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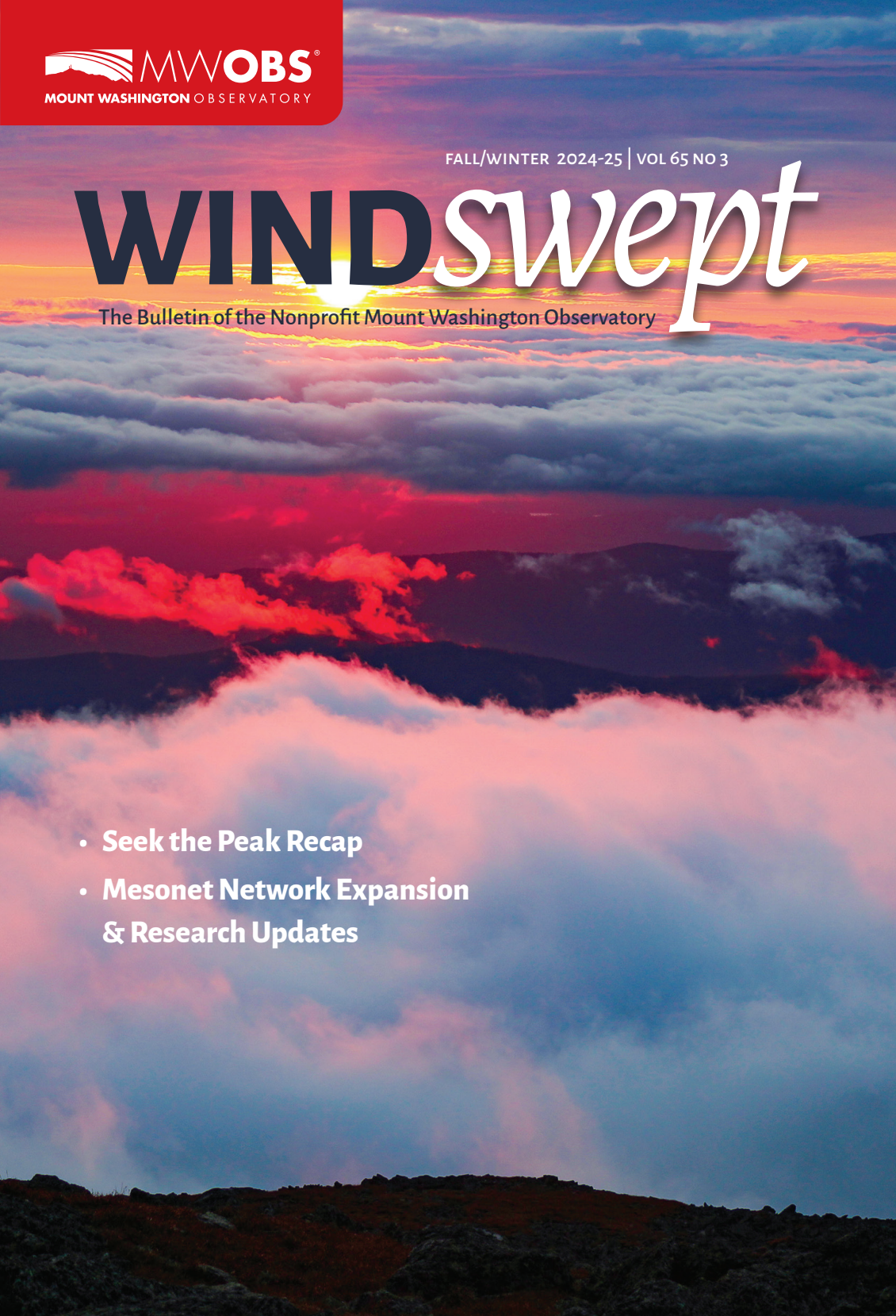
FALL/WINTER 2024-25 | VOL 65 NO 3

WINDswept

The Bulletin of the Nonprofit Mount Washington Observatory



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- **Mesonet Network Expansion & Research Updates**

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WINDswept

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Mount Washington Observatory® is a private, nonprofit, member-supported institution with a mission to advance understanding of the natural systems that create Earth's weather and climate. It serves this mission by maintaining a weather station on the summit of Mount Washington, performing weather and climate research, conducting innovative science education programs, and interpreting the heritage of the Mount Washington region.

Membership in the Observatory is open to all. Members who donate at least $60/year or $5/month receive: Tours of our famous mountaintop weather station (generally mid-May through mid-October); a one-year subscription to *Windswept™: The Bulletin of the Mount Washington Observatory*; meteorology and climate research news from the summit of Mount Washington, straight to your inbox; free admission to *Extreme Mount Washington*™ museum; advanced notice of special events; a 15% discount on all purchases in our museum and online shop; and free admission to more than 300 science centers through the ASTC Passport Program (restrictions apply, please see the ASTC website for details).

Members will receive the three issues of *Windswept* for the year following the quarter in which they join. Please make checks payable to the Mount Washington Observatory and send to: Mount Washington Observatory, PO Box 2310, North Conway, NH 03860-2310, or join at mountwashington.org.

