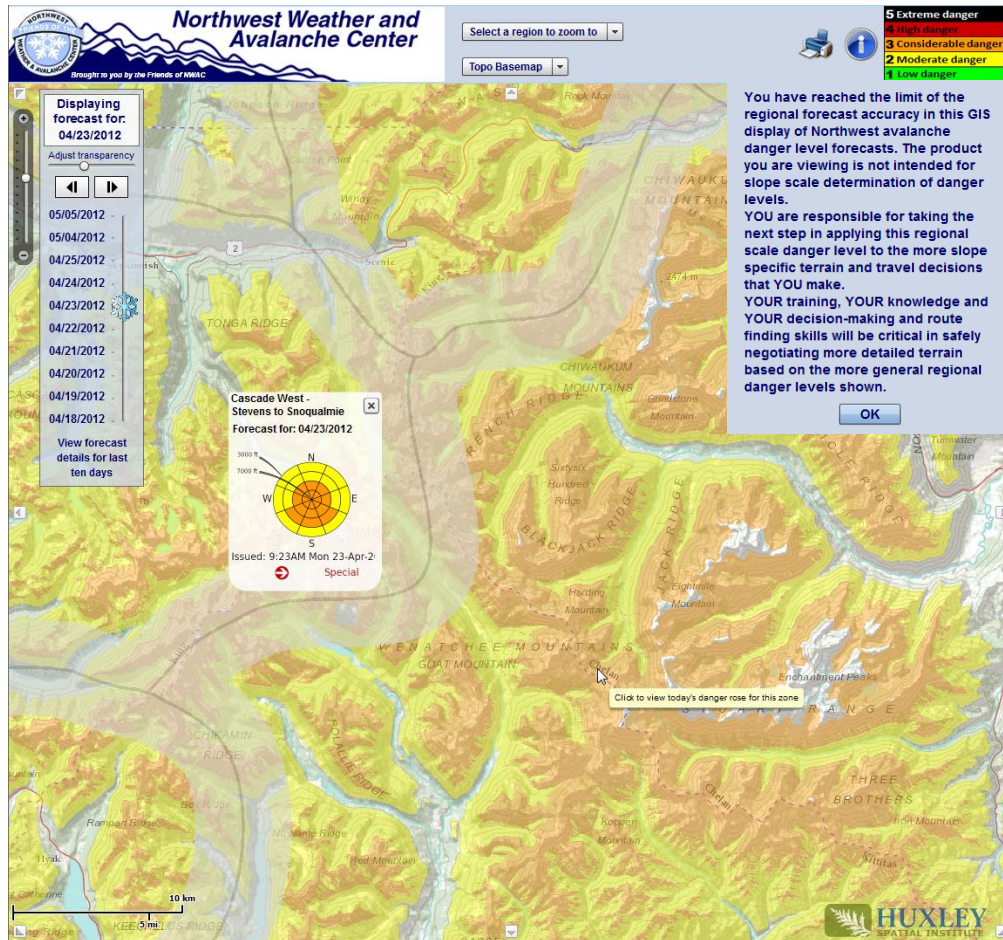


Northwest Weather & Avalanche Center



2011-2012 Annual Report

Report prepared by Mark Moore, Kenny Kramer and Garth Ferber



A partnership between the USDA Forest Service, Washington State Parks and Recreation Commission, National Park Service, National Weather Service, Washington State Department of Transportation, Northwest Winter Sports Foundation, Pacific Northwest Ski Area Association, Ski Washington, Washington State Snowpark and Snowmobile Programs, USDA Forest Service Fee Demo programs, Title II RAC programs, Ski Schools, Friends of the Avalanche Center and others.



**United States
Department of
Agriculture**



**Forest Service
Pacific
Northwest
Region**

Cover Photo credits:

Acting upon a proposal by Dr. Michael Medler of the Western Washington University (WWU) Institute for Spatial Information and Analysis, NWAC staff, the Friends of the Northwest Weather and Avalanche Center and WWU collaborated on a project to display daily avalanche danger rose information in a more user friendly, graphical interface. The sample GIS forecast displayed here shows the relevant danger rose information for the Cascade west slopes zone between Stevens and Snoqualmie Passes (as a popup) with the associated danger rose information draped over the topography by elevation and aspect for the NWAC forecast area displayed. While still a controversial topic amongst the North American avalanche community due to implied accuracy that is not possible with a regional scale product, the GIS display shown here has a limited zoom level. It can only be zoomed to a magnification that does not allow for slope scale decisions; furthermore, several popups that more specifically address this application limitation appear during the danger display process, ultimately relegating application of this regional scale product to the user for slope scale decisions. Phase II of this application is currently under final development and this should allow for user observations of avalanche, weather and snowpack conditions to be geo-tagged and displayed geographically for a user selected time period...most likely replacing the Snowpack Information Exchange currently being utilized for such information. This implementation should also allow for automatic field input from users via smart phone apps.

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A MESSAGE FROM THE DIRECTOR

First, it's been a great pleasure working at the NWAC since its inception 37 years ago, and for being part of an operation that has provided gradually expanding data and forecast products and services to both the public and our many important cooperators during these many and varied years of NWAC operation. As might be expected, there have been many challenges—both operational and financial—but we have successfully met these and hopefully exceeded expectations in a variety of areas. However, it must be stressed that any successes have resulted from a team effort...a team comprised of both dedicated staff as well as strong supporters and contributors from the federal, state, & private sectors...as well as from the public we serve.

Over the years, the NWAC has evolved into a highly regarded and unique regional avalanche forecast center. Its remote mountain weather data network is one of the most comprehensive such networks in any mountainous area of North America, while the mountain weather and avalanche forecasts are equally highly regarded and well respected. Meanwhile, our main conduit to the world...the NWAC web site...routinely records the highest overall usage and access of any regional avalanche center in the US. And while difficult to document the non-event, it is generally thought that the information provided by the highly committed NWAC staff has saved many lives and prevented many avalanche and mountain weather related accidents. Certainly several reports on the NWAC over its history corroborate such life-saving efforts.

It is my belief that our forecast staff are dedicated and highly professional and no doubt will continue to provide even better products in the years ahead as they respond to new and differing challenges. Some of these challenges will relate to the most effective and efficient application and integration of new technology into the forecast operation, while some will focus on new and more effective ways of maintaining, structuring and disseminating forecast and data products. However, they will all involve being optimally responsive to user needs.

This latest forecasting season of 2011/12 was the second La Niña driven winter in a row, and generally lived up to its heightened billing for enhanced cold and snowfall in the region. Most NW snowpacks met or exceeded average climatological snowdepths for much of the year, and along with some persistent weak layers produced many periods of avalanche warnings and some sad and unfortunate avalanche accidents...both regionally and nationally. But rather than focusing on those whom forecasts didn't reach, or who made decisions that resulted in injury or worse, we need to focus on all of those who heeded the forecasts and warnings, changed their behavior or plans, and made their trips safely. While we strive for zero fatalities and no accidents, this isn't normally realistic in an inherently dangerous setting of steep winter snowpacks spread inconsistently across widely varying terrain. We can't control the mountains any more than we can control those who use them or how and when they use them (at least to a degree). However, we still want to provide the best information possible so that those who do use the information as a starting point when they venture out into the mountains (and especially the back country) can make the best and safest decisions for themselves. Since avalanches give no free passes for experience or skill levels, it is up to BC travelers to be tuned in enough to know when the safe times are, and when they aren't. It's simply not enough to have the knowledge...it must be applied and applied continuously. Applying it once is not sufficient to enhance safety. But for most of us who are walking a fine line of safety, it's just a

question of tweaking behavior a little bit that makes all the difference between a good experience and a really bad one. And it is at least partially our responsibility to do as much as possible to encourage this attitude shift, and allow for the safest decisions possible.

In closing—in this my final year of leading the NWAC, I would like to offer the following as a suitable signout to my longtime friends—the Northwest Weather and Avalanche Center and all of its supporters, cooperators and users.

Snow Memories

After many years of forecasting snow, rain and sun —
And giving danger trends for snow-filled fun.
It's time to really enjoy a whole winter —
Without worrying whether each grain will sinter.
Time to look at snow through a new set of eyes —
Though I still don't want avalanches to be a surprise.
It's been a great challenge most every day —
Interpreting weather models to see what they say.
And then applying those thoughts to the current snowpack —
To see what we know, and what we lack.
So thanks for listening and applying the forecast —
For the most recent storm won't be the last.
Thanks for analyzing wind direction and speed —
And avoiding slopes on which snow slides feed.
Thanks for your focus and awareness out there —
And for trip reports about places you care.
Thanks to all who have helped to educate —
For because of you it's never too late.
To change where you go, and what you do —
And how you do it, is all up to you.
Snowpacks care little about experts or not —
They can't be bribed, or your safety bought.
So my wish is simple, when the season is done —
That no one has died, not even one.

—Mark Moore, May 2012

NWAC MISSION STATEMENT

To reduce the impacts of adverse mountain weather and avalanches on recreation, industry and transportation in Washington and northern Oregon through data collection, forecasting and education. This promotion of public safety is accomplished by providing cooperating agencies and the public with:

- * Mountain Weather Data
- * Mountain Weather Forecasts
- * Avalanche Forecasts
- * Education
- * Applied Research and Technology

A more complete NWAC Mission Statement is available via the web site at:

<http://www.nwac.us/about/mission/>.

How to get NWAC mountain weather and avalanche forecast information:

<http://www.nwac.us>

How to reach us for other information:

Northwest Weather and Avalanche Center

7600 Sandpoint Way NE

Seattle, WA 98115

206-526-4666 (messages)

nwac.sew@noaa.gov

OPERATIONS SUMMARY

Forecast staff at the NWAC are employed by the USDA-Forest Service from approximately mid-September to mid-June. The following is a summary of the main NWAC tasks during the three distinct parts of the operational season:

Fall Season (mid September to mid November):

- * Plan for upcoming season, discuss priorities and implement changes for better operation and enhanced products and services.
- * Prepare cooperator agreements and administer budgetary and funding items as needed (ongoing through season)
- * Attend and provide input and/or instruction at the International Snow Science Workshop (ISSW), Regional Avalanche Center Meetings, Northwest Snow and Avalanche Summit (NSAS), and National Avalanche School (NAS).
- * Office preparation especially of forecasting and weather station computers.
- * Weather station installation upgrades and repairs.
- * Preliminary mountain weather forecasting for ski areas and highways (WSDOT).
- * Issue special public avalanche statements (special conditions) as needed to highlight developing avalanche danger.

Winter Season (mid-November to mid-April):

- ✱ Provide daily mountain weather and avalanche consultations to ski areas, WSDOT crews and other cooperating agencies, starting at ~3 am, 7 days a week.
- ✱ Prepare and disseminate twice daily public mountain weather forecasts and a variety of daily avalanche forecast products 7 days a week; provide updates and special statements as necessary.
- ✱ NWAC weather station repairs; ensure high quality automated hourly data via the NWAC web site.
- ✱ Gather snow pack information first hand and from others; integrate into avalanche forecasts.
- ✱ Provide avalanche awareness presentations as time and staffing allow.
- ✱ Prepare and update web site pages with accident and snowpack statistics, and other educational information on weather, snowpack and avalanche awareness.

Spring Season (mid-April to mid-June):

- ✱ Continue to provide mountain weather and avalanche consultations to cooperating agencies, such as WSDOT avalanche crews at Washington and Cayuse/Chinook passes during their time of spring reopening.
- ✱ Issue special avalanche statements for the public as necessary.
- ✱ NWAC weather station upgrades or repairs; continue to provide quality data via the NWAC web site.
- ✱ Prepare for and host annual meeting; prepare and issue annual report.
- ✱ Plan budget and overall operations for next season.

INFORMATION EXCHANGE

Incoming Information

Through the winter NWAC forecasters rely on incoming information and data to make assessments of current mountain weather and avalanche observations. This information comes from the following sources:

- ✱ **Observer Network:** The duty forecaster at the NWAC receives at least daily weather and avalanche observations via telephone from professional ski patrols at most major NW ski areas, WSDOT avalanche crews, and NPS observers at Hurricane Ridge in the Olympics and Paradise on Mt Rainier. Updated observations and forecasts may be exchanged several or more times/day as the situation requires.
- ✱ **Backcountry Observations:** The NWAC makes as much use as possible of available back country snow and avalanche observations via phone calls and e-mail messages, the [FOAC Snowpack Information Exchange](#), and sources on the Internet such as [Turns-All-Year](#). Note that a more graphical implementation of the Snowpack Information Exchange is currently under final development and should be available for the winter of 2012/13 as an overlay to the GIS danger rose display.
- ✱ **NWAC Weather Stations:** The 47 NWAC weather stations at Hurricane Ridge (Olympics) and in the Cascade Mountains provide hourly temperature, relative humidity, wind, precipitation and snowfall information automatically via phone, radio and Internet

connections. See the Data Network section below for recent changes and planned updates to the weather station network.

- ★ **National Weather Service:** NWAC staff has access to all products and expertise of the National Weather Service Seattle office, including their AWIPS (Advanced Weather Information Processing System) and soon to arrive AWIPS-II weather computer systems, which display forecast model output, radar, satellite imagery, radiosonde information, surface and other observations.

Outgoing Information

The NWAC distributes mountain weather and avalanche information via the following means:

- ★ **Phone Consultations:** at least once daily with most ski areas, DOT avalanche crews, and observers at Hurricane Ridge and Paradise. Consultations may increase to multiple times/day during periods of rapidly changing weather and avalanche conditions.
- ★ **Public Avalanche Forecast Hotline Phone Recordings:** in Seattle and Portland. See Product Dissemination section for more information as to plans to discontinue such recordings via telephone in the summer of 2012. However, voice recordings may be made available via podcasts on the web site at some time in the future.
- ★ **Internet:** Visits to the NWAC web site for a variety of forecast, data and other mountain weather and avalanche information products have greatly increased over the past few years. See Product Dissemination section for more information.
- ★ **NWS Seattle Weatherwire:** Summary NWAC avalanche forecasts are distributed to the media and commercial vendors via the NWS Weatherwire service. NWAC forecasters also regularly add an “Avalanche” section to the highly popular and nationally distributed NWS Area Forecast Discussion (AFD) product during periods of Avalanche Watches, Warnings, and Special Conditions. NWAC Avalanche Watch and Warning generated products are also distributed automatically via the NWS Weatherwire service.
- ★ **Search and Rescue Assistance:** The NWAC provides weather and avalanche forecast assistance to County Search and Rescue teams when requested.
- ★ **NWAC mountain weather station data:** Data for NWAC weather stations for up to the past 22 years is available upon request. Future development plans call for such information to be available automatically via a data archival link on the web site.

2011-12 WINTER WEATHER AND AVALANCHE SUMMARY

Given that the La Niña winter season of 2010-11 stretched into June for the forecasters of NWAC, the expected back-to-back La Niña season for 2011-12 was met with trepidation to say the least! We were given periodic reprieves along the way however and managed to see our way through into a spring that is very welcomed and surprisingly feeling like spring. The following offer some highlights as well as some tragic lowlights of this past winter season in the Pacific Northwest.

The winter season really began to take shape in November, especially the latter half. NWAC began daily forecasting on November 17th as a strong storm cycle was upon us. Mt Baker Ski Area received over 40 inches of snow in the two days from the 16th to 17th with other Cascade sites about 15-20 inches. Thus began another long winter forecasting season. Prior to mid-November most areas had less than one foot of snow on the ground and by Thanksgiving snow depths had built to 3-5 feet with 69 inches on the ground at the base of Mt Baker! Always a relief for ski areas to be open by Thanksgiving and the deep new early snow provided a promising start to the season.

However, as is typically the case, the storm track over the Pacific Northwest is less continuous and more periodic, as it was during the previous La Nina season. As strong as the beginning of the season was, the period from Thanksgiving to Christmas proved as weak. Most areas only received 6-12 inches of snow during this time that was dominated by high freezing levels, with two periods exceeding 10,000 feet in early December producing a strong melt-freeze crust. A cold snap in mid-December allowed for faceting and weakening of the snow above and below that crust layer creating a weak layer involved in many future avalanches. The crust-facet combination would be evident in the snowpack for months to come.

The storms returned near Christmas with most areas receiving 2-4 feet of new snow from Christmas to New Years. However, the on again-off again nature of the season persisted into the New Year, with generally less than one foot of snow falling during the first half of January 2012.

The second two weeks in January were definitely of the on-again nature. Over 10 feet of snow fell during this period over most west slope areas of the forecast region, from Mt Hood in the south to Paradise and Stevens Pass in the central to over 11 feet at Mt Baker in the north and even over 8 feet at the low pass of Snoqualmie. Following an extended storm cycle, warming periods with heavy precipitation produced a significant avalanche cycle as evidenced by this photo of a large natural avalanche that released January 20th at Mt Hood Meadows failing on the late December crust.



Figure 1. Mt Hood Meadows, Absolute Magnitude path, SS-N-R3.5-4-D3-O--failure on facets below old crust by Tighe Stoyanoff on Jan 20 2012

This period also included the first of the three episodes which raised the avalanche danger level to its highest category of extreme or level 5. The avalanche warning period extended to all the forecast areas but included the extreme danger level in the Mt Hood area only, where the heaviest rain and highest freezing levels were expected. The well forecast event verified as NWAC weather stations at Timberline and Mt Hood Meadows received nearly 5 inches of rain on January 24th.

The storm hose once again was shut off after February 1st as a strong ridge of high pressure dominated, producing high freezing levels again climbing over 10,000 feet during the first week of February. This warm dry period produced another strong melt-freeze crust in most areas throughout the Northwest. The mid-season drought lasted from February 2nd through February 16th with most NWAC weather stations in Washington receiving only 3-6 inches of snow and Mt Hood not much better getting about 1 foot. As is the nature of the avalanche beast though, it is not only during the stormy periods when the dragon is active, but often when it's thought asleep as well.

In this case the weather patterns in early February conspired to develop a weak layer that would be evident for much of the rest of the season, especially in the north Cascades. The high freezing levels in early February formed a surface crust while the clear weather allowed for significant surface hoar to grow on the crust. These layers of surface hoar once formed are often destroyed by sun, wind or warming as they are very fragile, often producing an unknown distribution. However, the return to snowfall in this case on about February 8th arrived with gentle winds and very light snowfall, thus just covering and protecting the layer over a widespread region to lie dormant until stronger storms would build larger slab layers over one of the more notorious of weak layers.

By mid-February backcountry enthusiasts were anxiously awaiting a return to real northwest winter conditions. Those conditions arrived alright; unfortunately they came at the dear cost of four lives that were swept away in two separate avalanches on February 19th. By the morning of February 19th the two day storm had amassed snowfall totals over 30 inches at most west slope areas. That heavy recent snow along with very strong winds in combination with the lurking weak layers described earlier led to the fatal avalanche conditions. The fatal accidents included a party of snowboarders accessing a very steep slope outside the Alpental ski area, rarely attempted in the best of conditions, which led to one of the members being caught and carried over steep cliffs and killed. The other fatal accident occurred in the back country outside the Stevens Pass Resort boundary. A large 2-3 ft slab was triggered by the 7th skier of a large party entering a steep open slope just below the top of Cowboy Mt to the southwest of the resort. The ensuing slide caught four members of the group and swept them down a twisting tree lined chute over 2400 vertical feet to the valley floor of the Tunnel Creek drainage. One person who was hit by the slide near the top was able to resist its fury by hugging a tree, while another victim survived by a combination of luck and an airbag. Unfortunately, three other skiers perished in the slide...all local and long time Leavenworth residents which left the area stunned.

As terrible as February 19th proved to be, it could have been much worse as there were other accidents that occurred that day with more fortunate outcomes. In the Crystal Mountain backcountry a party of three were involved in two separate avalanche incidents in the same day! The second slide caught all three, totally burying one member and partially burying the other two, who once self-rescued were able to use a transceiver, probes and shovels to rescue their partner alive! Those involved in the accident describe it and show pictures here: http://www.turns-all-year.com/skiing_snowboarding/trip_reports/index.php?topic=23827.0

Also in the Crystal Mountain area a solo skier was caught, carried and arrested on a tree, sustaining life threatening injuries and later airlifted to safety.

More detailed summaries of these and other NW accidents can be found on the NWAC web site here: <http://www.nwac.us/accidents/>

The events of February 19th shook the backcountry community in this region deeply and will no doubt have a lasting impact for years to come. Here is an example of the sentiment along with some historical perspective taken from a popular regional backcountry enthusiast web forum:

Condolences to the families and friends of those who were lost yesterday.

I didn't know the victims, but I've been staggered by the scope of this tragedy. I've been trying to process it mentally. I reviewed my notes about avalanche accidents in the Northwest through 2011:

<http://alpenglowlow.org/ski-history/notes/book/logan-1996.html>

<http://alpenglowlow.org/ski-history/notes/web/www-avalanche-org.html>

Losing more than one member of the skiing and snowboarding community in single day is a horrible shock. It has only happened twice before. In 1999, one snowboarder and one skier were lost in the huge Rumble Gully avalanche just outside the Mt Baker ski area. In 2007, three snowboarders were buried at their

emergency bivouac in Union Creek near Crystal Mountain. Yesterday, we lost three at Stevens Pass in a single avalanche and another at Alpental in a separate accident. It was deadliest day for avalanches involving skiers and snowboarders in the history of Washington State.

