Range, Montana

*2 backcountry skiers caught, 1 buried
and injured*

Accident Summary

This summary is taken almost verbatim from the report written by Dave Briar, one of the three men involved in the accident. Briar writes his excellent report in the third person.

"On the morning of March 5, three experienced backcountry skiers (Dave Briar and two friends) set out for a day of skiing on a remote northwest-facing bowl in the southern Madison Range in southwestern Montana. The route entailed following two drainages for about 6 miles and then climbing the southeast face of 9,800-foot Earnest Miller Ridge. This face had an angle of 25–30°.

"Upon gaining the ridge, the skiers stopped for lunch and then began to determine the stability of the northwest face, the intended 'ski area' for the day. Wind-flagged trees on the ridge showed the prevailing winds to be out of the west, and the northwest face had the characteristic 'intermittent rock and wind-blown snowfield look' of a windward aspect in a shallow-snowpack year. The snow surface was a hard crust that would support walking in ski boots, covered with 3 inches of soft, windblown, new snow.

"The party found a snowfield that had a continuous fall-line from the ridge crest to the bottom of the bowl. The slope steepened to a measured 48°, narrowed to a 30-foot-wide gully as it dropped through a low rock band 200 feet below the ridge, and then opened into the top of a 400-yard-wide, 40° snowfield. This lower snowfield, in turn, fed three broad, shallow gullies which ran to the bottom of the bowl, a total of 1,000 feet below the ridge crest. There were no signs of natural releases anywhere along the 2 miles of ridge crest that was visible, nor were there indications of weak-layer collapse from any of the skiers that day.

"The party proceeded one at a time through the upper gully to the top of the lower snowfield where they stopped to dig a hole with a ski pole. They found 3 feet of hard, dense snow underlaid by 6 inches of perfectly-cupped depth hoar. Because this basal depth-hoar layer was to be found everywhere in southwest Montana this shallow-snowpack year, concern was noted and the one-at-a-time descent continued. During the remainder of the day, three descents were made and climbing skins used to regain the top of the lower snowfield.

"At 1645 with just enough daylight remaining to reascend the ridge and descend the southeast face, the party began the trip out. They decided that removing skis and kicking steps up the 48° upper snowfield would be the easiest method for reaching the ridge. As it turned out, two sets of steps were kicked up the slope, one up each side 5 to 8 feet off the rocks. As the first skier was just reaching the top of the slope with the second skier half-way up and the third beginning the climb, the snowfield fractured across the upper skier's footstep. A slab 30 feet by 60 feet and 12–15 inches deep moved intact for a few seconds. This allowed the upper skier to step off and the two lower skiers to begin scrambling toward the adjacent rocks before it broke up and carried them downslope. When the avalanche reached the top of the lower snowfield it triggered a second fracture that ripped 18 inches deeper into the snowpack, then ran another 50 feet before setting off the major 2- to 5-foot fracture that took everything to the ground.

"Of the two trapped skiers, one was fortunately deposited unhurt on the surface near the edge of the path about 400 vertical feet below the crown. The second was carried the

entire slope—almost 1,000 vertical feet—and was totally buried in a debris pile that measured 200 feet by 1,200 feet at the bottom of the basin. All three skiers were equipped with transceivers, shovels and probes.

“The skier who was carried part way down the avalanche was the first to reach the debris pile. Using his beacon he bracketed the location of the buried skier to an 8-foot-diameter circle within 4–5 minutes of burial. By that time the second rescuer had arrived with probe in hand and pinpointed the body at a depth of 4–5 feet near the center of the bracketed circle. With both rescuers shoveling, the buried skier’s face was exposed within 10–12 minutes of the original fracture, but he did not regain consciousness for an additional 3–4 minutes after being exposed. Total extraction of the victim took another 15 minutes, at which time a large contusion on the front of his right hip was discovered. He was immediately treated for hypothermia and seemed in good condition except for the injury which kept him from lifting his right leg without a great deal of pain.

“Based on the condition of the injured skier and the questionable stability of the remaining snow on the avalanched slope, the party decided not to reascend the slope but to follow an alternative way out by descending a northwest drainage to the road 3 miles north of the parked car. Complicating matters was the fact that one pair of skis and one pole were buried in the slide debris. Hence, the going was slow and by 2200 hours they decided to stop, light a fire and wait for daylight. The party reached the road at 1100 the next day.”

Avalanche Data

This avalanche was classified as an HS-AS-4-G, a large hard slab that ran to ground. Initial fracture came on a 48° slope, but it was the secondary fracture on a 40° slope that broke 2–5 feet deep and 1,200 feet wide. The avalanche was triggered on a northwest-facing slope at an elevation of about 9,750 feet and fell 1,000 vertical feet. The snow structure consisted of hard-slab snow on top of well-developed depth hoar.

Comments

The following comments are taken from Briar’s report. Here he summarizes the thoughts of the three skiers on their decision-making, the avalanche and the rescue.

“There is much to be said about skiing steep north-facing slopes in a depth-hoar season. The three skiers were all experienced in winter backcountry travel and nordic mountaineering and accepted full responsibility for the consequences resulting from decisions made on calculated risk. In retrospect the party singled out two key factors that contributed to the error in judgment. First and foremost was the unusually hard and spring-like quality of the pack. It wasn’t just a wind slab but dense, hard snow all the way down to the ubiquitous depth hoar. One of the skiers said, ‘It just didn’t feel like you were disturbing the bonds in the snowpack. Your skis stayed right on top. You could walk around without your skis and not punch through. I wouldn’t think of skiing that slope in deep snow when your skis are cutting deep into the pack.’

“The second factor was the old problem of being lulled into complacency after making a number of runs and spending the whole day out on the slope without incident. One of the skiers said, ‘We just didn’t think about how much different that little snowfield was from the main slope we had been skiing all day. In some of the steps on the way up the toes of our boots were hitting rocks underneath, but when the slab came out it was still deep enough to sweep us off our feet.’ A quick calculation shows that a 30-foot by 60-foot by 1-foot-deep slab of 30 percent snow weighs about 34,000 pounds, plenty large enough to trigger an avalanche where skiers alone might not. By kicking two sets of steps up the sides of the slope both lateral shear bonds would have been weakened. Add to that the mistake of putting all three skiers on the slope at one time and the effect is compounded.

“Concerning the rescue, the overwhelming realization after the accident was that while locating and digging out the victim went flawlessly, it was still almost too late. The victim was unconscious and barely breathing after only 10–12 minutes. Another 5 minutes and it probably would have been too late. In the very-possible event that both skiers caught had been buried, leaving only one person on top to conduct the rescue, this story might well have had a tragic ending. Secondly, when faced with having to spend the night out while evacuating an injured companion, the party vowed to always carry an emergency kit containing good fire-starting materials, extra food, extra warm clothes and a good first-aid kit with a

prescription drug for severe pain. The reality of surviving an accident but succumbing to a long, cold night was all too possible."

Briar's comments are right on target. Let us reinforce two points he made. First, most backcountry skiers find it easier to recognize soft-slab instability when they are skiing in the snow, and harder to recognize hard-slab instability when they are skiing on the snow and it appears bombproof. Second, speed of recovery is critical in all burials. This victim owes his life to beacons and the experts who knew how to use them. (See accidents 80-6, 84-2 and 84-5 for similar stories involving hard-slab conditions.)

83-9

MARCH 6, 1983

Big Cottonwood Canyon, Utah

1 climber caught, buried and injured

Weather Conditions

Weather records from Alta show that a storm had begun in the Wasatch Range on February 26 and snow had fallen daily from that day through March 6. A total of 6 inches fell on February 26–27, while 11 inches of snow with more than 1 inch of water fell on the 28th. March 1–3 brought 2–3 inches of snow daily, but only half an inch fell on the 4th. The storm then brought steady light to moderate snow on the 5th and then came to an end early on the 6th. In these last 24 hours, Alta recorded 13 inches new snow which contained almost 1.50 inches water. Northwest winds had averaged 15–25 mph all day on the 5th and 6th. Avalanche control on the morning of March 6 at Alta and Snowbird produced 20 size 2–3 soft-slab releases. This should have indicated widespread soft-slab formation in the Wasatch backcountry; however, the Wasatch Powderbird Guides dropped 60 hand charges without a single release on the morning of the 6th.

Accident Summary

On Sunday morning, March 6, a party of three skiers from the Salt Lake City area drove up Big Cottonwood Canyon, parked, and skied up Mill Creek Canyon. Their goal was a ski and

climbing ascent of Mt. Raymond, which lies northwest of Brighton. Two of the men, Michael Franklin, 37, and James Garrett, 30, wore avalanche beacons; the third, Eric Weber, 26, did not.

They climbed on skis to the saddle between Mt. Raymond and Gobblers Knob. There they met two other skiers—John Coburn and Nick Bervegan—who joined them for the climb to the summit. They left their skis at the saddle and kicked steps in the snow to reach the summit. On their ascent they walked one at a time over the top of a cornice. The ridge was about 8 feet wide at this point and the cornice had an overhang of 5 feet, which did not leave much room to pass by on the windward side. They reached the summit of Mt. Raymond, but they did not stay long since the weather had turned cloudy, windy, and cold.

On their descent, the party retraced their steps and soon came to the cornice. The time was 1327, and Weber was in the lead followed by Franklin. Suddenly the cornice collapsed right behind Weber, and Franklin went down. Weber recalled, "I was walking as far to windward as possible, and he was stepping in my footsteps. We were definitely on the ridge; if we'd had probe poles we would have been touching rock. I was about 6 feet from him when the cornice went. I heard an explosion like a shotgun blast next to my ear, and my heart sank. I ran back two steps to the edge (and looked down.) Michael was already a good 150 feet down. I got a glimpse of his jacket and billows of snow."

A piece of cornice and Franklin fell onto a 50° slope and triggered a small soft-slab avalanche part way down. Franklin was off on a 1,500-foot ride, which included a free-fall off a 50-foot cliff, and later recalled what it was like: "I never heard it. It went fast; it's a steep chute there. For the most part I was riding on cornice blocks and being pummeled around by them. About halfway down, the debris fractured an avalanche that ran on a sun crust. So it gathered more mass. I had a feeling of moving at a very high rate of speed. I felt myself go airborne when I went over the cliff—I could sense it. I went into a fetal position to try to cover my head.

"It was quite dark. I was on my back for most of the time. I was struggling really hard to get over on my stomach. I thought I'd have more control that way, but my pack and shovel on my back made it harder."

Very quickly he came to a stop, shallowly but totally buried. Franklin recalled, "I banged my head back and forth a few times to clear the snow, then it wasn't too hard to breathe. I was on my stomach in a push-up position. The snow was like cement. My fear was that I forgot to turn my beacon on. I always turn it on, but yet I was thinking, 'Did I really? Maybe this time I forgot!'"

Knowing that he had gone over a cliff, Franklin feared that his friends would have trouble reaching him. "It seemed like forever. I was very cognizant that I only had about half an hour. I'd read statistics of people's chances when they're buried. The tendency to panic was really great," he remembered. He had lost his hat and glove in the avalanche, and he soon became very cold. Now and then he shouted.

Rescue

The other four men tried to watch for Franklin as the avalanche accelerated down the chute. Garrett said, "I looked over the edge and couldn't see him at all. It was just a big cloud. I kept watching until it formed a tongue and came to a stop." Garrett was the only one of the four rescuers who wore a beacon, and he switched his to "receive." Also he had left his skis higher on the ridge than the others and was able to retrieve them quickly.

Garrett told Weber to ski out for help. Then he prepared to ski down the avalanche path. Garrett told Coburn and Bervegan to watch him as he started down. He remembered, "I was worried it might slide again. I started down the shoulder on the right side of the couloir looking down, then got into the couloir. I was able to make some turns, then approached a cliff and traversed."

Further down Garrett heard a faint yell. Again he recalled, "I thought that must be Michael. I shouted up to John and Nick to come on down. I came to the fracture line and then to another cliff, the 50-foot one Michael flew over. I traversed again then got into the runout."

The debris area was about 100 yards wide and long. Once on the debris he picked up the beacon signal. "I kept skiing on the debris, following the signal. It kept getting louder. I stopped once to turn down the volume. When I was right on top of him, I could see his hair sticking out of the snow. We started talking. He said, 'I'm glad to see you. Get me out of here!'"

From Franklin's position buried in the snow, he remembered, "I heard a voice, then I heard his beacon picking me up. I heard his footsteps coming right above me; he homed right in on me.

"He had a really hard time digging me out. The snow was like ice; he had to chop it. Without a shovel, there's no way I'd have gotten out. He literally had to dig every limb of my body out separately."

Franklin had been carried 1,500 feet down the slope and over a cliff. He had been buried 20 minutes, without hat or gloves, but luckily had had an airway to the surface. He was hurting from multiple bruises, especially one shoulder, and he was very cold, but he had amazingly escaped without serious injury.

The other two rescuers arrived to help dig Franklin out. Bervegan had skied down, but Coburn had left his skis on the ridge and scrambled down the avalanche slope on foot. When Franklin was out of the snow, he put on extra clothes from the rescuers' packs to get warm. The group decided that Franklin and Coburn would walk out, Garrett would travel with them, and Bervegan would ski out as fast as possible to call off the rescue. They traveled a short way, and then they heard the helicopter.

Weber had made it out to the road, flagged down a passing car, and gotten a ride to the nearest phone. His call to the sheriff mobilized the search and rescue team and the Wasatch Powderbird helicopter. He gave over the phone the exact location of the avalanche so the rescuers could fly directly to that spot.

The helicopter landed and airlifted Franklin and Coburn out.

Avalanche Data

The cornice collapsed near an elevation of 10,000 feet and fell, with its victim, down a west-facing gully that was estimated to have a 50° angle at the top. Part way down, this mass of snow triggered an avalanche that was classified as an SS-AC-2 (a small soft slab triggered by a falling cornice.) This avalanche was 1 foot deep and about 60 feet wide. From top to bottom, the snow and victim fell 1,000 vertical feet and 1,500 feet slope distance.

Comments

This is an amazing survival story; falls of this magnitude seldom return their victims without serious injury. Beacons worn by two of these

backcountry skiers made for a speedy and live recovery, even though through lucky circumstance, Franklin would have been found alive without a beacon. Nonetheless, the beacon hastened Franklin's recovery and minimized his exposure to the snow and hypothermia.

In retrospect Weber, who had skied out to notify the sheriff, had these thoughts: "If I had it to do over, I wouldn't have skied out, because that terrain was dangerous. Besides that, I think it would be better to be down there searching and helping to dig out. It took 40 minutes to get help, and what good is that if he's deeply buried."

Franklin agreed: "If I had been 7 feet under, we could have used a lot of help digging. The critical thing is to get as many survivors of the party down to the zone as fast as possible. The other big thing is that everyone take a couple of minutes to work it out and have one person in charge, taking responsibility the way James (Garrett) did. And everyone should have a beacon and shovel."

The three skiers without beacons vowed to buy them immediately, or in Weber's words: "I'm never skiing again without a beacon. I mean it." (See 84-11 for a less fortunate accident involving a cornice.)

83-10

MARCH 6, 1983

Deer Creek, Silverton, Colorado

2 backcountry skiers caught, 1 partly buried, 1 buried and killed

Weather Conditions

A small storm moved into the San Juan Mountains of southwest Colorado on February 25. From February 25 to March 2, Purgatory ski area, located 7 miles south of the accident site, recorded 20 inches of snowfall, while Red Mountain Pass, 12 miles to the north, received 30 inches. Then on March 4 through about noon on March 6, another 32 inches of snow fell at Red Mountain Pass. Winds recorded at an anemometer on Red Mountain Pass averaged 25-50 mph on March 5 and 30-55 mph on the 6th. The snow and blowing snow was falling on a snowpack weakened by depth hoar.

The avalanche danger in the San Juan Mountains was high to extreme, and an avalanche warning was posted on March 5. From March 4-6, 62 separate avalanches were logged along the U.S. Highway 550 corridor extending north and south of Silverton. Many of these blocked the highway, and Red Mountain Pass, north of Silverton was closed by avalanches on March 5-7. Many of the avalanches ran to ground and were classified as size 5 (maximum for the avalanche path).

Accident Summary

Into this storm three experienced backcountry skiers headed for a day tour. On Sunday morning, March 6, Phil Swanson, 32, Bill Plotkin, and Janet Zabka, who was Swanson's girlfriend, left Durango and drove north to Coal Bank Pass for a tour to Jura Knob and Deer Creek. This is a popular loop tour that offers excellent skiing, at least during nice weather and stable snow conditions. Skiers park at Coal Bank Pass, which is south of Silverton, and ski several miles to Jura Knob which offers a wide variety of aspects and steepnesses, all above timberline. They can then return via Deer Creek to hit the highway and catch a ride back to Coal Bank Pass.

That was the trip Swanson, Plotkin, and Zabka had in mind, but wretched weather and an avalanche ruined their day. Perhaps because they had done this trip many times before and two times in the last few weeks and had always avoided avalanche terrain, they left their beacons and shovels at home. They also were unaware that Red Mountain Pass, north of Silverton, had been closed by avalanches and that an avalanche warning was in effect for the San Juan Mountains.

The group skied through the trees for about 2 miles before breaking out above timberline on the southeast side of Jura Knob. In good weather the skiers would have had a stunning view of the San Juan Mountains at this point, but on this day they were treated to whiteout conditions that limited their view to a few yards. They talked over their situation and agreed that continuing to Jura Knob was hopeless and foolish. They decided to turn east and head into Deer Creek that would take them back to the highway.

The time was 1315 when they turned around and started feeling their way down a slope that would get them back into the trees. Swanson was in the lead, followed by Plotkin

and Zabka, when the slope steepened and Swanson realized they were not where he had thought they were. He stopped and shouted over his shoulder to Plotkin, "We've screwed up. Let's get out of here."

Swanson proceeded on a traverse of the steepening slope when Plotkin saw the snow fracture around Swanson. Swanson shouted, and turned his skis further down the fall-line in an attempt to get out to the edge. Plotkin then realized the snow around him had fractured and he too was starting to slide downhill. He last saw Swanson struggling to keep afloat in the avalanche before disappearing from view. Zabka had been far enough back that she could see nothing of the avalanche in the poor visibility.

Plotkin had been caught on the far east edge of the avalanche. He was carried only a short distance and was buried to the knees. It took a minute for him to kick his skis free from the snow, and by this time Zabka had caught up with him. They began shouting for Swanson and working their way down the avalanche path searching for clues.

The avalanche had fractured about 300 feet across and run about 300 vertical feet. Plotkin and Zabka could see only short distances as heavy snow kept falling and strong winds sustained whiteout conditions. The two searchers took off their skis and used them as probes. They searched and re-searched all areas where they thought Swanson could be buried. They found nothing, and after 3 hours and 15 minutes they gave up. They put their skis on and went out Deer Creek to the highway. At 1800 hours they flagged down a Highway Department snowplow and reported the accident. The plow driver radioed the alert, and at 1815 the San Juan County Search and Rescue Team was alerted. The team met with the sheriff and all agreed that a night search was too dangerous, given the serious weather and avalanche conditions.

The next morning at 0700 a helicopter flew the first rescuers to the site. This group included Plotkin, George Pastor and his dog Leo, and Chris George. The searchers were put down at a safe site while George went aloft and dropped eight hand charges from the helicopter to test the stability of slopes in the immediate area. Nothing released, so rescuers (more had been ferried in by helicopter) approached the avalanche using a safe route. They were spooked by several loud

"whoompf" sounds when they collapsed the snowpack on their approach.

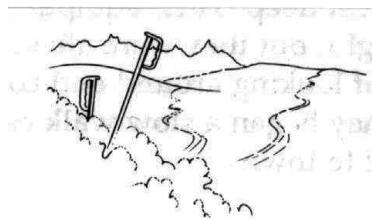
Winds of 50 mph were whipping across the slope when Pastor and his dog Leo entered the debris from the side. Leo worked into the wind and alerted on the far edge of the debris. Pastor was not convinced it was the real thing because it was well to the side of where Plotkin had estimated the last-seen area to be. (Poor visibility had made it extremely difficult to establish a last-seen point.) Pastor called Leo back to the last-seen point. When told to search, Leo went back to the first alert spot and started digging. Leo had made the find in 11 minutes. Shovelers dug down to Phil Swanson's body. His head was 3 feet under; his feet, 5 feet under. His skis had come off, but one pole and his pack were still attached. He had been buried 20 hours, and had died from suffocation.

Avalanche Data

This avalanche was an SS-AS-3. The fracture was 3 feet deep and about 300 feet wide, and the avalanche fell about 300 feet vertical. It released on an east-facing slope estimated to have a 35° pitch in the starting zone. It released above timberline at an elevation of 11,850 feet. The debris funneled into a gully and was up to 12 feet deep near the toe. However, the victim had not been carried that far, but rather was buried about two-thirds the way down the avalanche near the right edge.

Comments

This was a sad, needless tragedy. Three experienced skiers headed into the teeth of a howling snowstorm, had gotten disoriented in whiteout conditions, and one man died while trying to get to safe terrain after he realized the group's danger. For supposedly experienced back-country skiers to take such risk, especially after having left their beacons at home, is incomprehensible. All the evidence suggests that beacons and experienced users would have saved Swanson's life.



83-11

MARCH 9, 1983

Crested Butte, Colorado*1 out-of-bounds skier caught, buried and killed; 6 patrollers caught, 2 injured***Weather Conditions**

Very light snow had fallen daily at Crested Butte ski area on March 4–8. The total accumulation was only 7 inches for these 5 days, but winds on the 7th had averaged 20–36 mph and had created a shallow layer of soft-slab snow on all wind-protected slopes. This had been a winter of low snowfall in central Colorado, and the mid-mountain snowpack at Crested Butte was only 48 inches on March 9. The stability of the backcountry snowpack had been a concern all season because it had little strength due to considerable depth-hoar formation.

Wednesday, March 9, was the first clear day following 5 overcast days with very light snow. Mid-mountain temperatures had warmed into the mid 30s and the surface snow had thawed into a damp layer by afternoon.

Accident Summary

Keith Kudrna, 26, was an employee of a ski-rental shop at the base of the ski area. Shortly after noon Kudrna left the shop with an unknown companion to get in several hours of skiing. Sometime later, the two skiers ducked under the boundary rope on the west side of the ski area with the intent of skiing an area called the Banana Slide. This area is steep, rocky in places, dotted with trees, and faces northwest. The snowpack was riddled with depth hoar and had no stabilization either from explosive control or ski compaction. The boundary was clearly marked with ropes and signs warning of the avalanche hazard.

The two skiers had gotten to an area below the Upper Peel which was called the Banana Glades. While skiing the glades, Kudrna triggered a soft-slab avalanche that broke 3 feet deep to the ground. The avalanche swept him out of the trees onto an open slope and totally buried him. His companion searched for an unknown length of time then skied away from the area.

Rescue

At 1520 the ski-area receptionist received an anonymous phone call. The caller said an

avalanche had run out-of-bounds in the area of the Banana Slide and it was likely someone was buried in the avalanche. Then the caller hung up.

The receptionist called the patrol at 1522. Snow Safety Director Dan Ewert and patroller Eric Lamb responded immediately and skied to the site. There they saw the avalanche and two sets of tracks entering it. Next they saw the tracks of someone skiing and walking over the debris and only one set of tracks leaving the area. Ewert then spied a ski lying on the snow surface. He did a beacon search over a large area around the ski and got no signal.

While they were awaiting the arrival of a larger team of rescuers, Ewert and Lamb continued their visual search and began to scuff and spot-probe in the area of the ski. In about 10 minutes Ewert hit with his probe what felt like a body. With their shovels, Ewert and Lamb began digging around the probe pole. This spot was about 30 feet downhill from where the ski had been found.

At this time a party of seven patrollers arrived above the avalanche area. As they skied toward the debris area, they triggered a second avalanche adjacent to the first which was several times larger than the first. Six patrollers were caught, but none was buried. Two men suffered minor injuries, one lost his skis, and rescue gear, skis, and poles were scattered over the debris. The avalanche did not flow into the area where Ewert and Lamb were digging.

Another patroller arrived to assist Ewert and Lamb, and they found Kudrna's body under 4.5 feet of snow. He was lying face down, head downhill, mouth full of snow, and showed no life signs. They started CPR immediately, and as more patrollers arrived, they took turns with compression and ventilations. Soon a doctor arrived, and although CPR and other treatment continued for over an hour, the victim never responded. It was estimated he had been buried for 1.5 hours under 4.5 feet of snow and had died from suffocation.

Avalanche Data

Both avalanches were skier-triggered soft slabs, although the surface snow was wet. Both ran to ground. The first fractured 3 feet deep and 100 feet wide, ran 300 feet vertical, and was classed as an SS-AS-3-G. The second was 3 feet deep and 200 feet wide, ran 500 vertical feet, and was classed as an SS-AS-4-G. The

avalanches released on a northwest-facing slope of about 35° at an elevation of 10,700 feet. The starting zone was rugged and dotted with many trees and rock outcroppings.

Comments

A cowardly act by a scared skier delayed Kudrna's rescue. Kudrna's companion did not directly alert the patrol of the accident via patrol phones or lift phones. Apparently fearing retribution for skiing out-of-bounds, he skied to the base area to make his anonymous report from a pay phone. His identity was never ascertained.

Though this was a cowardly act after the fact, the fatal act was made by both men when they decided to ski a known avalanche area without having rescue gear. Only a beacon would have saved Kudrna's life. Even a faster response by the patrol would have likely been too late. And the patrol did everything asked of it ... and then some. In their haste to respond to an emergency, they chose an unsafe route. Fortunately the consequences of the second avalanche were minor.

83-12

MARCH 12, 1983

Porphyry Peaks, Grand Lake, Colorado

1 snowmobiler caught, buried and killed

Weather Data

The Porphyry Peaks rise to 11,335 feet in the northern mountains of Colorado. They lie 13 miles north of Granby and 6 miles west of Grand Lake, an area that is 10–15 miles west of the Continental Divide. No weather data are available from the accident site, but a storm on March 5–8 brought snow and wind to the area. At Berthoud Pass 33 miles south, this storm dropped 37 inches of snow, and north to northwest winds gusted to 55 mph on both the 5th and 6th. Such winds would have loaded with wind-blown snow all high-elevation slopes facing east through south.

Accident Summary

On the morning of Saturday, March 12, Bob

Barnes, 57, Ken Brady, and Gary Wells, all from Grand Lake, were riding snowmobiles along the east slopes of the Porphyry Peaks. At 1030 hours they were riding a contour at the 10,900-foot level and traversing a slope below the summit of a peak identified on the topo map only as Point 11,002. Locals call the area Little Chicken Hill. A large cornice, estimated to be 12 feet high, had formed at the ridge crest above the slope.

Barnes left the protection of mature pine and fir trees and entered an open slope. As he was riding across the slope in soft snow, his snowmobile became stuck. He dismounted and as he was digging out his machine, the slope fractured. The avalanche broke 4 feet deep and 300 feet wide and swept Barnes and his snowmobile down the slope. Brady and Wells witnessed the avalanche from farther down the mountain.

Rescue

Brady and Wells began their search and found the snowmobile fairly quickly. It was partly buried above a large tree. Other snowmobilers were in the area, and they were summoned, plus one man rode out for help. That man notified the sheriff at 1130 and was then able to round up a group of volunteers from Grand Lake. That group was headed for the avalanche site by 1200 with rescue gear including probe poles.

At 1345, a searcher with a probe hit Barnes's body. He was found face down, 4 feet deep, and 50 feet uphill from where his snowmobile had been found. He had been buried more than 3 hours. He showed no life signs and did not respond to resuscitation efforts. A rescuer radioed the sheriff, who called off a larger rescue party he was assembling. He instructed the rescuers to evacuate the body on a snowmobile sled to the trailhead. The coroner was at the trailhead and pronounced the victim dead.

Avalanche Data

This avalanche was a large soft slab triggered by snowmobile, and was classified as an SS-AV-4. The fracture averaged 4 feet, was much deeper in places, and was 300 feet wide. The starting zone angle was estimated at 30°. The avalanche fractured at an elevation of 10,900 feet and fell more than 1,000 vertical feet. The slope faced east-southeast and was bare of trees in the starting zone, though the

avalanche flowed through mature lodgepole pine and Douglas fir trees from the upper track to the runout.

Comments

Avalanche danger was not on the mind of this victim. The slope was an obvious avalanche starting zone: it was steep enough and was leeward of the prevailing storm winds. It had recently been heavily loaded, as evidenced by the large cornice at the top and the slabby snow that Barnes had gotten stuck in. His traverse had cut through the heart of the starting zone. Avalanche education tailored for snowmobilers is key to saving their lives.

83-13

APRIL 2, 1983

Mt. Shasta, California

2 climbers caught, 1 partly buried, 1 buried and killed

Accident Summary

On Saturday, April 2, three climbers set out on a planned 3-day climb of 14,161-foot Mt. Shasta in northern California. The three were Julien Harrison, 28, Dan Zimmerlin, 30, and Wes Wagon, 31. They left their car at Bunny Flat and began their climb on skis at 0900. At 1400 they were climbing Green Butte Ridge in deteriorating weather conditions: strong winds and blowing snow had reduced visibility to near-whiteout conditions. They were at an elevation of 9,300 feet and decided to stop and dig a snow cave for the night.

They searched the area for a suitable site before choosing a spot just below the ridge crest on the east side. It gave some wind protection, but Harrison said they should be careful because the slope was very steep. They set about digging the cave by alternating tasks: one would excavate, one would remove the snow from the entrance, and one would rest.

At about 1500, they had tunneled in about 10 feet. Zimmerlin was in the cave cutting out blocks, Harrison was in the entrance-way, and Wagon was standing outside the cave. Wagon heard a sudden loud crack like a gunshot. He looked up to see the snow fracturing all around the cave area, and then it crumbled

beneath his feet. He tried to run toward the ridge crest and safety but did not make it. The avalanche carried him on a fall of about 300 yards down the slope. Wagon came to a stop partly buried.

Zimmerlin, inside the cave, heard a sudden rumble and thought the roof was caving in. He and Harrison ducked down, but instead of caving in, the roof slid away. The snow slid over the top of Zimmerlin, but Harrison was struck by the moving snow and swept away.

Zimmerlin shook off the snow that had dusted him and stood up. The top of the cave was gone as was the top layer of snow all around. Harrison and Wagon also were gone. He grabbed his shovel and started running down the fall-line. He had gone several hundred yards when he heard Wagon call to him. Wagon had dug himself out and was standing on the snow, unhurt in his fall. There was no sign of Harrison, though.

The two survivors found Zimmerlin's skis on top of the snow. They used these for probes to randomly probe the debris looking for Harrison. After 30 minutes, Zimmerlin decided to ski out to the trailhead while Wagon stayed and searched, using a ski pole as a probe. As he skied down the avalanche debris, Zimmerlin went by much of their gear which was strewn over the surface. Shortly before 1700 he arrived at the Bunny Flat trailhead and reported the accident to people in the parking lot. The Siskiyou County Sheriff was notified a little after 1700.

Rescue

Wagon had searched alone, probing the snow, for more than an hour before giving up. He began the trek out and was met by a rescue party coming in on the sheriff's department snowcat. Wagon and Zimmerlin directed the rescuers back to the scene where they probed until 2100 hours without success. The sheriff then suspended the rescue for the night.

At 0700 the next morning about 30 rescuers traveled to the site to continue the search. They worked in both coarse-probe and fine-probe teams all day. Finally at 1510, they struck Harrison's body under 5 feet of snow. He had been carried 600 feet in the avalanche and was dead from his burial of 24 hours.

Avalanche Data

This was a hard-slab avalanche triggered by the climbers digging a snow cave in the start-

ing zone. It was classified as an HS-AO-3, the "AO" standing for "artificial, other," a miscellaneous trigger category. The avalanche released at an elevation of 9,300 feet and fell down an open, east-facing bowl.

Comments

Emergency snow caves can be lifesaving shelters, and sometimes climbers are forced to dig them where other hazards (for example, avalanches or ice falls) are present. It is a calculated risk. Perhaps that's what happened in this accident, or perhaps these climbers should have searched further for a less-steep and, therefore, less-dangerous slope to dig their shelter. Regardless, climbers and ski mountaineers must consider potential avalanche hazard in their choice of campsites.

A similar accident happened on January 17, 1976, near Berthoud Pass, Colorado, documented as 76-6 in a previous edition of *The Snowy Torrents*. A woman inside a snow cave died when an avalanche overran the area and collapsed the snow cave.

83-14
APRIL 16, 1983

Granite Mountain, Snoqualmie Pass, Washington

5 hikers caught, 2 partly buried and injured, 1 buried and killed

Weather Conditions

At Snoqualmie Pass, March had almost been a snow-free month, and a solid melt-freeze crust capped the snowpack throughout the area. On March 28, though, a snowstorm began. By April 9, 42 inches of snow had fallen at Snoqualmie Pass, and this snow was resting on the MF crust. April 10–15 brought sunny skies which caused the new-snow layer to settle but it still had not bonded to the crust underneath. Saturday, April 16, was bright, sunny, and warm.

Accident Summary

Thousands of skiers, hikers, and climbers had headed for the Snoqualmie Pass area on this Saturday morning. Granite Mountain is a 5,800-foot peak 5 miles west of Snoqualmie

Pass. By mid morning numerous climbing and hiking parties were on the mountain. The largest was a 17-member group from the North Seattle Community College Alpine Club.

Hiking alone and far above this group was John Scribner. Starting at the Pratt Lake trailhead, he had climbed about 2,000 feet and had achieved a south-facing ridge near the summit of Granite Mountain. The starting zones of a large avalanche path named GS-1 were on both sides of him at this point. When GS-1 produces a large avalanche and runs its maximum length, it can put snow on Interstate 90.

The time was 1120 when Scribner walked onto the snow in the open starting zone and started glissading down the avalanche path. He had gone several hundred feet when he triggered a wet-slab avalanche. Another climber watched Scribner as he rode the slab for a short distance before it gained speed and began to crumble. He was carried about 1,000 feet down the slide path and buried in the wet snow.

When the avalanche released, the Alpine Club group was climbing up the avalanche track. When they saw a wall of snow coming down on them, they scattered to get out of the avalanche track. Most made it, but at least four were caught. One who was caught was 27-year-old John Wright, who describes his experience: "I heard the roar and I heard someone yell 'Avalanche!' Then I saw it and yelled and tried to get out of the way. I got behind the biggest thing I could find, which was a tree. For a split second I thought I could hold on when the mass of snow came down, but I couldn't."

The avalanche jerked him away from the tree and swept him on a harrowing ride through clumps of trees. He tried to swim but it was impossible. He remembered: "I tried to go limp as I was knocked through the trees. I think that saved me from being really torn up. It's something I sure hope not to see again. It's amazing that so much snow went down the mountain so quickly. It was just a big white wall. It's like being hit by a high-balling freight train."

Wright was carried 100 yards and came to rest partly buried. He was bruised, cut and scraped all over but was not seriously injured. Not so lucky was David Schneider, 23. He was slammed into a tree and had both legs broken. He was buried with only his head, shoulder, and one foot sticking out of the snow.

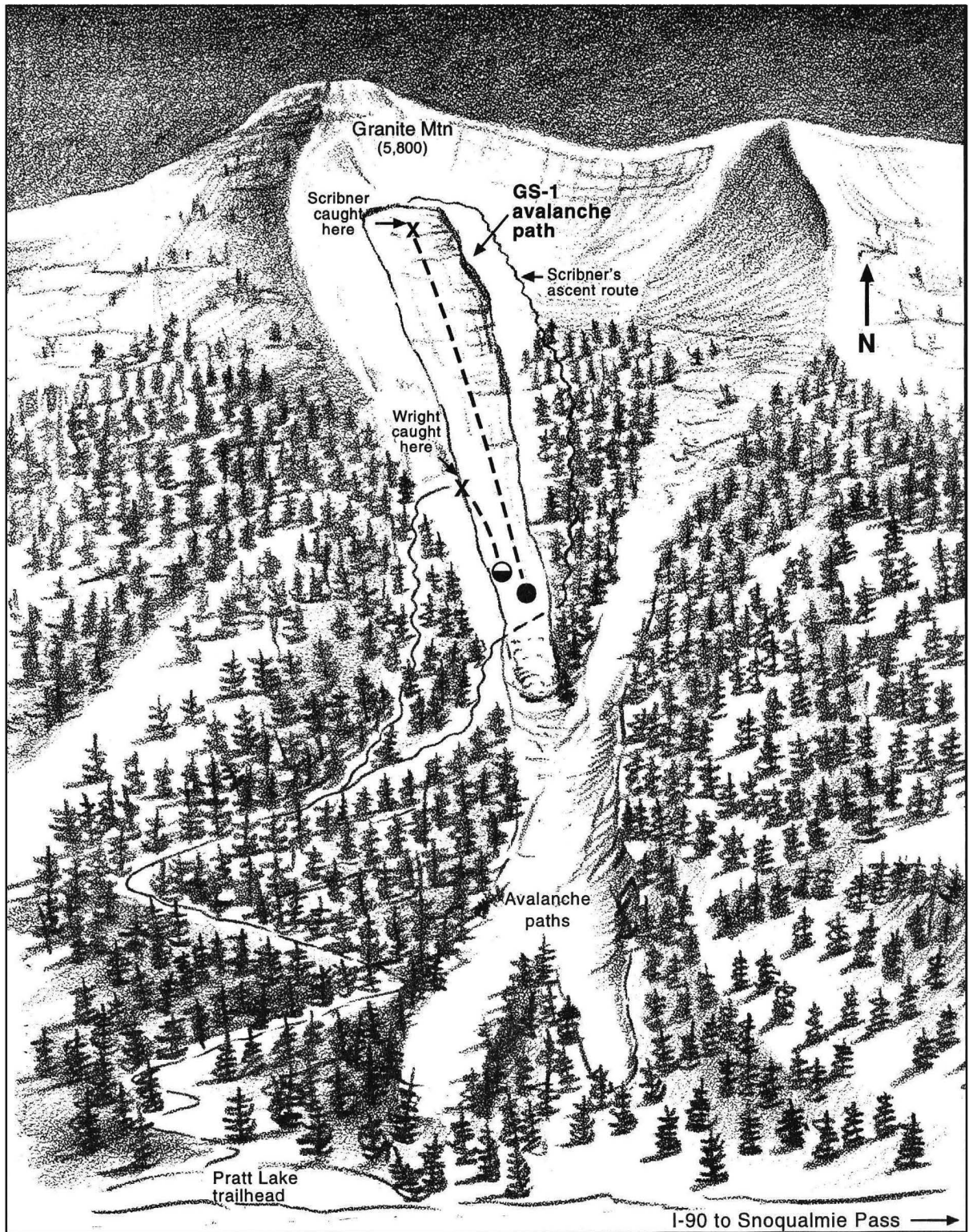


Figure 23. Accident 83-14, Granite Mountain, Snoqualmie Pass, Washington, April 16, 1983.

Rescue

A member of another hiking party witnessed the avalanche, ran back to the parking lot,

drove to Snoqualmie Summit, and telephoned the sheriff. Luckily, the King County Search and Rescue Team was conducting an exercise

nearby. This group, the Alpentel Pro Patrol, and Washington State DOT responded to the call. In all, more than 100 rescuers would be involved in the operation.

The witness who had seen Scribner trigger the avalanche was able to direct rescuers to the area where he had last been seen just as the avalanche was coming to a stop. Rescuers struck his body with probes in about 10 minutes and dug him out from 4 feet of wet, dense snow. He had been buried for 2 hours and showed no signs of life. He never responded to resuscitation efforts, and his body was evacuated by helicopter. Schneider, too, was evacuated by helicopter to a Seattle hospital for surgery.

There was a strange sidebar to this rescue. While rescuers were searching and tending to the victims, several people near the summit of Granite Mountain rolled rocks into the avalanche starting zone. This triggered two additional wet-slab avalanches, one of which narrowly missed a group of rescuers.

Avalanche Data

This avalanche was classified as a WS-AF-2 and was triggered by the man on foot glissading in the starting zone. The fracture was 1–2 feet deep and 300 feet wide. The bed surface was a melt-freeze crust. The avalanche fell 1,400 feet vertical down a south-facing avalanche path. The starting zone was at an elevation of 5,400 feet, and the slope angle was estimated to be 40°.

Comments

The season was spring and the weather, spring-like; but the snowpack had a winter-like structure with a slab that was poorly bonded to a crust. Glissading was the trigger, but skiing or walking, too, would have probably done the trick. A snowpit and shovel-shear test would have identified the danger. A similar glissading accident occurred a year later in this location. See accident 84-12 for the story.

83-15

JUNE 26, 1983

Mt. Shuksan, Washington

2 climbers caught and killed

Weather Data

Mt. Shuksan rises to 9,127 feet in Washington's North Cascades. It presents a difficult, technical challenge to climbers, especially the steep walls and glaciers of the north face. Storms can bring snow at any time during the summer, which means avalanche danger is present year-round.

About a foot of fresh snow coated the upper mountain on June 26. Clouds enveloped the mountain, and temperatures were warm within and below the cloud layer.

Accident Summary

A party of seven young climbers—all aged 19 to 20 years—headed up Mt. Shuksan early in the morning of Sunday, June 26. Their planned route to the summit was up the Price Glacier on the north face. But the weather never improved as the day wore on, and they were never able to break out of the clouds. By early afternoon, the warm temperatures had made the snow soft and dangerous. After reaching the 7,000-foot level, they decided to turn back.

They were in three rope teams on their descent. On the lead rope were Peter Travis, 19, and John Nelson, 20. They arrived at a spot on the glacier where they could descend a steep gully to avoid a crevasse or could climb back up to take a longer route on the side that avoided the gully and crevasse. Travis and Nelson went down the gully, and the second rope team followed. The third rope team, which included Stephen Henkel, 19, felt uneasy about descending the gully and chose the longer route.

Henkel described what happened next: "I heard a crack and looked up. A good-sized wall of snow was coming down. The second rope team looked up and were able to scramble out to the side. But a big wall of snow came flying down just enough to knock the first rope team off their feet." Travis and Nelson were swept down the gully and over a cliff. They were carried 1,000 feet down the rugged glacier. They came to rest on the surface, still roped together, but dead from injuries suffered in the fall. Henkel was lowered by rope over the cliff and went down to where Travis and Nelson lay. There was nothing that Henkel or any of the climbing party could do. They hiked out to notify rangers of the accident. The bodies of the two young men were evacuated about a week later, after the threat of more avalanches had passed.

Avalanche Data

The avalanche was classified as an SS-AF-2, and was triggered by the climbers on foot. Though it was a fairly small avalanche, it hit the two climbers with enough force and speed to knock them off their feet and carry them on a fatal fall over a cliff. The avalanche released at an elevation of 7,000 feet and fell about 1,000 feet down the glacier. The unstable slab resulted from a recent storm and warm temperatures, which increased the strain rate, on the day of the accident.

Comments

This was a climbing party with experience beyond their years. The group climbed together regularly, and individually they had made numerous ascents of major peaks in the Cascades and Canadian Rockies. But these young men were on a difficult route on the wrong day, a day on which a warm-up following a storm guaranteed an unstable surface slab. Only the third rope recognized the trap that was set and chose to go around it.

A climber's experience is defined by his or her skills on rock and ice, plus their ability to assess risk. It's a mind-trap to relax one's guard against risk on, say, a 40° snow slope after successfully climbing, say, a vertical rock face. But in reality, a climber's risk is often greater from avalanches on relatively gentle slopes than it is from verticality.

83-16 NOVEMBER 24, 1983

Day's Fork, Big Cottonwood Canyon, Utah

2 backcountry skiers caught and buried

Weather Data

November brought a steady procession of storms that rolled through Utah's Wasatch Mountains. By the end of the month, Alta would end up with almost 250 percent of normal November snowfall. By Thanksgiving Day, the 24th, Alta and the Wasatch Range were in the midst of a prolonged storm which had begun on the 17th. Alta recorded 48 inches

of snow from the 17th–24th, bringing the total depth on the ground to 42 inches. Along the ridgetops, however, snow depths of 5–6 feet were common. There had been a rapid buildup of the snowpack since November 8 when snows began in earnest, and this snow rested on about 6 inches of depth hoar at the ground.

The Utah Avalanche Forecast Center (UAFC) issued the following message for the Wasatch Mountains on the morning of November 24: "The backcountry avalanche hazard is moderate along steep upper-elevation ridgelines above 9,000 feet.... Avalanches are possible at ridgetop areas from windloading. Deep full-depth releases are possible on steep northerly aspects due to weak layers of temperature-gradient snow being overloaded in these lee ridgetop areas."

Accident Summary

A party of seven backcountry skiers parked at Alta and started climbing at the Forest Service Guard Station. Their planned tour was to climb up and over Flagstaff Ridge north of Alta and then ski down the north-facing slopes of Day's Fork, eventually reaching the Big Cottonwood Canyon road. It was the first ski day of the season for many of the party, and everyone was eager. The men's ages ranged from 23–26, and all but one were experienced backcountry skiers. The carried shovels, and six of the seven wore beacons. They called the UAFC hotline before leaving home in the morning.

When they reached Flagstaff Ridge, it was snowing lightly but the air was thick with blowing snow from strong west winds. They dropped over the ridge and dug a snowpit in the upper part of the north-facing slope they wanted to ski. They dug 5 feet to the ground and found 5 inches of depth hoar at the bottom but no other significant weak layers. They joked about triggering a climax avalanche breaking to the ground but felt the slope was safe to ski.

It was shortly after noon when they started down one at a time at spaced intervals, all making slow telemark turns until four skiers had descended the top pitch of upper Day's Fork. The fifth skier to head down was Tom Barker who made linked turns about 70 yards down and then dropped a pole. He shouted up to Rod Eyzaguirre and asked him to ski down and retrieve the pole. Eyzaguirre skied smoothly down to the pole and stopped with a

hard check. That check caused the snow to instantly fracture, and an avalanche broke 5 feet deep to the ground and 150 feet wide. Eyzaguirre and Barker were in the center of the avalanche, had no chance to react, and were carried down the slope. The four skiers that had already skied down managed to escape to the side as the avalanche went by. When the snow settled, both Eyzaguirre and Barker were missing.

Rescue

Both the missing skiers were wearing beacons. The four skiers at the edge of the avalanche turned their beacons to receive and skied onto the bed surface to start their search. They also shouted to the lone skier remaining above the avalanche to return to Alta and report the avalanche. He did so at Alta Central at 1303.

The rescuers started their search above the debris, and the search started badly. Because of inexperience and panic, there was no plan or organization to their search, and they could not use their beacons effectively. Fifteen minutes had passed before one of the rescuers heard a voice yelling from the snow. They dug down to find Eyzaguirre. He was buried in almost a standing position with his head 2.5 feet beneath the surface. His left arm was extended upward and his glove had come within 6 inches of the surface. With this arm he had been able to punch an airhole to the surface and had started shouting.

The four searchers partially dug out Eyzaguirre, who told his friends that Barker had been directly below him and that they should search about 15 feet directly down the fall-line. Some of the searchers started to dig, but Eyzaguirre told them to use their ski-pole probes and beacons first. A probe hit something, and then Barker's position was confirmed with a beacon. It took several minutes more for shovelers to dig down to Barker, who was almost 6 feet deep. He was in a prone position, face down; he was unconscious, blue, and not breathing. He had been buried about 25 minutes.

The rescuers started mouth-to-mouth resuscitation, and after 10–15 breaths, Barker started breathing on his own. In a few more minutes, Barker seemed to be just fine. Everyone was in remarkably good spirits, no doubt because both skiers had survived and Barker had made an astonishing recovery from a near-death experience.

No one had lost any ski gear, so the six skiers headed down Day's Fork to the road. At 1330, a Life Flight helicopter arrived at the avalanche site, but these rescuers could see six ski tracks leaving the area, and they called off any further search.

Avalanche Data

This avalanche was classified as an SS-AS-3-G. It fractured 5 feet deep to the ground, was 150 feet wide, and flowed about 900 feet slope distance. The crown was at an elevation of 10,200 feet and about 100 feet below the ridgeline. The slope angle was 35°, and the slope faced northeast. It was an open slope, with rock bands on the sides, that had been loaded by snow blown by west and southwest winds.

Comments

There are many things about this accident that are worthy of comment. First, the group was thinking "avalanche." They were equipped with rescue gear, they had called the Avalanche Center, and they dug a snowpit. So far so good. But after the snowpit, they seemed to lower their guard, for they did not ski one at a time. The first four skiers, even though separated, were on the slope at the same time.

Second, the avalanche was triggered by the sixth skier to descend the slope, and it broke only when a hard ski-check jolted the snow. These are two fairly common observations. For

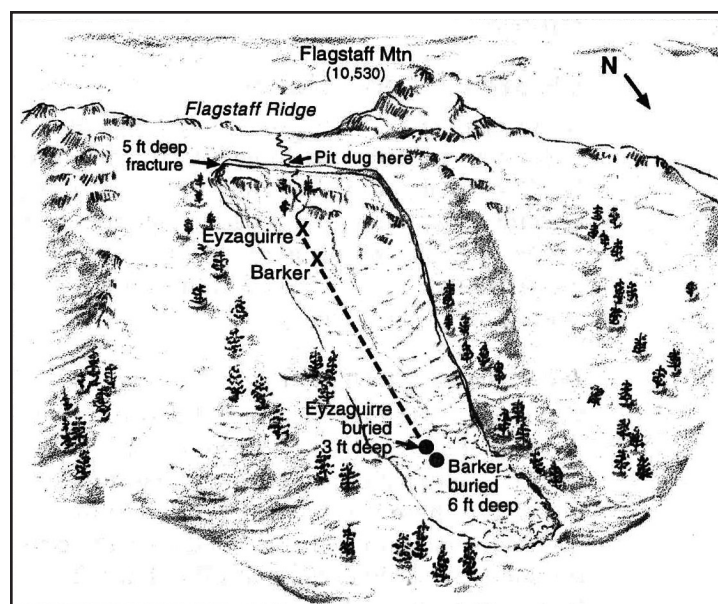


Figure 24. Accident 83-16, Day's Fork, Big Cottonwood Canyon, Utah, November 24, 1983.

example, it's frequently observed that a skier other than the first is the one to trigger an avalanche. Also, it appears common that a hard stop or fall will trigger an avalanche that would not have occurred had the person continued to ski smoothly. (See 84-6.) The lessons of these observations are obvious: be wary even if you are not the first skier down, and don't fall.

Third, beacons are useless unless you know how to use them. This rescue succeeded because of good fortune, not good training.

Fourth, this accident occurred on the exact slope of a previous and very similar accident. On December 2, 1977, three skiers triggered an avalanche that buried two of them. Both were saved because of expert use of beacons. It is believed that this was the first live recovery, by beacon, of an avalanche victim in the United States. This accident is documented as 77-10 in a previous edition of *The Snowy Torrents*. (See accident 81-13 for another accident in the Day's Fork area.)

83-17 DECEMBER 10, 1983

Crystal Mountain, Washington

1 patroller caught, partly buried and injured

Weather Conditions

On December 8–9, light snow had fallen at Crystal Mountain with a total of 11 inches and 1.40 inches of water. The morning of Saturday, December 10, brought light snow again with 3 inches of heavy, new snow; it contained 0.79 inch of water. West winds that morning were averaging 35–40 mph.

Accident Summary

The Crystal Mountain ski patrol was running its normal avalanche control routes on Saturday morning. Little activity was anticipated, but there was some concern that the high-density snow of the last 3 days had accumulated on a firm crust. Faith Burchard, 26, had been on the patrol for 7 years and had been running control routes for 4 years. She and patroller Charley Barron were running the

"00" route in Campbell Basin, which they started at 0900 from the top of the High Campbell Chair.

They had six hand charges between them. After they had thrown four (without any releases), they had run out of pull-wire ignitors because several of the ignitors had failed to work. They wanted to throw a charge into Chute 317, but now they could not. They decided to ski cut the next slope, Chute 318, which rarely slides. If it appeared stable, they would ski it and return later to control 317. Both patrollers made three Z-cuts in the top of Chute 318. The snow seemed stable, so as Barron watched, Burchard started to ski down. The time was 0930. She made several turns, and then the snow fractured around her and 50 feet above her.

Burchard relates what happened next: "After completing a turn to the left, I noticed the snow was moving around me. I went into a ski-pole self-arrest, but I couldn't slow myself or get an anchor due to too much snow moving. I was getting closer to the trees below me, so I turned and tried to ski with the snow. The snow immediately surrounded my skis and sucked them under. I released forward out of my bindings and went under the snow. I had the same feeling as when I used to body-surf in the ocean. There was a definite undertow effect under the surface of the snow.

"I started to swim and came up on top to see trees slightly to my right. I went back under and glanced off a tree with my right leg. I knew instantly that I had broken my femur. I continued to swim down with the slide sideways. I ended up in the major deposition zone on top lying on my left side with my broken leg on top of my good leg."

Rescue

Barron was left standing just above the fracture line. He had lost sight of Burchard on her way down, but the two patrollers quickly made radio contact after the slide stopped. In addition Burchard made voice contact with another patroller nearby. She apprised them of her broken leg and called for a tobaggan and splint. Forty-five minutes later she was at the first-aid room, and was then flown to the hospital via helicopter.

Avalanche Data

The avalanche was an SS-AS-3 and fell about 300 vertical feet. The slope faces southeast, and

the starting zone lies at an elevation of 6,700 feet and has a 38° angle. Chute 318 rarely produces avalanches and had not been closely checked for several days. The slab had built up from the snow and blowing snow of the last 2 days.

Comments

Patrolling can be hazardous duty, even when everything goes right. Things did not go right for Burchard and Barron when they wound up with a batch of faulty ignitors. This took away two hand charges they would have used for testing stability and protection. They took a calculated risk in skiing a chute that seldom avalanches. Their ski checking did not reveal the instability that existed lower on the slope. Since this accident, the patrol ski cuts this area on a more consistent basis and uses more hand charges.

Burchard recovered from her injury, and the next winter she was training her dog Joss to be an avalanche dog.

keeping up with its avalanche routes. The high-priority routes, of course, were those in-bounds; a lower-priority route, but still important, was an out-of-bounds area called Graveline Bowl. Graveline lies south of the ski area and was a potential expansion area for Copper Mountain. For a year or two, the patrol had been making periodic trips into Graveline to gather data, test stability, and test the feasibility of expanding into this terrain, initially for guided backcountry tours. December 18 offered the first opportunity for the patrol to go into Graveline in the winter of 1983–84.

At about 0900 on that Saturday morning, five Copper Mountain patrollers—Chuck Julin, 31, Bruce Cochran, 30, Jamie Mathews, 30, Mark Koepke, 29, and Mickey Johnston, 28—and a visiting patroller from Taos, Bruce Holthouse, went out of area to the top of Graveline Bowl. Their mission was an exploratory exercise for stability evaluation of this area; they were not planning on skiing it.

83-18 DECEMBER 18, 1983

Copper Mountain, Colorado

1 patroller caught, buried and killed

Weather Conditions

November and December of 1983 brought record snowfall to the Colorado mountains. Copper Mountain ski area recorded 80 inches of snow in November, and another 151 inches would fall by the end of December.

Saturday morning, December 18, dawned clear and cold, with a morning low temperature of -5°F and with 4 inches of new snow that fell overnight. It was the first clear morning in weeks, though by afternoon clouds would roll back in and snow would begin again. Copper Mountain had gotten new snow every day in the last 11 days of November and except for December 1, every day so far in December. A total of 113 inches had fallen in this time.

Accident Summary

Because of the unending snowfall, the Copper Mountain ski patrol had had its hands full

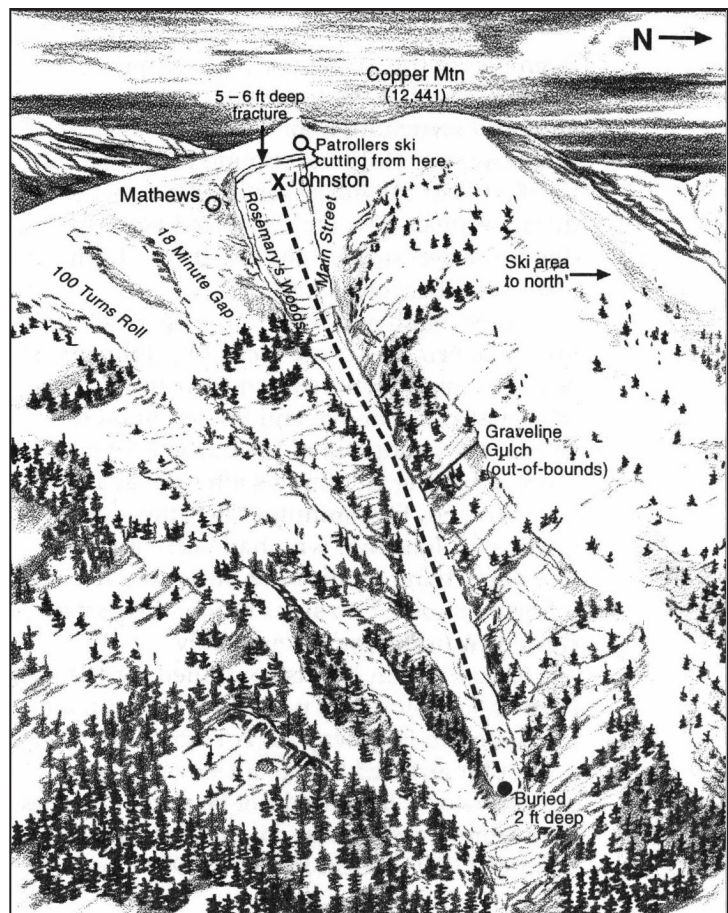


Figure 25. Accident 83-18, Copper Mountain, Colorado, December 18, 1983.

Before arriving at Graveline, they threw an initial hand charge in Spaulding Bowl without release. Working along the top of the bowl, they next threw three hand charges of 2 pounds each into Mainstreet, which was the first potential avalanche area they came to. Again, no release. Some of the patrollers then made a ski cut between Mainstreet and the top of the next slope, Rosemary's Woods. This was followed by a 2-pound hand charge into Rosemary's: no release.

The time was 0945 when Jamie Mathews made a ski cut across the top of Rosemary's Woods. He moved to a point of safety, and Mickey Johnston came in on lower ski cut in Rosemary's. Johnston's ski cut released a shallow soft slab, no more than a foot deep, but Johnston was caught and was carried downhill. Very quickly the fracture stepped down into older snow and produced a large, deep hard-slab avalanche. The avalanche roared down the main gully of Graveline, taking Johnston with it.

Rescue

Even before the avalanche had stopped, the five patrollers at the top were radioing in the alert and switching their beacons to receive. Mathews and Holthouse immediately set out for the toe of the debris, about 3,000 feet slope distance away. The others started working down the bed surface and debris, performing a visual and beacon search.

When Mathews and Holthouse reached the lowest debris area, they picked up Johnston's beacon signal. They radioed their find to the other patrollers above and homed in on the signal. They pinpointed the burial spot and started digging 10 minutes after the avalanche had released. Five minutes later, they had uncovered Johnston who had been buried 2 feet deep, lying on his back, head downhill. Johnston showed no signs of life; the patrollers started resuscitation immediately.

Resuscitation efforts continued for the next hour as Johnston was put in a toboggan and evacuated to Highway 91. A Flight For Life helicopter airlifted him to a Denver hospital, but Johnston's life could not be saved. He had died from massive internal injuries suffered in a fall of 1,000 vertical feet and 3,000 linear feet.

Avalanche Data

The initial slab failure was a shallow soft slab, but the fracture then broke into a dense, hard

slab beneath. The avalanche was classified as an HS-AS-4. It broke 5.5 feet deep and 120 feet wide. It released on an east-facing slope that had an angle of 35°. It released above timberline at an elevation of 12,200 feet and fell 1,000 vertical feet. The failure plane was found to be a thin layer of surface hoar sandwiched between two layers of hard-slab snow with densities of 410 kilogram per cubic meter.

This was a post-control release. The slope had been bombed and ski cut minutes before release. There had been no signs of instability that morning: control inside the ski-area boundary had produced no significant releases, and none of the five hand charges thrown by this control team had caused noticeable cracking or release.

Comments

Hard slab instability is notorious for not revealing itself until the moment of release. The Copper Mountain patrol relearned this fact in a tragic accident. Rosemary's is the most avalanche-prone slope in Graveline Bowl, and the control team did not give it the respect that it demanded. December 18 was late for the first mission into Graveline, especially in a season that brought record early snows.

There is considerable data showing that explosive control is not a conclusive test of stability. Hard slab frequently needs a big jolt, and big bombs—4 pounds, 8 pounds, or larger—are warranted. In the case at hand when explosives did not produce the desired results, the wise decision would have been to back off and return again soon with larger explosives.

The pain from Mickey Johnston's death was, understandably, huge to his family, friends, and the Copper Mountain ski patrol. This accident has been a lasting legacy for the ski patrol, for it has had a guiding influence on the way the patrol has conducted its business ever since. The effect is pervasive, from who gets hired (those with mountaineering experience are preferred) to how the job is done (don't take chances!)

83-19
DECEMBER 23, 1983

Alpine Meadows, California

2 snow players caught, and 1 buried

Weather Conditions

On the morning of December 23, Alpine Meadows recorded 9 inches of new snow, which contained 1.40 inches water equivalent. This dense snow was driven by winds that averaged 40–70 mph, so that soft-slab conditions were widespread. The Alpine Meadows ski patrol had a full morning of avalanche work and released 87 avalanches. As snow continued during the day, the patrol decided to control slides above the ski-area access road in the afternoon. They scheduled the control work for 1500, with the hope of being done before the lifts closed and skiers left the area. The patrol did not expect avalanches to reach the road. Just as control was to commence, however, the temperature warmed and the snow changed to rain. Control work produced larger slides than expected, which covered the road and stopped traffic.

Accident Summary

Two soft-slab avalanches released by explosives put snow 4 feet deep on the Alpine Meadows road at about 1530. Traffic stopped in a long line stretching back to the parking lot. One of those stopped was Tracey Volz and her Golden Retriever Avitar, who was being trained as an avalanche dog. People began to get out of their cars. They were socializing with other skiers and several kids began playing on the snowbanks along the road.

Two 13-year-old boys were sliding on the snow and having a snowball fight when they triggered a large bank slide. The resulting soft-slab avalanche flowed over the road and partly buried one car and totally buried one of the boys playing on the snow.

Volz and Avitar were outside their car when the avalanche broke. She saw the avalanche and saw the boy disappear in it. While people converged on the avalanche site, she took Avitar there and commanded him to search. In 1 minute Avitar alerted and was digging in the snow. The boy had been buried in a standing position with his head 6 inches beneath the surface. Many people helped dig him out and he was free a few minutes later, totally unhurt by the slide. In a short while the car that was partly buried was shoveled out, the road was cleared of avalanche debris, and traffic began to move.

Avalanche Data

This avalanche was classified as an SS-AF-1,

and was triggered by the boys walking on the steep bank above the road. It fell about 40 vertical feet but moved enough snow to completely bury the road and bury the boy in a standing position. The debris area was about 50 feet by 50 feet.

Comments

This accident shows how effective avalanche dogs can work; the dog made quick work of this search and made the find in less than minute. This was not a life-threatening burial because the boy had an airway to the surface and would have been located in a few minutes regardless; however, it is still remarkable to see trained dogs at work and realize the potential for more live recoveries as dogs in the avalanche workplace become more common.

83-20
DECEMBER 27, 1983

Wolf Creek Pass, Colorado

3 motorists caught and partly buried, 1 injured; 1 vehicle damaged

Weather Conditions

A storm moved into the San Juan Mountains on December 18 and brought snowfall every day to the Wolf Creek Pass area until the 28th. The heaviest snows fell on the 20th–23rd when 53 inches of snow containing 4.50 inches of water accumulated. Another 14 inches fell on the 24th to the morning of the 27th. Light snow fell on Wolf Creek Pass all day on December 27.

Accident Summary

Jack Julian, 52, his wife Charlotte, 54, and their 11-year-old granddaughter, Megan Ryall, were returning from a Christmas visit in Denver to the Julian's home in Mancos in southwest Colorado. At 1630, they were driving in their 1983 Eagle station wagon on U.S. Highway 160 over Wolf Creek Pass. They had topped the summit and were heading down the west side of the pass when they drove under a series of avalanche paths called the One-Sixty group. At that time a natural slab avalanche released in a path named Daniel and crossed the highway at the precise instant the Julian's car was passing by. Jack Julian saw the avalanche out of the

corner of his eye but could do nothing to avoid it. Megan Ryall remembered, "We saw a sign saying 'slide area,' and grandpa said, 'Here comes one!' There is a fog in front of you, it hits you and you're gone."

The avalanche knocked the car to the edge of the road and then down the steep embankment. The car rolled several times as it tumbled 300 feet down the mountainside before coming to rest on its wheels. Ryall remembered being thrown to the car's ceiling and then windows breaking and snow pouring in. The car stopped in the bottom of the ravine; the top half of the car was out of the snow, but the inside was about three-fourths filled with snow. No one else had seen the car go over the edge.

Charlotte Julian remembered the trip down the mountain being a white blur. "I didn't know whether we'd land right side up or be buried for the rest of our lives. I was absolutely buried in a car in snow. Fortunately we had enough air space and room to dig out." It took 30 minutes for Charlotte to dig and crawl out of her window and for Jack to do the same on his side of the car. Jack then dug out Megan who was packed in snow and pulled her out a broken window. Both his hands were bleeding from cuts from the broken glass.

