

Crown Butte Avalanche Fatality

1 snowmobiler caught, buried and killed

Cooke City, MT

Custer-Gallatin National Forest – December 31, 2022

SYNOPSIS

On December 31, 2022 a snowmobiler was killed in a very large avalanche north of Cooke City, MT near Daisy Pass on a southeast facing slope of Crown Butte at 9,800'. Two brothers (ages 17 and 21) from Washington state were snowmobiling uphill on adjacent slopes. The older brother was climbing a steeper slope and triggered the avalanche 200' below the top. He was carried and buried 5 feet deep near the toe of the debris which measured 10-15 feet deep. He was wearing an airbag pack that he did not deploy. Both riders had shovels and probes, but no avalanche beacons. A nearby group was gathered at the bottom of the slope when the slide happened. They noticed the powder cloud, turned around and saw a buried snowmobile and began to search. One rider went into Cooke City to alert Search and Rescue. Searchers located the buried rider with a probe line. He was extricated an hour after the avalanche happened, but resuscitation efforts were unsuccessful. The avalanche was 500 feet wide, 1.5-2 feet deep on average, 4 feet at the deepest and ran 600 vertical feet with a runout angle of 25 degrees. The avalanche is classified HS-AMu-R4-D3-O.

GPS coordinates and elevation:

Crown: 45.05148 N, 109.96152 W, elev. 9,940'

Victim: 45.04883 N, 109.95851 W, elev. 9,380'

Toe: 45.04872 N, 109.95833 W, elev. 9,380'

Video: <https://youtu.be/zjGCgBikpRw>

Pictures: pages 7-11

AVALANCHE

Two brothers from Washington state, Wyatt (age 21) and Bryce (age 17), were riding together on the afternoon of December 31, 2022 when Wyatt was caught, buried and killed in a very large avalanche on the south side of Crown Butte near Daisy Pass north of Cooke City. Earlier in the day the two were riding with their father and went over Daisy Pass to ride in the relatively flat meadows on the north side of Crown Butte. They discussed wind-loading patterns and noted fresh avalanche activity that involved the recent storm snow. All three carried avalanche shovels and probes, Wyatt and their father had airbag packs, and none of them had avalanche beacons. They had read the avalanche forecast that morning and the previous couple days. They also noticed the avalanche danger sign along the snowmobile trail leaving Cooke City showed "MODERATE" that morning.

Early in the afternoon the three came back over Daisy Pass and their father rode back to Cooke City. The brothers stayed out to ride on the south side of Daisy Pass, mostly on relatively low angle, rolling terrain

below tree line. Shortly before 3:45 p.m. they were climbing simultaneously on adjacent, but separate slopes, and intended to meet on a bench above an island of trees that separated the slopes. Bryce stopped at the top of the slope, then noticed an avalanche fracture on the other side of the island of trees that split the two slopes. He started his sled and headed to the bottom.

Wyatt had been side hilling towards the spot they intended to meet, following some older tracks, and then went straight up the big, steep slope above the tracks. He was 200' from the top of the slope when the avalanche released.

RESCUE

At 3:45 p.m. another group of riders was stopped in flat terrain at the bottom of the slope with their machines running when a powder cloud from the avalanche filled the sky with snow. They moved thinking they would be hit by the avalanche. When they stopped and turned around, they saw the handlebars of a buried snowmobile and started searching with avalanche beacons.

Bryce arrived at the bottom of the avalanche after the group began searching and informed them his brother was not wearing a beacon. They started spot probing and digging near the buried sled. One rider went back to Cooke City to alert Search and Rescue. Along the way he intercepted a couple other groups and directed them to the avalanche to help search. A total of 15-20 people arrived at the site to search.

At 4:10 p.m. members of Cooke City Search and Rescue (CCSAR) were alerted and responded to the scene along with a GNFAC forecaster and volunteer. Members of CCSAR organized a probe line with the other searchers and located Wyatt with a probe strike. He was buried 5 feet deep, approximately 50 feet uphill from his sled. His airbag was not deployed. Rescuers fully extricated Wyatt at 4:49 p.m., performed CPR and applied an AED for 8-10 minutes, but Wyatt did not survive.