Windswept: The Bulletin of the Mount Washington Observatory (ISSN 1098-7215, USPS 330-710) is published three times a year (spring, summer, fall/winter) by the Mount Washington Observatory. Periodical postage paid at North Conway, NH, and additional mailing offices. Editorial office to which all correspondence and address changes should be mailed is PO Box 2310, North Conway, NH 03860-2310 or submit via email to eestabrook@mountwashington.org

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WINDswept

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Cover Image: Sunset looking below the cloud deck on August 28, 2024. Photo by Corbin Tate.


CLIMBING TO THE
TOP OF NEW ENGLAND
SINCE 1869
THE MOUNT
WASHINGTON
COG RAILWAY
THE ROUTE OF INNOVATION

IN MY VIEW

Reflecting on a Summer of Community Impact & Stewardship

Ellen Estabrook

BY **ELLEN ESTABROOK,** WINDSWEPT EDITOR

Our last issue of 2024 brings with it many exciting developments in the organization's key impact areas of Education and Outreach, Recreation and Safety, and Scientific Research and Technology, as well as to the MWOBS community as a whole. As the Auto Road and summit buildings on Mount Washington close to the public for the season, our team hunkers down in preparation for winter. This is especially true for the summit staff, who recorded the first measurable snowfall of the season (0.1"!) over the first weekend of September, and have been hard at work preparing weather instrumentation since.

As we look back on a busy summer, it is important to bring to mind the valuable interactions the Observatory has with the community at-large. Busy visitation months mean students are traveling to the summit for place-based learning, partners and media representatives are engaging with the work of weather observers, and the broader public is connecting with our history, research, and weather in the *Extreme Mount Washington Museum*. Each year, around 300,000 guests visit Mount Washington State Park, and our museum, retail, and summit team play an integral role in their experiences and in the interpretation of Mount Washington's unique weather and ecology. That is a staggering number, to which we also owe thanks to the incredible Retail/Museum Attendants (Kelly and Corbin, pg. 48), and volunteers whose support is immeasurable.

Whether you attend the Observatory's *Science in the Mountains* webinars, hike with us for our annual *Seek the Peak*, or purchase fundraising products like the recent "Snowcat Tee," you, too, are a part of the community impact that makes the growth and progress of existing and future programs possible.

What will stewardship look like for you this year? There are many ways to get involved (see current volunteer opportunities enclosed) that can work with your schedule and interests. Or, perhaps you can branch out and learn about a new program that might be of interest to you. Either way, our team is so grateful for your involvement and support, and we look forward to ushering in a prosperous and program-filled 2025 with you as we head into the organization's 93rd year.

A Busy Autumn Season on Mount Washington

Drew Bush

BY **DREW BUSH,** EXECUTIVE DIRECTOR

I hope you have each had a wonderful autumn. Here at Mount Washington Observatory, our staff will spend the holiday season catching their breath after accomplishing an incredible number of new projects in the past few months.

First of all, our annual Seek the Peak event this past July came in over budget thanks to efforts by all of you, each of our hikers, and our partners in the recreational community. Words cannot thank you all enough for ensuring this event's success. We love celebrating our work with everyone who joined us at Mount Washington, and we appreciate all the research, weather forecasting, and educational work this event enables us to do each year.

In the months since Seek the Peak, we have been hard at work. We've launched successful new educational programs such as our Storm Scouts Summer Day Camp, a Medical Training Overnight to certify youth educators in Wilderness First Aid, and more opportunities for teacher professional development in weather and climate science through Peak Perspectives (our new summer, overnight program that complements the wintertime Arctic Wednesdays program). You can read more in this issue as our education team gears up for a busy school season in our "Education" report.

Someday soon, you may also hear us providing weather forecasting across the states of Vermont and New Hampshire thanks to new partnerships we are presently working to complete.

On the research side, we've signed a contract to test instrumentation for the United States Air Force's Weather Branch with the aim of making Mount Washington a long-term testing site,

launched new programs to involve undergraduate and graduate students in our research, and installed six new Mount Washington Regional Mesonet stations with our partners at the Mount Washington Cog Railway Company and Dartmouth College thanks to our Northern Border Regional Commission grant. This winter, we're excited to launch a new joint internship with the Appalachian Mountain Club and Hubbard Brook Research Foundation to create a new annual almanac on the climatology and biology of the White Mountains thanks to funding from the Cabot Family Charitable Trust. This effort will complement our existing joint internship with the United States Forest Service's Mount Washington Avalanche Center. Read more in our "Summit Operations," "Research Views," and "On Technology" sections.

Someday soon, you may also hear us providing weather forecasting across the states of Vermont and New Hampshire thanks to new partnerships we are presently working to complete. If you do, we hope you will consider joining us as a member and in supporting our work. Our year-end campaign has gotten into full swing, Giving Tuesday is almost upon us, and your help means all the difference in sustaining our work into its 93rd year. Thank you for being a part of all that we do.

Reporting From the Peak of Purr-fection

TRANSLATED BY **MAYA HARTLEY**

Paws and whiskers, fur-iends! It's your favorite feline weather purr-son reporting from the peak of purr-fection. I've been purring along quite splendidly up here at the Mount Washington Observatory. There has been a paws-itive increase in mice up here on the summit, so this summer I made the cat-tastic decision to work the night shift alongside my favorite human observers Alexis and Ryan in order to get the mice when they're most active! Night life is purr-fect, except the humans often kick me off of my favorite cat-nap spots to "use the keyboard" or "write down observations." Let's just say I have a fur-midable talent for being in the middle of everything.