Once outside they pulled on extra clothes to keep warm. They could hear the sound of a snowplow working on the highway far above. It was pulling out a pickup truck that had slammed into the debris on the highway and gotten stuck.

Jack Julian was having trouble breathing; it was agreed that Charlotte should go for help alone while Jack and Megan, who had lost her shoes, stayed with the car and tried to stay warm. Charlotte wrapped herself in a blanket and used a jacket for gloves and began the slow climb through deep snow to the highway.

Rescue

Several people were standing by their vehicles waiting for the plow to pull the pickup truck from the snow and begin clearing the snow from the road. The driver of the plow turned off his deisel engine to refuel, and in the silence, one of the men on the road heard a shout for help. Juergen VanBeekum of Phoenix remembered, "We went running up to the avalanche and saw a woman about halfway up the bank. I carried her up and my son Todd went down and carried the girl up."

By now it was almost dark. A State Trooper had arrived, and he was able to patch a call through to the Wolf Creek ski area that rescuers were needed. Seven patrollers responded to the call with a backboard, rope, shovels, headlamps, and oxygen. They hiked down to the car and found Jack Julian lying on a pile of clothes on the snow with a sleeping bag over him. He was shivering uncontrollably. They rolled him on the backboard, got him more warmly clothed, administered oxygen, and began a slow, difficult climb up the embankment to the highway. All three victims stayed overnight in the Del Norte hospital and were released the next day.

Avalanche Data

The avalanche was classified as an SS-N-4, and it buried the highway for a length of 700 feet with snow that was up to 15 feet deep. The Daniel avalanche path faces south and has a vertical drop of 1,600 feet.

Comments

The Colorado Highway Department had taken a calculated risk ... and lost. A control mission was scheduled for the next morning, and maintenance workers were counting on natural avalanches not releasing before avalanche control was carried out. They miscalculated by about 16 hours, and the result was a near-fatality as the avalanche made a direct hit on a moving vehicle. When they shot the next morning, an adjacent avalanche path buried the highway 8 feet deep by 200 feet.

For the Julians and Ryall, this was nothing short of a miracle survival. They walked away from a large avalanche that had totalled their car and easily could have claimed three lives. Knowing this, Charlotte Julian said from her hospital bed, "I've had enough snow to last a lifetime. I'm moving south." (For a similar accident, see 80-12.)

84-1

JANUARY 2, 1984

Alta, Utah

2 backcountry skiers caught, 1 partly buried and injured and 1 killed

Weather Conditions

Like a storm of biblical proportions, snow fell for more than 40 days at the Alta Ski Area in Little Cottonwood Canyon. The snow started near the end of November and continued to the last day of December 1993. During December alone, 244 inches of snow smothered the canyon. On December 31, 7 inches of new snow with 0.79 inches of water equivalent was recorded. Very light snow continued to fall during the day as the storm finally was winding down. West-northwest winds, 20–25 mph, caused light loading of wind transported snow on the lee sides of ridges. At 0800 artillery rounds were fired from the 75mm pack howitzer into several paths that affected the highway and the village. Several class 2 slides were released including two from the Little Superior area. One of these slides released from where the accident would later occur. Snow ended that night and skies cleared; winds shifted to the north-northwest and only 1 inch of additional new snow was reported on January 1.

Clear skies ushered in the new year; January 1 and 2 were the first sunny days in well over a month. Northerly winds on the 1st were strong enough to cause blowing snow along the ridges and mountain tops. The weather on the morning of the January 2 was clear and cool. The low temperature was 12°; north-northwest winds were light at 10–15 mph. It was a beautiful day.

Accident Summary

Spirits were high as Matt Ryan, 26, Paul Warschilka, 23, Dana Hauser, 21, Mic Thueson, 31, and David Taylor, 22, set out from Alta at 0730. The group headed to the Cardiff drainage. Their goal was to snowboard and ski Cardiac Bowl, on the backside of Superior Peak, and then return to Alta. Only Taylor was on telemark skis, the rest of the men were on snowboards (at that time called “wintersticks”), but wore snowshoes for the climb. Part way to Cardiff Pass the group met two other skiers, Steve Kauffman, 21, and Kirsten Davis, 21. Kauffman and Davis were planning to ski out Mill B to Big Cottonwood Canyon. Together the seven reached Cardiff Pass. After a short break the two groups joined together and started west toward Superior Peak. Everyone in group carried an avalanche rescue beacon and shovel. The skiers gained a quick lead ahead of the snowboarders who were

walking in snowshoes along the relatively flat ridge to Little Superior.

During the break, all seven agreed the snowshoers would hike directly up the steep ridge toward Little Superior while the skiers would venture out onto the south face to switch back their way to the top. On the approach to Little Superior one of the snowshoers, Matt Ryan, spotted a lot of wind-scoured snow on the edge of the face with a “big patch of smooth, undisturbed snow” in the middle of the south face. He knew this patch of smooth snow was a fresh slab deposited by recent northerly winds. The day before he watched plumes of blowing snow off the same ridge.

It was shortly before 0930 when the three skiers ventured out onto the face. Traveling 75–100 yards behind the skiers the snowshoers left the ski track to climb up the ridge. Ryan and Hauser paused to check the movement of the skiers, both men thought the skiers were headed for trouble. The skiers were headed out onto the steep face below the Little Superior ridge. Taylor and Davis had traversed far out onto the face so to make only one switch back to gain the ridge. They both thought a safer route would be to stay closer to the ridge and make several switch backs. Traveling behind Taylor and Davis, Kauffman also stopped to watch. He didn’t “like the looks of their route.” He too thought the safer route was closer to the ridge.

Kauffman wasn’t the only one having “bad vibes.” Davis was following about 45 feet behind Taylor, and she knew they were not in a safe place. She told him they needed to get to the ridge as quickly as possible, but Taylor continued to make his traverse. She slowed down to make more distance between Taylor and herself. After Taylor made his switch back she told him to come back down and they would take a different route to the ridge. He continued upward and Davis slowly traversed to the switch back. After watching Taylor and Davis venture further and further onto the face Kauffman hollered at Davis to come back. She said something to Taylor and he made another kick-turn.

Instantly the slope around them was in motion. Davis heard Kauffman yelling her name as she and Taylor were hurled down into a steep, narrow gully. The avalanche fractured to within 20 feet of Kauffman. Several of the snowboarders on the ridge also saw the

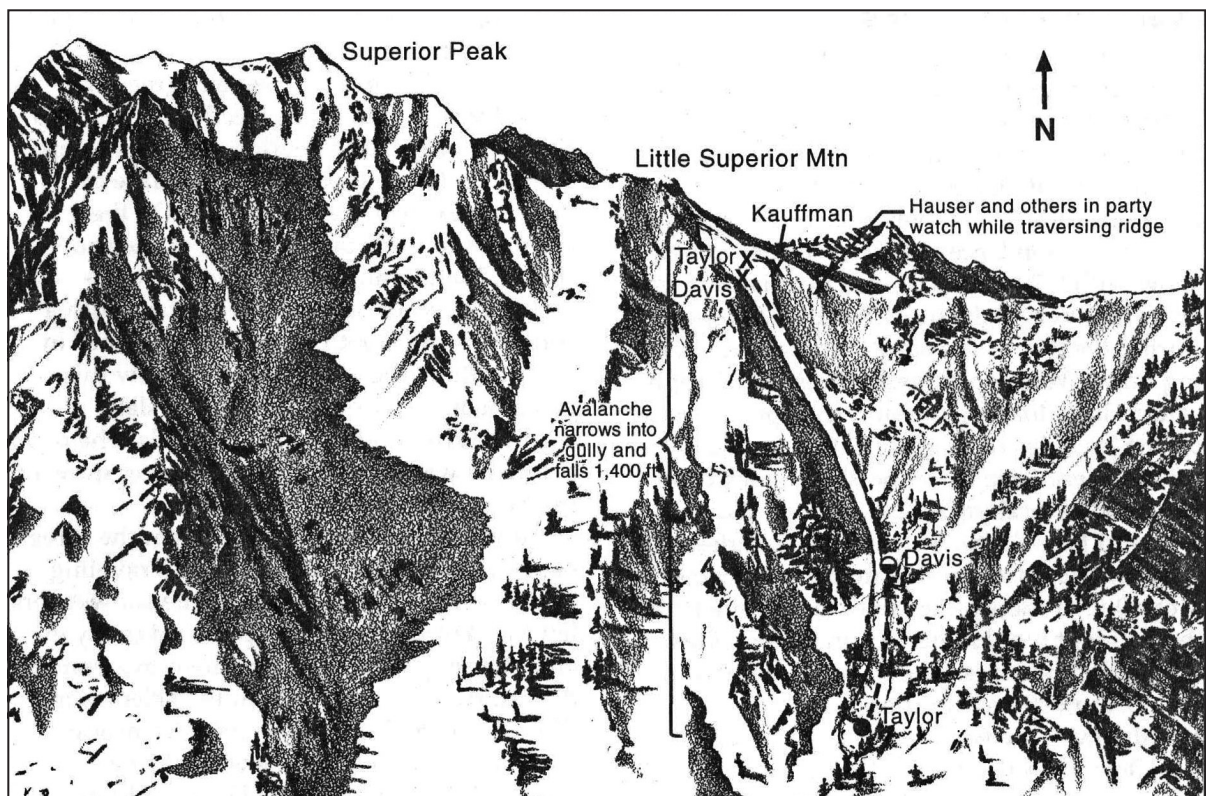


Figure 26. Accident 84-1, Alta, Utah, January 2, 1984.

slab release, but within seconds a powder cloud had formed and obscured the skiers in the avalanche.

When the snow fractured around Davis she knew immediately what was happening. She knew that she "was going for a ride," and decided at that instant that she was going to live and swim for her life. At first she tumbled wildly in the moving torrent, but by "swimming madly" she was able to steady herself and stay upright. She felt her skis hit rocks before she was flushed into the narrow gully. Submerged in the moving snow she used swimming motions again. One ski fell off and as the avalanche started to slow down she swam hard to get to the surface. Just as the snow stopped she popped out on top of the debris. One ski was still attached, but the other was only 20 feet above her. She quickly dug herself free, and then she saw Taylor lying on the snow several hundred feet downslope. She grabbed her other ski and ran down to him.

Taylor was unresponsive and had no pulse. Davis started cardiopulmonary resuscitation (CPR).

Kauffman ripped his climbing skins from his skis and quickly crossed to the bed surface only 20 feet away. He yelled back to the other

men; they too had witnessed the avalanche and were already heading to the slide path. Kauffman descended to the first bit of debris; there he pulled out his Pieps and started a beacon search as he descended. Hauser, sliding down the bed surface on his snowshoes and butt, raced down the path. He passed Kauffman and headed to Davis. As soon as Kauffman saw Hauser, Davis and Taylor he stopped his beacon search and bolted down the path. They decided that Hauser should go for help while Davis and Kauffman did CPR. The other snowboarders made their way down the path as fast as they could.

Rescue

Alta ski patroller Dave Robinson was riding up the Wild Cat Lift and watched the two skiers trigger the avalanche. After the powder cloud settled he could see at least one person in the debris. He notified dispatch at 0928. The patrol notified Alta Central, the central communication system for Little Cottonwood Canyon, and the Alta marshal and a deputy responded to the avalanche. The two officers drove to near the runout of the avalanche, and waited for Hauser. He briefed the Marshall and deputy that two people had been caught,

and that one was all right, but CPR was being done to the other victim.

During this same time Wasatch Powder Guides was mobilizing their helicopter and guides. Several guides and Snowbird patrollers headed to the heliport. At 0947 rescuers were flown to the accident site and helped with the CPR. A toboggan and a backboard were sling-loaded underneath the helicopter to the accident site.

Taylor was loaded into the toboggan and transported to the road. Rescuers reached the road shortly after 1000 hours where a doctor and paramedics worked to revive Taylor. He was transferred to a Life Flight medical helicopter and flown to a Salt Lake City hospital. At 1110 doctors pronounced Taylor dead. He had probably died by the time the snow stopped moving. The avalanche broke his neck and also caused massive internal bleeding.

Davis' injuries were painful but not severe. Right after the avalanche a surge of adrenaline fueled her efforts, and she did not notice she was hurt. It was not until later, when she had reached the road that she found herself in great pain and could barely walk. Most likely she suffered sprained ligaments and strained muscles.

Avalanche Data

Several hours after the accident, avalanche experts Peter Lev and Onno Wieringa did a fracture-line profile. On a southeast aspect the fracture line extended 150 feet across a 38° slope. At its deepest spot the fracture was 2 feet deep, but it tapered to only a few inches at each end. At 10,200 feet and just below the ridgeline, the slab released from a fresh drift, sometimes called a wind-pillow. It involved only new snow deposited by north-northwest winds during the previous day and a half. The weak layer was a less-dense layer of drifted snow, topped by a slab of heavier wind-transported snow. The vertical fall was 1,400 feet and Robinson said the avalanche traveled extremely fast. The avalanche accelerated as it was funneled into a very narrow track that in places was no wider than 15 feet. Lev and Wieringa described the avalanche as a combination soft slab and hard slab; it was classified as an SS/HS-AS-2-O.

Lev and Wieringa also retraced the tracks of both the skiers and the snowshoers. Both men found fracturing in the fresh wind-drifted snow along both routes.

Comments

This accident illustrates how capricious avalanches can be: one victim walked away while the other victim was killed. Avalanches don't care how well prepared its victims are. It is always best to travel in avalanche terrain as if you were not carrying avalanche rescue equipment. A simple adjustment in the route taken by the skiers would have saved a life. When dealing with avalanches the easiest route is not always the safest route.

This accident also highlighted the dynamics of the group. Though it was not known if Taylor had had avalanche awareness training, others in the group were trained and knew Taylor and Davis had gone beyond any limits of safety, but by the time Kauffman hollered it was too late. They all learned a painful lesson that it is better to voice concerns about safety earlier than later.

84-2
FEBRUARY 8, 1984

Mt. Katahdin, Maine

5 climbers caught, 1 partly buried, 4 buried, 2 injured and 2 killed

Weather Conditions

Southerly winds kept weather conditions mild over northern Maine in early February. At Chimney Pond, on the north side of Mt. Katahdin (5,267 feet) light rain fell overnight and on the morning of February 4 before changing to snow that afternoon. Nine inches of heavy, wet snow had piled up by the time the snow ended on the morning of the 5th. Only occasional snow flurries were reported on the 6th and 7th, but strong northwest winds on the mountain caused blowing snow. Wednesday morning, February 8, dawned clear and cold: -5°F. Winds were from the northwest at 10 mph. However, high on the mountain winds were much stronger and a lenticular cap-cloud shrouded the summit.

On Mt. Washington in New Hampshire (175 miles to the southwest), weather conditions were similar. At Tuckerman's Ravine 8.5 inches of snow and 1.45 inches of water equivalent fell during the same time period. Winds on the 6th and 7th were from the northwest at

50–60 mph. Observers at Tuckerman’s reported several slab avalanches running on cold, unconsolidated, less-dense snow.

Accident Summary

For this party of five experienced winter mountaineers from up-state New York, a climb of Mt. Katahdin would be the culmination of 6 months of expedition planning and preparation. Bob Esser and Ken Levenway had been on the mountain 4 years before. Both had extensive technical climbing resumes. The other three men: Stephen Hilt, Peter Cochetti and Rick Cumm had winter climbing experience and were excited by the challenge. They all met the Baxter State Park criteria for winter climbs on Katahdin.

The group started up the trail on February 5 and took the usual 2 days to ski the 16.5 miles into Chimney Pond. On their first day at Chimney Pond (February 7) the group did an easy warm-up climb on the Chimney. Afterwards Esser, Levenway and Cumm climbed the ice on the Pamola cliff. Hilt and Cochetti skied some nearby slopes. For some undisclosed reason they felt the snow conditions were very stable.

At about 0600 hours on the 8th, Esser, Levenway and Cumm set off to do a technical climb up Cilley-Barber. Meanwhile Hilt and Cochetti prepared to climb Baxter Peak via the Cathedral Trail. By 0800 Esser, Levenway and Cumm had returned to their base camp. Winds and temperatures were too brutal, and they opted to join Hilt and Cochetti to try the standard route.

About 0830, all five climbers set out into the wind and cold wearing full-face masks and goggles. From the west end of the pond the men followed the climbing trail through the last of the evergreens toward the base of a massive rock formation that resembles three cathedrals. Above treeline the trail climbs steeply across open slopes as it approaches the First Cathedral. The climbers were only 15–20 minutes from camp—approaching the First Cathedral—when they triggered an avalanche. All five were swept down the slope.

The avalanche knocked Cochetti onto his back. Covered by snow, he could only sense that he was falling head-first down the mountain on his back. During his ride he hit something hard, but his pack absorbed the blow. When the avalanche stopped, heavy snow set up all around him. Cochetti felt like he was

drowning; he couldn’t breath or see anything. At first Cochetti could move only his right arm. He struggled with all his might, and soon he was able to move both arms and clear the snow from his face. Buried about 18 inches deep but with both arms free, he was able to dig himself out.

Rescue

Once free of the snow Cochetti yelled and heard a voice. One climber’s head was out of the snow. He ran over and pulled off the face mask. It was Cumm, who was yelling, “There is somebody beneath me. Get him out!” Cochetti scraped away the snow from Cumm’s face and tried to dig down into the debris. Without a shovel he couldn’t dig fast enough. He could only claw away at the hard-packed snow. After 5 minutes of trying to dig with only his hands, Cochetti decided he had to get a shovel and get help. He glanced at his watch; it was 0956. Cochetti ran back to the Ranger’s cabin at Chimney Pond as fast as he could run.

Cochetti broke into the cabin and roused Ranger Charlie Kenny. Ranger Kenny got a quick description and location of the accident. He gave Cochetti a shovel and sent him back to the avalanche. Kenney alerted Park Headquarters of the accident, grabbed a shovel and ice axe and followed after Cochetti.

When Ranger Kenney reached the avalanche, Cochetti had already uncovered four heads. The two men checked the victims: Hilt and Levenway were unconscious and not breathing. Cochetti and Kenney dug them out and performed CPR but got no response. They then focused their attention on the other two injured men who had been yelling continuously.

It took considerable time to dig out the two injured men. Cumm suffered a broken leg and Esser was suffering from either a broken femur or pelvis. Hypothermia was becoming a serious threat; Kenney and Cochetti provided first aid and wrapped the injured men in extra clothes.

Shortly after 1100 hours, another Ranger who had been working near by arrived at the accident site. He reported other rescuers were in route. Soon after, evacuation of the two injured climbers was started.

By 1330, both men were at the Ranger’s cabin at Chimney Pond. Both men had suffered broken legs; Esser was spitting up some blood. Though both men were in considerable pain, their conditions were stable. At 1427, a

Maine Forest Service helicopter carrying a medical team was able to land at Chimney Pond. Cochetti, Esser and Cumm were put on board, flown to the Millinocket Airport and transferred to a waiting ambulance.

At 1530, a second Maine Forest Service Helicopter returned to Chimney Pond with litters, lunches and additional sleeping bags and packs for rescuers. Also on the helicopter was Kevin Slater from the University of Maine. Slater, an experienced mountain guide with considerable avalanche training, dug several snow pits in the vicinity of the avalanche and did a fracture-line profile. With daylight fading the helicopters had to return to their bases.

Back at the avalanche the rescuers had started the evacuation of the two bodies. Just as the sun set (1646 hours) the rescuers reached Chimney Pond. The bodies were transferred to snowmobile sleds and hauled out the 16 miles to the trail head at Abol Bridge. By 1900 hours all rescuers had reached the road and the rescue operation ended.

Avalanche Data

Slater reported the avalanche as a small hard slab that released on a east aspect at 3,500 feet in elevation. We would classify the avalanche as an HS-AF-2-O. The slide carried the climbers through a shallow gully and ended on a boulder field.

The avalanche was 2 feet deep; the dense hard slab was sitting a top of a thin layer of low density, unconsolidated snow grains that were perched atop an ice crust. Shovel shear tests showed the snow layers were poorly bonded; just sticking the shovel into the back of the column caused the slab to shear away.

Comments

At 5,267 feet it is the highest point in the state of Maine, and it towers 4,500 feet over the surrounding boreal forests. Conditions can be as harsh and brutal as found on any high mountain in the world. A winter climb is a goal for many New England mountaineers and backcountry skiers. Avalanches are not uncommon on Mt. Katahdin. In fact on the south side of the mountain is a drainage called "Avalanche Brook." The Baxter State Park map also labels an area along the route in as an "avalanche field." Though avalanches are common, avalanche accidents are not. These unlucky climbers were the first avalanche deaths recorded in the state of Maine.

The men were not clueless of avalanches; Cochetti had some avalanche awareness training, and for some untold reason the group felt the snow was stable on their climb of the Chimney. We can only guess at why they felt the snow was stable. Thick hard slabs are very common on the high peaks of New England. High winds typically plaster the snow into dense slabs. Many climbers and backcountry skiers think the hard snow is stable and safe. But sometimes these slabs are poorly bonded to the lower snow layer. (See 80-6, 83-8 and 84-5 for other hard-slab accidents.)

84-3
FEBRUARY 16, 1984

Snow King Mountain, Wyoming

1 out-of-area lift skier caught and killed

Weather Conditions

February 16 was cloudy and snowing lightly at Snow King Mountain Ski Area. In the previous 24 hours, 4 inches of snow had fallen at the small ski area above the town of Jackson. Unsettled weather from the 13th–15th had deposited 8 inches of snow. During that time winds blew occasionally up to 20 mph from the south and southwest. Avalanche control within the ski area on January 26 indicated an unstable snow cover. One-pound explosives released several slabs up to 3 feet thick.

Accident Summary

Snow King Mountain Ski Area, small but challenging, has a history of avalanche accidents just outside of the ski area boundary. Undisturbed snow and steep tree-covered slopes and gullies ending right at the edge of downtown Jackson entice skiers to leave the ski area and venture into the backcountry.

A short time before 1300, a group of four locals—Pierre Muheim, 27; Bob Jackola, Ed Garcia, and Jim Gates—left the top of the double chairlift and skied along the east ridge of Snow King Mountain. The men crossed the ski area boundary and a posted avalanche warning sign as they started the short climb along the ridge. From the high point just east of the

radio towers, the men put their skis back on and headed to what locals call Ferrin's Run or Ferrin's Slide, a known avalanche path.

Gates went first, and started to make several traverses at the top of the slope to "check the stability of the snow." As he started back across the slope he hesitated and stopped. Apparently the wait was too long for Muheim. He shoved off straight down the fall-line and had only made a few turns when the snow fractured. Gates yelled for him to head to the trees, but he turned the wrong direction. A spider web of fractures shot out in all directions and the torrent of snow swept him downhill into scattered timber.

Before the snow stopped, screams resonated back up the path as Muheim crashed through trees. The other three men quickly descended and followed Muheim's cries 250 yards down the slope. They found him immediately—not buried but wrapped around a pine tree. His right leg had been shattered by the impact with trees. Blood was spurting from his leg with each beat of his heart. Jackola and Gates did their best to aid their injured friend while Garcia skied down to get help. They tried direct pressure on the wound, but it did not control the bleeding. Soon after Garcia had left, Muheim lost consciousness. Jackola then headed down to make sure that rescuers had been notified. Within minutes Muheim stopped breathing. Gates started mouth-to-mouth rescue breathing, but he knew his friend was dying in his arms.

Garcia first skied to a house, but nobody was home. From there he raced to the Americana Hotel at the base of the mountain. Kicking his skis off he bolted inside to the Front Desk and reported the accident. The time was 1315 hours. Jackola arrived a few minutes later.

Rescue

At 1327, the first rescue column of five ski patrollers headed to the accident. A second column with three other patrollers was dispatched 10 minutes later. Both columns reached the accident at 1412, about 40 minutes after the avalanche. Muheim was unconscious, not breathing and was in severe shock. Soon afterwards he went into cardiac arrest.

Cardio-pulmonary resuscitation was started immediately and continued throughout the evacuation. Though not far from a waiting ambulance, travel was slow because of rotten snow conditions in the trees. Deep, loose sugar

snow—depth hoar—covered the ground. Patrollers on skis and hauling a sled with the weight of two men—the injured and one patroller doing CPR—sank to mid thigh in the sugar snow. It took a half-hour to evacuate Muheim to the ambulance.

At 1510, Muheim was wheeled into the Emergency Department at Saint John's Hospital. There doctors tried to resuscitate him but couldn't. Besides broken bones in his lower leg, his femur was also broken, and it had severed the femoral artery. Dr. Brent Blue explained, "He basically arrived to the emergency room without any blood in him."

Avalanche Data

Ferrin's Run starts as an open slope but the starting zone funnels into gully covered with scattered timber. The upper portion of the north-facing slope measured 35° in steepness and steepened to 40°. At an elevation of 8,000 feet the avalanche fractured 18 inches deep and 150 feet across. It initially released on a weak layer about 40 inches above the ground, but after running a short distance the avalanche bulldozed to the ground and entrained the entire season's snow cover. The avalanche traveled 300 yards down the slope; it was classified as an SS-AS-3-O.

Comments

This accident demonstrates how violent the ride in an avalanche can be, especially when the snow flows through timber. Fractured femurs and pelvises are life threatening emergencies. Broken bone ends can cut arteries and cause internal bleeding. Death can occur in minutes. Even a textbook rescue of speed and efficiency couldn't save Muheim.

A final comment is about attitudes. The men knew they were venturing into avalanche terrain. On this fateful day their tracks passed within a few feet of an avalanche warning sign, but over the years they had all skied Ferrin's Slide several times without incident. Muheim had had some avalanche awareness training, and as the skiers traversed out to Ferrin's, he even spoke about avalanches. The men knew there was some risk, but they seriously underestimated the danger that afternoon. They chose to ski an avalanche path that was a natural terrain trap: an open slope that narrowed into a tree-covered gully. Perhaps it was because their previous experience in that area told them that it would not be a problem.

Apparently their familiarity with the area caused a lack of respect and resulted in the death of a friend.

still rated moderate to high as the possibility of artificially triggered avalanches remained likely.

84-4 FEBRUARY 18, 1984

Ophir, Colorado

4 helicopter skiers caught, 1 partly buried and 1 buried

Weather Conditions

In Colorado the winter of 1983–84 got off to a very snowy start. Snowfall was practically uninterrupted from Thanksgiving to Christmas. Some sites reported snow every day of the month during December. At Telluride Ski Area in the San Juan Mountains of southwestern Colorado, snow fell on all but 7 days during December. The snowpack developed with a homogeneity uncommon for Colorado's continental climate.

January and early February saw an about-face in the weather pattern. Only 16.5 inches of new snow was reported at Telluride during January. Except for a minor dusting on February 9, no snow fell from January 27 to February 10. The dry January and early February contributed to two significant developments in the snow cover that would affect the stability for the rest of the winter. First, in early January large surface-hoar crystals blanketed the snow cover only to be covered by a shallow snowfall in the middle of the month. Second, cold temperatures from mid January through early February created faceted-snow grains in the upper portion of the snowpack. These two fragile zones would provide the failure planes for slab avalanches for the rest of the winter.

Finally in mid February, winter returned to the San Juan Mountains; at Telluride, 9 inches fell overnight on the 10th. A short dry spell of 2 days was followed by additional snows; 34 inches of snow with 1.28 inches of water equivalent fell between the 14th and 18th. The morning of the 18th dawned clear and cold. The Colorado Avalanche Information Center had issued a state-wide avalanche warning on the 16th. The warning was dropped at 1100 hours on the 18th. Natural releases had ceased, but the backcountry avalanche danger was

Accident Summary

On the morning of the 18th, Side-Winder Ski Tours, a helicopter-ski operation from Telluride, set out to ski the fresh powder in the alpine basins around Ophir. Ophir is a small hamlet just south of Telluride. After lunch two heli-ski groups were skiing north-facing slopes at treeline in Swamp Canyon east of Ophir. The group—two guides and two clients—made one run through the scattered timber along the edge of an obvious slide path. They returned to the top (at about 12,000 feet) for a second run. The skiing was excellent on the northeast-facing slope. Near the bottom of the run they traversed left into the center of the obvious north-facing avalanche path. They were heading toward the waiting helicopter when suddenly a wave of snow crashed into them.

Greg Williams, owner and operator of Side-Winder Ski Tours was in that small group. He said the avalanche “came out of nowhere” when it swept over the group. Williams and another skier ended up on the surface when the snow stopped. He quickly checked his watch; it was 1513 hours. By radio he called the second ski-group to come help. Two others in his group were quickly accounted for, but one client, Stu McCreedy, was missing.

Rescue

Williams and his other guide turned their Pieps (brand of avalanche beacon) to receive and started a beacon search. Within minutes the helicopter arrived and dropped off other guides. Coming in from a different direction the guides quickly picked-up McCreedy's signal. It took about 10 minutes to find and pinpoint the signal and another 5 minutes to dig down almost 5 feet to McCreedy.

McCreedy was face down and unconscious when his rescuers reached him. His last memory before losing consciousness was that the snow was so tight around him that he “couldn't move a pinkie.” His rescuers turned him over; he was not breathing and his skin had turned a sickening shade of blue. The guides cleared his airway and started rescue breathing. He quickly started breathing on his own and within minutes his color returned. By 1530, McCreedy was in the helicopter and

being flown to the hospital in Telluride. He was held over night for observations and released the next day.

Avalanche Data

The soft-slab avalanche released 2 feet deep on a north facing slope at 11,900 feet, but the initial failure occurred under the weight of the skiers low on the slope. The avalanche fell 1,900 vertical feet catching the skiers near the bottom of the slope. It was classified as an SS-AS-3-O.

Comments

When buried surface hoar or faceted snow exists, backcountry travelers must be leery of steep slopes directly above. Surface hoar and faceted-snow grains are extremely efficient in propagating shear fractures. Avalanche accidents and fatalities have resulted when skiers and snowmobilers on flat terrain initiate the shear failure which propagates upslope and undercuts the slab. Like pulling out the bottom log of a wood pile the slab releases and crashes down on the unsuspecting travelers.

Avalanche rescue beacons and shovels are a mandatory pieces of equipment for helicopter skiers (and others who work and play around avalanches). In skilled hands they offer the best chance to find a buried companion alive. Incidentally, it was handy to have a helicopter: the group lost four skis. Without a helicopter it would have been a long walk to Ophir.

84-5

FEBRUARY 21, 1984

Berthoud Pass, Colorado

2 backcountry skiers caught and 1 partly buried

Weather Conditions

The San Juan Mountains were not the only region getting heavy snows in Colorado. During December the Berthoud Pass and Winter Park-Mary Jane Ski Areas had record-setting snowfall. Snowfall in December was 250 percent of normal. But the region also incurred the same consequences of the dry spell in early January and February: surface

hoar and faceted snow. (For a more detailed description of the winter snowfall see the previous accident report, 84-4.)

Accident Summary

On Sunday morning, February 19, two backcountry skiers, Dale Anderson and Dave Bispham, left their car on the north side of Berthoud Pass. The men, both from Denver, started westward up the Second Creek drainage. At treeline they traversed north into the First Creek drainage. There they continued west up gentle slopes the broad ridge crest and the Mt. Nystrom trail, well above treeline. The men traveled the gentle trail northward to Parsenn Bowl (at that time an undeveloped area within Winter Park Ski Area.)

The two skiers started down the gentle northeast-facing slope of Parsenn Bowl. Four inches of fresh snow covered a thick, hard layer. At about 1220, the slope buckled beneath the two men. They had triggered a large hard-slab avalanche. Bispham escaped to the side, but Anderson was not so lucky.

Anderson made breast-stroke swimming motions and body surfed the moving snow for 40–50 yards. When the snow stopped moving he was trapped, buried to his neck but uninjured. Bispham came down and dug out his friend.

Avalanche Data

The avalanche was classified as an HS-AS-3-O. The fracture was 2 feet deep, and it stretched almost 400 yards across the northeast-facing, open slope. It released from about 11,500 feet in elevation but only ran 150 vertical feet. The slope was relatively shallow; at its steepest spot it measured only 28°.

A fracture-line profile dug the day after accident by the Winter Park ski patrol showed the weak layer to be a 2-inch-thick layer of faceted snow in combination of old surface hoar. Even though an almost 2-foot layer of very dense and well-sintered snow covered the surface hoar, the surface hoar was easily observed by the naked eye. Some of the grains were almost .5 inch in size. Beneath the faceted grains and surface hoar the bed surface was another hard layer of dense snow.

Comments

Hard-slab snow conditions are often misleading to the unaware backcountry traveler (see accidents 80-6, 83-8 and 84-2). These two skiers



Figure 27. Accident 84-5, Berthoud Pass, Colorado, February 21, 1984. Photo by Winter Park Ski Patrol.

probably thought the hard-slab was for their benefit; it made an excellent base for skiing the fresh powder. Instead the slab turned against them, and the white death almost claimed another victim. Hard-slab conditions should never be taken lightly. Hard slabs are inherently quite strong and can store a tremendous load of elastic energy, but sometimes—and in Colorado more often than not—hard slabs are poorly bonded to the snow below. The result can be some very large avalanches releasing over broad areas.

84-6 FEBRUARY 21, 1984

Marble, Colorado

3 helicopter skiers caught, 2 partly buried, 1 buried and 2 injured

Weather Conditions

The dry spell in January and early February

created weak layers in the upper portion of the snow cover throughout all of the Colorado Mountains. The Elk Mountains of central Colorado were no exception, and unstable conditions developed as soon as several mid-February storms left a fresh covering of new snow.

No detailed weather summary was available for the Marble area, but the morning of February 21 dawned mild and dry. No new snow was reported.

Accident Summary

Powder snow was hard to come by during January and early February, but for a group of Colorado First Tracks heli-skiers the skiing was good. Several of the 10 clients, including Tom Grey and Linda Conger, had previous helicopter-skiing experience in Utah and Canada. Another client, Dave Hoff, had extensive helicopter-ski experience in Canada. Hoff had also gained some first-hand knowledge of avalanches: He had been caught in one avalanche and had participated in three rescues.

By mid afternoon, the clients and two guides had already skied five runs, which is

usually a full day, when they decided to make one additional run. The skiers were ferried to a drop-off point at almost 12,300 feet on the northwest end of Treasure Mountain. At about 1600 hours, nine clients (one client sat out the last run), all expert skiers, and two guides started down the northwest flank of Treasure Ridge. The route angled down to a west-facing slope off White House Mountain and then continued down to the pick-up spot in Yule Creek.

The group had skied two-thirds of the way down when they stopped to analyze the terrain. At that point the slope aspect changed from northwest to west. Guide Bob Vandervoort wanted to check out the conditions. The guides knew the avalanche potential was greater on the lower portions of the runs, especially below 10,500 feet. The buried surface-hoar layer that formed in January was the weak layer and had been responsible for recent avalanche activity; the guides were tracking it closely.

Vandervoort skied down a short distance to a grove of aspens. His plan was for the group to come to his location and then traverse northward to a less exposed area. At about 1615 he called for the skiers to start down one-at-a-time and stick next to his track. Chief guide Crag Hall stayed at the top while clients Dave Hoff, Linda Conger and Joe Wilson skied down to Vandervoort. Client Tom Grey was next, but instead of following Vandervoort's instructions, Grey went to the left and made a few turns in an open area, then turned toward the group and fell. When Grey fell the slope avalanched; Grey was swept to the bottom. Wilson and Conger were also caught and carried a very short distance. Carried only 20 feet, Wilson was partly buried but uninjured. Conger was carried 30 feet and pinned against a tree by the flowing snow. She was seriously hurt.

Still at the top of the slope, Hall immediately radioed the helicopter of the accident. The pilot started the aircraft and flew to the accident site; he also notified the mechanic at the base to activate their rescue plan. Meanwhile, a head count showed only Tom Grey was missing.

Rescue

Hall sent Vandervoort down the slope to do a beacon search for Grey. Hoff followed behind, also searching with his beacon. Vandervoort raced down the path and over the debris. He

picked up Grey's signal, and while bracketing the signal he spotted a hand.

Grey had tumbled almost 1,200 vertical feet down the slope. Grey tells what happened when the snow started to slide. "I went over a cliff, I guess it was about 60 feet high, but I don't remember it. I was rolling over, talking to God, and when it started to slow down I started swimming. But then it started to go again, and I had to do the same thing all over again. I guess I didn't realize I had broken my arm until later." Asked about what someone thinks about during their ride in an avalanche Grey went on to say, "It's really hard to think about anything. I am not a religious person, but it's amazing who you start talking to. 'God, if I get out of this.' . . ."

Vandervoort and Hoff dug him out after a burial of about 10 minutes. At the same time, but at the top of the slide, Hall was digging out Conger and started first aid. The other skiers dug out Wilson. Conger described being in the avalanche as, "It's like you're an ant, and the avalanche is this giant foot that doesn't even know it's squashing the ant." She had a badly injured knee and possible internal injuries. Over his radio Hall learned that Grey had a broken arm and broken lower leg.

Hall decided to evacuate Conger first as it would take Vandervoort longer to splint Grey's arm and leg. Within minutes the helicopter was overhead and lowered a litter. Conger was placed into the litter and sling-loaded beneath the helicopter a short distance to Marble. The mechanic and volunteers from town met the helicopter and unloaded Conger. A few minutes later Flight For Life, a helicopter ambulance, arrived in Marble. The First Tracks helicopter returned to evacuate Grey. The flight nurse decided Grey was the more seriously injured and he was flown to the Aspen Hospital. Conger was taken by ambulance to Valley View Hospital in Glenwood Springs.

Avalanche Data

Classified SS-AS-3-O, the avalanche had a fracture depth of 12–18 inches and a width of about 200 feet. The crown was at an elevation of 10,200 feet and the avalanche fell 1,200 vertical feet. Like recent avalanches, it failed in the buried surface hoar layer.

Comments

It was unfortunate that a fun day of great ski-

ing nearly ended in tragedy. Helicopter skiers are often expert skiers looking for challenges and sometimes those skiers can be difficult to manage. Guides, as well as any leader of back-country trips, must be ready for such clients. In this case, Grey, either purposely or mistakenly, strayed from his instructed line and triggered the avalanche. His actions jeopardized the group and seriously injured another skier and himself.

Unknown to the guides and the flight nurse, Conger suffered a ruptured spleen when the avalanche pinned her against the tree. She almost bled to death during the drive to the hospital. Even at the hospital she suffered more bad luck: She caught hepatitis from the blood transfusions. Though she did not break any bones, her knee was severely damaged and required reconstruction.

At first Grey thought he was lucky to only suffer broken bones, but a blood clot settled in his lungs. He spent 45 days in the Aspen Hospital and several more weeks in a hospital back home in Minneapolis.

While Grey was bedridden in the Aspen Hospital, three Aspen Highlands ski patrollers were buried while doing avalanche control work (see accident 84-10). The men were pronounced dead in the same hospital where Grey was recovering. The reality of what had happened to him finally set in: "That for sure was my toughest night. I realized the true ramifications of what could have happened to me."

84-7
MARCH 15, 1984

Silverton, Colorado

2 residents caught and 1 home destroyed

Weather Conditions

In the San Juan Mountains by early March the buried surface hoar and faceted grains near the surface had started to gain some strength, but for the most part they remained cohesionless and provided a relatively easy shear layer. At nearby Red Mountain Pass a storm on March 11 left 15 inches of snow and 1 inch of water equivalent. Eighty-four inches of snow covered the ground. Six shallow soft-slab avalanches were spotted.

Another storm moved into the San Juans on the 14th, and snow fell through the 15th. From this storm another 15 inches of snow with 1.18 inches of water fell. The master snow stake showed 90.5 inches of snow on the ground. The morning of the 16th dawned sunny and clear.

Accident Summary

Nestled in the heart of the San Juan Mountains in southwestern Colorado, Silverton is surrounded by 12,000- to 13,000-foot peaks. Since the first miners wandered the steep mountains, avalanches have threatened the people and property of San Juan County. During the boom of the silver and gold mining days around the turn-of-the-century avalanches routinely destroyed aerial tramway towers, boarding houses, blacksmith shops and mills. All too frequently avalanches caught, buried and killed miners as they worked, slept or traveled the steep mountain slopes. Though the mines had all but closed down in San Juan County a new breed of westerner was venturing into the mountains to live and work. Not looking for gold or silver, the new residents were average people prospecting for the solitude of living in the mountains. They bought and lived on old mining claims.

In 1972, a Silverton man bought the Bluebell mining claim, and the following year built a small log cabin on the 25 acres. It was in a beautiful spot; the cabin was located in a forest clearing with plenty of water from a nearby creek. Access from the road was easy. Unfortunately, the clearing had been created by an avalanche running years before that crossed the valley floor and crashed through the timber on the opposite slope almost 100 yards above Cement Creek. The owner did not feel too threatened by avalanches; he spent three winters living in the cabin before moving back to Silverton.

Ben Barnes liked the cabin and bought it in 1981. During the next few years he put a lot of time, money and effort into it. He transformed it from a cozy cabin into a "good-sized, two-story house" complete with a basement and a hot tub. The house was fully paid for, but along the way his homeowner's insurance lapsed. "I needed the money for other things," said Barnes.

It was not uncommon for avalanches to run on the path across the creek from the cabin. The avalanches usually stopped short of the

valley floor, but during the winter of 1982–83, one large avalanche piled debris into the creek, and there it knocked out the cabin's water pump. Barnes was not too worried; his cabin was another 250 feet uphill from the creek.

At about 2000 hours Thursday evening, March 15, Barnes and his friend Teresa Bowles finished dinner and went upstairs to watch television. Barnes sprawled out on the couch and Bowles curled up on a love seat. About 20 minutes later they heard a whispering-like sound, somewhat like snow sliding off the roof. Barnes tells what happened next. "...then the house started to shake and then there was a roar and snow everywhere." Next the power went out. "The entire upstairs floor of the cabin tilted and everything started sliding to the low end of the room." Bowles and the love seat slid across the floor and stopped against the banister next to the stairs. The television ended up in Barnes' lap.

Both Bowles and Barnes and their dog emerged unscathed but in shock and awe. When the avalanche struck both knew exactly what was happening. About their harrowing experience Bowles adds, "We couldn't believe what had happened; we tried to show some emotion; we tried to cry and scream but we just couldn't show anything but shock. There was no way we were leaving that night; all of our belongings were gone but for our clothes in the upstairs closet." The two decided to stay put and made a bed on the floor. It was a long night. In the morning they would walk about a mile down to the Standard Metals Mine to report the avalanche.

All of their jackets, boots and skis had been in the now non-existent first floor so that morning, Friday, the couple wrapped their feet in sheepskin rugs. Barnes stepped out the upstairs window onto level snow. The avalanche had sheared the entire second story from the rest of the house and moved it about 20 feet. Everything else was buried. In the yard where there had been 12 pine trees only 3 still stood. There was no sign of the rest of the house, so the two walked out to the mine and a telephone.

Avalanche Data

No information was recorded about this natural avalanche.

Comments

Avalanche runout zones often look like good

building sites. Gentle, open slopes and easy access from the valley floor are enticing land characteristics to a builder and to the home owner. However, if an avalanche cleared the trees in the first place, it is only a matter of time before it clears out more trees. To a trained eye the Barnes cabin was built in a suspect location. Experienced avalanche workers know that sooner or later, given the right snow and weather conditions, all avalanche paths will eventually run larger than expected.

Unfortunately the cabin was built a year before the Colorado legislature passed House Bill 1041 that requires counties to consider the assessment of natural hazards as a factor in land-use decision making. The idea was to make building structures, especially homes in avalanche paths, basically illegal. The legislation was not retroactive, so it did not apply to structures already standing, like Barnes' cabin.

This avalanche was not Barnes' and Bowles' first brush with an avalanche. The couple had escaped from the jaws of the white death several weeks earlier. While backcountry skiing with friends Barnes, Bowles and a friend were caught and buried to their necks with only their faces out of the snow.

84-8
MARCH 17, 1984

Vail Pass, Colorado

2 backcountry skiers caught, 1 buried and killed

Weather Conditions

Snowfall began on March 15 when a winter-storm hit the Colorado high-country. At Vail Ski Area 17 inches of new snow had fallen by the time the storm ended late on the 16th. The morning of the 17th was sunny and cool. At 0900 the temperature was 15°F and winds were calm. Conditions were expected to deteriorate during the day as another upper-level storm system was expected to move into the mountains that night. A backcountry avalanche warning issued on the 16th remained in effect for all the Colorado mountains. Natural avalanches were possible but triggered avalanches were likely on steep open slopes.

Accident Summary

Greg Myers, 34, and Robert Wells, 35, planned to ski the Commando Run, a popular but long ski tour from the summit of Vail Pass to the town of Vail. In years gone by the 18-mile tour served as a training run for the World War II troops of the 10th Mountain Division. At about 0800, the pair left Wells' vehicle at the rest area near the summit of Vail Pass. Their goal was to ski all the way to Vail that day.

Both were experienced backcountry skiers and Myers had done the trip several times that season. Wells was visiting from Illinois. The travel was slow-going as the men had to break trail in the deep snow. By 1330 they had reached Two Elk Pass, only about half way. Wells was not feeling well, so the two decided to abandon the Commando Run and follow the Two Elk trail a couple of miles downhill to the east where it would intersect Interstate Highway 70 (I-70). From there they could hitch-hike back to their vehicle on the pass or ski down the old highway into town.

It was shortly after 1400 hours and the men were almost down and home free. They traveled out of the dense forest along Timber Creek and could see and hear I-70 less than 200 yards away. Wells was in the lead and Myers followed about 50 yards behind. At about 1420, Wells started across a steep but very short slope within 50 yards of the highway when it avalanched. It swept Wells down the short slope and buried him in the ravine.

The fracture had broken at Myers feet and he was carried only 10 feet. Myers quickly skied a little further ahead and saw only the avalanche where Wells had been. Myers bolted to the highway where he was able to flag down a trucker who called out on his CB radio about the accident. Myers then ran back to the debris. The avalanche was just off the interstate highway, and debris had flowed beneath the bridge.

Rescue

The only rescue equipment carried by Myers was a probe. He found a ski on the surface above a tree, but his probing yielded nothing. He stopped probing and started digging where he thought would be a likely area. Lacking a shovel, digging in the heavy, wet snow was slow, but he did find Wells' sunglasses. A little later Myers found the tail of the other ski and then Wells. The avalanche had buried him under a bike-trail bridge.

Myers uncovered Wells' head from 3–4 feet of snow. Wells was not breathing and had no pulse. It had been 70 minutes since the avalanche. Myers was sure that Wells was dead, so he returned to the highway. There he flagged down a motorist who drove him to the Vail Police Department.

Vail Mountain Rescue responded by driving up I-70 to mile marker 184. At 1800 hours, the coroner pronounced Wells dead and his body was evacuated.

Avalanche Data

This soft-slab avalanche was released by the victim as he traversed out onto the steep slope. It was classified as an SS-AS-1-O. The avalanche started from an elevation of 8,800 feet and had a fracture depth of 18 inches. The avalanche was 100 feet wide, ran 40 vertical feet down the 36° northeast-facing slope and piled debris 4–5 feet deep in the creek bottom.

The slab consisted of 18 inches of recent snows on top of a layer of 1–3 mm faceted grains. The faceted grains also served as the bed surface.

Comments

This accident is typical of backcountry avalanche accidents. Experienced backcountry travelers, but with little avalanche awareness training, trigger an avalanche that ruins the day's adventure. Even small slides can be just as deadly as large avalanches. Both men were experienced backcountry skiers with numerous ski trips in Colorado and Canada. Their limited avalanche training was garnered from some reading about avalanches. Myers said that they were cautious about the avalanche danger earlier in the day. However, it seems that once the men had almost reached the highway they threw caution aside and stopped thinking "avalanche." The result was poor route selection in the last 50 yards of their tour, and that ended in the death of one skier.

Also had the men been equipped with avalanche rescue beacons and shovels there was an excellent chance Wells could have been rescued alive. The avalanche was so small that it merely pushed Wells over and covered him up. With the right rescue gear he could have been uncovered in minutes.

84-9

MARCH 19, 1984

Dallas Divide, Colorado*2 backcountry skiers caught, 1 partly buried, 1 buried and killed***Weather Conditions**

Several storms dropped snowfall in the San Juan Mountains of southwestern Colorado on March 11-15 (see accident 84-7). At one time or another from the 16th–19th nearby mountain highways on Red Mountain Pass and the road to Ophir were blocked by avalanches. About 5 inches of new snow and strong winds were reported in the Dallas Divide area, about 10 miles west of Ridgway, on the 18th. A backcountry avalanche warning was in effect.

Accident Summary

Few details are available on this accident. Erdme Kuljurgis-Worswick, 28, and her brother Jens Kuljurgis, were backcountry skiing in an area about a mile from her home on Hastings Mesa. The two had skied at least several runs on a northwest facing slope. A large cornice topped most of the slope. At about 1500 hours, Kuljurgis-Worswick and her brother triggered an avalanche. She tried to escape to the side but was pulled down and buried. Her brother was also caught but only partly buried. He dug himself free, but without rescue gear all he could do was randomly dig by hand. He searched for his sister for an hour and a half before leaving to get help.

Rescue

Three and one-half hours after the avalanche Kuljurgis-Worswick was found by a probe line. She had been buried 10 feet deep. Rescuers started CPR, and she was flown by helicopter to a hospital in Montrose. Later that evening she was pronounced dead.

Avalanche Data

The avalanche, classified as an HS-AS-4-O, was triggered by the victim and her brother as they skied on the northwest-facing slope. The fracture depth was 3–6 feet and spread 500 feet across the open slope; it ran 300 feet down the slope.

Comments

Two important messages can be learned from this brief accident report. First, avalanches don't care if you are the first or 20th skier on a slope. Kuljurgis-Worswick and her brother had skied the slope most of the day. It took only some time before one of them skied over a stress-concentration spot. The extra weight in that one spot was enough to upset the balance of strength versus stress and cause the avalanche. The second message is that any steep slope can be an avalanche slope (see 85-6). The terrain on the Dallas Divide is quite gentle when compared to the steep, rugged massif of Mt. Sneffles that towers over the area. Small, broad slopes covered by grass, willows and, in places, aspens characterize these rolling hills. But even small slopes can be avalanche slopes if they are steep enough.

Family and friends were surprised that such an innocuous-looking hillside could be deadly. After the accident a memorial fund was established to finance better information for the winter traveler. Through the fund avalanche training and rescue equipment have been made available for backcountry travelers. Also, since the winter of 1984–85 the EKW Mountain Safety Fund has paid for the Colorado Avalanche Information Center's mountain weather and avalanche report heard twice daily on KVNF, a public radio station in Paonia serving southwestern Colorado.

84-10

MARCH 31, 1984

Aspen Highlands, Colorado*3 ski patrollers caught, buried and killed***Weather Conditions**

Colorado's mid-winter dry spell had created fragile layers of surface hoar and faceted-snow grains in the upper portion of the snowpack. These layers were the failure planes for slab avalanches and numerous avalanche accidents.

By March the snow cover had reached a critical point. The next big storm would produce major avalanches. Such a storm did strike the Aspen area from the 16th–20th. Strong winds and daily snowfalls of up to 8 inches

December in the Aspen area. At Aspen Highlands Ski Area almost 3 feet of snow fell, but settlement in the new snow and the faceted lower snow layers allowed the overall snow depth on the ground to increase only by 1 foot. At 0915 on the morning of December 31, Aspen Highlands reported 3.5 inches of new snow. Winds were very light from the north-west and the temperature was 14°F. The last significant snow fell on the 28th when 10 inches was reported.

Accident Summary

Snow was falling on the morning of the 31st when Jim Fitzgerald, 55, pulled up to Bonnie Golde's house outside of Aspen. By about 1015, the two had finished breakfast and drove up the Castle Creek Road to Ashcroft about 13 miles south of Aspen. Fitzgerald was very eager, almost impatient, to go skiing. On the drive to Ashcroft they discussed where they wanted to go. Fitzgerald rejected Golde's idea to ski in the lower-elevation Redstone area to the west of Aspen. He wanted to ski the high-elevation alpine terrain at the head of Castle Creek, and Pearl Pass or Taylor Pass were the only two choices. Neither Golde nor Fitzgerald had been to the top of Taylor Pass in winter, so both agreed that the day's adventure would be up Taylor Pass.

Moderate snow was falling when the two pulled into the parking area near the old ghost town of Ashcroft. By 1100 the two were headed south up Express Creek along the Taylor Pass road. (From this point on, stated times are only estimates, for neither Fitzgerald nor Golde wore a watch.)

After several miles of skiing up the road the snow stopped and the sun broke through the clouds. Golde described the scene: "It was one of those fairy tale dream days of fantasy clouds swirling, light snow blowing off the aspen trees, the sunshine sparkling off the gleaming snow, and blue skies." The two took their time, frequently stopping to admire the views and enjoy the warm sunshine.

The snowcovered road up Express Creek crosses the runout zones of several large avalanches that spill off the west side of Ashcroft Mountain. At the first avalanche crossing the pair discussed whether to cross separately. With a smile and total sincerity, Fitzgerald said, "It is my fantasy to die in an avalanche." Golde did not share that same fantasy; she told him she "rather leaned toward

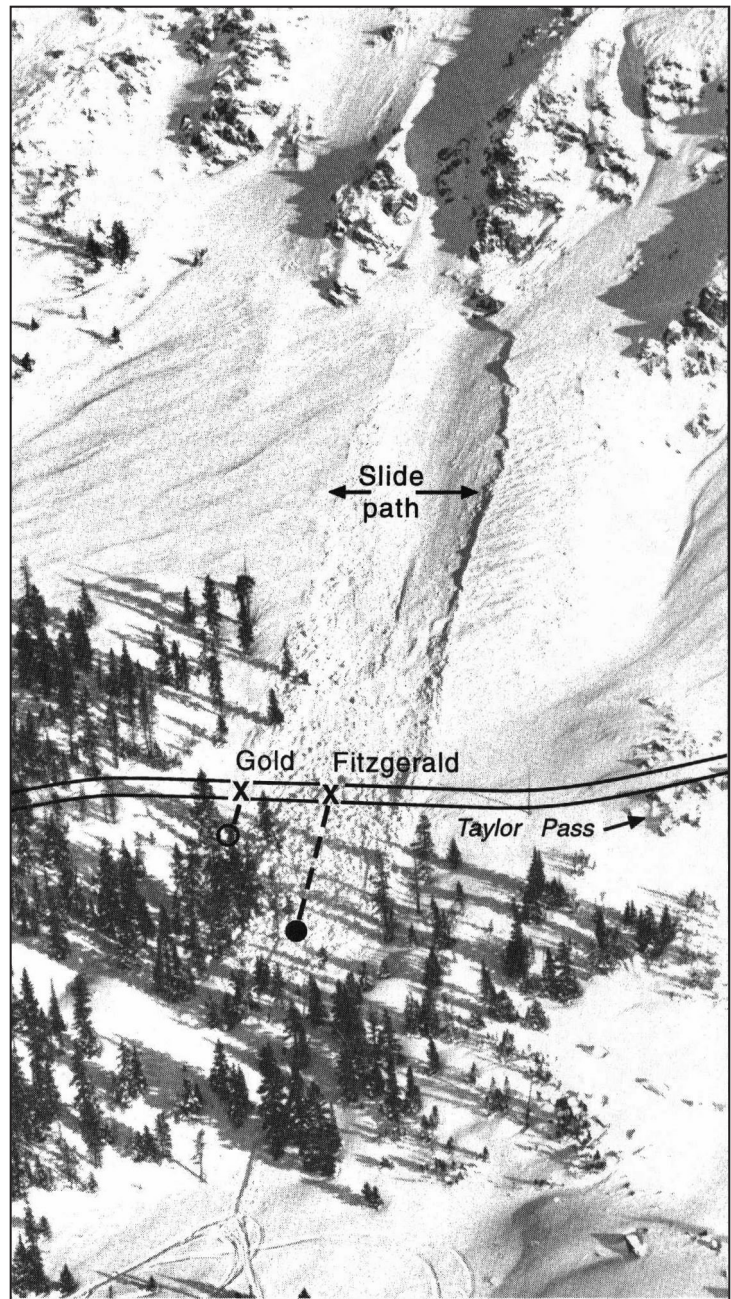


Figure 29. Accident 84-19, Ashcroft, Colorado, December 31, 1984. Photo by Devon Meyers.

the sea." The two crossed the runout zones one-at-a-time. Further up the valley they dropped lower into the drainage to avoid avalanche areas on both sides of the valley.

About mid afternoon, around 1430 hours, it started to snow again. Wind and snow made for harsh conditions, but the two skiers added layers of clothing and put their energies into the ascend. Further up the valley they rejoined

temperatures and sunny skies consolidated the upper layers of the snowcover. On the 24th, winter-like conditions returned and cool and unsettled weather continued through the end of the month.

Accident Summary

Highlands Bowl is a large open bowl on the east flank of 12,381-foot Highlands Peak. The bowl is several thousand feet across with 270° of exposure, though for the most part it faces to the northeast. The vegetative record shows that huge avalanches have thundered down from the top of the bowl to Castle Creek, 4,000 vertical feet below. Over the years Aspen Highlands has run tours into the bowl, guided by the ski patrol. Over the course of the 1983–84 winter the ski patrol had been guiding powder skiing tours in the bowl. In early April there was to be a figure-eight contest in the bowl as part of a state-wide ski patrol convention.

On Thursday, March 29, a team of five Aspen Highlands ski patrollers, led by Tom Snyder, an 8-year veteran of the ski patrol, tested the snow stability in Highlands Bowl by digging several snowpits (about 5 feet deep) and tossing explosives. The patrollers were testing the snow above and below an avalanche that released part-way up the bowl on the 8th. A snowpit dug in that old avalanche path showed 54 inches of snow had accumulated since it released. Concerned that there might be some deep-slab instability a 6-pound explosive charge was placed in a bore-hole in the old avalanche path. The detonation produced only a large hole in the snow. The patrollers skied the old path and left the bowl. Their conclusion: "Pits dug at the top of G-8 (path) generally stable and skiable with little concern."

The next day, Friday, patrol director Mac Smith met with Snyder and several other patrollers about their control plan for Saturday in the bowl. In addition to the regular control route, they decided that explosives should be tossed into the March 8 avalanche path as well, to again test for deep-slab instability. To do this, the plan was to cut long fuses and have one patroller hand-place two charges on the old slide path and ski back to the safety of the trees. The men reviewed photographs of the bowl to predetermine the shot placements and the route to and from the safety of the trees. The group decided if new snow fell overnight and totaled 6 inches or more, the control team

would avoid the G-8 path and concentrate on some other areas in the bowl. All agreed to the plan.

Only 4 inches of new snow fell overnight; the mission was on. Early Saturday morning, March 31, Snyder met with the Assistant Patrol Leader, John Rupinski to discuss the planned control operation. Snyder wanted to change the previously discussed procedures for controlling the G-8 path. He felt that enough explosives had been used in the area and based upon his previous stability tests Snyder felt there would be no avalanches. Rupinski felt they should stick to the plan that was previously agreed upon. After some discussion all agreed that the control team could change their plan based upon the snow conditions they encountered and the results of their control work.

At about 1000 hours the control team consisting of Tom Snyder, 35, Chris Kessler, 27, and Craig Soddy, 29, left the ski patrol headquarters and started the climb up Highlands Peak. Two other patrollers, Rupinski and Larry Lembke went to an area called Hyde Park on the flank of the bowl to serve as spotters.

The control team tossed several charges into starting zones as they climbed the ridge along the edge of the bowl. From the summit of Highlands Peak, seven more charges were tossed above and slightly to the north of the March 8 slide; these produced only minor sluffing of the new snow.

From the summit the control team skied down one-at-a-time through the upper portion of the G-8 path to a bench above the March 8 slide. On their way to the bench the men stopped and inspected the snow around the bomb craters. To Rupinski and Lembke, spotting from the opposite side of the bowl, the three men appeared small and vulnerable in the massive bowl. Rupinski radioed Snyder to express his concern for the team's safety. Snyder replied he was comfortable with their position and added, "Nothing is going to slide today."

Rupinski called back that if they felt secure they could do what Snyder had planned. From the bench, Snyder threw a charge to their left. The charge detonated, and as predicted, no avalanche. A few minutes later at about 1440, the next charge was tossed directly below them.

This time things went terribly wrong. The explosive triggered a slide in the March 8 path.

The snow below the three patrollers opened and began to move, and then fractures propagated uphill to the steep slope above the bench and the control team. There was no escape for the patrollers as the snow rushed at them from 300 feet above. Rupinski and Lembke watched in horror as the three men disappeared in the avalanche. The grinding hard-slab avalanche swept them 1,800 feet down the bowl in a mixture of massive, hard blocks of snow and fast-moving powder. When the powder cloud settled, there was no sign of the men.

Rescue

Over the radio Rupinski immediately alerted the rest of the ski patrol of the accident. Then he and Lembke skied to the slide. It took only minutes to traverse to the debris. Both men started searching with their avalanche rescue beacons. Within 5 minutes the signals from all three men had been pinpointed, but digging in the cement-like debris took time: the shortest recovery time was about 45 minutes, the longest 90 minutes. Snyder was buried 5 feet; Kessler, 6 feet; and Soddy, 8 feet. The battered bodies of the victims were air-lifted by helicopter to the hospital in Aspen. There they were pronounced dead; all had suffered massive traumatic injuries.

Avalanche Data

The hard-slab avalanche (HS-AE-3) released 4 feet deep, 1,000 feet across and 300 feet above the patrollers. The topmost fracture was at an elevation of 11,800 feet on a slope that exceeded 35°. It easily overran the shallow-angle bench which proved to offer no protection at all to the patrollers. The slope faced north-northeast, and the avalanche dropped 1,000 vertical feet.

Comments

The victims were competent, veteran avalanche men relying on a time-honored system of explosive testing, who were caught off guard by an avalanche they thought could not happen. There is no doubt, though, they erred in judging the snow stability and put themselves in an unsafe position. They deviated from their original, safe plan of control, and it cost them their lives.

This was the worst-ever avalanche-control accident in the U.S. It shocked patrollers throughout North America, as well as taught a lesson for all avalanche workers: Avalanches

do not lend themselves to easy understanding or prediction, so in their domain we must never drop our guard.

84-11
APRIL 14, 1984

Chair Mountain, Colorado

1 backcountry skier caught, partly buried and killed

Weather Conditions

April was cooler and snowier than normal in the Colorado mountains. Frequent snows and strong winds created large cornices. At Gothic, 17 miles southeast of Chair Mountain, snow fell daily from the 9th–13th. Fifteen inches of snow accumulated, and during that time afternoon high temperatures only topped the freezing mark once.

April 14 was the first clear day in almost a week and temperatures soared. At Gothic the afternoon high temperature reached 40°.

Accident Summary

On April 14, Len Wechter, 27, and Kathryn McIntosh, 24, were cross-country skiing in the McClure Pass area when Wechter decided to climb to the top of 12,721-foot Chair Mountain. Lots of unstable, loose rock lead to the summit of the peak and make summer ascents tedious and at times dangerous. An experienced mountaineer, Wechter knew that during the winter the wind-compacted snow would cover the loose rock and allow easy access to the summit. He said he would ski and climb to the summit alone while McIntosh could cross-country ski lower on the mountain. They were to meet at 1500 hours when they would set up camp to spend the night.

The pair started together, but almost immediately Wechter skied ahead. Alone, McIntosh skied for about 4 hours before returning to their truck to wait for Wechter. By 1800 he had not returned, and he was 3 hours overdue. McIntosh put her skis back on and set out along Wechter's probable return route. She skied for 2 hours but failed to meet Wechter. It was shortly after dark when she returned to the truck and there was still no sign of Wechter. Worried, she drove down the

pass to a nearby home and called the Gunnison County Sheriff's Department.

Rescue

At 2130, one member of McClure Pass Search and Rescue snowmobiled into the area where Wechter was last seen. He searched until midnight. With an unsuccessful scratch (or hasty) search, the rescue group decided to initiate a large-scale search at dawn using cross-country skiers and snowmobilers.

At 0630 Sunday morning, April 15, the searchers set out. They followed ski tracks made by Wechter to the base of the summit ridge of Chair Mountain where they found his skis and pack. Searchers followed Wechter's foot prints along the ridge to where they ended just below the summit—at a broken portion of the cornice. The falling cornice had triggered a small, slab avalanche.

From below, rescuers spotted the reflection of a metal object. It was Wechter's ski pole. The pole was still attached to his partly-buried body. Wechter had died from major traumatic injuries suffered in the 400–500 foot fall with the avalanche. Rescuers think he was dead before his body and the snow stopped moving.

Avalanche Data

Data on the avalanche and the slope are lacking. However, we do know the cornice overhanging the steep, north-facing bowl below the summit of Chair Mountain, and it appears certain Wechter collapsed the cornice which then triggered the small, slab avalanche.