WEATHER

Seasonal snowfall and precipitation data are from the Fisher Creek SNOTEL site at 9,100', 1.1 miles E of the accident site. Wind data are from the Lulu Pass weather station at 10,020', 1.5 miles NNE of the accident location.

Snowfall at Fisher Creek SNOTEL was slightly above average from October through December with a total snow depth of 68" equal to 17.7" of snow water equivalent (SWE) on December 31 (Figure 1). From December 24 to 31, the week before the accident, the area received 2-3 feet of new snow equal to 3.2" of SWE.

The week before the accident wind was mostly out of the west and southwest averaging 5-15 mph with gusts of 20-30 mph (Figure 2). From December 26-28 wind averaged 15-30 mph with gusts of 40-60 mph. On the day of the accident wind was west-northwest averaging 5-15 mph with gusts of 20-25 mph.

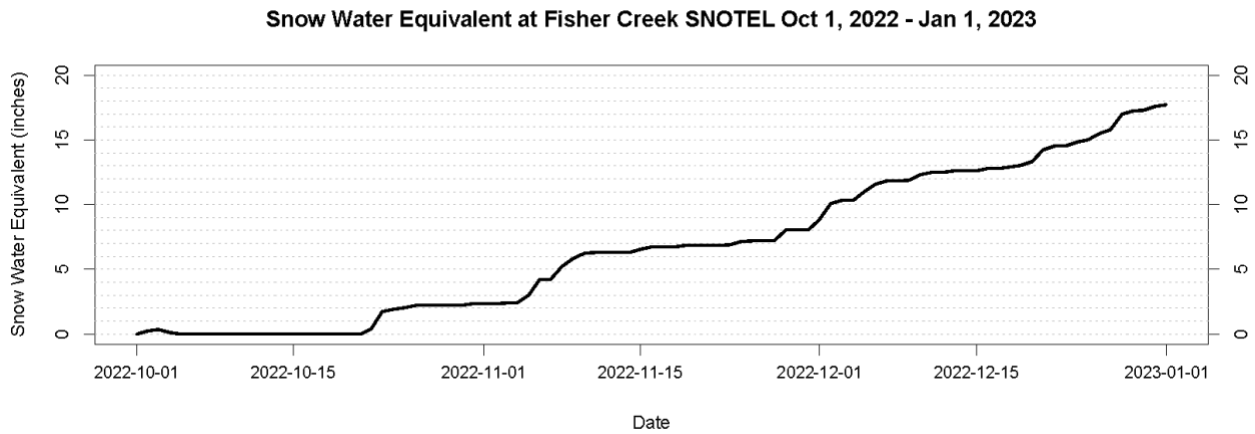


Figure 1. Snow water equivalent (start of day values at midnight) at Fisher Creek SNOTEL site from October 1, 2022 to January 1, 2023.