There have been even worse days in history, but they involved climbing parties. Fatal accidents involving multiple skiers are extremely rare in this state. I think that's why this event seems so overwhelming.

From the memorial at the Leavenworth Winter Sports Club ski hill, taken from Icicle.TV's site -- hundreds of skiers on the nighttime memorial run:



Figure 2. Photo from the memorial at the Leavenworth Winter Sports Club ski hill, taken from Icicle.TV's site -- hundreds of skiers on the nighttime memorial run

The storms kept coming over the days following the tragic accidents with rising freezing levels and heavy precipitation leading to a widespread avalanche warning for the entire region with the second period of extreme danger levels of the season. Between 2 to over 5 inches of water fell in 24 hours ending February 22nd at rising freezing levels prompting the extreme danger warning well ahead of time. There was one other close call however on February 21st in the Alpental backcountry near Snoqualmie Pass, when a party of three backcountry skiers triggered, were caught and partially buried by a slide being able to self-rescue with no injuries.

The storm cycles kept coming for much of March with even lower overall freezing levels. For a monthly period from February 17th to March 17th some impressive snowfall amounts were recorded. Most west slope areas received 150-200 inches of snowfall with Mt Baker totaling 290 inches in that 30 day period! Within this overall stormy period the third avalanche warning for extreme danger occurred. Following about nine feet of snow in six days warming along with 1-2 inches of water lead to the extreme danger on March 15th. The warning was issued on the 14th of March for the impending extreme danger. The warning clearly verified as a very large natural slab...with an estimated crown of 15 ft...released early on the morning of the 15th from Shuksan Arm in the Mt Baker Wilderness Area to the east of the ski area. The avalanche was noted as the largest ever seen in the area over the past 40 years by long time general manager Duncan Howat. The fracture line propagated a long distance along the ridge and debris ran toward the base of Chair 8 (Shuksan Arm Chair), destroying a tree buffer of 2ft + diameter trees before coming to rest just within the lower part of a closed run. Fortunately, due to this event, other large and unusual avalanches within the ski area, high winds, other deteriorating weather related events (road closure due to downed trees), and extreme avalanche danger in the BC, the ski area management wisely decided not to open the ski area that day hence no injuries resulted. Duncan Howat, the longtime general manager of the Mt Baker Ski Area, announced his decision for the ski area to remain closed in the lodge that morning to a



crowd of anxious and powder hungry skiers and boarders. Contrary to the anticipated response, the decision was met with rousing cheers; clapping and ultimate support, knowing their safety had been put first and foremost.

Figure 3 Massive natural avalanche releases adjacent to Mt Baker Ski Area 3-15-12. View up lower Rumble Gulley. Slide photo: Mike Trowbridge

March goes out like a lion!

Another strong storm cycle finished off the very active month of March. The last four days of March saw 3-5 inches of water equivalent fall over the region, amounting to 2.5 to over 4 feet of snow invoking three consecutive days of avalanche warnings.

Cool weather in the first week of April gave way to rising freezing levels and a dry period towards the middle of April allowing the NWAC to put to bed another winter season of avalanche and mountain weather forecasting on April 15th. However, periodic storms and the initial very warm weather of spring prompted issuance of several special avalanche statements from late April into the middle of May, making forecasters wonder about whether or not spring is actually a useful term in the Pacific NW.

NWAC 2011/12 Snowdepth Summary Chart

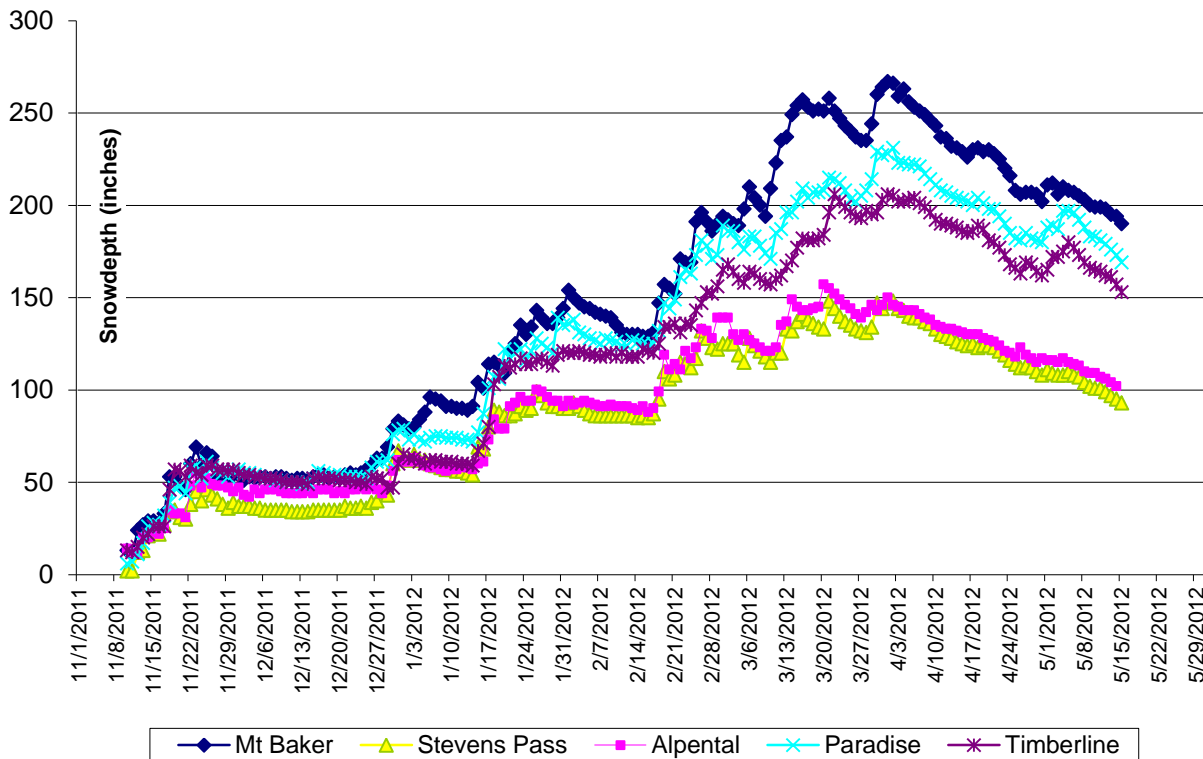
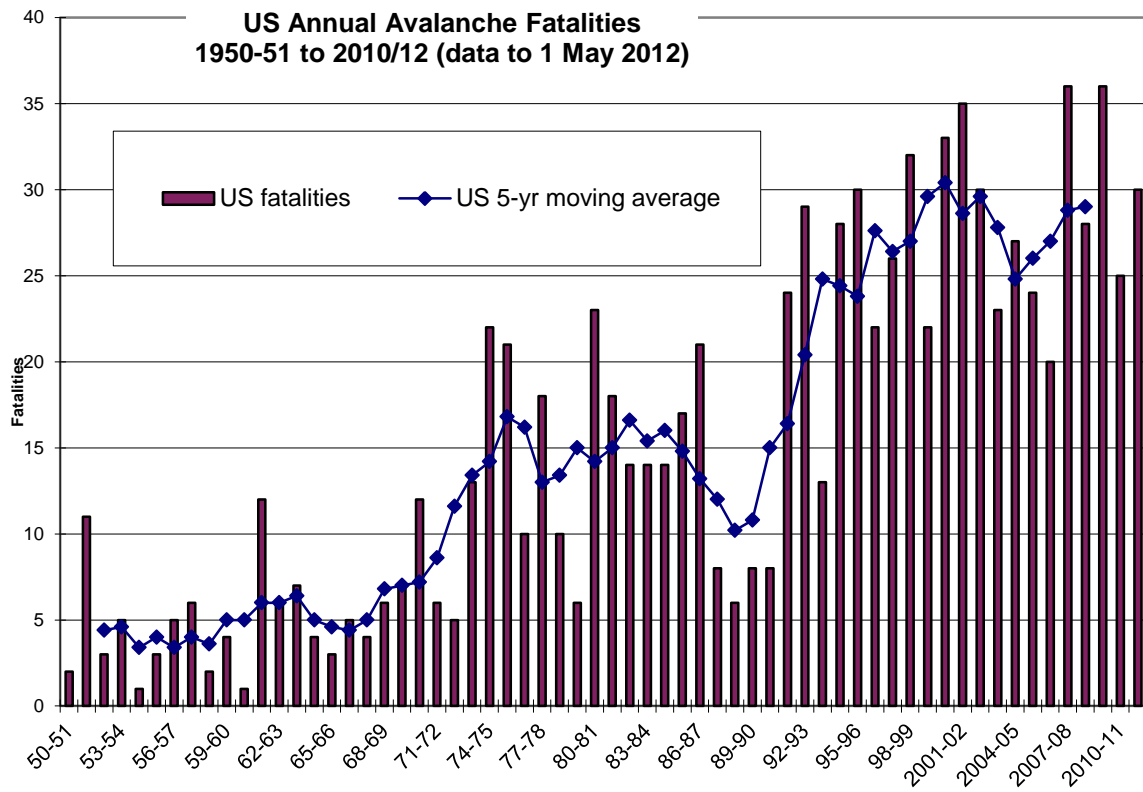


Figure 4. Total daily snowdepth plot for various NW mountain stations for the 2011-12 winter season.

AVALANCHE ACCIDENTS AND TRENDS

US And North American Statistics

As mentioned in the *Message from the Director* the past strong La Niña winter was a challenging one avalanche-wise in the NW...but it was even more challenging in other areas of the US, including Utah, Montana, Wyoming and Colorado—where a meager snowpack combined with cold conditions to develop a highly sensitive and long lasting layer of depth hoar or well faceted snow for most of the winter. When loaded by subsequent snowfalls, related enhanced danger persisted throughout the winter and into the spring, producing an above average number of avalanche accidents, close calls and overall fatalities. In the NW and western Canada, a problematic and very persistent facet/crust combination that formed in late January and early February provided the most severe of avalanche forecasting challenges and a rash of avalanche accidents, including the four fatalities recorded to date (thru May 1, 2012) in the NW.



Winter season

Figure 5. Annual US avalanche fatalities, 1950-2012

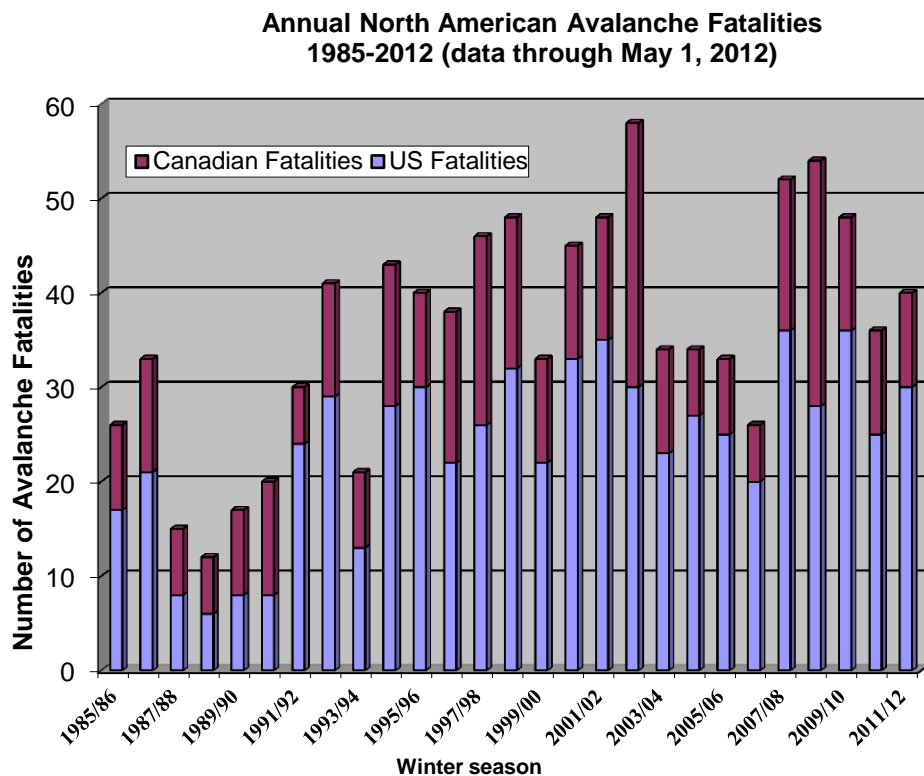


Figure 6. North American Avalanche Fatalities by year, 1985-2012.

However as in years past, when fatality statistics are compared with numbers of avalanche encounters that “only” resulted in injuries, it once again appears that a great many folks were given second chances in their snowpack conflicts with avalanche terrain. In any case, through

early May the US fatality toll stands at 30, slightly above the 5-year moving average of 29. Internationally for North America (Canada and the US), the annual fatality total thru the date of this writing (late May) stands at 40 (Fig 6).

At the time of this writing in the NW, though, a large amount of recent snow has yet to settle, stabilize and melt, and prior statistics suggest there are often secondary increases in

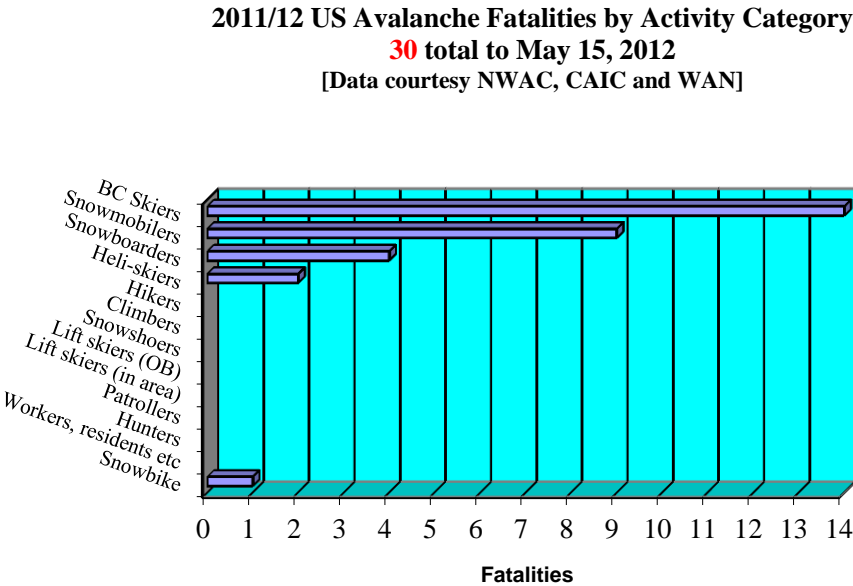


Figure 7. 2011/12 avalanche fatalities by activity category
 avalanche related fatalities in June, when BC traveler awareness of the avalanche phenomena seems to wane.

In stark contrast to many past winters when avalanche deaths by activity were dominated by snowmobilers, back country skiers suffered mightily in 2010/11 and again in 2011/12 and seemed to be the primary targets of these past two years of La Niña driven snowcovers. Overall during the past 10 years, US avalanche fatalities by user group have been led by either snowmobilers or BC skiers, who collectively comprise over 64% of all avalanche deaths since

Total	Percent	Activity
112	26.2%	BC Skiers
164	38.3%	Snowmobilers
58	13.6%	Snowboarders
2	0.5%	Heli-skiers
13	3.0%	Hikers
33	7.7%	Climbers
17	4.0%	Snowshoers
6	1.4%	Lift skiers (OB)
6	1.4%	Lift skiers (in area)
2	0.5%	Patrollers
1	0.2%	Hunters
13	3.0%	Workers, residents etc
1	0.2%	Snowbike

1997 (past 15 years)...and almost 57% of all deaths since 1985. During this most recent 15-yr period (1997-present), 164 snowmobilers (~38% of the total) and 112 BC skiers (~26% of the total) have been killed by avalanches. The following summarizes the remaining categories of US avalanche fatalities for the 1996/97 to 2011/12 time frame:

Table 1. Total US avalanche fatalities by activity category by percentage and number of deaths—1996/97—2011/12

Fortunately, after a bad season for lift skier fatalities (3 in-bounds fatalities) in 2008/09, this surprising trend has not been repeated in subsequent years, at least not to that extent. However,

with one patroller and one lift skier killed in 2009/10 by avalanche and another patroller death in 2010/11, awareness and focus on avalanches continues to be critical for all who spend a significant portion of their work in the snow. Note that the fatalities by activity category figure shown here do not include an additional 10 fatalities in Canada (including 3 snowmobilers, 3 back country skiers and 4 mechanized skiers—heli or snowcat access), all in BC). See the Canadian Avalanche Center database at: <http://www.avalanche.ca/cac/library/incident-report-database/view> for more detailed Canadian avalanche information.

Northwest Avalanche Statistics

Following on the heels of a strong La Niña in 2010/11 that produced significant PWL's (persistent weak layers) that developed in mid-January into mid-February and persisted in some fashion and produced avalanche issues well into May, the weak-moderate La Niña that dominated the winter of 2011/12 also surprised experienced travelers and produced many avalanche incidents involving buried weak layers. The monthly summary of avalanche warnings and special statements issued by the center indicates a shift toward more danger in the mid-late winter (consistent with development of early-mid season PWL's and subsequent loading by later winter snowfall). Meanwhile, the annual summary of avalanche warnings (Figures 8 & 9) issued by the NWAC indicates that the last two Niña dominated winters produced an overall increase toward more warnings and generally higher danger associated with Niña events in the NW.

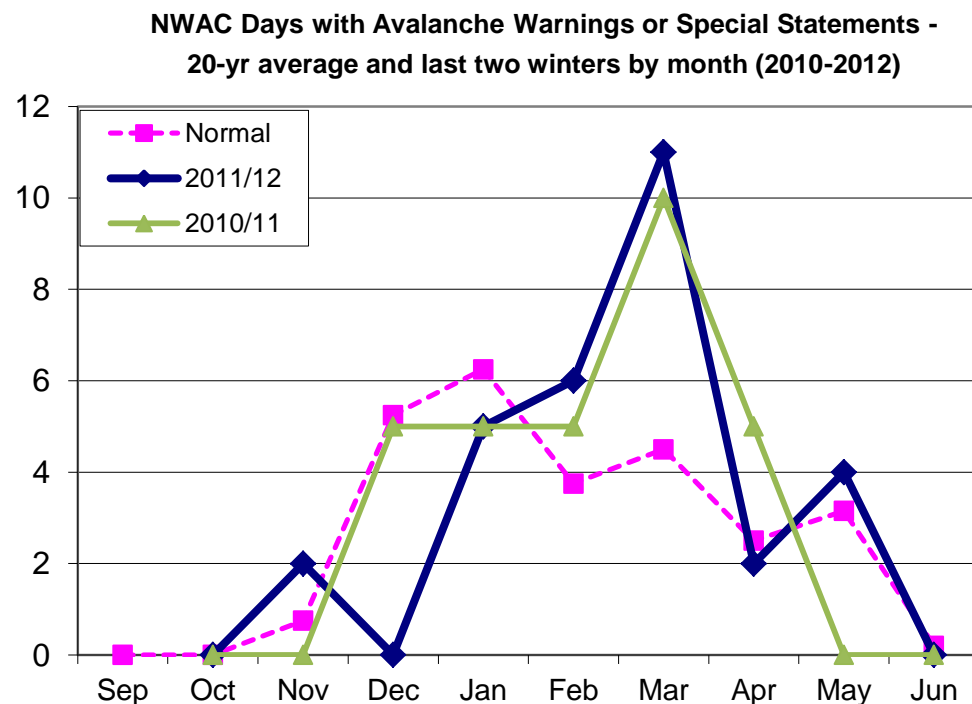


Figure 8. NWAC days/month with avalanche warnings or special statements

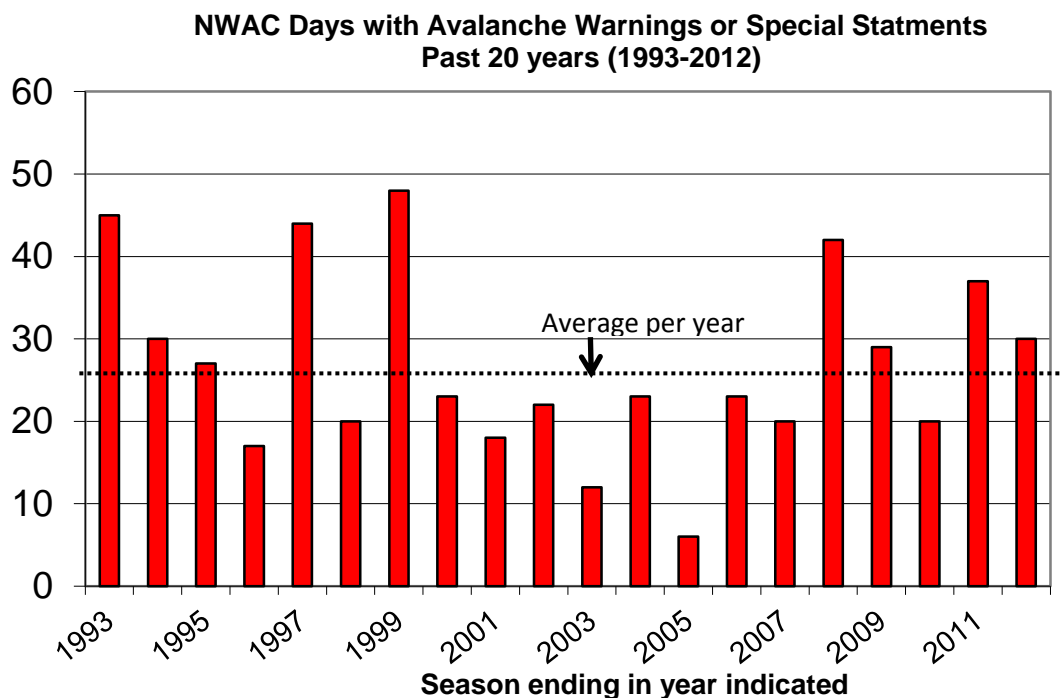


Figure 9. Days of warnings or special statements by year

With a total of 22 avalanche fatalities reported during the past five years in WA and OR, the four Northwest avalanche fatalities for the 2011/12 winter (at least thru the time of this report