As for the weather, it has been quite the cat-astrophe! We had a little storm recently, and I had to stay in my cozy spot on what the humans call a "radio". I'm not saying I'm a meow-gician, but it seems like whenever I'm napping in a spot, that's exactly where they'll end up needing to check the weather. I suppose you could call it my fur-tuitous influence! I hear the humans talk about how this winter will have some cat-titude! Wind advisories? More like wind "a-paw-sories"! I guess soon I am going to have to hop from lap to lap all day just to keep my whiskers warm!

Nimbus in the weather room, photographed by summer summit intern Jacob Garside.

When it starts to get cold up here, I focus on indoor exploring. The snow outside creates a purr-fect ambiance for curled-up catnaps and gentle stretches. I've taken to using this time to purr-sonally inspect every nook and cranny of my cozy quarters. The humans call it "weathering the clouds," but I purr-fer to think of it as "enhancing my nap quality."

From sunny stretches to snowy spectacles, I'm living a life that's anything but cat-astrophic. It's all part of the paw-some adventure! Until next time, keep your whiskers twitching and your tails high!

Fatality on Gulfside Trail

On the morning of Thursday, August 22, a passing hiker came upon the body of a deceased man on the Gulfside Trail, near the junction with the Westside Trail, about a half-mile below Mount Washington's summit. According to information from the New Hampshire Fish and Game Department, the deceased was Anthony Antenucci, 72, from Arlington, Virginia.

An investigation into this tragic incident revealed that Mr. Antenucci had ridden the train up the mountain on August 21 and attempted to hike back down that afternoon. According to the Observatory's weather records, conditions during that time period included poor visibility in fog, drizzle and rain, with the temperature mostly in the low 40s and high 30s F, and winds mostly in the teens and twenties (miles per hour), at times bringing the wind chill equivalent temperature into the high 20s F. Mr. Antenucci's clothing and equipment were not appropriate for those weather conditions. It is not known if a medical event occurred and if Mr. Antenucci's death was then occasioned in part by hypothermia, or if his death was due solely to environmental exposure. According to the Fish and Game Department, "He was not prepared for the conditions that were….present in the higher summits of the White Mountains." Our condolences go out to Mr. Antenucci's family and friends.

24th Annual Seek the Peak Exceeds Fundraising Goal

Hikers, sponsors, and volunteers participating in the 24th annual Seek the Peak in July raised over $228,000 to advance Mount Washington Observatory's commitment to real-time weather data and forecasting in the White Mountains. This result significantly exceeded the organization's goal of raising $200,000.

"The energy at our kick-off party,

A Seek the Peak hiker receives his fundraising prize at the Après Hike Expo, held at Great Glen Trails.

NH Senate Recognizes the Observatory

New Hampshire State Senator Cindy Rosenwald and Senate President Jeb Bradley deliver a resolution to Observatory trustees and staff. Photo by Peter O'Neill

The New Hampshire Senate presented a resolution to Mount Washington Observatory at the State House on October 10, 2024, recognizing the Observatory "for maintaining one of North America's longest continuous climate records." New Hampshire State Senator Cindy Rosenwald (District 13) delivered the resolution during the Senate's October 10 legislative session, which can be viewed online. Accepting the resolution, shown above, were Rob Kirsch, Observatory Immediate Past President and Trustee; Drew Bush, Executive Director; Karen Umberger, Trustee; and Charlie Buterbaugh, Director of External Affairs.

"*The Observatory is an iconic institution, not just for us in New Hampshire, but really worldwide for the research they do*," said Jeb Bradley, Senate President, who is retiring after a 32-year political career, which included his time as Chair of the Mount Washington Commission.

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trailheads, and Après Hike Expo was incredibly high as people from across the Northeast celebrated outdoor adventure," Drew Bush, MWOBS Executive Director, said. "Their efforts will now have a direct and important impact on our work."

The event continues to grow, with 366 hikers participating this year, representing an increase of 75 over last year's total. Seek the Peak touched more than 600 people, including 145 first-year participants and many new guests welcomed at the expo, held on July 20 at Great Glen Trails. Tuckerman Brewing Company hosted the kick-off party.

The Top Three Individual Fundraisers this year were Joan Kurtz, Christopher Nichols, and Lee Eckhart. The Nichols Clan won the Top Team Fundraiser award, The Kilted Hikers won in the Top Fundraising Student and Family Team category, and the Top Fundraising Business Team was Seeking Peaks for Diane.

The 25th Annual Seek the Peak will take place on July 18-19, 2025. Visit mountwashington.org for updates.

Observatory Welcomes Two New Staff Members

Mike Carmon

Carissa Milliman

This fall, Mount Washington Observatory (MWOBS) welcomed new staff members Mike Carmon, Summit Operations Manager, and Carissa Milliman, Development Coordinator.

Carmon, who grew up in central New Jersey, first joined the MWOBS team in 2008 for a three-month internship. This morphed into a near-10-year career at the summit station, during which he took on a variety of roles including Education Specialist, Senior Meteorologist, and even Interim Director of Summit Operations. He then worked for six-and-a-half years at White Mountain Science, Inc. (WMSI), a start-up nonprofit in Littleton, NH, driving growth in STEM education opportunities for students and educators across rural New England.