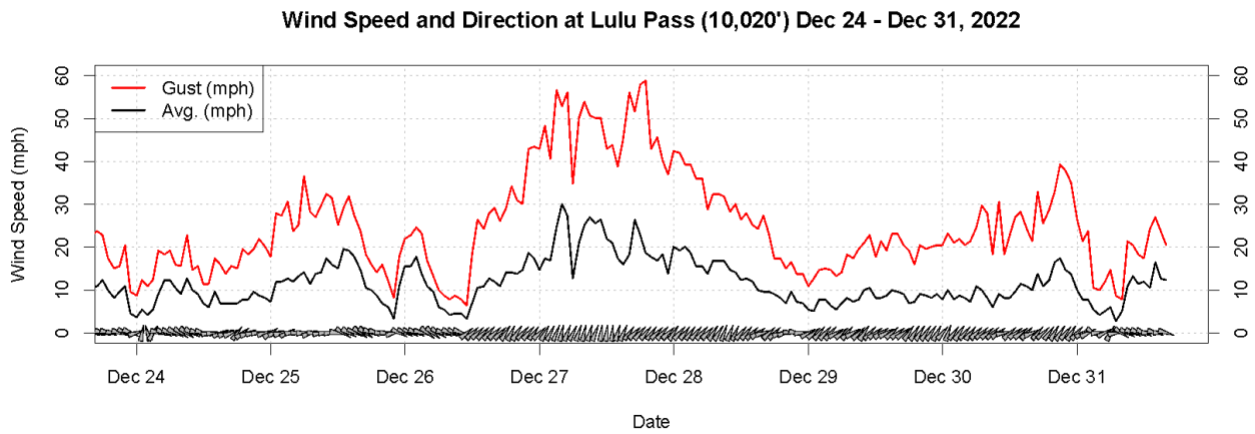


Figure 2. Wind speed and direction (hourly) from Lulu Pass from December 24 to December 31, 2022 at 4 pm. Wind direction is displayed as arrows along the bottom of the graph.

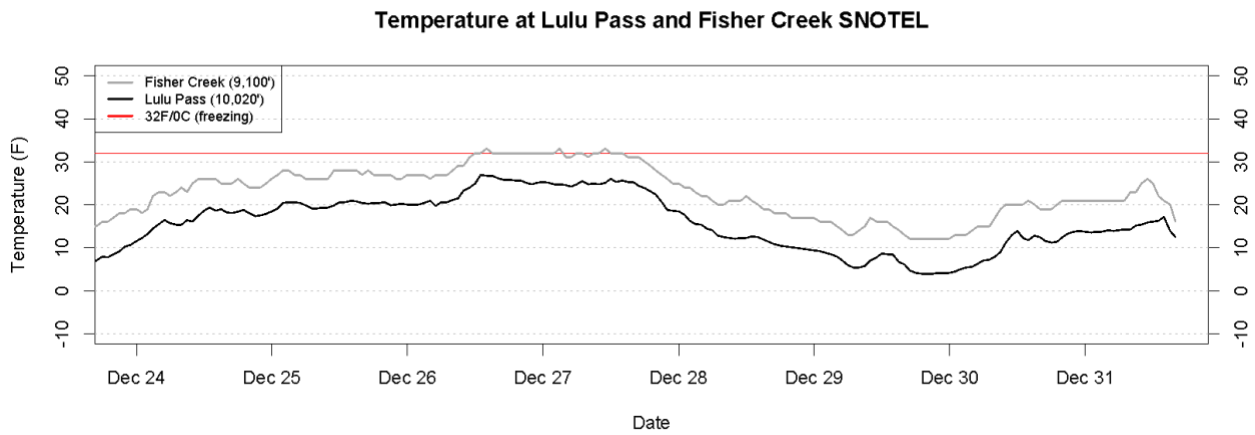


Figure 3. Temperature (hourly) at Lulu Pass and Fisher Creek SNOTEL from December 24 to December 31 at 4 pm.

Temperatures ranged from teens to low 30s F over the prior week. At the time of the accident temperatures were 13 F at Lulu Pass and 16 F at Fisher Creek (Figure 3).

SNOWPACK

The avalanche occurred on a southeast facing slope at 9,800'. The average slope angle of the start zone was 37 degrees with a maximum slope of 45 degrees (measured on CalTopo). The avalanche was 500 feet wide, 1.5-2 feet deep on average, 4 feet at the deepest and ran 600 vertical feet with a runout angle of 25 degrees. The avalanche is classified HS-AMu-R4-D3-O.

The snowpack at the crown of the avalanche consisted of a very hard (P+) slab of snow below soft (F/F+) new and wind-drifted snow from the last week. This slab was sitting on a layer of softer (4F), 1-2mm faceted grains which the avalanche broke on (Figure 4). The bed surface below the weak layer consisted of hard rounding facets.

The first major snowstorm of the season hit the mountains near Cooke City on October 23, and dropped up to 2 feet of snow equal to 2" of SWE. Then there was minimal snow until the area received 4" of SWE from November 4 to 10. From November 11-22 the area received 9" of snow equal to 0.5" of SWE. During this relatively dry period, the existing snowpack became weak in places.