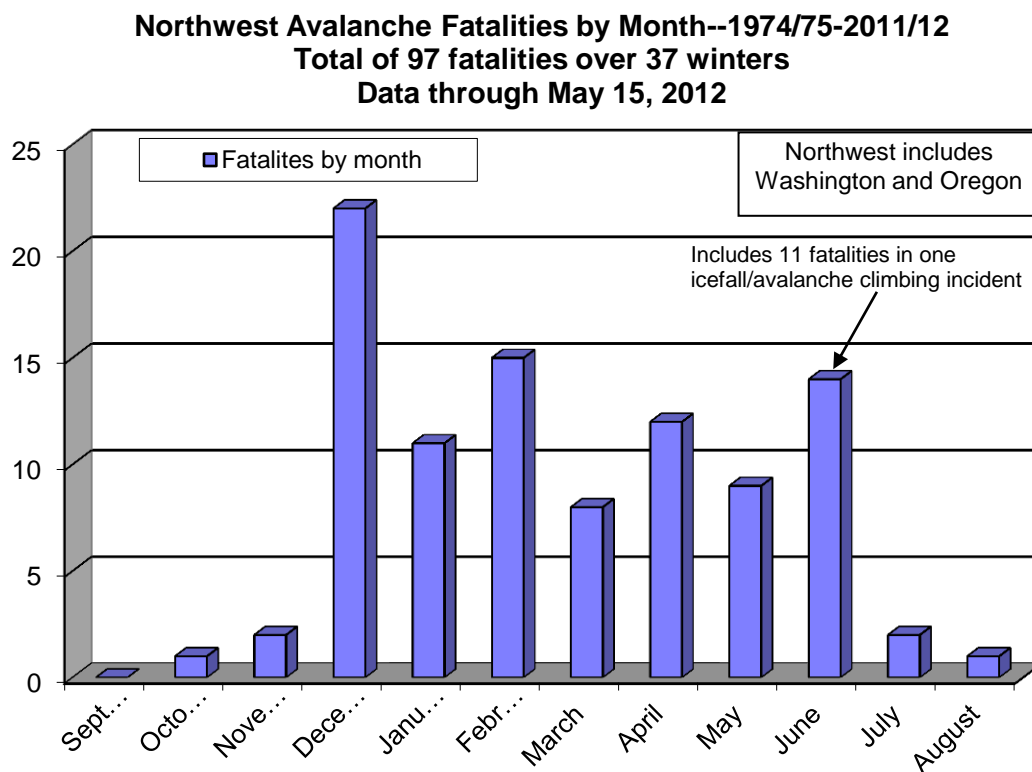


Figure 10. NW avalanche fatalities by month, 1974-2012.

printing in mid-late May) was slightly below the 5-year moving average of 4.4 fatalities/year for both WA and OR combined. As usual, detailed reports on the fatal accidents as well as on some luckier survivals can be found on the [NWAC web site accidents page](#).

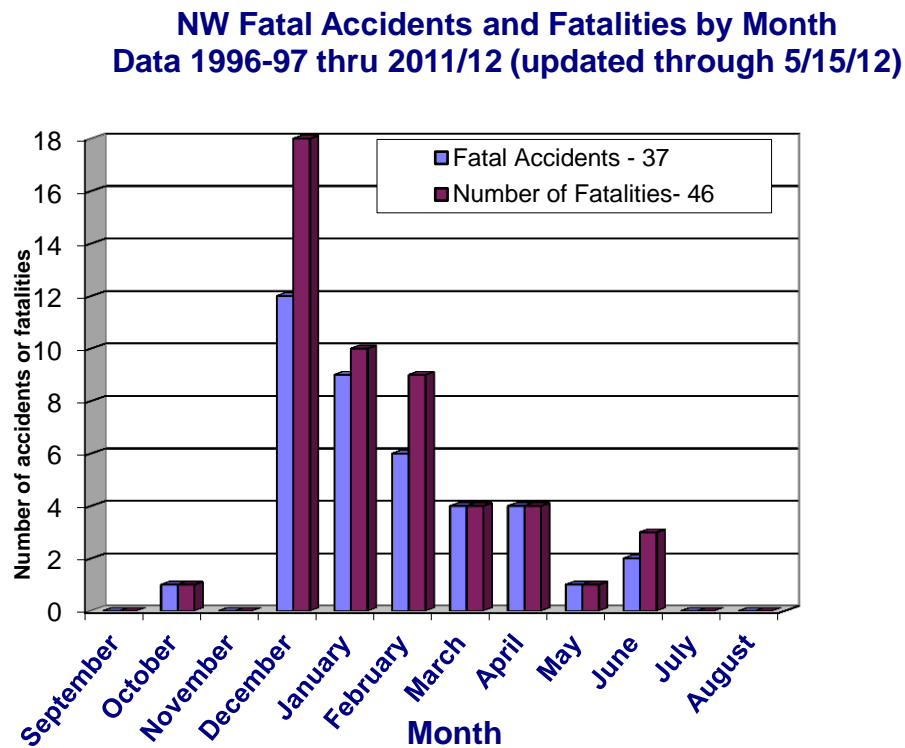


Figure 11. NW avalanche accidents and fatalities by month, 1996-2011.

From an analysis of NW avalanche fatalities by month for both the more recent term (past 15 years) and longer term (37 years), it appears that almost 25% of NW avalanche incidents and fatalities occur in December—a period often characterized by a more continental (i.e., faceted and weaker) snowpack in many NW mountain locations, one commonly associated with PWL's or persistent weak layers. Such snowpack instability/danger tends to last for a longer time (sometimes persisting into the subsequent spring in one fashion or another), and is often more difficult to discern by back country travelers as the unstable layers may be more deeply buried than casual examination may reveal. This bias toward early season incidents is illustrated in Figures 10 and 11 which span both the more recent 15 years (Fig 11) and the longer term (Fig 10—past 37 years) as well. However, they both underscore the fact that avalanche danger should be a year round concern as fatalities and accidents occur in almost every month of the year (they do occur in every month of the year if the monthly statistics are expanded to include the whole US).

As Figure 12 shows, most of the fatal NW incidents occurred when NWAC had forecast either a considerable or high danger for the back country, although a few occurred under moderate

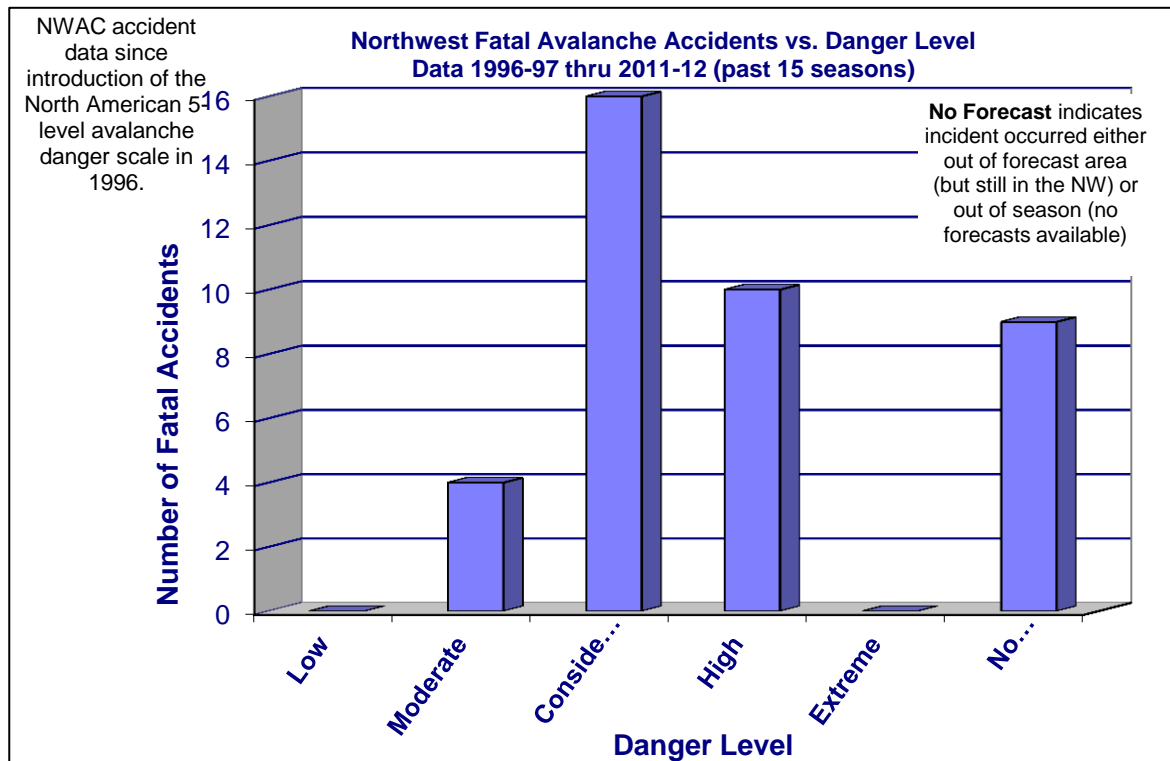


Figure 12. Northwest Fatal Avalanche Accidents by danger level, 1996-2012.

danger conditions. A significant number have also occurred either in areas not covered by the forecast or during times when the NWAC was closed (forecasters either in non-pay status or transitioned toward summer time fire-weather work).

Also as is evident from Figure 13, while the annual avalanche toll for the NW has experienced large year to year variability over the past almost 60 years, there has been a slow increase from the early 1990's. This gradual increase may be driven by a combination of factors, including greatly increased use of the back country overall, a more "extreme" mentality among back country users and the significant growth of some "newer" and more independent users such as snowboarders and snowmobilers. This trend could also be attributable to BC travelers: a) not having the forecast or, b) not being aware that there was a forecast or, c) not caring about the forecast. It is strongly hoped that the expanding NWAC web site presence as well as FOAC/NWAC expansion into social media are helping to improve the distribution of the forecast to a wider audience, and thus at least partially addressing the issues mentioned in a) and b) above. Although much more limited options exist for the NWAC to effectively address c) above, more innovative, easier to use, and more timely information exchanges (as are becoming possible via smart phones) may allow for increased opportunities to reach and affect more challenging user groups.

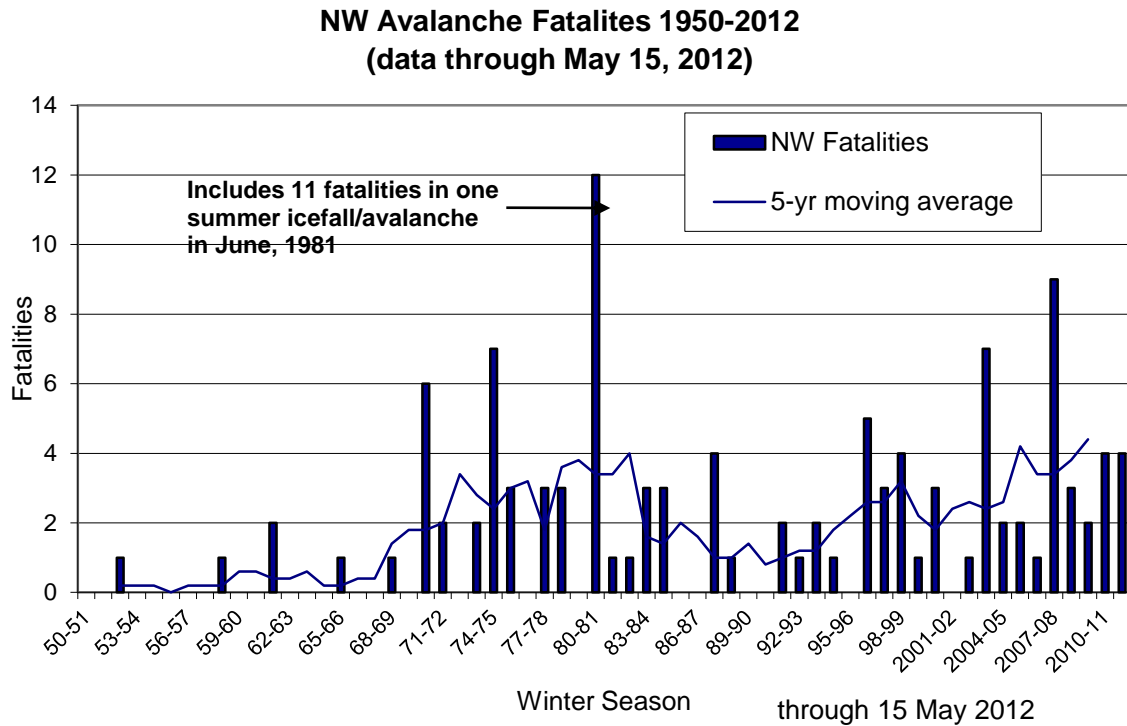


Figure 13. NW Avalanche Fatalities by season, 1950-2012.

During the 26-year time period for the US fatality table by state below (Table 2), a total of 645 (64) avalanche fatalities respectively have occurred in the US (Northwest) since 1985. This averages almost 25 avalanche deaths/year in the US as a whole and about 2.5/year for Washington and Oregon combined—or about 10% of the US total since 1985. Although the more recent 5 and 10-year running averages for the NW are up from the average of 2.5/year since 1985-86 (4.4 and 3.5 respectively), this shorter term increase is largely due to the record setting avalanche toll of 2007-08 when 9 fatalities were recorded in the Northwest.

UNITED STATES AVALANCHE FATALITIES by STATE																														
1985/86 to 2011/12 (to 15 May 2012)																														
Winter Season																											37 Years			
State	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	Total	Avg	State
CO	4	11	5	4	4	6	9	12	1	9	7	1	6	6	8	4	6	6	3	5	4	5	5	4	8	7	7	157	5.8	CO
AK	0	6	2	0	1	1	2	7	2	6	8	4	3	12	5	4	11	4	3	1	4	0	4	3	5	5	2	105	3.9	AK
UT	5	2	0	0	1	0	5	3	1	5	2	6	2	5	2	6	5	1	4	8	4	4	3	4	4	2	5	89	3.3	UT
MT	2	1	0	0	1	0	1	1	6	3	3	1	7	2	2	7	9	4	0	3	4	6	3	6	6	2	6	86	3.2	MT
WA	2	0	4	0	0	0	2	0	0	1	0	5	2	3	1	3	0	1	7	2	2	1	9	2	1	4	4	56	2.1	WA
WY	2	0	0	0	0	0	2	1	1	1	3	2	1	2	0	7	2	7	1	0	2	3	4	2	4	2	4	53	2.0	WY
ID	0	1	0	0	0	0	0	2	0	0	3	3	3	0	2	0	1	3	4	3	4	1	2	3	7	1		43	1.7	ID
CA	2	0	0	0	1	0	2	1	0	2	0	0	1	1	0	2	1	1	1	3	1	0	4	3	0	2	2	30	1.1	CA
NH	0	0	0	0	0	1	0	0	0	0	3	0	0	0	1	0	0	2	0	0	0	0	1	0	0			8	0.3	NH
OR	0	0	0	1	0	0	0	0	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1			8	0.3	OR
NV	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0			4	0.2	NV
NY	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0			2	0.1	NY
VT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0			1	0.0	VT
AZ	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			1	0.0	AZ
ND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0			1	0.0	ND
NM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0			1	0.0	NM
TOTAL	17	21	11	6	8	8	24	29	13	28	30	22	26	32	22	33	35	30	23	27	25	20	36	28	36	25	30	645	23.9	TOTAL

Table 2. Annual US Avalanche fatalities by state, 1985-2011.

Avalanche fatalities continue to lead the way for deaths by natural disaster in Washington State, as indicated by this pie chart showing fatalities by natural disaster from 1950-2010. However, it should be noted that this chart does not include indirect heat related deaths in

FATALITIES CAUSED BY NATURAL DISASTER IN WASHINGTON STATE, 1950-2010*

Compiled by Northwest Weather & Avalanche Center

Total number of fatalities by natural disaster = 424

*Avalanche data from 1950 through April, 2011; all other data thru end 2010

Data from WA-DEM, FEMA, DNR, USFS, NWS, U of W

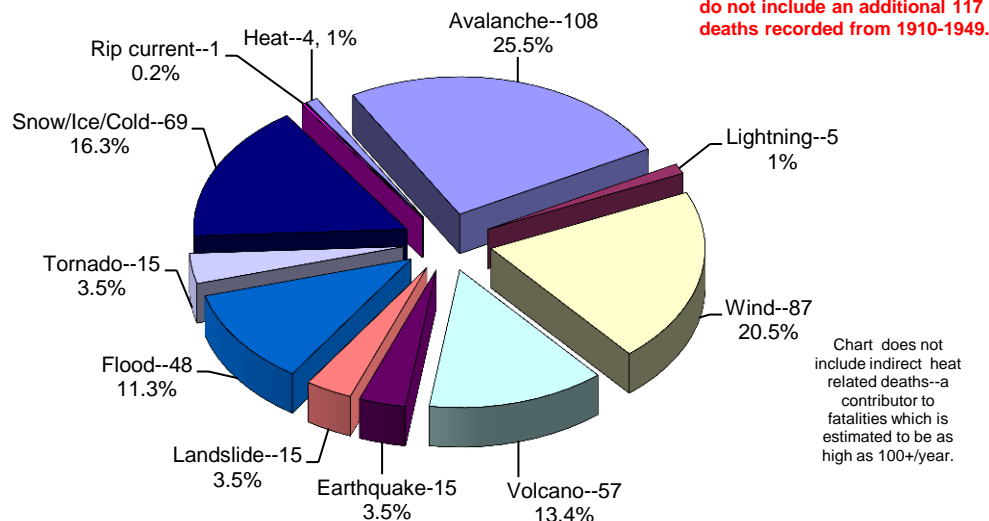


Figure 14. Fatalities caused by natural disaster in Washington State, 1950-2010.

Washington. While an indirect and difficult to measure statistic, it is estimated that approximately 100+ deaths/year (2010 personal communication with Dr. Lawrence Kalkstein, Research Professor of Geography and Regional Studies, University of Miami) may be attributable to excessive heat in the Puget Sound area and perhaps twice that number statewide.

PRODUCT DISSEMINATION AND USAGE

Selected FOAC-NWAC web site traffic statistics: 2011-12.

Overall Usage Statistics:

With an increasingly graphical interface, and several new features unveiled this year (e.g., GIS display of danger rose, primary avalanche concerns), the FOAC/NWAC web site continues to show a rather robust annual increase in usage for almost every category measured via Google Analytics. As some of the following figures indicate, total and unique user visits are both up as compared to last year (+7.2% and +23.3%, respectively). Meanwhile, all other standard measures also show slow but significant improvement over last year, including page views (+9%), pages/visit (+1.6%), average visit duration (+8.1%), bounce rate (-2.1%) and new visits (+14.5%).

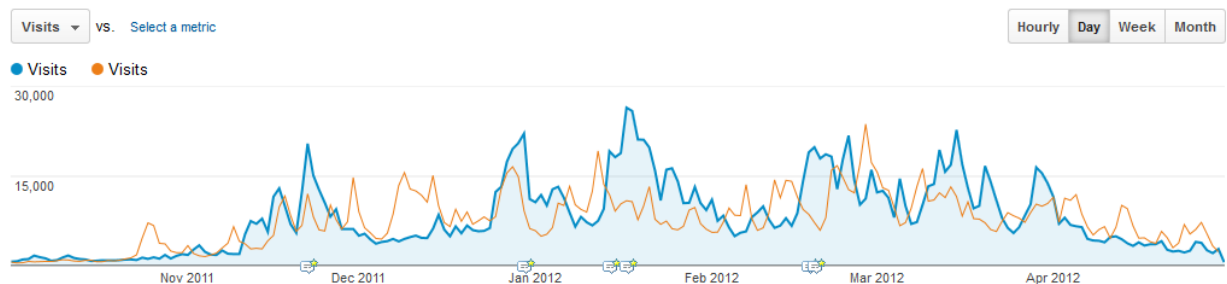


Figure 15. Daily web site access--2011-12 (blue) versus 2010-11 (orange).