Milliman, originally from Pennsylvania, has a background in communications, outreach, development, conservation, nonprofit management, and education. Before joining MWOBS, she served as the Community Steward for a local land trust, where she gained an immense appreciation for the natural world and, more specifically, the greater White Mountain region. Milliman has also worked as a classroom teacher in the local school district, where she always encouraged curiosity in her students to learn about the incredible and unique terrain nearby.

SPRING/SUMMER 2024 WEATHER DATA

	APRIL	MAY	JUNE	JULY
Temperature (°F)				
Average	24.5	39.5	48.2	52.8
Departure	+0.8	+3.2	+2.7	+2.9
Maximum	46	60	70	62
Date(s)	28th	22nd	19th	5th, 10th, 11th, 16th, 28th
Minimum	1	25	27	40
Date(s)	24th, 25th	10th, 11th	28th	19th
Precipitation (inches)				
Monthly	8.74	5.32	8.12	10.25
Departure	+1.43	-2.36	-0.47	+1.32
24-hour Maximum	1.92	1.34	1.03	2.09
Date(s)	3rd/4th	27th/28th	9th/10th	6th
Snowfall (inches)				
Monthly	36.8	1.2	0.2*	0.0
Departure	+3.7	-11.7	-1.1	± 0.0
24-hour Maximum	12.4	1.0	0.2*	0.0
Date(s)	3rd/4th	9th	9th	N/A
Season Total	303.0	304.2	304.4	0.0
Departure	+35.4	+23.7	+22.6	± 0.0
Wind (mph)				
Average	34.6	25.4	28.3	25.1
Departure	-1.0	-4.2	+1.5	-0.4
Peak Gust/Direction	123 E	86 SE	96 SW	83 NW
Date(s)	4th	27th	23rd	26th
Days 73+	14	5	11	3
Days 100+	4	0	0	0
Other				
% Sunshine	36	30	32	29
Clear Days	3	0	0	0
Partly Cloudy Days	4	3	8	2
Cloudy Days	23	28	22	29
Days with Fog	26	30	25	29
Days with Rain	9	19	23	21
Days with Snow	15	3	2*	0

*Some or all fell as hail

Spring/Summer 2024 Overview

BY **RYAN KNAPP**

April provided plenty of winter weather but by May, milder weather prevailed. Despite several days with precipitation, the month overall fell below the climatological norm for both rain and snow. Even warmer weather arrived for June and a wetter pattern allowed precipitation to nearly break even with wet and warm conditions lingering into July.

April 2024

A trough exited the region early on the 1st as high pressure built over the area. It remained overhead through the 2nd. A frontal system associated with a Great Lakes low on the 3rd provided snow before weakening. A coastal low on the 4th provided nearly a foot of snow and sleet, then an upper level low from the west provided nearly another foot of snow on the 5th/6th. A back door cold front on the 7th provided lingering fog for the day. High pressure provided fair weather conditions on the 8th/9th. A warm front on the 10th provided rain, then a low from the west provided rain on the 11th, which transitioned to snow for the 12th as the low stalled over the Gulf of Maine. Additional snow and sleet fell on the 14th/15th as the low remained offshore.

Fair weather conditions returned with high pressure on the 16th/17th, and then a warm front on the 18th resulted in snow and sleet transitioning to freezing rain/rain by the 19th. A cold front returned snow overnight. An upper-level trough settled overhead and steered a series of disturbances through the region from the 20th through the 22nd, providing light snow daily. High pressure on the 23rd provided a brief break in the winter weather. A strong cold front on the 24th returned snow/snow pellets and colder temperatures. High pressure returned fair weather conditions on the 25th/26th. An approaching warm front late on the 27th returned clouds/fog and some light rain showers overnight. The 28th experienced continued rain and isolated thunderstorms as

the front passed. High pressure briefly provided clearing on the 29th, then a Great Lakes low returned rain showers overnight and into the 30th.

May 2024

Rain showers ended early on the 1st as high pressure provided brief clearing. A trough on the 2nd provided another round of thunderstorms, rain, and some short periods of sleet. Fair weather returned on the 3rd and remained through the 4th. A low on the 5th returned fog and rain/drizzle, with a secondary low on the 6th providing continued fog/drizzle/rain. High pressure returned fair skies on the 7th as low pressure approached from the west. Rain returned on the 8th, and then a robust cold front returned snow on the 9th. High pressure built on the 10th, with summits remaining in the fog, then clearing with the ridge eventually returned on the 11th. A weak trough and onshore flow provided fog/snow on the 12th. A warm front swung north on the 13th and stalled along the international border. A series of disturbances moved along the northern boundary, providing rain/drizzle for the 14th-16th.

A reprieve from the wet weather occurred late on the 16th and lingered into the 17th as high pressure built down from the north. A low to the west drew moisture from a weaker low offshore, providing fog/drizzle/rain for the 18th/19th. High pressure on the 20th provided brief clearing. As the ridge slid offshore, it rotated western US and Canadian wildfire smoke/haze over the region, affecting air quality. A low from the west overnight into the 21st returned summit fog and light rain showers before tapering early on the 22nd as a Bermuda High built rotating warm/humid air into the region. A cold front on the 23rd returned cooler conditions along with rain. Clearing from northern high pressure returned briefly on the 24th before a cold front provided another round of fog and showers overnight. High pressure briefly cleared summits on the 25th before a weak warm front returned fog/rain overnight into the 26th. A more potent low from the west provided rain overnight, which lingered for the 27th/28th. The low slowly shifted northeast on the 29th, and then high pressure built for the 30th/31st

June 2024

High pressure continued from the 1st through the 3rd, providing fair skies, decreasing winds, and milder temperatures. A back door cold front on the 4th returned clouds/fog and light rain showers by the afternoon. An upper-level low on the 5th provided thunderstorms and rain showers. An occluded front and a trailing low provided rain showers on the 6th. Low pressure retrograded over the region for the 7th/8th, providing rain showers and thunderstorms. The low stalled for the 9th/10th, providing continued rain showers. Drizzle/showers lingered on the 11th, then tapered on the 12th as high pressure built over the region. Clearing finally returned on the 13th. A cold front

to the north provided rain showers and neighboring thunderstorms on the 14th. Intermittent clearing returned on the 15th as high pressure built and crested on the 16th.