Comments

Throughout mountaineering history, cornices and climbers have always been a dangerous mix. Many famous and very experienced mountaineers have met their demise when they stepped too close to the edge of a cornice. Freshly-formed cornices, especially in spring, should be avoided. At the far end of the cornice the fresh layer of snow is generally poorly bonded to the old cornice surface. The cavities caused by the deformed layers under the roof of the cornice are major sources of structural weakness. In the spring, warmer air temperatures soften the snow along the cornice roof and face, increasing deformation and stress. A climber or skier venturing too far onto the cornice may meet with the ride of their life when the snow beneath them collapses.

84-12

MAY 18, 1984

Granite Mountain, Washington

1 climber caught and injured

Accident Summary

May 18 brought fine weather to the Cascade Mountains in northwestern Washington. Dr. Ronald Aronoff, 37, and a friend chose this day to climb Granite Mountain. The 5,800-foot peak just west of Snoqualmie Pass is popular with Seattle-area climbers. They reached the top without incident and started down. At about 1630 the pair were glissading down a steep snowfield at the 3,400-foot level to tree-line. Aronoff either lost control during his glissade and triggered a small wet-loose avalanche, or his glissade triggered the avalanche that caused him to lose control. The moving snow carried him down slope and left him entangled in a tree. Regardless of the cause of the small, wet-snow avalanche the outcome for Aronoff was serious. He suffered deep gashes on his face caused by his ice axe and other head injuries as he tumbled down the mountain. His friend raced off to get help. Rescuers reached Aronoff at about 2100 hours. His condition had deteriorated and he was fading in and out of consciousness. He was helicoptered off the mountain at about 2130 hours. He later made a full recovery.

Comments

Warm temperatures, wet snow and late-in-the-day timing can be a dangerous combination of conditions for both natural and human triggered avalanches. Granite Mountain is a popular place for Seattle-area climbers and a popular place for avalanches. Another climber was killed by an avalanche at this site in April 1983 (see accident 83-14).

84-13

MAY 27, 1984

Source Lake, Washington

1 hiker caught, buried and killed

Accident Summary

The Memorial Day weekend was sunny and

hot, and brought climbers, hikers and campers out in droves to the Cascade Mountains to escape the heat. One of those hikers was Jeffrey Wing, 23. On Sunday, May 27, he and two friends were hiking in the Source Lake area near Alpentel Ski Area on Snoqualmie Pass. The Source Lake area has been the scene of several fatal avalanches over the years and posted signs warn of the avalanche danger. According to newspaper accounts, Wing, shirtless and wearing a backpack, took a shortcut through an area posted with avalanche-warning signs. At about 1800 hours, he triggered a small, wet-snow avalanche that carried him over a 100-foot cliff. Searchers recovered his body the next day.

Comments

Few details were available for this fatal avalanche accident. Like the accident that occurred 9 days before on Granite Mountain (see accident 84-12), warm temperatures, wet snow and late-in-the-day timing can lead to deadly consequences.

84-14

NOVEMBER 8, 1984

Big Cottonwood Canyon, Utah

1 backcountry skier caught and buried

Accident Summary

On November 8, Chris Larson decided to take advantage of a winter storm that was pounding the Wasatch Mountains for some early-season powder skiing. A short write-up in the December, 1984 issue of *The Avalanche Review* briefly told his story.

Traveling alone, Larson left the valley floor of Big Cottonwood Canyon about midday on the 8th. By 1500 hours he had reached the ridgetop where he encountered a raging winter storm. Howling winds and snow falling at a rate of almost 2 inches per hour produced whiteout conditions.

Before starting down, Larson tried to ski-test a couple of slopes, but the storm made it impossible for him to see what affect he was having on the slopes. Playing it safe, he opted for a safer route down a relatively gentle slope.

Near-zero visibility and thick, heavy new snow made the skiing difficult. Also, Larson's early-season technique was a bit rusty and he fell over when he misjudged a small obstacle. While struggling to get back on his feet Larson spotted a small avalanche moving off to his side. He knew it would not reach him, so he calmly went back to his struggle to stand up. What Larson missed was that the small slide triggered the snow above him. It resulted in a second avalanche that would not miss Larson.

The avalanche flowed over him and pinned him face down, spread-eagle. Just before the snow hardened, he was able to create a very small air pocket in front of his face with one hand. But since he was alone an air pocket would do him little good; it would only prolong the inevitable. He had another chance, though. His other arm was outstretched and seemed to be only inches from the surface. He tried to twist and turn it and could move it enough to increase the size of the hole, but he could not reach the surface. Clawing at the snow and on the verge of blacking out, his fingers broke through to the surface. It seemed like a river of fresh air poured into his lungs.

Recharged, Larson worked to free himself. Slowly he could dig under his body, with no place to put the excavated snow he rolled it into small snowballs and threw it out the air hole. After a while he could lower his torso and was able to remove his pack. He used one of the stays to dig. Clumsy, cold hands made the digging even more difficult, but he as able to dig down and free his feet from both bindings. It took almost 3 hours, but finally Larson was able to wiggle out of his tomb.

Free from the snow, Larson had only completed part of his self rescue. After a brief rest he dug out his skis and set out for home. It was tough going, without poles Larson descended through the darkness and storm.

The next day, November 9, in the warmth and security of his home, Larson sipped schnapps and hot chocolate. His body ached from the ordeal the day before; ligaments in his knees and hips were damaged but would heal.

Comments

When traveling alone in the backcountry there is little, if any, room for error. Larson figures that the avalanche that buried him involved only new snow 6–8 inches deep in an area no more than 30 feet across, yet it almost killed

him. Larson was extremely lucky, few buried avalanche victims—especially traveling alone—ever get to tell their story.

84-15 **OCTOBER 17, 1984**

Mt. Kelso, Colorado

2 backcountry skiers caught, 1 buried and killed

Weather Conditions

The season's first snows fell at the end of September and the shallow snow never melted from the shaded north-facing slopes. Almost daily light snows fell in October, but the shallow snow was subjected to a strong temperature gradient. By the middle of October the lowest layers had changed into well-developed, faceted snow grains—depth hoar—on the high elevation, north-facing slopes.

At nearby Berthoud Pass, less than 10 miles north of Mt. Kelso, 46 inches of snow had fallen from late September to October 16. The most significant snow was 10 inches that was reported on the morning of the 16th.

On the morning of the 17th, another 2 inches of new snow was reported at Berthoud Pass. Skies were overcast with occasional very light snow falling. The temperature at 0940 was 21°F.

Accident Summary

The new season was off to a terrific start with fresh mountain snows, but no ski areas were open so two Summit County men, Dale Einstahr, 31, and Dan Johnson headed into the backcountry in search of powder. On the morning of the 17th, the men pulled into Bakerville, a very small mountain hamlet on Interstate 70 about 5 miles east of Loveland Ski Area. They were able to drive most of the way up the Stevens Gulch road. Just past the abandoned Josephine Mine they left their vehicle and bush-whacked up to the north-northeast ridge of Kelso Peak. They followed the gentle wind-blown ridge to the summit of the 13,164-foot peak. After a brief lunch break the pair were ready to start down the north face, a shallow bowl-like feature that ends in a long and very narrow gully.

At 1300 hours, in swirling clouds, snowfall and winds, Johnson pushed off the summit. Wanting to get a feel for the snow and potential avalanche conditions he ski cut the slope making several "Z's" and stopped about 100 vertical feet below the summit. Excitement and expectations ran high, it looked like their goal of several thousand vertical feet of deep-powder skiing—in October—was to be a reality. Einstahr then skied down and past Johnson. About 100 feet below Johnson, Einstahr hit some buried rocks. He stopped and did a kick turn. Suddenly a fracture tore across the slope at Johnson's feet, tipping him over onto bare ground. When he scrambled back onto his feet, Einstahr was gone and the avalanche had increased in size.

Johnson struggled down along the bare ground, stripped clean by the avalanche. A little over 1,000 vertical feet from the summit the debris started where the moving snow had funneled into the narrow gully. From that point debris filled the narrow gully—in places only 20–30 feet wide—for another 1,000 vertical feet. Lacking rescue equipment, all Johnson could do was kick and scuff the snow as he searched the debris. The only clue he found was Einstahr's backpack. It had been ripped off his back and was carried to the very end of the debris.

After 2 hours of searching and finding no other clues, Johnson gave up his search. He returned to their vehicle and drove down to the Bakerville Inn to report the accident.

Rescue

Shortly before 1600 hours, the Clear Creek County Sheriff's Department notified Alpine Rescue Team of the avalanche. While the rescue team responded, the rescue leader asked for assistance from nearby Loveland Ski Areas. The patrollers were busy getting ready to open their area the next day. The first rescuers arrived at Bakerville around 1700 hours, and the first rescue column, consisting of Loveland ski patrollers and Johnson, headed out. In a four-wheel-drive pickup with all the wheels chained, they were able to drive to within a quarter-mile of the avalanche. They walked in the rest of the way and reached the base of the slide at 1755 hours. An additional column of five rescuers from Alpine and one friend of the victim followed closely behind. Other rescuers were dispatched as they arrived.

Working in the fading light, Accident Site Commander Ron Kidder, also the Loveland Ski Patrol Director coordinated the hasty search. The pack was re-found, but lacking rescuers and facing a large search area in the narrow gully, Kidder assigned people to spot-probe likely burial areas along the curves of the track and runout zones. Meanwhile, he and Johnson climbed up the gully to the starting zone. They found worsening weather, but no additional clues. At about 1820, just as they started down, Kidder got a call on the radio that rescuers had made a probable strike.

About 100 feet above the toe of the debris, a friend of the victim—using a 12-foot probe—hit something, something buried over 10 feet. Other probes gave the outline of a body. That something proved to be a ski boot, and after more than a half hour of digging by over a dozen rescuers, they reached the body. It took rescuers another half-hour of digging before they could free the body.

Rescuers attempted CPR without success. A heart monitor was hooked up, but it showed no activity. Einstahr was pronounced dead at the scene. By 2130, all rescuers and the body were out of the field and the operation was concluded.

The avalanche had stripped Einstahr of his skis, poles, hat, goggles, and gloves and buried him 11 feet, face down. Buried for 6.5 hours, Einstahr had died of suffocation; both his nose and mouth were packed with snow and he had no air pocket. Other than minor lacerations to his head, there was no other trauma or obvious broken bones.

Avalanche Data

The avalanche that the two men triggered was classified as an SS-AS-3-G. It released on the steep north side of Kelso Mountain. The avalanche was actually two parts. The first part was only about 100 feet across where it broke 2–3 feet deep at Johnson's feet. But after running for only a few hundred feet it triggered the failure of a much larger area, up to 500 feet across. The additional snow, channeling into a narrow track and runout zone, resulted in the long-running avalanche that fell 2,200 vertical feet.

Though a fracture line profile was not done, snow conditions on similar aspects at nearby Loveland showed 18 inches of fairly homogenous new snow covering 4–6 inches of well-developed faceted grains. Though it was

not known for sure, there was a good chance that old snow left behind from the previous season was in the starting zone.

Comments

October avalanche accidents in Colorado happen often enough when snows come early. Backcountry enthusiasts must be prepared for avalanches at any time when venturing onto steep snow-covered slopes. Though at times the men thought about avalanches, they had no rescue equipment and were unprepared for an emergency. More importantly they were inflexible in their decision to ski the bowl. That was their objective before they left their vehicle.

84-16
DECEMBER 2, 1984

Park City, Utah

1 backcountry skier caught and partly buried

Weather Conditions

After 9 days of dry weather, winter returned to the Wasatch Mountains late on the 24th of November. At Snowbird Ski Area, about 8 miles southwest of Park City, 51 inches of snow fell from November 25 to December 1. During the storms west to northwest winds averaged 25–35 mph. Skies were clear on the morning of December 2, and at 0630 the temperature was 6°F. Winds were from the northwest and averaged 28 mph, but soon afterwards wind speeds dropped to only 15 mph. Only 2 inches of new snow was reported, all of which had fallen the day before.

Accident Summary

At about 0930, seven experienced backcountry skiers left the Big Cottonwood Canyon road at Silver Fork. The group's goal was the untracked powder to the north—on the other side of the ridge—in Dutch Draw. Using climbing skins the group skied up the south-facing slopes above Willow Heights. Not seeing any recent avalanche activity the group felt the snow was stable. The climb to the ridge—2,000 vertical feet above the cars—went quickly, and in a little under two hours the group was overlooking the fresh powder in Dutch Draw.

It was a good powder-ski day; weather conditions were perfect: lots of recent snow, sunny skies, cold temperatures and light winds. On the ridge the skiers hurried to remove and pack away their climbing skins. The plan was to ski one-at-a-time the north to northeast-facing slopes into Dutch Draw. Tom Banks, 28, started down first.

Friends on top of the ridge watched Banks push off and then carve perfect telemark turns in the fresh powder. After only a few turns the slope steepened and Banks disappeared from view. The mood was upbeat while the others waited for their turn, but at the same time no one realized Banks's misfortune.

Almost immediately after skiing out of view from his friends, Banks triggered a soft-slab avalanche. Even as the snow fractured around him and started to move, Banks was able to make several more turns before getting knocked off his feet. Banks remembered being completed under the moving snow and headed toward thick timber. Only when the snow stopped did he surface, hanging onto a tree and buried waist deep.

No one had witnessed the avalanche, and it was probably the second person to ski down that discovered the avalanche and found Banks stuck in the debris in a thick stand of timber. Banks was freed by his ski partners. He suffered a few bumps and bruises and a sore leg, but otherwise he was in good condition. The same could not be said for his skis. One was lost and the other was broken.

Avalanche Data

The avalanche was classified as an SS-AS-3-O. The fracture was 22 inches deep and 180 feet across. The slab released at an elevation of 9,800 feet on an open slope that faced north-northeast. The slide traveled 500 vertical feet. At the top of the slope, before Banks disappeared from view, the slope angle was about 30°. However, where the convex slope steepened, and where he triggered the slide the slope steepened to 38°.

A fracture-line profile dug the following day showed there was about 43 inches of snow on the ground. Below the bed surface the remaining snow was sintered and well bonded. The weak layer was a thin layer of surface hoar crystals. The crystals measured 3–8 mm and formed during a week's worth of cold, dry conditions before the Thanksgiving holiday. The slab consisted of three storm layers of snow

that were just starting to consolidate and bond to each other, but not to the surface-hoar layer.

Comments

Banks's close encounter was a good learning experience for the group, even for such experienced and well-equipped backcountry skiers. Everyone was prepared for an avalanche emergency; they all carried beacons and shovels and several even had probes. But in their decision-making process they were not quite so prepared and triggered an avalanche. Afterwards, the group met and identified what they would do differently next time. They recognized their most serious error was that they failed to re-evaluate the snow conditions as slope aspects and slope angles changed. They all felt that they needed to dig more hasty snow pits to help their evaluations. On the day of the accident no pits were dug. Had snow pits been dug, the group would have found the weak surface hoar layer. And lastly, they learned the importance of keeping all members of the group in sight at all times. After their own critique, they all no doubt became wiser and safer backcountry skiers.

84-17

DECEMBER 11, 1984

Teton Pass, Wyoming

1 backcountry skier caught

Accident Summary

On a stormy December morning, three experienced skiers and mountaineers, Jack Levan, Tom Bennett, and Bill Gill, headed to the summit of Teton Pass about 10 miles west of the town of Jackson for powder skiing. For a savvy bunch of mountaineers the men were in their element: they enjoyed being out in a winter storm. Though strong winds and snow produced near whiteout conditions, the trees offered just enough contrast and depth perception for good, but difficult skiing. Venturing into the midst of a storm, the men did not want to fall prey to an avalanche, so they came loaded for bear. They carried avalanche rescue beacons, shovels, collapsible probe poles and even some snowpack analysis equipment.

From the top of the pass the skiers headed south along the ridgetop trail past the radio tower and then skied down through the trees in the Olympic Bowls area. Gill was the first to reach the bottom of the run where he encountered a steep but shallow gully. He traversed across the gully and climbed onto a south-facing slope. Levan was next but as he emerged from the trees he triggered a small, shallow slab on the north-facing slope that ran into the gully. Cautiously, Levan and Bennett were able to cross the gully and join Gill.

Once on the south-facing slope the men traversed one-at-a-time going from trees to trees until they reached what appeared to be a skiable slope. While Bennett and Levan watched and waited from an area of thick timber, Gill ventured out between some rocks to ski-test the slope. The small slope fractured and knocked Gill down, but he was able to arrest his fall by jamming the tail of one ski into the snow.

With both north- and south-facing slopes unstable, the group decided they had better retreat to the ridge line. The weather conditions were increasing the snow instability; the men realized it was time to head home. As Levan traversed up toward the ridge he released his second avalanche, and the group's third of the day. The slide fractured out along Levan's ski tracks. Like the other two slides it was a shallow soft slab, about 10 inches deep, but it was almost twice as large as the previous slides. Cautiously the men made their way to the ridge and retreated back to the pass and their vehicle.

Comments

These men were experienced and knowledgeable about avalanches, and knew exactly the dangers that lurked on the snow-covered slopes. But even with all their experience they encountered one too many avalanches. Any less experienced skiers probably would have gotten into much more serious trouble.

84-18 DECEMBER 13, 1984

Aspen, Colorado

1 backcountry skier caught, buried and killed

Weather Conditions

In early December just over 2 feet of snow covered the ground on the Aspen Mountain Ski Area. A strong temperature gradient metamorphosed the snow into well-developed faceted snow grains. Though not quite mature depth hoar, the faceted grains were totally loose and cohesionless. On December 9, 5.5 inches of heavy, wet snow fell as the air temperature climbed to 40°F. The new snow formed a dense, hard layer over the sugar snow as the temperatures cooled. Snow started to fall again on the 11th, and by the morning of the 13th another 21.5 inches of light snow had blanketed the slopes.

Accident Summary

An avid skier, Archie Wallen, 27, always seemed to be in pursuit of powder snow whether it was in the backcountry or out-of-bounds off Aspen Mountain Ski Area. By early December he had already made 30 backcountry ski trips including three trips down Highlands Bowl (the site of several recent accidents, for example 81-25 and 84-10). Wallen was an avalanche-savvy backcountry skier; he travelled cautiously and prepared. He always carried his beacon and shovel. Several weeks earlier he had climbed for more than seven hours up a peak only to turn around because he felt the weather and snow conditions were becoming too dangerous.

From his apartment he shared with three friends, Wallen could gaze out on the steep and virtually unskied out-of-bounds area called Ute Chutes. He thought of the Chutes as his own private playground. On December 11, he had walked up and skied the Chutes, so it was no surprise on the morning of Thursday, December 13, when Wallen pointed out the line he intended to ski in the Chutes to his childhood friend and housemate Jay Fletcher. The two agreed to meet later that afternoon at 1300 hours at the Sundeck restaurant at the top of Aspen Mountain. At 1045, Wallen headed out the door.

Wallen failed to make his afternoon meeting with Fletcher and did not come home that night, but Fletcher and other roommates were not too concerned. On Friday morning when Fletcher went out to start his car, he looked up at the Chutes. He saw one pair of ski tracks in the upper meadow of the Ute Chutes, but the lower chutes, still in the shade, were not visible.

By Friday afternoon there had been no sign of Wallen and his roommates were worried. Wallen's car was parked in its usual spot and his downhill ski equipment had not been returned to the apartment. Friends were called and Wallen's favorite hang-outs were checked without success. At 1803 hours Fletcher called the Pitkin County Sheriff's Department to report his friend missing. By 1900, Mountain Rescue Aspen had been notified and agreed to start a search early the next morning, December 15. Snow conditions were too dangerous for a night search.

Concerned for Wallen, Fletcher and three other friends, Rick Wilder, Frank Whitney and Bob DeWaard, organized their own search effort. On the night of the 14th, Wilder started up the Ute Trail but found the snow conditions too unstable and turned back.

Rescue

Before sunrise on Saturday morning the 15th, Wilder, Whitney and DeWaard tried again. Using climbing skins and mountaineering skis the men climbed up Aspen Mountain and followed Wallen's tracks from the ski area boundary off Gentleman's Ridge. Fletcher stayed at the apartment to meet with the local mountain rescue team.

After sunrise, Fletcher was met by Greg Mace from Mountain Rescue Aspen; Robin Perry, Aspen Mountain Ski Patrol Director; and Pitkin County Sheriff's Deputy Rounsefell. From the apartment the three skiers could be followed with binoculars. Shortly before 0800 the skiers had followed Wallen's track to the head of the second Ute Chute. With binoculars, rescuers waiting at the apartment then saw the fracture line. In the flat, early morning light they could tell that an avalanche had swept down the entire length of the chute.

The skiers traversed down the bed surface. About 100 feet below the fracture line they found one of Wallen's skis. The men continued their zig-zag descent of the path and stopped about three-quarters of the way down the avalanche.

At about 0800 hours Fletcher heard shouts for help from the search area. Mountain Rescue Aspen team leader Greg Mace left for the bottom of the chute where other rescue team members were waiting.

After several minutes, the three skiers started down. By 0810, Whitney had skied out to the road and met briefly with Mace.

Whitney reported that they had found Wallen's body. An arm was sticking out of the snow. Though buried less than a foot deep, Wallen apparently had not struggled under the snow; he probably had been knocked unconscious. Sadly, Wallen lived for some time under the snow. A 3–4 inch space surrounded Wallen's head, and his breathing had created an inch-thick ice crust before he finally died of suffocation. Mountain Rescue members climbed to the site and retrieved the body.

Avalanche Data

The avalanche was classified as an SS-AS-3-O. At an elevation of 8,800 feet, Wallen had released a soft-slab avalanche in the steep 40° chute. The 1.5-foot deep fracture line extended about 100 feet across the chute; the avalanche fell 680 vertical feet down the northeast facing chute.

A quick snowpit dug along the fracture line showed 12–18 inches of fresh, heavy snow covered a 6-inch layer of sintered snow. This rested on faceted, sugar snow near the ground. The avalanche initially released in the new snow on top of the sintered layer, but ripped down into the sugar snow below.

Comments

This would not have been a fatal avalanche had the victim not been skiing alone. With a hand sticking out of the snow he would have been quickly found. Perhaps Wallen had gained a false sense of safety and confidence, and that led to his death. Wallen's earlier experience—from 2 days before—told him he would be all right. But like many victims in *The Snowy Torrents*, he failed to re-evaluate the changing conditions. In two days, more than a foot of snow fell and turned a marginally stable slope into an unstable slope that only needed a trigger.

84-19

DECEMBER 31, 1984

Ashcroft, Colorado

2 backcountry skiers caught, 1 partly buried, 1 buried and killed

Weather Conditions

Light snow fell on 13 of the last 18 days in

December in the Aspen area. At Aspen Highlands Ski Area almost 3 feet of snow fell, but settlement in the new snow and the faceted lower snow layers allowed the overall snow depth on the ground to increase only by 1 foot. At 0915 on the morning of December 31, Aspen Highlands reported 3.5 inches of new snow. Winds were very light from the north-west and the temperature was 14°F. The last significant snow fell on the 28th when 10 inches was reported.

Accident Summary

Snow was falling on the morning of the 31st when Jim Fitzgerald, 55, pulled up to Bonnie Golde's house outside of Aspen. By about 1015, the two had finished breakfast and drove up the Castle Creek Road to Ashcroft about 13 miles south of Aspen. Fitzgerald was very eager, almost impatient, to go skiing. On the drive to Ashcroft they discussed where they wanted to go. Fitzgerald rejected Golde's idea to ski in the lower-elevation Redstone area to the west of Aspen. He wanted to ski the high-elevation alpine terrain at the head of Castle Creek, and Pearl Pass or Taylor Pass were the only two choices. Neither Golde nor Fitzgerald had been to the top of Taylor Pass in winter, so both agreed that the day's adventure would be up Taylor Pass.

Moderate snow was falling when the two pulled into the parking area near the old ghost town of Ashcroft. By 1100 the two were headed south up Express Creek along the Taylor Pass road. (From this point on, stated times are only estimates, for neither Fitzgerald nor Golde wore a watch.)

After several miles of skiing up the road the snow stopped and the sun broke through the clouds. Golde described the scene: "It was one of those fairy tale dream days of fantasy clouds swirling, light snow blowing off the aspen trees, the sunshine sparkling off the gleaming snow, and blue skies." The two took their time, frequently stopping to admire the views and enjoy the warm sunshine.

The snowcovered road up Express Creek crosses the runout zones of several large avalanches that spill off the west side of Ashcroft Mountain. At the first avalanche crossing the pair discussed whether to cross separately. With a smile and total sincerity, Fitzgerald said, "It is my fantasy to die in an avalanche." Golde did not share that same fantasy; she told him she "rather leaned toward

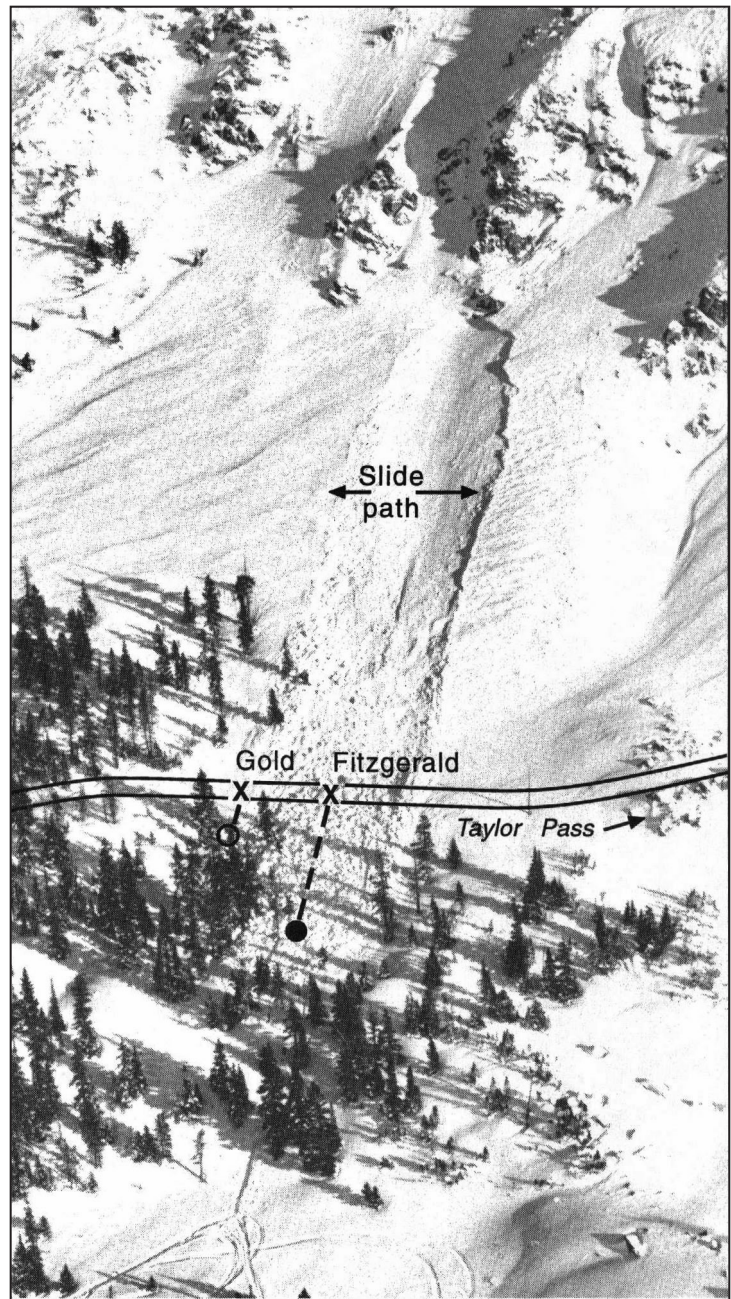


Figure 29. Accident 84-19, Ashcroft, Colorado, December 31, 1984. Photo by Devon Meyers.

the sea." The two crossed the runout zones one-at-a-time. Further up the valley they dropped lower into the drainage to avoid avalanche areas on both sides of the valley.

About mid afternoon, around 1430 hours, it started to snow again. Wind and snow made for harsh conditions, but the two skiers added layers of clothing and put their energies into the ascend. Further up the valley they rejoined

the summer road below the switchback for the final climb to Taylor Pass. The summer road was difficult to follow. In some places drifted snow completely obliterated any sign of the jeep road. They discussed stopping for lunch, but the stormy weather spurred them to skip lunch and continue on. Fitzgerald and Golde decided to try for the pass.

Though the weather was stormy the two carried very little gear. Both were good tele-mark skiers. Fitzgerald had considerable backcountry and avalanche experience, but Golde had little experience in the backcountry and almost no avalanche awareness training. Neither carried avalanche rescue or emergency equipment; all they had in their packs was lunch and some ski waxes.

The route steepened and the wax on Fitzgerald's skis was no longer biting, so he stopped to put on climbing skins. Golde continued to traverse up the slope through the trees to the upper switchback that leads to the summit of the pass. On the road she waited for Fitzgerald. With his climbing skins on his skis he quickly caught up to Golde. They were less than a .5 mile from the summit when it stopped snowing. Enjoying their good fortune the two embraced, and after a kiss both said, "Let's go for it."

The two continued their climb along the snowcovered road; Fitzgerald was leading. It was probably around 1530 when they had moved just beyond the last stand of trees. From this point Golde had trouble following Fitzgerald. Even with climbing skins, her skis were sliding on the steep, drifted, icy snow. Fitzgerald stopped and waited while Golde regained her footing. She was feeling uneasy about the difficulty of the traverse when Fitzgerald turned to her and said, "I don't feel comfortable here." She answered, "Neither do I," and asked, "Shall we turn back?" He answered her question with another question, "How's your karma, Miss Snowflake?" Love was definitely in the air and with a big smile she stated, "Today, being with you, it feels pretty good." Cornices overhanging the slopes above made them both a little nervous about the possibility of an avalanche. He finally asked if they should go to the top. Golde said, "Sure," but before either could move they both heard a muffled noise. They looked up and saw an avalanche headed right toward them.

Golde watched Fitzgerald turn and point his skis downhill and heard him yell, "Here it

comes!" Golde turned downslope and headed toward a small tree. Within seconds she was knocked off her feet by the churning snow and carried 30 feet into the tree. She grabbed it and was able to hang on. She lost sight of Fitzgerald who was swept away in the avalanche. When the snow stopped sliding, she expected him to pop out of the snow and say, "Wow." She heard nothing. Later Golde said that silence had never been more terrifying. She called and called his name, but heard nothing. She started to scream his name. Not wanting to panic, Golde calmed herself by controlling her breathing. Not having avalanche rescue training she set out to try and find her buried friend. She crossed over the debris several times, occasionally stopping to call out his name. She would stand quietly hoping to hear any small sound before moving on. It started to snow again, and she knew it would soon be getting dark. After a brief search she followed their tracks the five miles back to Ashcroft, skiing as fast as she was able.

She arrived in Ashcroft shortly after 1700 hours; she went to the Toklat Lodge that was run by the Mace family. Greg Mace, a leader of Mountain Rescue Aspen, was at home at the lodge. At 1718, Mace reported the accident to the Pitkin County Sheriff's Department and Mountain Rescue Aspen.

Rescue

Mace carefully interviewed Golde and had good idea about where his friend and fellow mountain rescue worker was last seen. Shortly after 1735, Mace left the lodge on a snowmobile to break trail up Express Creek for the other rescuers that would soon be arriving. Golde stayed behind in the care of Mace's sister. Later Golde would return to the site of the avalanche to help rescuers find her friend.

Behind the lone Mace, Rick Dean and another nine mountain rescuers followed on snowmobiles. They quickly caught Mace. It was difficult going; the snowmobiles frequently got stuck in the loose, unconsolidated sugar snow. Back in Ashcroft another 20 mountain rescuers waited to provide support if needed. It took rescuers almost 3.5 hours to reach the accident site, but within 15 minutes of searching by headlamp, a ski tip was spotted sticking out of the snow. Still attached to the ski, Fitzgerald's lifeless body was completely buried. CPR was started immediately but discontinued after almost an hour when there had

been no change in Fitzgerald's condition. At 2155, his body was loaded into a snowmobile sled, and his friends started the somber ride back to Ashcroft.

Avalanche Data

At 11,560 feet, the road along which Fitzgerald and Golde were skiing was not steep, but it traversed across a steep northwest-facing slope at treeline. Directly above the road loomed a 40° snow covered slope. The skiers triggered the slide from the road when the faceted snow beneath them collapsed. The top of the avalanche was at 11,800. The fracture line was 1–2 feet deep and spanned 90 feet across a shallow gully. The avalanche was classified as an SS-AS-2.

Comments

Fitzgerald had most likely let his avalanche guard down since they were skiing along the road. It wasn't until it was too late that he realized the danger they were in. In the weak continental snow cover it is not uncommon to trigger avalanches from low on a slope or even from flat areas (see accident 84-4). Until all backcountry travelers are taught this characteristic of avalanche releases more deaths and accidents are certain to occur. Sadly, like the fatal accident 2 weeks before (84-18), this one probably would not have been a fatal avalanche had the skiers carried, and the survivor known how to use, beacons and shovels. Even without avalanche rescue equipment, survivors of a backcountry avalanche should stay and search until they feel they have done all that is possible. A longer, more careful search probably would have revealed Fitzgerald's ski, and their adventure would have ended happily. Instead it ended in tragedy; Fitzgerald's fantasy came all too true.

ing snow and created shallow, hard-slab conditions at the Bridger Bowl Ski Area near Bozeman. On the morning of the 3rd, ridgetop winds were blowing from the west at 35 mph. At 0800 the temperature was 27°F.

Accident Summary

The upper portion of the mountain was closed for avalanche control work on the morning of January 3. Ski patrollers Rod Campbell, 28, and Jeff Kiefer, 26, were working in the Three Bears area—a steep area of narrow gullies bisected by several cliff bands. The pair had already thrown two explosive hand-charges but had gotten no results.

Shortly after 0900 hours Campbell had just thrown a shot into Papa Bear and again got no results. At this point Campbell and Kiefer conferred—three hand charges had not produced avalanches. Both men felt the snow cover was stable and probably would not slide. They decided to ski cut the remaining small pockets to breakup the existing slab. At 0910 hours Campbell started a traverse across the north side of Papa Bear. Kiefer followed a short distance behind, but a small ridge blocked his view of Campbell.

Within seconds of starting his traverse, the snow around Campbell fractured. Before he could react the jumbled blocks of snow knocked him off his feet and swept him down a gully. Campbell was carried over a 20-foot cliff and then carried another 120 vertical feet downslope. Before the avalanche had stopped Kiefer had skied up over the small ridge just in time to see the last of the debris stop moving.

Fortunately, the moving snow did not pile up and Campbell remained on the surface of the debris when the avalanche stopped. He luckily suffered only a deep bruise to the thigh of his right leg. After a moment to regain his composure he radioed Kiefer and alerted him of his little mishap and that he was all right.

Avalanche Data

Classified as an HS-AS-2-O, this avalanche had a fracture depth of 18 inches and a vertical fall of 200 feet. The small slab was only 50 feet across and released from a leeward east-facing slope at 7,800 feet in elevation. The slope angle was estimated to be 35°.

Comments

It is these small avalanches that often catch their victims unaware and both Campbell and

85-1

JANUARY 3, 1985

Bridger Bowl, Montana

1 ski patroller caught and injured

Weather Conditions

Though no new snow had fallen in over 3 days, steady westerly winds had caused blow-

Kiefer underestimated the avalanche danger. The lack of results with explosive testing led them to believe that the snow cover was stable. However, fresh wind slabs are seldom absolutely stable. Changes in slope aspect, steepness, topography—even subtle changes—can vary the stability of the snow across a single slope. Patrollers and backcountry skiers should not be lulled into thinking the snow is stable but must always be on the lookout for changing conditions. Campbell and Kiefer based their conclusion on a sample size—three hand charges—that was too small. Campbell was lucky that he escaped this avalanche with only bumps and bruises. The consequences of a ride, even in a small avalanche down gullies, over cliff bands and through trees can be serious. After this close call the ski patrol modified its procedures and now use more explosives and sometimes even roped-belays to safeguard patrollers.

85-2

FEBRUARY 3, 1985

Grand Teton National Park, Wyoming

1 climber caught, partly buried and killed

Weather Conditions

On January 28 and 29 a total of 5 inches of new snow had fallen at nearby Jackson Hole Ski Area. A bitter cold, arctic airmass moved over northwestern Wyoming late on the 29th. Only a dusting of new snow fell from the frozen skies, and the high temperatures stayed well below 0°F on the 30th and 31st. The low temperature at the top of the tram (10,310 feet) on the morning of the 31st was -35°F. Avalanche workers at the ski area reported the top 1–3 inches of snow had quickly metamorphosed into well-developed faceted snow grains under the influence of a super strong temperature gradient. Another 2.5 inches of new snow had fallen by the morning of February 3, and during this time the daily high temperatures never climbed above -3°F. During this cold spell west to north winds were light. At 0600 on the morning of February 3, the temperature at 9,748 feet was -14°F. During the day the tem-

perature warmed to only -8°F; and ridgetop winds were less than 15 mph.

The U.S. Forest Service rated the backcountry avalanche danger low. Though natural avalanches were not expected the National Park Service added to their daily reports on February 2–3 that “widespread pockets of unstable shallow soft slab could be found at higher elevations.”

Accident Summary

Late in the afternoon of February 2, Bruce Melliger, 29, called Grand Teton National Park to register a friend and him to climb a couloir on the northeast side of Mt. Wister (11,490 feet). Ranger Lynn Woodward took down the required information and told Melliger to either fill out the late registration box or telephone upon his return. During their conversation Ranger Woodward asked Melliger if he was going to take his avalanche rescue beacon. He said he would have it. After Melliger hung up, Woodward filled out the permit and placed it on the board in the Permits Office.

Early the next morning, February 3, Melliger showed up at the Permits Office just as the rangers arrived. He had had a change in his plans; he would be climbing solo—his friend had cancelled. Melliger talked with Ranger Dan Burgette.

As they talked Ranger Burgette learned Melliger was not familiar with Mt. Wister. Burgette added that though he had not climbed the mountain he was very concerned about Melliger’s proposed route. To climb the Northeast Couloir above Lake Taminah, Melliger would have to ascend a large, steep north-facing snow slope. Burgette was leary of a solo climber tackling such a route even though the U.S. Forest Service had been rating the backcountry danger at low for about two weeks. They talked about the avalanche conditions and Melliger agreed not to climb the route, but he still wanted to do a one-day solo climb of Mt. Wister. He knew that a local climber had soloed the mountain in January.

Burgette informed him the climber ascended the Southeast Couloir. The two men reviewed the guidebook and both agreed that the Southeast Couloir was the logical route to solo. The couloir is a narrow gully—in places only 10 feet wide—with several rock bands. Burgette knew that Melliger was an experienced mountaineer and sometimes climbed solo. The Southeast Couloir was well within

Melliger's capabilities. At 0830, Melliger left the Visitor Center in his yellow Honda Civic and headed to the trailhead at Taggart Lake.

Melliger skied to the base of a couloir on the southeast side of Mt. Wister, where he cached his skis, poles, and shovel. He began climbing the narrow couloir, kicking steps in the snow as he passed the lower rock bands. Melliger was probably approaching the upper part of the couloir when he triggered a shallow soft-slab avalanche. It was only about 6 inches deep, but this was enough snow to knock Melliger's feet out from under him. Without protection he was swept on a fast and fatal plunge down the couloir.

Rescue

The next morning, February 4, Ranger Burgette learned that the Melliger had not signed out from his climb. Burgette called the emergency number that Melliger had indicated on the permit. Melliger had not come home. Burgette then drove out to the Taggart Lake trailhead where he found Melliger's yellow Honda covered by snow. Melliger was overdue, not a serious situation but a situation that required more investigation. From different positions along the Park roads spotting scopes were used but no sign of Melliger was observed.

At about 1000 hours a helicopter was placed on standby. Plans were made to initiate a search if Melliger failed to show-up by late morning. By 1120 there had been no sighting of Melliger, and the search mission was started. Seasonal rangers Renny Jackson and Jim Woodmencey were recruited, and the helicopter was requested to respond to the Park. Additional rescuers including avalanche dogs from the Jackson Hole Ski Area were notified and placed on standby.

Shortly after 1300 hours Rangers Burgette and Jackson were flown up Avalanche Canyon to do an aerial reconnaissance of the canyon and Mt. Wister. From the air the rangers spotted a recent avalanche in a southeast-facing gully on the east shoulder of Mt. Wister. Also the men could see tracks leading into the avalanche. At 1350 hours the two rangers were dropped off below the avalanche and the helicopter returned to pickup Rangers Woodmencey and Berkenfield.

At 1615 the second team of rangers was dropped off and the men followed Melliger's tracks up toward the gully and the avalanche. The tracks were mostly filled by wind-blown

snow. About 20 minutes later the rangers found Melliger's skis, poles and shovel cached near the base of the couloir. It was all too obvious what had happened; the helicopter was sent to Jackson Hole to pickup the avalanche search dogs and their handlers. The rangers moved out onto the debris and started their hasty search. At 1447 hours they found Melliger's body mostly buried in the shallow debris.

Melliger's body was found at 9,200 feet. He had suffered obvious major injuries and probably died during the avalanche. There was no sign that he tried to move after he stopped.

It is uncertain how far Melliger had climbed up the couloir. Rangers could discern his foot tracks going through the lowest rock band. It can only be assumed that Melliger had climbed up the center of the gully, and his tracks were swept away.

Avalanche Data

From the air, a 6-inch fracture could be seen just below the ridgecrest at the top of the southeast-facing gully. The shallow fracture line extended 100 feet across the starting zone but the avalanche funnelled into the narrow gully and spilled over several rock bands before spreading out in the fan-shaped runout zone. It ran from an elevation of 10,500 feet to 8,800 feet. The avalanche could have been triggered by the victim, or the avalanche could have released naturally. Rangers did see a natural avalanche on the other side of the mountain.

Comments

This accident illustrates two important points. First, that super-cold temperatures can quickly weaken the snow cover. Over a period of only days the low density surface snow lost strength as faceted grains developed from kinetic or temperature-gradient metamorphism. The new faceted grains became the weak layer for the little snow that fell during the first couple of days in February. The second important point is that even very shallow—6-inch- deep—avalanches can turn into killers for the unroped or solo climber. It takes relatively little moving snow to knock a climber off his feet and tumble him down a gully. While no one knows how high Melliger had climbed before the avalanche swept him to his death, one thing certain was that he was climbing the wrong gully. The gully he had

signed out to climb was further west and below the summit of Mt. Wister. Though he was killed in the wrong gully, he might have met a similar fate even if he had climbed the correct gully. Both were high elevation gullies that faced southeast, so the snow and avalanche conditions would have been similar. The message is still same. When climbing solo there is no margin for error.

85-3

FEBRUARY 9, 1985

Snowy Range, Wyoming

2 snowmobilers caught and buried, 1 killed

Accident Summary

On Friday evening February 8, Steven Marquardt and Dennis Jeperson, both of Laramie headed west into the Snowy Range in southeast Wyoming for a weekend of snowmobiling. The men drove to the end of the plowed portion of Wyoming 130, just west of the small town of Centennial. From there it was about a 1-mile snowmobile ride to a cabin that Marquardt leased in Mountain Meadows. Both men were avid outdoorsmen; they also both worked for the U.S. Forest Service and knew the area well.

After an early breakfast Saturday morning the men climbed on their snowmobiles. Snow and blowing snow caused poor visibility that initially kept the men close to the cabin. The weather improved, so the men headed north through the "mini-glacier" area and eventually ended near Rock Creek Knoll. Both machines were running low on gas, so the men tried to find the Sand Lake Road to return to the cabin. They searched for a short time but couldn't find the road and ended back in the Rock Creek Knoll area.

At about 1015 Marquardt and Jeperson stopped to look over the east flank of Rock Creek Knoll, an area they wanted to cross. A large cornice overhung the slope, but old snowmobile tracks crisscrossed the slope and the entire knoll. Jeperson remarked that the slope looked like a good avalanche area. Marquardt agreed. Jeperson, in the lead, started out making a loop. Marquardt followed, presuming that they were turning around to

take a different route. They crossed on a bench about a third of the way up the knoll, but Jeperson swung around the loop a second time. But this time he started up the knoll and Marquardt followed.

As they climbed up and across the slope the hillside fractured around them. Marquardt saw the moving snow, and both men were in the middle of the moving slab. Within seconds Marquardt was tossed from his machine into the tumultuous flow of the avalanche. He tried to swim but when the snow stopped he was buried. Immediately he tried to free himself, but all he could move were his hands. He clawed away at the snow with his hands and soon he could move his arms. Marquardt then enlarged the space around his face. With more digging he could move his body and he started inching his way upwards to fresh air and life. Marquardt slowly dug through 3 feet of compacted debris. After 30 minutes Marquardt wiggled free from his tomb. The first thing he saw was his snowmobile at the bottom of the avalanche. Marquardt then expected to hear or see his friend; instead he was met by only the eerie sound of the wind.

Fearful of a second avalanche, Marquardt moved his snowmobile away from the debris. If he lost his machine, he would have a long walk through deep snow to get help. Marquardt returned to the debris and searched for his friend. Marquardt kept searching until he felt he could do nothing more without additional help.

It was a lonely ride back to the parking area at the end of Wyoming 130. There he met other snowmobilers. There Marquardt asked Bill Salisbury to drive back to Centennial, about 6.5 miles down the road to call for help. On a piece of paper Marquardt wrote his name and the location of the avalanche and handed it to Salisbury. At 1330 hours the emergency call to 911 was made; Salisbury returned to the road closure to await rescuers.

Meanwhile at the road closure Marquardt had found some gas, so he and two other snowmobilers returned to the accident site to continue the search. They found Jeperson's snowmobile, but no sign of his friend. Sometime after 1400 hours the three returned to Wyoming 130 to meet and guide rescuers back to the accident site.

Rescue

After the 911 call the Albany County Sheriff's

Department mobilized deputies and equipment. The nearby Snowy Range Ski Area was notified and sent four trained National Ski Patrollers plus one of the ski area's owners. Into a pickup truck the patrollers loaded a snowmobile, a trauma toboggan, probe poles, shovels, oxygen and personnel bivouac gear. The group was headed by Neil Mathison an experienced avalanche-hand who had spent many seasons patrolling at Bridger Bowl Ski Area in Montana, and who also was an Albany County Sheriff's Deputy.

At about 1445 hours Marquardt and the other two snowmobilers who had helped search returned to the parking area and briefly met with the rescuers. They had found Jeperson's snowmobile. While rescue equipment was being loaded onto snowmobiles, Mathison talked with Marquardt and then briefed and organized the rescuers. By 1500 hours, 10 rescuers from the Sheriff's Department, the ski area, a couple of volunteers and Marquardt headed to the accident site.

Rescuers were slowed in their return to the avalanche when one of the snowmobiles broke down, but field repairs soon got it going again. After a cold and windy ride on a rugged trail the rescuers reached the avalanche at 1556 hours.

While gear was being unloaded from the snowmobiles Mathison carefully interviewed Marquardt. Marquardt pointed out where he had been buried and where the two snowmobiles had been found. Mathison identified an escape route and the rescuers started the hasty search. Based on the flow of the avalanche and the victim's probable trajectory, Mathison instructed the rescuers to concentrate on spot probing an area of small trees and around the Jeperson's snowmobile. The hasty search was done in about 5 minutes, but it was unsuccessful.

A coarse-probe line was started at the toe of the debris to search the highest probability area. The line worked uphill and after 15 minutes of probing, two rescuers—next to each other—had a strike. Mathison kept the line moving while he and another rescuer started digging. The digging was slow and difficult in the compacted debris, but at 1627 hours they reached Jeperson's body.

Jeperson was found about 20 feet uphill of his snowmobile, just uphill of a small tree. He had been buried for 6 hours under 4 feet of snow. Snow was tightly packed around his

body, including his face. An Army MAST helicopter had been requested but bad weather in Cheyenne had grounded the aircraft. Rescuers loaded the body into a sled and headed back to the trailhead. By 1800 hours all rescuers had returned to trailhead.

Avalanche Data

The slab that failed under Marquardt and Jeperson was larger than a football field. Rescuers estimated the avalanche fractured 3 feet deep for 450 feet across the east-facing slope. It ran just over 200 feet down the slope where most of debris piled up on the bench the men had driven their machines across earlier.

Comments

We will never know why Jeperson took that second lap and started his snowmobile across the face of Rock Creek Knoll. Possibly the old snowmobile tracks in the area gave Jeperson a false sense of security and lulled him onto the slope, but only moments before the avalanche both men agreed the slope was avalanche prone. Jeperson must have thought the risk was acceptable; perhaps he believed that he would't be caught or that nothing serious would happen if he was caught.

Neither man was equipped for avalanche rescue (Marquardt was extremely lucky, few buried victims, especially those buried several feet, are able to dig free), but tragically they knowingly chose to play in avalanche terrain. This accident raises the question: What is an acceptable risk? It's a question that all individuals and groups venturing into avalanche terrain must answer. Sadly, a wrong answer can result in painful lesson learned.

85-4

FEBRUARY 9, 1985

Lolo Pass Winter Recreation Area, Idaho

1 backcountry skier caught, buried and killed

Weather Conditions

Idaho and Montana were also chilled by the arctic blast that roared through the northern Rockies in late January and early February.

From January 27 to February 6 temperatures stayed well below 0°F throughout the northern Rockies. At first surface hoar formed but it and the underlying snow quickly changed to faceted snow. Bitter cold air temperatures caused extreme temperature gradients of 50–150°C per meter that persisted for many days. It resulted in a relatively thick layer of faceted snow at the snow surface that would become the failure plane for many avalanches.

Late on the 6th warm, moist Pacific air pushed into the northern Rockies and replaced the dry arctic air. Heavy snow was reported at Lolo Pass on February 7 and 8. Though no official measurements were taken strong south to west winds and over 2 feet of new snow were reported. By the morning of February 9, the snow had stopped, but a thin overcast obscured the sky

Accident Summary

Lolo Pass straddles the border of Utah and Montana along U.S. Highway 12, about 40 miles west-southwest of Missoula, Montana. At the pass the Clearwater National Forest (Idaho) manages a cross country and snowmobile trail system. Formally called a Winter Recreation Area it could not be called a true developed recreation area. Though the U.S.F.S. maintained and groomed the trails and users had to buy trail passes, the skiers and snowmobilers were on their own if something went wrong.

Though no cross country trails were set to the top of Mt. Fuji, it was a popular spot with backcountry-downhill skiers, and that was where three Missoula men headed on Saturday morning, February 9. Jeff Kinderman, Bill Thomas and Dan Twohig, 32, were good friends and fellow U.S.F.S. smokejumpers; they thought the powder skiing would be excellent. Kinderman and Thomas were fairly proficient telemark skiers and knew the area well. Twohig was new to the sport of telemark skiing but was learning fast. None of the men had had any avalanche awareness training. The men bought their “Park-n-Ski” passes at the U.S.F.S. Visitor’s Center and used the groomed trails to access the undisturbed powder between trails. The skiing was not as good as they had expected. During the storm strong winds created thick, slab-snow conditions that made for tricky skiing. Also the men experienced collapsing and “whoompfing” and cracks shooting out underfoot several times

that morning. That was a new experience for them, but sadly they did not understand its significance.

Shortly before 1400 the men separated for their last run of the day. Twohig was to meet his two friends at the pass, but he was going to take a different route down. Twohig ended up taking his last run down the north face of Mt. Fuji, an old clear cut. Only a few small spruce trees poked through the snow as he traversed out onto the slope. At about 1400 hours Twohig’s morning fun ended quickly and forever; skiing alone he had triggered a large avalanche and was buried.

Rescue

Members of a local nordic ski patrol occasionally patrolled the trails at Lolo Pass. At about 1410 Carolyn Black, of the 5-Valley Ski Patrol spotted the avalanche debris. Black and six others skied to the avalanche and did a cursory search. At first it was unknown if anyone had been buried. It wasn’t until Twohig failed to show up to meet his friends that they realized the seriousness of the avalanche. It wasn’t until almost 1700 hours that a full-fledged rescue effort was started. Searchers found one of Twohig’s ski poles in the debris that evening at 1838 hours. Searchers continued to look until shortly after 2100 hours when darkness and worsening weather halted the operation. That night rescue teams around the region were asked to respond the next morning to assist in the search.

By about 0830, February 10, the first searchers were headed back to the avalanche. Strong winds and falling snow reduced visibility so that at times the safety officer could not even see all the rescuers, but the search continued. By early afternoon 65 people were manning probe lines. A little after 1400 hours a ski was found in the same general area as the ski pole that was found on the 9th. Searchers kept looking until sundown but had found nothing else when they were ordered off the mountain.

Strong winds, new snow and a looming cornice had threatened searchers on Sunday. So on Monday morning, February 11, explosives were used trigger any unstable slabs. Five shots were tossed by hand but caused no avalanches. It was early afternoon when searchers returned to their probe lines. Again the weather was miserable, as heavy, wet snow fell most of the afternoon. By late afternoon, 78 people and several search dogs were

involved in the search effort, but by sundown all attempts to find Twohig had failed. Rescuers pulled off the mountain for the third night.

Rescuers returned in force Tuesday morning, the 12th. Fresh search dogs from Utah searched the debris first, before the probe lines were started, but the dogs were unsuccessful. Winds at the top of Mt. Fuji had increased to 50 mph under thick, overcast skies. While visibility was still good control work was tried again at mid day, but the explosives failed to dislodge any fresh slabs. Rescue leaders felt safer having tested the snow stability and by early afternoon over 100 people were back on probe lines.

At 1449 a prober struck a buried ski. The ski was still attached to Twohig's body. He had been buried under 4 feet of snow, about 250–300 feet below where the ski had been found on Sunday. Here was no indication that Twohig struggled after his burial. Death by suffocation probably came quickly; rescuers reported that his mouth and nose were packed with snow.

Avalanche Data

On the afternoon of February 11, two U.S.F.S. Snow Rangers Jean Thompson and Remy Pochelon, who worked in other National Forests, came to investigate the avalanche. The hard-slab avalanche had fractured from 2–10 feet deep on the north side of Mt. Fuji. The avalanche was up to 175 yards across but the length of the fracture line was more than twice the width of the slide. The fracture line extended across the top of the slide at an elevation of about 6,900 feet and down the west flank. A shallow ridge immediately to the west trapped blowing snow allowing westerly winds to load the starting zone. The avalanche fell about 800 vertical feet. Heavy snow and strong winds that afternoon kept the Snow Rangers away from the top of the slide, so they dug a pit in the undisturbed snow north of the debris.

Even at the bottom of the slope they found all the necessary ingredients for an avalanche. Two feet of fresh snow covered 3 inches of surface hoar and faceted snow. The new snow and weak layer were perched on top of a half-inch-thick ice crust that topped a thick, 3-foot hard layer of well sintered snow. From a topographic map and interviews they estimated the starting zone to be about 33° in steepness. They also learned that the slope had been

skied the day before the accident and maybe even the morning of the accident.

Comments

This story didn't end after the rescue. Twohig's wife sued the U.S.F.S. alleging that they failed to inspect and warn of the avalanche danger. A motion by the U.S.F.S. to reject the law suit was denied, and the U.S.F.S. quietly settled the action out of court. This was not the first avalanche on the north side of Mt. Fuji. At least three or four other avalanches had occurred in the same spot in the previous 10–12 years, and these avalanches occurred during almost identical storm conditions to the February 1985 event. None of the staff at the U.S.F.S. Visitor's Center knew of the earlier avalanches, nor did the staff have any avalanche awareness or rescue training.

Ultimately, the backcountry traveler must assume responsibility for their own safety, and in this accident Twohig's ignorance of avalanches caused his death. A little avalanche awareness training on the part of the skiers might have prevented this accident. Twohig and his friends experienced obvious danger signs of unstable snow. Unfortunately they lacked any avalanche training, so they did not know that cracking, collapsing and "talking snow" meant avalanches. Though ignorance was to blame we should also add that the old ski tracks might have attracted Twohig onto the avalanche path. But, an experienced avalanche hand knows never to equate previous ski tracks with safety when unstable snow conditions exist.

85-5

FEBRUARY 10, 1985

Mt. Si, Washington

2 climbers caught, 1 injured and 1 killed

Weather Conditions

At nearby Snoqualmie Pass on Interstate 90 the Washington Department of Transportation and the Alpentel Ski Area each had recorded 17 inches of new snow at 0700 hours Sunday, February 10. During the day the temperature rose to 32°F, and throughout the day light to

moderate snowfall continued. Winds at the pass and at the ridgetops were generally light and variable, though Alpentel reported a one-hour period of southwest winds averaging 35 mph during the previous 24 hours.

Accident Summary

At 4,767 feet, and 25 miles east-southeast of Seattle, Mt. Si offers a close-by challenge for Seattle-area climbers. Peter Vander Molen, 27, and Brad Kingery, 22, were climbing near the top of the Haystack (the rock mound) at the top of Mt. Si. Both men were roped together. At about 1400 hours Vander Molen, in the lead, triggered a small slab avalanche that caught both climbers. Vander Molen was swept down the gully about a rope length (150 feet) and was slammed into a small tree. Kingery called out for his friend but got no answer. He downclimbed, following the rope, and found Vander Molen had sustained severe head injuries.

Kingery briefly tried to make his friend more comfortable before he left to get help. During the avalanche Kingery had suffered minor leg injuries but adrenaline powered him onward. He downclimbed the route and raced to a nearby house to report the accident.

Rescuers from the King County Sheriff's Department, Seattle Mountain Rescue Council, local ski patrols, and Explorer Search and Rescue responded. But they arrived too late. Vander Molen had succumbed to his injuries by the time the first rescuers reached him.

Avalanche Data

Little is known of the avalanche but rescuers estimated that the slab was 2–3 feet deep, and it had released in a narrow and very steep gully. In the gully where Vander Molen was leading the slope angle was estimated to be greater than 70°.

Comments

Though this ill-fated climbing trip was undertaken in stormy-weather conditions, northwest climbers are used to much worse weather conditions. Even though the weather conditions were bearable the threat of avalanches was great. A fresh slab on any super-steep slope is a deadly combination even for roped climbers. As long as climbers and even backcountry skiers continue to tackle steep slopes during times of unstable snow conditions they will trigger avalanches.

85-6

FEBRUARY 12, 1985

Roberts, Montana

3 snow players caught, 2 buried and 1 killed

Accident Summary

Roberts is a small rural town about 40 miles southwest of Billings on the way to the resort town of Red Lodge. The town is situated in the rolling hills of south-central Montana, not what people would call avalanche country. Avalanche country is considered to be a bit further west in the Gallatin National Forest where Montana's highest mountains are located.

It was a quiet Tuesday afternoon, and after school chores were done, so Steve Anders, 9, Bryant Nutting, 9, and Bryant's little brother Paul, 7, headed out sledding before dinner. The boys carried their sleds to a steep hill above Rock Creek, about a half mile east of town. Wentworth Hill or Cemetery Hill (the cemetery is across the street) was a popular sledding spot for the kids and adults of Roberts.

The three boys rode their sleds and boxes down the usual parts of the hill, but after awhile the boys were looking for more excitement. They moved to a part of the hill where a cornice overhung the wind-drifted snow below. It was getting late, probably a little after 1700 hours when the boys, filled with excitement stood at the cornice; never before had any of the three challenged such a steep slope.

Bryant Nutting went first and was already at the bottom of the hill when Anders and the younger Nutting jumped off the small cornice and started sliding down on their rear ends. Suddenly the slope fractured, even behind the cornice at the top of the slope. Anders instinctively pushed a hand in front of his face. Both boys were buried close together and could talk. Anders remembers Paul Nutting ask, "Can you help me?" Anders responded that he couldn't and asked about Bryant. Soon afterwards Anders lost consciousness.

Bryant watched in terror as the avalanche engulfed his friend and little brother. Realizing that he couldn't dig out the pair he ran back to the school to find their mother who worked at the school.

Rescue

At the school, Greg Jakkola, a high school student working after school, was one of the first persons to see Bryant come running in. In tears, Bryant told of the avalanche. Rescuers were needed, so Jakkola raced to the gym to alert the boys basketball team. At the same time Jackie Loper, the school clerk, started calling people in town to recruit rescuers.

Basketball practice for the 14 boys on the high school team ended early when Jakkola burst through the doors to the gym. Coach and school superintendent Ron Marshall told the boys to get dressed and where to go. Within minutes they were out of the locker room and headed to the avalanche. Some of the boys ran to the sledding hill while others got rides.

Players and residents of Roberts started arriving at the avalanche. Eventually 50–60 people came out to search. The slide area was small and lacking probe poles the rescuers started digging. At first shovels were in short supply, so rescuers dug by hand. Anders was found first, almost 35 to 40 minutes after the avalanche. He had been buried 4 feet deep. Once uncovered the 9-year-old third grader quickly regained consciousness and was able to tell rescuers where to look for Paul.

About 5 minutes later basketball player Mike Pettitt uncovered a pants leg and Paul Nutting was quickly dug out. He too had been buried under 4 feet of snow, but Paul was not as lucky as his friend. Though buried only slightly longer snow was packed around his face and head. Cardiopulmonary resuscitation was started immediately and continued as the Red Lodge ambulance crew ferried the boy to a nearby field where a medical helicopter waited. Paul was flown to a Billings hospital.

For almost a week Paul was in critical condition, hooked to a respirator. Sadly, Paul didn't respond to treatment and had no brain function, yet his parents did not give up hope. Four years earlier Paul's grandfather had suffered a heart attack and was "clinically dead for 11 to 12 minutes." The family was told that he would not survive. For more than six weeks the elder Nutting was comatose and the family regularly faced the dilemma of whether to continue life support. Paul's grandfather did survive and made a complete recovery. Probably for this reason Paul's family held out for the hope that their little boy would also survive. But the family would not be so lucky twice. On February 21, Paul was removed from live sup-

port. He quickly died in the Billings Hospital; his condition had never changed.

Avalanche Data

No data about the avalanche was recorded, but from a newspaper photograph and from the boy's description of the snow the avalanche was a combination of soft and hard slab. It fell less than 100 vertical feet. The weak layer was most likely faceted snow that developed during the same cold spell that was responsible for accidents 85-2 and 85-4.

Comments

This accident reinforces the message that even small avalanches can be just as deadly as large avalanches. No matter how small a slope, given the right snow conditions, small but steep slopes can be lethal. This avalanche turned deadly because of an unintended consequence of the rescue.

Remember both boys had been buried close together. It can be deduced that both boys initially had air pockets since they could talk back and forth. However, when rescuers uncovered Nutting they reported no air pocket. What happened?

The avalanche fell only a short distance which did not cause the snow to pack together and densify. Rescuers, first on scene, were easily digging through the debris with their hands. It appears that this was a sad case where rescuers while digging out Anders trampled Nutting's air pocket. Rescuers probably cannot prevent such occurrences. It is a risk that all rescuers must recognize, and if it should occur, it should cause no guilt or shame for rescuers when a thorough rescue effort—like the one done by the citizens of Roberts—has been attempted.

85-7

FEBRUARY 12, 1985

Crystal Mountain Resort, Washington

1 ski patroller caught

Weather Conditions

During January snowfall at Crystal Mountain Ski Area was in short supply. Only 4 inches

fell during the entire month. Dry conditions and high temperatures above freezing resulted in a stout ice crust on the snow surface. At the end of January arctic air also intruded into the Pacific Northwest. Even with its maritime location the surface snow at Crystal Mountain underwent the same changes—the development of surface hoar and faceted snow grains—as observed in the Rocky Mountains. From February 1–3, 12 inches of low-density, dry snow fell. Even though temperatures were not as cold as temperatures in the Rocky Mountains, the low temperature at Crystal Mountain dropped to -1°F on February 3 and 4. High temperatures during the week of cold weather reached only into the teens.

After two dry days, snows returned to Crystal Mountain on February 5. Back to back storms left daily snows through the 12th. The storms totaled 37 inches of snow with 2.97 inches of water equivalent plus 0.45 inches of rain on the 11th. Strong west winds started to blow on the 10th and transport snow into starting zones. Control work with explosives on the morning of the 11th released 15 soft-slab avalanches. Control teams reported the slabs were poorly adhered to the old snow. Snows, winds and rains continued on the 11th. West winds of 35–48 mph closed the top of the mountain and turned the soft slabs into hard slabs. At 0530 on February 12, skies were clear and the temperature was 15°F . Winds were light from the northwest. By afternoon temperatures had only warmed into the mid 20s. Avalanche control work with hand charges produced another 11 slides; all were hard slabs and ranged from 1–3 feet deep. The control teams had also observed that the winds had caused snow loading to occur lower in the starting zones than usual, and that lower shot placements tended to be more effective.

Accident Summary

During the afternoon of February 12, Crystal Mountain third-year pro-patroller Mark Billington and Richard O'Neill, a visiting patroller from Schweitzer Basin, Idaho (on a ski patrol work exchange) were skiing together. Both men were on duty and in uniform when they headed to an area called Exterminator Ridge. Along the east side of the ridge was a permanent rope closure, posted with "closed" signs to keep skiers out of a steep, rocky avalanche area.

Billington and O'Neill skied part way down the rope closure before they ducked under rope to gain entry into Reynold's Chute. Earlier that morning explosives had been tossed high into the chute but no avalanche released. O'Neill waited next to a tree near the top of the chute while Billington started down. About half way down the chute Billington was forced to stop. To his chagrin the chute narrowed into a tight neck and exposed rocks blocked his descent. While standing in the middle of the chute he heard a muffled "whoompf" and felt the snow collapse beneath him but nothing moved. He shot a nervous glance upwards to O'Neill.