The first graph (Figure 15) illustrates the daily web site usage for 2011/12 (in blue) as compared with 2010/11 in orange; the second graph (Fig 16) shows the overall modest growth in user visits to the web site over the past three seasons of operation (since introduction of the new Django coded and more graphically oriented web site). To place these figures in more user friendly context comparisons between 2011/12 and 2010/11 (October 1 thru April 30 of the respective years with most recent year first):

- **Overall visits:** 1,746,700 versus 1,628,800; +~118,000 visitors
- **Unique visitors:** 456,650 versus 370,400; +~86,000 unique visitors
- **Page Views:** 3,580,600 versus 3,285,670; +~290,000 page views
- **Pages/visit:** 2.05 versus 2.02; +~1.6%
- **Avg. visit duration:** 1:48 minutes versus 1:40 minutes; +~8.1%
- **Bounce Rate:** 56.6% versus 57.8%; -~2.1%
- **% New Visits:** 24.5% versus 21.4%; +14.5%

It is also interesting to note the geographical distributions of web site users. Overall, US visitors comprise about 98% of user visits, with Canadian visitors making up about 1.4% of the total. The remaining ~1% include (in order of decreasing visits) UK, Mexico, Australia, Germany, France, Italy, Saudi Arabia, Japan, Bulgaria and China...as well as 142 other countries/nations.

While it is not surprising that most web site users are clustered in Washington and northern Oregon (about 90% of the total US visits), it is more surprising that web site usage has also shown modest visitor growth from around the globe (however, it is unknown if this growth is being fueled by more internet access globally or more snow-savvy users interested in more snow and avalanche related information).

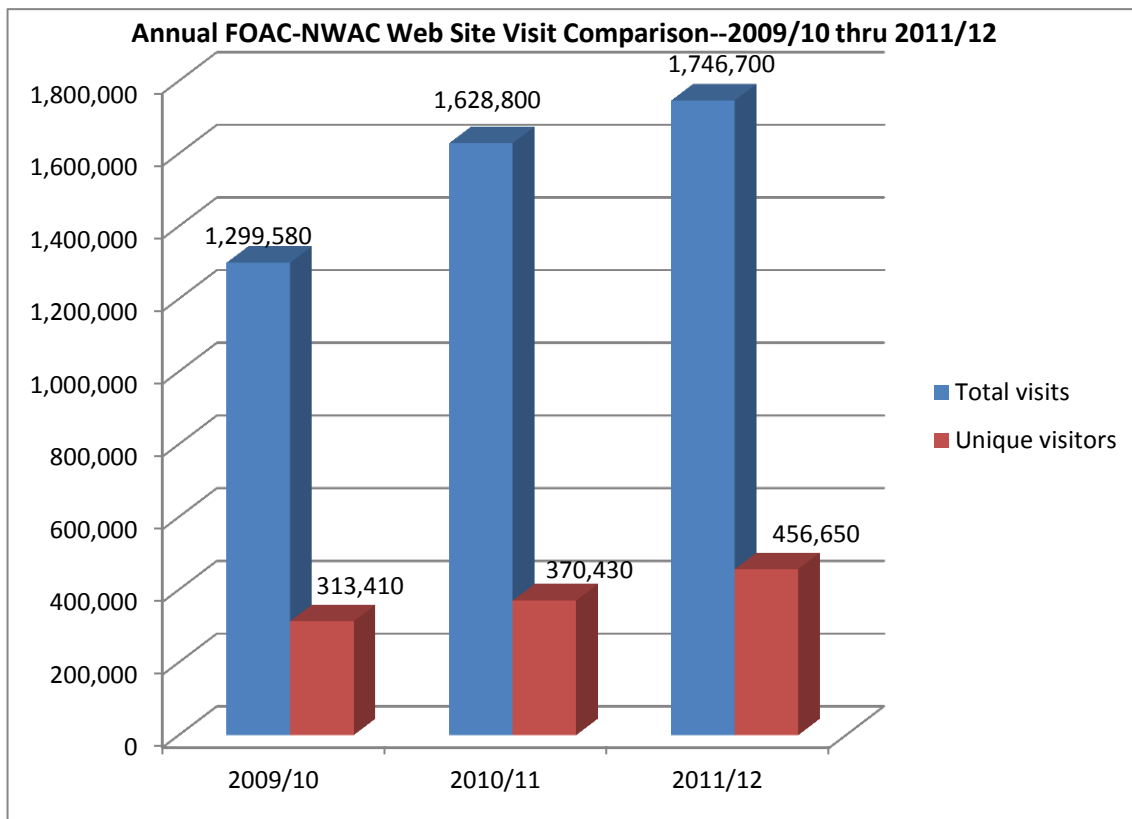


Figure 16. Annual FOAC-NWAC Web Site Visits and Unique Visitors by year, 2009-2012—for the period Oct 1-Apr 30 of each indicated year.

In any case, the top 10 US State accesses of the web site (in descending order of user visits) include Washington, Oregon, California, Texas, Colorado, New York, Illinois, Arizona, Idaho, and Utah, with all except Oregon and New York showing (mainly) modest annual increases in visits over time. At this point, it is not known why 2011/12 Oregon visits to the web site dropped about 5% or ~60,000 visits compared to 2010/11.

More locally during the past year, as can be seen from the following graph (Fig 17) showing the number of web accesses by physical location of the access point within Washington State (top 25 locations only), most web site visits originate in Seattle or Bellingham. However, when all locations are summed for either west slope or east slope locations, about 15% of the overall visits originate in locations east of the Cascade crest (e.g., Wenatchee, Spokane, Yakima,

Ellensburg, Winthrop, Leavenworth and Kennewick) with the remaining 85% of users coming from west side locations.

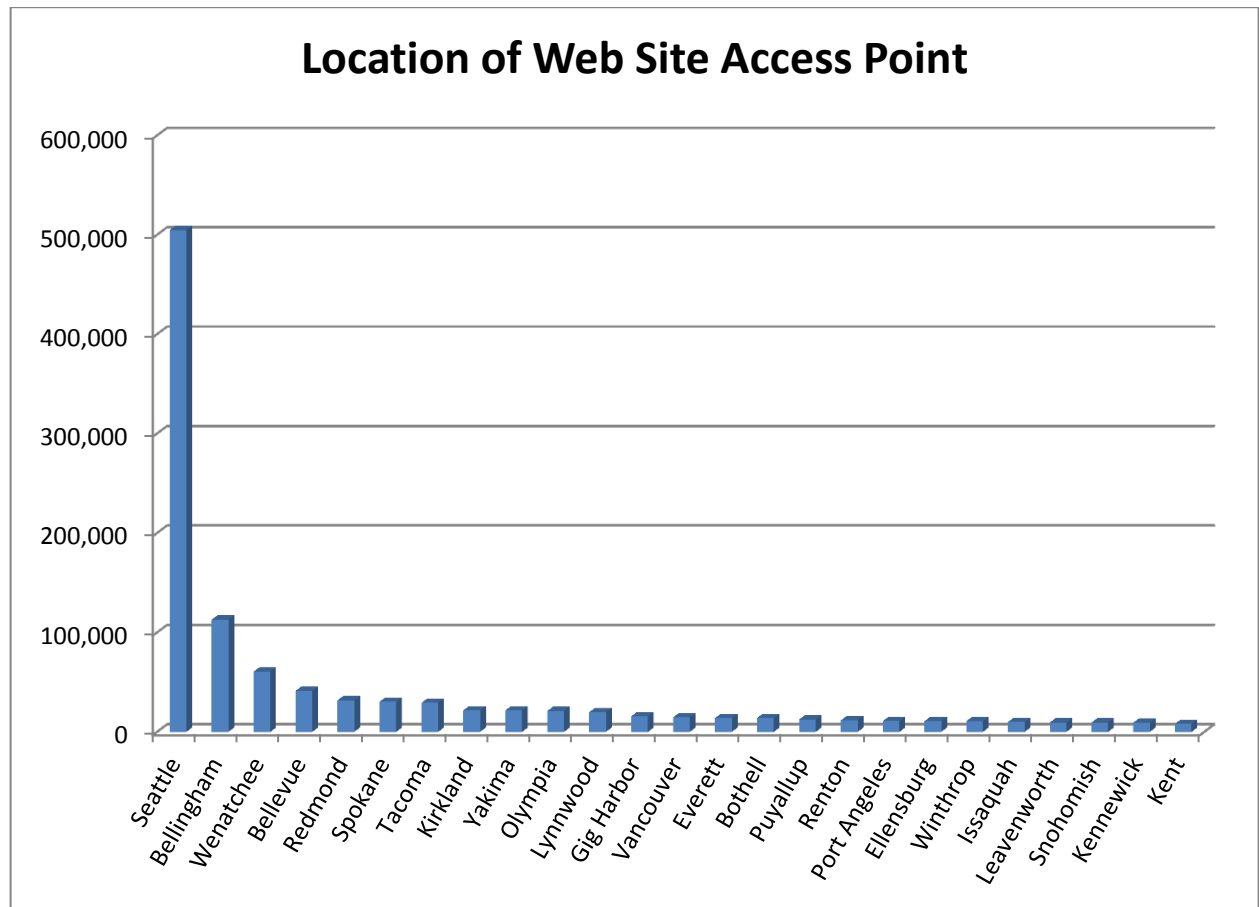


Figure 17. Originating location and visit totals for 2011/12 web site access.

If total visits and unique visits are averaged for the annual period of record (~210 days), average daily totals are 8,323/day and 2,177/day, respectively. In reality, this daily (or weekly) usage is more often driven by the weather and avalanche conditions at the time, with this number ranging from about 4,000 to 30,000 total visits/day (28,000 to 210,000 total visits/week) or from about 7,000 to 50,000 unique visits/week.

Types of Visits:

During the past few years, about 75% of all visits are returning visitors with 25% new visitors. This indicates that there is both user loyalty and that the site is also attracting a significant number of new visits/year. While about 25% of the total visits happen only once (~428,000 visits), well over 50% of the visitors return 9 or more times/season with about 20% visiting the site 100 or more times/year.

During the past winter season (Oct-Apr), the top browsers for accessing the web site included (with annual percentage use in parentheses): Safari (31%), Internet Explorer (30%), Firefox (18%), Chrome (11%). Top operating systems used to access the site included: Windows (51%), Macintosh (21%), iPhone (12%), Android (8%) and iPad (4%). Top ISP's are spread

across a great many vendors, among them Comcast (~30%), Qwest (8%), Verizon (6%) and Frontier (6%).

The percentage of mobile or smart phone visits continues to rise and has almost doubled every year since 2009, with almost 27% of visits now driven by cell phone use and 73% from more traditional devices such as PC's or laptops. Currently mobile phone usage counts for about 25% of site accesses; in the 2010/11 winter these figures were ~15% mobile and 85% traditional, respectively, while in 2009/10 the cell phone usage percentages were around 8% with over 91% from more traditional sources (see Figure 18).

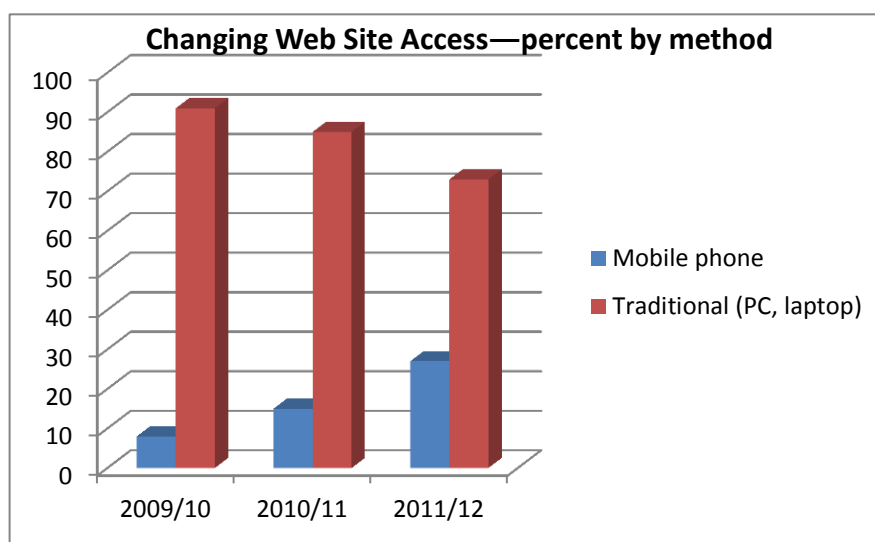


Figure 18. Changing methods for web site access

In terms of kinds of mobile devices accessing the web site for last season, the iPhone accounted for ~44% of mobile visits overall, the iPad ~14%, various Android devices ~19%, and a variety of others about 23%.

Most Used Products:

The most accessed pages for the web site include the home page (~20% of all visits), the current weather forecast (~12%), current avalanche forecast for a variety of zones (~11%), current hourly weather data for Mt Baker and Mt Hood Meadows (~6% each), for Crystal Mt and Snoqualmie Pass (~5% each), and for White Pass, Alpentel, & Stevens Pass US 2 (~2-3% each).

On another note, the new GIS based display of danger rose information became operational in late January. Visits to this page increased significantly in February and March, and then decreased in April and May (much like the overall web site usage figures). Total pageviews of this new page (which will be adding snow, weather and avalanche observations to the geographic displays prior to next winter) reached 12,853 (Feb-early May) with 7,616 new or unique visits.

Referrals/Referred Visits:

About 27% of overall user visits come directly to the web site (no referrals) with ~16% referred by Google. Of those total visits referred to nwac.us by other sites, ~15% come from crystalmountainresort.com, ~14% from other NWAC site pages, ~13% from skihood.com, ~11% from either wsdot.wa.gov or wsdot.com, ~9% from summitatsnoqualmie.com, , ~6%

from skiwhitepass.com, ~4% from Stevenspass.com and Timberlinelodge.com, and ~2% from methownet.com.

When searching for the FOAC/NWAC web site, the top search keywords include (in order of decreasing usage):

- nwac
- northwest avalanche center
- nw avalanche center
- nwac mt baker
- nwac.us
- northwest weather and avalanche center
- nwac forecast
- nw avalanche
- www.nwac.us

Phone Recordings:

With rapidly changing technology and user preferences, the long standing phone recordings of avalanche forecast information are slated for greener pastures at the end of the 2011/12 winter season. Since its zenith of usage in the mid 1990's (average of 25-30,000 calls annually), the phone recording access has dwindled to less than 3,000/year. Spread out over the winter season (~6 months), this averages about 500 calls/month or ~125/week, with peak accesses of about 250 calls/week recorded during last winter. When compared with Internet access of up to 20-30,000 visits/day on the web site, such dissemination methods no longer seem to serve the public in an effective fashion. This discontinued operation will be discussed at the annual NWAC Cooperator meeting and the NWAC Advisory Council Meeting in late May and early June, but it is thought that forecaster and user time may be better spent than on phone recordings that may be difficult to recall and that are reaching a small and declining audience.

ENSO, SNOWPACK AND AVALANCHE ACCIDENTS

The acronym ENSO stands for El Niño-Southern Oscillation, the periodic heating (or cooling) of near surface waters in the equatorial tropical Pacific Ocean. The occurrence of ENSO events have long been linked to global climate changes when one of its warm (El Niño) or cool (La Niña) phases is underway. While this is not the place to describe the event in detail, several interesting, possibly ENSO-related trends have been studied of late, including the potential correlations with North American avalanche accidents as well as NW snowdepths and snowpacks (for more detailed info on ENSO events, consult the [NCEP web site](#) as well as several articles in the December 2010 issue of the [Avalanche Review](#); see also the publication archives section of avalanche.org at:

http://www.americanavalancheassociation.org/tar/TAR29_2_LoRes.pdf).

Preliminary and possible correlation effects of ENSO and avalanche accidents were presented in an ISSW 2008 paper by Mark Moore entitled: [ENSO AND AVALANCHE FATALITIES: IS THERE A CORRELATION?](#) From the results of an updated analysis of this correlation (through the winter of 2012), it still appears as if ENSO events impart some effect on the "character" of the snowpack, its evolution or the timing of its development, and associated avalanche activity and danger (reflected by associated avalanche fatalities during the winter of

the event). And of course when the jetsream and main storm track of incoming Pacific weather systems is affected by ENSO, this translates into significant snowfall and resulting snowdepth effects as well.

ENSO Snowdepth Effects:

As the following figures (Figures 19-23) of annual snowdepth accrual indicate, the recent La Niña years of 2010/11 (strong La Niña) and 2011/12 (weak to moderate La Niña) suggest an overachieving snowpack during this cool phase of ENSO. This evolution toward greater than normal snowdepths in Washington and northern Oregon seems to be most dramatic during the mid-late winter, and often correlates to an extended and normally cool and wet spring.

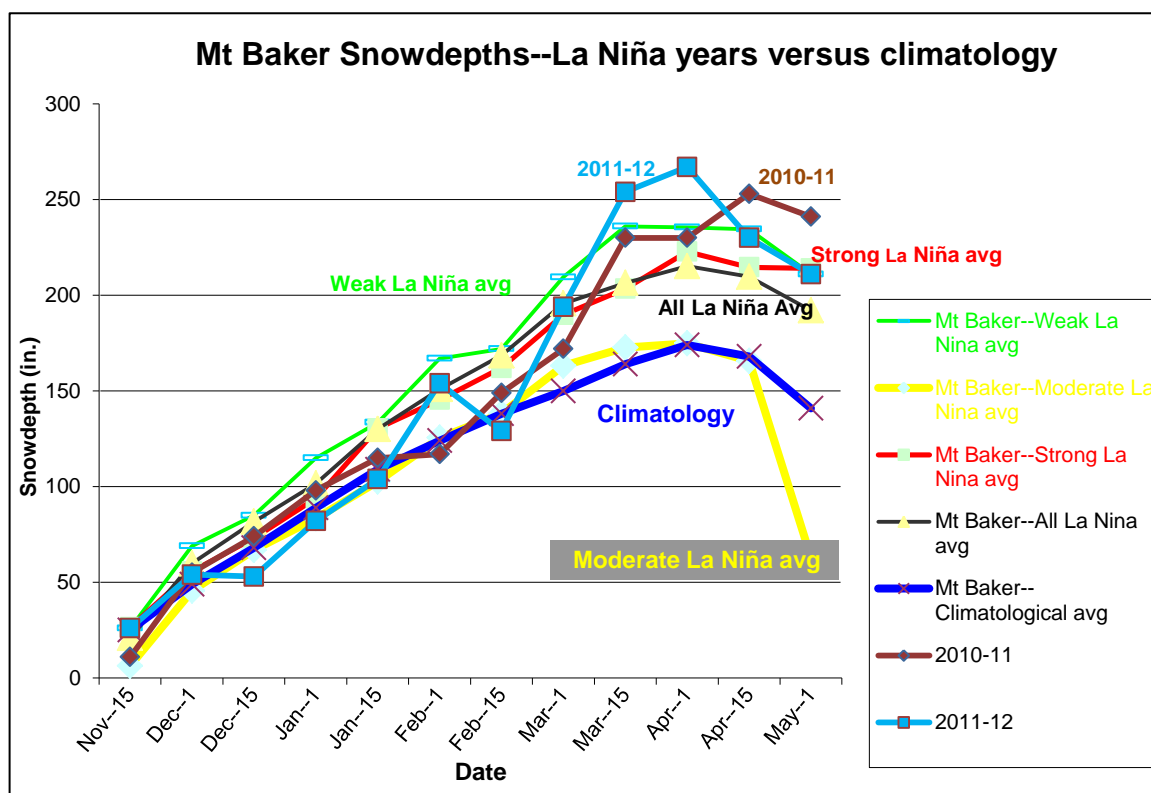


Figure 19. Mt Baker, WA--La Niña snowdepth evolution versus normal (climatology). 2010/11 winter was a strong La Niña while the past winter was a weak to moderate event.