The GNFAAC's first daily forecast with danger ratings was on November 23, and danger was rated MODERATE. From November 27 to December 11, snowfall was steady and delivered 65" of snow equal to 5.3" SWE. During this time, avalanche danger was between MODERATE and CONSIDERABLE. On December 6 on the north side of Daisy Pass, half of a mile from the fatal avalanche on Crown Butte, a snowmobiler triggered a large avalanche that broke on weak, sugary snow near the bottom of the snowpack. On December 9 a pair of snowmobilers triggered a deep slab avalanche on Fisher Mtn., 1 mile from the Crown Butte avalanche site, as they were crossing a low angle slope below (<https://www.mtavalanche.com/node/27148>). This avalanche broke 3-6' deep and 300' wide on a heavily wind-loaded slope. It likely failed on weak snow near the bottom of the snowpack that formed during late October or early November.

From December 12 to December 19 the area received 8" of snow equal to 0.7" SWE. Avalanche danger remained MODERATE for the possibility of triggering large to very large avalanches on weak layers near the bottom of the snowpack. A layer of small, faceted grains was observed near the surface of the snowpack at the end of this relatively dry period. Avalanche danger rose to CONSIDERABLE on December 21 after the area received 20" of new snow equal to 1.5" SWE. On December 22 and 23 temperatures were -20 to -30 F. After this cold snap, steady snowfall resumed and between December 23 and 31 the area received 2-3 feet of snow equal to 3.2" of SWE. Avalanche danger rose to CONSIDERABLE on December 25, 27 and 28, and was otherwise MODERATE. Earlier in the day than the fatal avalanche on December 31 a snowmobiler on Sheep Mtn., 2 miles east of the fatal avalanche, triggered a 1-4' deep, 150' wide hard slab big enough to bury or injure a person (<https://www.mtavalanche.com/node/27426>).

The avalanche forecast on December 31, 2022 stated:

Triggering large avalanches is a serious possibility today. You could trigger an avalanche within the snow that's fallen over the last week, on a weak layer buried just beneath that, or deep in the snowpack... Continued loading every day this last week by new snow and wind drifting has kept stressing the weak layers and building thicker and more cohesive slabs of fresh snow. In general, the snowpack has been able to keep up and accommodate the loading. Triggering slides has become slightly less likely, but by no means does that mean conditions are safe. While the likelihood has gone down a little bit, the potential size and destructive power has not decreased.

As Alex identified in yesterday's video from Cooke City, wind loaded slopes are where you're most likely to trigger a slide today ([Cooke City video](#)). Steering clear of wind drifts altogether would be a wise call. Watch for signs of instability in the new snow, such as shooting cracks, collapses or recent avalanches. Assessing the deeper weak layers will be harder. Snowpack tests aren't necessarily going to give you actionable information. For now, simply don't trust those deeper weak layers. Tone down your objectives appropriately for the possibility of triggering large, deep slides.

If you're considering riding steep slopes today, ponder this analogy: as we've gotten a few days out from the last rapid loading event (which hit particularly hard in the southern areas) we've removed a couple bullets from the gun you're playing Russian roulette with. But the gun's still got at least one bullet left. Is that really a game you want to play today? As an alternative, mellow slopes (less than 30 degrees steep) will hold good riding conditions without the risk.

Human triggered avalanches remain possible and the avalanche danger is MODERATE.

[GNFAC Avalanche Forecast for Saturday, December 31, 2022](#)