A warm front on the 17th provided fog/showers. A Bermuda High built towards the region providing increasingly hot and humid conditions with summit temperatures cresting at 70F by the 19th. The stagnant air also led to moderate air quality by the 18th, which lingered with the ridge through the 20th. A boundary aloft provided daily convective activity, resulting in rain showers and thunderstorms. A cold front overnight on the 20th provided additional rain/thunderstorms and cooler conditions by the 21st. The front stalled to our south on the 22nd, resulting in continued fog, drizzle, and rain. A low from the west provided a warm front on the 23rd and a cold front on the 24th, providing continued fog/rain. A weak ridge provided brief clearing on the 25th, and then a cold front returned fog/rain by the 26th. A secondary cold front on the 27th provided rain, drizzle, and sleet. High pressure cleared skies and allowed temperatures to rebound on the 28th. A warm front on the 29th and a cold front on the 30th provided drizzle/rain on both days.

July 2024

A weak disturbance provided intermittent fog and rain showers on the 1st, then high pressure returned on the 2nd and lingered into the 3rd. A warm front on the 4th provided fog and light rain. The front stalled over the region on the 5th providing thunderstorms/showers. A low on the 6th provided additional thunderstorms/showers. High pressure provided fair weather conditions on the 7th/8th. A warm front on the 9th provided thunderstorms/rain, with the remnants of Beryl providing another round of thunderstorms/rain for the 10th/11th. The heaviest rain fell over Vermont, where widespread destructive flooding occurred. A Bermuda High built on the 12th as a boundary lingered overhead. Heat, humidity, and a tropical flow allowed daily convective activity for the 12th/13th. The ridge crested with fair conditions on the 14th, then slid offshore on the 15th as a weak shortwave returned fog/rain.

A cold front from the west on the 16th provided thunderstorms/rain, with rain showers lingering on the 17th. A trough on the 18th provided light rain and cooler conditions. High pressure allowed for clearing on the 19th, with fair weather lingering into the 20th. A cold front on the 21st provided fog/rain, then clearing briefly returned for the 22nd. A warm front on the 23rd provided thunderstorms/rain. The front stalled on the 24th, leading to occasional rain/drizzle through the 26th. High pressure returned on the 27th, clearing fog but returning wildfire smoke from western North America, which reduced visibility and affected air quality through the 28th. Low pressure retrograded on the 29th, providing fog, drizzle, and rain that lingered into the 30th. Another low from the west on the 31st provided another round of thunderstorms/rain.

Flash Flooding: From the Ground Up

BY **FRANCIS TARASIEWICZ**

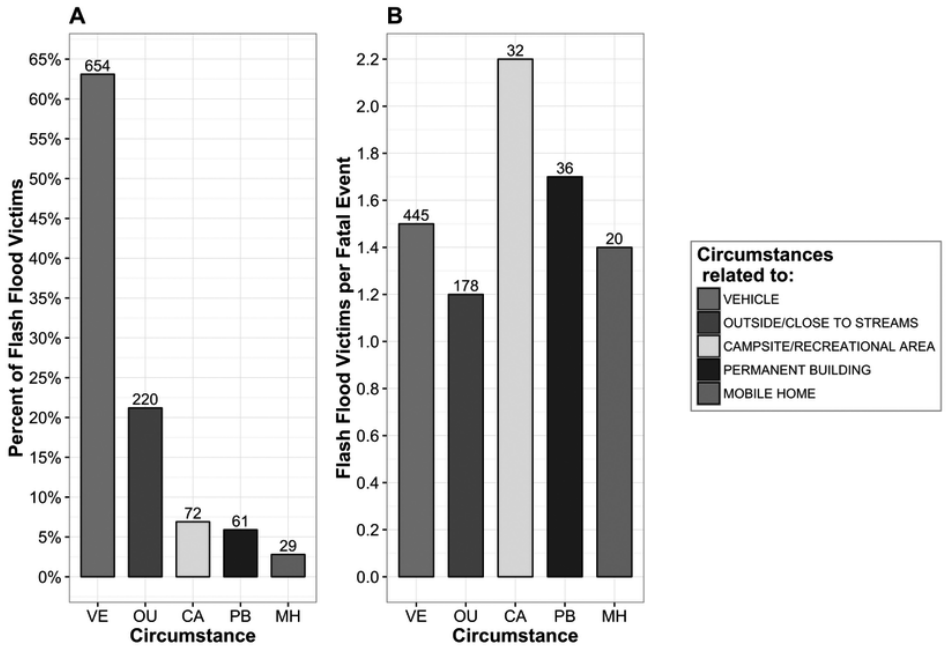
Following only behind extreme heat, flooding ranks as the second leading cause of weather-related fatalities both nationally and globally. One study has suggested that between 1900 and 2011, 7 million lives have been lost to flooding. An especially dangerous form of flooding, rapid onset, or flash flooding, takes an average of 96 lives per year in the United States. Of these, over half (63%) are the result of drivers traversing floodwater. As a result, flash flooding is the most lethal thunderstorm-related weather hazard, surpassing tornadoes and even lightning!