It was 5–10 seconds later when Billington heard another "whoompf," but this time the snow above and below him fractured and started to slide. Billington swung his skis into the fall line of the chute. Instantly a wave of snow pushed him through the gap between the rocks. The avalanche stripped him of his hat, goggles and both ski poles. He was moving fast, but couldn't see anything as the avalanche flushed him down the chute. His right ski popped off and moving snow turned him around backwards. Soon his left ski released and now free of all his equipment he started making swimming motions. Billington was able to roll onto his belly and kept swimming with the flowing snow until it stopped. He ended up on the surface.

Avalanche Data

Billington classified his avalanche as an HS-AS-2-O. He released two separate slabs simultaneously low in the gully at an elevation of 5,600 feet. Both were hard slabs and both were about 1 foot deep; combined, the two extended 100 feet across the gully. At the neck the moving snow reached a depth of about 8 feet which explains why Billington didn't hit any of the exposed rocks. Reynold's Chute faces northeast, and this avalanche fell about 200 vertical feet.

Comments

Reynold's Chute was a permanently closed area for skiers and ski patrollers. That afternoon even though the chute had been tested with explosives earlier in the day, the snow conditions and other control results indicated it was a very dangerous place to be. This avalanche was not a post-control release. The strong winds caused loading lower in the path

than usual, and the control team simply tossed their charge too high in the gully to be effective. The slab was only waiting for a trigger. Billington was lucky that only the lower portion of the gully released. The small slide enable him to swim in the flow of the avalanche. And once again swimming motions—he said he did a crawl-type stroke—proved to be effective and enabled Billington to get to the surface. Even in this small avalanche he was very lucky that he wasn't injured or even killed. Years earlier another skier was less fortunate (see accident 80-14).

85-8 FEBRUARY 21, 1985

Alta, Utah

1 out-of-bounds skier caught and buried

Weather Conditions

After 6 days of dry and sunny conditions, snow started to fall at the Alta Ski Area late on February 19. By the morning of the 20th Alta had received 10 inches of new snow and the light snow continued to fall through the day and into the night. By morning of the 21st skies had cleared, and snow stake showed another 5 inches of new snow had fallen. The water equivalency of the storm total was 1.87 inches. At 0530 the temperature was 13°F, and it would warm to 32°F that afternoon.

Accident Summary

On the morning of February 21, Utah skiers turned out in droves at the local ski areas to enjoy the fresh powder and sunny skies. One of those skiers, Ron Gregory, 34, of Salt Lake City, headed up Little Cottonwood Canyon to Alta. He had brought with him climbing skins and his avalanche rescue beacon, but intending to ski only within the ski area he stowed his gear in a locker at the base of the ski area. Gregory managed only one run off the Wildcat ski lift when the crowded lift lines soured his desire to ski the ski area. Wanting to ski less crowded slopes Gregory decided to venture into the backcountry. He returned to the base area and retrieved his skins and beacon.

Gregory took the rope tow to the Albion Lift. While riding up Albion, Gregory spotted a backcountry skier traversing a steep west-southwest facing slope. With skins on his telemark skis Gregory headed to Sunset Ridge. Alone, he was afraid to ski off the ridge until some other skiers arrived. Gaining confidence with the arrival of other skiers he asked if they would watch him ski down. They agreed, and Gregory skied off the ridge toward the bottom of Catherine's Pass.

Gregory took off his skis and hiked up Catherine's Pass and headed to the north and west toward Mt. Wolverine (10,795 feet). In a small bowl off Wolverine he met a family from New York on their first trip to Utah. About 20 tracks snaked down the bowl. Looking over toward the Solitude Ski Area a southwest-facing backcountry bowl had been skied from "side to side." The only avalanche activity he saw was off East Cardiff, and that avalanche he thought had been triggered by explosives the day before. At this point Gregory decided to ski down Patsy Marley, a southwest-facing mountainside to the east of Albion Basin, back into the Alta Ski Area. At about 1330 hours he skied off Mt. Wolverine by traversing to the west and downward through the scattered trees. Along the way he occasionally jumped up and down with as much force as possible just to see if he could initiate any local failures. He got nothing.

Gregory stopped his traverse at the last sure safe spot to survey the slope below. He felt a small triggered release was possible. He thought that such an avalanche would be very small and that he could ski out of its way, and such an avalanche would not reach the ski area below. There were no skiers below him, so he started down. His skis carved through the fresh snow, spraying snow up onto his body as he linked his first few turns. By about Gregory's sixth turn something was wrong; he tells what happened next: "I saw the snow cracking on my right side and ahead of me. I looked further to the right, and I could see snow fracturing into sections about 3 square feet and then into smaller sections. I then looked left and in back I saw my last few tracks disappearing and the fracture line forming above and all around me. The avalanche didn't start at the fracture line and move down, but seemed to all move in unison—the snow above me, below and on both sides of me began moving instantly. I thought of skiing

out but couldn't seem to move diagonally, only downward."

At first the avalanche was not moving all that fast. He remembers having enough time to think about wanting to remove his skis, but he didn't think he would be able to undo his safety straps.

In seconds this relatively slow-moving avalanche accelerated. A powder cloud formed and Gregory lost visibility; he could feel and hear wind. Gregory continues his story: "I knew I was in real trouble. A few seconds later I hit something—maybe a rock—that was hard. It flipped me up, and I hit something else hard. Then I hit a branch or small tree and heard and felt it snap and I pushed it away from me. I hit several other things but I'm not sure what. Each collision hurt and knocked the wind out of me. I couldn't see them coming and wasn't expecting them.

"Again I began to accelerate even faster and I consciously thought that I was moving fast enough that when I hit a tree it would be all over for sure. I tried to decide which would be the best way to hit but figured it didn't really matter. I knew that there were trees and cliffs all over where I was headed. I assumed I was dead, for sure. I spread my arms slightly to help balance and keep me up in the snow and grimaced waiting to hit a tree.

"My speed now was faster than I care to recall; it seemed it was like tucking High Rustler [a very steep expert ski run at Alta] from top to bottom. On I flew and then in a few more seconds I really did fly. I was launched off something, and I was airborne. I was up for what seemed like a hell of a long time. Then I landed. I sank in a little but wasn't hurt. After landing it seemed as if I wasn't moving with the snow any longer and it was over. I could still move and began struggling to get higher, but I don't know if I was moving up or down.

"Then the snow began pounding down on me...it solidified instantly. I wanted to get my hands to my face but didn't make it. I could barely wiggle my finger tips, and so I decided I would use them to dig a tunnel to my face. I tried this but obviously didn't get too far. Then frustration and panic set in and I wanted to move, God I wanted to move. I think I flexed every muscle in my body as if I could move the whole mountain, but nothing moved. I realized it was stupid to panic and struggle and that I should just try to relax.

"I started to calm down and it seemed like a surrealistic dream or nightmare. I'm not sure if the things I remember as happening next were after [a rescuer] cleared my airway and I began breathing or while I was still underneath the snow. I remember dreaming and there was lots of pain...I can't remember what hurt, just that it was seemingly unbearable."

Rescue

Amy Kadleck, a long time Alta skier, was riding the Albion lift when she heard a rumble that developed into a roar. She first thought the ski area was doing avalanche control work as she watched the avalanche tear down the steep slope. When the avalanche poured over the cliffs it looked like a waterfall and caused a huge powder cloud. Alta patroller Jeff Brewer was also riding the Albion lift and watched the powder cloud and moving snow envelope the summer road and pile into a beginner ski run. During the winter, skiers from the Albion lift can ski down the snow-covered road to reach their homes. At 1356 hours—before the powder cloud had settled—Brewer had radioed ski-patrol dispatch about the avalanche. Kadleck had to wait until she reached the top of the lift to report the slide.

Ski patroller Dan Howlett was in the main the office when the avalanche was reported. He hopped on a snowmobile and headed toward the avalanche. As he drove he heard another patroller report over the radio that there was a skier track going into the slide. While racing up a ski run Howlett flagged down Dr. Rick Brown, a medical doctor that skis with the patrol, and towed him behind the snowmobile to the slide. Patrolmen Gus Gilman, also riding a snowmobile, pulled up to the debris at the same time, about 4 minutes after the dust cloud had settled.

Howlett and Gilman turned their beacons to receive and started to search the debris below the summer road. They found a broken ski and a pair of ski poles, though one pole had been tossed just outside of the debris. They soon picked up a beacon signal and quickly zeroed in on the buried skier. They knew the victim was buried deeply. With their beacons set to the lowest receive setting, they could not hear a signal.

The patrollers started to dig. Three minutes after arriving on scene they hit Gregory's boot buried 2 feet below the surface. Additional patrollers arrived so Howlett

stepped out to become Accident Site Commander. It took four rescuers digging with shovels another 5 minutes to uncover Gregory's face buried 5 feet down.

Hypoxia (or lack of oxygen) had turned Gregory's skin dark blue by the time rescuers had uncovered him. His teeth were shut tight, and snow was firmly packed inside his gums, lips and in his nostrils. When the snow was cleared away from his nose and mouth Gregory started gasping for breath and then to breathe on his own. His color quickly returned to normal. The ski patrol took Gregory down the mountain where an ambulance took him to a nearby hospital. He was kept overnight and released the next day.

With the rescue of Gregory completed the ski patrol's job was only partly finished. Fearful that the avalanche may have caught an unsuspecting skier within the ski area the debris had to be searched. Two separate beacon searches were tried and three avalanche rescue dogs searched the debris but showed no interest. Finally about 100 people probed the entire debris area without results. Satisfied that no one else had been buried the search effort was called off at 1645 hours.

Avalanche Data

Gregory triggered the avalanche on a south-west-facing, 40° slope. The fracture line was 2 feet deep and extended 150 feet across the slope. The avalanche fell 1,200 vertical feet; Gregory was carried about 1,000 vertical feet over trees, rocks, mine dumps and a cliff. The avalanche was classified as an SS-AS-3-O.

Comments

Gregory ended his narrative with a simple sentence, "God or ski patrols watch out for fools." Whether it was divine intervention or the well-trained ski patrollers that saved Gregory, this accident illustrated two important points. Even though Gregory was skiing alone he wore his avalanche beacon and rescuers were able to find him quickly. A beacon left at home or turned off is no good (see accident 85-19). Secondly, this rescue demonstrated why rescuers should always do a beacon search even if it is not known that the victim was wearing a beacon. There is always the chance that someone buried in an avalanche—like Gregory—might be wearing a beacon.

85-9

FEBRUARY 22, 1985

Powder Mountain, Utah

1 out-of-bounds skier caught, buried and killed

Weather Conditions

No detailed weather observations were recorded, but other Wasatch ski areas on the morning of February 22, reported overcast skies and occasional light snows. Only a dusting of new snow had fallen and winds were generally calm. It is likely that the storm that dropped more than 1 foot of snow over the Wasatch earlier in the week (see accident 85-8) also

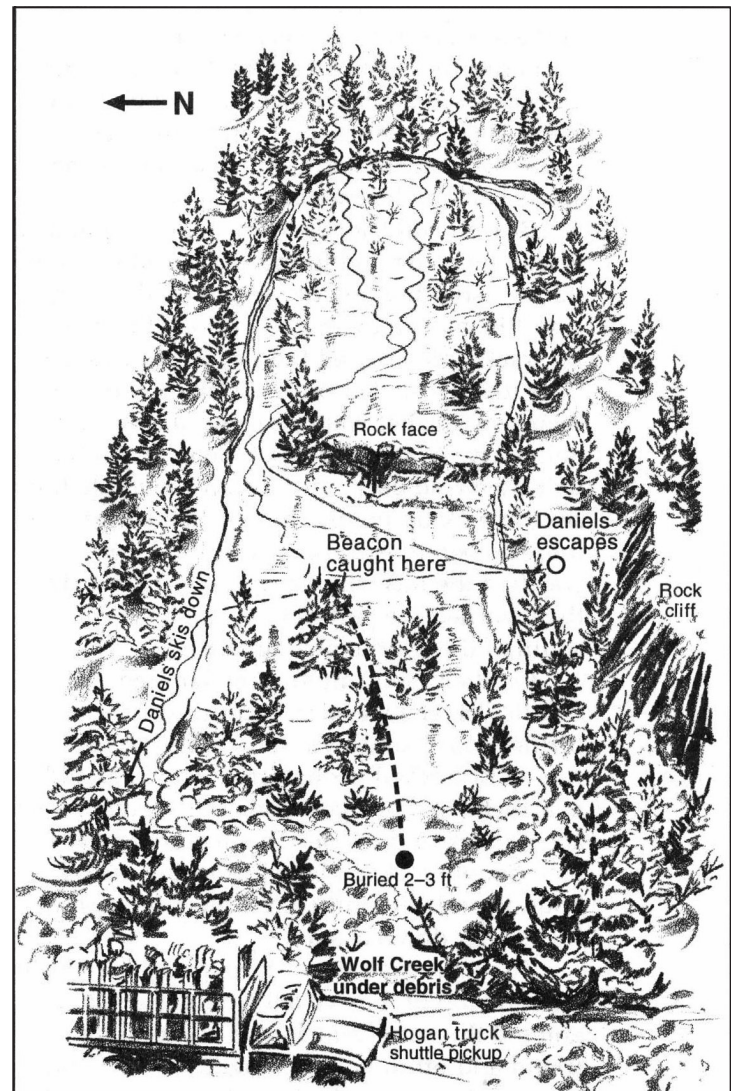


Figure 30. Accident 85-9, Powder Mountain, Utah, February 22, 1985.

blanketed Powder Mountain (about 18 miles northeast of Ogden in the northern Wasatch Mountains) with similar amounts of new snow.

Accident Summary

By the end of the week undisturbed powder from Wednesday's storm (February 20) could still be found in the backcountry, just beyond ski area boundaries. On Friday the 22nd, two Ogden men, Charles Beacon, 29, and friend John Daniels, headed to the Powder Mountain Ski Area. Their goal was to ski the "Powder Country" or what the locals called the "backside." From the top of the ski area skiers can ski the groomed runs on one side or drop off the "backside" to ski powder. Without hiking, the runs are long and vary from open bowls to steep tree skiing. The ski patrol does avalanche control work in the area not just for the safety of the skiers but also to keep the road (Utah 162) open to the ski area. The "backside" runs all end about 2 miles down the canyon from the ski area. A shuttle, actually a livestock truck with benches and ski racks, ferries the skiers back to the base area.

Beacon and Daniels were not disappointed Friday morning and found untracked snow in the tree-studded powder slopes on the "backside." However, by midday Friday too many ski tracks crisscrossed the slopes—at least for their liking—so Beacon and Daniels worked their way further south, beyond the ski area boundary. At the bottom of their ski run the pair traversed back north or up-canyon to the shuttle pick-up point. The shuttle had arrived minutes before and the driver, Bill Hogan, watched the men shuffle up to the truck. He then warned the pair not to ski the slopes south of the shuttle pick-up area.

On their next run the men ignored the shuttle driver's warning and ventured even further south, or down canyon. Besides the lure of untracked snow further south, an old avalanche had bridged Wolf Creek giving easy access back to the road. This feature and the fact that other skiers were venturing out-of-bounds probably influenced their decision to ski further down canyon.

The pair skied down through open trees to near the top of the avalanche slope. As they entered the path Daniels was ahead of his friend and off to Beacon's right. A short, but steep rocky area and a large tree caused both skiers to turn north to get around the obstacles. As Daniels cut back to the south, just

below the rocks, he sensed that something had happened and glanced upslope only to see moving snow headed towards him. He skied a fast traverse to the south to escape. He turned in time to see Beacon caught in the slide and then disappear in the moving snow.

Bill Hogan, the shuttle driver, had just stopped to pick up a skier and also watched the avalanche. He said it released just as Daniels turned left around the rocks and the tree, and the fracture line then propagated up hill into the trees above. He watched Beacon round the tree and ski down toward the snow bridge. From behind, the avalanche quickly overtook Beacon and covered him in the moving mass. The debris plowed into the creek and pushed up onto the highway. A small tongue of debris 6 feet deep blocked on the highway. Before grabbing his radio to report the avalanche he glanced at his watch: it said 1414 hours. He and his load of skiers—turned rescuers—drove a short distance to the slide.

Rescue

As soon as the snow stopped moving Daniels skied back to the north and skied down the north edge of the slide. At the bottom of the slide he joined the other would-be rescuers from the shuttle to probe with their skis for Beacon. While searching Daniels found one of Beacon's skis on the south edge of the debris. Within 5 minutes the first of almost 50 rescuers, ski patrollers and skiers converged at the avalanche.

Rescuers quickly identified the most likely burial area, based on the last seen area and Beacon's ski. It also helped that the avalanche was very narrow, not much wider than 50 feet. Accident Site Commander Theon Palmer organized two fine-probe lines of about 15–20 people to search the likely burial area. The probe lines had barely started moving when a strike was made.

Diggers quickly uncovered a hand and then Beacon's face from under 2.5 feet of snow. He had been buried in a sitting position with his arm up stretched. He was unconscious, and rescue breathing was started as soon as the rescuers had dug out his chest. Beacon's feet were still buried. It took another 5 minutes of digging to completely free Beacon. He was pale when uncovered and not breathing. The only obvious wound found by rescuers was slight bleeding from a small hole in Beacon's head. Still unconscious and not breathing he

was removed from the snow at 1440 and was transported back to the ski area. A Life Flight helicopter flew Beacon to a Ogden hospital where he was pronounced dead on arrival. He had died instantly of a broken neck.

Afterwards patrollers examined the tree below the last seen area and found a portion of his hat stuck to a small stub on the tree trunk.

Avalanche Data

The avalanche was classified as an SS-AS-3, fracturing up to 2 feet deep but only 80 feet wide. The slab released on a west-facing slope at an elevation of 7,600 feet and fell 400 vertical feet. The slope angle where the two skiers triggered the avalanche was 37°. Debris in the creek was estimated to be 20 feet deep, and it took several hours after the accident before the debris on Utah 162 was cleared.

Comments

Certainly Beacon and Daniels would have been wise to follow Hogan's warning not to ski out-of-bounds. In the width of a rope or a sign, skiers leave the safety of the managed snow within a ski area to the uncertainty of the backcountry. On the day that the two chose to venture out-of-bounds the snowcover was mostly stable. Unfortunately as the two skied past and around the rocks they found a pocket of unstable snow. UAFC forecaster Duain Bowles visited the area the next day and found the snow cover in the surrounding area to be strong and stable. However, immediately around the rock outcrop depth hoar had formed and it collapsed under the weight of the skiers. His conclusion was that this avalanche was an isolated event. After the accident 30 explosive charges were tossed before the "backside" was reopened on Saturday. No other avalanches occurred.

Afterwards Daniels felt that they should have been wearing rescue beacons and carrying shovels; however, the gear would not have changed the outcome of this accident. Proper rescue gear and safe-travel protocol always reduce one's avalanche risk, but once caught in the fury of an avalanche, a victim's survival often depends on luck. Sadly, on this day luck did not ride with Charles Beacon.

85-10

MARCH 2, 1985

Hatcher Pass, Alaska

3 snowmobilers caught, 1 partly buried, 2 buried and 1 killed

Accident Summary

On Saturday afternoon, March 2, a group of five Alaskans on snowmobiles left the Little Susitna Bridge in Willow and headed to the Hatcher Pass area. At about 1615 the group triggered a large slab avalanche that caught the three lead snowmobiles. Traveling at the front of the group Keith Lovejoy was flipped off his machine and tossed into the moving snow. When the avalanche stopped he was buried to his waist. Lovejoy was left to dig himself free while others in the group searched for the two other buried men.

Casey Cleper was also swept off his machine, but unlike Lovejoy who was buried with his head out of the snow, Cleper was buried head first, only his feet stuck out of the snow. His friends quickly spotted Cleper's feet and freed him from the snow. Cleper then assisted in searching for Bobby Barclay.

After Cleper and Lovejoy were free, another member of the group was sent back to the trailhead to get help. The other three continued searching for several hours by digging and probing with willow branches.

Sometime early in the evening the first rescuers arrived and started an organized search. At 2030 a probeline found Barclay in 10-12 feet of snow. He had been buried 5 feet below where Cleper was found. He was taken by helicopter to a hospital in Palmer where attempts to revive him were unsuccessful.

Avalanche Data

In most avalanche accidents the victims trigger their own avalanche. This accident was no different. In the brief newspaper article about the accident Lovejoy tells of snow sliding out from underneath him.

Comments

The lack of data on this accident prevents analysis.

85-11

MARCH 4, 1985

Mineral Fork, Utah

2 helicopter skiers caught, 1 injured, and 1 buried

Weather Conditions

At Snowbird Ski Area in Little Cottonwood Canyon 11 inches of cold, dry snow was reported on the morning of March 3. The light, 5 percent density snow (50 kilograms per cubic meter) continued to fall that day and evening. On the morning of the 4th, another 9 inches had fallen. During the day the temperature reached into the upper 20s.

Accident Summary

On Monday, March 4, a Utah Powderbirds group of heli-skiers was in Mineral Fork drainage in Big Cottonwood Canyon. At about 1100 hours rear guide Peter Whittaker stood at the top of a open powder slope and watched his group ski down the southeast-facing slope. The lead guide and eight skiers were at the bottom when the lead guide called over the radio and asked Whittaker to ski a different aspect and to check conditions for the next run.

Whittaker glided over to the slope and shoved off. He made about two turns when he noticed that everything was moving. The whole slope around him had fractured and was sliding. The slab quickly broke up and gathered speed. He could barely see above the moving snow and the rising powder cloud, but he could see some trees and they were coming up fast.

In seconds he was slammed into a tree. The force of the avalanche pushed his head and shoulders around one side, and his legs were wrapped around the other side. Just when he thought he might black out the avalanche stopped.

He still had his radio and could hear the pilot saying he could see him, but the next transmission scared him. Over the radio he heard that one of the other skiers had been buried and was missing.

From below an "island of safety" the eight skiers and their guide watched, probably in amazement, as their rear guide triggered an avalanche. Within seconds their amazement probably changed to fear when they realized the avalanche was headed right towards them.

Their so-called safe spot was not going to be so safe, so the skiers took off as fast as they could skate in the soft snow.

Only one skier, a young woman from New York, wasn't fast enough. The avalanche bowled her over from behind and buried her.

After the snow stopped the lead guide quickly did a head count and found that one client was missing. Still pinned against a tree, Whittaker grabbed his radio and in a dazed state asked for his skis and poles. That transmission was a good-enough indication that he was relatively okay and would have to wait. Back on the debris the lead guide switched his avalanche rescue beacon to receive and started to search. Almost immediately he picked up her signal and in minutes had dug the buried woman out from 3 feet of snow.

She had been buried face down and was not breathing, but after her mouth was cleared she started to breathe on her own. It appeared that she had also suffered seriously leg injuries. Her skis had been stripped off her feet and her legs were folded backwards. The helicopter was called in and within 6 minutes of the avalanche she was being flown to a nearby hospital. There her leg injury was found not to be serious. She later walked out on her own from the hospital.

While the guides rescued the woman, Whittaker waited, still partly buried against the tree. While he waited he could feel swelling in his abdomen and felt the pains in his body increase. After the woman was evacuated other guides returned to rescue Whittaker. Quickly, he was loaded into the helicopter and flown to the hospital. He had suffered a ruptured spleen, broken ribs and a severely sprained knee. He eventually made a complete recovery.

Avalanche Data

The avalanche that Whittaker triggered that almost killed him and the woman skier was a soft slab. No other specifics about the avalanche were given, but the one report stated the sliding layer was once again the weak layer of faceted snow that formed during the intense cold period in late January and early February.

Comments

This accident showed that even the experts are sometimes fooled, but when things go wrong, properly trained and equipped skiers with

beacons and shovels can save a life. Avalanches were nothing new to Whittaker. Working as a professional mountain guide and professional ski patroller, he was well trained and experienced around avalanches, but because he worked in the mountains full time he had had a few close calls. In the late 70s he was caught and injured in an avalanche. A few years later in 1981 (see accident 81-22), he witnessed the destruction and carnage of a large avalanche that caught 22 climbers and killed 11, but it was this little avalanche in Mineral Fork that changed Whittaker. He came away from this avalanche humbled and much more respectful of avalanches. He later said, "I learned not to be so concerned about making nice tracks and getting face shots when I'm skiing. I learned to be a little more conservative, a little more aware of that slope. I also learned that there really is no such thing as an 'island of safety.' Safety is all relative. Now, I'm always prepared for the worst. Sometimes, I'm lucky."

"Always prepare for the worst" are good words to live by for people who work and play in avalanche country.

85-12
MARCH 10, 1985

Eagle River, Alaska

1 backcountry skier caught and killed

Accident Summary

While only a few miles from Anchorage, the South Fork of the Eagle River area is both a housing development and a backcountry adventurer's dream. Modern homes are perched at and just below timberline. Right outside the front doors and the back doors are the wild Chugach Mountains. Though the immediate mountains are not as rugged as many of the Chugach peaks, the rounded peaks around South Fork reach well above treeline.

It was probably these qualities that attracted Captain Fernin Koch, 29, to the area. A flight surgeon at nearby Fort Richardson, Koch was an avid outdoors man who moved to Eagle River 4 or 5 months earlier.

On Sunday morning, March 10, Koch and his two dogs left their home to ski one of the

unnamed peaks in the area. After a short walk up Hiland Road, he turned left and started the 2,000-vertical-foot climb up the mountain. After a quick climb through the open willows at the bottom of the slope, he was soon kicking steps in hard snow on a broad open slope above treeline. The dogs followed, and nearby residents from the comfort of their homes followed his progress with binoculars.

At the top of the mountain Koch put his skis on and soon started down, making a few tentative turns on the hard snow. One of the dogs refused to follow down the steep slope. Residents watched as Koch side-stepped back up to the disobedient hound and drug it down. He pulled the dog down far enough so that the dog would have to follow. Koch then started to ski again.

From below, several residents watched the entire side of the mountain fracture and avalanche. Engulfed by the raging torrent of snow Koch and his dogs were swept down the hour-glass-shaped slope. The local volunteer fire department responded and found the victim within 15 minutes of the avalanche. They found his battered body on the surface of the debris, but the report makes no mention of what became of the dogs.

Avalanche Data

The avalanche that Capt. Koch triggered was a large hard slab (HS-AS-4). It fractured 410 feet across the heavily wind loaded 34° slope. The fracture line varied in depth from 4–6 feet, and the avalanche fell almost 2,000 vertical feet. So powerful was the avalanche that all the branches of a 40-foot spruce, near the bottom of the avalanche, were broken off for the first 22 feet above the ground. Snow was plastered on the trunk of the tree for its entire height.

Comments

The next day avalanche experts Doug Fesler and Jill Fredston climbed up the peak to learn how Capt. Koch triggered such a large avalanche. They found several clues Koch no doubt would have also observed and should have warned the Captain that he was venturing into a deadly trap. First, the few spruce trees at the bottom of the slope were missing branches on their uphill sides. Second, on the top Fesler and Fredston experienced hollow, drum-like sounds, and shovel-shear tests showed the snow layers on the steep wind-loaded slope to be poorly bonded. It is not

known if Capt. Koch had avalanche training, but it seems from the obvious clues of instability that were present that he had no training, or maybe he dismissed their message because he had already skied the same bowl earlier in the winter. Had Koch had a little knowledge about avalanches, he probably would have picked another spot to ski that day.

85-13

MARCH 15, 1985

Big Cottonwood Canyon, Utah

a close call

Weather Conditions

Early on March 10 light snow started to fall at the Solitude Ski Area in Big Cottonwood Canyon. By the morning of the 13th, 25.5 inches had fallen. During the storm winds were light from the north and east and caused little if any loading of leeward slopes. March 14 was sunny and the high temperature reached 38°F. The 15th was also sunny, but cold in the morning. During the afternoon the high reached 39° F, and winds were less than 10 mph.

The Utah Avalanche Forecast Center issued their morning backcountry avalanche report at 0730 on Friday, March 15. It said the danger was rated high on northwest to northeast to east aspects 30° and steeper between 8,500 and 10,500 feet elevation. The report went on to say that large, deep slides, from 2–6 feet deep, were likely and that these slopes should be avoided.

Accident Summary

In Salt Lake City, spring seemed to be in full bloom and in the air was perhaps a little amour when Scott Ogilvie, 23, suggested a one-day ski tour to his friend Barbara Sheldon, 25. Sheldon was fairly new to backcountry skiing. She was more of a “golf-course skier,” but to improve her skills she took a cross-country downhill course offered by the University of Utah. Ogilvie was also in the course and their friendship blossomed.

Ogilvie planned a one-day tour starting in Big Cottonwood Canyon. Their route would take them part way up Beartrap Fork and then

angle to the northwest up the side of the drainage to the top. From top they would ski out Mill Creek.

March 15 was another sunny and warm morning in Salt Lake City when Sheldon arrived at Ogilvie’s home at 0900 hours. Sheldon borrowed some heavier-duty backcountry ski gear from Ogilvie’s sister. Ogilvie meant to call the UAFC hotline but in the rush to leave he forgot. He wasn’t too concerned as the weather for more than a week—in the city—had been sunny and warm. He knew that the greatest avalanche danger occurred during times of precipitation.

In separate cars they headed to Mill Creek Canyon. At the end of the plowed road Sheldon parked her car and joined Ogilvie for the drive to the trailhead in Big Cottonwood Canyon.

At Beartrap Fork in Big Cottonwood Canyon the pair attached climbing skins to their skis and started the climb to the ridges. The initial climb from the canyon floor up Beartrap Fork was fairly steep but the climbing eased further up the drainage. Then the ascent route followed mostly gentle terrain with a southerly aspect. The two made good time skiing on frozen sun crust.

About a mile up Beartrap Fork the pair turned west and headed to the ridge separating Beartrap Fork and the Mill D drainages. Their goal was a saddle at about 9,100 feet on the ridge. From the saddle the rest of the tour would be all downhill, or so they thought. The climb to the saddle went quickly and once at the saddle they enjoyed a well-deserved break with a leisurely lunch in the solitude of the mountains. So far they had not seen anyone else. They reveled in the beauty of the day, the warmth of the sun and their overall good fortune to be alone, but together in the mountains.

After a lounging in the sun after lunch, Ogilvie was getting restless. While Sheldon was content with a short tour with no particular destination, Ogilvie wanted to “cover ground.” After some prodding by Ogilvie the paired started off. With climbing skins still on they traversed a west-facing slope covered by aspens. Though the slope was not steep Ogilvie mentioned the possibility of avalanches and that both needed to think about avalanches as they continued the tour.

Once out of the aspens the pair angled over to a narrow ridge. They figured they

could follow the ridge down into the basin and continue their tour to Dog Lake. On both sides of the northerly-pointing ridge were steep, open slopes. Shaded from the sun the north-east-facing slope to their right looked soft and enticing; however, it was not an option since neither Ogilvie or Sheldon carried any avalanche rescue equipment. As the pair gazed across the tempting slope Ogilvie mentioned that if they were in a larger group and all carried avalanche rescue beacons, he would ski it. But today, lacking rescue equipment and skilled friends, he and Sheldon should follow the ridge down.

The ridge was fairly narrow and neither felt comfortable trying to ski it, so they left their climbing skins on. This allowed them to ski in control straight down the narrow ridge. Travelling one-at-a-time Ogilvie went first and Sheldon followed. As they descended the ridge steepened. On a small and somewhat flat spot on the ridge Ogilvie stopped next to a bushy pine tree. Below him the ridge ended on the steep snow-covered slope. It was the same slope that they did not want to venture onto. Ogilvie figured he was safe next to the tree. Besides being dead center on the ridge, the tree was the only object around that was directly connected to the ground. Ogilvie was troubled, unsure of what to do next and knowing that all too soon Sheldon would be down to his tenuous spot.

Ogilvie was perplexed, but before he could continue pondering their predicament he remembers muttering "Oh sh—!" In the blink of an eye the mountain around him started moving. To his right and left avalanches were running. He glanced up at Sheldon; she was stopped, but snow on both sides of her was moving. She watched the northwest slope slide; he watched the northeast slope. When the snow stopped they were left perched on a narrow peninsula of snow about 12 feet across, but just below Ogilvie the peninsula ended with a 3–4-foot deep fracture line.

Caught off guard by their close call Ogilvie knew he had to do something. He started by apologizing to Sheldon for getting them into this little incident. She was not too bothered by it (Ogilvie attributed that to her inexperience rather than her confidence in his abilities) and took the avalanche in stride. She thought Ogilvie had things under control. It was 1430 and the next decision was an easy one. They chose to retreat.

The pair started side-stepping back up the ridge. Stray cracks and detached blocks littered both sides of the narrow ridge. They faced to the west as they gently climbed; to them this side of the ridge looked to be the most suspect. On this side the fracture line was 3 feet tall, but on the other side it was 4 feet. It was a very tense 15 minutes while they side-stepped up the steepest portion of the ridge, thinking that at any second the snow beneath them might slide. Finally they reached exposed rocks along the ridge and safety. They removed their skis and continued the rest of the climb on foot. Along the way they found a large block of snow with their ski tracks running across the top of it. In another area they found the fracture line had cut through their ski tracks.

Ogilvie wasn't too keen to ski any more slopes, but to get out they had one more suspect slope to cross. In the distance they heard a helicopter, and checking his watch it was starting to get late: 1500 hours. The helicopter was not far away, so Ogilvie decided to try and attract their attention. Waving a ski back and forth it was not long before they were seen. As the helicopter approached, fear returned to Ogilvie about what would they think. He felt the helicopter people might judge Ogilvie and Sheldon to be fools or jerks for triggering an avalanche, or even worse, charge them an exorbitant fee for a short ride back to their car.

The Utah Powderbirds' helicopter hovered over the ridge and dropped off guide Jim Reid about 50 yards away from Ogilvie and Sheldon. When the helicopter flew off the two rushed over to Reid. Instead of a critic Sheldon and Ogilvie were relieved to be met by someone with a warm smile, and soon the helicopter returned to pick up the three.

The ship was low on fuel so instead of going back to their car Ogilvie and Sheldon had to take a side trip to Park West. From there a Powderbird's van drove them and other clients to the main office in Park City. Reid volunteered to drive them back to Sheldon's car after work. It was after dark when they got back to her car.

Sheldon invited Ogilvie back to her parents house for a late dinner and to meet her folks. On the way over Ogilvie got Sheldon to agree to not tell her parents about the day's adventure until later. He wanted to make a good first impression; he did not want to appear "as a jerk who nearly killed their

daughter." Ogilvie reported the evening was a success, and that he and Sheldon continued to see each other but no longer go backcountry skiing together.

Avalanche Data

No details of the slab avalanche were recorded other than the slope on the northeast side of the ridge was about 35° in steepness and northwest side was almost 50° in steepness. The slopes faced mostly to the north and released from an elevation between 8,800 and 9,000 feet.

Comments

Several mistakes made in Salt Lake City led to this close call in the mountains. First, Ogilvie neglected to call the UAFC avalanche hotline. The report was right on in its description of the avalanche danger and in where not to go. Second, he assumed the snow conditions were fairly stable because the weather in Salt Lake City had been so mild. In their favor Sheldon and Ogilvie demonstrated a very important fact that staying alive in avalanche country is best done by avoiding the avalanche prone slopes when conditions are unstable, and not necessarily by carrying or having to rely on avalanche rescue equipment. Even though they were inexperienced, they were "thinking avalanche" and that, with a some luck, kept them out of trouble.

85-14

MARCH 19, 1985

Park City, Utah

1 out-of-bounds lift skier caught, buried and injured; 1 lift skier caught, buried and killed

Weather Conditions

After a cold and snowy first 2 weeks, spring-like conditions were the rule during the middle of March at the Park City Ski Area. The last fresh snow, 2 inches, fell on March 13. Skies cleared on the 13th, but temperatures stayed relatively cool; the high temperatures were slow to climb into the 30s. It was not until the 18th that highs reached into the low 40s and the upper portion of the snow cover turned

from dry snow to damp snow. Some spring melting was finally occurring. The snow surface refroze that night as temperatures dipped into the mid 20s. Skies were clear again on the 19th and the temperature would again climb into the low 40s.

Accident Summary

When an international World Cup ski race visits resort workers sometimes refer to the event and all of its hoopla as a circus. In addition to the regular skiers thousands of invading spectators come to cheer their favorite racers. From the parking lots to the skiers on the mountain, crowd control can be a problem. On Tuesday afternoon March 19, 2,000 spectators lined the women's slalom course at Park City.

To ensure crowd control went smoothly race stewards at the top of the race-lift directed spectators to follow signs to the course. Ten signs and arrows steered skiers to the course. Also, prior to the race the route was publicized in all the major Utah newspapers as well as the official race publication. Because of the large expected crowds and the threat of avalanches due to warming temperatures, the area off the Ridge was closed. Over 3,400 feet of flagged-rope and 35 posted CLOSED signs marked the closure. Two ski patrollers on snowmobiles and two volunteers also patrolled the rope closure to keep skiers out of the area. The race and crowd control ran smoothly, at least until the end of the slalom race.

At 1338 hours, just minutes after the women's slalom race had been completed, the ski patrol received the report of an avalanche close to the course. Two brothers, Robert, 20, and Dave Beckett, 23, looking for a shortcut to the race course had ducked under the rope closure. The brothers started to traverse the heavy, wet snow in the Gobblers Point South area. Just below a small rock band the wet snow collapsed around them starting a small, wet-slab slide. The slide gained in size and momentum. Robert was in the moving morass of snow and was carried down. He was carried over a 20-foot-high rock band and through a grove of aspen trees before the moving snow buried him on an old and unused cat-road. Luckily his hand stuck out from the debris. The slide continued to ooze down the slope.

Also on their way to the race course were Marilyn Harrell, 36, and her husband A. Jackson from Kinston, North Carolina. They were skiing down the marked route along the

Gotcha Cutoff road, the only route for skiers to the race course. At the same time, surging out of the trees from above, the wet-snow avalanche piled onto the trail. Marilyn had a moment to react to the moving snow, but maybe fear and panic wiped out her thoughts of escape. The wet snow buried her on the road. Other skiers, including her husband, skidded to a stop as the snow piled onto the road.

Rescue

Patroller Duffy McCabe headed up the first rescue column. He and four other patrollers and a rescue dog arrived on scene at 1343, 5 minutes after the accident. Already almost 100 skiers, their route blocked by the slide, were at the slide. Most were already searching the debris with skis and poles but others were wandering about. McCabe organized the hasty search with about 80 skiers volunteering to help. In addition to the few probes carried by the patrollers, the searchers used skis, ski poles, and even bamboo poles to spot probe the debris. With the shovels also brought by the patrollers, searchers started digging in the last-seen area.

During the hasty search rescuers found Robert Beckett. He had been buried for 12 minutes and suffered from bumps, cuts, bruises and hypothermia. He was quickly taken down the mountain and transported to a Salt Lake City hospital.

At the same time Beckett was uncovered (1350 hours) the second column of ski patrol rescuers arrived. Within another 5 minutes the first probe lines were started. Skiers continued to pour into the area. By 1405 hours up to 200 people were at the site. To help search rescue dogs were brought in. Crowd control was now a real problem.

While most skiers helped search, some were just wandering over the debris calling the rescue dog and trying to pet him. These people were asked to help, but some were simply ordered away. Locating and keeping track of eyewitnesses in the huge crowd was another serious problem faced by the ski patrol.

At 1417 hours probers found Harrell's lifeless body in a crouched, somewhat self-protecting position under 10 feet of snow. After a burial of 39 minutes she wasn't breathing and had no pulse. Rescuers and doctors started cardiopulmonary resuscitation. They were able to restart her heart and breathing, but she did not

regain consciousness. A medical helicopter flew her to the University of Utah Health Sciences Center in Salt Lake City. Harrell died the next day from heart failure and hypothermia.

Avalanche Data

The day after the avalanche Duffy McCabe returned to the slide area and conducted a fracture line profile along the south flank. There was no crown face or fracture line since the avalanche pulled out away from a rock band. Weather conditions on the 20th were similar to the day of the accident, so snow conditions were similar even though McCabe did his snow analysis at 1245 hours, about an hour earlier in the day than when the Beckett's triggered the slide.

This WS-AS-3 avalanche was on an east-northeast-facing slope at 8,400 feet. The avalanche failed on a stout ice-crust about 2 feet below the snow surface. The slope angle in the starting zone, below the rock band, was 35°.

McCabe also found the snowcover to be isothermal and except for the one ice crust the snowcover was all temperature-gradient (faceted) grains that were undergoing melt-freeze metamorphism. Shear tests were inconclusive, but he noted that there was lots of "weak temperature-gradient snow around the rock bands." Ski penetration was 12–16 inches in the damp snow; however, ski checking in the area produced no other wet slides. He felt the weakness was isolated to the snow around the rock outcrops.

Comments

The instability in the snow was associated with the rock band. This is very similar to the situation that occurred a month earlier at Powder Mountain (see accident 85-9). This is not a surprise as rocks and other large buried objects increase the temperature gradient locally, which can often cause the snow cover to weaken from kinetic metamorphism. The Beckett brothers chose to ski the slope in the wrong place and at the wrong time. One year later the victim's husband filed a \$5.6 million lawsuit against the ski area and the Beckett brothers. The suit contended the ski area was negligent for failing to keep skiers out of the avalanche area and failed to warn Harrell of the avalanche dangers in the area. The brothers were named as defendants, claiming they triggered the avalanche by skiing in a closed and

dangerous area. The suit sought \$5 million in general damages, \$600,000 for lost income, \$50,000 for pain and suffering and \$9,962 in special damages for medical and funeral expenses. The suit was settled out of court.

While a decision about bad luck or negligence was never made by the courts, the ski patrol faced a situation uncommon in most avalanche rescues. Few avalanche rescues suffer (or luxuriate) from too many rescuers, but when avalanche accidents happen in high-use areas, crowd control can become a major issue for rescue leaders. The ski patrol added bullhorns to their stage-one rescue packs to help manage the crowds.

85-15**MARCH 24, 1985**

First Creek, Berthoud Pass, Colorado

2 backcountry skiers caught, 1 partly buried and injured, 1 buried and killed

Weather Conditions

An upper-level storm system blew into the Front Range of Colorado late on March 21 and changed the spring-like conditions back to winter with strong northwest winds. On the morning of the 22nd, the low temperature was -7°F at the 11,314-foot study site at Berthoud Pass. The high temperature that day only reached 15°. Skies on the 23rd remained cloudy with very light snow, and the temperature warmed to 30°F. Though only 5 inches of snow fell at the study site, strong winds at ridgetop levels caused considerable blowing snow and heavy loading of leeward starting zones. Ridgetop winds during this period were strong from the northwest and averaged 30-60 mph. A peak gust of 90 mph was recorded early on the 23rd.

Sunday the 24th saw a significant improvement in the weather. Skies were sunny and winds decreased during the day. The high temperature that afternoon reached 44°F.

Accident Summary

Robert Belter, 39, of Denver and his brother Mike were among a party of seven skiers and snowshoers who spent the weekend at a small,

rustic backcountry cabin in First Creek. The cabin, less than a mile from U.S. Highway 40, is about 2 miles north of Berthoud Pass and just south of Winter Park Ski Area. The cabin and the First Creek drainage area are popular destinations for weekend backcountry skiers. That weekend the two Belter brothers and one other member of the group were on skis while the rest of the group traveled on snowshoes.

Strong winds and blowing snow on Saturday kept the group from venturing much beyond the cabin. But on Sunday the 24th, winds had died and the sun shone brightly. By midday the mild weather enticed the Belters to climb to the top of the drainage. A third person from the group might have joined the brothers for the short trip, but newspaper accounts of what happened that afternoon were vague. It is known that from the cabin the brothers headed northwest toward the saddle between the Twin Cone peaks. Their goal was to ski the broad, open bowl below the saddle. What is certain, though, is at about 1300 hours the group's weekend adventure turned into a nightmare. Shortly after starting their descent, the two brothers triggered a sizeable hard-slab avalanche that swept both men down the bowl.

When the moving snow stopped, Mike Belter was buried to his waist. It did not take too long for him to free himself, but instead of spotting his brother all he saw was a jumbled mass of snow. It is not known whether Mike went to the cabin to get help, or if someone in their group saw the avalanche and the group headed up to the avalanche. One member of the group, John Bryne, snowshoed back to U.S. 40. At the highway he was able to flag down a passing motorist who drove Bryne to the Berthoud Pass Ski Area at the top of the pass.

Rescue

It was just before 1400 hours when Bryne was dropped off at the Berthoud Pass Ski Area. The ski patrol immediately notified the Grand Country Sheriff's Department who in turn notified the local mountain rescue team, Grand County Search and Rescue. Other rescue teams were also notified and responded, including a Flight for Life medical helicopter from Denver. A hasty search team from the top of the ski area set out on skis and snowshoes for the avalanche.

The first rescuers from the Berthoud Pass ski patrol arrived at the avalanche at about

1500 hours, just about the same time as the helicopter arrived. Rescuers and friends of the victim started a thorough hasty search while the helicopter continued to ferry rescuers to the site.

The hasty search effort located several clues, though newspapers failed to mention what clues were found. The papers did mention rescuers were able to position their probe line with confidence because of the clues. It took only about 6 minutes of coarse probing to locate Belter. Shovelers found his body buried in 3 feet of snow. When they uncovered his face at 1545 hours, Belter showed no signs of life. Immediately rescuers attempted mouth-to-mouth resuscitation on the mostly buried Belter, but snow had packed so tightly around the body, no air could be forced into his lungs. It was several more minutes before Belter was dug free and cardio-pulmonary resuscitation (CPR) was started.

Rescuers continued CPR for another 20 minutes until the helicopter returned. Within minutes Belter was loaded into the helicopter and flown to a Denver hospital. There surgeons tried open heart massage, but Belter's burial of 2 hours and 45 minutes had been too long. He was pronounced dead later that evening.

Avalanche Data

The avalanche was classified as an HS-AS-2. The men triggered the avalanche on a south-east- to east-facing slope above treeline. The avalanche fractured 4 feet deep, but no other dimensions were noted.

Comments

This accident highlights a disturbing trend in recent avalanche accidents: avalanche-aware travelers—sometimes without rescue equipment—venturing onto steep slopes during obvious times of unstable snow. These misadventures result in triggered avalanches. At best the avalanche teaches a hopefully-humbled traveler new respect, but sometimes the avalanche encounter teaches a painful lesson ending in serious injury or death.

The weather conditions on Friday and Saturday created the instability and the danger that lead to the avalanche accident on Sunday. Though by Sunday the weather had improved, the instability of the fresh slabs was much slower to change. Avalanches were not unknown to Belter. A member of a large

mountain club, he had attended avalanche-awareness trainings, but under bright-blue skies he and his brother skied onto a steep and freshly windloaded slope. Apparently their pursuit of pleasure overrode all thoughts of self preservation. To make matters worse, the Belters did not carry—nor did anyone else in their group—avalanche rescue gear. Without the gear there was no chance of a speedy rescue that might have saved Belter.

85-16

MARCH 31, 1985

Ski Sunlight, Colorado

1 out-of-bounds lift skier caught and partly buried

Weather Conditions

In late March winter had returned with vengeance to the Central Mountains of Colorado. At the Ski Sunlight, 11 miles south of Glenwood Springs, winter only tightened its grip. From March 28 to the morning of the 31st, the ski area received 48 inches of new snow. The new snow covered a thin ice crust that had formed during spring-like conditions earlier in the month. During the storm winds were generally light from the west; the peak gust during the four-day period was only 30 mph. However, west winds did increase and averaged 21 mph for a 12-hour period from midnight to midday on the 31st.

The new snow kept the Sunlight ski patrol busy. A small ski area, Sunlight is not known for steep terrain, much less avalanche terrain, but this storm was dumping loads of snow. The main avalanche area, called East Ridge, is a permanently-closed area surrounded by a rope closure and posted signs. Each morning patrollers checked the closure to make sure the ropes and signs were in place and visible. Avalanche control work with explosives was tried in the area on the 29th and 30th with minimal results.

On the 31st avalanche control work was tried again. Between 1000 and 1100 hours explosives and ski-cutting produced only a few small, shallow-slab and loose-snow avalanches. The patrollers noted all ropes and closure signs were in place.

Accident Summary

Dry, powder snow at the end of March is a treat for skiers of all ages, and Kent Bradley, 13, was certainly having fun at the Sunlight Ski Area. It was after 1300 hours when Bradley and a friend left the top of the No. 1 chairlift. At the junction of the Grizzly and Defiance ski runs the two separated. Bradley started down Defiance, a steep expert ski run. At the entrance to the ski run two signs cautioned skiers. One sign read "Do Not Ski Alone," and the other read "Experts Only." It is not known if Bradley saw and read the signs. If he did, he certainly did not follow the signs' warnings.

Alone, Bradley started down Defiance but when he reached the steep face he changed his mind. Apparently scared by the steep pitch, Bradley crossed the closure rope along the side of the run to traverse back to the base area. Probably oblivious to the danger, Bradley skied across four separate avalanche starting zones. Luckily the snow in slide paths Spores Bowl, Heathen, The Slide and The Roll all stayed put under his skis. At the fifth starting zone, Doose, his luck ran out.

Though the Doose slide path is small, Bradley released a relatively large slide. About two-thirds of the way across the path the slope fractured like a spider's web. Bradley was swept downhill about 350 feet. During his ride he lost his skis and poles. When the snow stopped he was buried to his chest against the uphill side of a 12-inch-diameter aspen tree. Bradley was able to dig himself free and started back to the base area. Without skis Bradley walked, wallowed and generally floundered his way back to the base area where he found his friend at about 1400 hours.

Without skis Bradley was not much of a ski buddy, plus he might be in trouble if he came home without his ski equipment. To help out a friend, Bradley's friend notified the ski patrol and asked the patrollers to retrieve the skis. The friend also described the location of the avalanche as occurring on the east side of the Defiance ski run: an open run. Immediately, ski patrol director Tod Elston and another patroller set out to investigate. At 1405 hours they left the top of the mountain and skied down to Defiance, but when they arrived they could not find any sign of an avalanche. Visibility was poor from snow and blowing snow, but even several more trips to the area failed to locate an avalanche. Finally at 1600 hours other patrollers from across the

bowl spotted Bradley's tracks and the avalanche.

Avalanche Data

Bradley triggered a sizable avalanche in a small avalanche path. The hard-slab avalanche fractured 4 feet deep and was only 100 feet across. Bradley released the slide on a steep, 40°, east-northeast-facing slope. Located far below treeline it released at an elevation of 8,700 feet and fell 120 vertical feet. The debris in the trees was estimated to be 10 feet deep. The avalanche was classified as an HS-AS-4, a large slide on a small path.

Though the slope had been tested with explosives for 2 days prior to the accident and at 1000 hours that morning, this was not a post-control avalanche. Most likely the increasing winds finally loaded enough snow onto the slope to upset the balance of stress and snow strength. Three hours of additional wind loading of snow and the extra weight of Bradley were too much for the snow to stay in place. (See accident 83-4 for another avalanche at the same site.)

Comments

This scenario was ripe for tragedy. Skiing alone, poor visibility, increasing winds, and an avalanche all spelled disaster for young Bradley. He was extremely lucky not to be hurt or even killed by the avalanche. This was the second close call in Doose's three winters (see 83-4). Closures within ski areas are to be respected. Not only do they protect skiers from avalanches but also protect skiers other hazards such as shallow snow conditions, rocks, downed timber, and mine shafts. People violate rope closures all too often. Most of the time nothing happens to the out-of-bounds skier or snowboarder. But like playing with a loaded gun, venturing into closed areas sometimes results in avalanche accidents.

85-17

MAY 12, 1985

Whitehorse Mountain, Washington

6 climbers caught, 3 partly buried, 3 buried and 1 killed

Accident Summary

On May 12, Denaë Rideout, 28, and two cousins, Jeff Tucker, 27, and Jeff Kollgaard, set out to climb Whitehorse Mountain, a 6900-foot peak about 20 miles north of Stevens Pass. Rideout reportedly had climbed the mountain many times, and Tucker had climbed throughout the world, including in the Himalayas. To climb Whitehorse Mountain usually Rideout would leave the trailhead by 0600 hours, but on this Sunday (Mother's Day) they didn't set off until 0800. Their goal was to make the climb part of an annual event on Mother's Day.

Under sunny skies the three climbers started up the glacier route on the north side of the peak. Though it had snowed 18 inches the day before, strong winds had stripped away much of the snow low on the route. As they climbed higher they encountered deep snow in places that seriously slowed their progress. At one point it took over an hour to travel a quarter of a mile in chest-deep snow.

At about 1600 hours and about 700 feet below the summit they were caught in a small avalanche. Two of the three were partly buried. After digging themselves out the three continued their climb in spite of the obvious avalanche danger. The temperature was described as hot, even on the north side of the peak.

A short distance below the top, the three summit-bound climbers were joined by two Seattle climbers, Brian Griffen and Edward Whalen. At about 1630 hours and only 200 feet below the summit, a second avalanche released. The climbers said they heard a boom and looked up to see an avalanche aimed right at them. One of the Seattle climbers had been on some rocks putting on his crampons. The avalanche missed him but buried the other four climbers. The Seattle climber quickly found and dug out Kollgaard who had been buried to his neck. The two then spotted Tucker's hand sticking out from the snow and dug him free. Now three searchers strong the climbers heard the yells of the buried Seattle climber and quickly dug him out. The four men then searched for almost an hour but failed to find Rideout. They marked the area where she had been last seen with a blue foam pad secured in the snow and started the descent for help.

The next day 18 searchers from Seattle Mountain Rescue found her body under 2.5 feet of snow, 18 hours after the avalanche. She

had died of suffocation. Her body was found face down with no air pocket.

Avalanche Data

Very few details of the slab avalanche were recorded. Though the air temperatures were warm the accident report did not mention whether the slab was dry or wet, soft or hard. It did mention that the fracture line was 3 feet deep, and the slide was over 400 feet across on the 37° north-facing slope.

Comments

This accident is another one where the victim's pursuit of pleasure overrode all thoughts of self preservation (see accident 85-15). It was not known if any of the climbers had avalanche training, but one would think the first avalanche—that partly buried two climbers—sent a clear warning of the avalanche danger. The climbers ignored the warning and their folly turned deadly. Perhaps their closeness to the summit, or their desire to make the climb a part of an annual event led these experienced climbers into a fatal trap.

85-18
SEPTEMBER 22, 1985

Castle Peak, Colorado

2 climbers caught and injured

Accident Summary

The Elk Mountains are one of Colorado's most rugged mountain ranges. Under the steep north face of Castle Peak (14,265 feet), in Montezuma Basin is one of Colorado's largest permanent snowfields. It has always been popular with mountaineers and summer back-country skiers. After the heavy spring snows of 1985 considerable snow remained throughout the summer in both upper and lower Montezuma Basins.

Winter was off to an early start when the first major storm of the season dropped 2 feet of snow in the Elk Mountains of central Colorado in early September. Mountaineers Craig Huey, 25, and Chip Faurot, 26, and a friend, were able to drive the rugged four-wheel-drive road high into the lower basin. While their friend waited with the vehicle, Faurot and

Huey started out on foot at the 12,900-foot level. Initially they were postholing through 2 feet of snow that covered a talus field.

As they climbed upwards the slope steepened, and instead of rocks under foot, the new snow covered névé, or old summer snow. At about 13,500 feet the pair triggered a small sluff on the 40° slope. They kept on climbing. A moment later with Huey in the lead, they triggered a small slab avalanche.

Both men were caught and bowled down the slope. Though both managed to stay on top of the moving snow during their 600 vertical-foot ride, Faurot was slammed hard into some rocks. Neither man was buried, or even partly buried after the snow stopped, but both were injured. Head lacerations were the most obvious injuries as the pair staggered back to their waiting friend and their vehicle.

At the hospital in Aspen, Huey was treated for minor head cuts and some bumps and bruises. Faurot's injuries were much more serious. Doctors found Faurot had four broken ribs, a depressed skull fracture and a chipped left elbow. He was transferred to a hospital in Grand Junction where he later made a complete recovery.

Avalanche Data

The small slab-avalanche triggered by Huey and Faurot was classified as an SS-AF-2. The 35-foot-wide soft slab fractured 2 feet deep to the old summer snow. It released on a northwest-facing slope at 13,500 feet in elevation, and it fell just over 600 vertical feet.

Comments

This accident is typical of many early season avalanche accidents involving climbers. At high elevations, above treeline, new snow is frequently accompanied by wind creating shallow slabs that in places cover old summer snow. Fresh snow bonds poorly to old, icy, summer snow. Left alone the new snow can withstand the natural stresses of a slab on a steep slope and not avalanche; however, the additional weight of a climber or skier can cause too much stress, resulting in an avalanche. Only time can help to bond new snow to old summer snow. The question, of course, is: "How soon after fresh snow will conditions be stable and safe?"

These two climbers were obviously too early and learned a painful lesson. In Colorado experience shows that the time required is fre-

quently weeks to more than a month for new snow to bond to old summer snows.

85-19

NOVEMBER 13, 1985

Sunset Peak, Utah

5 backcountry skiers caught, 2 buried and killed.

Weather Conditions

Early snows in mid October deposited 2–3 feet of snow over the Wasatch Mountains, but dry and mild conditions after the storms melted all but north-facing slopes above 9,500 feet. The kinetic metamorphism process affected this snow for a month and turned the grains into faceted snow. Light rain started on November 5 and formed a thin ice crust before changing to snow. Only a couple of inches of snow fell that day. This storm was followed by another weak storm that left another couple of inches of snow on the 7th. Both of these shallow layers of new snow metamorphosed under a temperature gradient until new snow started to fall on the 10th. On the morning of the 11th, the Snowbird Ski Area reported 6 inches new, but moderate snow continued to fall during the day. During the day both the Alta and Snowbird ski patrols reported lots of fresh windslab and shooting cracks under ski cuts on north- and east-facing slopes. By the morning of the 12th, Alta and Snowbird had received another 16 inches and 18 inches, respectively. Control work with explosives produced avalanches, and several large natural avalanches were spotted in the backcountry. The morning of the 13th was cloudy but not snowing.

On the morning of November 13, the Utah Avalanche Forecast Center rated the backcountry avalanche danger high for the northern Wasatch Mountains on slopes 35° and steeper facing northwest to east above 9,000 feet. Triggered and natural avalanches were likely. On the other aspects and at lower elevations avalanches were possible.

Accident Summary

By Wednesday morning, November 13, a thick blanket of fresh snow covered the Wasatch

east-northeast aspect just underneath Rocky Point (the peak just west of Sunset Peak). They found some fairly strong faceted snow near the base and no clean shears. This information combined with their experiences from a few days before, when they skied similar northerly aspects without incident, gave them confidence that they could find safe skiing. They skied a northeast facing slope below Rocky Point. As they climbed back to Catherine's Pass two skiers, Doyle Murray and Heather Garwood joined this first group of three skiers. Murray and Garwood had followed their tracks from Brighton. The five moved east, toward Sunset Peak, and skied down past their first set of tracks. Spirits soared as the skiers carved turns in the deep powder.

The group followed their zig-zag ascent route back toward Catherine's Pass. Ash, Gruver, Wilson and Murray decided to traverse upwards to the saddle between Rocky Point and Sunset Peak. The new goal was to ski the drainages off Sunset Peak. Garwood, nursing a cold, stayed at Catherine's Pass.

At the pass the group was joined by another three skiers, husband and wife, Tim and Julie Wiggins, and a friend, Bruce Englehard. They too had followed the tracks from Brighton. The two men joined the first group and headed to the saddle, while Julie Wiggins stayed at the pass with Garwood.

At the saddle the group broke off several cornices onto the slope. One piece, about 6 feet long and 2 feet thick, rolled all the way down the slope. The cornice test, the snowpit dug earlier and their previous ski runs were increasing the party's confidence, but there was still obvious instability in the snow. During the storm an avalanche released off the north-face of Pioneer Peak, one peak to the east of Sunset Peak. Everyone at the saddle was aware of this slide and its aspect.

The main drainage off Sunset Peak, below the saddle, funnels into a gully. Ash, Gruver, and Wilson decided to stay on the western edge. This side presented a northeast aspect rather than the northerly-facing, east-side of the drainage.

At this time another four skiers, Robin Waxman, Carol Petrelli, Steve Bader and Michael Mendenhall arrived at Catherine's Pass. They had skied up the Little Cottonwood side from Alta. Moments later, from the Brighton side, Brian Kelm and Shawn Carter finally arrived. Kelm and Carter chatted briefly

with Garwood before heading toward the saddle to join their friends and the other skiers. At the pass all the remaining skiers watched the skiers at the saddle.

Meanwhile at the saddle, Ash was the first skier into the drainage. Snow flew over his body as his skis carved through the deep snow. Wilson waited until Ash was safely out of the way at the bottom before starting down. Stacking his turns next to Ash's, Wilson joined him at the bottom. Both runs were made non-stop. Murray was next. His ski technique, perhaps a bit rusty so early in the season, failed him. He took three or five hard falls as he skied down.

There was some confusion as to whether Murray had completed his run as a breakover on the slope obscured the skier. When Murray started down Garwood left the pass to join him at the bottom. When she pulled up next to Ash and Wilson, she was mistaken for Murray by all the skiers in the saddle at the top of the slope. Actually, Murray had fallen again at the base of the slope and could not be seen by the skiers above.

At this time Ash and Wilson decided to move away from the slope to get a better view of the skiers coming down. So they, and Garwood turned their backs as they scooted off to the west.

At the saddle, Tim Wiggins cut across the top of the slope to the east side of the drainage. Gruver, still at the saddle, was uneasy about that side of the slope and wanted to watch Wiggins. He hollered to Wiggins and asked him to wait while Gruver climbed up the ridge to a better vantage point. While Wiggins waited, Englehard skied part way down to a small clump of trees on a small rock outcrop to also watch Wiggins.

It was 1440 when Wiggins, maintaining his horizontal traverse, slowly moved another 15–20 feet eastward. He jumped forcefully two or three times in an attempt to disturb the snowpack. Englehard tells what happened next: "Nothing happened so he took two more steps. At this time low thunder-like sounds rolled out of the snowpack from under the Sunset Peak area to the saddle with the simultaneous appearance of a fracture 12–15 feet above Wiggins." The east side started to slide first; the west side of the drainage released seconds later.

Wiggins knew instinctively what was happening. He turned sideways in what Englehard

described as a “combat stance” to brace against the moving snow. But no match for the moving snow, Wiggins was instantly pushed downhill. He swung his skis around into the fall line, but the moving snow swallowed his skis. Initially Wiggins was able to remain upright by sitting back on his skis. He looked to be riding or skiing the avalanche as he was carried past Englehard. At this time the west side of the slope was now in motion and was being funneled down toward Wiggins. About 40 feet below Englehard, Wiggins disappeared in the cloud of snow and moving debris.

All around Englehard snow was moving, but he wasn't. On his little outcrop basically in the middle of the starting zone, he stood on a small island of snow that didn't move.

At the bottom of the slope, almost a quarter of a mile away from the saddle, Ash, Wilson and Garwood also heard the low thunder-like sound. They turned around to see Wiggins being tossed into the air by the avalanche. All three yelled at Murray who was now running as fast as he could to escape, only to be engulfed by the moving snow. The powder cloud settled over Ash, Wilson and Garwood. They had just barely escaped the actual debris.

All the skiers at Catherine's Pass watched the avalanche tear down Sunset Peak. They knew that at least one was caught, and Julie Wiggins knew it was her husband.

Rescue

Immediately an avalanche rescue beacon search was started. From the top Gruver, Englehard, Kelm and Carter turned their beacons to receive and started descending. From the bottom Ash and Wilson readied for their beacon search. Garwood was also wearing a beacon, but she had never practiced with it and was confused as to what to do. Ash and Wilson asked her to go for help. She left for Brighton knowing that two were buried. Then Ash and Wilson started their beacon search. From the pass Petrelli and Bader skied down and joined Ash and Wilson.

Julie Wiggins started down from the pass telling others at the pass that “my husband was up there.” She stopped half-way and yelled back to Waxman and Mendenhall to get help. Julie continued down to the debris.

Mendenhall headed to Alta to get help, and Waxman headed to the debris.

One of the searchers at the bottom of the slope saw Murray's hand sticking out of the snow. It was 1445 hours. Murray had been carried about 50 yards across the flats and pushed into a tree. Skis, poles and gloves had been stripped away. Buried about 2 feet and on his side, he was not breathing when uncovered about 10 minutes later.

Meanwhile the top rescuers (Gruver, Kelm, Carter and Englehard) were descending and doing their own beacon search. Gruver was down first and called out if everyone had been found. He was told that the victim had been found. It assumed that it was Wiggins because he thought that Murray was safe with Ash and Wilson.

CPR was being started on Murray, when Kelm, who was only half-way down the path, yelled down to learn if everyone had been found. Gruver, who was still thinking that there was only one victim and not recognizing Murray yelled back, “All clear.” Gruver had only met Murray and Wiggins earlier that day.

Kelm, Gruver, Carter and Englehard descended to where the others were working on Murray. After 15 minutes of CPR Murray started breathing on his own, though he did not regain consciousness. Englehard immediately recognized Murray and asked about his friend, Tim Wiggins. Even though minutes earlier the group's consensus was that everyone had been found, they now realized their mistake. Ash and Petrelli stayed with Murray while the rest of the group (six people) renewed their beacon search for Tim Wiggins. Everyone was equipped with beacons and shovels, and several skiers had probes.