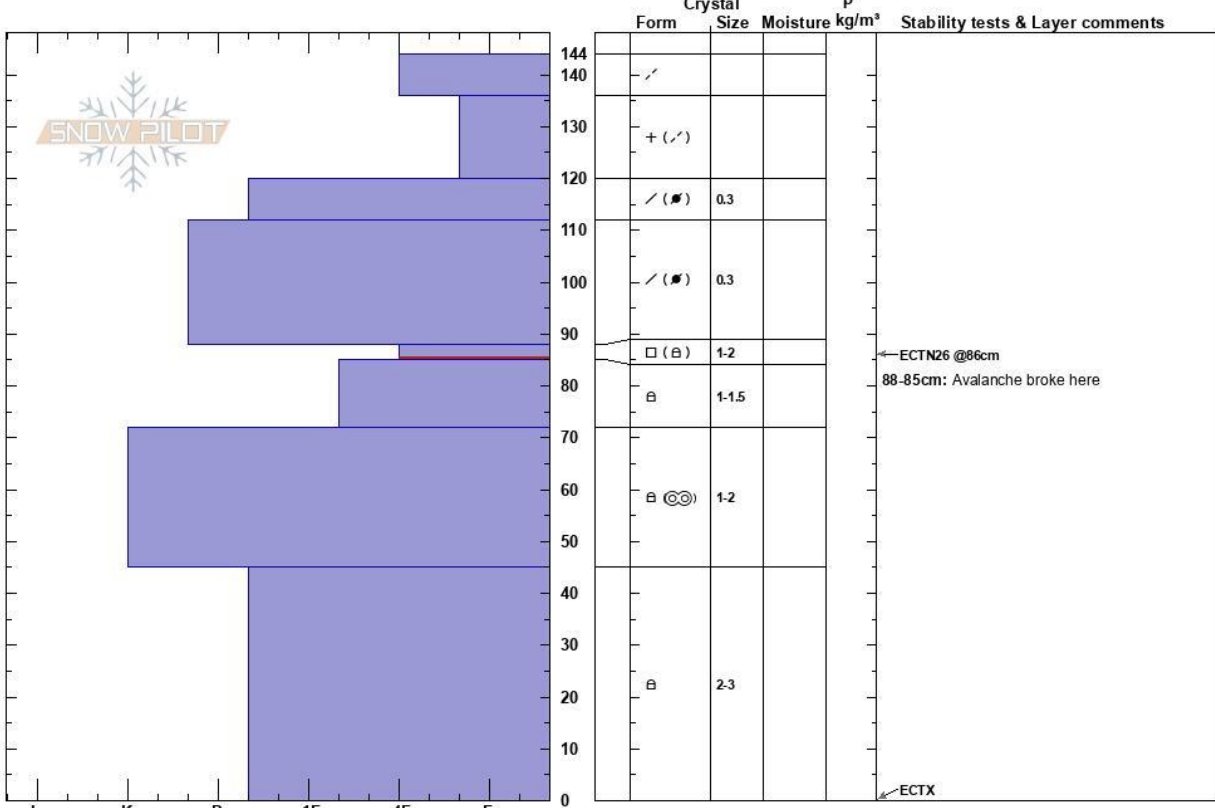
Crown Butte Fatality
 Cooke City
 MT
 Elevation: 9889 ft
 Aspect: 120°

Alex Marienthal
 01/01/2023 - 10:45am
 Co-ord: 45.05148N, -109.96152W
 Slope Angle: 27°
 Wind Loading: yes

Stability: Poor
 Air Temperature:
 Sky Cover: OVC
 Precipitation: S-1
 Wind: S Moderate

HS:144
 PF:25
 Layer Notes:
 88-85cm: Avalanche broke here
 88-85cm: Problematic layer

Specifics: Pit is adjacent to avalanche: crown; Recent avalanche activity on similar slopes; Recent avalanche activity on different slopes



Notes: Crown profile from HS-AMu-R4-D3-O, 1 rider caught, buried and killed on 12/31/22. Crown was average 2 feet deep and maximum 4 feet deep. 500' wide and ran 600 vertical feet. More info at: <https://www.mtavalanche.com/node/27422>

Figure 4. Snowpit profile from the crown of the avalanche. Observed and recorded the day after the avalanche.

INVESTIGATION

Alex Marienthal of the GN FAC obtained details of the accident during the recovery efforts and through interviews with group members on December 31, 2022 and January 1, 2023.

Any questions should be directed to:

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Photo 1. Avalanche and rescue scene on December 31, 2022.



Photo 2. Looking up avalanche from burial location. Taken during rescue on December 31, 2022.



Photo 3. Crown of avalanche. Photo taken from the rescue site on December 31, 2022.



Photo 4. Sled buried in avalanche debris. Probe is near where rider was buried.



Photo 5. Crown of the avalanche during GNFA's site visit on January 1, 2023. Crown profile dug on other side of the rock in foreground.



Photo 6. Debris of avalanche, and holes where rider (left) and snowmobile (right) were buried.



Photo 7. Looking up to crown on January 1, 2023.



Photo 8. Looking down path from crown on January 1, 2023



Photo 9. Full view of avalanche from bottom on January 1, 2023.