Flash flooding results from several meteorological and non-meteorological factors; this edition of Weather 101 seeks to explore flash floods from the ground up.

For a flood to occur, the ground needs to fail at its job of absorbing rain water or snowmelt. In hydrology, the first part of understanding an area's flood risk is understanding the capacity for soil to allow for the infiltration of rainwater. Excess overland flow, or runoff, occurs when soils are too wet, or, paradoxically, too dry, to allow for infiltration of rainwater. Think about trying to pour water onto a wet sponge. Runoff produced in this manner then pools into low-lying areas, streams, and rivers. If runoff is sufficient, then rapid flooding begins.

Topography plays a big role as well. Flash flooding is common across the intermountain west, where watersheds – areas where runoff drains to – are typically confined between mountains. Smaller watersheds react quickly to heavy rain and resulting runoff. Especially vulnerable to flash flooding are watersheds that contain non-permeable surfaces. Asphalt, concrete, and even ice can create ground surfaces that block the infiltration of water. For flash floods, vegetation with deep roots, not turf grass, is your friend. Plants, and certain animals (shout out to the humble beaver) help infiltration and slow runoff so that precipitation can be better absorbed.

The math of flash floods is surprisingly straightforward. It largely depends on two factors: the amount of precipitation produced, and the rainfall rate. Precipitation produced is a function of the average rainfall rate multiplied by the



Circumstances leading to flash flood fatalities (percent) figure from Galateia et al. 2016

duration of the event. Rainfall rate is a bit trickier. The rate of rainfall has a lot to do with the efficiency of precipitation (the mass of precipitation divided by the influx of water vapor into a cloud) multiplied by the rate of ascent of air, and the amount of water vapor the air can hold. Simply put, clouds that can easily convert water vapor to precipitation – without losing too much mass to evaporation in the process– are excellent rainfall producers. The most efficient rainfall producers are found in the tropics where thunderstorms and towering clouds turn nearly all of the water in the troposphere into precipitation. Outside of this "cloud math," the meteorology of flash floods is again fairly simple. The atmosphere needs to be rising to condense high levels of water vapor into clouds, the clouds need to be slow moving and efficient at producing rain, and that rain needs to repeatedly move over the same area.

There are a variety of meteorological scenarios that bring about localized extreme rainfall and flash flooding. This includes thunderstorms, stationary fronts, tropical systems, orographic upslope flow, atmospheric rivers, and ice jams to name a few. Thunderstorms are the most common trigger of flash flooding, but here in the White Mountains flooding is most often the result of upslope flow. The topography and prominence of the Whites forces air to quickly rise and condense into prolific

rain-producing clouds. Oftentimes, the resulting orographic precipitation processes put the Green and White Mountains into the "jackpot" zone with each storm. Of course, flooding isn't much of a concern on the summits rather, the runoff from the mountains pours into the surrounding valleys, streams, and rivers.

Flash floods are among the hardest phenomena to forecast due to their small scale and locally catastrophic impacts. As I mentioned before, most flash flood events result from enormous thunderstorms that are hard for models to process. A growing body of research seeks to turn the tides to better inform future flash flood forecasts.

Flash flood forecasts are becoming even more important as our warming atmosphere is able to hold increasing amounts of moisture. Those most vulnerable to floods include folks who live in apartments below ground level, as was the case with the remnants of hurricane Ida which dropped 12 inches of rain across New York City. Even more vulnerable still are hikers, campers, communities near rivers and streams, and, especially drivers. For people in those communities my advice is simple. First and perhaps most importantly, if in a vehicle of any size, please follow the National Weather Service's advice: Turn Around, Don't Drown. It takes only a foot of water to sweep a vehicle away.

Beyond the Classroom: Inspiring Youth, Teachers, and Outdoor Leaders with Hands-On Experiences

BY **BRIAN FITZGERALD**

Students are back in the classroom this fall, but for Mount Washington Observatory's (MWOBS) education team, the learning never stopped over the summer. Storm Scouts: Extreme Weather Camp was one of three brand new programs offered by MWOBS with the support of the Dorr Family Foundation benefiting youth, teachers, and other youth-supporting adults. The Storm Scouts camp hosted 14 fifth-through-eighth grade youth across two week-long sessions hosted at the Observatory's North Conway administrative offices.

Run in partnership with Conway School District's Project SUCCEED, MWOBS educators brought a balance of weather-themed summer camp fun, outdoor recreation, and learning experiences both in the valley and on trips to the summit weather station.

Young learners weren't the only ones who were able to access MWOBS learning opportunities. A total of 15 K-12 teachers from across the region took part in Peak Perspectives: Professional Learning in Weather & Climate Education on two separate overnight experiences. During the overnight adventure, Weather Observers & Education Specialists led forecasting challenges, teachers took part in climate change and art activities, and the full group demoed a community weather interview project that can be shared with students in their classrooms. For participating educators, program highlights ran the gamut: from learning the latest citizen science protocols, to experiencing the summit environment, to enjoying a brilliant sunrise. For one teacher, it was immersion in all aspects of the learning experience.