Carter and Gruver, both members of the Solitude ski patrol and well practiced in beacon searches, and Ash all picked up Wiggins's signal; however, the others were so eager they started to dig before the signal could be pinpointed. Only by jumping into the hole did they learn the buried unit was still down slope. The signal was finally pinpointed about 10 feet away from the where the initial digging was started. After digging a 3- to 4-foot hole in the spot pinpointed by the beacons, probing confirmed the buried Wiggins.

After 40 minutes under 6 feet of snow, Wiggins's body was pulled from the hole. His lifeless body was cold and pale, pupils were fixed and dilated and unresponsive to light. He also had a compound fracture to his right, lower leg. He was placed onto four skis and

CPR was started. His wife Julie, a nurse in Salt Lake, worked to revive her husband.

Just before 1500 hours Garwood reached the Brighton Ski Area and reported the accident. Word was relayed to Alta Central Dispatch. Minutes later Mendenhall arrived in Alta and reported that one skier had been found, but the other was still missing. The Alta ski patrol and a Life Flight medical helicopter were asked to respond. At 1507 hours six patrollers and backcountry rescue personnel and one rescue dog were snowmobiled to the base of the Supreme chair lift. They rode the lift and started the half mile traverse to Catherine's Pass.

At about 1532 the Life Flight helicopter picked up Marsha Dudley, a Snowbird ski patroller, and her avalanche dog, Tansy, and ferried them to the avalanche. They arrived at 1542, minutes before the other rescuers arrived. The helicopter landed closest to Wiggins who had been placed on a tarp. In the blinding whiteout caused by the helicopter's rotors, Wiggins was dragged over to and lifted into the helicopter. Life Flight took off and flew him to Salt Lake City. Immediately afterwards Englehard gathered some equipment and with Julie Wiggins started back to Brighton.

As the Life Flight helicopter took off Dudley requested a second helicopter for Murray. As the first helicopter was leaving Murray's condition took a turn for the worse. He vomited which blocked his airway. Dudley worked to reopen an airway but muscle spasms had locked his jaw. She was able to clear his nose and breathe through his nose. While she did rescue breathing two others worked to clear his airway, but he kept vomiting. The more he vomited the weaker his pulse became, then it was non-existent. For the second time that afternoon CPR was started on Murray. Dudley and Waxman did CPR for 10–15 minutes before four Alta ski patrollers arrived.

When Murray's condition worsened a Channel 5 television-news helicopter was flying toward Alta. The helicopter was asked to assist in the rescue. It landed in Alta and picked up two paramedics with advanced life support equipment. At about 1610 hours "Chopper 5" had dropped off the paramedics and aggressive advanced life-support treatment was started. At 1615 the Air Med helicopter arrived on the scene. On the ground medical crews worked on Murray for at least

another 20 minutes before taking off and flying to a Salt Lake City hospital.

Life Flight returned to pick up the "stranded paramedics" and ferried them back to Alta. The rest of the skiers and patrollers skied out to either Alta or Brighton, getting out just before dark.

Both men died as a result of the avalanche. Murray died later that night. Wiggins died the next day.

Avalanche Data

This avalanche was an SS-AS-4; the entire path avalanched with a fracture line varying from 3–5 feet deep. At the top of the avalanche the fracture line was 180 feet across, but lower down the avalanche widened to 250 feet before funneling into a narrow gully near the bottom of the path. Wiggins most likely triggered the slide as he moved across the 35°, north-facing starting zone. At about 10,500 feet the avalanche fell 600 vertical feet. To the Utah Avalanche Forecast Center personnel who examined the fracture it appeared the avalanche failed just above the November 5 ice crust in a weak kinetic-snow layer.

Avalanche Forecaster Brad Meiklejohn dug fracture line profiles of both this avalanche on Sunset Peak and the natural avalanche on Pioneer Peak that had occurred the day before. The fracture line profiles were nearly identical, and both avalanches failed on the same weak layer.

Comments

These skiers were well-equipped for an avalanche emergency. All carried avalanche rescue beacons and shovels. Most of the skiers were expert skiers and well experienced in avalanche danger evaluation, rescue and emergency medical care, but even the best prepared groups cannot always save their friends from the white death. Though everyone did the best they could, this accident illustrated the confusion that results when several different groups of skiers come together in the mountains.

In all rescues when confusion reigns it is important for someone to take charge. In organized avalanche rescue, ski patrols and mountain rescue teams appoint an Accident Site Commander. In the backcountry when friends are forced into rescue mode this role must often be assumed. Afterwards several of the skiers thought a site commander would have eliminated most of the confusion.

Rescuers sometimes must make the difficult decision as to which victim is transported by helicopter first. Usually the medical personnel on board medical helicopters will triage, or the sort the victims for treatment and evacuation. In this accident a triage was never done, neither by the rescuers or by the helicopter crew. The Life Flight helicopter landed closest to Wiggins, so he was airlifted out first even though he was in full cardiac arrest and had never taken a breath on his own. Murray, who aspirated soon after Life Flight left had to wait another 30 minutes for the second medical helicopter to arrive. Rescuers should be guided by the principle of doing "the greatest good for the greatest number," which means save the most savable first.

85-20 NOVEMBER 17, 1985

La Plata Mountains, Colorado

2 miners caught and buried, one killed.

Weather Conditions

Early November was mild and dry, but winter returned with vengeance to the Colorado mountains. Especially hard hit were the La Plata Mountains, a range of 12,000- to 13,000-foot peaks to the west of the San Juan Mountains in southwestern Colorado. About 15 miles northwest of Durango, the La Platas are the first high mountains that storms approaching from the west and southwest hit.

After 9 dry days snow started to fall late on November 10. By the morning of the 17th over 4 feet of snow had fallen at the Bessie G, a gold mine located at the 12,000-foot level on Snowstorm Peak. At 0800 on the 17th, the Purgatory Ski Area, about 16 miles northeast of the Bessie G, 14 inches of new snow was recorded. Back at the Bessie G light to moderate snowfall continued all day. Early in the storm strong south and southwest winds were reported.

Accident Summary

On Sunday, November 17, two miners, Lester Jay Morlang, 31, and Jack Ritter, 58, were working alone at the Bessie G. More snow was

in the forecast and both men were in a race against nature to finish a protective snowshed over the east portal. Ritter had mined the Bessie G on and off for a decade and this storm was about as bad as he had seen. At about 1800 hours Morlang was standing in the elevated bucket of a front-end loader working on the shed roof. Ritter was handing supplies up from below when without warning everything turned white. Later Morlang recounted that it was "quiet as a whisper."

Snow crashed down upon the men. Ritter was hit by the full force of the moving snow and was probably killed instantly. Morlang was tossed from the bucket and buried near the front-end loader and at the mine entrance. His right hand was just inches from his face and at first he could only wiggle the fingers. Soon he had made a pocket big enough to cup his hand. By moving his hand back and forth he was able to brush the snow away from his face and take his first breath. He kept wiggling in a struggle to free himself, and in time he had kicked and pushed and shimmied until he could move his whole body. He still had his miners helmet on head and found its head light was still working. With renewed confidence he started digging using his helmet as a makeshift scoop.

Slowly he tunnelled his way horizontally through the snow. When he got tired he rested and during the night Sunday he slept for a couple of hours in his tunnel. His rubberized-waterproof suit over heavy layers of clothes protected him from the cold. Morlang kept digging, a few inches at a time. At times he thought he wouldn't survive the "ice coffin." He sometimes thought he would die, but he kept digging. Finally, at about 1600 hours Monday afternoon, Morlang broke through to the surface, 22 hours after he was first buried. Even though he was met by savage winds over 50 mph, moderate snowfall and heavy blowing snow, he thought he was "in heaven."

Morlang headed for a stand of spruce trees where he dug a trench and lined it with pine boughs. He covered the top with more boughs. In his tiny shelter he tried to build a fire, but his fingers—frozen stiff—wouldn't work. While he was huddled in pine boughs in a dark snow trench with only the thoughts of a fire for warmth, Snowstorm Peak unleashed another avalanche. Snow crashed through the spruce trees and poured into his trench. Buried 2 feet deep by a second avalanche, Morlang was

again able to wiggle free. And for the second night in a row he had to sleep in an icy tomb. The temperature at nearby Red Mountain Pass dropped to -4°F that night.

On Monday morning, Jess Ritter, Jack's son, and co-worker Tom Hall started toward the west portal of the Bessie G. They had previously agreed to meet Morlang and Ritter at 0700 and take them off the mountain. Blizzard conditions forced the men to turn back. The men kept trying, and eventually they had to abandon the heavy-equipment vehicles they were driving 2 miles from the west portal. Drifts 15 feet deep in places blocked the road. On foot, the two men reached the meeting place, a small cabin, about noon, but Morlang and Ritter were not there. Jess Ritter then hiked to the west portal of the Bessie G. It was a 1800-foot trek in the mine tunnel in water that at times was knee deep to reach the east portal. He found the portal plugged with snow. He knew immediately what had happened and feared that his dad and Morlang had been buried. It took more than 5 hours for Jess Ritter and Hall to retrace their route and get to a telephone. Just before 1800 hours the La Plata County Sheriff's Department received word of the accident.

Lt. Bill Gardner was the search and rescue (SAR) coordinator for the county. He immediately called in local SAR experts and placed a conference call with staff from the nationally known Silverton (Colorado) Avalanche School and with an avalanche and explosives expert Chris George. While the winter storm raged over southwestern Colorado that evening, it was an easy, but at the same time hard, decision to not field rescuers that night. Instead they prepared for an all-out rescue effort to start Tuesday morning.

The plan was for a helicopter to fly a hasty search team and a rescue dog to the east portal. At the same time rescuers on foot would enter the mine via the west portal and tunnel through the debris to meet the east-side rescuers.

By Tuesday morning the weather had improved slightly, but enough to allow a helicopter to fly. At about 0830 Chris George flew in the first helicopter to assess the situation. When they reached the area of the east portal all they saw was snow. There was no sign of the portal entrance. What they did see were plenty of potential avalanches. Landing was out of the question, but a quick fly-by was possible.

Strong winds of 45–55 mph buffeted the helicopter as pilot Robert Coma moved closer to the avalanche. Coma carefully worked the helicopter down the east-side of the mountain allowing George to view the avalanche area. While George and Coma did not see Morlang, George saw plenty of heavily-loaded avalanche slopes. It would be too dangerous to have rescuers on the east side of the mountain until explosives could be used to trigger the threatening avalanche paths.

Morlang was awakened by the sound of the helicopter and bolted from his snow hole. He frantically waved his arms at the helicopter but could only watch as it flew away. Dejected he decided to keep moving.

Back on the ground the explosive charges were made up and George returned to the air. Before rescuers could be allowed into the field the avalanche danger had to be reduced. On both sides of the Bessie G explosives were dropped from the air. Of the 14 shots dropped 11 produced avalanches.

On the ground Morlang's spirits soared when he heard the helicopter return. But instead of being rescued he found himself dodging avalanches. One of the triggered avalanches overran his snow trench. Morlang had moved far to the north and below the portal into scattered trees. He was in an area that the pilot and George were not looking for him to be in. Morlang must have felt like a sitting duck in a shooting gallery as triggered avalanches crashed down around him. Lady luck continued to watch over him: for a third time Morlang was caught, but this time he was only buried chest deep.

After the control work was completed two helicopters were used to carry miners and rescuers to the west portal. By 0930 all the rescuers had started the long walk through the wet tunnel. The Durango Fire Department loaned rubber boots to the rescuers for the 1800-foot hike. By noon they had dug through the snow blocking the east portal. Certain that two men had been buried they started digging. At 1305 hours they found the body of Jack Ritter. Thoughts of finding Morlang alive disappeared, but the rescuers kept digging.

With rescuers searching the east portal area, one of the search managers, Butch Knowlton, decided to have a look at the avalanche area. He and pilot Coma flew back to the site to make one last check of the avalanche path that had buried the east portal.

As they flew toward a ridge on their way to the path the ship was rocked by winds. Coma suggested they turn around and try to come up the path from the bottom. Coma banked the ship into a right turn and Knowlton saw tracks. Quickly pointing the tracks to Coma they both saw something yellow moving in the snow. Back at the search base leaders heard the two men shouting into their radios, "He's alive! He's alive!"

It was 1325 hours when Morlang heard the helicopter again and waved desperately hoping to be seen. He was in a very narrow ravine almost 2,000 feet below the mine. He had descended into the ravine on hard packed avalanche debris, but was now bogged down in chest deep snow.

Knowlton realized that even with the helicopters there would be little chance of getting rescuers to Morlang that day (all rescuers were in the mine tunnel). He also doubted that Morlang could survive another unprotected night. Knowlton and the pilot decided the rescue would have to occur now but there was no place to land.

Coma eased the helicopter into the narrow ravine. Only 5 feet of space separated the spinning main-rotor and the gully walls. Coma would try to gently place the left runner onto an upturned spruce tree while Knowlton would retrieve Morlang. Watching the rotors, and ravine walls and the man below, Coma and Knowlton gingerly lowered toward the spruce.

Morlang was not about to let this helicopter fly away; when the machine was close he jumped. He wrapped his arms around the right runner and tried to swing a leg up onto the runner. His hands, frozen solid, were useless.

Coma was afraid that Morlang would grab the runner and was ready for him. His sudden added weight caused the ship to tip down and to the right. Coma applied power. Glancing upwards Knowlton saw the rotor blade slicing into the snow on the gully walls. Coma said they had to do something fast. Knowlton unhooked his safety belt and jumped into the snow. He pulled Morlang off the runner and onto the spruce. Coma was able to regain control of the ship. To load Knowlton and Morlang, Coma had to turn the ship slightly. As he maneuvered the passenger door closer to Knowlton the rear rotor spun into the snowy wall. Fortunately for all three men the

rotor sliced only through snow. There was no time for fear or second thoughts; Knowlton pushed Morlang up and into the helicopter and dove in next to him. Coma gave full power and the ship lifted out of the ravine. In 15 minutes they were at the hospital in Durango.

Avalanche Data

There was no data available about the avalanche that struck the east portal of the Bessie G mine.

Comments

The odyssey of Jay Morlang is arguably the most remarkable story of avalanche escape and survival in United States history. Besides being caught in three avalanches, being buried twice, fearing he would die of exposure, and almost having a helicopter crash on him, Morlang defied long odds by surviving 22 hours under the snow. Only one other person in North America has survived a longer burial in direct contact with the snow. In 1965 a Canadian highways worker was buried and survived a 25.5-hour burial.

85-21

NOVEMBER 21, 1985

French Gulch, Colorado

2 backcountry skiers caught, buried and killed.

Weather Conditions

Daily snows were reported during a 2-week period prior to this accident at the nearby Breckenridge Ski Area. About 43 inches of new snow fell and winds during the period were primarily from the northwest to the southwest averaging 15-25 mph. On the morning of the 21st snow on the ground at the ski area was 33 inches.

Accident Summary

Two Breckenridge men, Tim McClure, 34, and Steve Field, 33, left Breckenridge late Thursday afternoon, November 21, for a short afternoon ski trip. At about 1500 hours the men drove up French Gulch, just east of town. The goal was to head to the base of Mt. Guyot, about 3 miles

east of Breckenridge. They drove to the end of the plowed road just past the old townsite of Lincoln. At the trailhead the men attached climbing skins, and with McClure's dog probably made quick time traveling up the French Gulch trail. They did not carry any avalanche rescue gear. A little over a mile up the gulch the men turned left and headed up Little French Gulch. They were headed to an area they had skied previously but not yet that season.

A late-afternoon outing was not uncommon for these two backcountry skiers. McClure and Field were expert telemark skiers who every year skied until the last of the snowfields melted by summer's end. Both men were familiar with the area and frequently did short ski trips. They confidently planned to be back into town by early evening. Field had a dinner party that he was expected to attend.

McClure was interested in avalanches. He had attended avalanche schools and studied on his own. He frequently dug snowpits and monitored the snowpack for changes during the winter. Friends described him as "very aware and cautious." Field was "less concerned" about backcountry dangers than his friend but would always agree to safety rules when recommended by others in a group.

The men found generally little snow had drifted across the old jeep road in Little French Gulch. On the uphill side of the road a blanket of snow filled in the cutslope, but on the downhill side the tops of dried grass still protruded from the snow. At about 11,400 feet in elevation, the men moved out from the timber into an open avalanche path. From the edge of the road the slope rose a steady 30° for about 400 vertical feet. It steepened to about 34° as road traversed across the slope. The men were probably not concerned about their risk; they ventured out together into the path. Perhaps the slope did not look threatening with some grass sticking out of the snow, but their error in awareness proved to be fatal. No witnesses saw the avalanche release, bury and kill the two skiers and their dog.

Later that night friends of the two skiers became concerned when they didn't return. Field failed to show up for his dinner party.

Rescue

The next day, Friday, November 22, at about 1030 hours a concerned friend, Rick Hum, called Jon Gunson, Summit County Rescue Group coordinator, to report the skiers over-

due. Hum volunteered to make the short drive to the trailhead and check for the skiers' car. At 1100 hours the unlocked car was found parked at the trailhead with the keys in the car. The cold car started right up. Immediately the rescue group was "formally called out," and members were asked to respond to the trailhead.

Hum and another man, Jeff Hill, set out for Little French Gulch and a third skier headed to check out a small shelter off the trail called the "dome." It would have been the likely spot for the men to spend the night if they had had problems. At 1130, Hum and Hill reached the junction of Little French and French gulches. There they found a set of ski tracks and the tracks of the dog going up Little French Gulch. There was no sign of tracks coming down. Fifteen minutes later the pair reach a cabin at the southeast end of Little French Gulch. Further up the drainage they spotted a large avalanche. The men followed the ski and dog tracks into the avalanche debris. No tracks exited the other side. Hum and Hill started the hasty search. The debris had piled into narrow gully and was no more than 60 feet across by about 300 feet in length. Other than the tracks leading into the slide the men found no other clues.

Meanwhile at the trailhead the first rescue team members were starting to arrive. Soon two snowmobiles were sent to pack the trail to the avalanche, and other rescuers started to arrive. A thorough hasty search was done, but the only clue was the tracks. At about 1355 hours the first probe line was started.

Because of the narrowness of the debris field, but having plenty of rescuers, Accident Site Commander Bob Kluge lined up the team in a "modified" coarse probe. Rescuers stood shoulder to shoulder so that probes were spaced about 15 inches apart. The probe line moved up the gully and at 1418 they found the dog. It was buried over 6 feet deep. Eighteen minutes later the probes found Field. His body was buried about 10 feet deep and was 15 feet up the gully from the dog. Minutes later McClure's body was found. He was buried about 10 feet and was 15 feet above Field. By 1555 both victims and the dog had been evacuated.

It appeared the men were climbing one-behind-the-other with the dog bringing up the rear. The victims were found with skis and attached climbing skins, poles and packs on.

The men and the dog had been pushed about 20 vertical feet down into the gully.

Avalanche Data

The soft-slab avalanche fell 500 vertical feet on a north-northeast facing slope at treeline. At an elevation of 11,800 feet the fracture line was 3-4 feet deep for 280 feet across the slightly concave-shaped slope. Most likely the skiers traveling along the shallow, snowcovered road triggered the avalanche. The men were about 150 feet out from the edge of the forest when the accident occurred.

A snowpit dug in the undisturbed snow next to the avalanche revealed lots of weak, faceted snow along the ground. One-third of the snowcover was faceted grains. Like pulling the log out from the bottom of the wood pile, the faceted-snow grains along the road probably failed in compression under the weight of the skiers. The resulting collapse failure propagated far upslope releasing the slab over 400 vertical feet above the road.

Comments

In the weak snow cover of the continental climate it is not uncommon for backcountry travelers to trigger avalanches from low on a slope, or even from flat areas beneath steep slopes. McClure and Field were probably not aware of this manner of triggering avalanches. It is not always taught in avalanche awareness courses. Improved avalanche awareness training will help to educate backcountry travelers about triggered-avalanche releases low on a slope. But no matter how many avalanche clues backcountry travelers are taught to recognize, unless people feel threatened they seldom take preventative actions.

Cascade Mountains. It towers almost 8,000 feet above the surrounding peaks. Some of the world's most brutal weather conditions occur on the flanks of this high peak. Situated about 100 miles from the Pacific Ocean, the mountain generates its own weather as the moist-laden winds stream over it. On November 21-22 a storm left 24 inches of cold, dry snow at the Paradise Visitor Center (5,400 feet) on the mountain's south side. During the storm the winds were very light and the high temperatures reached only into the teens. Conditions stayed cool and unsettled until early on the 25th when another storm moved over the peak. Winds at Paradise increased during the day, and by afternoon southwest to west winds averaged 20-30 mph. No doubt that higher on the mountain the winds were much stronger. Heavy snow fell all day at Paradise.

Accident Summary

Ed Viesturs, 26, and Andy Politz, 26 had intended to do an early winter climb of Mt. Rainier. The pair drove to Paradise early on the 24th and set out on skis for Camp Muir. They reached Camp Muir (10,188 feet) at 1100 hours and spent the night. At 0700 the next day, the pair set out toward Gib Ledge in a raging storm. At about 11,000 feet they turned around due to poor route conditions and deteriorating weather. They arrived back at Camp Muir at 1100. There they briefly rested before continuing their descent to Paradise. At about 1200 they set out again into the storm.

Travel down the Muir Snowfield was very slow and difficult. The men followed compass bearings as they descended through the white-out conditions caused by snow and blowing snow. Even with skis on they sunk to their knees in the new snow. Normally the descent to Paradise would have taken less than 2 hours, but in the storm it had taken over 8 hours to reach Panorama Point. Slowly and cautiously the pair continued their descent past Panorama Point in zero visibility caused by blowing snow and darkness.

It was about 2230 when the pair reached the 5,800-foot level on the ridge that runs from Panorama Point to Alta Vista. They were in an area near the "First Hill" when Politz triggered, and was caught in an avalanche. He was swept only about 100 vertical feet downhill but was completely buried. In a blink of an eye Viesturs was alone. His headlamp was useless in the blowing snow and darkness.

85-22 NOVEMBER 25, 1985

Mt. Rainier National Park, Washington

1 climber caught and buried

Weather Conditions

At 14, 410 feet, Mt. Rainier is the king of the

Politz was buried on his side, only a few inches of snow covered his face, but his feet were buried about 2 feet deep. It took some 15 minutes for him to dig himself out of the snow. In the darkness he was able to make voice contact with Viesturs and told him not to come down the hill.

Politz continued to work his way down and eventually stumbled across the Edith Creek water building. Realizing where he was, he was able to orient himself and return to Paradise at 0030. The Visitor Center had long been closed and he knew there was nothing that could be done for his friend still stuck out in the storm. Any action to find his friend would have to wait until morning. Politz spent the rest of the night sheltered in a bathroom. At 0700 that morning Viesturs had still not returned to Paradise or to their car, so Politz alerted the National Park Service.

Ranger Gary Olson got the report of the overdue climber, and he drove up to Paradise. He met Politz at 0830 and reviewed what had happened the night before. The two were getting ready to head out and search for Viesturs when a plow driver reported a man had just come off the mountain and skied into the upper parking lot. Politz and Olson drove to the lot and met Viesturs.

After the avalanche stole Politz into the night, Viesturs waited at the top of the slope for about an hour. He could hear Politz calling, and knew that he was okay and moving down. Viesturs, however, could not move down in the darkness and the storm. He back-tracked about 300 yards up the ridge and dug a small snow cave where he spent the night. He awoke at about 0700 and spent some time looking for Politz before returning to Paradise at 0915.

Avalanche Data

Because of darkness and the storm no observations of the avalanche were made. The avalanche did occur on a east-facing slope which was a lee slope during the storm.

Comments

In hindsight it was easy to say that men's main mistake was leaving Camp Muir in a storm, and that they tried to travel through avalanche terrain at night. Both were very experienced and knew the area well, and they were also comfortable traveling in severe weather. They almost made it to Paradise without incident. But even for the most experienced moun-

taineers traveling in a storm, at night, and in avalanche terrain, can sometimes be too much. Viesturs made a wise decision by retreating to safety and digging in for the night rather than blindly trying to descend a known avalanche slope.

85-23
NOVEMBER 29, 1985

Sugar Bowl, California

2 lift skiers caught, 1 partly buried and 1 killed

Weather Conditions

The first three weeks of November were relatively dry at Sugar Bowl Ski Area in the Lake Tahoe Basin, about 41 miles west of Reno, Nevada. Snow fell only during three storms on the 1st, 10th and the 18th. On November 22 only 29 inches of snow covered the ski area study plot. Temperatures the previous week had remained cool; the daily high temperatures stayed below freezing. Snow started to fall over the Tahoe Basin late on the 22nd as a strong storm moved in. By the morning of the 25th, Sugar Bowl Ski Area had recorded a total of 40 inches of new snow. The snow base had climbed to 59 inches. Another storm moved into the region early on November 27. Only 1 inch of snow was reported that morning, but during the day the snowfall intensity increased. By the morning of the 28th, another 11 inches of snow had fallen. Snow continued to fall, and at 0600 on the 29th, an additional 20 inches of new snow was reported. The temperature was 28° and winds were very light. However, during most of the storm the southwest winds averaged 15–25 mph.

Accident Summary

To say the Sugar Bowl ski patrol had been busy at the end of November was a bit of an understatement. The new ski season had been off to a slow start with less than 3 feet of snow on the ground, but in 6 days the area had received 6 feet of snow. In addition to avalanche control work, there was much other work to be done on the mountain. Tower pads and temporary signs had to be raised as the snow piled up; new rope lines were being strung while older ones were removed as ski

terrain was opened for the first time that season.

On the morning of November 29, an avalanche control team visited the Steilhung run, a steep, north-facing slope that had not yet been opened. Two hand charges were tossed onto the slope but failed to produce releases. Then the patrollers ski cut the slope six times, and again nothing happened. Satisfied the snow was stable and the slope was safe, they opened the run.

Later, as the first two skiers ventured onto the slope it fractured around them and swept them into the trees below. The debris flowed in fingers through the trees. When the snow stopped, one skier was lucky and only partly buried. The other skier was very unlucky and had been buried.

No details about the rescue were mentioned other than the buried skier was found dead on the downhill side of a tree. He had been buried 7 feet deep for 80 minutes. The cause of death was due to head trauma.

Avalanche Data

The avalanche was classified as an SS-AS-3. It fractured 2.5 feet deep and 150 feet across. The fracture broke along one of the previous ski cuts, but the fracture's location relative to the bomb craters was unknown. It was noted that one of the skiers had skied within 20 feet of one of the craters.

Comments

Few details are available for this fatal accident. Obviously, this accident was a post-control release, the type of accident that sends chills down the spines of ski-area avalanche workers. The patrol had relied on a time-honored system of explosive testing and protective ski cutting, only to be rudely fooled by the snow cover.

85-24

DECEMBER 2, 1985

Jackson Hole, Wyoming

6 ski patrollers caught, 4 partly buried, 1 buried and killed

Weather Conditions

At higher elevations in the Teton Range snow

on the ground had lingered from an early October storm. On sun-exposed aspects an ice crust formed that was later covered by light snows in early November. In the presence of a strong temperature gradient the new snow was transformed into weak, faceted snow grains. Deep-slab instability developed when heavy snows fell during the latter half of November. Jackson Hole Ski Area was not yet open, but at the nearby Teton Pass study plot the Wyoming Highway Department recorded 81.5 inches of snow, including 14 inches that fell on the 29th–30th. By December 2, snow on the upper parts of the mountain had covered the ground for approximately 65 days.

Light snow continued to fall on December 1–2. At 0600 on December 2, the 24-hour snow stake showed 4 inches of new snow. Light snow was falling but late in the day the intensity increased. The ski area had not yet installed their wind instrumentation, but southwest winds during the day were estimated at 20–25 mph and caused some blowing snow. The high temperature reached 25°F.

Accident Summary

On Monday morning, December 2, Jackson Hole ski patrol members reported for their first day of work. The patrollers would be working on the mountain in preparation of the ski area's scheduled opening the following Saturday, December 7. Before heading onto the mountain, ski corporation avalanche forecaster Jim Kanzler gave a detailed briefing of the snow and avalanche conditions.

Most of the snowpack-structure information gathered by Kanzler was from a snowpit he had dug the day before on Teton Pass. There he found four weak shear planes. The easiest shear was 32 inches down from the surface where very weak faceted-snow grains covered an ice crust. Kanzler told the patrollers and avalanche control teams that he was most concerned about the deep-slab instability posed by this weak layer. Then patroller Peter Mackey related his experience with the same layer. A natural avalanche the week before on Teton Pass had destroyed a car; the avalanche released on the same ice crust layer. Mackey told the group that the layer was very weak, and that he was also concerned the layer could cause the deep-slab instability problems well into the ski season. Though deep-instability was the main topic of the morning's report, Kanzler also expressed concern for shallow

surface slabs from instability in the new snows. After the morning meeting, avalanche control teams and work teams headed out onto the mountain.

At about 1000, three ski patrollers skied down from the top of the tram to Dean's Slide, high on the southeast side of Rendezvous Peak. Near the top of the path a one-pound charge was tossed into a pillow of snow, but released no avalanche. The patrollers ski-checked the area by crisscrossing the slope one-at-a-time as they moved down to a lower shot placement. This time a two-pound charge was buried a little over 2 feet into the snow, but the result was the same: just a large hole blown into the snow. Again, skiing one-at-a-time the patrollers crisscrossed their way down the path. The trio experienced no signs of instability and continued on with the rest of their control mission.

Later in the morning Kanzler rode the tram to the top of Rendezvous Peak (10,450 feet). He and John Carr headed to the north side of Rendezvous Bowl where Kanzler dug a pit. He was not happy with what he found. The pit showed deep-slab instability and very unstable conditions. The sliding layer was the same ice crust that he had found on Teton Pass, but in Rendezvous Bowl faceted-snow grains were both above and below the ice crust. At about noon Kanzler notified the two snow safety leaders by radio and advised them that the bowl should be closed. Rendezvous Bowl was quickly closed to all workers, even though the morning's control work with bombs and artillery on the entire mountain produced few avalanches and showed little evidence of instability. However, work crews could continue to work in areas adjacent to the bowl.

During the afternoon ski patrollers were busy stringing ropes and placing signs. At about 1600 a group of eight patrollers—on sign detail—left the top of Rendezvous Peak. It would be the last work project of the day; they spread out and started placing "closed" signs just below Corbett's Couloir on the eastern side of Rendezvous Bowl. The eight, Todd Harley, Margo Erjavec, John Huff, Bruce Tlougan, Jerry Balint, Glen Jaques, Jim Rosco and Paul Driscoll, 48, regrouped on the Lower East Ridge traverse to look at Dean's Slide. It was about 1615 hours. The morning's ski tracks had been mostly filled in by new snow and blowing snow, but only 5 minutes earlier three ski-area workers had just skied the upper

portion of Dean's Slide. Balint suggested they ski down one- or two-at-a-time to place signs along the north side of the path.

Balint started down first with a shoulder load of signs. He made one turn and stopped to place a sign. Erjavec dropped in below and put in another sign. She was followed by the other patrollers who started to place signs. All of the patrollers but Driscoll were grouped together about 100 yards below the East Ridge traverse. Driscoll, with a shoulder load of closed signs mounted on 2 x 2 inch posts, had gone ahead of the others and was much lower on the slope when Jaques and Tlougan traversed out to make a turn. Tlougan watched a fracture suddenly zipper across the slope and instantly pull apart 4–5 inches. He tried to self arrest by jamming his bundle of signs into the snow. At the moment it probably seemed like the thing to try, but within a second or two the whole slope fractured around him and started moving. He dropped the signs and started swimming motions and tried to steer himself toward some trees. The time was 1619. When the snow stopped he was caught on a small tree.

Jaques tossed his signs when he saw the slope fracture above him. The slide knocked him over and carried him a short distance. Balint was below Tlougan and off to the north side when the slide released. He heard Tlougan yell and turned around just in time to be clobbered by a wall of rushing snow. Tumbled in the flow, he was stripped of his skis and poles. He started swimming and fought to stay on the surface. When the moving snow stopped he too was only partly buried. Erjavec had just placed a sign and had her back to the slope when she heard some shouts. She glanced back to see Tlougan, Balint and Jaques in the giant blocks of moving snow. She yelled out, "Watch the workers," but before she could move she too was swept down by the slide. She was carried and partly buried a short distance down slope.

As soon as the snow stopped moving everyone was yelling for the person they had last seen. It took only a minute or two to account for everyone but Driscoll. Tlougan, Balint, Jaques and Erjavec were all okay and on the surface of the debris. But several minutes of yells and radio calls for Driscoll went unanswered.

Immediately they switched their beacons to receive and a beacon search was started.

Someone called out on the radio and reported the avalanche.

Rescue

Others on the mountain knew something terribly wrong had happened when they heard the radio calls for Driscoll. At the top of the mountain, patrol director Dean Moore and patrollers Bob Nelson and Mark Wolling were just leaving when they heard the first radio traffic. They waited for several minutes, but when they heard additional radio traffic asking about Driscoll they headed to the accident site. Moore's little group discussed getting rescue equipment, but when they heard another group would be at the Mountain Station (the top of the tram) within minutes, they rushed off.

Moore stayed at the top of the slide to direct other patrollers to the debris via a route lower down the slope. He was fearful of unthinking rescuers crossing the remaining snow above the fracture line and triggering a second avalanche. Nelson and Wolling skied down to help.

Though the patrollers were experienced in the use of avalanche rescue beacons they had trouble picking up the signal. Several patrollers reported receiving a weak but false signal, and several others reported receiving the radio broadcast of the local FM station KMTN. This led to some confusion and it was not until almost 10 minutes after the avalanche that Balint yelled out that he had a strong signal at the bottom of the debris. Immediately after the slide had stopped he had found his skis and started a beacon search working toward a bunch of signs scattered near the bottom of the debris.

Peter Mackey had a group of six patrollers working on the far side of Rendezvous Bowl when they heard the radio traffic about the avalanche. They immediately started walking uphill. Two patrollers continued up to Mountain Station to get a toboggan ready while the others climbed only high enough to safely traverse to the accident side. Only one patroller in the group had a shovel so he was instructed to wait at the top of the debris until Driscoll's position was pinpointed.

At Mountain Station, patrollers Ron Matous and Stuart Kennedy readied an akja (a type of rescue sled), but from the top of the mountain with their radio they could not talk to anyone at the accident site. Matous then heard over his radio that no one at Mountain

Station was answering their radio. He raced inside and tried to use the phone to make a call about that last radio message but only got a busy signal. Minutes later he heard over the radio that they had found Driscoll, so he headed back outside. Before leaving the top, Kennedy asked if they should bring shovels or any other gear. Matous didn't think they needed more equipment so Kennedy set off with the akja. Matous followed on his skis. As he skied away he kept trying to reach the accident-site rescuers over the radio but had no luck. He finally raised Moore who confirmed that no shovels, only the akja, was needed. It was only later, when he was almost to the debris, that Matous heard radio traffic requesting shovels.

The debris was quit firm, but moving over the large blocks of hard snow was difficult. Even so, the patrollers hurried to Balint's location. Once the beacon signal was pinpointed, ski-pole probes confirmed Driscoll's location. But there were no shovels. The patrollers started digging with the tails of their skis while the one patroller with a shovel skied down. It took 10 minutes of digging with the one shovel to reach Driscoll who had been buried 6 feet deep. More rescue equipment and shovels soon arrived, but it took an additional 20 minutes to uncover his body before rescuers could start CPR and move his body to the akja.

In hideous conditions Driscoll's fellow patrollers started the somber, but urgent evacuation. To describe the evacuation as difficult is an understatement. Darkness and moderate snow blinded the rescuers as they hauled the heavily-loaded akja in the deep snow. The patrollers had to break trail through the deep snow all the way to mid mountain before they could travel on packed snow. They reached the bottom of the mountain at 1823 where attempts by doctors to revive Driscoll were unsuccessful.

Buried for 40 minutes under 6 feet of snow was too long for Driscoll. The avalanche had pushed him—back first—against a tree. That blow probably took away what little breath he had when the snow stopped. The cause of death was suffocation.

Avalanche Data

The avalanche that released under the patrollers was a large hard slab. The fracture line was 5–7 feet deep and extended 300 feet across the slope. It was classified as an HS-AS-4,

and it most likely released on the buried ice crust. Little data about the avalanche is known. Heavy snow that evening buried the avalanche site under a new blanket of deep snow.

A few days later, 21 kilograms of explosives were lowered into Rendezvous Bowl. The resulting avalanche released the entire bowl—over 2,500 feet across. It released on the ice crust but quickly stepped to the ground and travelled over 1,200 vertical feet down the mountain.

Comments

Dean's Slide, located about 400 feet below the top of Rendezvous Peak and on the east side of Rendezvous Bowl, is considered the safest way off the top of the mountain. Scattered conifers separate the path from the bowl, but early in the season the trees act like snow fences catching the blowing snow off Rendezvous Bowl. Long-time patrollers could remember only a few similar large slides from Dean's Slide, and most occurred early in the season.

The avalanche was not a post-control release even though explosives had been used on the path earlier that morning. Conditions changed dramatically during the day; new snow and winds added an additional 12 inches of new snow to the slope since the morning control work. This additional weight significantly changed the stability of the slope. A marginally stable slope that morning that resisted explosives became an unstable slope by late afternoon. The weight of eight patrollers was too much for a slope that only minutes before had supported the weight of three skiers.

Besides the changing snow conditions there were human factors that might have contributed to the accident. It was the patrol's first day on the mountain and little knowledge of the snow and stability conditions existed. Even though there was an obvious weak layer in the snowcover, the morning's control results with explosives were minimal. Since the explosives did not confirm the instability or danger, the patrollers may not have used as much caution as was necessary for being out on steep slopes so early in the season. Working in a ski area they may have been lulled into a feeling of security, but in reality they were dealing with backcountry snow conditions and the uncertainty of a backcountry snowpack.

The ski patrollers also learned a very painful lesson: an avalanche rescue beacon is

worthless without a shovel. Before the accident the patrollers usually carried their shovels only during avalanche control missions done in the morning. Once the control work was finished, the shovels were then left behind. Now, when beacons are worn, the patrollers also carry shovels. Unfortunately this potentially deadly operating procedure—no shovel—continues to be practiced by many ski patrollers around the United States who wear avalanche rescue beacons.

What about the avalanche rescue beacons receiving the local FM radio station's broadcast? The transmitter for KMTN (96.9 MHz) is located above the town of Jackson, about 7 air-miles away. An avalanche rescue beacon is not a radio (they work on the principle of audio induction), but the simple electronics of low-frequency avalanche rescue beacons (2.275 KHz) can mix frequencies. In the presence of a powerful transmitter an avalanche rescue beacon can become a radio receiver. After the accident the ski area's avalanche rescue plan was updated to include a provision for rescue leaders to request the assistance from the County Sheriff to temporarily suspend KMTN's broadcast if interference is significant.

The loss of a co-worker and friend was a terrible way to start a ski season. Paul Driscoll's death was the first avalanche fatality at the Jackson Hole Ski Area in 21 years of operation, but sadly it would not be their last that season. Three months later, avalanches would claim another patroller and destroy buildings on the mountain (see accidents 86-10 and 86-15). Other incidents in which shovels were needed but not carried can be found in 80-1, 80-10, 82-13 and 83-3.

86-1

JANUARY 3, 1986

Mt. Blackburn, Montana

3 backcountry skiers caught, 1 partly buried

Weather Conditions

A shallow, early-season snowcover and one of the coldest Novembers on record in Montana created ideal conditions for extensive depth

hoar development in the northern Rockies. Though December was much warmer, snowfall was sparse and the snowcover remained shallow. At Bridger Bowl Ski Area, 15 miles north of Bozeman, only 17 inches of snow fell all month. The bright sunshine and warm temperatures helped to consolidate and strengthen the snow on the south-facing slopes, however, on the north facing slopes an entirely different situation was developing: a cold snow cover with ideal conditions for the development of depth hoar. On December 31, light snow began to fall and continued through January 3. Though only 8.5 inches fell at Bridger Bowl Ski Area, the new snow was accompanied by strong west winds of 20–30 mph. This was the first fresh powder to fall since December 17.

Accident Summary

The new year was off to an auspicious start with the first fresh snows in two weeks. On January 3, two men and one woman left Bozeman to backcountry ski on the northeast spur of Mt. Blackburn, 20 miles south of Bozeman. The small group enjoyed the 8 inches of new snow on a southeast facing slope. The skiers said the new snow rested on top of a “bombproof” sun crust that was above weaker faceted snow grains. During the early winter these south-facing slopes receive sunshine until about noon.

After several runs, the skiers decided to try the north face of the mountain. While breaking trail on the north side, both men noticed the lack of the “bombproof” layer that they had encountered on the southerly slopes. The woman was following in their track. The three spread out using the infrequent scrub pines as stopping points. While they were traversing about 300 feet below the summit, the slope fractured and avalanched to the ground. Both men were able to hang onto small trees, but the woman was swept down the 30–40° slope.

Somehow during her wild ride she was able to release one of her skis just before going over a 30-foot cliff. When the avalanche stopped she was buried to her neck and fortunately suffered only cuts and bruises. Her two friends quickly descended to her and spent 30 minutes digging her out.

Avalanche Data

Few details are available about the avalanche but a reasonable guess would classify the

avalanche as an SS-AS-3-G. The avalanche fell almost 1,000 vertical feet while traveling about one-third of a mile down the mountain. The avalanche path faced north to northeast.

Comments

This accident illustrates two important conditions for avalanches. First, the lack of snow and warm winter temperatures do not stabilize the snowcover. These conditions may help to stabilize and strengthen the sun-exposed southerly slopes as thick suncrusts form, but the shaded northerly slopes can weaken and become more avalanche prone with time. Second, even very little new snow on top of a weak depth-hoar base is dangerous. Less than one foot of snow fell over several days but it was enough to create a shallow slab.

The party seemed to be experienced and had some avalanche awareness training. They skied the edge of slopes close to the trees. While traversing, they spread out using the small trees for protection. Also, the woman knew to shed equipment when caught and was able to release one ski. This might have saved her life. If both skis had remained on, there is a good chance she might have been buried even deeper. Even with some avalanche training the group’s eagerness to ski fresh powder mislead them and caught them off guard.

The group became overconfident after skiing the stable south-facing slopes. In search of more powder they set out to tackle the north-facing slopes. Though they encountered an obvious clue—depth hoar with no strong suncrust—they failed to reassess the risk and modify their ski plans.

86-2
JANUARY 6, 1986

Provo Canyon, Utah

1 backcountry skier caught, buried and killed

Weather Conditions

Heavy snows fell in the Wasatch Mountains during November and early December. Then came three weeks of dry, clear weather. Surface hoar and upper-level kinetic metamorphism was extensive. From December 29 to January 4,

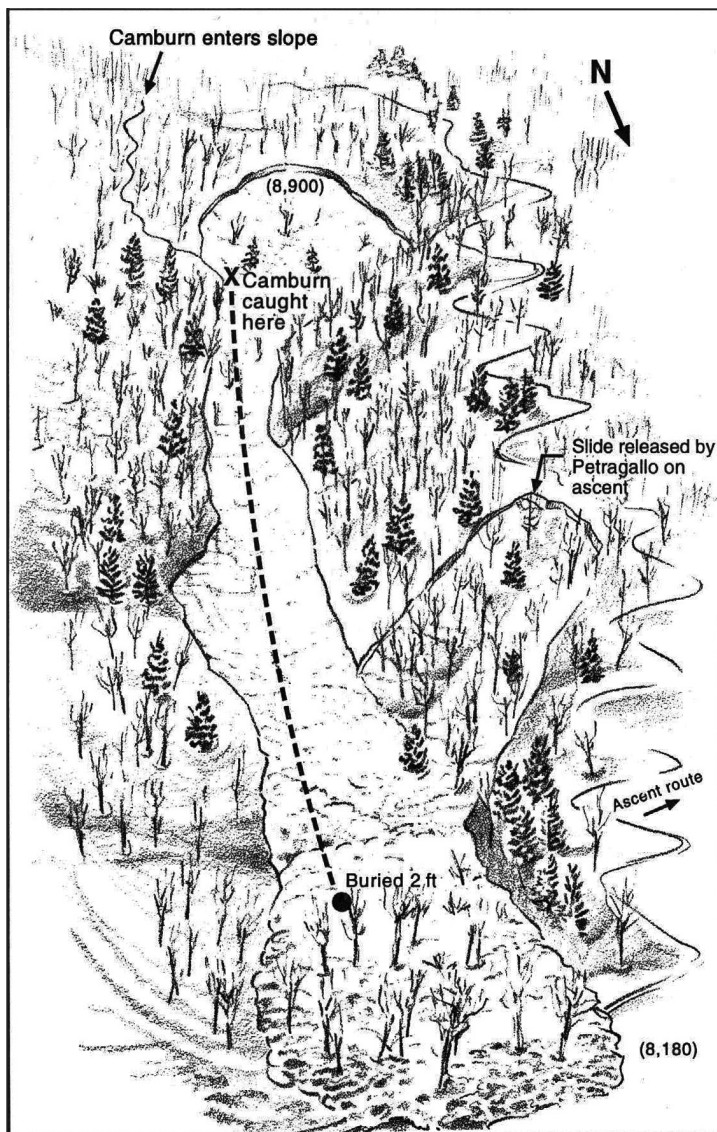


Figure 32. Accident 86-2, Provo Canyon, Utah, January 6, 1986.

several small storms left up to 8 inches of new snow on top of the weak snowpack.

Late on the night of the 5th, a vigorous storm hit the Wasatch. Early in the storm rain fell below 7,500 feet and wet snow fell at the higher elevations. Southwest to northwest winds gusted to 70 mph at the ski areas in Little Cottonwood Canyon, about 20 miles to the north of Provo Canyon. On the morning of the 6th, 4–6 inches of snow had fallen. Snowfall continued during the morning, tapering to flurries and partial clearing during the afternoon. Winds remained strong from the northwest, and temperatures dropped during the day from the mid 20s to single digits by afternoon. Shortly after sunrise, temperature

sensors at nearby ski areas recorded a 4–7° drop in one hour.

Accident Summary

A group of three experienced backcountry skiers left Salt Lake on the morning of January 6, intent on skiing the terrain in the South Fork of Provo Canyon. Douglas Camburn, 33, Fred Henion, 25, and Mike Petragallo, 26, were well equipped and carried rescue beacons, shovels and other necessary gear. They called the Utah Avalanche Forecast Center and were informed the hazard in the Provo Mountains was moderate.

The three parked their car at the gate for the Trefoil ranch and started up the trail. Their goal was to ski up Water Hollow, a north-south running side canyon, for a day of skiing in a lightly treed bowl just east of Windy Pass. Travel was slow; even in the sheltered creek bottom the high winds drifted snow, making trail-breaking difficult.

After two hours and three miles, the group arrived at the base of the bowl at about 8,000 feet. Concerned about the avalanche danger, the three discussed the conditions and opted to follow a minor ridge rather than climb directly to the pass, and thus avoid crossing several major avalanche paths.

Petragallo was in the lead as the group climbed a broad, windswept ridge. After climbing some 300 feet, he released a small, slab avalanche about 30 feet in front of his skis. This slide ran down the opposite side, the north side, of the ridge from where the party was ascending. This slide ran very fast through thick aspens and deposited snow into a gully below.

Camburn, the most experienced member of the group, took a close look at the fracture line. He noted the slab had failed on a layer of upper-level faceted snow buried 2 feet below the surface. The group continued up the ridge; wary of the north-facing side that continued to be cross-loaded by strong, gusty northwest winds.

At about 1330, the group reached a broad summit at 9,500 feet, .5 mile east of Windy Pass. After lunch the three enjoyed three runs on a gentle north-northeast facing slope.

At 1530, the party began their return and contoured west toward their ascent route. About 1600, the three stopped in the aspens at the top of the gully near their ascent route. The gully was broad and ill-defined at the top, and

the view of the lower gully was blocked by mature conifers.

Camburn skied first and disappeared into the pines after 10 turns. Henion and Petragallo waited for an “all clear” call. It never came.

Rescue

After a short wait Henion started down next to Camburn’s tracks. Passing through the pines Henion saw six or eight turns which vanished into a fresh avalanche. He called for Petragallo to come down.

The two turned their rescue beacons to receive. Petragallo hurried to the bottom to search the main debris area. Henion searched the benches and trees in the upper portion. Petragallo found a ski about 300 feet lower down, and 150 feet below that he picked up the signal from Camburn’s beacon. Henion hustled down to help. Henion pinpointed the signal and immediately found Camburn buried 2 feet deep against an aspen tree.

Within 10 minutes from when Henion and Petragallo last saw Camburn, he was uncovered from the snow. He was not breathing and had no pulse. Blood in his nose and mouth made artificial respiration difficult, but for 30 minutes Henion and Petragallo did CPR with no positive results. The victim showed no life signs.

The avalanche had carried Camburn nearly to their ascent route. Realizing their friend was dead, Henion and Petragallo attempted to bring the body out, but because of increasing darkness and lacking a sled they decided to return to their car and report the accident.

That evening a rescue group was organized to recover the body but because of the avalanche danger, they postponed the recovery until the following morning. A Life Flight helicopter, an air ambulance service from Salt Lake City, was used to remove the body, and to minimize the number of rescuers exposed to avalanche danger.

Avalanche Data

The soft-slab avalanche was classified as an SS-AS-3-O with a 1–3 foot fracture on a slope of 37°. The fracture line ranged from 25 feet across to 125 feet. It released from an elevation of 8,900 feet; the vertical fall was 720 feet. The slide released on a north-northwest-facing, lightly treed slope, and it curved around into a west-facing gully. It failed on the same upper-

level faceted snow layer that Camburn identified in the earlier avalanche.

Comments

Three weeks of dry, cold weather created a weak snowpack especially on the northerly facing slopes. Add to this the heavy new snow and strong winds and conditions were primed for avalanches. The group was unfamiliar with the area: Water Hollow is a difficult area to travel because the narrow valley is bounded by steep slopes. Nonetheless the group knew the avalanche danger, but chose to do the tour because they felt they could do it safely. The three were well prepared, were equipped with rescue beacons and shovels, and were familiar with their use.

The most obvious clue to the danger was the avalanche they triggered while climbing the ridge out of the valley. The slide released when the group was 30 feet away and on the opposite side of the ridge. Henion said “it opened our eyes but not enough.” Later in the day they unknowingly skied into the same gully they had released earlier.

Extreme caution must be exercised when touring when the snow is unstable. This tour ended tragically for an experienced, and avalanche-prepared group. They did not know the area or the terrain and could not see the entire slope as they started down. Also the slope emptied into a narrow gully—a terrain trap—where the debris piled up. The slide probably released as Camburn skied across the toe of the slope and into the gully. The slope failed in compression, like pulling out the bottom log from a wood pile.

Sound advice is offered by Utah Avalanche Forecast Center avalanche forecaster Brad Micklejohn who wrote the avalanche report. In his report he stated, “Rescue beacons do not guarantee safe passage through avalanche terrain, and backcountry travelers should travel as if they were not carrying them.”

86-3
JANUARY 16, 1986

Steam Mill Canyon, Utah

1 backcountry skier caught

Weather Conditions

Throughout the Wasatch the snowpack was weak. A three-week dry spell in December had caused extensive surface hoar and upper-level kinetic metamorphism development. At nearby Beaver Mountain Ski Area several small storms between December 29 to January 7 left 20 inches of new snow on top of the weak snowpack.

On the morning of the 16th, an additional three inches fell. Skies were generally overcast with scattered snow showers, and temperatures were in the low to mid 30s. About mid-day winds increased from the west causing some snow transport onto the easterly aspects. Since January 10, no avalanche activity had been reported to the Utah Avalanche Forecast Center—throughout the northern Wasatch—from either the backcountry or ski area control work.

Accident Summary

A group of four experienced backcountry skiers—Ron Stagg; Kent Stephens, 31; Al Soucie, 37; and Kevin Kobe, 24—left Salt Lake City for a day of backcountry skiing. Soucie was interested in evaluating the stability of some higher elevation slopes in the backcountry around Logan.

From the bottom of Steam Mill Canyon the group headed up a ridge looking to find a north- to east-facing slope to dig some pits and do some skiing. On their ascent the group took time to test the leeward slopes with ski cuts and by kicking off pieces of the overhanging cornice. Blocks as big as a person, and some even bigger, caused no slab avalanches as they rolled 100 feet down the slope. Occasionally a block would cause a minor sluff of the new snow on slopes up to 40° in steepness.

Further up the ridge Stagg pointed out a slope he had skied the last time he had climbed the ridge. It was steep with scattered trees and faced more to the east. Soucie, who was in the lead, was more interested in the slope below them. Soucie explained to the group why it would be safer to try the less steep slope first in case of a surprise release: “It was lower angle, wide open with only a couple of boulders at the bottom, and it had a more gradual runout.” The group agreed, and it was decided a good representative spot to dig a snow pit was 50 feet below the ridgeline.

They did several shovel shear tests but none produced any clean or easy shear layers.

The group took some time looking at the snow layers and Soucie explained the snow structure and answered questions as they examined the snow.

Conditions looked pretty safe. Based on their observations of no obvious shear layers in the snow pit and their tests of adjacent slopes on the ascent, the group decided to ski the slope one at a time. Everyone had a shovel, but only Soucie and Stagg had rescue beacons, so one of them would ski first. Soucie wanted another quick pit to be dug about mid slope to compare the layering with what was found at the upper snowpit.

Stagg had his skins off first and was ready to go. In his words, “I took off and made six or seven telemark turns. Then I stopped and was ready to make another turn when I had the sensation of moving. I looked around and saw the whole slope had broken up and was moving. . . . At the same time I yelled I turned my skis downhill and sat on the back of my skis.”

The other three watched Stagg as he was carried down, staying on top of the moving snow. The slide came to rest in the flats below; Stagg stayed on top and appeared to be all right. Stephens and Kobe, both emergency medical technicians, descended to Stagg, and Soucie went to look at the fracture line to decipher the surprise release.

Avalanche Data

The soft-slab avalanche was classified as an SS-AS-2 with a 40 centimeter fracture on a slope of 35° at 8,900 feet. About half way down, it steepened to 40°. The slide released on a north-east-facing, open slope and fell 350 vertical feet.

Comments

The group did almost everything right, even expecting the unexpected. Every decision they made was done so with the idea of minimizing their risk. The tour could have turned into a disaster if one of the skiers not equipped with a rescue beacon had triggered the slope and been buried.





Figure 33. Accident 86-4, Hell Roaring Mountain, Montana, February 4, 1986. Photo by Steve Kelly and Hungry Horse News.

86-4 **FEBRUARY 4, 1986**

Hell Roaring Mountain, Montana

1 snowcat operator caught and partly buried, 1 vehicle damaged

Weather Conditions

Only three inches of snow fell at nearby Big Mountain Ski Area during the month of December and much of the snowcover had turned to depth hoar. Though seasonal snows fell during January, there were no large storms. By the end of January a series of weak storms brought steady, light snows to northwestern Montana. From January 28 to February 4, 28 inches of new snow fell at Big Mountain. The morning of February 4 dawned clear. It looked to be a good day to be at work in the mountains, but it was also a good day for triggering avalanches.

Accident Summary

On the morning of February 4, Merl Phillips, of the Montana Fish, Wildlife and Game

Department, was plowing a new snowmobile trail across the south side of Hell Roaring Mountain, about one mile north of the Big Mountain Ski Area. The new trail would link two existing snowmobile trail systems and give easier access to the backcountry near the Big Mountain Ski Area. Constructing new trails had not been easy that winter as the early winters' snows were shallow and the pack had turned to depth hoar. Finally after one week of new snow there was enough snow to plow the trail. Planners chose the Hell Roaring Mountain route as they considered it to be less avalanche prone than an alternative trail.

Before making the first cut across Hell Roaring Mountain, snowcat-plow operator Phillips and another Fish, Wildlife, and Game employee, Mike Baker, unhooked the trail grooming device. The device, an Idaho Special, is pulled behind a snowcat and cuts and packs the trail. However, when traversing steep slopes the Idaho Special does not track well and tends to slide downslope. So the plan was for Phillips to plow the road first without the groomer, then return for the groomer and make a second pass. Following an old summer jeep road Phillips started the snowcat, a DMC 3300 similar to ones used in many ski areas to

groom ski runs, across the sparsely-treed, open slope. Mike Baker, on a snowmobile followed several hundred feet behind.

It was about 1400 hours when the slope above the trail released and hit the snowcat on its right side. In the instant before the avalanche heaved them off the road, Phillips hit the left brake, locking the left track, which pivoted the machine down the slope.

The DMC 3300 is designed with a boat-like bottom and that gave the machine some buoyancy as it was swept down-slope in the moving snow. As the snowcat crashed through and over small pine trees, it was the plow blade in front that protected both Merl and the machine in the 1,500-vertical-foot ride. Watching from his safe vantage point Baker said it "looked like a toboggan ride" as the snowcat plunged down the mountain.

When the avalanche stopped, the snowcat was buried to its doors. Phillips was not injured though he was a bit shaken up from the wild ride. The snowcat suffered little damage—\$2,500 worth—and one track spun off the machine a short distance above where it eventually stopped. A week later, with some new replacement parts installed, the snowcat was driven back up the avalanche debris to the trail.

Avalanche Data

This avalanche, classified as an SS-AO-3-G, was released by the snowcat as the machine undercut the slab. It was a soft slab that fractured 3 feet to the ground, and fell 1,600 vertical feet. The slope was 33° in steepness and faced south-southeast.

Comments

It is important when working or recreating in the backcountry to learn what the current avalanche conditions are. At the time of the accident, conditions were ripe for triggered avalanches. The snowcover reached a critical point as steady, light snows piled up on top of a significant depth-hoar layer. Usually Montana Fish, Wildlife and Game personnel talked to the staff at Big Mountain Ski Area; however, on this fateful day there was no communication. Had the groups talked the Montana Fish, Wildlife and Game personnel would have learned that ski patrol control teams at Big Mountain released 14 avalanches on February 3 and another 16 slides on

February 4. Several of these avalanches were large, destroying 25-year-old trees.

Later Phillips remarked that they did not speak to the ski area personnel that morning for several reasons. The Montana Fish, Wildlife and Game personnel were busy and did not want to fall behind in their work schedule, so no telephone call was made. Also there was a feeling of overconfidence among the workers; they felt there would be no problems so a call was not necessary. That phone call could have prevented Phillips' close call.

Accidents like this that affect workers can be avoided when an avalanche safety work plan is developed and implemented. The plan aids in decision-making by helping to evaluate hazards and prescribes safety measures for workers.

86-5
FEBRUARY 7, 1986

Mt. Ellis, Montana

2 backcountry skiers caught, buried and killed

Weather Conditions

Winter snows had been sparse throughout the northern Rocky Mountains. During December, only 17 inches of snow fell at the Bridger Bowl Ski Area. The shallow snow cover quickly turned to depth hoar. Snowfall in January was only slightly better: just over 3 feet fell. The morale of all winter recreationists quickly improved as steady light snows fell in early February. From the 1st to the 7th, 16.5 inches of new snow and 1.67 inches of water equivalent were reported at Bridger Bowl. The snow base increased from 36 inches to 51 inches by the morning of the February 7.

Accident Summary

On Friday, February 7, Spencer Ore, 27, and his brother David, 33, left Bozeman at 0900 for a day of backcountry skiing in the Mt. Ellis area 10 miles southeast of Bozeman. In reconstructing the accident, searchers determined the brothers parked at the New World Gulch trail head. By about 1000, the two headed southwest to Mt. Ellis. They were last seen by another backcountry skier, Bill Powers, at

about 1400 hours on a ridge north of summit. They told Powers they had not skied the northeast face of Mt. Ellis before and asked about the best route down. They indicated they would probably follow his tracks.

Powers waited for the brothers below the summit for about 15 minutes before skiing down. As he started down, Powers noted that there were already three to six sets of ski tracks that appeared to have been made earlier in the day. He skied down the face to the head of a gully (Chute 2) where he then traversed right through an old burned area to a smaller chute (Chute 1) not far away. Powers, who skied the area frequently, waited again in a big meadow at the bottom of the mountain in hopes of seeing the brothers again. He did not, and he returned to his car shortly after 1500 hours.

The Ore brothers were experienced outdoorsmen who had started backcountry skiing only a few years before. If they were late getting home they instructed their wives not to worry until midmorning Saturday. They indicated if they "got into trouble" they would spend the night in the woods and ski out the next day. When they failed to return home by 1100 hours Saturday morning Spencer's wife contacted the Gallatin County Sheriff's office.

Rescue

A ground search was initiated Saturday afternoon (the 8th) for the missing men. Their vehicle was found at the trailhead but searchers on snowmobiles and a Civil Air Patrol airplane failed to find the skiers. Late that afternoon, however, observers in the airplane spotted ski tracks leading into a fresh avalanche in Chute 2 on the northeast side of Mt. Ellis. No tracks led out of the avalanche. With dwindling daylight, searchers were called back; it was decided to mount a major search effort of the avalanche on Sunday, the 9th.

Early on the 9th, 21 searchers set out for the accident site. The first team flew by helicopter to the top of Mt. Ellis; they carried explosives. Their mission was to reduce the threat of additional avalanches crashing down on searchers. Using hand charges they triggered avalanches; debris from several of these overran the debris of the first avalanche. When the site was deemed safe trained search dogs and their handlers from Bridger Bowl Ski Patrol and the Gallatin County Sheriff's department arrived.

Meanwhile, snowmobilers started shuttling in additional searchers up the 3-mile trail. Deep, soft snow stopped the first snowmobiles about a quarter mile from the slide, but by later in the day a path was beaten to the toe of the debris. By midmorning searchers had started probe lines. For the next 3 days more than 35 people volunteered to help, and for 3 days searchers probed the debris without success. On the evening of the 11th, with worsening weather in the forecast, the search effort was suspended.

For the rest of the winter and spring family members, a U.S. Forest Service Ranger and a Gallatin County Sheriff's deputy periodically returned to the accident site to search for clues that might have started to melt out. Finally on June 19, a brother of David and Spencer found a ski pole sticking out from under the snow. That afternoon a small party of rescuers returned and recovered both bodies from the bottom of Chute 2.

Avalanche Data

Classified as an SS-AS-3, this avalanche traveled 1,800 feet down the slope, carrying the brothers into a narrow gully and burying them deeply. Secondary avalanches triggered by explosives added to the deep burial. Rescuers estimated that the men were buried about 22 feet. The avalanche started on a broad, open east-facing slope at an elevation of 8,330 feet. It fractured 4–6 feet deep and was 800 feet across, but the avalanche then funneled into a narrow, confined gully.

Comments

It is believed that the men followed Powers' tracks to the head of Chute 2. Perhaps they started down the narrow gully, or maybe they had started to traverse when they triggered the avalanche. Rescuers suspect the men were aware of the avalanche danger. Karen Ore, wife of David, was quite sure her husband had seen the printed avalanche warnings in the local paper. The local U.S. Forest Service Snow Ranger issued avalanche warnings earlier in the week. The warnings appeared in the local newspaper and were heard on local radio stations during the week. The warnings stated that old avalanche paths and slopes of 30° to 60° should be avoided. Perhaps the brothers gained false confidence by seeing Powers and other ski tracks on the slope. It seems that Powers was a lucky man.

Avalanche educators have hopes that avalanche awareness lectures and avalanche warning programs can minimize this kind of accident.

86-6

FEBRUARY 13, 1986

Sundance, Utah

1 house damaged

Weather Conditions

Winter finally returned to the Wasatch Mountains with cold upper-level north-northwest flow on February 11. At the Utah Department of Transportation Alta study plot, at 8,800 feet and 14 air miles north of the Sundance Ski Area, light snow started to fall. By 0430 on February 12, 14 inches of very light snow had fallen. The average density of the new snow was only 4 percent (40 kilograms per cubic meter). During the day the flow aloft became zonal with strong westerly winds. The high temperature climbed to 26°F as the west winds brought warmer air and more dense snow to fall. At 0330 on the 13th, 12 inches of very heavy, wet snow had fallen. The average density of this new snow was 22 percent (220 kilograms per cubic meter). The water equivalency for the 2 days of snowfall was 3.27 inches and climbing. Heavy, wet snow continued to pile up at a rate of an inch-an-hour during the day.

The heavy, new snow was creating an inverted snowpack and very dangerous avalanche conditions in the backcountry. The Utah Avalanche Forecast Center issued an avalanche warning on the morning of the 13th. The backcountry danger was rated extreme and large destructive avalanches were certain. The warning advised backcountry travelers to stay well away from the runout zones of large avalanche paths.

The warning would remain in effect until the 22nd. This was the start of a series of major winter storms and avalanches that would deal death and destruction across the western United States for more than a week.

Accident Summary

Real estate mogul Robert Allen constructed a

mountain dream home just northwest of the Sundance Ski Area, about 10 miles east of Orem. Built in 1984, the 7,000 square-foot custom home, with furnishings, was valued at over a million dollars. The home also had spectacular views of Cascade Cirque and the Stewarts Cascades (waterfalls) on the east side of Mt. Timpanogos. The view included nearly 5,000 vertical feet of relief. The only problem was that the home was located in a known avalanche path. Two other homes were located in the runout zone; one above and one below the Allen house.