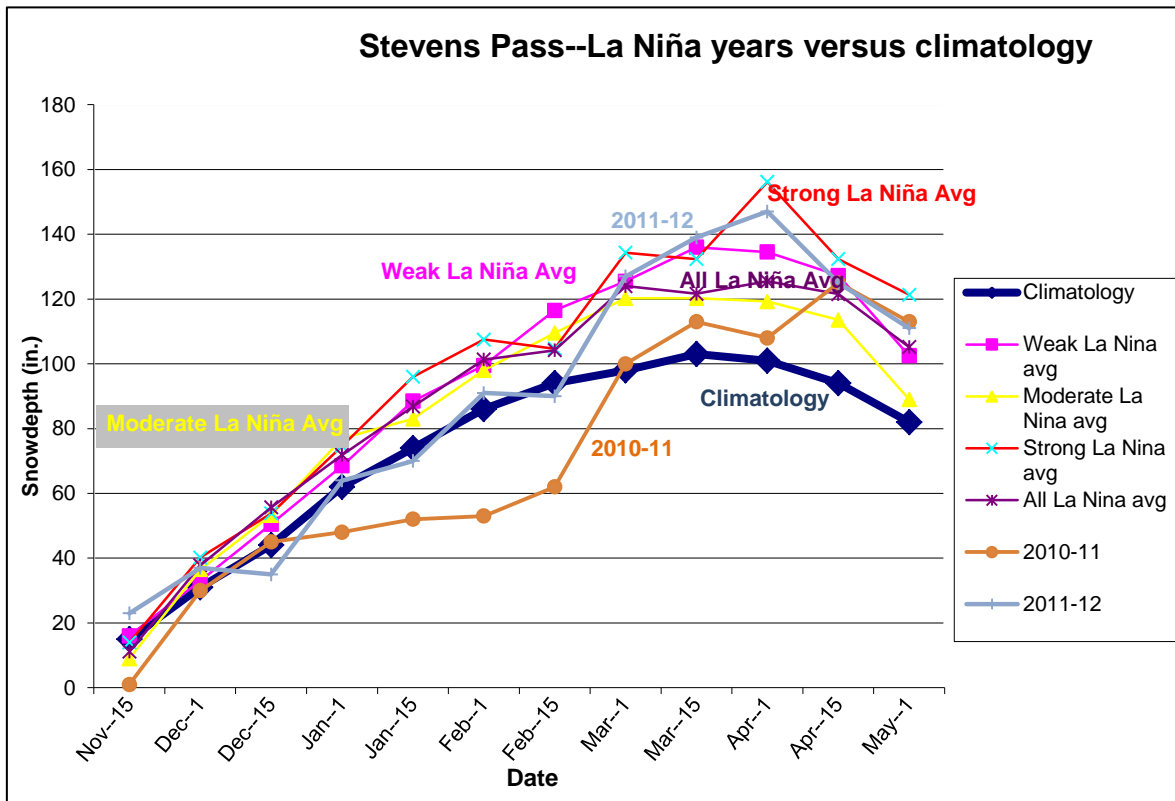


Figure 21. Stevens Pass, WA—La Niña snowdepths versus climatology

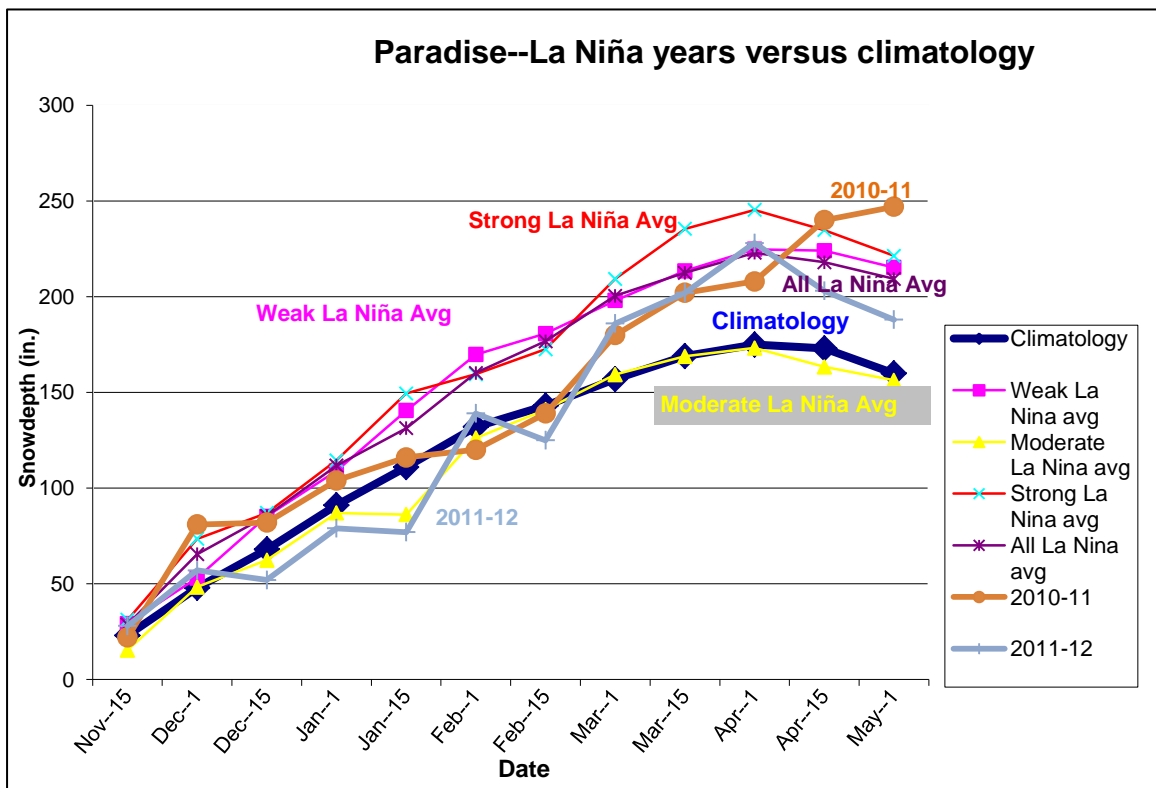


Figure 20. Paradise, WA—La Niña snowdepths versus climatology

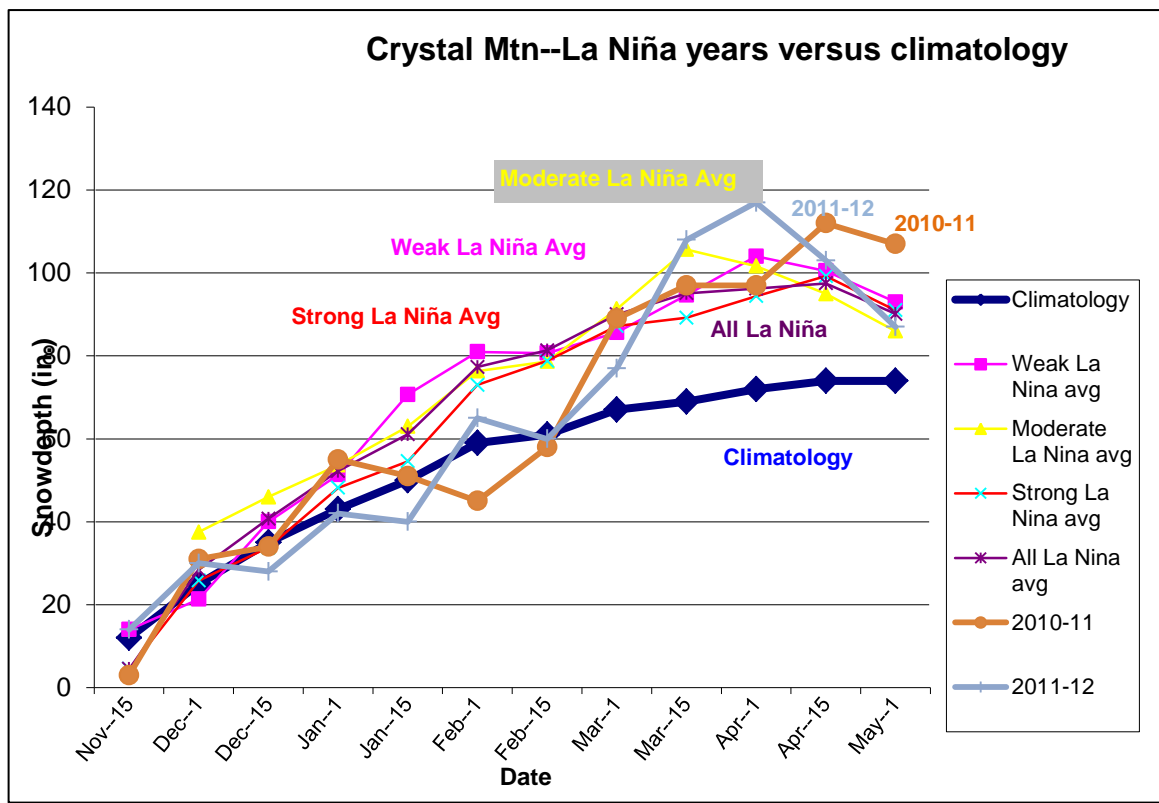


Figure 22 Crystal Mt, WA—La Niña snowdepths versus climatology

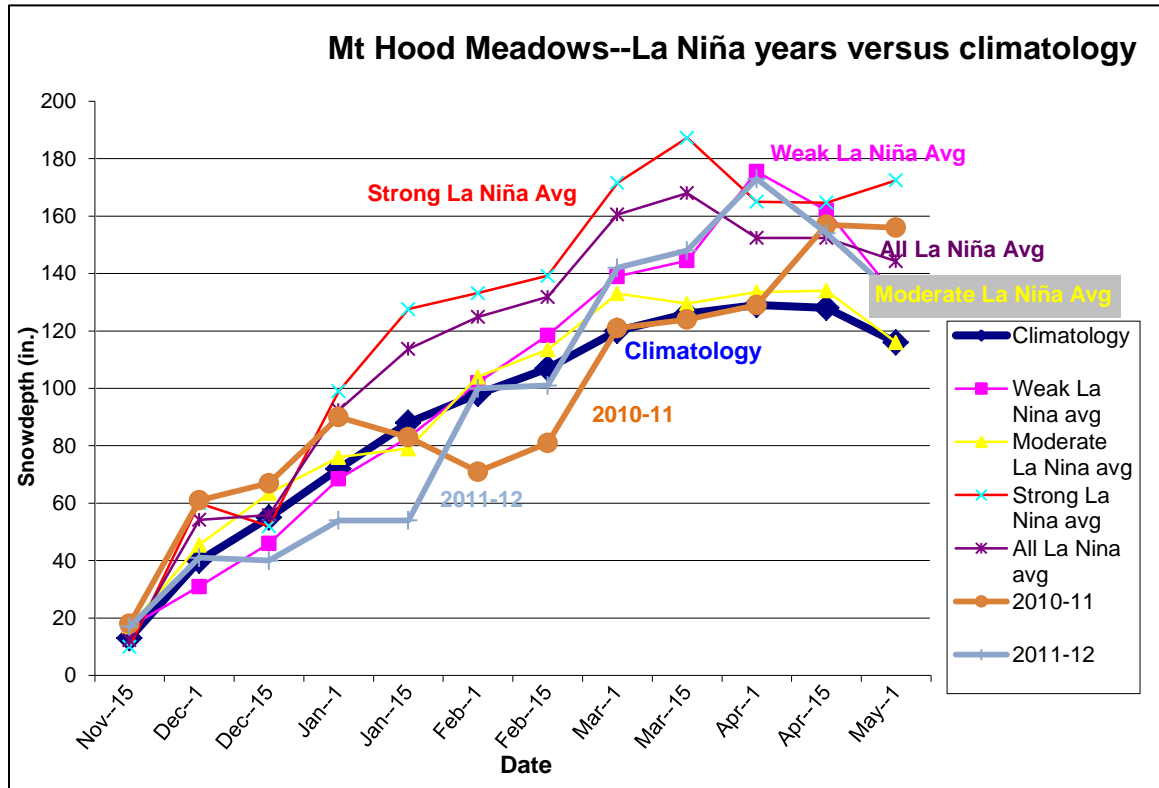


Figure 23. Mt Hood Meadows, OR—La Niña snowdepths versus climatology

Possible ENSO Effects on Avalanche Fatalities:

As is evident from the snowpack figures above, ENSO events affect both the timing and magnitude of snowpack development. This evolution can and does have an affect on snowpack structure and stability, or the overall “character” of the snowpack...or how weak, how strong and it what relationship. When this varying *character* of the snowpack during ENSO events is combined with the human factors of those who travel across it, there seems little doubt that

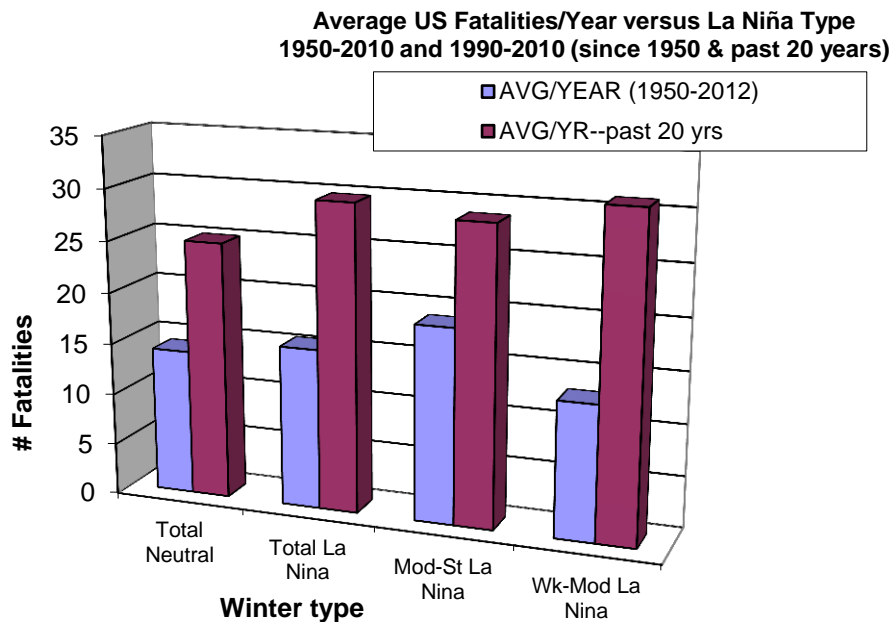
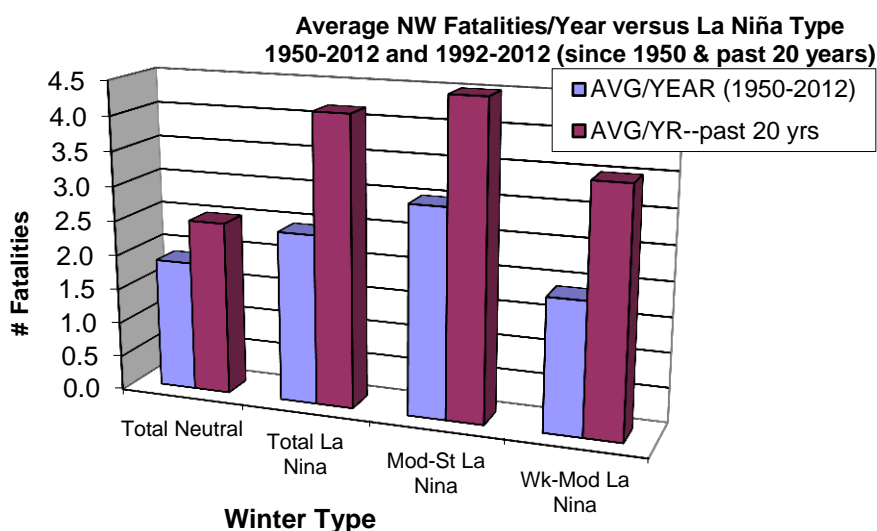


Figure 24. Average US fatalities/yr versus La Niña type

conditions arise, BC travelers may approach these unusual conditions in ways that have always worked before, but unknown to them, not under these new and different sets of stability conditions.

While a relatively small number of ENSO events may skew the results, recently updated

Figure 25. Average NW fatalities/yr versus La Niña type



resulting unusual snowpacks may produce unusual stability patterns and as a result unusual avalanche accidents (either an excess or deficiency), depending on whether the resulting snowpack is unusually shallow, unusually deep, unusually weak or unusually strong or some atypical combination of the above. When atypical snowpack

analyses obtained when comparing ENSO events with annual avalanche fatalities by state and country still seem to corroborate some sort of relationship. Figure 24 and 25 illustrate the apparent change in avalanche fatalities that have been experienced in the NW (WA & OR) and US

respectively, during different types of La Niña (LN) winters as compared with neutral winters (neither La Niña or El Niño). These figures also compare this fatality trend across two time periods—1950-2012 and 1992-2012 (past 20 years).

While no clearcut guidelines are evident for the LN/Fatality relationship over the longer time period since 1950, a modest percentage increase in avalanche fatalities is indicated over the shorter time frame (past 20-yr term) for both the NW and the US as a whole. However, as mentioned before, the relatively small number of events analyzed for the past 20-yr time frame may limit the usefulness and applicability of this relationship.

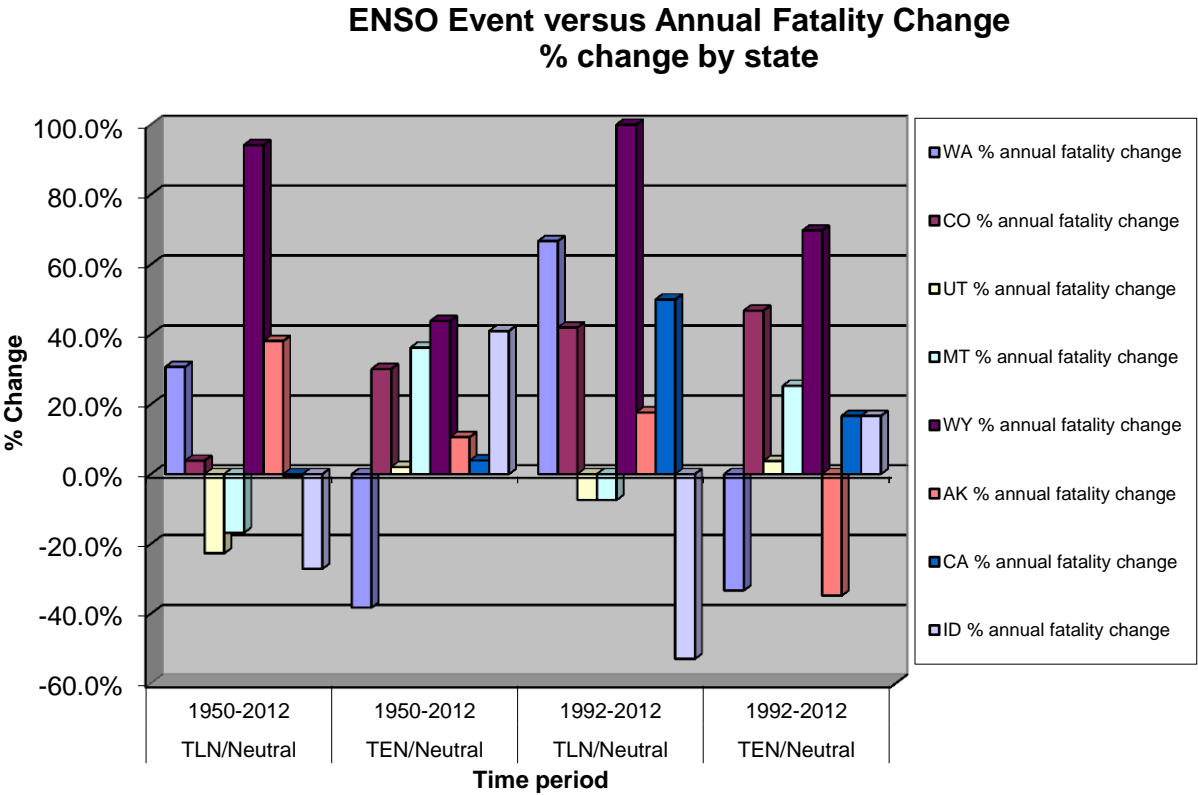


Figure 26. ENSO event versus annual fatality % change by state

If this relationship is extended over a broader region and is analyzed to include both La Niña (LN) and El Niño (EN) events, Figure 26 shows the respective percentage fatality change of LN and EN over neutral winters for the states of WA, CO, UT, MT, WY, AK, CA and ID.

EDUCATION

In September 2011, the Friends of the Northwest Avalanche Center (FOAC) hired Scott Schell as their Education Coordinator. Scott began managing all FOAC education efforts, expanding the adult programs and furthering the development of the youth and snowmobile programs reaching a wide range of winter outdoor enthusiasts. In addition to Scott's time and the instructor's time, many volunteer hours were contributed to make these efforts a success.

During the 2011-2012 season, with FOAC spearheading and presenting the majority of the avalanche education classes, together the FOAC and NWAC conducted 79 Avalanche Awareness presentations to user groups at retail stores, agencies, and organizations, reaching over 2800 interested attendees in the states of Oregon and Washington.

In addition to the avalanche awareness presentations, FOAC funds were spent to continue public outreach by developing, updating and printing signs, brochures and other informational materials, including awareness signs installed at Washington and Oregon Sno-Parks and trailheads. The FOAC produced and distributed roughly 3000 avalanche safety brochures, 7500 avalanche hotline cards and 2500 avalanche safety checklist cards.