In addition to teacher and youth programs, foundation support and partnership with SOLO and Maine Health's Memorial Hospital lead to MWOBS hosting a summit overnight medical training program at the end of August. A mix of MWOBS and New Hampshire State Park staff, along with members of the public who regularly work with youth outdoors were Wilderness First Aid and CPR certified by medical educators at SOLO. This unique experience allowed participants to learn using active training scenarios outside on the summit environment in addition to classroom space within the Observatory's weather station. Overwhelming interest and positive participant feedback from this program experience makes a strong case for seeing

Project SUCCEED and MWOBS Staff with Storm Scouts and their handmade wind anemometers during summer camp.

this program return in the not-so-distant future.

One more highlight of the past summer was the launch of weather station tours for the public. As in the past, members of the Observatory continued to enjoy tours as a benefit of membership with no cost, and for the casual visitor to the summit of Mount Washington, more than 1,000 members of the public were able to learn directly about the work of MWOBS in the heart of our summit operations. Summit partners such as the Mount Washington Cog Railway, Mt. Washington Auto Road, and Mt. Washington State Park have all been instrumental in helping spread the word about this opportunity to the public to continue to improve the overall summit visitor experience.

As we look ahead to the traditional school year, MWOBS educators are already providing programs during and after the school day at area schools, and even running our first field trips to the summit. Significant support from the Neil and Louise Tillotson Fund from the New Hampshire Charitable Foundation and the Kendal C. and Anna Ham Charitable Foundation have set MWOBS on its way toward accomplishing its goal offering more than 500 school day, after school, virtual, and field trip programs. These foundations are helping the Observatory provide low – or in some cases no-cost programming to schools right in our backyard in the Mount Washington Valley and Coos County. If you know a school district or teacher who might benefit from Observatory programming, be sure to spread the word!

The arrival of winter will also mean a return for several popular programs such as the Arctic Wednesdays professional development for teachers, public winter overnight EduTrip programs, and partner-led overnight climbing trips to the summit. Also, the Observatory will work through the summary and findings from an ongoing visitor experience assessment conducted by undergraduates from Worcester Polytechnic Institute (WPI). Students participating in the White Mountains Project Center, led by WPI Professor Corey Denenberg Deh-

ner, have been hard at work developing comprehensive survey tools to capture input from visitors to the Observatory's Extreme Mount Washington summit museum and weather station. The project's objectives are to help MWOBS assess current visitor experiences and formulate recommendations to improve visitor understanding of the Observatory's work and how to make them more accessible to a wide range of visitors.

With all the current programming underway at the Observatory, whether it's through a direct experience on the mountain, or virtually through a Science in the Mountains lecture, we hope you'll find at least one way to engage with us. Happy learning!

Storm Scout camper on the instrument tower with Kestrel instrument measuring wind speed.

2024 Program Stats

- **K-12 Programs**
  - School Day: 60 programs, 1,444 students served
  - Virtual: 60 programs, 1,459 students served
  - After School: 38 programs, 360 youth served
  - Field Trips: 25 programs, 796 students served
  - Teacher Professional Development: 10 programs, serving 38 teachers
  - Storm Scouts Summer Camp: 2 programs, 14 youth served
  - School Memberships: 13
- **Adult & Family Programs**
  - EduTrips: 6 programs, serving 54 adults
  - Climbing Trips: 5 programs, serving 40 adults
  - Science in the Mountains: 10 programs, serving 1,409 adults
  - Extreme Mount Washington Museum: interpretative services provided for +300,000 annual visitors
  - Weather Station Tours: provided to at least 1,483 members, new members, and visitors to the mountain

FEATURE

A Family's North Star: In Memory of Caryl Brensinger

BY **ELLEN ESTABROOK**

With each remembrance feature, we are reminded of the reverence held by many for the highest peak in the northeast, bringing forth the importance of celebrating the legacies of the individuals who left their imprints upon it; each in their own singular, significant way. Through their care, their strength of spirit, and their lifelong dedication to learning and shared experiences, these stewards of Mount Washington reflect what Mount Washington Observatory and its partners strive to instill—a curiosity and compassion for the natural world and a desire to share its teachings with others.

Young Caryl at Cedar Pond, Milan, NH, June 1962.

Our team recently had the honor of speaking with the family of Caryl Brensinger, whose life embodied not just the qualities described above, but also an inextinguishable love for the outdoors, adventure, and scientific inquiry.

Please join us in getting to know one of the mountain's stewards, Caryl, through her husband, Barry, her son, Cam, and her daughter, Evelyn, who recently joined us for a conversation from their respective homes in New Hampshire to share about Caryl's life and to celebrate her advocacy and legacy.

Caryl illustrated a love and respect for the outdoors from a young age, likely originating from growing up in New Hampshire's North Country. A true New Englander, she thoroughly enjoyed and was fascinated by the Granite State's cold winters and storms. Skiing from

Caryl at home, May 2010.

a young age and exploring the White Mountains undoubtedly added to the lifelong at-home, and at-one, feeling that Caryl would return to throughout her life. Whether she was skiing on Wildcat as a teenager or later peering from their family ski house in Bretton Woods, a glimpse of Mount Washington was never far from view—this, too, would remain a constant.