The Allen home was built in the willows and young aspens at an elevation of 6,700 feet, near the top of the runout zone of the Bearclaw Cabin avalanche path. The path is a steep northeast-facing gully directly above and southwest of the Sundance Mountain Home Development. It was named for a cabin built in the early 1970s for the Hollywood movie, "Jeremiah Johnson." That cabin was destroyed some years later. The Bearclaw Cabin path was identified in the Sundance Ski Area avalanche plan that was filed with the U.S. Forest Service in February 1984. An adjacent, but smaller path, the Water Tank Slide, overlaps the Bearclaw Cabin runout zone.

On February 13, Allen's dream home was reduced to a nightmare. At 1537 hours, a large avalanche released from the Bearclaw Cabin path and crashed into the rear of the house. The snow flowed over, around and through the home. Furniture and personal belongings were swept out of the house and scattered downhill in the debris. Fortunately no one was at the house when the avalanche struck, for certain death would have occurred. A week later snow was still piled 20 feet deep along the rear of the house. A short time later a Utah County building inspector condemned the wrecked house. The other two homes were only dusted by the powder cloud and were not damaged.

Structural engineers said the house could be repaired, but extensive work was required. They also stated the house could not be repaired and occupied until avalanche defense structures could be built. Experts Beat vonAllmen, Peter Lev and Stephen Schueler were hired to investigate the avalanche and to evaluate the site to best mitigate the hazard. Because of the steep slopes in the track and in the runout zone above the Allen house and its neighbors they determined defense structures

would be ineffective and would not protect the homes. However, supporting structures could be used in the starting zone to hold the snow in place, and vonAllmen recommended the installation of avalanche netting. But he pointed out serious permitting problems would be encountered. Though the runout zone was on private property, the starting zone was within a designated U.S.F.S. wilderness area.

Allen chose not repair his dream home, and abandoned the damaged house. In 1987 his insurance carrier filed suit against the development company (Transamerica Insurance Company v. Sundance Development Corporation and others). On November 8, 1989 the court dismissed the suit and ordered each party to bear its own costs.

Avalanche Data

Severe weather kept avalanche workers from visiting the starting zone after the slide. However, evidence after the avalanche told what happened. The starting zone and track of the Bearclaw avalanche path are both 37°. The avalanche fell about 1,900 vertical feet to the house. Near the top of the runout zone the house is located on a 17° slope, too steep for large avalanches to decelerate and stop before hitting the house.

The vegetative record around the house told of a history of avalanches. This was not the first, nor will it be the last, avalanche to reach the area of the house. Uprooted and broken trees lie decaying in the avalanche path. Older, still-standing trees within the path and near the house show scarring on the uphill sides caused by earlier avalanche events.

Consulting engineer vonAllmen and avalanche expert Lev thoroughly studied the avalanche event. Their conclusion was, "the avalanche that struck the Allen residence was not unusual, and it was far short of the potential." Because of the inverted snowpack widespread natural avalanching occurred throughout the Wasatch on the 13th and only involved the new snow. The experts felt that this avalanche also involved only new snow. If it had released into deeper layers, or later in the storm, a much larger and more damaging avalanche would have resulted.

While inspecting the area during the summer of 1986 the men deduced that actually two slides were responsible for the damage to the house. The Bearclaw Cabin and the Water Tank Slide paths released simultaneously.

Debris from the Bearclaw Cabin avalanche reached the runout zone first. Debris from the Water Tank Slide flowed into the runout zone and helped to push the Bearclaw debris into the house.

Comments

Avalanche runout zones can be attractive building sites (see accident 84-7), and most homeowners probably build without fully realizing the danger and the consequences they might incur. Though Utah County has a natural hazards ordinance, the zoning ordinance does not include avalanches. Thus, there was no process to keep development out from avalanche areas where the risk was unacceptable. One study of the Allen avalanche found that the avalanche hazard at the Sundance Mountain Home Development was "either ignored or not recognized." Avalanches were not considered in the planning, designing and construction of homes in the Bearclaw Cabin runout zone.

Without strong avalanche zoning ordinances future accidents of this kind are certain, not just in Sundance but in all mountain developments where structures and homes can be affected by avalanches. In the absence of zoning regulations buyers must be made aware of the avalanche threat. Having a home destroyed, or loved-ones killed, is a ignominious way to name an avalanche path.

86-7

FEBRUARY 15, 1986

Reflection Lakes, Mt. Rainier National Park, Washington

1 ski tourer caught and partly buried

Weather Conditions

Saturday, February 15, was cloudy and snowy at Paradise (5,400 feet) on the south side of Mt. Rainier. At 0845, 8 inches of heavy, wet snow (1.45 inches of water equivalent) was reported, and the temperature was already 32°F. Winds were light from the southwest, averaging 15 mph. At Narada Falls, a thousand feet lower in elevation and a short distance down the road, it was raining.

Accident Summary

John Jennies, 30, and Annette Frahm left their car at the Narada Falls (4400 feet) parking lot for an overnight snowcaving trip. It was raining as the two skied up the trail toward Reflection Lakes (4,854 feet). The couple followed the unplowed Stevens Canyon road to the lakes. At Reflection Lakes snow was falling and the couple started to scout areas to dig a snow cave. It was shortly past 1500 hours when they found a likely looking spot. Jennies and Frahm left their heavy packs on the snow-covered Stevens Canyon Road and climbed a steep hill above the road. About 200 vertical feet above the road Jennies attempted to ski a short, but steep convex slope.

The slope released. Jennies had no time to react and was carried a short distance. He was pushed onto his side, head downhill. As the snow piled on top of him it formed a mound around him, keeping his head from being buried. When the slide stopped Jennies' head was sticking out from the bottom of the mound. Snow piled up around his shoulders; his feet, still in the ski bindings were buried 4 feet.

Uninjured but caught fast in the heavy, wet debris Jennies had to wait for Frahm to get a shovel from their packs (left on the road). It took 30 minutes to dig out Jennies. After the close call the couple dug a snow cave on an adjacent slope and skied out the next day via the Mazama Ridge route.

Avalanche Data

The northeast-facing, 45° slope, is at an elevation of 5,000 feet. Classified as an SS-AS-3-O, the avalanche was 50 feet across and 200 feet long and fell 100 vertical feet. The slab consisted of fresh snow that was only 10 inches deep. Though winds were relatively light, stronger gusts had caused blowing snow and the slope was in the lee of the wind.

Comments

Both Jennies and Frahm were experienced cross-country skiers, and both had basic avalanche awareness training. Frahm had attended one or two formal avalanche classes, and Jennies had attended two formal classes. However the lure of a few turns on a steep pitch overcame his better judgment. Avalanches are quick. The release and acceleration are instantaneous, and even a strong and experienced skier like Jennies could not react

once the slope avalanched. He stated that he did not have time to ski out of the avalanche or to even try swimming motions once he was pushed over. Short slopes and small avalanches can turn into killers and Jennies was lucky his head was not buried. Had the avalanche fallen further and travelled faster it would have no doubt completely buried him.

86-8
FEBRUARY 15, 1986

Twin Lakes, California

1 resident buried and killed; 1 house destroyed and 1 house damaged.

Weather Conditions

In the middle of February a steady fetch of Pacific moisture was aimed at the coast of California; for 9 days storm after storm would pummel the Sierra Nevada. Reminiscent of the storm cycle of March 1982 (see accident 82-14) the February 1986 snows caused avalanches to run unprecedented distances and with extreme forces. Throughout the Sierras avalanches tore through mature forests. In places trees as old as 350 years were mowed to the ground.

The February cycle started innocuously enough; on the morning of the 12th, 5 inches of new snow and 0.8 inches of water equivalent were reported at Mammoth Mountain Ski Area about 40 miles south of Twin Lakes. During the day the storm intensified: on the morning of the 13th, another 24 inches of snow and 4.95 inches of water equivalent were added. The 14th brought 7 inches of snow (1.55 inches of water equivalent) and the 15th delivered 16 inches (4.00 inches of water equivalent) more. On the 15th, very heavy (3–4 inches an hour) snow fell all day. On the morning of the 16th, another 26 inches of snow and 5.25 inches of water equivalent were added to the total. Strong winds caused heavy loading of avalanche starting zones. On the 14th and 15th, winds gusted to 60 mph. Temperatures during the storm were mild; highs were in the upper 20s to low 30s and overnight lows were generally in the mid to lower 20s. At Twin Lakes, a small resort community northeast of Yosemite National Park and near Bridgeport in Mono County, heavy wet snow fell accompanied by strong winds.

Snows continued to fall through the 20th when skies finally cleared and the snow stopped. During the onslaught from February 12–20 at Mammoth Mountain Ski Area, 139.5 inches of snow with 27.37 inches of water equivalent fell.

Accident Summary

In November 1985 the Aaron family had finished construction of their beautiful mountain home overlooking Lower Twin Lake in Bridgeport. The two-story house measured 35 feet by 35 feet, and like any great mountain home it had a massive fireplace—20 tons of reinforced concrete. The family knew that avalanches could threaten the house and had discussed what to do when the danger was high. It was agreed that they would retreat to the basement.

In February, son John, 28, was staying at the house alone with his dog. He was writing travel books. He had spent 3 years hitchhiking around South America gathering information on the people and the countries. John Aaron loved traveling; he would hitchhike to Alaska in the summer and return to the Sierras for the winter.

While the storm raged Aaron had spent Saturday, February 15, shooting pool at a neighbor's house. Early in the evening he went home. About 2030 hours his friends got real concerned because of the storm. They called to say "We're going to bring you down to our house because the weather's so bad." Aaron declined their offer saying he would be safe in the basement. That was the last anybody heard from John Aaron.

At 2108, the lights started to flicker in houses across the valley, then they went out. An avalanche struck two power poles behind the Aaron house, snapping the line. The slide hit the house, and then a second slide followed the first. Other slides ran in the area. Neighbors heard the avalanches and the crashing of homes but did not go outside because of the danger.

The next morning neighbors found one vacant house destroyed; another house was surrounded by avalanche debris but undamaged. The Aaron home was destroyed. The upper two stories were carried 200–300 feet down the hill and onto the Twin Lakes Road.

They knew that John was in the house, either in the basement or on the first floor getting ready for bed. But they did not know

which. Using the positions of other houses and power poles they flagged an outline where they thought the foundation might be. John's father and a brother came to dig. In one week they only managed to dig a hole 6 feet deep in the debris. The avalanche danger remained extreme and organized rescuers were held back until the 21st. At this point let us follow rescue-dog expert Sandy Bryson's report that appeared in the March 15, 1986 issue of *The Avalanche Review*.

Rescue

"Imagine going to an avalanche rescue in a boat!" Friday, February 21, Mono County SAR (search and rescue) took skiers in boats to evaluate the Bridgeport avalanche area and then took two WOOF search dog teams across Lower Twin Lake. The boat broke a skim of ice as it headed across the mirrored water. Along the north side of both lakes a broad shoulder of mountainside rose thousands of feet with scrub sage, gullies and few trees—perfect avalanche terrain. At the base of these gullies were the toes of dozens of 'mole' avalanches, lumpy, many-fingered slides that came down after the storm in unusual array.

"Forty or so cars were trapped along the lake's road—all snowbound. A sheriff's deputy said they had called the people to get out of there, but they wouldn't go. To the east a huge slide had taken several little A-frames and turned them 180°. Plows were starting to bite through the 25-foot slides to get to the rescue site.

"The dog teams started to search the avalanche along the 70-foot-wide swath of debris. One team worked high while the other worked low, then they switched. Chris Salisbury and her German Shepherd, Lance, began on the lower half while Judy Cross and her Golden Retriever, Zeke, worked near the foundation site. Seconds after he started searching, Zeke alerted and dug hard. Judy pulled him out, restarted him, and he alerted in three more spots close by. He really dug hard, but it was like solid ice and he was going to bloody his paws. The handler asked for assistance and asked rescuers to dig in this location. The snow at this point was over 35 feet deep. Meanwhile Lance had a strong alert in the exploded debris below. Neither handler told the other where her dog alerted so they could get an unbiased 'second nose' reaction.

“They traded places. Lance alerted in the same places Zeke had. They defined a little high-probability triangle. Marines from the Mountain Warfare Training Center at Pickle Meadows were coming that afternoon to help probe and shovel.

“While Chris was working above, Judy went down to the ‘house’ and started scrambling through the rubble with Zeke. Handler-dog partnership was important because it was so treacherous. The dog had to be controlled yet willing to work each place asked, sometimes in very tight or precarious positions. Everything would suddenly tilt a little. A dog needs great drive to work something that difficult.

“Zeke had an alert in the remains of the bathroom...back under the Jacuzzi. Lance had given an alert from the outside in exactly the same place. That afternoon the Marines tore apart the back part of the structure. They found the boots and gaiters Aaron had worn February 15. That was the freshest human scent. There were other clothes, shoes, mattresses...but that’s where the dogs alerted.

“Late in the day, Marines digging up above the north wall of the basement thought they heard whining. They dug a small round hole toward the sound. Suddenly, a dog popped out of the hole! It was John’s German Shepherd, Sadie. She ran around and around greeting everyone happily. Then she went over and took a big dump. She probably hadn’t relieved herself in 6 days. The dog was found along the back foundation. Sadie had some scabs over her eyebrows and on her nose and one cut on her side. Otherwise, she was unscratched. When she came out alive, searchers kept thinking, ‘surely John could still be alive.’ He could have been if he’d been in the right place.

“The next day, the 22nd, the SAR teams returned to the avalanche. This time they could drive into the site. Chris returned with Lance, and Marty Cross handled Zeke while Judy accompanied them with a probe pole. On day two, rescuers had created deep gashes where the dogs’ alerts had been the first day. They also dug along the lines of the foundation and above the fireplace. The fireplace had been massive—20 tons of concrete with 0.75-inch rebar. The family couldn’t believe it was gone. Half of it was down the hill with the other rubble. The first floor had collapsed on the basement. There was about 2 feet of crawl

space under the floor boards. Marty put Zeke in. He brought out Aaron’s jacket. The dog was interested in the hole. Both dogs showed interest in that immediate area. Aaron’s scent was probably diffusing along the slab of the collapsed flooring. There was glass everywhere but you couldn’t see it until it was too late.

“That day they concentrated on removing snow since they had positive alerts in the one small area. Rescuers just wanted to move the snow and find Aaron as fast as possible.

“The dogs worked in and around all those people—40 Marines, Forest Service personnel, sheriff’s deputies, family—and with food, the snowcat smell...the dogs worked regardless, because they knew what they were after. At the lower site, Chris checked places as they wrecked it. But the dog found nothing. Nothing was there.

“The Marines dug but were not getting anywhere fast. So they brought in a cat and bladed back and forth across the site. They moved about 25 feet of snow and debris. Right afterwards, the dog teams went back in to search in case the victim was still alive. Marty put Zeke in and, ‘boom’ he alerted and dug like crazy. Marty probed something soft. They brought Zeke back in. He dug and tugged out Aaron’s pants, proudly. Then the dog dove back into the hole and dug again until he was literally upside down. Mary said, ‘I know my dog knows where this man is.’

“The scent had permeated everything in that small radius. The dynamics had to be an air-scent cone that fanned outward and upward through the rubble and snow. By the time the scent got to the top of the surface snow 35 feet above after 6 days, it had to diffuse across a 30-foot diameter circle. Then they dug and bladed down to begin pinpointing the scent in a 6-foot radius nearer the body.

“Rescuers dug. The dog got into it, digging while standing on his head. Six feet down, one of the guys said, ‘We got him!’ Aaron’s head was right where the dog had been digging. Aaron had been sleeping by the wood stove and had evidently hung his clothes up to dry near him. He probably heard it coming and had brought his hands up over his nose and mouth. There was an ice mask over him. He was in a sleeping bag. He was under tongue-and-groove flooring. They had to bring in a chainsaw to saw off all the debris.

“Searchers estimated the dogs had first alerted 35 feet above Aaron. One of the

Marines standing near the hole kept saying, 'That dog found that guy!'

"The family was all right there. Judy went over to Walter Aaron, took his hand and said 'Walter, there's your son.' He would not leave that avalanche until he saw his son. The brother who is a medic leaped in the hole. He touched the body, frozen solid, and ricocheted like a bullet back up out of the hole. Then he settled down. The father went over and sat down. He looked up and said 'That mountain killed my son, didn't it?'"

Avalanche Data

The avalanche that killed John Aaron was classified as a WS-N-5-G. It released from an elevation of about 8500 feet and fell almost 1500 vertical feet. The wet avalanche debris was filled with dirt, rubble and trees.

Comments

A question the family asked was why rescuers were so slow to respond. The evidence showed that Aaron probably lived for some time after he was entombed. Because of the extreme avalanche danger and poor visibility rescue leaders waited until conditions stabilized. They followed a tenet of rescue: "Don't make an accident even bigger." They wisely chose to wait until the rescue could be effected safely.

Destructive avalanches are not uncommon in the Twin Lakes area. On February 10, 1978 two motorists and a snowshoer were swept off the road and drowned in Lower Twin Lake. After the avalanche cycle of February 1986, Mono County conducted a county-wide study. A consultant was hired to prepare a two-zone format—high and moderate—based on impact pressure criteria and return intervals for large avalanches. The study also used statistical and historical methods to anticipate avalanche runout distances.

A use-restriction avalanche ordinance was proposed; however, public outcry proved overwhelming. After months of heated workshops, meetings and hearings the county withdrew the proposed ordinance. No ordinance was adopted; rather a watered-down version was amended to the county's General Plan. The amendment simply requires that before anyone builds or subdivides in an avalanche area, they must sign an "acknowledgment of the hazard."

The Aarons sadly overlooked the three most important rules of real estate investing

where they chose to build their dream house: location, location, location. [Author's note: in February 1993, 10 summer homes were damaged or destroyed in another major avalanche cycle in the same area.]

86-9

FEBRUARY 17, 1986

Brighton, Utah

2 snowboarders caught, 1 partly buried and injured, 1 buried and killed

Weather Conditions

Strong westerly winds laden with Pacific moisture had been dumping snow on the Wasatch Mountains as well as the entire west. The ski areas of Brighton and Solitude in Big Cottonwood Canyon were less than 1 mile away from the accident site. On the morning of the 17th Brighton reported 5 inches of new snow overnight, and Solitude, 6 inches. The new snow was between 12–15 percent density (120–150 kilograms per cubic meter). At 0600, the temperature was 28°F. During the day temperatures rose to the mid and upper 30s and 2 more inches of 20 percent density snow fell at both areas. Also light rain was reported up to 9,000 feet and the westerly winds were still 15–30 mph with higher gusts. Since the series of storms had started on the 11th, 33 inches of snow had fallen at Solitude. Moderate to strong southwest to west ridgtop winds buffetted the area the whole time.

Accident Summary

Early on the afternoon of the 17th four Salt Lake City men parked their car close to the junction of Utah 152 and the Guardsman Pass road, just north of the town of Brighton. David Rosenberg, 23, Stephen Pollack, 21, Camron Carpenter, 18, and Brad Lindsey, 18, were going to spend the afternoon snowboarding on the hill above the Guardsman Pass road. Already at least 10 other snowboarders were in the area.

Leaving their car, the four hiked a short distance up the snowcovered road; they turned off to the east and climbed to the ridge above the road. Shortly after 1300 hours the four descended down to the road. Rosenberg decid-

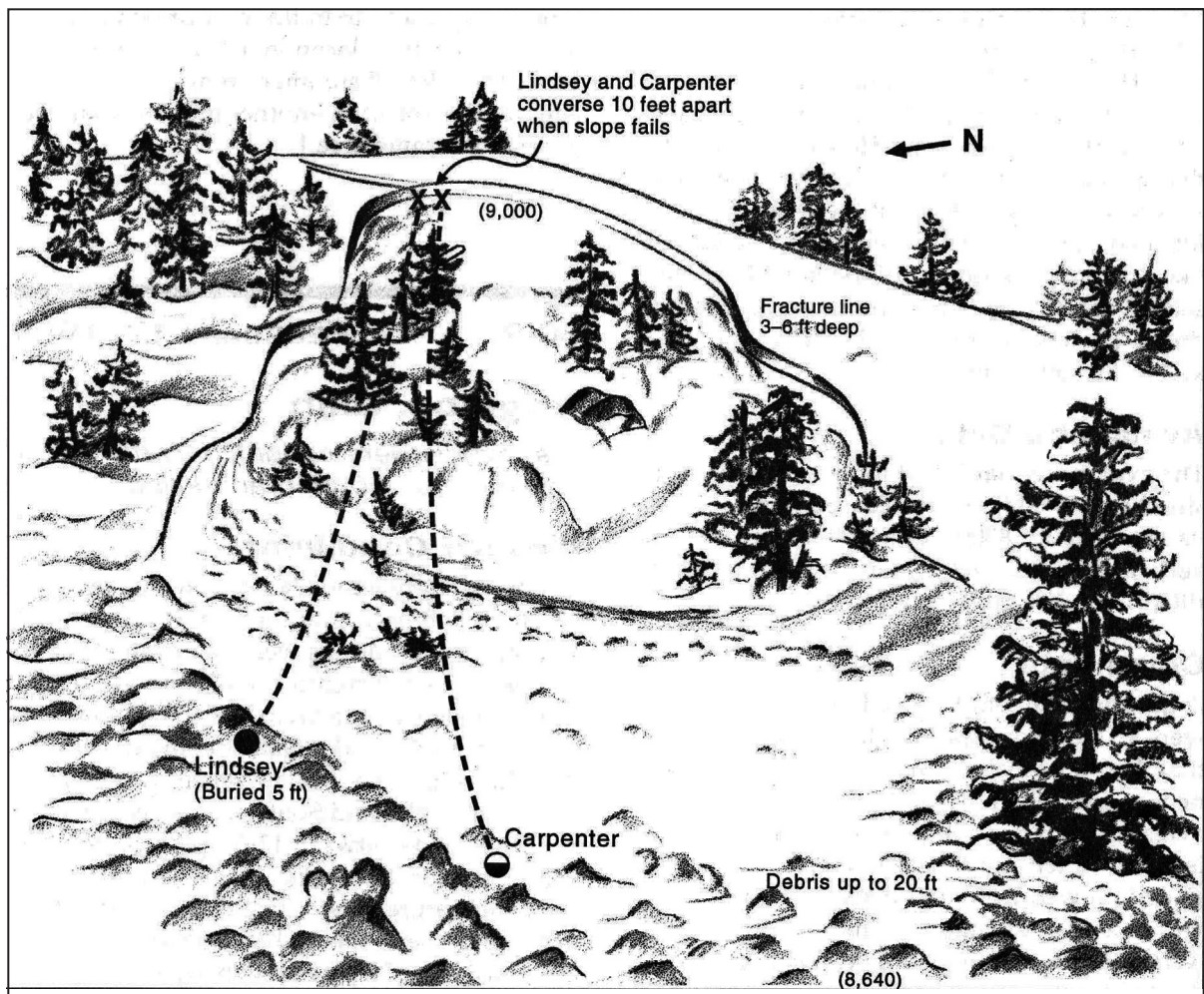


Figure 34. Accident 86-9, Brighton, Utah, February 17, 1986.

ed to wait at the car while the other three returned for another run. They climbed up their original trail back to the ridge. On the ridge at about 1600 hours it was snowing moderately and they could feel blowing snow in their faces. Pollack decided to make his second run down the same steep west-facing slope that they had descended earlier. Carpenter and Lindsey decided to try an adjacent slope and started to traverse in that direction.

Traversing across and slightly downward to reach the slope, Lindsey and Carpenter were breaking through snow drifts. Though still in the trees Lindsey triggered a small soft-slab avalanche that knocked him over. Realizing they were in a dangerous place they decided not to descend the steep slope but traverse quickly to a safe area. While traversing they continued to release small slabs. Lindsey and Carpenter stopped—about 10 feet apart—and were talking when they felt the whole

slope start to move. Carpenter tried to wedge his board between two trees but was pulled down. He tried to grab a tree but could not hang on. Carpenter tumbled many times in the moving snow, and he hit several trees. His snowboard was stripped off his feet. He lost sight of Lindsey.

Pollack was lower down on an adjacent slope when he looked up and saw the avalanche. He had to traverse out of the way to avoid being caught. When the snow stopped he hollered down to Rosenberg to go get help and then started searching for his friends. Others in the area came to help.

Rescue

Carpenter, partly buried and suffering from a broken leg, was found very quickly by Pollack and others. Lindsey was nowhere to be seen.

Within 10 minutes of the accident Rosenberg had notified the Brighton Touring

Center, and two rescuers and a rescue dog were sent immediately. Before leaving they notified the Solitude Ski Patrol. Five patrollers and a second rescue dog were dispatched within minutes.

It was a quick trip to the accident site and the rescuers from the Touring Center arrived on-scene within 20 minutes of the accident. They initiated a hasty search and quickly found Lindsey's snowboard hung-up in a tree almost directly below where Lindsey had entered the slope. While some rescuers searched for clues, others did a beacon search without success. Three probe poles were given out and the people were instructed to probe the most likely burial areas below the snowboard. The rescue dog from the Touring Center searched without results.

About 30 minutes after the accident the first patrollers from Solitude started to arrive. The Solitude rescue dog arrived minutes later and started to search the same area below Lindsey's snowboard. The dog quickly detected the victim's scent and located Lindsey. Probing confirmed the spot.

Buried for almost 45 minutes, Lindsey's lifeless body was uncovered from 5 feet of snow. Rescuers started cardio-pulmonary resuscitation and transported the victim to a waiting ambulance. Lindsey was taken to a waiting Lifeflight helicopter at the entrance of Big Cottonwood Canyon and flown to the University of Utah Medical Center where he was pronounced dead. The causes of death were severe trauma and asphyxiation.

Meanwhile rescuers splinted Carpenter's broken left leg, a fractured femur. He was transported by ambulance to a nearby hospital.

Avalanche Data

The slope that avalanched was 42° in steepness and faced northwest. The fracture line ranged from 3–6 feet in depth; the avalanche width was 300 feet, and it fell 360 vertical feet from a top elevation of 9,000 feet. Debris piled up to 20 feet deep. The avalanche was classified as an SS-AD-4 and was triggered by Lindsey and Carpenter. This was a large avalanche relative to the slope; broken trees 12–16 inches in diameter were found in the debris.

A fracture line profile done by avalanche forecasters from the Utah Avalanche Forecast Center a day after the accident determined that the avalanche released on faceted grains. These faceted grains formed in the upper portion of

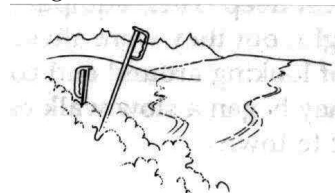
the snowpack—about 2 feet above the ground—during the dry, cold and clear period at the end of December. The slab created by the warm and wet February snows simply overloaded the weak, soft layer, which was fist hardness and the weakest layer of the snowpack. This layer was the cause of several other avalanches in the area.

Al Soucie, an avalanche forecaster with the Utah Avalanche Forecast Center, noted in his accident report that two other avalanches ran during the previous 2 weeks. On February 2, a small avalanche released on the same slope where the fatal accident occurred. The second slide released on February 16 and it was within sight of the accident site.

Comments

The persistent heavy snows in the Wasatch Mountains made for dangerous avalanche conditions in the backcountry, and this group had no apparent knowledge or fear of avalanches. Otherwise the group would have taken conditions more seriously and changed their plans and stuck to less steep slopes. From where the group parked their car an old fracture line was visible on the same slope on which they would later be caught. A 42° slope, heavy wet snow, strong winds, a weak snowpack, and two people on the same slope are a deadly combination of factors; all the danger signs were present. The group carried no rescue equipment; it is doubtful that it would have saved Lindsey's life. Both Carpenter and Lindsey were carried through a small stand of thick timber. Lindsey's snowboard was badly bent. It was a shame the victims realized that they were in a dangerous position too late to prevent the accident.

It is not surprising that the Brighton Touring Center rescue dog failed to locate the victim. It takes time for the scent to diffuse upward through the snowpack. In avalanche debris the diffusion rate is about 15 minutes per meter. Thus if a rescue dog arrives on-scene too soon there may be no scent. This may explain why the Solitude dog was successful when it arrived 15 minutes after the Brighton dog.



86-10

FEBRUARY 17, 1986

Jackson Hole, Wyoming*1 ski patroller caught, buried and killed***Weather Conditions**

For 5 days strong winds and heavy snow ravaged the Jackson Hole Ski Area, as the same wet Pacific storms that hit Utah (see accidents 86-6 and 86-9) swept into Wyoming. On the morning of the 17th west-southwest winds averaged 35 mph, and gusts over 100 mph raked the top of Rendezvous Peak. In the past 24 hours 12 inches of new snow, with 1.5 inches of water equivalent had fallen. Since the storm had started on the 13th, 64 inches of snow with 7.62 inches of had accumulated. During the storm, gunners had shot the Moran Face and adjacent steep areas daily with the recoilless rifle, while patrollers tossed hand charges daily beginning on the 15th. Also, on the 15th a small natural avalanche released on Moran Face; however, on the 16th two large bombs were detonated without results. On the morning of the 17th the artillery control team fired one round from the 105-millimeter recoilless rifle into Moran Face. The round hit a tree and detonated, but did not release an avalanche. Control work elsewhere on the lower portion of the mountain failed to trigger avalanches except for one highly-active avalanche path.

Accident Summary

Shortly after 0800, ski patrolmen Tom Raymer, John Bernadyn, and Paul Rice received the go ahead from the artillery crew to begin hand charge control work on Moran Face. It was snowing about 1 inch per hour when the patrollers left the top of the Casper Chair Lift and started across the Moran Traverse. The three carried Skadis (avalanche rescue transceivers), shovels, and six explosives (11 pounds). Though the ski area was closed and only ski patrol hazard reduction teams were allowed on the mountain, they made sure the flip-sign read "closed."

They tossed their first explosive charge, a 1-pounder, onto a small steep pitch about 50 yards from the main portion of Moran Face. The charge detonated but no avalanche released. They then traversed toward Moran Face and stopped beside the last two trees to

evaluate the situation. Up above they could see where the artillery round had blown up the tree. Though the round hit the tree they felt the concussion of the blast had shocked the slope hard.

Right before the entrance to the Face are two small slopes, one above and one below the traverse. Raymer threw a charge onto the upper pitch at the same time Rice threw a charge onto the lower pitch. Both 2-pound charges exploded, but again, nothing happened. No avalanches.

Rice then skied out onto the Face toward an old shot hole and some old debris. The slope had released naturally 2 days before. Rice continued past the hole to a tall rock outcrop. He noticed the snow was less deep—2 feet instead of the 4 feet they had encountered earlier. Bernadyn crossed below to another rock. While Raymer waited, Bernadyn threw a hand charge downslope. Another explosion but no avalanche. Raymer traversed across. Then Rice threw a fifth hand charge: again, no results.

After six explosive charges (one artillery shot and five hand charges) and no avalanches, the three took time to discuss what to do next. Rice and Bernadyn were perched on rocks, but Raymer was out on the slope.

About 40 seconds had passed before they decided to leave the slope. It was then that Rice saw a large avalanche release on the slope above Raymer. He yelled a warning, and Raymer, standing still, looked uphill and saw the slide. He swung his skis downhill and started to ski down but the avalanche hit him immediately. He disappeared.

The slide missed Bernadyn and Rice who were standing on rocks out of the avalanche path. They tried to watch Raymer but could only see the whiteness of the avalanche. From the force of the moving snow, they knew Raymer would be carried well down the slope.

Rescue

Rice immediately reported the accident on his radio. Rice skied to Bernadyn, who was just pulling his beacon out. Rice said he would try to search very quickly and asked Bernadyn to follow more slowly and thoroughly. After three wide traverses from the last seen area Rice found a ski. He stopped and stuck the ski upright into the snow. After determining Raymer's probable trajectory in the slide, Rice started skiing down again. Raymer's ski was

almost 300 feet below the last seen area. Rice continued down but still had no signal. He later reflected that the debris seemed to go on forever. The debris entered into the trees and finally Rice picked up a signal from Raymer's Skadi. Three or four minutes had passed. Rice radioed to Bernadyn to come down.

Bernadyn and Rice narrowed their search immediately around a big pine (3–4 feet in diameter), but they could not turn the volume down to the lowest setting without losing the signal. They knew Raymer was buried deeply. Patrollers starting arriving, but probing and digging failed to locate Raymer. Another patroller verified the area using his beacon. They knew Raymer had to be under or just uphill of the tree.

Branches above the snow got in the way of rescuers. They could not get an exact position with their beacons. Buried branches had to be cut away so shovelers could dig. Rescuers kept digging and probing. Every 5 minutes or so they would re-do the beacon search and put a trained rescue dog in the hole. All indications were they were in the right area, but they still had not found Raymer. After 30 minutes additional rescuers arrived: ski school instructors, ski guides, hosts, and a few locals who had volunteered. They kept digging, probing and searching, but no luck. Finally, they reached the ground. Using his beacon on its lowest volume setting vertically along the pit wall, Rice heard Raymer's signal. They had missed him, Rice knew he was close. He called for the area to be probed. Nothing. They decided to enlarge the hole and quickly they found Raymer. He was not breathing, and both legs were broken; he had been buried for 45 minutes at a depth of 10–12 feet.

Cardiopulmonary resuscitation was started immediately. He was transported down the mountain to the medical clinic in the base area where he was pronounced dead.

Avalanche Data

This slide was classified as an SS-AO-5-O and was a post-control release. It fractured 3 feet deep about 100 feet above where Raymer was standing. He was carried 600 feet down through stands of mature timber on the east-facing slope. The 37° slope released from about 8,400 feet in elevation. It was the largest avalanche observed on Moran Face area since the ski area opened in 1965.

Comments

This was a deadly example of a post-control release that ran minutes after the last hand charge had detonated. The avalanche released the snow where the first three hand charges had been thrown. Though we don't understand the process of post-control releases, we suspect that the following scenario is plausible: The explosives jolted and weakened the snow in the immediate vicinity of the bomb crater but strong snow between the blast areas held the slab in place, at least for a few minutes. As stress was redistributed in the slab over the next few minutes, the strong areas could no longer hold the slab in place and shear failure occurred over the entire slab. Raymer himself may have been the ultimate trigger when he skied onto the slab. Since the accident the ski patrol has added two additional artillery targets in the avalanche path.

This accident demonstrates that even a textbook rescue done by professionals cannot save all avalanche victims. The overhanging branches mixed in the debris greatly hampered the rescue, though a faster rescue probably would not have saved Raymer's life anyway: no one in the United States has yet to survive a burial deeper than 6 feet. The deep burial resulted from the trauma Raymer sustained during the fall; it made self-help impossible.

86-11
FEBRUARY 17, 1986

Teton Pass, Wyoming

2 motorists caught, 3 cars caught, 2 buried and 1 damaged

Weather Conditions

Wyoming Highway 22 winds through the Teton Mountains over Teton Pass in north-western Wyoming. The pass is located about 10 miles west of the town of Jackson and about 7 miles south of the Jackson Hole Ski Area. For a detailed report on the nearby weather conditions see accident 86-10.

Accident Summary

On the morning of the 17th, Stan O'Jack of Teton Village (perhaps tired of all the snow) began a trip by car to sunny San Diego,

California. Driving conditions were treacherous as falling snow and strong winds caused poor visibility as well as slick roads.

While slowly driving up the east side of Teton Pass, O'Jack became stuck in avalanche debris that was already on the road. He had gotten only as far as the road curve on the east edge of the Glory Bowl path. He also noticed two other cars that were stuck in the debris just a head of his vehicle. O'Jack left his car to check out the situation. A couple from one of the cars had already struck out on foot to find a snowplow. O'Jack and the driver of the other car, Don Thompson, decided to wait.

Thompson suggested that the two wait in O'Jack's car. O'Jack noted that his car was further back from the center of the Glory Bowl; he later recounted, "...it looked safer." The two men walked through the snow back to O'Jack's car and climbed in. O'Jack continues the story, "We got in, and we had just introduced ourselves when suddenly there was all kinds of snow and then a huge thud.

"My car was rotated 90° and shoved to the edge of the road. Then it went totally dark." He continues, "We rolled down the window and started pulling snow into the cab. We must have dug through 2 to 3 feet of snow, but we were able to dig ourselves out."

The men climbed out of the buried car to find up to 5 feet of avalanche debris covered the vehicle. O'Jack's car proved to have been the better spot to wait; Thompson's car was covered under 15–20 feet of debris.

Avalanche Data

No specifics about the avalanche were mentioned in the newspaper accounts, but we can deduce that this was at least the second avalanche in the same path. It is not uncommon for large avalanche paths to release naturally several times during a storm, sometimes only minutes apart.

Comments

This scenario is one that frightens highway avalanche workers. A small avalanche blocks the road causing traffic to backup under the path or under adjacent paths. Frequently when this happens, motorists get out of their vehicles and dawdle around the vehicles or out on the debris. A potential disaster suddenly develops.

In this case both men were lucky to be alive. O'Jack's car was far enough to the side

to not be hit by the main force of the avalanche. The highway crosses the lower portion of the confined track of the Glory Bowl, and avalanches hit the road with full force. Had the men not reached the car when the avalanche struck both would have been buried, and this deadly storm could have added two more victims to its list.

This close call illustrated what motorists should and shouldn't do when driving avalanche-prone roads. Never try to drive through avalanche debris, for getting stuck only turns you into a target for another avalanche. Keep the windows rolled up; closed windows can prevent snow from filling the cab, trapping or even burying motorists. It is also a good idea to wear a seat belt even if waiting in your car; avalanches are violent. And lastly, carry extra clothing or blankets in case you do become trapped.

86-12
FEBRUARY 19, 1986

Alta, Utah

1 lift skier caught, buried and killed

Weather Conditions

Northern Utah and especially Little Cottonwood Canyon were also hit hard by the warm, wet Pacific storms. On February 19, at Alta precipitation started early. Initially snow was falling above 9,000 feet, and light rain was reported at lower elevations. As the temperatures cooled during the day precipitation increased. Southwest winds were sustained at 30–40 mph and gusts to 70 mph were frequent. It had been snowing an average of one-inch-per-hour all day, and by 1400 hours 9 inches of new snow was reported since 0400. At about 1500 hours, the snow began to decrease but strong winds continued to cause blowing snow.

Sugarloaf Mountain is a very avalanche-prone section in the ski area. As the snow continued to pile up the Alta Snow Safety personnel were growing more and more concerned. On the 18th, avalancher rounds were shot into Sugarloaf Face and Sugarloaf Shoulder. The explosives triggered new-snow avalanches that ran over the cliffs to the edge of Cret

Lake. Results were minimal and it was decided not to shoot Sugarloaf Bowl. Usually the Shoulder and Face are more responsive to explosives than the Bowl; it was decided to close the area to let the snow settle and strengthen naturally. Hand charges tossed by the ski patrol were ruled out because of the avalanche danger and poor visibility.

On February 19, the skiing public were confined to groomed runs. The Sugarloaf and Devil's Castle areas were closed. A sign line was used to keep skiers off starting-zone areas on Sugarloaf Mountain and out of the Cecret Lake runout area. The adjacent ski run, Devil's Elbow, was open.

Accident Summary

On vacation from their Massachusetts home, Paul Muscovitch, 16, and his father, Edward Muscovitch, were enjoying the new powder. The two left the top of the Sugarloaf lift and started skiing down the Devil's Elbow run. Because of avalanche conditions skiers were confined to groomed runs, but Paul, wanting to make a few turns in untracked snow, traversed above the run onto a small hill known as Monkey Hump, just below Cecret Lake. Paul's father stayed back to watch.

Paul had just started to ski down when skiers riding the Sugarloaf chair lift saw an avalanche and began yelling. Paul heard them and realized that he may be in trouble. He dropped into a tuck position and pointed his skis downhill. In seconds the avalanche crossed Cecret Lake, shot over Monkey Hump and "rained down" on Paul. Witnesses last saw him near the uphill side of some trees. As soon as the powder cloud settled Ed Muscovitch and other skiers raced to the last seen area and started probing with their skis.

Rescue

At 1515, the Alta Ski Patrol received the report of the avalanche. Within minutes two ski patrollers arrived on scene and started the hasty search, concentrating on areas where witnesses reported seeing skiers just prior to the avalanche. Additional patrollers, rescue equipment, and a rescue dog were dispatched immediately. Within an hour of the accident nearly 100 rescuers and four rescue dogs were on the scene.

First reports from witnesses stated there was at least one victim wearing a red parka, Paul Muscovitch, and possibly one or two oth-

ers trapped in the slide. As the search progressed on the mountain, the base-area lodges were also being checked for any missing skiers.

Two hours after the avalanche searchers had still not found Paul or anyone else. The Alta Town Marshall who had been questioning witnesses re-visited Mr. Muscovitch. Muscovitch was certain his son was buried near a small group of trees below Cecret Lake. Probe line teams and dogs had already searched the area three times. Muscovitch was so certain that searchers were directed back to the area and started to dig debris from out around the trees.

At 1800, Paul was found in some branches next to a tree. He had been buried 10 feet for almost 2 hours and 45 minutes. Efforts to revive him were started immediately by a doctor on the scene. Paul was quickly taken to a waiting Life Flight helicopter and transported to a Salt Lake City hospital. He was pronounced dead later that evening.

After evacuating Paul all rescuers were cleared to a safe area while control work was done on the remaining avalanche areas that affected the rescue site. Though rescue leaders felt Muscovitch was the only missing victim, they were not sure. Eyewitness accounts were conflicting, so it was decided that the whole slide would be searched again with dog teams and all alerts would be probed and dug out. No other victims were found, and the operation was halted at 2030 hours. Just in case someone was later reported missing, rescue equipment was left at the site. By 2300, all out-of-place vehicles in the town of Alta had been checked, and by the following morning no one was reported missing.

Avalanche Data

Sugarloaf Bowl faces north-northwest and is 39° in steepness. The fracture ranged from 3 feet to 9.5 feet at the deepest spot; overall it averaged 5 feet. It released from an elevation of 10,720 feet, and the avalanche was 650 feet wide and fell 960 vertical feet. The avalanche was classified as an HS-N-5-O. Avalanche researcher Sue Ferguson who filed the incident report estimated the total mass to be 11–14 million kilograms. The adjacent slopes, Sugarloaf Shoulder, Main and Face did not release.

Ferguson estimated the avalanche released naturally, triggered by the new falling snow as

it was snowing quite hard most of the day. Wind loading probably played a less important factor as the west-northwest winds would not significantly load the northerly-facing Bowl.

The runout distance of the avalanche was extraordinary. The experience of the Alta Snow Safety team was that avalanches off Sugarloaf either 1) stopped on the lake or broke through the ice, or 2) turned down the natural drainage to the northeast of Secret Lake. As phenomenal as the runout distance seemed, careful study of the snow conditions explained the unusual event.

In her report Ferguson identified two factors as the probable reasons why the avalanche had such an extraordinary runout. First the condition of the starting zone was abnormal. Prevailing northwesterly winds in the Wasatch usually scour Sugarloaf Bowl, while Sugarloaf Shoulder, Main, and Face are best loaded by northwest winds. During this storm cycle strong winds blew from the southwest to west. In addition, the density of the new snow in February was nearly twice the density of Alta's average February snows (140–150 kilograms per cubic meter compared to 87 kilograms per cubic meter). Perhaps too dense to sluff or blow away, the snow in the starting zone may have built up deeper than normal.

The second factor for the avalanche's extraordinary runout were the conditions in the runout zone. Ferguson identified four other factors that may have influenced conditions in the runout zone of this avalanche. In the past, when the Bowl released, adjacent slopes also released diverting the flow from the Bowl into a drainage northeast of the lake, or sent the avalanche crashing down onto the lake. This time only the Bowl released and the avalanche was not diverted; it traveled a straight line, over more gentle terrain onto the lake. A second factor may have resulted from an avalanche that ran a few months earlier. On November 25, 1985, an avalanche crashed through the ice on the lake. The old debris may have kept the February avalanche from crashing through the ice and from losing energy and momentum. A third factor was that the surface snow was firm. Surface snow conditions at the time of the fatal avalanche were unusually solid. Surface snow densities were at least 200 kilograms per cubic meter more than twice the normal density of new snow at Alta. The firm surface may have allowed the debris to travel further by inhibiting the usual resistance

encountered when the debris plows into fresh snow. And fourth, Ferguson noted that on the day of the accident much of the snow fell as graupel. It has very little strength, and flows freely like ball-bearings when stressed. A surface layer of graupel on the lake may have reduced the frictional resistance of the moving avalanche and allowed it to move further.

Comments

Paul Muscovitch was an unlucky victim of circumstances. He was in the wrong place at the wrong time. Skiers in the area did not release the avalanche; it released naturally high above them, and this was the first time the Alta Snow Safety team had observed an avalanche travel over Monkey's Hump. According to the 1978 avalanche atlas and 20 years of experience, no avalanches had traveled over Monkey's Hump and onto the Devil's Elbow ski trail. Even Bengts Sandhall (a long time avalanche worker in Little Cottonwood Canyon) who co-authored the 1969 Safety Plan had never seen an avalanche go over Monkey's Hump. However, information during the accident investigation shed found that this was not the first avalanche to travel past Monkey's Hump.

Ray Lindquist, who was the Snow Ranger at Alta in the late 50s and early 60s recalled two avalanches that ran out into the same area as the February 19 slide. He even penciled in an extended runout area onto his copy of the 1969 plan. Accident investigators also found a 1974 outline that included the Devil's Elbow in the runout zone; however, it did not show starting zones. Unfortunately the information from the edited 1969 plan or the 1974 outline was never passed along to the Alta Snow Safety team.

This accident illustrates several problems that rescuers often face in an avalanche rescue. The deep burial (10 feet) near a tree makes probing difficult as it is almost impossible to distinguish a person from a tree branch. Also the dogs were unsuccessful in finding the victim. This may have been the result of 100 rescuers trampling over the area and contaminating the site, but that was not case initially. Most likely the dogs were unsuccessful because they arrived too soon. It takes time, maybe up to an hour, for the scent to rise through 10 feet of snow. By the time the scent broke the surface the debris could have been sufficiently contaminated by the rescuers and snowmachines that the dogs could not find the scent.

It is also not uncommon to have conflicting reports about the numbers of people caught in an avalanche. Correctly done, the entire path was searched after Muscovitch was found, and the search effort continued late into the night in the Alta town lodges and parking lots until search leaders were sure no one else could have been buried.

86-13 FEBRUARY 20, 1986

Logan Canyon, Utah

1 very large avalanche

Weather Conditions

Strong winds and wet, heavy snows and frequent rains continued to blast the Wasatch Mountains of northern Utah. Since February 11, Wasatch ski areas reported over 40 inches of snow and more than 5.0 inches of water equivalent. A thick blanket of heavy snows covered a weak snowpack along the steep mountains of Logan Canyon.

Avalanche Data

Sometime on February 20, a massive avalanche released from the steep eastern face of the ridge between Beirdneau Peak and Mt. Elmer. Over one million cubic yards of snow raced down the narrow drainage of Wood Camp Hollow—about 13 miles east of Logan—tearing out trees and boulders. The avalanche was classified as an SS-N-5; it released from about 8,600 feet and fell 3,100 vertical feet as it raced 2.5 miles down the drainage. At its widest spot in the starting zone, the slide was over 1 mile across. In the valley runout zone debris was piled 60 feet deep.

Comments

Though this was not an avalanche accident it is certainly a noteworthy avalanche event. The avalanche debris in the summer of 1986 looked much like a glacier. The last of the debris did not melt away until the summer of 1987.

Large and long-running avalanches are not unfamiliar to the Beirdneau Peak area of Logan Canyon. In January 1971, several drainages to the southwest of Wood Camp Hollow, two large avalanches ran more than



Figure 35. Accident 86-13, Logan Canyon, Utah, February 20, 1986. Photo by Mike Van Horn.

one mile, both damaged and destroyed several houses and structures. Though no structures were damaged in the February 20 event, these long-running avalanches should serve as a reminder to developers and builders. Permanent structures built in avalanche paths eventually get struck.

86-14 FEBRUARY 20, 1986

Arapahoe Basin, Colorado

2 ski lifts struck and 1 damaged

Weather Conditions

Since February 4, steady but very light snows fell along the Front Range of Colorado. The Loveland Pass area received daily snows. On the 13th, the first of several Pacific storms struck the Front Range mountains with vengeance. Colorado was not to be left out by the warm and wet Pacific storms that had slammed into much of the western United States. From the 13th-20th, Arapahoe Basin Ski Area, located on the west side of Loveland Pass received 59 inches of snow. During that week winds at the ski area varied from the southwest to northwest and averaged 15-25 mph, and gusts were in the 40s.

On February 17, the ski area suggested to the Colorado Department of Transportation (CDOT) that it might be time to control the “Little Professor.” This southeast-facing avalanche path sits opposite the ski area. Both U.S. Highway 6 and the ski area parking lot are in the runout zone. The highway past the ski area up to Loveland Pass was already closed by other avalanches and poor visibility. Continued stormy weather kept CDOT control teams at bay. A control team did try to ski up the highway in an attempt to reach the starting zone but were turned back by avalanches and poor visibility. It was not until February 20—and 36 inches of additional snow—that control work could be attempted.

At Arapahoe Basin Ski Area on the morning of the 20th at 0620 hours 11 inches of new snow was reported, and it was snowing heavily, but soon afterwards snowfall decreased. Winds were from west at 10–20 mph, and the temperature was 25°F.

Accident Summary

Despite marginal flying conditions caused by light snow and low clouds, Colorado Heli-Ski, under contract with CDOT to do helicopter bombing, was able to fly. The highway and the ski area were both temporarily closed.

According to the ski area avalanche control plan all people and vehicles were cleared out of the parking lot and adjacent buildings. Avalanche workers were certain control work would produce a large avalanche; even a Denver television station was on-hand to document the event.

The helicopter arrived at the ski area at 0800 hours but was unable to fly northward over the Little Professor because of poor visibility. To the south, over the ski area, the weather was slightly better. The ski area used the helicopter to control the East Wall. The East Wall is the eastern portion of the cirque that rings the ski area. Sixteen class 2–4 avalanches were released by explosives tossed from the helicopter.

By about 0920, the weather had improved just enough for the pilot to creep the helicopter up the Little Professor. In the clouds and swirling snow the helicopter disappeared from view of observers on the ground. At 0925, three charges were tossed into the starting zone. Two minutes later observers on the ground heard the muffled “pops” as the charges detonated. It was followed by several

seconds of nothing before the powder cloud of a large avalanche blew into view.

Observers were not disappointed. At mid track the avalanche became airborne as it raced over a bench. It ripped through a wedge-shaped stand of mature conifers that divides the lower track. The slide crossed U.S. Highway 6 and slammed into the parking lot. The powder cloud enveloped the entire base area. When the airborne snow settled debris covered the highway, the parking lot, the lower terminals of the Molly Hogan and Pallivicini chairlifts. The debris ended upslope near the top terminal of the short Molly Hogan beginner chairlift. The moving snow had traveled almost 900 feet after crossing the highway.

Debris on the highway averaged 15 feet deep along the centerline for 300 feet. The entire parking lot and the lower terminal to the Molly Hogan were covered about 6 feet deep. The lift shack was packed with snow. Even more remarkable was the damage done to the lift. The entire motor room (including 2 motors, gear reduction assembly and other equipment), about 12,000 pounds, was sheared off the lower terminal and moved 75 feet upslope. The cable, with about 3,000 pounds of load, was derailed on both sides of the terminal and one chair was pulled off. Over at the lower terminal of the Pallivicini Lift shallow debris covered the ground but caused no damage.

After the avalanche, the ski area remained closed for another 1.5 hours while a temporary road was plowed through the parking lot to access another lot. Clearing the entire parking lot required 122 man-hours using four front-end loaders, five snowcats and one grader. The ski area estimated their losses at \$39,000 for loss of revenue, snow removal and lift repairs.

Avalanche Data

This avalanche was classified as an SS-AE-5. It released from an elevation of 12,000 and fell 1,230 vertical feet. The fracture line was estimated to average 6 feet deep, with a maximum depth of 10 feet, and it extended about 450 feet across the starting zone. The southeast-facing starting zone measures 30–35° in steepness.

Comments

The magnitude of the storm had prevented CDOT from performing control work on the Little Professor until the storm had lessened. By the time control work could be done so

much new snow had already accumulated in the starting zone that it produced a major avalanche. The strong winds were a significant factor in the size of the avalanche. Because of local topography the southeast-facing starting zone of the Little Professor loads with blowing snow from wind directions ranging from southwest to northwest.

After the avalanche CDOT positioned a 106-mm recoilless rifle above the top terminal of the Molly Hogan Lift. The gun position gives a flatter trajectory to the artillery rounds that must be fired very near the ridge crest reducing the chances of an over-shoot. And it also provides gunners with better visibility of the starting zone. But even with the new gun position and the adoption of a more comprehensive avalanche reduction program, large, destructive avalanches remain a threat. Blind firing during periods of poor visibility is not undertaken as any high-flying artillery round shot northward would probably land in the base area of Loveland Ski Areas or Interstate 70.

86-15 FEBRUARY 24, 1986

Jackson Hole, Wyoming

2 buildings and 1 race course destroyed

Weather Conditions

From February 12-21 the steady flow of wet Pacific storms also slammed into the Teton Range of northwestern Wyoming. During the 10 days, the Jackson Hole Ski Area received 90 inches of snow, with 11.55 inches of water equivalent, at their snow-study plot at 9,570 feet. For 10 days, winds at the top of Rendezvous Peak (10,400 feet) averaged 27 mph with peak gusts to 120 mph. (See accident 86-11 for details early in the storm.) On the 18th, several large, long running avalanches reached the valley floor not far from the ski area.

The snow ended on the morning of the 21st, but the break in the weather was brief. That night a new storm from the Pacific bore down upon the Tetons with new snow falling in the mountains and rain in the valley.

From the night of the 21st to the morning of the 24th an additional 27 inches of snow and

1.62 inches of water blanketed the Jackson Hole Ski Area. West winds averaged 25 mph.

Accident Summary

By the morning of the 24th the mid- and upper-portions of the ski area had been closed for 7 days due to strong winds and high avalanche danger. Only a couple of lower mountain lifts remained periodically opened for skiers (all lifts were closed on the 18th). No avalanche reduction had been undertaken for 8 days in the Headwall area. Due to high winds gunners could not reach the number 3 gun tower, a 75-mm recoilless rifle. The 105-milimeter recoilless rifle was not fired into the area because of a shortage of ammunition.

For 10 years the ski area fired an average of 65 rounds each winter from the 105 recoilless rifle. At the start of the 1985-86 ski season the ski area had 167 rounds; by the morning of the 24th only 20 rounds remained.

On Monday morning, February 24, gun crews dusted off their weapons. At about 0720, the first shot at the Headwall from the 105-milimeter recoilless rifle sent 2 kilograms of high-explosives into the clouds toward target number 13. As expected, it released an avalanche and about 10 seconds later people watching at the bottom of the mountain spotted the powder cloud. A large hard-slab avalanche had pulled out of the Headwall and raced down the Amphitheater run. After a short time the powder cloud settled and observers at the bottom of the mountain thought the avalanche soon lost steam. Unknown to observers below, the avalanche—still moving—was breaking off 3-foot-diameter trees. The slide continued to plow down the mountain. It overran the Halfway House restaurant and toilet facility near the bottom of the Thunder Chair. Along the way the avalanche also destroyed the coin-operated race course.

The avalanche continued into Dick's Ditch, a permanently closed area, where it encountered a wet snowpack. Striking the wet snow slowed the avalanche but didn't stop it. When the slide was seen again it was observed oozing under the tram, at 4-5 mph, carrying trees, rocks and toilets. When it passed under the tram, residents of houses that suddenly appeared to be in the runout zone were immediately warned by telephone. The avalanche finally oozed to a stop near the valley floor, about 100 feet from a home in Teton Village.

Avalanche Data

The avalanche was classified as an HS-AA-5-O. It started in dry snow at 9,600 feet in elevation, and it came to rest at 6,300 feet, a vertical drop of 3,300 feet. Its length was 1.5 miles. The fracture measured 7 feet and extended a quarter mile across the Headwall area. The avalanche began moving as a wet-snow avalanche after Dick's Ditch.

Comments

A key factor here was the decision not to fire the 105-mm recoilless rifle at the Headwall targets earlier in the storm. The Forest Service requested gunners fire on all targets on February 18. However, to save the remaining 105 rounds for use in the Casper and Moran areas, the ski area elected not to shoot at the Headwall targets. Had reduction work been performed on the 18th perhaps less snow would have been in the starting zone on the morning of the 24th.

Another factor that might have influenced their decision not to shoot was that the ski area never expected such a large release (see accident 86-13 for a similar event). A terrain analysis done in 1964, a year before the ski area opened, showed the Headwall slide path stopping above the Halfway House. During the 1969-70 season an avalanche from the Headwall ran to within 150 yards, but to the north, of the Halfway House. That slide had been the largest avalanche ever observed at the ski area, and it did not continue down the lower face and into the valley floor.

Following this avalanche several changes were made at the Jackson Hole Ski Area. The ski area now evacuates Teton Village residents who live in the runout zones when conditions might produce very large, threatening avalanches. Also during severe storms of long duration when the upper mountain is closed, avalanche reduction is undertaken at least on an every-other-day basis. This lessens the probability of large destructive avalanches. Lastly, the ammunition inventory was significantly increased so that the ski area could manage reduction efforts in a season with two worst-case storms. Even with these changes all avalanche workers should realize that sooner or later, given the right snow and weather conditions all avalanche paths will eventually run larger and longer than expected.

86-16

FEBRUARY 26, 1986

Vail, Colorado

1 out-of-bounds lift skier caught, buried and killed

Weather Conditions

During the first 3 weeks of February light snows fell daily at the Vail Ski Area. From the 4th-21st, 80 inches of new snow was reported at the top of the ski mountain (elevation 11,250 feet). Clear skies and spring-like conditions were the rule on the 25th and 26th.

Temperatures at the top of the mountain reached 43°F on the 25th and 40°F on the 26th. It was much warmer in the valley. During these 2 days numerous wet avalanches, both wet slabs and wet loose releases, were observed on the surrounding mountains.

Accident Summary

On February 25, Derek Holley, 39, of Essex England and friends Garron Baine, also from England, and Jane Chessie, of Portland, Maine were skiing their first day at Vail. Early that morning, while on their first ride up the Vista Bahn chairlift, Holley remarked that he would like to ski the area below the chairlift. The spot he identified under the Visa Bahn is known as the Tower 7 Chutes. It is a permanently closed avalanche area surrounded by signs and a double rope fence. Chessie tried to temper his friends boldness by telling him, "wait until you see the back bowls, you won't need this...." Holley and Chessie spent the entire day skiing the back bowls while Baine stayed on the easier front-side of the ski mountain. At the end of the day they re-united at Los Amigos, a popular watering-hole in Vail Village.

On their second day, February 26, the three spent the morning skiing together, but after lunch Holley and Chessie skied the expert runs together while Baine skied alone. It was agreed that if they became separated they would meet at Los Amigos when the lifts closed.

At 1455, Holley and Chessie were riding up Chair 5 from the back bowls when Holley said he would like to ski another run in the bowls. Chessie informed him that the bowls would be closed by the time they would reach the top of the lift. Holley stated, "Oh,

we'll just go under the ropes." Chessie, a ski patroller in Maine said Holley's retort was that Chessie was "too regimented." Once at the top of the lift Holley agreed to ski down the front side to meet Baine at Mid-Vail.

At about 1530, the three friends were united at Mid-Vail. Baine volunteered to lead the way to the base area. An intermediate skier, Baine wanted to show Holley that his skiing had improved. Baine set off first, followed by Chessie; Holley was last. After only skiing a short distance Holley cut off onto Spruce Face, an open intermediate run. Chessie and Baine tried to convince him into following them, but Holley had already started down saying he would meet them at Los Amigos.

Holley never arrived at Los Amigos. Baine and Chessie knew that he could only ski out to Vail Village so something must have happened. After waiting 45 minutes Baine and Chessie notified the ski patrol of their missing friend.

Rescue

At about 1720 hours a Vail Security Patrolman met with Baine and Chessie. They said their friend may have ducked under the closure ropes below Spruce Face along Gitalong Road. They also added that Holley was an expert skier that liked to take chances and ski the trees. They also mentioned his earlier comment on his desire to ski the closed area. At 1810, two ski patrollers were dispatched by snowmobile to the area and quickly spotted a fresh avalanche. One set of ski tracks entered the slide, but no tracks came out. In the narrow creek bottom debris was piled deep.

An all-out rescue was mobilized. That evening personnel from the ski patrol, ski school, lift department and snowcat crews assisted. Searchers were aided by a rescue dog and portable lighting. At 2200, the search was suspended for the night after failing to locate Holley. A concurrent search of the bars in town also failed to locate the missing skier. The search was scheduled to start again at 0500 hours on the 27th.

On the morning of February 27, 35 searchers returned to the accident site. Three rescue dogs searched the area first without success. Then seven probe lines, each with five patrollers, probed the area. Dogs searched the area a second time and alerted. A fine probe line was started and at 0835 probers found Holley.

He had been buried 16.5 hours in a sitting position, leaning to his side. His skis were still on his feet, and his poles were still in his hands. His head was 5.5 feet below the snow surface. Death from suffocation came quickly, as there was no ice mask around his head which would have indicated that he had lived for some time after the avalanche.

Avalanche Data

The Tower 7 Chutes is a permanently closed avalanche area on the lower half of the ski area. The moderately steep east-northeast-facing slope is covered by grass and relatively thick stands of young aspens. The slope ends in the narrow bottom of Mill Creek. The avalanche was classified as a WS-AS-4. Releasing at an elevation of 9,000 feet the avalanche was 450 feet wide and fell 200 vertical feet. The fracture line was 3 feet. Debris was 12 to 15 feet deep in the creek bed.

Though it will never be known, avalanche workers suspect Holley traversed across and down about one-third of the slope before cutting down a steep 43–47° bank. They theorize the bank released first; it in turn caused the failure of the broader but less steep slope (27–30°) above.

A fracture-line profile done on the morning of the 27th showed the new snow that had fallen earlier in February had settled into a cohesive layer of equi-temperature snow about 13 inches thick. Below that, and to the ground, was 36 inches of old and very wet, faceted snow grains and depth hoar.

Comments

Baine described Holley as a risk taker, a "high flyer." He literally was; he had been a jet-fighter pilot, a group not known for any shortage of bravado. Holley was an expert skier; in the Alps he skied both downhill areas and off-piste, or in the backcountry. Baine stated that "he knows all the dangers of avalanches and was aware of them." However, Chessie added, "being the out-of-bounds skier that he was, I can only say that the ropes probably didn't mean anything to him. He was used to skiing where he wanted to, and when he said he was going to ski down there it was too late."

Though Holley was experienced with snow conditions in the Alps, he was not experienced with the weak depth-hoar snow cover of the Colorado Rocky Mountains. His defiant attitude left a widow and two young children

alone in England. Too often closure violations result in tragedy, as numerous accidents in *The Snowy Torrents* testify (85-14, for example). To discourage such incidents the State of Colorado passed a statute in 1979, the Colorado Ski Safety Act, making ski closure violation illegal and punishable by a jail sentence and/or a fine up to \$300.

After the accident Baine had kind words for the people involved in the rescue effort. He was impressed in "...the extraordinary professionalism that I've encountered on this mountain by the security people, ski patrol people and everybody else associated with this. It's a sort of extraordinary partnership and teamwork. They've shown to me great kindness and sympathy and understanding and it amazes me, I'm sure." These kind words apply to all rescuers involved in avalanche rescues.

86-17

AUGUST 3, 1986

Mt. Baker, Washington

4 climbers caught, 2 partly buried, 2 injured and killed

Weather Conditions

At 10,778 feet, Mt. Baker towers over the forested slopes of northwestern Washington. It is the northern-most volcano of the American Cascades. The Nooksack Indians called it Koma Kulsan (white steep mountain) as it is almost entirely sheathed in snow and ice. It receives extremely heavy snowfalls and supports 20 square miles of active glaciers.

Conditions were clear and calm on the morning of August 3. Above 7,000 feet a 0.75-inch-thick ice crust formed on the snow surface. It was firm enough to make crampons useful, but weak enough that climbers occasionally broke through.

Accident Summary

Neophyte climbers Tom Waller, 19, Kurt Petellin, 21, and Steve Raschick, 20, taught by their guide Ian Kraabel, 23, had spent 2 days on Mt. Baker honing their mountaineering skills. They practiced ice climbing, glacier travel and rescue techniques with the hope of climbing to the summit. Kraabel and a friend had recently started Summit Mountain Guides.

At 0200 hours, August 3, the four climbers set out under clear skies with the northern lights blazing overhead. They planned to take 6 hours to climb the Roman Wall route from their 4,500-foot base camp. Once on the glacier the climbers roped up, on one rope; the climbing order was Kraabel first, Waller, second; Raschick, third; and Petellin last. They followed the standard route up the Coleman Glacier until they reached the start of the Roman Wall at an elevation of 8,800 feet. At about 0500 hours the sky was just starting to turn light, but the sun was still behind the mountain when the men reached the bottom of the Roman Wall. Instead of crossing to the Deming Glacier and climbing the Roman Wall route, the group decided to climb a steeper, more direct route to the summit. The new route followed beneath a small ice fall called the Roman Mustache.