Table 3. FOAC and NWAC avalanche education, 2011/12

Date	Location	Instructor Name	Type of class	Total Participants
11.9.2011	REI Southcenter	Tino Villanueva	Adult	14
11.10.2011	REI Issaquah	Scott Schell	Adult	28
11.12.2011	REI Southcenter Snowshoe Festival	Matt Schonwald	Adult	25
11.13.2011	REI--NSAS	Garth Ferber	Adult	250
11.14.2011	REI Alderwood	Scott Schell	Adult	30
11.15.2011	Margaret Wheeler Presents at OR	Margaret Wheeler	Adult	34
11.29.2011	REI Seattle	Jonathon Spitzer	Adult	160
12.1.2011	Patagonia Seattle	Matt Schonwald	Adult	58
12.3.2011	Premier Polaris in Monroe	Dave Jordan	Snowmobile	16
12.6 .2012	Oregon Nordic Club Ski Fair	Em	Adult	50
12.6.2011	Second Ascent	Ian Nicholson	Adult	42
12.7.2011	REI Southcenter	Matt Schonwald	Adult	8
12.8.2011	REI Seattle	Matt Schonwald	Adult	40
12.8.2011	Backcountry essentials - B-HAM	Lyle Haugelson	Adult	27
12.13.2011	Assumption School - B-Ham - grade 6	Joesph Anderson	Youth	24
12.13.2011	Assumption School - B-Ham - grade 7	Joesph Anderson	Youth	22
12.13.2011	Assumption School - B-Ham - grade 8	Joesph Anderson	Youth	26
12.13.2011	REI Issaquah	Ken White	Adult	25
12.13.2011	Mountaineers Snowshoe Committee	Scott Schell	Adult	12
12.15.2011	EVO - Seattle	Scott Schell	Adult	38
12.15.2011	REI - Alderwood	Dave Jordan	Adult	17

12.20.2011	REI - Redmond	Dave Jordan	Adult	12
1.5.2012	REI - Alderwood	Tyler Reid	Adult	18
1.6.2012	Hurricane Ridge Sports Club - Port Ang.	Tyler Reid	Adult	21
1.7.2012	REI Snow Shoe Event on the snow	Em	Adult	50
1.9.2012	Second Ascent	Ian Nicholson	Adult	56
1.9-13.2012	Holden Village	Em	Adult	83
1.10.2012	REI - Outreach	Ken White	Adult	20
1.10.2012	Ski Hawks Club - Tacoma	Dave Jordan	Adult	21
1.10.2012	REI - Seattle	Jonathon Spitzer	Adult	38
1.11.2012	OR - Seattle	Matt Schonwald	Adult	35
1.11.2012	REI - Southcenter	Dave Jordan	Adult	26
1.12.2012	Explorer West School - 6th, 7th, 8th grades	Matt Schonwald	Youth	95
1.12.2012	EVO - Seattle	Scott Schell	Adult	46
1.14.2012	NFS - Mt. Adams	Em	Adult	35
1.17.2012	REI - Issaquah	Ken White	Adult	7
1.19.2012	Backcountry essentials - B-HAM	Lyle Haugeison	Adult	11
1.21.2012	Mount St Helens Institute trip leaders	Em	Adult	8
1.23.2012	REI - Tacoma	Ken White	Adult	26
1.25.2012	Lynwood Moto Plex	Dave Jordan	Snowmobile	45
1.25.2012	REI - Redmond	Tyler Reid	Adult	19
1.26.2012	Crystal Mt NAI Level II	Mark Moore	Adult	20
1.26.2012	Everett Mountaineers	Ken White	Adult	30
1.26.2012	REI - Olympia	Tyler Reid	Adult	28
1.27.2012	UW Hydrology	Mark Moore	Adult	20
1.27.2012	Mazamas FOAC Benefit	Em	Adult	100
1.28.2012	Portland Mountain Rescue	Em	Adult	40
1.28.2012	Crystal Mt. Freeride School	Tyler Reid	Youth	36
1.29.2012	Crystal Mt. Freeride School	Tyler Reid	Youth	20
2.1.2012	REI - Alderwood	Dave Jordan	Adult	19
2.6.2012	Second Ascent	Ian Nicholson	Adult	48
2.7.2012	Explorer School - Redmond _ 2nd Grade	Dave Jordan	Youth	25
2.7.2012	WAC - B/C class avy awareness lecture	Scott Schell	Adult	32
2.8.2012	REI - Issaquah	Alexis Alloway	Adult	11
2.8.2012	Clark County Sheriff's SAR	Em	Adult	50
2.9.2012	REI - Bellingham	Joesph Anderson	Adult	45
2.9.2012	REI - Seattle	Ken White	Adult	42
2.9.2012	Dog River Coffee - Hood River	Em	Adult	52
2.11.2012	Clark SAR - outdoor beacon searches and stability test	Em	Adult	25
2.15.2012	REI - Southcenter	Dave Jordan	Adult	22
2.15.2012	OR - Seattle	Matt Schonwald	Adult	4
2.16.2012	EVO - Seattle	Matt Schonwald	Adult	7
2.17.2012	Billings Middle School - Greenlake	Alexis Alloway	Youth	28
2.17.2012	UW - Wilderness Medicine Interest Group (WMIG)	Forest McBrian	Adult	15
2.21.2012	Tele Tuesday - Mt hood Ski Bowl	Em	Adult	35

2.21.2012	REI - Redmond	Dave Jordan	Adult	34
2.22.2012	Mountaineers Snoshoe Club lecture	Scott	Adult	105
2.23.2012	Chelan County Snowmobile Club	Dave Jordan	Snowmobile	24
2.23.2012	Backcountry essentials - B-HAM	Lyle Haugelson	Adult	28
2.23.2012	BSA - Chief Seattle Council Meeting	Scott Schell	Adult/Youth	45
3.5.2012	BSA - troop 189 Avy Awareness	Dave Jordan	Youth	32
3.6.2012	Decision Making in Avy Terrain - Lecture Series	Margaret Wheeler	Adult	75
3.8.2012	BSA - Roundtable Meeting - Aurora District	Matt Schonwald	Adult/Youth	16
3.12.2012	SOS Outreach - Awareness Course	Alexis Alloway	Youth	20
3.25.2012	Dog River Coffee - Field Session	Em	Adult	10
4.28.2012	Klondike NP	Scott Schell	Adult	25
5.1.2012	WAC - climbing class avy awareness lecture	Forest McBrian	Adult	30
5.30.2012	AMS Lecture Series	Mark Moore	Adult	30

Totals

2846

As the table below indicates, during the past 16 winter seasons these educational efforts have reached almost 30,000 people.

Table 4. NWAC avalanche education efforts by season, 1996-97 thru 2011-12.

Year Start	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Persons	1178	1820	2440	1800	1800	2600	1486	1657	2858	1396	1868	1362	1918	1778	1500	2846
Total for 16 Seasons				29,307												

ISSW 2012



Squaw Creek comfortably accommodated the largest gathering of snow and avalanche professionals and enthusiasts to date—920 paid registrants with 98 of these attending from outside North America. Now the 18th official ISSW is scheduled for September 17-21 of 2012 at the Dena'ina Center in Anchorage, AK—the first time that the ISSW has been held in the home of some of the largest avalanches and some of the most imposing and inspiring avalanche terrain in the world.

After the first special and rather spectacular European ISSW at Davos, Switzerland in the fall of 2009, the ISSW returned to Squaw Valley 24 years after its first visit in 1986, with the Resort at



From the official [ISSW12 web site](#):

The International Snow Science Workshop will be held September 17-21, 2012 at the Dena'ina Center in Anchorage, Alaska. The setting for this year's symposium is the urban environment of Alaska's largest city surrounded by several mountain ranges within view of the conference center including: the Chugach Mountains, Alaska Range, and the volcanic Aleutian Range. We cordially invite you to join this biennial meeting of snow scientists and avalanche practitioners to continue striving toward the ISSW motto of, "The Merging of Theory and Practice." Traditionally, ISSW has provided the avalanche industry a forum to: discuss theories, explore innovative concepts, and maintain the state-of-the-art practice in the field of avalanche work.

The boundless climate zones ranging from the temperate coastal rainforest in the southeast region to the frozen arctic environment in the northern region make Alaskan avalanche issues complex in the numerous mountain ranges that rise directly from sea level along the coast to elevations as high as 20,320 feet (6,194 meters) in Alaska's interior. ISSW 2012 sincerely welcomes avalanche professionals from around the world to visit our unique aspect of mountain culture only found in Alaska. Although most of this 5 day event will be located inside, all ISSW participants will have the opportunity to leave the lecture halls for a field day to go explore a small portion of Alaska's spectacular mountain scenery and learn about a few of Alaska's avalanche programs.

The success and importance of ISSW to its many participants can be summed up with the following, again extracted from and courtesy of the 2012 web site:

With winter sports in the backcountry growing each year, the hazard to enthusiasts is increasing. Snowboarding, hi-tech snow machines and fat skis have all contributed to the popularity of winter recreation. This is no longer the sole domain of a small group of telemarkers. Heli skiing and Cat skiing have grown in popularity and the terrain being accessed is steeper and more remote than ever before.

In Alaska industrial activities are common in mountainous environments with avalanche risk. Additionally, it is common in Alaska for workers to engage in off-time recreational activities that expose them to avalanche risk. Many companies are proactive in terms of providing educational opportunities to employees because of this off-shift risk.

While avalanche injuries and fatalities continue on the rise, the vast majority of these incidents are preventable. The professionals who attend the ISSW have dedicated their lives to education, forecasting, and communication with the backcountry using public. Their work saves lives and promotes safe winter backcountry travel for winter enthusiasts. Not only is ISSW an opportunity for peer to peer interaction, but also an opportunity for backcountry users to interact with the leading professionals in the industry.

NWAC forecast staff plan to attend this important information exchange, as many new state of the art advances in avalanche control, theory, education, forecasting, and instrumentation will

be discussed and expanded upon. And forecasters are eager to participate in this essential sharing of avalanche, weather and snowpack knowledge and wisdom from friends and colleagues across the globe. Traditionally this workshop offers an invigorating start to the following winter, energizing forecasters for all of the important work to be accomplished.

WEATHER STATION NETWORK

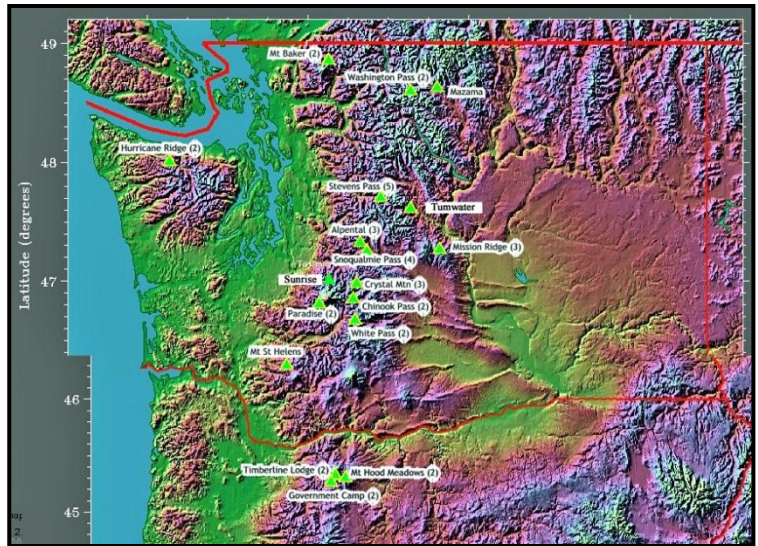
Figure 27. NWAC weather station network.

Summary and Status of NWAC Weather Station Changes and the Network—2011-12 Season

With the addition this past year of another weather station—this at the WSDOT Berne Snow Camp about 8 miles east of the Stevens Pass summit—the NWAC managed network of remote automated mountain weather stations now total 47 individual sites with dataloggers and associated instrumentation. To

be sure, maintenance and repair of this extensive data network is a challenging and somewhat daunting task. Fortunately, NWAC staff and the network are blessed with many critical cooperators and contributors without whose efforts the network and the data would founder. Highway department, ski area, National Park Service, Forest Service and other partners have stepped up BIG time to help with installation, repair and troubleshooting of both sensors and the overall network infrastructure, including power and communication issues.

Also, as much as time, money, energy and internet access allow, NWAC staff are trying to slowly convert current phone line weather stations over to internet accessed sites. Over the past few years, this has become a preferred method for weather station access as it allows for both more streamlined (much quicker retrieval) and more reliable access for either data retrieval or troubleshooting.



Mt Hood Ski Bowl

- Upper weather station for wind speed, direction, temperature and total snow depth had been experiencing numerous communication problems via an antiquated phone system. During the fall of 2011, NWAC forecasters worked with their very helpful IT staff to change from telephone access to internet access. To facilitate this transition, a new internet modem and new data logger were installed with the new system working great all year

Sunrise and Chinook Pass

- Owing to power issues at Sunrise, the Sunrise station is no longer able to act as the base radio station for either the upper Sunrise Knob site (wind speed, direction, air temperature, relative humidity) or the Chinook Pass weather stations (Chinook Pass and upper Chinook Knob)
 - Several differing configurations of batteries and solar panels were installed to hopefully provide sufficient power for RF communications; unfortunately, power requirements from a combination of the phone to RF modem, the radio and the Noah-II cumulative precipitation gage were too high to allow for continuous operation, and the amperage requirements drained two 120 amp-hr batteries within two weeks.
 - This necessitated attempting to install a backup RF system at Crystal Mountain where both more reliable phone lines exist and where AC power is available for such a high power draw system.
 - This new RF base station at the top of Crystal Mt was installed as both an internet accessed site and a phone accessed site over the late fall and winter. To date, neither system seemed to work correctly and the equipment was returned to the vendor for repair in the spring
 - Necessary RF equipment was repaired and returned to the NWAC in late April, and NWAC staff are planning to work on this system in the late spring and summer to hopefully fix this intermittent communication problem for the long term
 - The Crystal Mt mountaintop station as well as several other possible sites will be considered for this installation, with plans to first try to reestablish the comms link to Chinook Pass (upper and lower RF stations) and Sunrise Knob via a reinstalled phone to RF modem, new radio transmitter and repaired coax cable to the antenna. Since WSDOT south-central avalanche control personnel are very interested in getting hourly weather data from Chinook Pass back on line as soon as possible, several alternative mountain top sites to Crystal Mt



Figure 28. Depth gage hats at both Chinook Pass and Sunrise that help prevent snow accumulations from creeping over the sensor and preventing measurement.



Figure 29. Kenny working on the Chinook Pass precipitation gage...clipped in at the top of a 30 ft tower.

will be considered for the RF base station link.

- Due to issues with the NOAA-II cumulative precipitation gage at Sunrise Base, the weight measurement assembly (WMA) was returned to the manufacturer for repair. Unfortunately, even after repair, the unit did not initiate a series of self check steps correctly, and no precipitation measurements were made at this site last winter. It is hoped that a more reliable precipitation system will be installed here at some point in the future.
- Despite the fact that the Chinook Pass weather station was not accessed during the past winter, the datalogger should still be storing most or all of the seasonal data, and forecasters plan to visit the site in late May or early June to retrieve the data for archiving purposes. And since a site visitation in the fall which added a depth gage hat and some repair of the precipitation gage, hopefully all of the data collected should be reliable.



Figure 30. The 30 ft Chinook Pass base station tower with supporting struts, datalogger enclosure, RF antenna, total depth sensor, and precip gage on top.

Washington Pass

- RF power issues at the Delancey Ridge repeater site brought the system down in late summer. This issue was addressed by the WSDOT north-central avalanche control team who flew to the site in the fall of 2011, installed new batteries and realigned the directional yagi antenna . After the installation of a new base station by a cooperative effort of WSDOT and NWAC staff in the fall of 2010, and relighting of the propane heated gage in late fall of 2011, the revitalized station responded and worked flawlessly for the 2011/12 winter.

Berne Snow Camp

- This new Cascade east slope weather station for the 2011/12 winter was installed as a cooperative effort between north-central WSDOT avalanche control personnel and NWAC staff. The 20-ft tower and associated sensors are shown in Figure 31. This station provided much needed east slope precipitation and snowdepth data (the site lies at the 2700 ft level about 8 miles east of Stevens Pass and the Cascade crest), as well as giving NWAC forecasters important temperature data for wintertime inversions and a shift from east to westerly pass winds.



Figure 31. 24-hr depth sensor with hat—installed adjacent to Berne weather tower supporting AT, RH, precipitation gage, total depth sensor and datalogger/modem enclosure.

Mission Ridge

- At the request of the ski area, NWAC staff in cooperation with Taylor Scientific provided a digital wind speed and direction readout for the lift operator and ski patrol at the top of the mountain in both the upper lift station and

the patrol building. The system was installed at Mission Ridge in early January, 2012. Along with an NWAC provided SDA04-4 channel analog output module to condition the datalogger outputs for the digital readouts, such instantaneous readout capability proved beneficial for both lift operations and patrol operations over the past winter. NWAC also provided a new mid-station snow depth sensor to replace an old and ailing one.

Tumwater Mountain

- After performing significant access road maintenance to this ridgeline station east of Leavenworth, WSDOT north-central avalanche control personnel also performed some much needed system maintenance, as well as installing a new snow depth sensor as well as an internal temperature sensor inside the propane heated gage that gives information about whether or not the unit is properly heating.
 - Alas, early snowfall prevented subsequent site access and the propane hookup to the precipitation gage was not possible. However, this summer should provide the necessary time to ensure more complete future operation.

Timberline Lodge

- Responding to issues with the lower heaters for an older Met-1 precipitation gage, NWAC staff visited the site late in the fall of 2011, replacing the gage with a newer 12-inch heated tipping bucket gage from Met-1. Forecasters also repaired some broken wiring to the 2.5 volt supply for wind direction, and reinstalled a repaired Pucci chair wind direction base, rerunning the necessary wiring up through the lift assembly.

Mt Baker

- When the total snow depth sensor stopped working in early December, the Baker snow safety director went to the site and looked up. Lo and behold, he saw a spider web spanning under the sensor view of the snow surface beneath the protective “hat”. One strand passing under the sensor had accumulated moisture drops from the increased clouds, and he could see this from the ground. He went up and broke it off with a stick of bamboo...miraculously making it work again! Cool huh? Awesome fix!
 - After strong winds picked up and flung a 24-hr snow depth sensor at Mt Baker 50 ft or more, the sensor filled with water and a cable was broken. This sensor was also replaced over the winter.

Camp Muir

- After a successful summer of hourly weather system and webcam operation with some great and informative pictures of weather and snow conditions looking south from the Camp Muir weather station tower, the web camera enclosure became rimed in late November of 2011. This prevented transmission of useful pictures and prompted unfortunate action on the part of some well-intentioned but uninformed back country travelers. In an attempt to free the camera enclosure from rime, the travelers vigorously hammered on the enclosure, severely damaging both camera and its internal processor.
 - Subsequent visits to the site by NPS Park Rangers over the winter confirmed the damage, and necessary repairs were performed over the winter. Unfortunately, not all the repair was successful and reestablishment of the link between the camera and the CR1000 datalogger has proved unsuccessful to date. It is hoped

that further troubleshooting by NPS rangers will allow for a return of this important and most visual part of the Camp Muir weather system.

- Meanwhile the wind speed sensor experienced some damage over the latter part of the winter, and is now being repaired by Taylor Scientific, manufacturer of this normally robust and relatively indestructible sensor. Plans call for this to be returned to the Park in early June with wind speed readouts likely operational again by late June. When it is reinstalled, plans call for complete checkout of the transmitter base wiring, as well as troubleshooting of the fuse/tranzorb lightning protection box.
- Possible plans are also afoot to wire the datalogger to a wireless internet connection now available in the nearby Muir climber's hut. When this internet access becomes possible, it should streamline data and image retrieval in the future when all of the data and images are once again available.

Blewett Pass

- A new east slope weather station for this higher elevation pass site (4100 ft) to the southwest of Wenatchee is planned for the summer as another collaborative effort by WSDOT avalanche control personnel and NWAC. Site power is already available for an RWIS station there (for monitoring highway surface conditions), and this would provide much needed and complimentary information for a variety of interested users, including WSDOT, NWAC, NWS and the public. Plans call for a 20 ft tower, datalogger, phone modem, battery and battery charging system, grounding system, heated precipitation gage, air temperature and relative humidity, total snow depth and possibly 24-hr snowdepth. Much thanks to WSDOT avalanche personnel for engaging in this joint endeavor!

Mt Hood Meadows

- While most of the Mt Hood Meadows weather systems (there are three separate stations) worked well for much of the season, some issues associated with snow depth sensors required repairs to the 24-hr snow depth base (broken after frozen into the snow following a rain event), and several depth sensors needed replacement intermittently. Fortunately, the snow safety personnel on the ski patrol understand the system well enough to perform the necessary sensor swaps, and return of the damaged sensors for repair.