About 0700, they heard a rumbling sound. Petellin looked up and saw an avalanche rapidly bearing down on them. He glanced over to his left and saw Kraabel, the guide, running from the ice. Petellin took off running in the same direction as Kraabel. All four tried to run but could not escape the avalanche.

Petellin was knocked from his feet and tumbled in the turbulent flow of the avalanche. Just as he thought, "I don't want to be under this stuff," he started swimming motions. He popped out on top of the moving snow, but just in time to be pushed down a 75-foot crevasse. He was buried up to his waist in snow and ice. He had a dislocated left shoulder, but otherwise Petellin was all right.

Waller was carried over the crevasse and buried to his neck. He was doubled over by a large block of ice that was on his back. His ice ax was pinned against his chest. The block of ice had torn off his backpack and ripped through his clothing and skin. He suffered serious injuries, broken ribs, a collapsed lung, and multiple lacerations and bruises.

Both Raschick and Kraabel were buried in the crevasse.

Rescue

Mt. Baker is a popular mountain. According to the United States Forest Service over 6,000 people climb the peak each year. Other groups saw the avalanche. A group of five Seattle climbers were ascending the standard route, Roman Wall, when they heard a tremendous roar and watched the avalanche crash down

on the four climbers. They hurried to the runout zone.

Steve Sieberson and Chris Moore reached the site first, about 15 minutes after the avalanche. They quickly found Waller. While Moore continued to search, Sieberson worked on freeing Waller. The block of ice was so large that Sieberson had to chop much of the block away with his ice ax before he could move it. As the other climbers arrived they administered first aid to Weller while Sieberson joined Moore to look for the other climbers. As Moore approached the crevasse he heard Pelletin's yells. Pelletin hollered up that his shoulder hurt but that he was otherwise all right. Knowing that time was running out for the other buried climbers, Moore left Pelletin and continued to search. Pelletin was able to free himself after digging for 30 minutes. Above the crevasse, Moore spotted two objects in the debris. It was a hat and glove. Knowing the climbers were roped together he returned to search the area below the crevasse.

Sieberson describes what happened next: "I looked up and there was a man standing up there talking on a radio. It was the Canadian group (the North Shore Rescue Team, B.C. Mountain Rescue Group) we had seen on the mountain. They radioed Vancouver, and it is hard to believe, but 45 minutes after the avalanche there was help on the way." Members of the North Shore Rescue Team were on a recreational climb of Mt. Baker when they witnessed the avalanche. They contacted their base in Vancouver who notified the Whatcom County, Washington Sheriff's Office. Rescuers and a helicopter were on the way. The Canadians, assisted by some of the Seattle climbers, lowered a rope to Pelletin and pulled him out of the crevasse. Both Pelletin and Waller were slightly hypothermic. Each man was placed with a rescuer into a warm sleeping bag.

Both sections of the rope to which Waller was tied ran back toward the crevasse about 75 feet away. It appeared that one or both of the remaining climbers were buried in the bottom of the crevasse. Moore rappelled the 50 to 60 feet to the debris in the crevasse; he was also belayed from above by a separate rope. Moore began to dig out the rope that ran from Pelletin. After 30 minutes he had only managed to free a few feet of the rope that continued to go straight down in the debris. The danger of additional ice fall and avalanches

was increasing and there would be no escape for an unlucky rescuer in the crevasse. Moore was pulled out of the crevasse.

By now other climbers were arriving to assist in the rescue. Climbers dug out both sections of rope from Waller's knot to the crevasse. One section ended at Kraabel's broken harness and the other section ended at a broken end. The rope had broken when tons of snow and ice fell into the crevasse.

A Navy helicopter dropped off Bellingham Mountain Rescue Council personnel and a medic. By 1145, the two surviving climbers were loaded into the helicopter and flown to a Bellingham hospital.

Additional searchers from Bellingham Mountain Rescue Council, assisted by search dogs, continued the search for Kraabel and Raschick during the remainder of the day. Because of the threat of additional avalanches the search was called off by noon the next day, August 4.

One month later, on September 4, a group of climbers reported seeing a body deep in the crevasse from which Pelletin had been rescued. Rescuers from the Bellingham Mountain Rescue Council recovered both bodies from the crevasse on September 6. At least 6 feet of snow and ice covered the men. The lower wall of the crevasse had pulled away from the pile of debris revealing Raschick's body. Kraabel's body was found under Raschick's. Both men had been crushed by the weight of the snow and ice.

Avalanche Data

On the northwest side of the mountain at an elevation of 9,200 feet a portion of the ice cliff, about 200 feet across and 40 feet high, crumbled. The falling ice released the snow below. Less than 100 feet below the ice when it fell, the climbers were engulfed by the snow and ice. Its collapse was probably due to normal glacial movements. The ice and snow avalanche fell about 400 vertical feet. In the runout zone the avalanche spilled into a 8-foot-wide crevasse, 75 feet deep. Except for the extreme right hand side, the avalanche filled the crevasse to the top and continued down slope. Debris on the glacier was estimated to range from 3 to 12 feet deep.

Comments

The guide chose an appropriate route when the group changed plans to climbed the

Roman Mustache route. Snow conditions at the time were generally stable. The group started climbing early, before sunrise and were on the route even before sunshine reached the ice cliffs. The ice cliffs and ice fall in the Roman Mustache area are generally quite stable. Dunham Gooding, director of the American Alpine Institute (a guide service and climbing school that frequently trains on Mt. Baker) stated after the accident, "Our climbers are in that area very frequently, and we are familiar with the ice cliffs that dropped the debris (which triggered the avalanche)." He added, "We know those cliffs drop debris about three or four times a year in very small amounts, so the cliffs are unsafe maybe a minute each year."

Though the exact freezing level was unknown for the night before the avalanche, the freezing level remained high. Groups camped lower on the glacier reported that numerous ice avalanches could be heard from high on the mountain. However, Kraabel's group camped below the glaciers and may have been too low to have heard the rumbling sounds of ice avalanches. Ice avalanches are not uncommon on glacier-covered mountains (see accident 81-22).

As more and more people carry two-way radios and cellular telephones into the mountains, accidents can be reported fast and rescue teams can respond immediately. Had the Canadian group not been carrying their hand-held radios Waller might not have survived the many hours required for someone to leave the mountain and notify a rescue team.

Lastly, summer avalanches on Mt. Baker should be no surprise. An avalanche on the Roman Wall route in July 1939 caught 25 climbers. Six were killed. Thirty-nine years later in August 1978 an avalanche on the Roman Wall route killed one climber.

More than a foot of snow fell in many mountain areas. Strong winds accompanied this storm, and high-elevation avalanche starting zones got their first load of windblown snow. A second storm on October 2–3, added more snow. At 14,265 feet, Quandary Peak is the 14th highest mountain in Colorado. It is 6 miles southwest of the town of Breckenridge.

Accident Summary

Two ski mountaineers were climbing a steep couloir on the north side of Quandary Peak. Both were wearing crampons and had their skis strapped to their backpacks. While climbing at 13,100 feet, Mark Venery, 21, triggered a small slab. The avalanche fractured up to 2 feet deep around him and instantly the moving snow knocked him off his feet. He tried to self-arrest with the self-arrest grips on his ski poles, but couldn't. Once the snow began sweeping him downslope even an arrest with an ice ax would have been fruitless. In seconds he was swept downhill, about 75 yards, into some rocks.

Avalanche Data

This avalanche was an SS-AS-2-O. It involved only the season's new snow fracturing 1.5 to 2 feet deep to the old snow from the winter of 1985–86. The avalanche was 120 feet across and traveled about 300 feet slope distance.

Comments

The only mention of Venery's friend in the accident report was that he was not caught. Venery was not so lucky; his ride in the avalanche, and collision with rocks at the bottom, was violent. Venery suffered head cuts when he piled into the rocks, and he also reported tendon injuries in his legs. These injuries most likely occurred to his knees and ankles when the points of his crampons snagged in the snow as he tumbled down in the avalanche. Also, the avalanche and his crash into the rocks broke both skis that were strapped to his pack.

Conditions for this type of accident form in scattered areas of the high mountains long before the ski season begins (see accident 85-18). One windy day can quickly form small but dangerous slabs in gullies and couloirs. Backcountry travelers should always think "avalanche," especially when venturing onto steep snow slopes, regardless of slope size or time of year.

86-18
OCTOBER 6, 1986

Quandary Peak, Colorado

1 ski mountaineer caught, partly buried and injured

Weather Conditions

The winter's first lasting snows fell in the Colorado mountains on September 24–26.

86-19 NOVEMBER 20, 1986

Alta, Utah*1 hiker caught, buried and killed***Weather Conditions**

Up to 4 feet of snow fell in the Wasatch mountains in late September. On shaded slopes above 9,000 feet the snow remained through the clear and dry October weather. By early November temperature-gradient metamorphism had turned the existing snow into a weak snowpack composed of faceted grains. A series of weak storms in early November created shallow slab conditions.

On November 18 and 19 another fast moving storming hit the Wasatch. Above 10,000 feet about 6 inches of wet (150–200 kilograms per meter) snow fell. Strong southwest to northwest winds of 30–50 mph blew the snow into avalanche starting zones creating widespread hard slab conditions. The weather cleared late in the day on the 19th and conditions remained clear through the early evening of the 20th.

Late in the evening of November 20, the weather deteriorated when another storm moved into the Wasatch. Winds increased from the south-southwest and temperatures began to climb, passing the freezing mark between 2200 and 2300 hours. By very early morning on November 21, light rain was falling which changed to snow later in the day as temperatures cooled.

The Alta Ski Area had not yet opened for the ski season; however, the ski patrol had been working on the mountain getting ready for the new season.

Accident Summary

Paul Janda, 27, a recent immigrant from Czechoslovakia had recently started working at the Alpenglo Day Lodge in Alta. At 1900 hours on Thursday, November 20, Janda left the Alpenglo to go for a walk. He told friends that he was going to hike up the ski area to the Sugarloaf area. It was a moonlit night, and he was lightly dressed in sweat pants, a sweater, a hat but no gloves.

Janda probably was enjoying the solitude of his hike up Sugarloaf Mountain (11,051 feet). The dark silhouettes of the peaks may have reminded him of the mountains in his

native Czechoslovakia. Just enough moonlight reflected off the snow to light his way. From the summit he descended down the east ridge to the saddle between Sugarloaf and the Devil's Castle. The snow was calf-deep but didn't seem to slow his progress. At the saddle he started down a steep north-facing slope.

On Friday morning, November 21, Janda did not report for work. After talking to friends and co-workers the manager of the Alpenglo, Dean Marsh, realized that Janda had never returned from his hike. At 0745, Marsh notified Alta Central, the centralized communications system for Little Cottonwood Canyon. Alta Central notified the Alta ski patrol, and at 0750 a search for the overdue hiker was initiated.

Rescue

A five-member hasty search team from the ski patrol quickly found Janda's tracks. About 0815 the team spotted an avalanche in an area between Sugarloaf Mountain and Devil's Castle. They continued to follow and search the immediate area of Janda's tracks. Although it was likely that Janda had been buried in the avalanche, following his tracks was the wisest search strategy.

New falling snow was starting to cover the tracks and any other clues as to Janda's whereabouts. It was possible that he could have sought shelter higher on the mountain by crawling under a tree. Also, if Janda was buried in the avalanche, the safest way to approach the slide would be from the top.

The tracks climbed Sugarloaf Mountain (11,051 feet). They followed the west ridge over the summit and descended down the east ridge to the saddle between Sugarloaf and the Devil's Castle. From this spot the tracks descended only a short distance and disappeared at the fracture line. It was 1015 hours when the search operation for a missing hiker changed to an avalanche rescue. Fifteen additional rescuers from the Alta and Snowbird ski patrols, the U.S. Forest Service, and Alta Central responded.

A thorough hasty search was done but turned up no clues, so probe lines were started. At 1130 a rescue dog and handler from Snowbird were flown to the accident site by a Life Flight helicopter. About this time a second rescue dog arrived. Both dogs failed to alert on anything at the avalanche. Probe lines continued searching. The weather was deteriorating

and at 1215 the Life Flight helicopter had to lift-off to return to Salt Lake City. Rescuers continued to search and a short time later, at 1235, a probe line found the victim.

Janda was found near the middle of the debris field, buried under 5–6 feet of snow. He had lived for a short time under the snow as an ice mask had formed around the his head. Rescuers suspected he had been buried 12–14 hours; no CPR was done, instead it was decided to keep the body cold by packing it in snow.

Without the helicopter to evacuate Janda, the ski patrollers had to evacuate him by toboggan to the base of Alta. However, it was no easy task. Adjacent slopes were avalanche prone and before rescuers could cross them explosives were used to control the slopes. At 1400 hours the victim was transferred to an ambulance and transported to Alta View Hospital in Sandy, Utah. There he was pronounced dead on arrival.

Avalanche Data

The avalanche was a hard slab triggered by the victim. It was classified as an HS-AF-3-O. Although the avalanche was not witnessed, the victim apparently released the slide while he was walking down the 37° north-facing slope. It started at an elevation of 10,700 feet and fell 300 vertical feet. At the top of the starting zone the avalanche was 40 feet across but widened

to 120 feet in mid track. It fractured 1-foot deep across the top but reached 3 feet deep along the flanks.

Snow conditions were quite unstable. On November 23, additional avalanche control work was done in the Alta area with extensive avalanche activity resulting. In the Sugarloaf Mountain and Devil's Castle area slopes adjacent to the accident site produced class 3–4 avalanches that fractured to depths of 2–4 feet.

Comments

This was, in effect, a backcountry accident in a developed area. The Sugarloaf Mountain and Devil's Castle is a difficult area to control (see accident 86-13), so it is one of the last areas controlled by the ski patrol and opened in the ski area. However, this accident was the fault of the victim's own ignorance.

Avalanche forecaster Brad Meiklejohn in his accident investigation clearly states the factors that lead to this accident: "The victim did everything wrong. He went by himself, totally unprepared, at night, without saying exactly where he was going, into extremely avalanche-prone terrain." Meiklejohn also notes in his report that there could have been a communication problem. Janda understood little English, and he might not have fully comprehended what he had been told about the avalanche conditions.

Evaluating Avalanche Risk and Avoiding and Surviving Avalanches

Avalanche fatalities in the United States are on the increase. The 5-year moving average in Figure 36 now stands at an average of 20 deaths per year. The accidents described in *The Snowy Torrents* reveal those activities that most often lead to avalanche encounters and illustrate how and why victims get themselves into trouble.¹ Figure 37 shows avalanche fatalities by activity group, and clearly points out the most hazardous activities: climbers, backcountry skiers, lift skiers (out-of-bounds), and snowmobilers head the list. The category lift skiers (out-of-bounds) includes skiers who leave the ski area boundary or ski into “closed areas” within the ski area boundary. The category lift skiers (in area) are skiers killed on open terrain within ski areas. It is important to note that only four skiers have been killed by avalanches on open terrain within ski areas since 1980, and no in-area skiers have been killed since 1986.

Figure 38 shows the distribution of avalanche fatalities by state, and Figure 39 shows the distribution by month. Avalanches do not occur exclusively in winter nor only in western states. Avalanche deaths have occurred in every month of the year and in three eastern states. (Several close calls have even occurred in Michigan—see accidents 80-13 and 82-5).

Public education is the key to saving the lives of people who, knowingly or unknowingly, expose themselves to avalanche danger. This chapter draws upon the experiences of others to help people evaluate conditions, minimize risks, avoid and survive avalanches, and make avalanche rescues when companions are caught. In essence, it is far easier and less painful to learn from other people’s mistakes.

Risk

Risk taking means exposing oneself to the chance of injury or death. Risk can be involun-

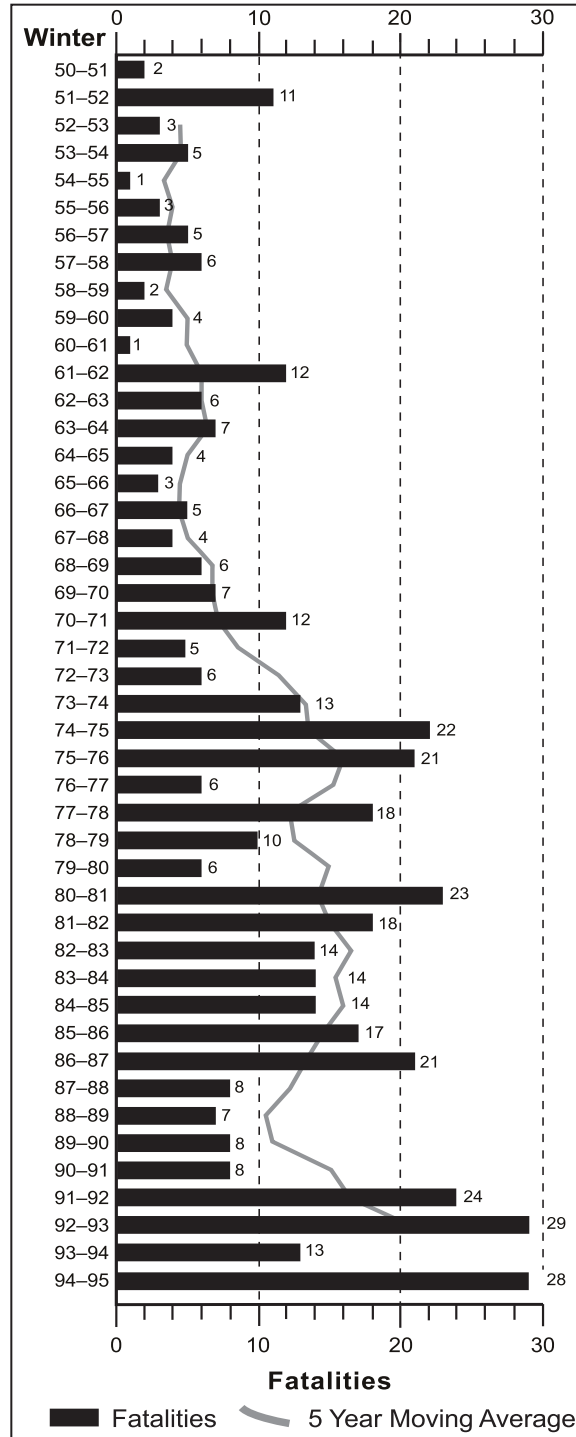


Figure 36. Avalanche fatalities by winter in the U.S. from 1950 to 1995.

¹ Avalanche records prior to 1950 are woefully incomplete. For that reason, the 45-year record from 1950 to August 31, 1995 has been used for analysis in this chapter.

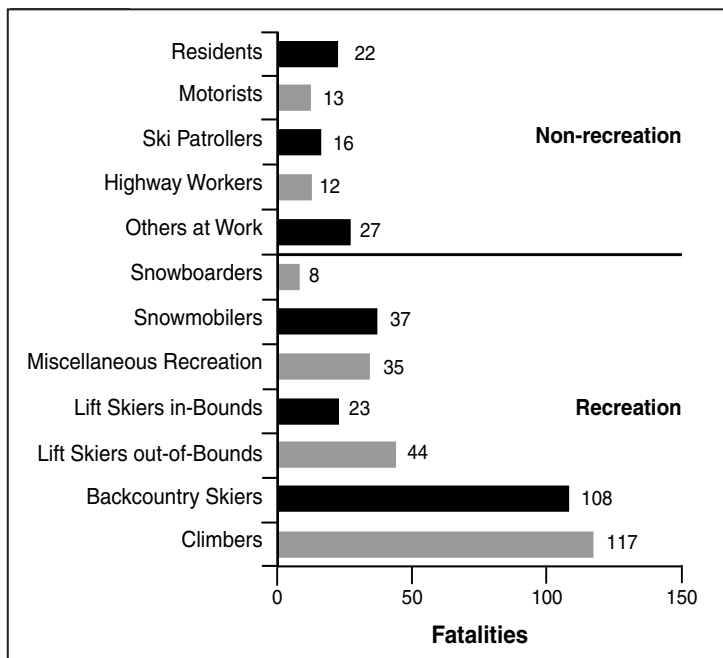


Figure 37. Avalanche fatalities classified by activity categories from 1950 to 1995.

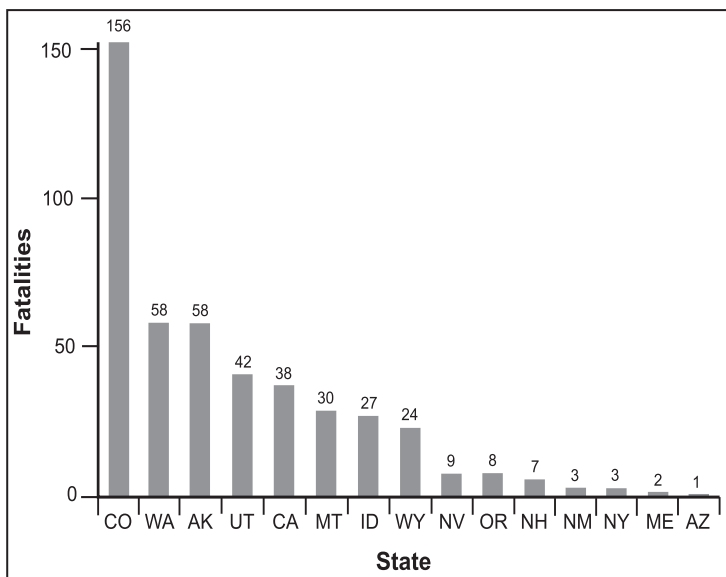


Figure 38. Avalanche fatalities classified by state from 1950 to 1995.

tary, where a person is exposed to avalanche danger through no fault of their own—e.g., the motorists stalled under the avalanche path—or it can be voluntary, where a person knowingly exposes himself or herself to risk. The majority of accidents reported in *The Snowy Torrents* occurred because somebody voluntarily took a

risk. In fact 87 percent of all avalanche victims trigger the avalanche that catches them.

Most recreation involves some risk, but recreating in potential avalanche terrain carries a high degree of risk. In order to determine acceptable risk, recreationists must evaluate the risk in proportion to the benefits: the greater the benefits, the greater the risk that is acceptable. For example, a group of tired and cold ski tourers near the end of the day may have to decide if the benefits of a shortcut through avalanche-prone terrain (which would get them to warmth and shelter an hour faster than the longer, safer route) is worth the risk. At the other extreme, expedition climbers often accept the risks of high altitude, storms and avalanches for the benefits of the climbing experience.

Avoiding Avalanches

Avalanches do not just happen by accident, they occur for particular reasons. A backcountry traveler or worker armed with common sense and a little education can avoid avalanches and prevent accidents. If one plans to venture into steep, snow-covered terrain, expect to encounter avalanches. To avoid avalanches, develop skills to recognize the clues to avalanches and learn how to evaluate snowpack stability. In short, learn where and when recreation, travel and work is safe in mountainous terrain.

1. Sources of avalanche information:

Information on avalanche conditions is available from several sources. One is your local avalanche forecast center. In some parts of the country (the Rockies of Colorado and Montana, the Wasatch and La Sal Mountain Ranges of Utah, the Cascades of Washington and northern Oregon, the Lake Tahoe-Donner Summit area and the east-central Sierras of California, the Smokey, Sawtooth and Pioneer Mountains of Idaho, and the Teton Mountains of Wyoming) daily reports of mountain weather, snow and avalanche conditions are available via recorded telephone messages. When warranted, avalanche warnings are issued jointly by the avalanche forecast office and the National Weather Service and are broadcast over local radio and television. Other sources for the latest avalanche information can include the Forest Service or National Park Service and ski-area patrols.

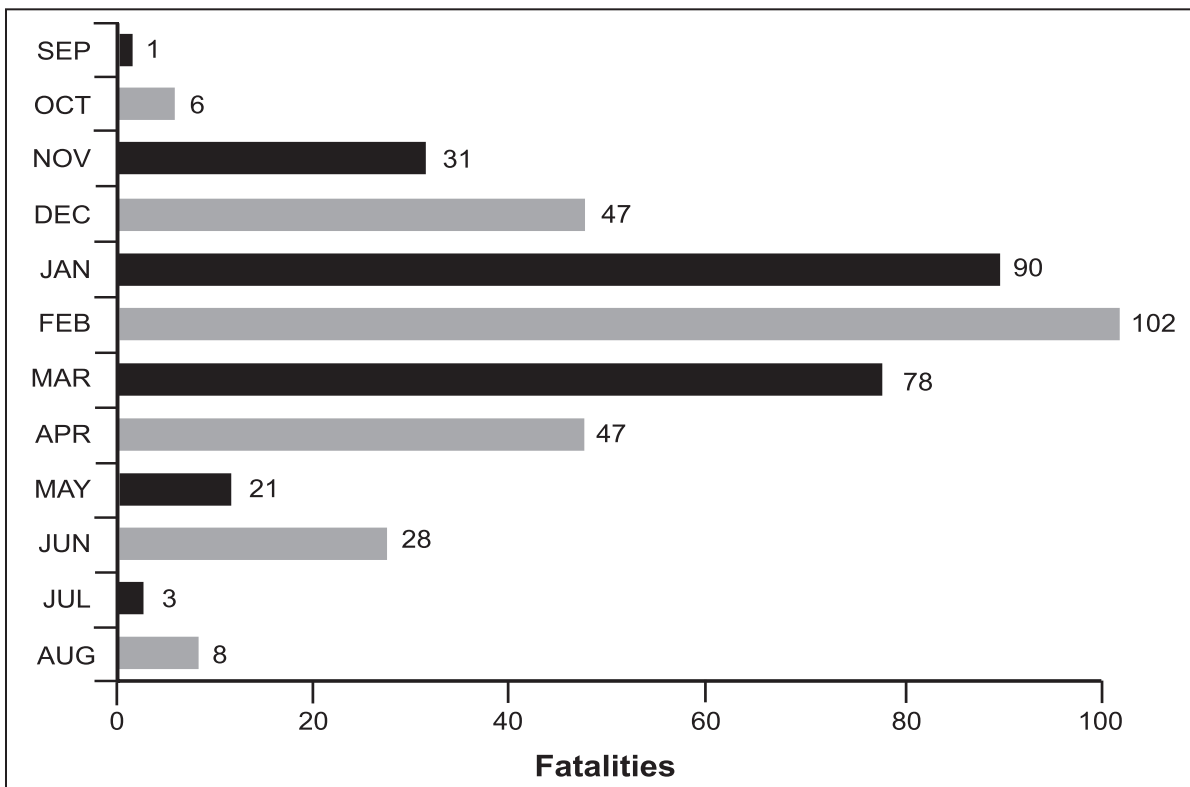


Figure 39. Avalanche fatalities classified by month from 1950 to 1995.

When skiing within developed ski areas, respect all closures. Ropes and signs mark closed terrain. If unsure whether a trail is open or closed ask the ski patrol first. Closures, and especially avalanche closures, are purposeful and to violate them is to invite trouble (see accidents 81-26, 83-11, 85-7, and 86-16). Ski areas have a responsibility to the skiing public not to abuse avalanche closures by applying them when no avalanche hazard exists. Skiers will soon realize the ski area is merely “crying wolf” and will no longer respect the closures. Skiers who leave the ski area boundary to test their skills on ungroomed terrain in the backcountry should only leave the ski area through open gates. These skiers should remember that they, not the ski area nor the ski patrol, are responsible for their own safety and should plan accordingly.

2. Equipment for backcountry travel:

When traveling in avalanche terrain, all party members should be equipped with rescue equipment: transceivers, shovels, and probes. Transceivers or avalanche rescue beacons, such as the Pieps, Ortovox, and Skadi, offer the best chance for a live recovery if used properly. To be effective, each party member must have a

rescue beacon and be practiced in its use according to the directions supplied with each unit. Equally important, party members must be equipped with shovels for quickly digging down to the buried victim. Probes can help to pinpoint the buried victim. Either collapsible or sectional probe poles, or special ski poles that screw together after the grips and baskets have been removed can speed a rescue effort.

This rescue equipment is not intended solely for backcountry travelers. Lift skiers who frequently ski avalanche-prone terrain inside or outside ski area boundaries will be doing themselves a favor by carrying and knowing how to use beacons, shovels and probes.

Special Note Regarding Beacons: For years there were two different frequencies that avalanche rescue beacons operated on: the North American low frequency (2.275 kHz) and the European high frequency (457 kHz). The low frequency (2.275 kHz) was used with the first design of avalanche beacons in 1968. Beacons on this frequency have become obsolete and are no longer manufactured. In the mid 1980s, European countries started using the much higher frequency, 457 kHz. The high

frequency beacons offer a greater range and better electronics. It has become the standard world wide. Users of the low frequency beacons are urged to retire their units and invest in the high frequency (457 kHz) beacons.

3. Identification of avalanche areas and dangerous conditions:

Safe travel in the backcountry requires a knowledge of terrain, weather and snowpack-stability evaluation. Avalanche paths are easiest to identify below treeline where past avalanches have destroyed trees and have created a trim line in the vegetation. Also, broken and damaged trees are clues to past avalanche events. But some avalanche slopes are not so easily spotted. Above treeline, steep lee slopes frequently avalanche, and short, but steep, gully walls and road cuts can also avalanche. *The Avalanche Handbook* (McClung and Schaerer, 1993) and *Snow Sense* (Fredston and Fesler, 1994) (see page 265 for additional resources) contain many good photographs of avalanche paths and offer detailed guidelines for identification.

The best clue of instability and dangerous conditions is recent avalanche activity. Other

clues are hollow sounds beneath the feet or skis, or collapse of the snow beneath the feet, or cracks shooting out from under foot. See accident 85-4 for example. These clues are sometimes referred to as “talking snow.” When the snow talks, it is saying conditions are very unstable.

4. Avalanches related to slope steepness and aspect:

There is a definite relationship between avalanches and slope steepness. Avalanches are most frequent on slopes of 30°–45°. Figure 40 graphically confirms this fact. It is possible to trigger an avalanche on shallow slopes where steeper slopes rise above (see accidents 84-4, 85-21, and 86-2). Snow-country travelers should learn to judge snow steepness with accuracy. Better yet, a small inclinometer can be purchased to accurately measure slope steepness.

There is relationship between avalanches and slope aspect. Figure 41 shows that most avalanches (64 percent) release on north- to east facing slopes. These shaded slopes keep the snow cold and dry and are often sheltered leeward slopes where large amounts of wind-

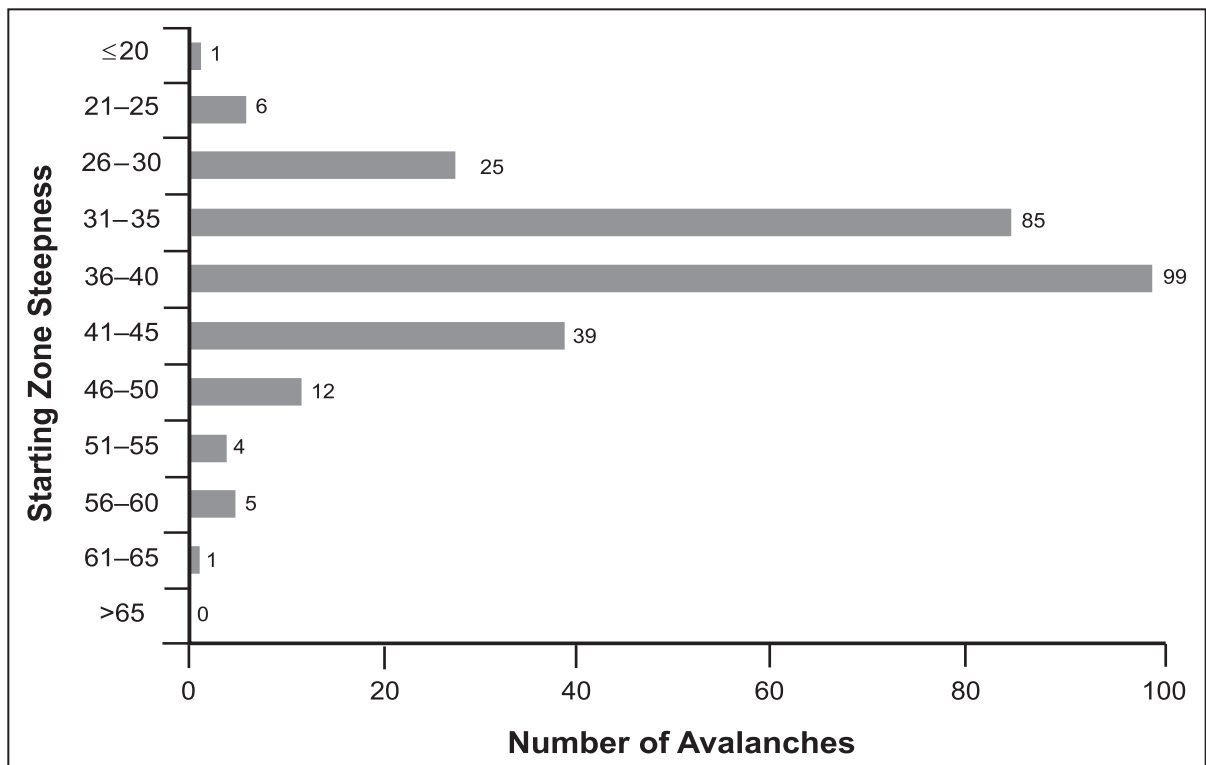


Figure 40. Slab avalanches classified by starting zone steepness, based on a sample of avalanche accidents in the U.S. from 1950 to 1995.

drifted snow are deposited. The same conditions that entice skiers and mountain climbers also create dangerous avalanche conditions.

The fact that 38 percent of the avalanche accidents in the sample from 1985 to 1995 occurred in ski areas does not bias the statistics. When ski area accidents are excluded from the sample, the distribution of backcountry accidents (the shaded portion of Figure 41) remains about the same. Sixty percent of the backcountry accidents occurred on north- to east-facing slopes. It is important to remember that avalanches can release on slopes of all aspects. When major storms are in progress, all slopes may be unstable.

5. Avalanches related to storms:

While it is a general rule that most avalanches occur during storms, the same is not true of avalanche accidents. Stormy weather tends to discourage backcountry travelers from tackling steep slopes. A significant number of avalanche accidents did occur within the last 24 hours of a storm. One should be especially cautious if snow has fallen within 24 hours, especially if accompanied by strong winds. Storms need not be large to produce dangerous slab conditions; a few inches of new snow with strong winds can produce dangerous slabs on lee slopes and gullies. Unfortunately, good powder skiing and avalanches go hand-in-hand.

6. Route selection and safe travel:

There are a few hard and fast rules for route selection when traveling in avalanche country. Whether on foot, snowshoes, skis or snowmobiles, travelers are usually forced to choose a route that is a compromise between the more efficient (more direct, least exhausting) and the safest. The safest route is to avoid dangerous or suspect slopes altogether by traveling along the valley floor or ridge tops, staying slightly on the windward side of ridges (away from cornices), or in dense timber.

Signs of instability such as wind slab, heavy snow or rain, indicate the prudent decision is to turn back or alter the route. Often, however, it is necessary or desirable to venture onto a suspect avalanche slope, and it is here that five safe-travel rules must be applied:

- a. Do travel one-at-a-time.
- b. Do not travel above your partner, and stay out from beneath your partner.
- c. Do not travel out of sight from each other.

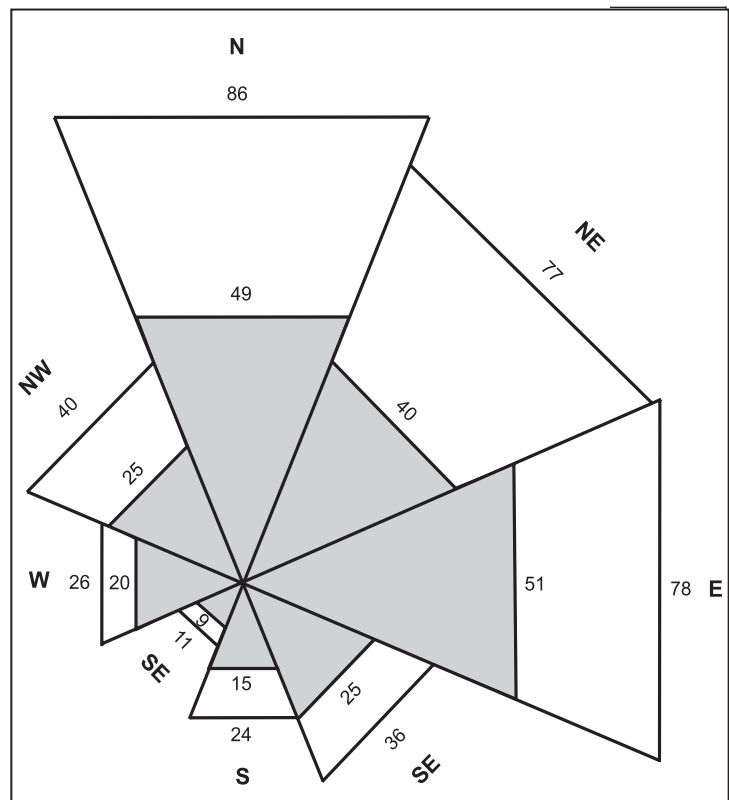


Figure 41. Avalanches classified by starting zone aspect. Outer rose includes all avalanches. Shaded, inner rose includes backcountry avalanches only (ski area avalanches excluded), based on a sample of avalanche accidents in the U.S. from 1985 to 1995.

- d. Do not stop in the middle, or at the bottom of steep slopes.
- e. Do have an escape route.

If crossing a suspect slope, cross very high (above the normal failure zone) or very low (in the runout zone). Never stop in the middle of the slope; stop only at either side or at safe spots such as large trees or rock outcrops, along the way. If the slope is especially wide, traversing members should spread out and be spaced several hundred feet apart. Traverse in the same track, less snow is disturbed, thus the chance of triggering the avalanche is minimized. If possible, try to cross with a slight downhill traverse; this will minimize exposure time.

If ascending a suspect slope, keep far to the sides. Avoid long traverses out onto steep slopes or with steep slopes directly above. Shorter traverses mean more zigzags and lots of kick-turns, but by sticking close to the side of the slope should the slope fracture, the victim has a greater chance of escaping out to the side of the avalanche.

If descending a suspect slope, again, keep close to the sides rather than the middle of the slope. Stay to slopes where one can see the entire length of the slope and with ones that have gradual, open runouts. Avoid slopes that end in terrain traps such as cliffs, gullies or dense trees. If out of voice contact, use signals to be sure that the exposed person is clear before the next person starts down.

Sometimes there may be no safe route and a slope must be crossed. Use a climbing rope to belay the crossing, or if instability is suspected try to trigger the slope first.

7. Additional safety measures:

People who play, work or travel in avalanche country can take several precautions, in addition to commonsense thinking and proper route selection, to increase their chances of survival if caught and buried. Bundle up before entering an avalanche slope. Tighten all clothing, zip up zippers and pull on a cap. This will ensure some degree of warmth if buried. If carrying a day pack or any pack that is not cumbersome, leave it securely strapped on your back. The pack offers additional protection to someone in the avalanche, and it ensures that the other equipment will be available after the avalanche. The old school of thought held that a heavy pack should be slung over one shoulder, or the straps loosened, so that the pack could be easily shed if caught. Packs are not easily shed and a heavy pack carried on one shoulder increases the likelihood of a fall and triggering an avalanche. If you cannot carry a heavy pack confidently across an avalanche slope, don't try to cross the slope. Instead, look for a safer alternative route.

If on skis, remove the ski-pole straps so that the poles can be thrown away. It is much easier to swim with the avalanche if your hands are free. Remove or detach retention or safety straps from skis. It is important that alpine-style bindings be properly set so that the skis will stay attached and allow the avalanche victim to ski to the edge of the slide if possible, but once the victim is knocked down, the bindings should release which will make it easier for the victim use their legs while swimming with the avalanche. Attached skis tend to pull the victim to a deeper burial. This is an important point because many three-pin or cable telemark bindings are designed never to accidentally release. Backcountry skiers using heavy-duty telemark

equipment should consider using a releasable binding system.

Snowmobilers should be aware that approaching steep slopes from the bottom is far more dangerous than when approaching from the top. Highmark is a game frequently played by snowmobilers who try to drive up a steep slope as high as possible, then turn around and come down. It is much safer to play this game on windward rather than leeward slopes. It is also wise to stay close to the edge of the slope. If it avalanches, one can quickly power their machine off to the side.

Motorists can also take precautions to protect themselves when driving mountain highways. Keep windows rolled up when crossing avalanche paths. An avalanche can quickly fill a vehicle through an open window. Also, a closed window is stronger than a partly-opened window. While the chances of an avalanche striking a moving vehicle are very slim, the chances of a stopped vehicle being struck rise dramatically, so never stop in avalanche paths. If an avalanche has blocked the road, turn around or back up to wait in a safe area. Additional clothing carried in the vehicle will make waiting more comfortable. A motorist should never attempt to drive through even a small deposit of debris and if stuck in debris do not attempt to dig out. It is probably best to wait with another motorist in a safe area. If avalanches block the road in both directions, it may be best to wait inside the vehicle with the seatbelts securely fastened.

Surviving Avalanches (If You Are the Victim)

In a split second an avalanche victim must make several rational decisions as the snow fractures and slides.

Whether on foot, skis or snowmobile, if caught in an avalanche try to escape to the side or try to grab onto a tree. Attempt to stay on your feet or with your machine as long as possible. Yell, then clamp your mouth shut and breath through your nose. A mouthful of snow can be impossible to expel, and this can hasten suffocation if completely buried.

If knocked off your feet or from your snowmobile, put all your effort into swimming with the avalanche. (The effectiveness of swimming has been documented throughout this volume: see accidents 83-2, 84-1, 84-5, 85-7, 85-24, and 86-17). If skiing, drop poles (wrist

straps should have been removed earlier) and start making swimming motions with your arms. At the same time try kicking with your legs as best as possible (if your skis have been ripped off this will be easier). It is not important which swimming stroke you use; it is most important to fight for your life. Some victims who have been thrown forward and are being carried headfirst downhill have mentioned doing breast stroke with the arms seemed to be effective. Others who were being carried feet first found that a treading-water motion with arms and legs to be effective. With swimming motions you may have some control over your depth and direction of movement in the avalanche. If, however, the avalanche is large and turbulent, you will probably be helpless. A time you might not try to swim with the avalanche is if you are being carried into heavy timber. In this case it may be best to try and tuck in your arms and legs for protection.

When the avalanche begins to slow to a halt, make every effort to reach the surface thrusting upward with swimming motions. If still buried, try to place one or both hands in front of your face and do every thing possible to create a breathing space as the avalanche stops. Some people who knew they were near the surface thrust a hand or foot upward in an effort to break through to the surface.

If you are completely buried when the avalanche stops and you can move in any way, keep trying to improve your position and work your way to the surface. If near the surface, you will likely know which way is up. Spitting, moving snow and watching its movement or seeing a hint of daylight will help you determine up from down. If you are completely pinned, try to wiggle your head to enlarge your air space, stay calm to conserve your air and energy, and await rescue.

Rescue (If You Are the Survivor)

If you are the survivor or a witness to an avalanche you must act quickly and with authority; your actions over the next few minutes may mean the difference between life or death for the victim. First, establish the victim's last-seen area by noting its relationship to natural features. Travel safely to that spot and mark it with a piece of equipment or clothing. Begin your search downhill from that spot. Use an avalanche rescue beacon if the victim was so equipped. Otherwise, work downhill in the flow of the avalanche and quickly search for clues and scuff and probe the snow with probes, skis or ski poles.

If the accident occurred in or very near a ski area, and if you are not the only rescuer, one person should notify the ski patrol immediately because a large group of rescuers is available and usually only minutes away. If you are the only rescuer, at least make a quick, but thorough, search for surface clues before leaving to notify the patrol. Check and leave any clues securely in place.

If the accident happened in the backcountry, all rescuers should search and probe the area as thoroughly as possible before sending for outside help, which probably lies several hours away. If you go for help, you are usually going for a body recovery.

Time is of the essence in all avalanche rescues, so be familiar with the statistics of the next chapter. For the buried avalanche victim time is their enemy. After only 30 minutes, a victim's chance for survival fall below 50 percent. The statistics are not entirely grim, most people (87 percent) found within the first 15 minutes are found alive. Though few people survive long burials, fortunate circumstances can allow the victim to live many hours or even days (see accidents 82-14 and 85-20). Thus, no rescue should be abandoned prematurely; give all victims every possible chance.

The Deadly Statistics of Avalanche Burials

Data from avalanche burials have been compiled from documented accidents that occurred between 1950 and 1995. This sample includes accidents reported in this volume, those reported in the first, second and third volumes of *The Snowy Torrents*, and those that took place from 1987 to September 1995. These data have been analyzed to determine survival probabilities for totally buried victims.

Numerous factors affect the victim's chances for survival—injury, duration of burial, depth of burial, clues on the surface, body position, snow density, presence of airspace, size of airspace, safety equipment, etc. A victim's rescuers cannot know which factors are at work in any given burial, so they must be aware of the cold, hard statistics of survival based on a large number of cases.

All victims included in the study samples were completely buried, with the exception of a few cases where a ski tip, pole, hand or foot was visible. But even in these cases, the victim's head was beneath the snow, and he or she was unable to dig out, and survival depended on a quick rescue. No victims buried in vehicles or in the wreckage of buildings are included in determining survivability. Such victims can be shielded from the snow which allows for sizable airspaces. The statistics are not biased by extreme circumstances. (Anna Conrad, for example, survived for 5 days at Alpine Meadows, California, in the rubble of a demolished building [see accident 82-14]).

Three important points stand out in this study: 1) Only 228 of 575 victims survived; thus a completely buried victim has only a 40 percent chance of survival, regardless of all other factors. The statistic become even less optimistic when those buried victims who were found because of an attached object or body part protruding from the snow were removed from the data sample. Survival chances decreased—only 29 percent of totally buried victims survived. 2) No victim has survived a burial deeper than 7 feet. 3) No victim has survived a burial longer than 22 hours. Thus, 6 feet and 22 hours are the limits of the "life zone" in this sample.²

Survival Versus Burial Depth

Figure 42 shows depth of burial and that survival probability diminishes with increasing burial depth. In the shallowest burials the victim has about an 87 percent probability of survival, and survival prospects diminish rapidly with depth. Suffocation is the greatest cause of death for buried victims, and there are three important reasons why deep burials are most often fatal: 1) the snow is denser at greater depths, so it is more difficult to create an airspace; 2) the victim finds it almost impossible to expand his chest to breathe against the compressive weight of the snowpack; 3) and probably the most important reason, the time involved for location and recovery are longer than for shallow burials.

Survival Versus Burial Time

Figure 43 illustrates the probability of survival relative to the elapsed time of burial. Note that the median or 50 percent survival time is about 30 minutes. In other words, after a burial of 30 minutes, only 50 percent of the victims can be expected to survive. The statistics are more optimistic if the buried victim can be found within the first 15 minutes: almost nine in ten victims survive. However, as noted above, survivability plummets to only one in two after 30 minutes. After 1 hour one in three victims will survive, after 2 hours one in six, and after 3 hours one in ten. Clearly time is of the essence

² There are several documented cases that have occurred outside the United States in which victims buried completely and in direct contact with the snow have survived for more than 22 hours or burials deeper than 7 feet. One remarkable case occurred in January 1960 near Invermore, British Columbia, Canada. James Duke, 59, a Ministries of Highways employee, was swept away and buried while acting as an avalanche lookout for a work crew. Defying all odds, he was found alive 25.5 hours later beneath 5 feet of snow. An airspace the "size of a washtub" around his head saved his life.

In the early 1990s a Swiss mountain guide was buried 22 feet and survived. Other guides were nearby and immediately pinpointed the buried man's beacon signal, but it took more than four hours of digging for rescuers to reach the buried guide.

for the buried victim, and rescuers must be keyed into this fact.

A buried victim's chance for survival directly relates not only to burial time and burial depth but also to the type of rescue. Table 1 compiles the statistics on survival as a function of the type of rescue. The message is clear and blunt: *virtually the only way a buried victim will survive is to be found by his or her companions.* Of those found alive, 63 percent were rescued by others in the party. About one-in-five victims were found alive by organized rescue teams. While this statistic may seem encouraging, it is biased in that most of those found alive were found by ski patrols where well-equipped and well-trained rescuers were only minutes away. In the back-country if outside rescue units are needed, in effect, it assumes that a dead recovery is all that can be expected.

Table 1. Type of rescue for buried avalanche victims, based on a sample of avalanche accidents in the U.S. from 1950 to 1995.

	Self Rescue	Found by Party Members	Found by Organized Rescue Team	Total
Alive	42 (16%)	159 (63%)	53 (21%)	254
Dead	—	66 (20%)	262 (80%)	328
TOTAL	42	225	315	582

Methods and Statistics of Rescues

Table 2 describes the method of rescue for buried avalanche victims. It should be no surprise that the best chance of survival occurs when a body part, like a hand or foot, or an attached object, like a ski tip, protrudes from the snow and allows for a quick rescue. In some cases this is the result of luck, but in other cases it testifies to the value of actively fighting or swimming with the avalanche, or thrusting a hand upward when the avalanche begins to slow down. Either way, this statistic shows the advantages of a shallow burial—less time required to search, shorter digging time and the possibility of attached objects or body parts visible on the debris. Of the fatalities in this category, some were skiing alone with no one to spot the hand or ski tip and rescue them. In several other incidents the search was abandoned prematurely to seek organized rescue. When rescue teams arrived they found the ski, or hand, sticking out of the snow (see accident 84-19).

The hasty search is anything but hasty. Rescuers quickly scuff the snow surface and spot probe likely burial areas have saved a number of buried victims. For the hasty search to be successful it requires quick thinking and quick action the part of the rescuers. They must mark the last seen area to limit the search area and by using the flow of the avalanche

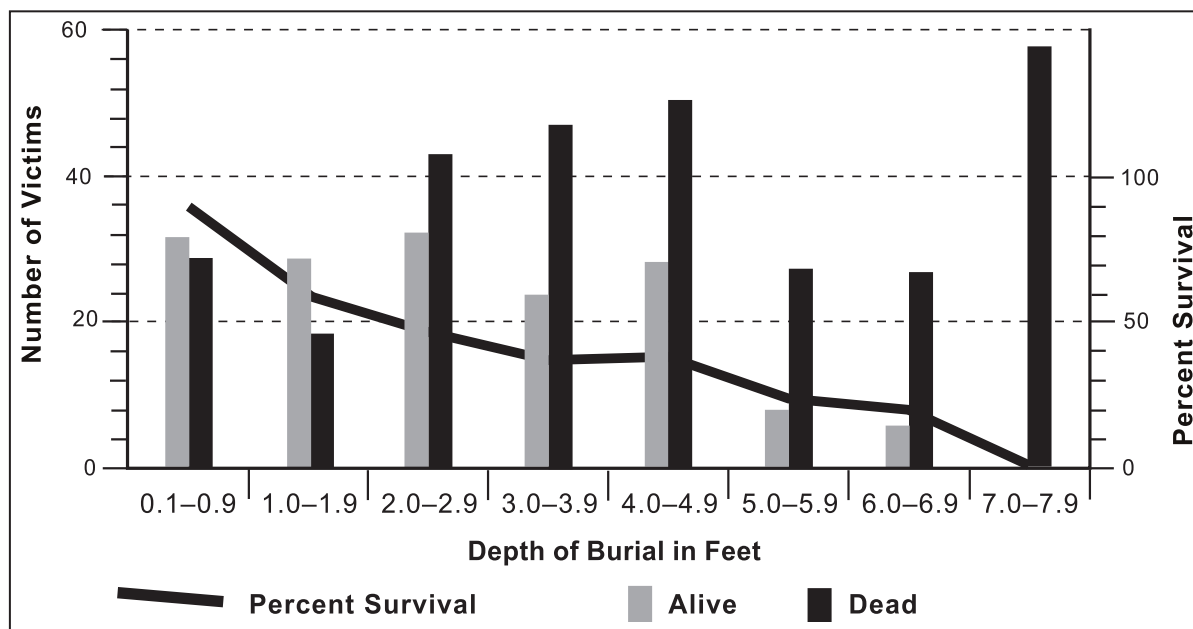


Figure 42. Percent survival versus depth of burial, based on a sample of avalanche accidents in the U.S. from 1950 to 1995.

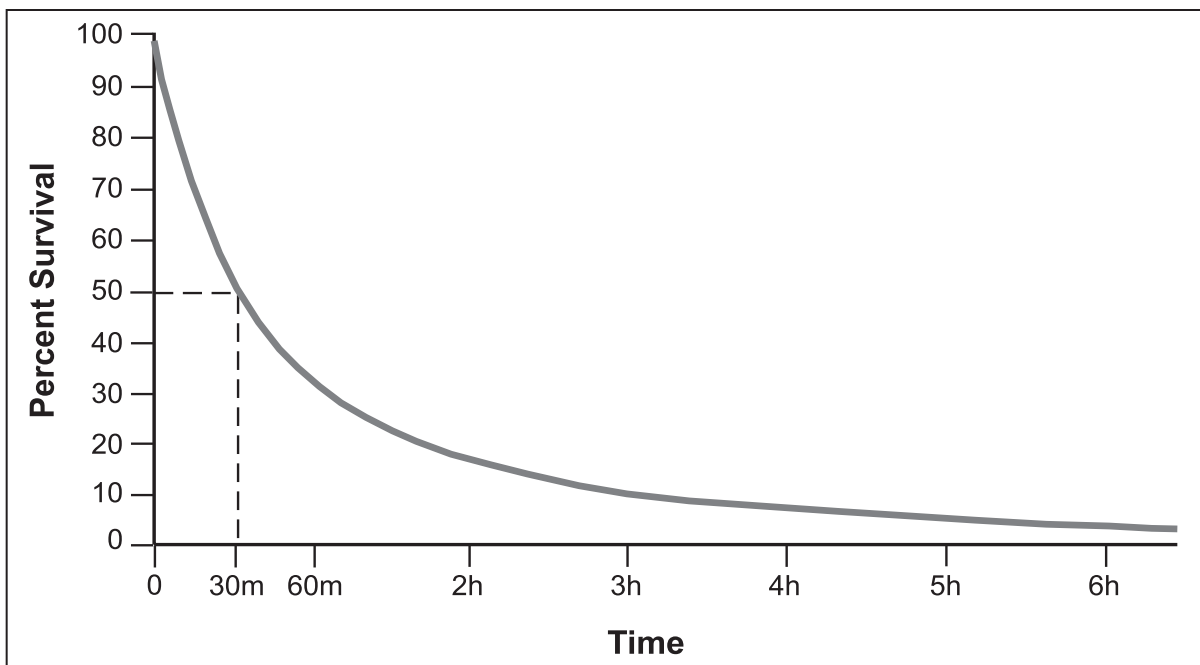


Figure 43. Percent survival vs. elapsed time of burial, based on a sample of avalanche accidents in the U.S. from 1950 to 1995.

and any clues found deduce the likely burial spots.

Table 2. Method of rescue for buried avalanche victims, based on a sample of avalanche accidents in the U.S. from 1950 to 1995.

Method	Found Alive	Found Dead	Total
Attached object or body part	97	30	127
Hasty search or spot probe	22	27	49
Coarse or fine probe	19	121	140
Rescue Transceiver	31	36	67
Avalanche dog	5	24	29
Voice	18	1	19
Avalanche cord	1	0	1
Other (digging, bulldozer)	16	14	30
Found after a long time span	0	35	35
Not found, not recovered	0	31	31
Not known	19	28	47
TOTAL	228	347	575

Organized probe lines have found more victims than any other method, but because of the time required, most of the victims are recovered dead. Only 19 people were found

alive by this method, with 121 recovered dead. The statistics confirm the statement made above that the survival of backcountry victims lies with the party members and not with outside rescue teams. Backcountry travelers should always be prepared for avalanche emergencies. When traveling in avalanche country, rescue beacons, shovels and probe poles should be carried by each member of the group.

Using avalanche rescue transceivers is the best method to find the completely buried victim if carried and used correctly. There are several cases of recklessness in the accident records. One victim was the only member of a group not to carry a transceiver; another left his transceiver turned off. There are also several cases in which the signal was quickly located but no one in the group carried shovels. In other cases, members in the group could not locate signal and had to wait for trained rescuers to arrive. Several victims also died because their friends were not practiced with transceivers and could not search fast enough. An avalanche rescue beacon and shovel in trained hands are a buried victim's best hope for survival, but it is still no guarantee of a live recovery. Even in textbook rescues—the signal is quickly located and the victim is dug out in

a short time—slightly more than one-half of the victims are found dead.

Despite the insulating properties of snow, 18 victims who were shallowly buried were able to yell and be heard by their rescuers (voice contact). This is a good reason for quiet and orderly rescues. An unfortunate case was an avalanche accident in 1974 where the victim's moans were heard by rescuers, but the victim was dead when he was uncovered 20 minutes later.

A word of caution about avalanche cords. The data show that no one has been found dead using an avalanche cord. It is partly true. In January 1978, four backcountry skiers using avalanche cords were caught and buried. The cords were also buried, and it was not until October, after the snow melted, when the first victim was found. These four victims are logged in the category "found after a long time span". Avalanche cords are ineffective and should not be used.

Trained avalanche-search dogs are capable of locating buried victims very quickly but because they are often brought to the scene long after the avalanche, there have been few live rescues. As increasing numbers of ski areas are keeping trained dogs on-site the number of live recoveries is increasing. There have been three live recoveries during the mid 1990s (Jackson Hole, Wyo., 1992; Kirkwood Meadows, Calif., 1993; Copper Mountain, Colo., 1994). Burial depths for victims recovered alive ranged from 2–5.5 feet. Fatalities have been found as deep as 7 feet.

For 35 victims, the rescue was called off after several days. The bodies were recovered

several weeks to months after burial. Because many of the bodies were partially melted out, the burial depth could not be measured. But for 10 victims, depths were estimated at between 20 and 33 feet, considerably deeper than the length of a probe pole.

In the not-found, not-recovered category, 31 victims were never found. Presumably they were swept down glaciers and into crevasses. Five victims, one in Montana, one in Nevada and three in California, were swept off a road or highway into a body of water and drowned.

When we consider the large numbers of people exposed to avalanche hazard each winter compared to the annual average number of avalanche fatalities (20 for the 1990s), there is a low probability that someone will be caught in an avalanche at a given time and location. However, once a victim is buried, chances for survival are low—about one in three.

Overall, the statistics of avalanche burials do not favor the buried victim—more will die than will live. Thus, prevention of accidents is the key to saving lives. No rescue method or device is an adequate substitute for proper route finding and decision-making. But when an accident does occur, speed of recovery is still the critical factor in live rescues. Rescuers must be aware of the grim statistics presented here in order to speed their efforts, but at the same time, no rescue should be abandoned prematurely on the assumption that the victim could not possibly be alive. For even after 6 hours, approximately 3 percent of the victims, or about 1 in 35, can be expected to be found alive, and no avalanche victim should ever be denied this small chance at life.