Hurricane Ridge

- The temperature controller board and wind speed sensor located on the Hurricane Ridge radio tower failed in the early winter. Fortunately, Taylor Scientific (the sensor manufacturer) was able to provide a spare temperature controller board and NWAC ventured to the site to replace both the board and an ailing wind speed sensor. Weather conditions proved ideal as a strong upper ridge provided mostly sunny and almost windless conditions for this often difficult climb up the communication tower. Repairs proceeded smoothly, and the wind speed and direction sensors functioned well for the remainder of the winter and should still be spinning as this is being written in late May of 2012.

Alpentel

- Most of this weather station components functioned smoothly for last winter, only requiring replacement of a snow depth sensor...which was mailed to the Snoqualmie Pass avalanche control team for a short trip to Alpentel for replacement. It is great having on-site instrumentation expertise as that provided by both north-central and south-central WSDOT avalanche control staff.

Snoqualmie Pass

- Most of the Snoqualmie Pass weather stations and associated communication and weather equipment are maintained and repaired as needed by WSDOT avalanche control staff. The data is polled at the remote RF stations by a DOT PC located in the Hyak maintenance station, and then retransmitted to an FTP site where NWAC PC's automatically retrieve, format and disseminate the hourly information over the NWAC internet site

Dirty Face

- NWAC forecasters piggybacked on a supply flight with the Okanogan-Wenatchee National Forest on a fire weather supply flight to perform some system repairs at the remote Dirty Face ridgetop station. While this allowed forecasters to fix several issues with loose cables and wind speed, checking and double-checking all data before departure, of course a wind direction problem did not surface until after their departure and has been intermittent ever since. This normally represents a cable or intermittent break...but of late (late April and May), the previously intermittent wind direction has resolved itself with data appearing quite normal. However...another instrumentation check this summer or fall is possible...along with a longer term resolution of the problem.



FOAC, REGIONAL SKI AREA ASSOCIATIONS AND OTHER PRIVATE SUPPORT

Since private support is critical to NWAC operations, it is altogether appropriate to include a summary of shared activities of the NWAC, the Friends of the Northwest Weather and Avalanche Center (FOAC), Regional Ski Area Associations and other important cooperating groups during the Fall 2011 to Spring 2012 period. Certainly heartfelt thanks are in order for the tireless support offered by FOAC Board and Volunteers in helping to enhance avalanche education as well as NWAC visibility and viability through both direct support and the evolving FOAC-NWAC web site.

New Website

Over the summer, fall and early winter of 2009, and again over the spring, summer and fall of 2010 and 2011, the Friends of the NW Weather and Avalanche Center (FOAC) provided necessary funding and direction for an expanding collaborative web presence, interface and home for NW avalanche related information, including NWAC data, forecasts and a variety of avalanche/mountain weather information, papers, articles, videos and links. FOAC contracted with [Web Collective](#) of Seattle, who performed the web design and coding in Django, with the resulting web site hosted at [Slicehost](#), a private VPS (virtual private server). For informational purposes, Django is a high-level Python Web framework that encourages rapid development and clean, pragmatic design. Developed about six years ago by a fast-moving online-news operation, Django was designed to handle two challenges: the intensive deadlines of a newsroom and the stringent requirements of the experienced Web developers who wrote it. It

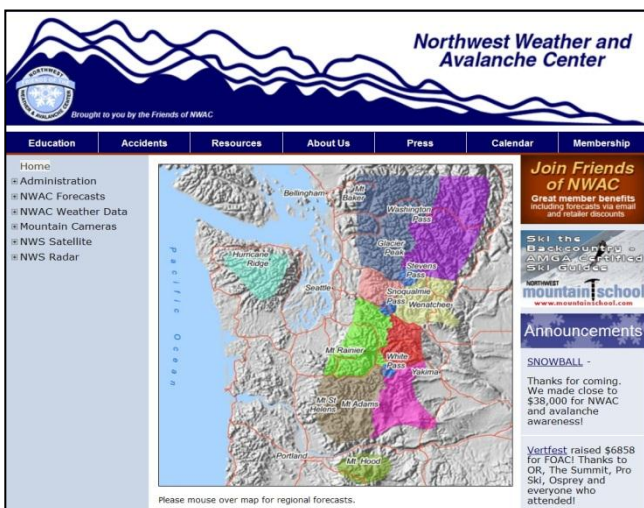


Figure 32. FOAC-NWAC home page—fall 2009

\$20,000/year during its first two seasons of use and over \$30,000 last winter).

allows developers to build high-performing, elegant Web applications quickly, and it is hoped that the new web site embodies some of this high performance and at least some of its elegance. Since its inception, the site has been administered by FOAC, who have now provided the ~\$50,000 to date for its development, along with many hours of donated time and expertise of several FOAC Board members. With FOAC administering the site (and providing NWAC with a great internet venue for enhanced access to and distribution of avalanche safety services), a select group of paid advertising on the site has brought in some significant revenues to FOAC (about

Late in the fall of 2009, FOAC and NWAC rolled out Version 1 of the new collaborative website, and it was put into operational use for the winter! As might be expected, the new site and related on-line forecast preparation resulted in a major change in the way NWAC describes the avalanche and weather situation. This resulted in some initial difficulties and modifications in preparing and disseminating the primary and enhanced weather and avalanche forecast products and a later daily issuance of the avalanche forecasts. Unveiled in the 2010/11 winter, Phase 2 of the web site integrated further forecast enhancements to an overall better, more detailed and reliable product through both the 2-day and 3-day time period, along with the introduction of a two or three day danger rose and a much improved mobile device presence and availability.

By now most users and cooperators are probably familiar with the recently evolving face of NWAC products and services available through the FOAC administered web site. Version 2.2 upgrades which took place over the Summer and Fall of 2011 were also funded by FOAC. While Web Collective was disbanded in the summer of 2011, several of its primary

programmers took over the web site development and related programming thru the new company Bitbamboo. This work allowed for further site improvements that included:

- Google Site Search function to allow for easier site navigation and easier location of desired data, articles or educational resources
- Better and more robust and reliable templates and editor for forecast entry
- Collaboration with software developers to:
 - allow seamless integration with the GIS based danger level (see the GIS based application section below) and geographical avalanche information display. When this WWU-based display becomes more operational by fall of 2012, the snow, weather and avalanche observation portion should replace the popular Snow and Avalanche Information Exchange and allow for more direct user interaction in viewing, depositing and sharing avalanche related information
 - develop an informational sharing agreement with application developers to help ensure reliable and accurate danger or other data displays
 - allow hosting of the central regional server software for iPhone/Droid Instant Avalanche Information Apps

Overall during the period 2003-2012, the FOAC have dedicated almost \$350,000 toward NWAC and outreach efforts that support avalanche education and awareness in the PNW region. This total involves both direct and indirect support of NWAC, and includes a rather wide range of programs developed to help expand avalanche awareness and education through a variety of venues. Such support includes the following:

- Avalanche Education Efforts and Programs targeted toward youth and the snowmobile community, e.g., Alpine Safety Awareness Program, the Know the Snow Initiative, and most recently new educational efforts spearheaded by FOAC's recent addition of a dynamic Educational Coordinator, Scott Schell
- Development and administration of the collaborative NWAC-FOAC web site, including providing, configuring and paying for the server and the appropriate bandwidth for the web site
- Development, printing and distribution of avalanche awareness signs for Snowparks and trailheads
- Development, printing and dissemination of Avalanche Safety Checklist cards
- Reprinting and distribution of several avalanche awareness and education brochures and hot line business cards
- Collaboration with and funding or partial funding of several avalanche education venues including NSAS and Vertfest
- Donations of several PC's, peripheral equipment and associated software to NWAC
- Avalanche education video production
- Donations of a variety of weather sensors and data loggers for the NWAC data network
- Direct donations to the Forest Service to help support NWAC Operations

A chart (Fig 33) outlining the history of FOAC support from 2003-2012 (projected thru June 1, 2012) is presented below. [Please also note that at least some of this support is made possible by the many companies who collaborate with FOAC and advertise on the web site.]

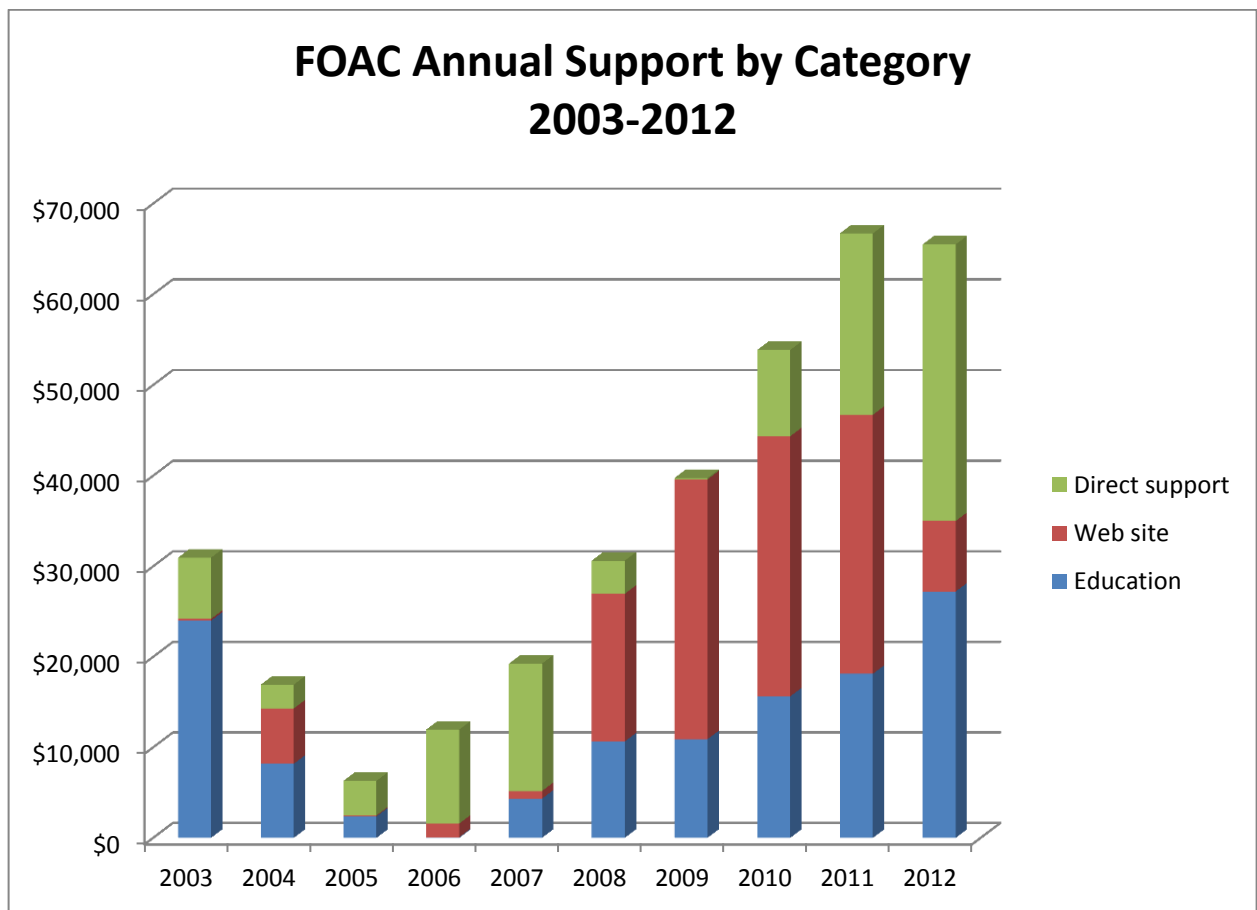


Figure 33. Annual FOAC support of NWAC by category

Technological Advances in Avalanche Information Sharing

In order to further promote winter safety and critical avalanche information exchange, the NWAC and FOAC are also collaborating with several software programmers and designers to allow for development and introduction of new and innovative ways to view and share avalanche related information (generated by users and cooperators alike). These developments range from unique and compelling GIS applications that allow for more visual and more user friendly methods for input and viewing avalanche danger geographically...to smartphone apps that streamline field entry and subsequent sharing of weather, avalanche and snowpack observations...to better ways of accessing, viewing and interacting with historical forecasts and the reams of hourly mountain weather data produced and archived by the Avalanche Center.

GIS based applications

NWAC's first collaborative effort into geographical informational system display of forecast

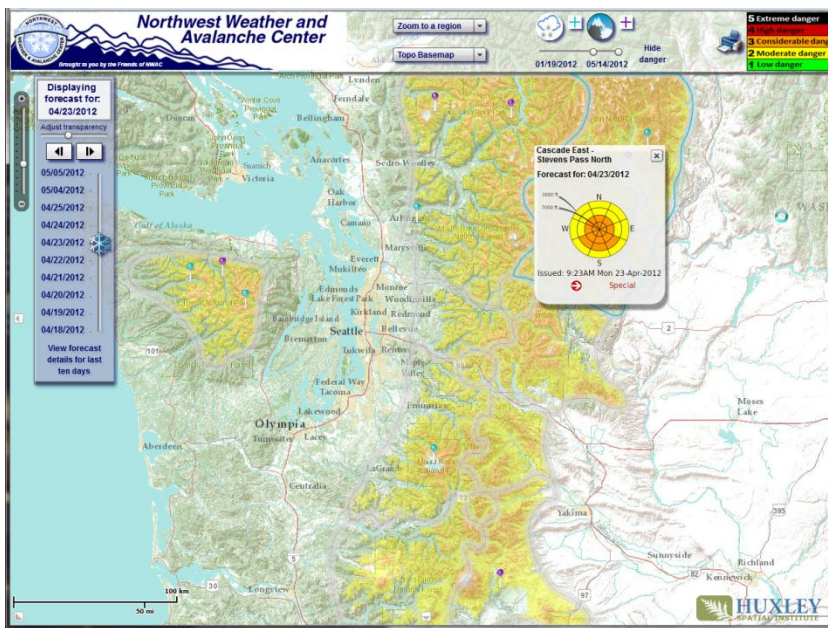


Figure 34. Sample NWAC geographical avalanche danger rose and observation display—developed by Ben Kane and Dr. Michael Medler of WWU

products is with the GIS department of Western Washington University, who gave an informational presentation on its potential at a monthly FOAC Board meeting in the spring of 2011. The planned development included the creation of automatic danger level overlays by elevation and aspect on either a GIS or Google Earth interface, along with an interactive user interface that allows for near real-time geographical plotting and display of a layer of user generated photos, snow profiles, or trip reports. Further collaboration with

the WWU GIS professor and graduate student evolved over the summer of 2011 with an operational version of Phase 1 of the informational display (danger rose information only) unveiled in January of 2012. The sample layer mapping of the danger rose information is shown above, with the applicable danger rose for the day and zone of interest shown in the mid-upper right. In its current iteration (spring of 2012), danger rose information is available for the past 10 forecast days by either clicking on a day or using the slider bar for scrolling back and viewing past danger roses to help put the present forecast and its evolution in perspective. Future plans call for this historical functionality to extend over a broader archived time period, possibly extending into past seasons.

In the above most recent research iteration of the GIS page shown in the figure above, user or forecaster added info such as avalanche accidents, snowpits, avalanche photos, and other stability info will become available in the fall of 2012 as another layer through clickable icons on the associated GIS display (top navigation bar).

However, as emphasized during all of its development, such geographical mapping of danger rose information must be approached with a great deal of caution and care in any implementation, as a higher resolution geographical display of danger rose information does not include any new information beyond that inherent in the regional danger rose...and inferred accuracy at higher resolution limits is not justified. As a result, zooming in on the geographical danger rose mapping is limited (the danger level info will disappear at higher zoom levels to be replaced by weather telemetry, snowpack and avalanche observations, photos, and other more site specific information), and in any case should not allow a user to attempt to achieve slope specific danger information from an otherwise regional danger rose product. The most important uses of such a product should be confined to a broad overview of the extent and distribution of avalanche danger(s), and their trends over time, rather than a way to get more

specific danger information—no matter how appealing this application may appear. Certainly such a product must balance acceptable precision and accuracy, and should only be presented as a different (more visually appealing?) way of viewing danger rose information rather than a way of gaining more information that has little basis in fact.

Smartphone applications

A very promising “*Instant Avalanche Information Exchange*” development that became available last winter is a user friendly

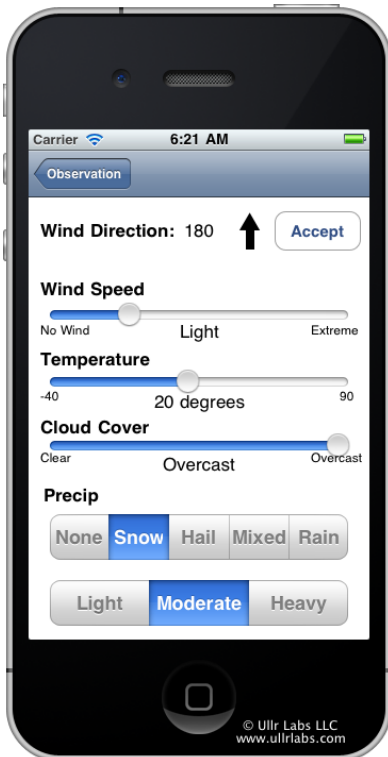


Figure 36. Initial observation entry screen of ULLR smart phone app

iPhone (and soon Android) specific application that streamlines and enhances smartphone entry of data such as current weather, snowpack, stability test, photos and other site specific avalanche related information. This potentially exciting avalanche related smartphone app was developed by Bob Hoffman and Scott Chamberlin (associated with the company ULLR Labs LLC)

Once the app is opened on the web phone, weather and avalanche observations or reports are automatically geo-tagged by the app with current location (latitude and longitude and elevation), aspect, slope or snow profile inclination. After some easy preliminary info is entered, a full suite of current weather and snow profile entry data is available via clever and quick graphical manipulations of the smart phone touch screen.

Figure 35. Data entry screen for the Current Weather module

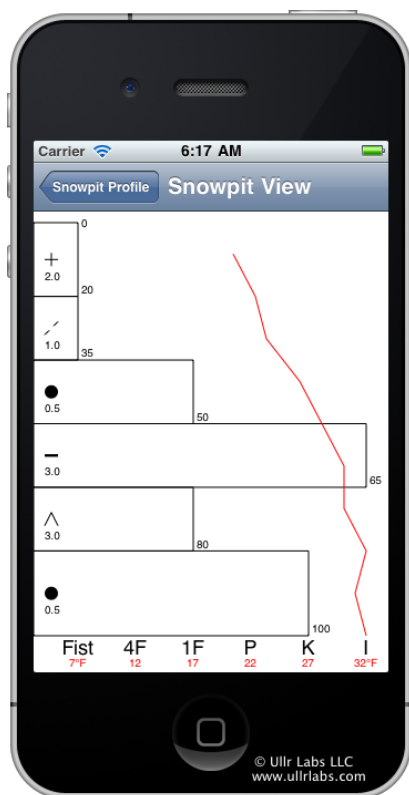


Plotted profiles are instantly available that include layer temperatures, hardness, density, crystal and grain type, along with all of the common snow stability tests (e.g., Rutschblock, Compression, Shovel, Hand, Stuffblock, Extended column, etc.) which are also easily user enterable. With the ability to add photos or videos to each report (which is sent to a central regional server), the resulting information can be instantly available to avalanche forecasters or other users who are notified when new information (within a certain defined radius of their location) becomes available.

Worthy of further mention is the avalanche stability algorithm in the app that analyzes the observational information and adds context sensitive stability or danger level comments or remarks about the stability or slope information entered. The danger guidance integrates information from the US [SWAG](#) (Snow, Weather and Avalanche Guidelines) or other published literature (including [McCammon's lemons approach](#) to snowpack stability

parameters) in its list of stability recommendations ...with more detailed information about tests and any recommendations only a click away (sort of like having an avalanche reference in the field with you). The accompanying iPhone screen shots from this app give potential users some idea of the data entry methods and the resulting snow profile graphs.

Figure 37. Sample plotted snow profile after data entry



According to the Ullr Labs Instant Avalanche App developer in early May of 2012:

- Washington was the top location for shared observations during the past year (the app is available for a variety of regions and avalanche centers),
- the Android version will be available in June (interested users can check for updates on the UllrLabs web site)
- a new observation form and observations interface will be supported before next season
- the iPhone app will feature integration of top user requests before next season

In any case, NWAC and FOAC plan to work with the developers to ensure that the data entered is easily retrievable and can be added to the existing national SnowPilot database, and that automatic notifications of new data points are sent to requesting users.

It is interesting to note that several other vendors have shown interest in developing apps to display danger rose and other NWAC data via smart phones. Future FOAC plans call for a unified contract or other user agreement to be developed over the summer which would allow broader but help ensure

responsible access to and dissemination of NWAC products and data for next year.

Social Media Applications

The Friends of the Northwest Weather and Avalanche Center continue to expand a well-received web presence at [Facebook](#) (almost 3,000 followers). This site acts as another informational portal for avalanche related education, activities, announcements, updates etc. for an increasing number of interested users. Seasonal FOAC newsletters are also posted here as well as notes about and updates of avalanche watches, warnings, and other danger related updates. Although NWAC does not administer its own Facebook account, NWAC staff have a [Twitter presence](#) that has become increasingly active over this past year. During the past three seasons, NWAC forecasters have sent out almost 200 tweets about both current and anticipated avalanche danger. Despite no links or other public notifications to let folks know about its existence (the NWAC Twitter presence will be announced next fall), NWAC Tweets have attracted an increasing number of followers (almost 400) that include most other regional and local avalanche centers as well as a variety of on-line news services, ski and other winter sports groups. It is believed that in addition to the enhanced NWAC web site, social media offers yet another method to promote avalanche safety and reach interested users who either might not

know of the Avalanche Center's operation or might not wish to spend the time to peruse the site without a compelling reason to do so.

NSAS 2011/12

The Northwest Snow & Avalanche Summit (NSAS) is a professional development seminar for avalanche workers and a continuing education opportunity for recreationalists. NSAS is intended for ski patrollers, forecasters, ski guides, search and rescue teams, as well as other occupations that occur on and around snow. The content of NSAS is relevant to professionals and recreationalists alike.



NSAS is put on by the Alpine Safety Awareness Program. [The Alpine Safety Awareness Program](#) (ASAP) is a community-based effort that uses local resources to teach alpine safety skills to children and adults throughout the Pacific Northwest. ASAP's aim is to save lives and reduce injuries by proactively increasing alpine safety awareness. Since 1999, they have reached more than 30,000 students and adults through their programs. Their goal is to make safety a habit among all winter outdoor enthusiasts. The 5th annual NSAS was strongly supported with a full house (over 250) attending the daylong event at the flagship [REI Seattle](#) store. A host of commercial vendors were also

present in support of the event. This year's engaging host of presenting speakers included:

- Karl Birkland - Director USFS National Avalanche Center
- Zach Guy - Researcher, Montana State University
- Mike Richardson - Avalanche Research Blogger
- Karl Klassen - Caa Public Bulletin Director, Mtn. Guide
- Oyvind Henningsen - Director, Everett Search And Rescue
- Garth Ferber – NWAC Avalanche Meteorologist
- John Scurlock - Alpine Photographer/photo Historian

Snowbash 2011/12

Snowbash followed closely on the heels of a very successful Northwest Snow & Avalanche Summit (NSAS). Snowbash, the annual raucous event that that ushers in the Northwest winter and helps to raise the profile of NWAC, hopefully gets folks thinking about avalanches as the backcountry community readies itself for another season. It most definitely is a good time,



found a good new venue at the Nectar in Ballard, and again featured great live music by the *Tripwires*. It was the eleventh night of great music, beer drinking, socializing and raffle to raise funds for FOAC, and results indicated that over \$8,000 was raised in support of FOAC and its educational, outreach and operational efforts. This event grows in popularity each year and 2011/12 was no exception!



Vertfest 2012

Over the past six years Vertfest has become annual gathering for the Pacific Northwest backcountry ski community. Vertfest offers an opportunity for beginners, adventurers and seasoned pros alike to join together to challenge themselves and celebrate with a weekend of events. Building on the success of years past, a challenging rally course and a popular awards program offered by [Outdoor Research](#) (the primary sponsor), this year's event (with the main races retitled the Monika Johnson Memorial Rally) on a snowy February 18th added:

- Rally divisions of Race, Recreation, 50+, and Splitboard
- Stanley Cup Fun Race
- Ski Photography clinics with Grant Gunderson and Jason Hummel,
- Sidecountry Steeps clinics with renowned skier Kim Havell
- Avalanche Awareness (terrain selection and companion rescue) and a host of other clinics, with instruction from the Alpentel Ski Patrol, Pro Guiding Service, Scarpa Boots, La Sportiva, Osprey Backpacks, Jones Snowboards.



Figure 38. Vertfest 2012 participants climbing up Ingrid's Inspiration. Photo courtesy [the Snow Troopers](#).

on race day! For a summary of the day's events, check out this [link](#).

The demos and great spirits continued into Sunday, the 19th. Overall, a record setting 158 hardy participants engaged in the Rally on the 18th and congratulations are offered to all who braved the stormy conditions to compete and share in the festive atmosphere! Following the race, a large celebration ensued in the Alpentel base area bar complete with live music (by *Daydream Vacation* and *Head Like a Kite*), a huge raffle, the Awards Ceremony and plenty of time to enjoy drink and

food. Participation was excellent, spirits were high and both skies and the course were filled with snow as over 13 inches of fluffy stuff arrived

Unfortunately, with all the snow falling over the Vertfest Weekend (some 2-3 feet or more arrived in some locations), the avalanche danger increased as well. On Sunday, this snow

(which fell on and stressed some old surface hoar layers) resulted in two separate avalanche accidents in the NW...with three skier fatalities in the Stevens Pass back country, and one snowboarder fatality in the back country of Alpentel.

2012 Vertfest Details:

158 Competitors; 130 partakers spread across eight clinics; 300+ Demo participants; raised over \$16,000 for FOAC.



Snowball 2012

4th annual Snowball Dinner and Auction on April 20, 2012.

The spring's end-of-the-season celebration and fundraiser for the Northwest Weather and Avalanche Center's support group, FOAC, was held in the ballroom of the new Mountaineers headquarters near Magnuson Park (and coincidentally adjacent to the NWAC offices at the Western Region HQ on NOAA). Despite the continued intermittently dire state of the economy, the event sold out quickly and additional tables were added to increase the capacity with some 300+ attendees. FOAC board members with the awesome help of a whole host of volunteers put on a fantastic evening that is becoming an event not to be missed. Many friends and familiar faces took part in an evening of live and silent auctions, as well as a delicious dinner and much camaraderie. Snowball's proceeds of over \$64,000 shows a high level of dedication and commitment from a large group who value the importance of NWAC and the services it provides. Many thanks and much appreciation go out to all those who help to support NWAC and its efforts.

Regional Ski Area Support

Northwest ski area support of the NWAC has long been acknowledged as a very vital part of the program, and has helped ensure its viability over the years. In addition to annual donations from member organizations such as PNSAA, Ski Washington, and the Northwest Winter Sports Foundation, regional ski areas provide a host of important operational services that help ensure timely and accurate NWAC products and data. These vital services include:

- lift access for snow studies and weather station visits,
- technical support, electrical and phone line assistance for automated weather stations,
- reliable and timely snowpack stability and weather information
- help in disseminating avalanche and weather forecast information
- avalanche education efforts
- search and rescue efforts for avalanche impacted travelers

NWAC is very grateful for the close relationship that we have enjoyed with all of the regional ski areas over the many years of its operation. This close relationship was exemplified this past spring when PNSAA presented all of the NWAC forecasters with an unprecedented three "[Forest Service Partner of the Year](#)" Awards at its spring meeting in Bend, OR. Some of these details follow:

Bend, OR – Last evening, the membership of the Pacific Northwest Ski Areas Association (PNSAA) broke tradition and presented three Forest Service Partner of the Year awards – one each to Garth Ferber, Kenny Kramer, and Mark Moore. The Partner honor is reserved for a USDA Forest Service employee who significantly and decisively helps to improve the quality and safety of Pacific Northwest winter sports facilities. Ferber, Kramer, and Moore are meteorologists employed by the Northwest Weather and Avalanche Center (NWAC) – a unit of the USDA Forest Service. In recognition of their nearly 70 years of combined service to the NWAC, the Association is pleased to share 2012 Partner of Year awards with the NWAC's Ferber, Kramer, and Moore...

"By providing ski area operators solid and reliable forecasts of mountain weather and potential avalanche danger, the NWAC staff helps take some complexity out of day-to-day ski area operations," observed Duncan Howat, general manager at northwest Washington's Mt. Baker Ski Area. "I have thoroughly enjoyed 36 years of near daily interaction with this Forest Service unit, which is comprised of dedicated professions," added Howat.

"The PNSAA is pleased to be in a position to honor the current NWAC staff," noted Scott Kaden, PNSAA President. "Since its inception, the NWAC has served the public well by effectively reducing the impacts associated with adverse mountain weather and hazardous snow packs. The Association salutes the NWAC for the important work it does each and every winter – the mountain weather data collection, weather and avalanche forecasting, and public safety-related outreach work with different user groups," added Kaden.

It is the hope of the NWAC and all forecast staff that this mutually beneficial relationship may continue for many years to come, and NWAC staff are pleased to provide such services in the interest and goal of promoting safe winter travel.

Other Private Support

In addition to the larger and higher profile events and private support venues listed above, other contributions and events within the private sector have become increasingly important in helping raise money for the FOAC, NWAC and their educational and operational goals. Such support includes the following partial list...and for each one and all the effort involved, we are grateful:

- Mt Baker Ski Area (Duncan and Gwyn Howat)
- Mt Baker Ski Area Splitboard Fest
- John Baldwin slideshow at the Mountaineers
- The Mountaineers
- Fiorini Ski School
- The North Face
- TeleTuesdays
- KGB Productions for the Freerider/Wyoming Triumph Film
- Innate for the art & snow culture event, The Cascadian Collection
- Other private individuals

NWAC BUDGET SUMMARY

Current and Future—Fiscal Years 2012 and 2013

As has been experienced many times of late, both NWAC operating expenses and NWAC support revenues remained flat for FY12 (winter of 2011/12) across all cooperator groups—federal, state and private. Fortunately some important donation carryover from FY11 (~\$37,000) allowed for relatively normal forecast operations during this above normal year in terms of snowfall, snowdepths and avalanche accidents.

With the main driving force behind operational budget increases being relegated to salaries (which comprise about 80-90% of the NWAC budget in any given year), and federal salaries once again remaining unchanged for the third consecutive year, NWAC staff were able to once again fulfill and slightly expand program goals despite several significant changes in the web site, enhanced forecast products and a new instrumentation site at Berne Snow Camp to the east of Stevens Pass (possible primarily due to great support and field work by the north-central WSDOT avalanche control team based at Stevens Pass). However, the robust forecasting year just past is projected to leave significantly less carryover for FY13, and with Title II/RAC funds either not available or not funded, next winter may produce some funding challenges in the later part of the season. The exact amounts of these challenges will depend on several factors that are difficult to anticipate, including:

- capital equipment expenditures dictated by either last year's damage or next winter's unknown conditions
- salary expenses associated with a new avalanche forecaster/meteorologist
- some overlap between the departing director/forecaster and the new meteorologist

Despite the anticipated staff changes, and despite the data and product improvements expected, it is hoped that the transition between the “old order” and the “new order” will be as seamless as possible for overall Avalanche Center operations. In order to maintain the most responsive, efficient and effective products and services possible, NWAC staff and the Forest Service will endeavor to do a lot with a little...as shown by the budget figures that follow.

Table 5. Sources of Funding for FY12 and FY13; Total direct and indirect funding.

NWAC Budget—Sources of Funding			
Funding Source [Direct Support]		FY12	FY13
		[projected]	[projected]
Federal		\$124,000	\$127,000
	USDA-Forest Service	\$75,000	\$75,000
	National Park Service	\$17,000	\$17,000
	USDA-FS Fee Demo	\$32,000	\$35,000
Washington State		\$134,500	\$134,500
	Parks and Recreation Commission (includes State General Fund \$)	\$79,000	\$79,000
	Department of Transportation	\$45,000	\$45,000
	WA Supplemental Budget	\$0	\$0
	Snowpark Program	\$5,500	\$5,500
	Snowmobile Program	\$5,000	\$5,000
County		\$0	\$0
	Title II/Resource Advisory Comm.	\$0	\$0
Private + Carryover		\$92,631	\$68,420
	PNSAA	\$5,000	\$5,000
	Ski Washington	\$5,000	\$5,000
	NW Winter Sports Foundation	\$15,000	\$15,000
	FOAC ¹	\$30,000	\$20,000
	Other private	\$630	\$0
	Carryover from FY11 / FY12	\$37,001	\$23,420
TOTAL [Direct Support]		\$351,131	\$329,920
Estimated In-Kind Support (+0% FY12, 0% FY13)		\$234,406	\$234,406
[Indirect support]	USDA-FS (~30% of direct support)	\$30,000	\$30,000
	WSDOT (obs + equip. support)	\$23,883	\$23,883
	NPS (obs + equip. support)	\$5,725	\$5,725
	NWS (office costs + product access etc)	\$69,467	\$69,467
	PNSAA (obs, power, phone etc)	\$7,925	\$7,925
	All (one time cost for data support)	\$63,406	\$63,406
	FOAC (web site development + equip)	\$34,000	\$34,000
GRAND TOTAL [DIRECT + INDIRECT]		\$585,537	\$564,326

¹ FOAC donation shown above for FY12 does not include ~ \$17,000 applied to web site development (GIS & web site enhancements) and other NWAC indirect support (including software and hardware) in FY12, and another ~\$27,000 for avalanche education efforts

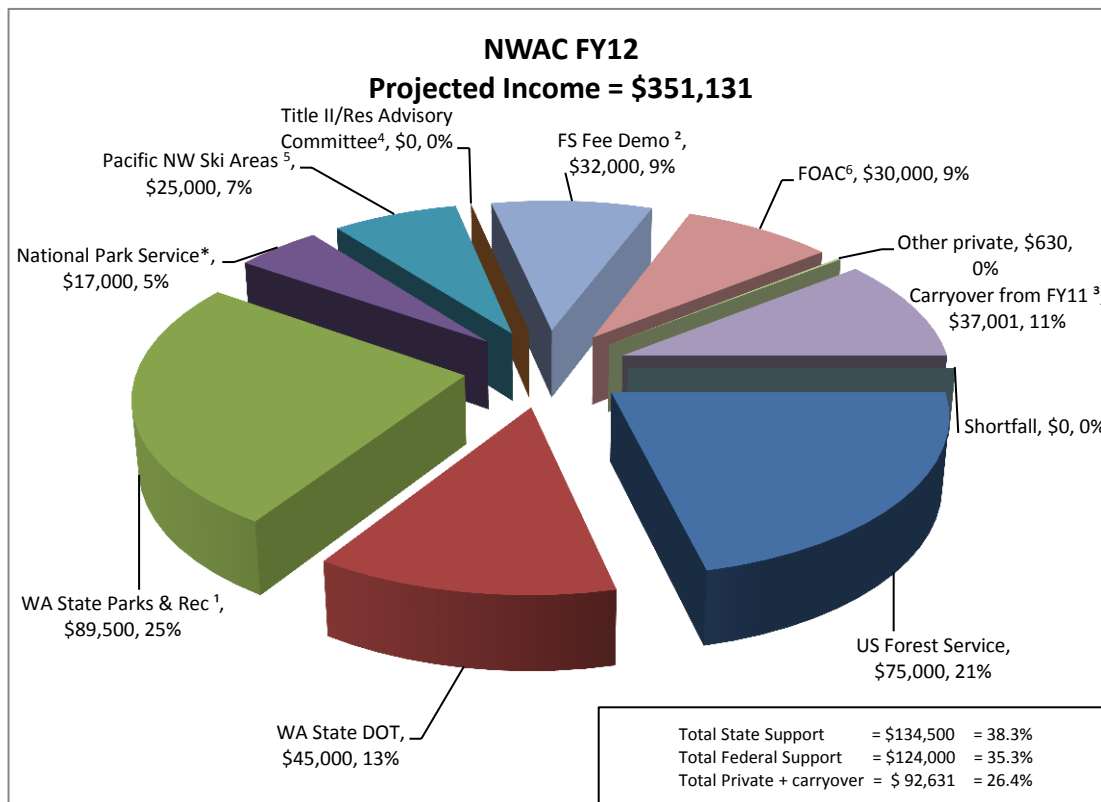


Figure 40. Projected FY12 Income

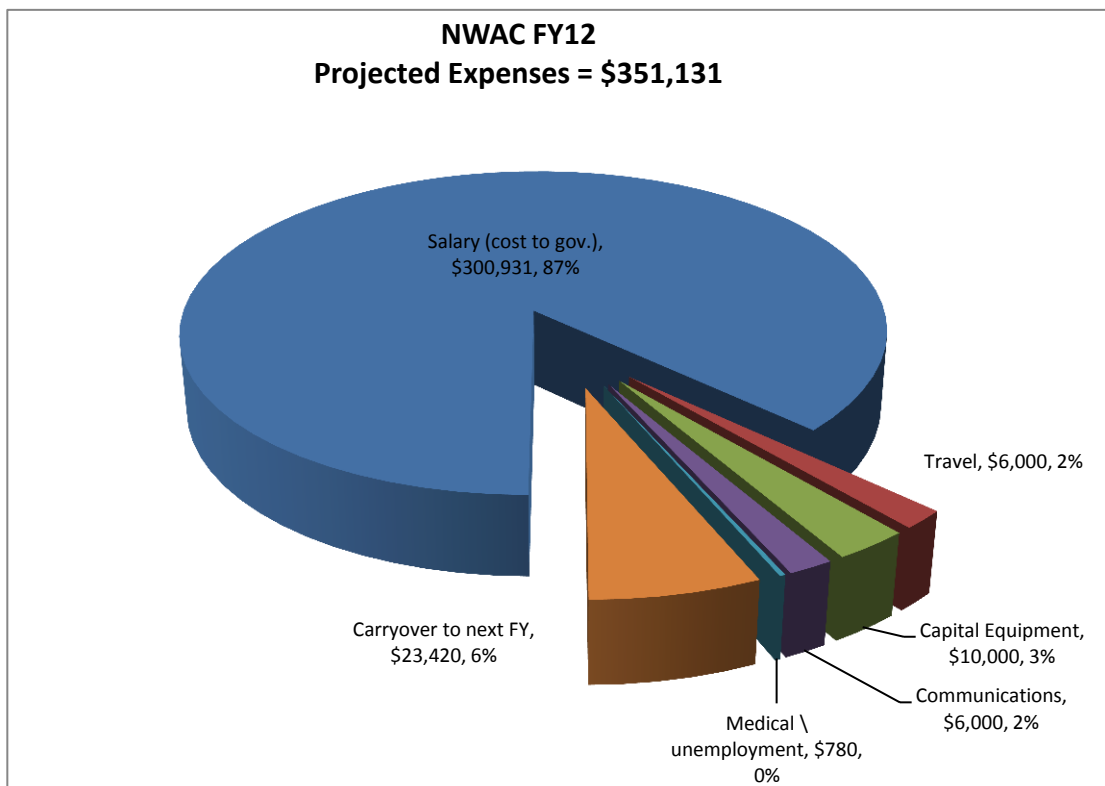


Figure 39. Projected FY12 Expenses

NWAC STAFF

Biographies and photos of both current and past forecasters at the NWAC are available on the [staff page](#) of the NWAC web site. However, short summaries of current forecast staff (three full time avalanche-meteorologists) during the past winter are also given below.

- * **Mark Moore** – Director and forecaster at the NWAC since its inception in 1976. Focal point for budgeting, avalanche accident information, web site evolution and development, computer and weather station management, avalanche poet. Experienced weather station guru and fire weather researcher in the summer (www.airfire.org).
- * **Kenny Kramer** – Forecaster at the NWAC since 1990. Focal point for AWIPS (Automatic Weather Information Processing system) maps and macros, Resource Advisory Committee (RAC/Title II) proposals. Northwest Region 6 FS-RAWS instrumentation coordinator in the summer between bike rides and golf.
- * **Garth Ferber** – Forecaster at the NWAC since 1993. Local BC legend, focal point for weather station programs and data, forecast products, FOAC Snow Pack Information Exchange. Summer biker, hiker, climber and general adventurer.

THE LAST WORD

It's now late May after a La Niña season –
A challenging year for many a reason.
Persistent weak layers during mid-winter –
Formed over a crust and did not sinter.
Later snowfall and wind formed bad combinations –
Especially near the Stevens and Alpental stations.
In addition to deaths, there were too many close calls –
Too many back country mistakes where the avalanche falls.
When you leave Resort Boundaries..in case that was missed –
Here slides and deep snow are just some of the risk.
No patrol nor control to make things okay –
And if you need rescue, you will have to pay.
So please take some time, to check out the snow –
Think about danger, and whether you'll go.
But whatever you decide, when you step thru the gate –
The responsibility's yours, as well as your fate.

–Ruminations about the back country from late May in the PNW—Mark Moore

LIST OF ACRONYMS USED

AWIPS—Advanced Weather Information Processing System
FOAC—Friends of the Northwest Weather and Avalanche Center
ISSW—International Snow Science Workshop
NCDC—National Climatic Data Center
NCEP—National Center for Environmental Prediction
NPS—National Park Service
NSAS—Northwest Snow and Avalanche Summit
NSAW—Northwest Snow and Avalanche Workshop
NWAC—Northwest Weather and Avalanche Center
NWS—National Weather Service
PNSAA—Pacific Northwest Ski Area Association
RAC/Title II—Resource Advisory Committee (Federal Grant Program)
USFS, USDA-FS—United States (Department of Agriculture) Forest Service
WSDOT—Washington State Department of Transportation
WSPRC—Washington State Parks and Recreation Commission