Accidents in All Four Volumes of *The Snowy Torrents*, 1910–86

No.	Date	Location	State	Activity	People					Vehicles		Structures Damaged
					Caught	Partly Buried	Totally Buried	Injured	Killed	Caught	Damaged	
10-1	3/1/10	Wellington	WA	Motorist or traveler	99	0	0	0	96	0	0	0
26-1	4/2/26	Telluride	CO	Resident	7	0	4	0	2	0	0	1
39-1	7/22/39	Mt. Baker	WA	Climber	25	0	5	0	6	0	0	0
41-1	1/1/41	Alta	UT	Ski tourer–mountaineer	1	0	1	0	1	0	0	0
51-1	11/18/51	Arapahoe Basin	CO	Lift skier out-of-bounds	1	0	1	0	0	0	0	0
53-1	2/7/53	Source Lake	WA	Ski tourer	2	0	2	0	1	0	0	0
56-1	2/19/56	Tuckerman Ravine	NH	Climber	5	3	1	0	1	0	0	0
56-2	3/1/56	Lookout Pass	MT	Motorist	5	5	0	0	0	1	0	0
56-3	3/2/56	Mace	ID	Resident	18	0	0	0	1	0	0	24
56-4	3/5/56	Leeks Canyon	WY	Lift skier out-of-bounds	1	0	1	0	1	0	0	0
57-1	1/17/57	Arapahoe Basin	CO		0	0	0	0	0	0	0	0
57-2	2/5/57	Wardner	ID	Resident	4	4	0	1	1	0	0	9
57-3	2/6/57	Lookout Pass	MT	Railroader	1	0	0	0	0	1	0	0
57-4	2/24/57	St. Marys Lake	CO	Climber	5	2	1	3	1	0	0	0
57-5	4/8/57	Dam Slide	CO	Highway worker	3	0	3	0	2	2	2	0
58-1	2/12/58	Loveland Basin	CO	Ski patroller	3	1	1	1	0	0	0	0
58-2	3/9/58	Snow Basin	UT	Ski tourer-rescuer	5	0	2	0	2	0	0	0
58-3	3/16/58	Silver Creek	WA	Snow ranger	3	3	0	3	0	0	0	0
58-4	4/19/58	Berthoud Pass	CO	Lift skier out-of-bounds	1	1	0	0	0	0	0	0
59-1	1/25/59	Alta	UT	Lift skier in-bounds	3	0	0	0	0	0	0	0
59-2	2/11/59	Sun Valley	ID	Others at work	1	0	1	0	0	0	0	3
59-3	3/1/59	Bridger Bowl	MT	Ski patroller	1	1	0	0	0	0	0	0
59-4	6/20/59	Mt. Hood	OR	Climber	5	0	5	1	1	0	0	0
60-1	1/13/60	Solitude	UT	Lift skier out-of-bounds	1	0	1	0	0	0	0	0
60-2	2/13/60	Berthoud Pass	CO	Ski tourer	1	0	1	0	1	0	0	0
60-3	3/9/60	Superior Creek	ID	Others at work	3	0	1	0	2	0	0	0
60-4	2/60	Bridger Park Mountain	MT		0	0	0	0	0	0	0	0
60-5	3/19/60	La Plata Peak	CO	Climber	3	2	1	0	1	0	0	0
60-6	12/23/60	Bridger Bowl	MT	Ski patroller	1	0	1	0	0	0	0	0
61-1	2/23/61	Aspen Mountain	CO	Lift skier out-of-bounds	1	0	1	0	1	0	0	0
61-2	11/24/61	Arapahoe Basin	CO	Lift skier in-bounds	1	0	1	0	1	0	0	0
61-3	12/31/61	Bridger Bowl	MT	Lift skier out-of-bounds	4	2	0	2	0	0	0	0
62-1	1/7/62	Loveland Pass	CO	Motorist	7	7	0	0	0	1	1	0
62-2	1/62	Bridger Bowl	MT		0	0	0	0	0	0	0	0
62-3	1/21/62	Twin Lakes	CO	Resident	9	0	9	0	7	11	11	6
62-4	2/10/62	Swift Creek	WY	Snowshoer	2	1	1	0	1	0	0	0
62-5	3/4/62	Dotsero	CO	Others at work	9	0	0	0	0	1	0	0
62-6	3/25/62	Granite Mountain	WA	Climber	2	0	2	0	2	0	0	0
62-7	12/31/62	Taberg	NY	Snow player	2	0	2	0	2	0	0	0
62-8	12/30/62	Stevens Pass	WA	Ski patroller	2	1	1	0	0	0	0	0
63-1	3/2/63	Alta	UT	Lift skier in-bounds	3	2	1	1	0	0	0	0
63-2	3/3/63	Red Mountain Pass	CO	Motorist	3	0	3	0	3	1	1	0

No.	Date	Location	State	Activity	People					Vehicles		Structures Damaged
					Caught	Partly Buried	Totally Buried	Injured	Killed	Caught	Damaged	
64-1	1/12/64	Cardiff Pass	UT	Ski tourer	2	1	1	0	0	0	0	0
64-2	1/20/64	Snow King Mountain	WY	Ski patroller	1	0	1	1	0	0	0	0
64-3	1/25/64	Georgetown Canyon	ID	Others at work	1	1	0	0	0	0	0	2
64-4	3/7/64	Solitude	UT	Ski patroller	1	1	0	1	0	0	0	0
64-5	3/7/64	Alta	UT	Lift skier in-bounds	1	0	0	0	0	0	0	0
64-6	3/12/64	Snow King Mountain	WY	Ski patroller	2	1	0	0	1	0	0	0
64-7	3/14/64	Squaw Valley	CA	Lift skier out-of-bounds	1	0	1	0	1	0	0	0
64-8	3/29/64	Snow Basin	UT	Snow ranger	3	0	1	0	1	0	0	0
64-9	4/4/64	Mt. Washington	NH	Climber	2	0	2	0	2	0	0	0
64-10	1/24/64	Alta	UT	Others at work	1	1	0	0	0	1	0	3
64-11	3/7/64	Pocatello	ID	Snow player	2	0	2	0	2	0	0	0
65-1	1/2/65	Sugar Bowl	CA	Snowshoer	2	0	1	0	1	0	0	0
65-2	1/29/65	Farmington Canyon	UT	Others at work	1	0	1	0	0	0	0	0
65-3	1/29/65	Snowbank Mountain	ID	Others at work	1	0	1	0	1	1	0	0
65-4	1/30/65	Georgetown Canyon	ID		0	0	0	0	0	0	0	1
65-5	1/31/65	Homestake Lake	CO	Others at work	1	0	1	0	1	0	0	0
65-6	4/4/65	Mt. Baldy	CA	Lift skier out-of-bounds	9	2	1	1	0	0	0	0
65-7	12/20/65	Geneva Basin	CO	Lift skier in-bounds	2	0	2	0	1	0	0	0
65-8	12/31/65	Park City	UT	Lift skier in-bounds	3	1	2	0	1	0	0	0
66-1	2/5/66	Mt. Baker	WA	Ski tourer or taveler	5	3	1	0	1	0	0	0
66-2	3/11/66	Snoqualmie Pass	WA	Motorist or traveler	3	2	1	0	0	2	1	0
67-1	1/5/67	Jackson Hole	WY	Ski patroller	1	0	1	1	0	0	0	0
67-2	1/6/67	Smiths Fork Road	WY	Others at work	1	0	1	1	0	1	0	0
67-3	1/7/67	Loveland Pass	CO	Climber	7	1	3	1	2	0	0	0
67-4	1/15/67	Silverfork Canyon	UT	Ski tourer	11	5	3	2	0	0	0	0
67-5	1/21/67	Alta	AT	Lift skier in-bounds	3	3	0	1	0	0	0	0
67-6	2/11/67	Twin Lakes Pass	UT	Ski tourer	2	0	1	0	0	0	0	0
67-7	2/12/67	Parley's Canyon	UT	Climber	2	1	1	0	2	0	0	0
67-8	2/18/67	Skyline	ID	Ski patroller	16	14	2	0	2	0	0	0
67-9	4/21/67	Alta	UT	Lift skier in-bounds	7	3	1	1	0	0	0	0
67-10	11/26/67	Arapahoe Basin	CO	Ski patroller	1	0	1	0	1	0	0	0
68-1	1/27/68	Alpental	WA	Ski patroller	1	1	0	0	0	0	0	0
68-2	2/3/68	Stevens Pass	WA	Snow ranger	2	1	0	0	0	0	0	0
68-3	2/8/68	Alpental	WA	Ski patroller	1	0	1	0	0	0	0	0
68-4	2/15/68	Aspen Highlands	CO	Ski patroller	1	0	1	0	0	0	0	0
68-5	2/19/68	Rock Canyon	UT	Hiker	2	1	1	0	1	0	0	0
68-6	2/22/68	Bridger Bowl	MT	Others at work	1	1	0	0	0	0	0	1
68-7	2/24/68	Leadville	CO	Snowmobiler	1	0	1	0	1	0	0	0
68-8	3/16/68	Mission Ridge	WA	Lift skier out-of-bounds	2	1	1	0	0	0	0	0
68-9	3/17/68	Mammoth Mountain	CA	Lift skier in-bounds	6	2	2	0	1	0	0	0
68-10	3/30/68	Stevens Pass	WA	Lift skier in-bounds	1	1	0	0	0	0	0	0
68-11	12/8/68	Mt. Hood Meadows	OR	Lift skier in-bounds	1	1	0	0	0	0	0	0
68-12	12/27/68	Slide Mountain	NV	Ski tourer	1	0	1	0	1	0	0	0
69-1	1/8/69	Bighorn Mountains	WY	Snowmobiler	2	0	1	0	0	0	0	0
69-2	1/26/69	Ketchum	ID		0	0	0	0	0	0	0	1
69-3	1/26/69	Niwot Ridge	CO	Climber	1	1	0	0	0	0	0	0
69-4	1/26/69	Crystal Mountain	WA	Ski patroller	1	1	0	0	0	0	0	0
69-5	1/27/69	Loveland Basin	CO	Lift skier in-bounds	1	0	1	0	0	0	0	0
69-6	1/29/69	Redcliff	CO		0	0	0	0	0	0	0	3
69-7	1/30/69	Omak	WA	Snow player	2	0	1	0	0	0	0	0

No.	Date	Location	State	Activity	People					Vehicles		Structures Damaged
					Caught	Partly Buried	Totally Buried	Injured	Killed	Caught	Damaged	
69-8	2/3/69	Pinehurst	ID	Resident	1	0	1	1	0	0	0	1
69-9	2/14/69	Mt. Rainier National Park	WA	Snow ranger	3	3	0	0	0	0	0	0
69-10	2/21/69	Alyeska	AK	Ski patroller	5	0	0	2	0	0	0	0
69-11	2/24/69	Mineral King	CA	Resident	2	0	0	0	1	0	0	2
69-12	2/25/69	Kyle Canyon	NV	Resident	3	0	2	0	2	0	0	2
69-13	3/1/69	Bear Valley	CA	Lift skier in-bounds	1	0	1	0	0	0	0	0
69-14	3/5/69	Alpentel	WA	Ski patroller	2	2	0	1	0	0	0	0
69-15	3/9/69	Mt. Rainier National Park	WA	Ski tourer	1	0	1	0	1	0	0	0
69-16	3/16/69	Blackfoot River	MT	Motorist	4	0	0	0	1	2	2	0
69-17	4/12/69	Alyeska	AK		0	0	0	0	0	0	0	1
69-18	4/15/69	Alta	UT	Lift skier out-of-bounds	1	0	0	1	0	0	0	0
69-19	12/13/69	Crystal Mountain	WA	Ski patroller	1	1	0	1	0	0	0	0
69-20	12/14/69	Alta	UT	Ski tourer	4	0	0	0	0	0	0	0
69-21	12/25/69	Breckenridge	CO	Others at work	4	2	1	2	0	0	0	0
69-22	12/29/69	Glacier National Park	MT	Climber	5	0	5	0	5	0	0	0
70-1	1/24/70	Alpentel	WA	Lift skier in-bounds	1	1	0	0	0	0	0	0
70-2	1/29/70	Alta	UT	Lift skier in-bounds	4	2	1	0	1	0	0	0
70-3	2/16/70	Schweitzer Basin	ID	Ski patroller	3	1	1	0	0	0	0	0
70-4	3/2/70	Red Mountain Pass	CO	Highway worker	1	0	1	0	1	1	1	0
70-5	3/30/70	Jackson Hole	WY	Ski tourer	1	1	0	1	0	0	0	0
70-6	5/17/70	Cottonwood Canyon	UT	Hiker	3	0	0	0	0	0	0	0
70-7	12/28/70	Mt. Baker	WA	Lift skier in-bounds	1	0	1	0	1	0	0	0
70-8	12/28/70	Alum Creek	NV	Snowmobiler	1	0	1	0	1	0	0	0
70-9	12/30/70	Crystal Mountain	WA	Lift skier in-bounds	2	0	2	0	0	0	0	0
71-1	1/10/71	Breckenridge	CO	Lift skier out-of-bounds	2	1	0	0	0	0	0	0
71-2	1/10/71	Juneau	AK	Climber	1	0	1	0	1	0	0	0
71-3	1/13/71	Logan Canyon	UT		0	0	0	0	0	1	0	6
71-4	1/15/71	Snoqualmie Pass	WA	Motorist	2	1	1	0	1	2	0	0
71-5	1/16/71	Crystal Mountain	WA	Ski patroller	3	0	1	1	0	0	0	0
71-6	1/17/71	Ketchum	ID	Misc. recreation	2	1	0	1	0	0	0	0
71-7	1/20/71	Willow Creek	ID	Snowmobiler	1	0	1	0	1	0	0	0
71-8	1/24/71	Stevens Pass	WA	Resident	16	0	13	4	4	0	0	7
71-9	1/24/71	Stevens Pass	WA	Highway worker	1	0	1	1	0	1	0	0
71-10	1/25/71	Stevens Pass	WA	Highway worker	1	0	1	1	0	2	0	0
71-11	1/27/71	Snoqualmie Pass	WA		0	0	0	0	0	0	0	1
71-12	1/27/71	Crystal Mountain	WA	Lift skier in-bounds	1	1	0	1	0	0	0	0
71-13	2/27/71	Snowmass	CO	Ski patroller	1	1	0	0	0	0	0	0
71-14	3/5/71	Jackson Hole	WY	Lift skier out-of-bounds	1	0	1	0	0	0	0	0
71-15	3/6/71	Aspen Mountain	CO	Lift skier out-of-bounds	1	0	1	0	0	0	0	0
71-16	3/13/71	Sun Valley	ID	Snow ranger	1	1	0	1	0	0	0	0
71-17	3/16/71	Aspen Mountain	CO	Guide	1	0	1	0	1	0	0	0
71-18	4/12/71	Eklutna Glacier	AK	Climber	3	1	2	0	2	0	0	0
71-19	10/17/71	Pole Creek Mountain	CO	Hunter	2	0	2	0	1	0	0	0
71-20	11/28/71	Vail	CO	Lift skier in-bounds	2	1	1	0	0	0	0	0
71-21	12/13/71	Jackson Hole	WY	Lift skier in-bounds	3	0	0	0	0	0	0	0
71-22	12/27/71	Snowbird	UT	Lift skier in-bounds	1	0	1	0	0	0	0	0
71-23	12/31/71	Snowbird	UT	Lift skier in-bounds	2	0	2	1	0	0	0	0
72-1	1/5/72	Hyder	AK	Motorist	3	0	0	4	0	1	1	0
72-2	1/9/72	Kelly Canyon	ID	Lift skier in-bounds	8	7	1	0	0	0	0	0
72-3	1/11/72	Alpentel	WA		0	0	0	0	0	0	0	2

No.	Date	Location	State	Activity	People					Vehicles		Structures Damaged
					Caught	Partly Buried	Totally Buried	Injured	Killed	Caught	Damaged	
72-4	1/11/72	Stevens Pass	WA		0	0	0	0	0	0	0	4
72-5	1/25/72	Snowbird	UT	Ski patroller	2	2	0	0	0	0	0	0
72-6	1/29/72	Mt. Rose	NV	Lift skier out-of-bounds	7	2	4	0	2	0	0	0
72-7	2/27/72	Alta	UT	Ski tourer	2	2	0	0	0	0	0	0
72-8	3/1/72	Mission Ridge	WA	Snow ranger	2	2	0	0	0	0	0	0
72-9	3/4/72	Mt. Baker	WA	Others at work	3	3	0	0	0	0	0	1
72-10	3/4/72	Snoqualmie Pass	WA	Motorist or traveler	3	0	3	0	0	1	1	0
72-11	4/22/72	Mt. Baker	WA	Ski tourer	2	1	1	0	0	0	0	0
72-12	5/7/72	Girdwood	AK	Hunter	2	0	0	1	0	0	0	0
72-13	5/10/72	Mt. Garfield	WA	Climber	2	2	0	0	2	0	0	0
72-14	5/14/72	St. Marys Glacier	CO	Climber	10	6	1	0	0	0	0	0
72-15	8/20/72	Mitchell Lake	CO	Hiker	1	0	0	0	1	0	0	0
72-16	9/26/72	Yosemite National Park	CA	Hiker	1	1	0	0	1	0	0	0
72-17	12/8/72	Aspen Mountain	CO	Lift skier out-of-bounds	1	0	1	0	1	0	0	0
72-18	12/13/72	Steamboat	CO	Lift skier in-bounds	5	3	2	0	1	0	0	0
72-19	12/25/72	Crystal Mountain	WA	Ski patroller	1	0	0	0	0	0	0	0
73-1	1/22/73	Sun Valley	ID	Helicopter skier	5	3	1	0	1	0	0	0
73-2	3/24/73	Taos Ski Area	NM	Lift skier out-of-bounds	2	1	1	0	1	0	0	0
73-3	4/14/73	Alyeska	AK		0	0	0	0	0	0	0	1
73-4	4/14/73	Whittier	AK		0	0	0	0	0	0	0	1
73-5	5/10/73	Vail Pass	CO	Motorist	2	0	0	0	0	2	1	0
73-6	10/13/73	Rocky Mountain National Park	CO	Climber	2	1	0	0	2	0	0	0
73-7	11/19/73	Mt. Shasta	CA	Climber	5	2	3	0	1	0	0	0
73-8	11/24/73	White Pass	WA	Ski patroller	2	1	0	1	0	0	0	0
73-9	11/25/73	Mt. Baker	WA	Ski patroller	1	0	1	0	0	0	0	0
73-10	12/05/73	Mt. Hood Meadows	OR	Ski patroller	1	1	0	0	0	0	0	0
73-11	12/19/73	Breckenridge	CO	Lift skier out-of-bounds	2	2	0	0	0	0	0	0
73-12	12/27/73	White Pass	WA	Snow ranger	1	0	1	0	0	0	0	0
73-13	12/28/73	Berthoud Pass	CO	Motorist	1	1	0	1	0	1	1	0
73-14	12/29/73	Eisenhower Tunnel	CO	Motorist	16	14	0	2	0	7	3	0
73-15	12/29/73	Park City West	UT	Lift skier in-bounds	2	1	1	0	1	0	0	0
73-16	12/30/73	Alta	UT	Resident	2	2	0	1	0	5	5	6
73-17	12/30/73	Flattop Mountain	AK	Climber	10	8	2	1	1	0	0	0
74-1	1/1/74	Tanaina Peak	AK	Climber	2	1	1	0	1	0	0	0
74-2	1/15/74	Schweitzer Basin	ID		0	0	0	0	0	0	0	1
74-3	1/16/74	Grand Teton National Park	WY	Ski tourer	7	1	5	0	3	0	0	0
74-4	1/27/74	Source Lake	WA	Snowshoer	2	0	2	0	2	0	0	0
74-5	2/7/74	Juneau	AK	Highway worker	1	0	1	0	1	0	0	0
74-6	2/15/74	Skagway	AK		0	0	0	0	0	8	0	0
74-7	3/2/74	Heavenly Valley	CA	Lift skier in-bounds	3	1	1	1	1	0	0	0
74-8	11/7/74	Rocky Mountain National Park	CO	Climber	1	0	1	0	0	0	0	0
74-9	11/11/74	Berthoud Pass	CO	Ski tourer	1	1	0	0	0	0	0	0
74-10	11/18/74	Mt. Rainier	WA	Climber	1	0	1	0	1	0	0	0
74-11	11/23/74	Arapahoe Basin	CO	Ski patroller	1	0	1	0	1	0	0	0
74-12	12/15/74	Monarch Pass	CO	Ski tourer	1	0	1	0	1	0	0	0
74-13	12/21/74	Guanella Pass	CO	Ski tourer	1	0	1	0	1	0	0	0
74-14	12/27/74	Lookout Pass	ID	Lift skier out-of-bounds	1	0	1	0	0	0	0	0
74-15	12/28/74	Aspen Mountain	CO	Lift skier out-of-bounds	1	0	1	0	1	0	0	0
74-16	12/31/74	Juneau	AK	Others at work	1	0	0	0	0	2	0	0
75-1	1/9/75	Crested Butte	CO	Lift skier in-bounds	1	0	1	0	1	0	0	0

No.	Date	Location	State	Activity	People					Vehicles		Structures Damaged
					Caught	Partly Buried	Totally Buried	Injured	Killed	Caught	Damaged	
75-2	1/9/75	Multorpor	OR	Lift skier in-bounds	1	0	1	0	0	0	0	0
75-3	1/14/75	Garfield	CO	Ski tourer	2	0	2	0	2	0	0	0
75-4	1/15/75	Castle Creek	CO	Ski tourer	1	0	1	0	1	0	0	0
75-5	1/16/75	Chugach State Park	AK	Climber	1	0	1	0	1	0	0	0
75-6	1/17/75	Ingalls Creek	WA	Snowshoer	1	0	0	1	0	0	0	0
75-7	1/19/75	Owen Creek	WY	Ski tourer	1	0	1	0	1	0	0	0
75-8	2/5/75	Sun Valley	ID	Lift skier out-of-bounds	4	0	1	0	1	0	0	0
75-9	2/6/75	Pats Peak	NH	Ski patroller	2	1	0	2	0	0	0	0
75-10	2/8/75	Centennial	WY	Snow player	14	2	3	0	1	0	0	0
75-11	2/13/75	Alpine Meadows	CA	Lift skier in-bounds	2	1	1	0	0	0	0	0
75-12	3/21/75	McGinnis Glacier	AK	Climber	2	1	1	0	1	0	0	0
75-13	3/23/75	Hecla	MT	Snowmobiler	1	0	1	0	1	0	0	0
75-14	4/25/75	Red Mountain Pass	CO	Highway worker	1	0	1	1	0	1	1	0
75-15	4/26/75	Mt. Hood	OR	Climber	4	0	4	0	1	0	0	0
75-16	4/26/75	Mt. St. Helens	WA	Climber	24	2	18	2	5	0	0	0
75-17	5/10/75	Portage	AK	Hunter	4	0	1	1	1	0	0	0
75-18	11/15/75	Juneau	AK	Ski tourer	1	0	1	0	1	0	0	0
75-19	11/26/75	Loveland Pass	CO	Hiker	1	0	1	0	0	0	0	0
75-20	11/26/75	Copper Mountain	CO	Ski patroller	1	0	1	0	0	0	0	0
75-21	11/27/75	Rocky Mountain National Park	CO	Climber	2	2	0	0	0	0	0	0
75-22	11/30/75	Mission Ridge	WA	Lift skier in-bounds	1	0	1	0	0	0	0	0
75-23	11/30/75	Mt. Rainier National Park	WA	Snowshoer	4	2	2	0	1	0	0	0
75-24	12/30/75	Schweitzer Basin	ID	Lift skier out-of-bounds	1	0	1	0	0	0	0	0
76-1	1/6/75	Alta	UT	Lift skier out-of-bounds	1	0	1	0	1	0	0	0
76-2	1/10/76	Pocatello	ID	Climber	2	0	2	0	2	0	0	0
76-3	1/10/76	Jackson Hole	WY	Ski patroller	11	10	1	0	0	0	0	0
76-4	1/11/76	Chittenden Mountain	CO	Ski tourer	2	1	0	1	0	0	0	0
76-5	1/12/76	Jackson Peak	WY	Ski tourer	2	0	2	0	2	0	0	0
76-6	1/17/76	Berthoud Pass	CO	Ski tourer	11	9	2	0	1	0	0	0
76-7	2/9/76	Red Mountain Pass	CO	Motorist	32	0	0	0	0	10	1	0
76-8	2/11/76	Loveland Pass	CO	Misc. recreation	1	1	0	0	0	0	0	0
76-9	2/14/76	Mt. Baker	WA		0	0	0	0	0	0	0	1
76-10	2/19/76	Mt. Marathon	AK	Climber	1	0	1	0	1	0	0	0
76-11	2/21/76	Bridgeport	CA	Climber	1	0	1	0	1	0	0	0
76-12	3/1/76	Hailey	ID	Snowmobiler	1	0	1	0	0	0	0	0
76-13	3/2/76	Alpine Meadows	CA	Lift skier in-bounds	5	2	3	0	3	0	0	0
76-14	3/16/76	Ketchikan	AK	Others at work	1	0	1	0	0	0	0	0
76-15	3/20/76	Grand Targhee	WY	Ski tourer	1	0	1	0	1	0	0	0
76-16	3/27/76	Silver Peak	WA	Snowshoer	1	0	1	0	1	0	0	0
76-17	3/29/76	Mt. Nast	CO	Others at work	1	0	1	0	1	0	0	0
76-18	4/9/76	Juneau	AK	Hiker	4	4	0	4	0	0	0	0
76-19	5/15/76	Big Four Mountain	WA	Climber	1	1	0	0	1	0	0	0
76-20	7/4/76	Rocky Mountain National Park	CO	Climber	1	1	0	0	1	0	0	0
76-21	8/6/76	Mt. Foraker	AK	Climber	4	0	3	0	3	0	0	0
76-22	11/14/76	Rocky Mountain National Park	CO	Climber	2	0	0	2	0	0	0	0
76-23	12/12/76	Sheep Mountain	AK	Snowshoer	1	0	1	0	1	0	0	0
77-1	1/15/77	Bridger Bowl	MT	Lift skier in-bounds	1	0	1	0	0	0	0	0
77-2	1/16/77	Big Sky	MT	Ski patroller	2	2	0	0	0	0	0	0
77-3	1/20/77	Mt. Baldy	CA	Snow player	7	3	2	1	1	0	0	0
77-4	2/6/77	Valdez	AK	Others at work	1	0	1	0	1	0	0	0

No.	Date	Location	State	Activity	People					Vehicles		Structures Damaged
					Caught	Partly Buried	Totally Buried	Injured	Killed	Caught	Damaged	
77-5	3/3/77	Snowbird	UT	Lift skier in-bounds	2	0	1	1	1	0	0	0
77-6	3/26/77	Sheep Creek	WY	Ski tourer	2	1	1	0	1	0	0	0
77-7	5/22/77	South Arapahoe Peak	CO	Climber	3	0	0	1	1	0	0	0
77-8	7/3/77	Rocky Mountain National Park	CO	Climber	2	1	0	2	0	0	0	0
77-9	11/02/77	El Diente Peak	CO	Climber	1	0	0	0	1	0	0	0
77-10	12/02/77	Big Cottonwood Canyon	UT	Ski tourer	3	0	2	1	0	0	0	0
77-11	12/31/77	Mt. Rainier National Park	WA	Climber	1	0	1	0	1	0	0	0
78-1	1/06/78	Sheep Mountain	CO	Ski tourer	2	0	2	0	2	0	0	0
78-2	1/21/78	Turnagain Pass	AK	Ski tourer	5	1	4	0	4	0	0	0
78-3	2/8/78	Alta	UT	Snow player	2	0	2	0	0	0	0	0
78-4	2/09/78	Lost Canyon	CA	Highway worker	1	0	1	0	1	1	0	0
78-5	2/10/78	Twin Lakes	CA	Motorist, snowshoer	3	0	0	0	3	0	0	0
78-6	2/10/78	Red Mountain Pass	CO	Highway worker	1	0	1	0	1	1	1	0
78-7	2/14/78	Bridger Bowl	MT	Ski patroller	1	0	0	1	0	0	0	0
78-8	4/16/78	Mt. Sopris	CO	Snowmobiler	1	0	1	0	1	0	0	0
78-9	4/23/78	Mt. Rainier National Park	WA	Ski tourer	7	4	2	0	0	0	0	0
78-10	5/8/78	South Halfmoon Creek	CO	Ski tourer	10	1	0	0	0	0	0	0
78-11	5/30/78	Mt. Foraker	AK	Climber	3	0	0	0	2	0	0	0
78-12	5/30/78	Mt. McKinley	AK	Climber	2	1	1	2	0	0	0	0
78-13	5/30/78	Mt. Rainier	WA	Climber	7	0	0	1	0	0	0	0
78-14	5/31/78	Mt. Rainier	WA	Climber	3	0	1	0	1	0	0	0
78-15	8/27/78	Mt. Baker	WA	Climber	3	0	1	2	1	0	0	0
78-16	11/25/78	Rocky Mountain National Park	CO	Climber	2	0	1	1	0	0	0	0
79-1	1/6/79	Guanella Pass	CO	Ski tourer	3	0	1	0	1	0	0	0
79-2	1/19/79	Helper	UT	Miner	7	0	1	0	1	0	2	0
79-3	1/20/79	Stevens Pass	WA	Snowshoer	3	1	1	0	1	0	0	0
79-4	2/7/79	Snake River	WY	Motorist	9	0	3	1	0	7	0	0
79-5	2/10/79	Silverhorn	ID	Lift skier out-of-bounds	1	0	1	1	0	0	0	0
79-6	2/10/79	Loveland Basin	CO	Lift skier out-of-bounds	1	0	1	0	1	0	0	0
79-7	2/11/79	West Yellowstone	MT	Others at work	1	0	1	0	0	0	0	0
79-8	2/13/79	Glacier National Park	MT		0	0	0	0	0	0	0	1
79-9	3/3/79	Sun Top Mountain	WA	Snowshoer	7	0	1	2	0	0	0	0
79-10	3/4/79	Mt. Rainier National Park	WA	Climber	4	1	3	1	2	0	0	0
79-11	3/11/79	Chugach State Park	AK	Snowshoer	2	0	2	0	0	0	0	0
79-12	3/14/79	Winner Creek	AK	Guide	1	0	1	0	0	0	0	0
79-13	3/30/79	Mt. Baldy	CA	Lift skier in-bounds	2	1	1	0	0	0	0	0
79-14	4/2/79	Desolation Lake	UT	Ski tourer	3	1	2	0	1	0	0	0
79-15	4/26/79	Grand Teton National Park	WY	Climber	2	0	0	0	2	0	0	0
79-16	5/9/79	Mt. Hunter	AK	Climber	2	0	1	1	1	0	0	0
79-17	11/04/79	Mammoth Mountain	CA	Ski tourer	2	1	1	0	1	0	0	0
79-18	11/22/79	Telluride	CO	Ski tourer	1	0	1	0	1	0	0	0
79-19	12/24/79	Taos	NM	Ski tourer	1	0	1	0	1	0	0	0
80-1	1/7/80	Copper Mountain Resort	CO	Ski patroller	1	0	1	1	0	0	0	0
80-2	1/11/80	Brighton	UT	Ski tourer	1	0	1	0	1	0	0	0
80-3	1/12/80	Squaw Valley	CA		0	0	0	0	0	0	0	1
80-4	1/12/80	Near Ketchum	ID	Others at work	0	1	0	0	0	3	0	2
80-5	1/13/80	Cameron Pass	CO	Ski tourer	1	0	1	0	0	0	0	0
80-6	1/13/80	Tucker Mountain	CO	Ski tourer	3	0	3	0	0	0	0	0
80-7	1/18/80	Big Mountain	MT	Lift skier out-of-bounds	1	0	1	0	1	0	0	0
80-8	1/19/80	Red Mountain	WA	Snowshoer	2	2	0	2	0	0	0	0

No.	Date	Location	State	Activity	People					Vehicles		Structures Damaged
					Caught	Partly Buried	Totally Buried	Injured	Killed	Caught	Damaged	
80-9	1/19-22/80	Seward Highway	AK	Motorist, railroader	3	0	0	0	0	15	15	0
80-10	1/20/80	Telluride Ski Resort	CO	Ski patroller	1	0	1	0	0	0	0	0
80-11	2/2/80	Mission Ridge	WA	Ski patroller	1	0	1	0	0	0	0	0
80-12	2/18/80	Red Mountain Pass	CO	Motorist	2	2	0	0	0	1	1	0
80-13	2/19/80	Sleeping Bear Dunes Nat. Lake.	MI	Snow player	4	0	1	0	0	0	0	0
80-14	3/15/80	Crystal Mountain Resort	WA	Lift skier in-bounds	2	2	0	0	0	0	0	0
80-15	11/15/80	Taos Ski Valley	NM	Ski tourer	1	0	1	0	1	0	0	0
80-16	11/27/80	St. Mary's Clacier	CO	Ski tourer	3	1	2	0	2	0	0	0
81-1	1/5/81	Hatcher Pass	AK	Snowmobiler	1	0	1	0	0	0	0	0
81-2	1/31/81	Ketchum	ID	Ski tourer	1	1	0	0	0	0	0	0
81-3	2/1/81	Big Cottonwood Canyon	UT	Ski tourer	1	0	1	0	1	0	0	0
81-4	2/2/81	Geneva Peak	CO	Helicopter skier	1	0	0	0	0	0	0	0
81-5	2/3/81	Berthoud Pass	CO	Ski tourer	1	0	1	0	0	0	0	0
81-6	2/9/81	Logan Canyon	UT	Ski tourer	3	1	1	0	0	0	0	0
81-7	2/15/81	Ski Schweitzer	ID	Lift skier in-bounds	1	0	1	0	1	0	0	0
81-8	2/15/81	Lamoille	NV	Snowmobiler	1	0	1	0	1	0	0	0
81-9	2/22/81	Eas Fork Mineral Cr. Big Cottonwood Canyon	UT	Snowcat skier	3	3	0	3	0	0	0	0
81-10	3/1/81	Mt. Baldy	CA	Lift skier out-of-bounds	2	0	2	0	1	0	0	0
81-11	3/1/81	Mill Creek Canyon	UT	Ski tourer	1	0	1	0	1	0	0	0
81-12	3/3/81	Wolf Creek Pass	CO	Ski tourer	1	0	1	0	1	0	0	0
81-13	3/8/81	Day's Fork, Big Cottonwood Canyon	UT	Ski tourer	3	1	0	0	0	0	0	0
81-14	3/15/81	Pyramid Peak	CO	Ski tourer	1	0	0	1	0	0	0	0
81-15	3/15/81	Telluride	CO	Ski tourer	4	0	0	0	0	0	0	0
81-16	3/17/81	Timberline Ski Area	OR	Lift skier out-of-bounds	3	1	1	1	0	0	0	0
81-17	3/31/81	Snowmass Ski Area	CO	Ski patroller	2	0	2	1	1	0	0	0
81-18	4/8/81	Arapahoe Basin Ski Area	CO	Ski patroller	3	1	0	1	0	0	0	0
81-19	4/12/81	Red Lodge	MT	Snowmobiler	1	0	1	0	1	0	0	0
81-20	4/12/81	Source Lake	WA	Ski tourer	0	6	4	2	0	1	0	0
81-21	6/10/81	Mt. St. Elias	AK	Climber	2	1	1	1	0	0	0	0
81-22	6/21/81	Mt. Rainier	WA	Climber	22	0	11	0	11	0	0	0
81-23	12/03/81	Richardson Highway	AK	Motorist	8	0	8	0	0	0	0	0
81-24	12/20/81	Turquoise Lake	CO	Hiker	2	1	1	0	1	0	0	0
81-25	12/27/81	Aspen Highlands	CO	Ski patroller	1	0	1	0	0	0	0	0
81-26	12/29/81	Sugar Bowl Ski Area	CA	Lift skier out-of-bounds	1	0	1	0	0	0	0	0
82-1	1/04/82	Squaw Valley	CA	Ski patroller	2	0	2	0	0	0	0	0
82-2	1/5/82	Telluride	CO	Ski patroller	1	0	1	0	0	0	0	0
82-3	1/5/82	D. L. Bliss State Park	CA	Misc. recreation	2	0	1	0	1	0	0	0
82-4	1/6/82	Arapahoe Basin Ski Area	CO	Lift skier out-of-bounds	1	1	0	0	1	0	0	0
82-5	1/10/82	Sleeping Bear Dunes Nat. Lake.	MI	Ski tourer	3	2	1	0	0	0	0	0
82-6	1/23/82	Cumbres Pass	CO	Ski tourer	1	0	1	0	1	0	0	0
82-7	1/25/82	Mt. Washington	NH	Rescuer	2	0	2	0	1	0	0	0
82-8	2/14/82	Aneroid Lake	OR	Ski tourer	2	0	1	0	1	0	0	0
82-9	2/19/82	Aspen Highlands	CO	Lift skier out-of-bounds	1	1	0	1	0	0	0	0
82-10	3/13/82	Arapahoe Basin Ski Area	CO	Lift skier out-of-bounds	1	0	1	0	1	0	0	0
82-11	3/18/82	Mt. Alyeska Ski Resort	AK	Snow ranger	1	0	0	0	0	0	0	0
82-12	3/22/82	Sun Valley	ID	Helicopter skier	1	1	0	1	0	0	0	0
82-13	3/22/82	Park West Ski Resort	UT	Lift skier out-of-bounds	2	0	1	0	1	0	0	0
82-14	3/31/82	Alpine Meadows Ski Area	CA	Others at work	12	0	0	0	7	0	0	0

No.	Date	Location	State	Activity	People					Vehicles		Structures Damaged
					Caught	Partly Buried	Totally Buried	Injured	Killed	Caught	Damaged	
82-15	4/3/82	Denali National Park	AK	Ski tourer	2	1	1	0	1	0	0	0
82-16	6/20/82	Mt. Hood	OR	Climber	5	3	0	2	1	0	0	0
82-17	11/13/82	Twin Lakes	CO	Hunter	1	0	1	1	0	0	0	0
82-18	11/14/82	Montpelier	ID	Hunter	1	0	1	0	1	0	0	0
82-19	12/7-8/82	Big Sky	MT	Lift skier in-bounds, ski patroller	6	0	2	1	0	0	0	0
82-20	12/19/82	Philipsburg	MT	Snowmobiler	1	0	1	0	1	0	0	0
82-21	12/24/82	Big Sky	MT	Ski patroller	1	0	1	0	1	0	0	0
82-22	12/25/82	Montezuma	CO	Ski tourer	1	0	1	0	1	0	0	0
83-1	1/1/83	Stanley	ID	Snowmobiler	1	0	1	0	1	0	0	0
83-2	1/02/83	Hatcher Pass	AK	Ski tourer	2	1	1	0	0	0	0	0
83-3	1/30/83	Wolf Creek	CO	Ski tourer	1	0	1	0	1	0	0	0
83-4	2/02/83	Ski Sunlight	CO	Ski patroller	1	1	0	1	0	0	0	0
83-5	2/19/83	Point Six Mountain, Missoula	MT	Ski tourer	2	1	1	2	0	0	0	0
83-6	2/19/83	Hyalite Canyon, Bozeman	MT	Ski tourer	2	0	1	0	1	0	0	0
83-7	3/03/83	Eldora	CO	Ski tourer	1	0	1	0	0	0	0	0
83-8	3/05/83	Madison Range	MT	Ski tourer	2	0	1	1	0	0	0	0
83-9	3/06/83	Big Cottonwood Canyon	UT	Climber	1	0	1	1	0	0	0	0
83-10	3/06/83	Deer Creek, Silverton	CO	Ski tourer	1	0	1	0	1	0	0	0
83-11	3/09/83	Crested Butte	CO	Lift skier out-of-bounds, ski patroller	7	0	1	3	1	0	0	0
83-12	3/12/83	Porphyry Peaks, Grand Lake	CO	Snowmobiler	1	0	1	0	1	0	0	0
83-13	4/02/83	Mt. Shasta	CA	Climber	2	1	1	0	1	0	0	0
83-14	4/16/83	Granite Mountain	WA	Hiker	5	2	1	2	1	0	0	0
83-15	6/26/83	Mt. Shuksan	WA	Climber	2	0	0	0	2	0	0	0
83-16	11/24/83	Big Cottonwood Canyon	UT	Ski tourer	2	0	0	0	0	0	0	0
83-17	12/10/83	Crystal Mountain	WA	Ski patroller	1	0	0	1	0	0	0	0
83-18	12/18/83	Copper Mountain	CO	Ski patroller	1	0	1	0	1	0	0	0
83-19	12/23/83	Alpine Meadows	CA	Lift skier in-bounds	1	0	1	0	0	0	0	0
83-20	12/27/83	Wolf Creek Pass	CO	Motorist	3	3	0	3	0	1	0	0
84-1	1/02/84	Alta	UT	Ski tourer	2	1	0	1	1	0	0	0
84-2	2/08/84	Mt. Katahdin	ME	Climber	5	0	4	2	2	0	0	0
84-3	2/16/84	Snow King Mountain	WY	Lift skier out-of-bounds	1	0	0	0	1	0	0	0
84-4	2/18/84	Ophir	CO	Helicopter skier	4	1	1	1	0	0	0	0
84-5	2/21/84	Berthoud Pass	CO	Ski tourer	2	1	0	0	0	0	0	0
84-6	2/21/84	Marble	CO	Helicopter skier	3	2	0	2	0	0	0	0
84-7	3/15/84	Silverton	CO		0	0	0	0	0	0	0	1
84-8	3/17/84	Vail Pass	CO	Ski tourer	1	0	1	0	1	0	0	0
84-9	3/19/84	Dallas Divide	CO	Ski tourer	2	0	1	0	1	0	0	0
84-10	3/31/84	Aspen Highlands	CO	Ski patroller	3	0	3	0	3	0	0	0
84-11	4/14/84	Chair Mountain	CO	Climber	1	0	0	0	1	0	0	0
84-12	5/18/84	Granite Mountain	WA	Climber	1	0	0	1	0	0	0	0
84-13	5/27/84	Source Lake	WA	Climber	1	0	0	0	1	0	0	0
84-14	11/08/84	Big Cottonwood Canyon	UT	Ski tourer	1	0	1	0	0	0	0	0
84-15	10/17/84	Mt. Kelso	CO	Ski tourer	1	0	1	0	1	0	0	0
84-16	12/12/84	Park City	UT	Ski tourer	1	1	0	0	0	0	0	0
84-17	12/11/84	Teton Pass	WY	Ski tourer	1	0	0	0	0	0	0	0
84-18	12/13/84	Aspen	CO	Ski tourer	1	1	0	0	1	0	0	0
84-19	12/31/84	Ashcroft	CO	Ski tourer	2	0	1	0	1	0	0	0
85-1	1/03/85	Bridger Bowl	MT	Ski patroller	1	0	0	1	0	0	0	0

No.	Date	Location	State	Activity	People					Vehicles		Structures Damaged
					Caught	Partly Buried	Totally Buried	Injured	Killed	Caught	Damaged	
85-2	2/03/85	Grand Teton National Park	WY	Climber	1	1	0	0	1	0	0	0
85-3	2/09/85	Snowy Range	WY	Snowmobiler	2	0	2	0	1	0	0	0
85-4	2/09/85	Lolo Pass Winter Rec. Area	ID	Ski tourer	1	0	1	0	1	0	0	0
85-5	2/09/85	Mt. Si	WA	Climber	2	0	0	1	1	0	0	0
85-6	2/12/85	Roberts	MT	Snow player	3	0	2	0	1	0	0	0
85-7	2/12/85	Crystal Mountain Resort	WA	Ski patroller	1	0	0	0	0	0	0	0
85-8	2/21/85	Alta	UT	Lift skier out-of-bounds	1	0	1	0	0	0	0	0
85-9	2/22/85	Powder Mountain	UT	Lift skier out-of-bounds	1	0	1	0	1	0	0	0
85-10	3/02/85	Hatcher Pass	AK	Snowmobiler	3	1	2	0	1	0	0	0
85-11	3/04/85	Mineral Fork	UT	Helicopter skier	3	0	1	1	0	0	0	0
85-12	3/10/85	Eagle River	AK	Ski tourer	1	0	0	0	1	0	0	0
85-13	3/15/85	Big Cottonwood Canyon	UT	Ski tourer	0	0	0	0	0	0	0	0
85-14	3/19/85	Park City	UT	Lift skier out-of-bounds	3	0	2	1	1	0	0	0
85-15	3/24/85	First Creek, Berthoud Pass	CO	Ski tourer	3	2	1	0	1	0	0	0
85-16	3/31/85	Sunlight Ski Area	CO									
85-17	5/12/85	Whitehorse Mountain	WA	Climber	6	3	3	0	1	0	0	0
85-18	9/22/85	Castle Peak	CO	Climber	2	0	0	2	0	0	0	0
85-19	11/13/85	Sunset Peak	UT	Ski tourer	5	0	2	0	2	0	0	0
85-20	11/17/85	La Plata Mountains	CO	Miner	2	0	2	0	1	0	0	0
85-21	11/21/85	French Gulch	CO	Ski tourer	2	0	2	0	2	0	0	0
85-22	11/25/85	Mt. Rainier National Park	WA	Climber	1	0	1	0		0	0	0
85-23	11/29/85	Sugar Bowl	CA	Lift skier in-bounds	2	0	2	0	1	0	0	0
85-24	12/02/85	Jackson Hole	WY	Ski patroller	6	5	1	0	1	0	0	0
86-1	1/03/86	Mt. Blackburn	MT	Ski tourer	3	1		0		0	0	0
86-2	1/06/86	Provo Canyon	UT	Ski tourer	1	0	1	0	1	0	0	0
86-3	1/16/86	Steam Mill Canyon	UT	Ski tourer	1	0	0	0	0	0	0	0
86-4	2/4/86	Hell Roaring Moutain	MT	Others at work	1	1	0	0	0	1	1	0
86-5	2/07/86	Mt. Ellis	MT	Ski tourer	2	0	2	0	2	0	0	0
86-6	2/13/86	Sundance	UT		0	0	0	0	0	0	0	2
86-7	2/15/86	Mt. Rainier National Park	WA	Ski tourer	1	1	0	0	0	0	0	0
86-8	2/15/86	Twin Lakes	CA	Resident	1	0	1	0	1	0	0	2
86-9	2/17/86	Brighton	UT	Snowboarder	2	0	1	1	1	0	0	0
86-10	2/17/86	Jackson Hole	WY	Ski patroller	1	0	1	0	1	0	0	0
86-11	2/13/86	Teton Pass	WY	Motorist	1	0	0	0	0	2	1	0
86-12	2/19/86	Alta	UT	Lift skier in-bounds	1	0	1	0	1	0	0	0
86-13	2/20/86	Logan Canyon	UT		0	0	0	0	0	0	0	0
86-14	2/20/86	Arapahoe Basin	CO		0	0	0	0	0	0	0	1
86-15	2/24/86	Jackson Hole	WY		0	0	0	0	0	0	0	3
86-16	2/26/86	Vail	CO	Lift skier out-of-bounds	1	0	1	0	1	0	0	0
86-17	8/03/86	Mt. Baker	WA	Climber	4	2	2	2	2	0	0	0
86-18	10/04/86	Quandary Peak	CO	Climber	1	1	0	1	0	0	0	0
86-19	11/20/86	Alta	UT	Hiker	1	0	1	0	1	0	0	0

Avalanche Accident Reporting Form

(Attach additional pages whenever needed)

A. General Information

- 1. Accident date: _____
- 2. Accident time: _____
- 3. Exact location: _____

4. No. of persons caught _____; partly buried ____; buried ____; injured ____; killed _____

5. Victim(s):

	Name	Age	Address/Phone
(1)			
(2)			
(3)			
(4)			
(5)			

	Condition/injuries	Experience level	Avalanche training
(1)			
(2)			
(3)			
(4)			
(5)			

6. Eyewitnesses or other members of the party:

Name	Age	Address/phone

4. Description of search procedures including location of clues, method used to locate victim(s), duration of search, etc.



5. Time and location of victim(s) when found:

6. Depth of victim(s); length of time buried; body position (head upslope or downslope, on back or stomach, parallel or sideways to fall-line, sitting or standing):

7. Cause of injury or death (include coroner's report if applicable):

8. Time rescue was concluded: _____

9. Other pertinent information:

D. Weather and snowpack data

1. Preceding weather synopsis including instrument reading when available; and weather at the time of the accident including cloud cover, precipitation, temperature, wind, etc.:

2. Snowpack structure including locations of weak layers, crusts, slabs, free water, etc.:

3. Was an avalanche warning (formal avalanche forecast), or other restrictions, or closures in effect?

E. Avalanche data

- 1. Avalanche classification (SS-AS-3-G, etc.): _____
- 2. Dimensions: width _____, slope length (crown to toe) _____, vertical fall _____
- 3. Crown face: depth _____, length _____
- 4. Depth of debris: _____
- 5. Other pertinent information:

F. Terrain data

- 1. Crown line elevation: _____, toe of debris elevation: _____
- 2. Starting zone slope angle in degrees: measured _____, or estimated _____
- 3. Vegetative cover (gladed, open, bushes, etc.): _____
- 4. Shape of avalanche path (gully, open slope, etc.): _____

G Conclusions and recommendations

- 1. Cause of accident; could anything have prevented it, etc.:

Signed _____

Print name _____

Address/telephone _____

Send to: Colorado Avalanche Information Center, 10230 Smith Rd., Denver, CO 80239; 303/371-1080

The following attachments should be included whenever possible:

1. A full narrative summary of the accident and rescue.
2. A vicinity map showing location of accident relative to the nearest town or landmark.
3. A detailed diagram with scale, legend, and north direction arrow and showing slide area, fracture line, deposition zone, landmarks, victim's (and others route, positions of all persons at time of accident, last seen point(s), location of clues, area probed, where victim(s) was found, and location of closure signs if applicable.
4. First-person statements of eyewitness or survivors.
5. Photos.
6. Newspaper stories.

Glossary

- Airblast** A strong rush of air produced in front of a large, fast-moving, powder avalanche. Potentially destructive. A powder cloud is not an airblast. Airblasts are generally rare.
- Artificial avalanche** An avalanche triggered by a cornice fall, an animal, man or his equipment.
- Aspect (or exposure)** The compass direction in which a slope faces. A north-facing slope has a north aspect.
- Avalanche** A mass of snow sliding, tumbling, or flowing down a mountainside. Synonymous with **snowslide**.
- Avalanche control** Artificial means of releasing an avalanche or testing the stability of the snowpack. Commonly used methods are protective skiing, test skiing, hand charges, and artillery fire.
- Avalanche cord** A brightly-colored cord (usually red) with one end tied to the person and some 50-feet of cord trails behind. If the person is buried in an avalanche, a portion of the cord might remain on the surface to be found by a rescuer, which he trails to the victim. While a cord is better than nothing, an avalanche transceiver is far more reliable for locating the victim.
- Avalanche cycle** A period of one to several days during which many avalanches fall as a result of a major storm or thaw.
- Avalanche hazard** A threat to life and property from avalanches.
- Avalanche path** The entire area down which an avalanche moves, made up of the starting zone, track, and runout zone. Also called **slide path**.
- Avalauncher** A commercially available, compressed-gas gun that launches an explosive projectile. Used for avalanche control.
- Bed surface** The main sliding surface of a slab avalanche. Often smoothed and hardened by the sliding snow. Can also be the ground. Also see **surface avalanche** and **ground avalanche**.
- Belay** To secure (a climber or skier) by a rope held firm either by a fixed object or by another person.
- Bergschrund** The crevasse that separates the moving ice at the head of a valley glacier from the rock above.
- Buried** A person is buried in an avalanche if he or she is completely beneath the snow when the avalanche stops. Persons with only a ski tip, hand, or foot protruding from the snow are considered to be buried. Persons in vehicles or buildings that are completely buried are considered to be buried. By definition, a person who is buried is also considered to be caught. Also see **caught** and **partly buried**.
- Caught** A person is considered caught in an avalanche if he or she is in any way involved in the moving snow. Also see **buried** and **partly buried**.
- Climax avalanche** Avalanche which involves layers of older snow (other than the last storm), sometimes sliding on the ground.
- Control route** A predetermined itinerary for the delivery of hand charges from safe locations above the avalanche paths.
- Cornice** An overhanging mass of snow formed from wind-drifted snow along the crest of a ridge. The steep slope below a cornice is often the starting zone for an avalanche.
- Cohesion** The condition where individual particles are united or bonded together to form a coherent unit.
- Concave** Curved like a segment of the interior of a circle or hollow sphere.
- Convex** Having a surface that is curved or rounded outward.
- Crown** The snow which remains on the slope above the crown surface after an avalanche.
- Crown face** The top fracture surface of the slab, usually smooth, clean cut, and angled 90 degrees to the bed surface.

Crust Generally thin layer of cohesive snow caused by light winds or warm weather.

Debris (avalanche debris) A mass of snow, soil, rock, trees, etc., brought down by an avalanche.

Delayed-action avalanche An avalanche that releases between storms without apparent cause. (See also **direct-action avalanche**.)

Delayed avalanche See **post-control release**.

Density (of new snow) Mass per unit volume of snow, expressed in kg/m³. The density of water is 1,000 kg/m³. Typical new snow densities range from 30 to 200 kg/m³. Also see **water equivalent**.

Depth hoar Large, coarse grains of snow formed by kinetic metamorphism (formerly called temperature gradient, or TG metamorphism) within the snowpack. Depth hoar grains have distinct faces and corners, sometimes appear as pyramids and cups, and can grow to a size of 10 mm. Often growing just above the ground where the temperature gradient is largest, depth hoar forms a very weak layer with little cohesion which is highly susceptible to shear or collapse. Same as **sugar snow**.

Direct-action avalanche An avalanche that releases during or shortly after a storm. See also **delayed-action avalanche**.

Equi-temperature snow A term formerly used to describe a layer of the snowpack in which the snow grains are small and rounded (0.1 to 0.5 mm diameter) and usually well-bonded. **Equilibrium form** is the current term to describe ice grains created by the rounding process.

Exposure See **aspect**.

Faceted snow Snow containing angular grains with sharp corners and smooth faces, or facets. These grains have been recrystallized by temperature gradients within the snowpack. The early stages of depth hoar.

Fall line The steepest or most direct path down a slope; the direction perpendicular to a contour line.

Firn Granular, old snow that has survived a summer melt season.

Flank The side boundary of an avalanche.

Fracture line A well-defined line where the moving snow breaks away from the more stable snow above. Also called **crown face**.

Grain A mechanically separate particle of ice in the snow cover on the ground. May consist of several crystals.

Graupel Snow crystals completely enveloped in rime that fall from the sky as small pellets.

Ground avalanche An avalanche that involves all snow layers and the ground is the bed surface. Also see **surface avalanche**.

Hand charge An explosive charge thrown by hand onto an avalanche slope. Used for avalanche control.

Hard slab A snow slab having a density greater than 300 kg/m³. Results from high winds or compaction. Often leaves angular blocks of snow in the debris of an avalanche.

Hasty search A rescue procedure for quickly searching and scuffing the surface of avalanche debris. Rescuers are looking and listening for clues to a victim's location before establishing a probe line.

Homogeneous (snowpack) Similar throughout.

Howitzer (or pack howitzer) A portable military artillery weapon for firing an explosive round into a distant target. Seventy-five-mm pack and 106-mm howitzers are used for avalanche control.

Ice mask A thin layer of ice formed by snow melting back from the face of a breathing avalanche victim and refreezing. This effectively seals off any air supply to the victim from the surrounding porous snow.

Injured A category of the avalanche toll for an accident.

Inversion Cold air near the ground with warmer air above.

Isothermal (snowpack) Same temperature throughout. In terms of avalanches the snowpack temperature is close to 0°C.

Killed A category of the avalanche toll for an accident.

Kinetic snow (also called temperature gradient or TG snow) See **depth hoar**; **faceted snow**.

Lee or leeward (side of a slope)

The side sheltered or protected from the wind. An east-facing slope is in the lee of a west wind. Opposite of **windward**.

Loose-snow avalanche An avalanche that releases at a point in cohesionless snow and spreads downhill in an inverted V-shape. Usually smaller, less forceful, and less dangerous than a slab avalanche. Also called a **point-release avalanche**.

Metamorphism Changes in the texture and structure of snow on the ground caused by pressure and temperature conditions.

Orographic lifting Forcing of air up and over a mountain. Enhances precipitation if air is saturated.

Out-of-area (ski area related) Open terrain outside of the ski area boundary accessed by the ski lifts.

Out-of-bounds (ski area related) Closed terrain within or outside the ski area boundary.

Partly buried A category of the avalanche toll for an accident. A person is partly buried in an avalanche if he or she is covered by snow anywhere from the ankles to the neck when the avalanche stops. By definition, a person who is partly buried is also considered to be caught. See also **caught** and **buried**.

Point-release avalanche See **loose-snow avalanche**.

Post-control release An avalanche that releases naturally or artificially within minutes to hours following avalanche control measures.

Probe line A line of rescuers, formed along a contour and facing uphill, organized to probe the snow with poles to locate an avalanche victim.

Probe pole A metal pole used to penetrate the snow to locate an avalanche victim.

Protective skiing Deliberate day-to-day skiing of avalanche slopes to stabilize the snowpack. The starting zone is cut several times in a crisscross pattern to break up the slab. Protective skiing is ineffective and not recommended on hard slab. Also called **ski cutting**. Compare with **test skiing**.

Recoilless rifle A military artillery weapon with severe backblast that eliminates recoil; for firing an explosive round into a distant target. Mounted either on a permanent platform or on the bed of a vehicle, 75-mm, and 105-mm, and 106 mm rifles are used for avalanche control.

Rime An ice formation created when supercooled water droplets carried by the wind strike a solid object and freeze on contact. Collects on airborne ice crystals (see **grau-pel**) and the upwind sides of trees, towers, etc.

Runout zone The lowest part of an avalanche path where the avalanche debris stops because of a decrease in slope angle or a natural obstacle.

Settlement A relatively slow decrease in thickness of a snow layer due to metamorphism. Usually creates a stronger snow structure through sintering.

Shear Stress applied to the snowpack by gravity pulling it down hill, promoting slippage between a slab and its adjacent snow layer underneath. Failure occurs when shear stress exceeds shear strength, overcoming the friction between the layers. Compare with **tension**.

Sintering A bonding together of snow grains through equilibrium metamorphism resulting in a stronger snow layer.

Slab avalanche An avalanche that releases a large area of cohesive snow at once.

Slide path See **avalanche path**.

Slope distance The length of an avalanche measured on or parallel to the surface of the ground.

Sluff Small avalanche running less than 75 vertical feet. Usually harmless with small volume of moving snow.

Snow crystal Particle of snow in the atmosphere.

Snow grain Particle of granular snow in the snowpack.

Snowslide Synonymous with **avalanche**.

Soft slab A snow slab having a density of less than 300 kg/m³. Often provides good powder skiing. Breaks up quickly into small lumps in an avalanche.

Stabilize To compact the snow or relieve stress in the snowpack and thereby reduce

the chance of avalanche release. Stabilization can occur naturally with time or can be effected with avalanche control.

- Stable (snow)** Snow which is well anchored and bonded with sufficient internal strength so as not to be susceptible to avalanching.
- Starting zone** The area where an avalanche releases. Also called “zone of origin”.
- Stauchwall** The downslope fracture surface or lower perimeter of the slab, usually obliterated as the slab slides over it.
- Stress** The physical pressure, pull, or other force exerted on the snowpack from gravity or external loading.
- Study plot** A site at which precipitation, temperature, and snow cover measurements are taken daily. These data are used with other measurements, such as wind, to estimate avalanche hazard.
- Substratum** Layer of snow within the snowpack.
- Sugar snow** Same as **depth hoar**.
- Sunballs** Balls of wet or damp snow which roll down a slope during warm weather.
- Surface avalanche** An avalanche involving the surface layer or layers of the snowpack, with a bed surface of snow, not running on the ground. Also see **ground avalanche** and **bed surface**.
- Surface hoar** A layer of feathery ice crystals that form on the snow surface by condensation of water vapor from the air to the cold snow surface. If buried by a snowfall, these crystals (generally a few millimeters to a centimeter in thickness) provides a weak, potential shear-failure layer for a slab avalanche.
- Sympathetic avalanche** A slide released by a skier, explosive charge, another avalanche, etc., that is some distance from the initial trigger.
- Temperature gradient** Change in temperature per unit change in depth (of the snowpack) expressed as degrees C (celsius) per meter, e.g., 10°C/m.
- Temperature gradient (TG) snow**
See **depth hoar**; **kinetic snow**.
- Tension** Stress applied to the snowpack by gravity pulling it down hill. Tension stress occurs in the snow closer to the top of the

slope, particularly on convex-shaped terrain in the starting zone. A slab fails in tension when tensile stress exceeds tensile strength. Compare with **shear**.

- Test skiing** An attempt to release avalanches on selected small slopes by skiing across the normal fracture zones. Test skiing is used as an indicator of hazard buildup and the possible need for more control measures, particularly with explosives, on larger avalanche paths. Compare with **protective skiing**.
- Terrain trap** An harmless-looking slope that appears to have little threat of avalanching. The slope may also have other dangers such as a cliff, timber, or a gully at the bottom.
- Toe (of an avalanche)** The tip of the avalanche debris after an avalanche has come to a stop. The toe marks the farthest extent of the sliding snow.
- Track** The middle part of an avalanche path below the starting zone and above the runout zone. The area where the avalanche attains its maximum velocity.
- Transition (of a slope)** A sharp change in the steepness of a slope. Going down the slope, a transition to a flatter area is called a “bench” or “step”; a transition to increased steepness is called a “roll”, “drop-off”, “cliff”, etc.
- Trigger** A force or event which starts an avalanche.
- Unstable (slab or snowpack)** Near the point of failure; when stress and strength of the slab are very nearly equal. Additional snow loading, an explosive charge, a skier, or anything that increases stress could cause avalanche release.
- Vertical fall distance** The drop in elevation of an avalanche from the starting zone to the toe of the debris.
- Water equivalent** The liquid water content of a given amount of snow or mixed snow and rain. Usually determined by weighing.
- Windload** Snow deposited by wind on the lee side of a mountain, ridge or other obstacle; snowdrift.
- Windward (side of a slope)** The side facing into the wind. Opposite of **lee** or **lee-ward**.

Additional Study Materials

Literature

Avalanche Accidents in Canada II: A Selection of Case Histories of Accidents, 1943 to 1978

By Chris Stethem and Peter Schaerer
1980, Division of Building Research, Paper 926,
National Research Council, Ottawa, Ontario,
Canada

Avalanche Accidents in Canada I: A Selection of Case Histories of Accidents, 1955 to 1976

By Chris Stethem and Peter Schaerer
1979, Division of Building Research, Paper 834,
National Research Council, Ottawa, Ontario,
Canada

Avalanche Handbook No. 489

By Ron Perla and Pete Martinelli
1976, U.S. Department of Agriculture,
Washington, D.C.
OUT OF PRINT

Avalanche Handbook, new edition

By David McClung and Peter Schaerer
1993, The Mountaineers, 1011 SW Klickitat
Way, Seattle, Washington 98134

Avalanche Safety for Skiers and Climbers

By Tony Daffern
Cloudcap, P.O. Box 27344, Seattle, Washington
98125, (206) 365-9192

Handbook of Snow

Edited by Grey and Male
1981, Pergamon Press, Inc., Maxwell House,
Fairview Park, Elmsford, New York 10523

Search Dog Training

By Sandy Bryson
1976, Boxwood Press, Pacific Grove, California
93950

Snow-Avalanche Hazard Analysis for Land-Use Planning and Engineering

By Art Mears
1992, Bulletin 49, Colorado Geological Survey,
1313 Sherman Street, Room 715, Denver,
Colorado 80203, (303) 866-3340

Snow Sense

By Jill Fredston and Doug Fesler
1994, Alaska Mountain Safety Center, Inc.,
9140 Brewsters Dr., Anchorage, Alaska 99516,
(907) 345-3566

The ABC of Avalanche Safety

By Ed LaChapelle
1979, The Mountaineer Books, 302 2nd Ave.
W., Seattle, Washington 98119, (206) 285-2665

The Avalanche Book

By Betsy Armstrong and Knox Williams
1991, Fulcrum Publishing, Inc., 350 Indiana
Street, Suite 510, Golden, Colorado 80401,
(303) 277-1623
or Colorado Geological Survey, 1313 Sherman
Street, Room 715, Denver, Colorado 80203,
(303) 866-3340

The Snowy Torrents, Avalanche Accidents in the United States 1972-79

By Knox Williams and Betsy Armstrong
1984, Teton Bookshop, Box 1903, Jackson,
Wyoming 83001, (307) 733-9220

The Snowy Torrents, Avalanche Accidents in the United States 1967-71

By Knox Williams
1975, General Technical Report RM-8, U.S.
Department of Agriculture, Forest Service,
Rocky Mountain Forest and Range
Experimental Station, Fort Collins, Colorado
OUT OF PRINT

The Snowy Torrents, Avalanche Accidents in the United States 1910-66

Edited by Dale Gallagher
1967, U.S. Department of Agriculture, Forest
Service, Alta Avalanche Study Center, Alta,
Utah
OUT OF PRINT

Avalanches and Snow Safety (formerly The Avalanche Enigma)

By Colin Fraser
1978, Charles Scribner's Sons, New York, New
York
OUT OF PRINT

The Avalanche Hunters

By Monty Atwater
1968, Macrae Smith Company, Philadelphia,
Pennsylvania
OUT OF PRINT

The Avalanche Review

Newsletter of the American Association of
Avalanche Professionals
P.O. Box 34004, Truckee, California 96160

Videos

Avalanche Awareness: A Question of Balance
30 minutes
Pyramid Films, San Francisco, California

Avalanche Dynamics
11 minutes
University of Washington Press, P.O. Box
50096, Seattle, Washington 98145-5096,
(206) 543-8870

Avalanche Rescue: Not a Second to Waste
27 minutes

Colorado Avalanche Information Center (CAIC)
10230 Smith Road, Denver, Colorado 80239,
(303) 371-1080

Avalanche Rescue Beacons: A Race Against Time
38 minutes

People Productions, 1630 N. 63rd Street, Suite
7, Boulder, Colorado 80301, (303) 449-6086
or Colorado Geological Survey, 1313 Sherman
Street, Room 715, Denver, Colorado 80203,
(303) 866-3340

Hazards of Avalanche and Crevasse
British Mountaineering Council, London,
England, United Kingdom

Temptation: An Avalanche Tragedy
23 minutes
Department of Agriculture, Forest Service,
Lakewood, Colorado

Winning the Avalanche Game
60 minutes
Backcountry Access, Boulder, Colorado,
(800) 670-8735

Metric Conversion

A. Distance

inches to centimeters 1 inch = 2.54 centimeters;
 multiply the known length in inches by 2.54;
 example: to convert 55 inches into centimeters,
 $55 \times 2.54 = 139.70$ centimeters

feet to meters 1 foot = 0.3048 meters;
 multiply the known length in feet by 0.3048;
 example: to convert 250 feet into meters,
 $250 \times 0.3048 = 76.20$ meters

miles to kilometers 1 mile = 1.61 kilometers;
 multiply the known length in miles by 1.61;
 example: to convert 6 miles into kilometers,
 $6 \times 1.61 = 9.66$ kilometers

B. Velocity

miles per hour (mph) to
 meters per second (mps),
 commonly used for wind
 speed 1 mile per hour = 0.45 meters per second;
 multiply the known mph by 0.45;
 example: to convert 35 mph to mps,
 $35 \times 0.45 = 15.75$ mps

mph to kilometers per
 hour, commonly used
 for avalanche velocity 1 mile = 1.61 kilometers;
 multiply the known distance in miles by 1.61;
 example: to convert 65 miles per hour into kilometers
 per hour, $65 \times 1.61 = 104.65$ kilometers per hour

C. Temperature

degrees fahrenheit (F) to
 degrees celsius (C) $C = \frac{5}{9} (F-32)$;
 example: to convert 25 degrees F into degrees C,
 $C = \frac{5}{9} (25-32)$; $= \frac{5}{9} (-7)$; $= 0.56 (-7)$; $= -3.92$ degrees C

Simplified Metric Conversion Tables



Distance

ft	m	mi.....km
.....(can also be used for mi/h to km/h)		
10.30	.....11.61	
20.61	.....23.22	
30.91	.....34.83	
41.22	.....46.44	
51.52	.....58.05	
61.82	.....69.66	
72.13	.....711.27	
82.43	.....812.87	
92.74	.....914.48	
103.04	....1016.09	
206.09	....2032.19	
309.14	....3048.28	
4012.19	..4064.37	
5015.24	..5080.47	
6018.28	..6096.56	
7021.33	..70112.65	
8024.38	..80128.74	
9027.43	..90144.84	
10030.48	100160.93	

Temperature

°F	°C
mps	
10037.78	....10.45
9032.22	....52.25
8026.67	..104.50
7021.11	..156.75
6015.56	..209.00
5010.00	..2511.25
404.44	....3013.50
320.00	....3515.75
30-1.11	...4018.00
20-6.67	...4520.25
10-12.22	.5022.50
0-17.78	.6027.00
-10-23.33	.7031.50
-20-28.89	.8036.00
-30-34.44	.9040.50
-40-40.00	100

Velocity

C.....mph
45.00

dawing

The Snowy Torrents is a compilation of avalanche accidents in the United States. The people and places are real, and their stories make compelling reading. This book is intended for anyone who skis, snowboards, snowshoes, climbs, snowmobiles, or works on snow in the mountains. These stores of near misses, survival, and death by avalanche may help save your life.

**Colorado Geological Survey
Department of Natural
Resources
Denver, Colorado 90203
1996**

isbn



Nick Logan

Nick Logan is the Associate Director of the Colorado Avalanche Information Center where he has forecasted avalanches for the Colorado mountains since 1983. He was a professional ski patrolman for the Breckenridge Ski Area (1971–1991) where he worked extensively with snow and avalanches. Major snow studies he has worked on include a project to determine the effects of artificial snow compaction in avalanche terrain, and a study focused on heat transfer within the snowpack and its relationship to backcountry avalanche accidents. His involvement with numerous avalanche rescue operations and investigations has reinforced his commitment to avalanche education and accident prevention. He has been an instructor for the American Avalanche Institute and the National Avalanche School and currently resides in Breckenridge, Colorado with his wife and two daughters.

Dale Atkins

Dale Atkins is presently an avalanche forecaster with the Colorado Avalanche Information Center. His introduction to avalanches came more than 20 years ago when he participated in his first avalanche rescue. After more than 24 avalanche rescues he remains active in mountain rescue and ski patrolling and also serves as a U.S. representative to the International Commission on Alpine Rescue. Dale has contributed numerous magazine articles and professional papers. He has also written and produced two avalanche rescue videotapes for search and rescue personnel and recreational-backcountry users. Active in avalanche awareness and safety trainings, Dale has been an instructor at the National Avalanche School, the Colorado Department of Transportation, the American Avalanche Institute and other regional avalanche schools.

Special Publication 39

The Snowy Torrents

Avalanche Accidents in the United States 1980–86

By Nick Logan and Dale Atkins

Cover photo: Avalanche near Campo Italiano in Torres Del Paine National Park, Chile, in February 1995 by Kevin Cushman.

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The Snowy Torrents—Avalanche Accidents in the United States 1980–86

CGS/1996