After starting a family with her college sweetheart (Caryl and Barry married during her junior year at the University of New Hampshire), family adventures would indeed continue. Her daughter, Evelyn, recalls exploring with her mom as some of her fondest memories growing up: "We would hike in the White Mountains regularly—that was the thing we did to spend time together. It left an imprint on me." She spoke, too, of her mother's generosity of spirit, shared with her children, grandchildren, and those lucky enough to be in her orbit.

The family recalled a winter backpacking trip in Carter Notch to encapsulate Caryl's affinity for adventure:

"It was well below zero that night," Cam recalls of their stay in the hut. "We were in 20-30 degree bags—I'm not sure anyone slept that much." Cam, on break from college with a few winter trips already under his belt with the mountaineering club, recalls his mother's connectedness to nature, her self-assuredness, and her pure joy in conditions that many would describe as "Type 2 fun."

"If there's a gene for the outdoors, I think I inherited that from my mother," Cam adds, who founded the outdoor gear company NEMO Equipment over 20 years ago.

"That can be traced to her in a lot of ways," he explains. She was there from the business's first days, offering exceptional bookkeeping and banana bread. "Before long that morphed into a full-time accounting job—all told she was here for most of the 22 years."

In addition to her accounting assistance, Caryl had an impressive career in health sciences and teaching, reflected in her daughter Evelyn's career as a leader in public education policy.

"My Mom was an immensely curious person," recalls Evelyn, who is Co-Director of the Partnership for the Future

of Learning as well as a board member at the New Hampshire Charitable Foundation. "She had an extraordinary energy—an endless appetite to learn new things."

Caryl's interest in life sciences was complemented by an insatiable curiosity for all sciences, including astronomy, astrophysics, geology, and meteorology and climatology.

Inspired by the potential of scientific discovery and the awe and grandeur of the greater universe, Caryl closely followed the Observatory's communications and often shared photographs and forecasts from the summit.

"Her greatest passion was science," explained Barry, her husband of 51 years. "She was greatly concerned about climate change, and knowing the work (the Observatory) does, there was an intellectual and emotional connection for her."

He also spoke of a quiet courage imbued by Caryl, as well as her spark, and shared with us the fateful Thanksgiving during which they crossed paths in a true "love at first sight" moment. When it came to writing this piece together, Barry offered, "I can't imagine a better way for her to be recognized," describing Mount Washington as her "apex of nature."

Before we ended our visit with the Brensinger family, they shared with us a touching tribute and visual manifesto to symbolize and celebrate their North Star over Mount Washington. While the image remains in safekeeping with their family, we will very much have Caryl in our thoughts when blue hour washes the Northern Presidentials in the most brilliant purple hues, as she keeps a watchful eye on Mount Washington and the Observatory.

Caryl & Barry hiking, location unknown, early 1990s.

Mount Washington Observatory joins the Brensinger family in celebrating Caryl's beautiful life and the footprints she undoubtedly left in the hearts of so many, and wishes to thank her and her family for their support of the Observatory in her memory.

Thank you to Evelyn Aissa, Cam Brensinger, and Barry Brensinger for their collaboration on this piece.

FEATURE

A Deep Dive into Peak Wind Data

BY **KARL PHILIPPOFF**

Mount Washington is known as the "Home of the World's Worst Weather," with our single most noted extreme weather events usually linked to our high winds. For this article, I decided to delve a bit into our wind data, namely one of the pieces of information that we have noted daily since the 1930s— our daily peak wind gusts. Most of the following graphs and statistics, except where noted, will be based on only this piece of information.

First off, since this a preliminary analysis, I did not attempt to homogenize the data over the time interval studied. Homogenization would have taken into account changes in the placement, height and exposure of the instruments used to measure wind speed on the summit since the 1930s, in addition to the changes in the instruments themselves. It would also attempt to adjust for changes in the structures built on and removed from the summit and how they may or may not have affected the measured winds. In addition, no attempt was made to fill in missing data at the daily or sub-daily level that was not immediately available for this analysis (possibly caused by issues such as instrumentation malfunctions, icing, etc.). However, there is not a lot of missing data overall, with only a total of 421 days (1.3% of the 32,714 days) of missing peak gusts over the nearly 90 years of data used in this study.

Another important disclaimer is that the data used for this analysis extends from January 1, 1935 to July 25, 2024, and so does not capture the highest wind gust ever measured on the summit on April 12, 1934 (231 mph). Thus, in all tables and figures shown below, keep the dates over which this analysis is valid in mind. The data set over this time frame consist of all daily peak wind gust speeds, time of occurrence, and direction. For the most part, this analysis will be focused on the wind speeds measured, as this seemed to be the most interesting focus for a short article.

With those caveats in mind, here is a peek at some of the data!

One of ways we can slice the data is to look at the peak wind gusts on a single day date, for instance, January 1st, and determine what the distribution of wind gusts looks like on that particular day and then continue looking at each individual day over an entire year. One common way to visualize the distributions is to use what are called percentiles. The

percentile of a dataset, in this case, peak wind gusts, is the percentage of the data that falls at or below this value. For instance, the 25th percentile wind gust means that 25% of the data fall at or below this value, while 75% of the daily wind gusts exceed this value, while the 75th percentile refers to the value that 75% of the data falls at or below, with only 25% of daily wind gusts exceeding this value.

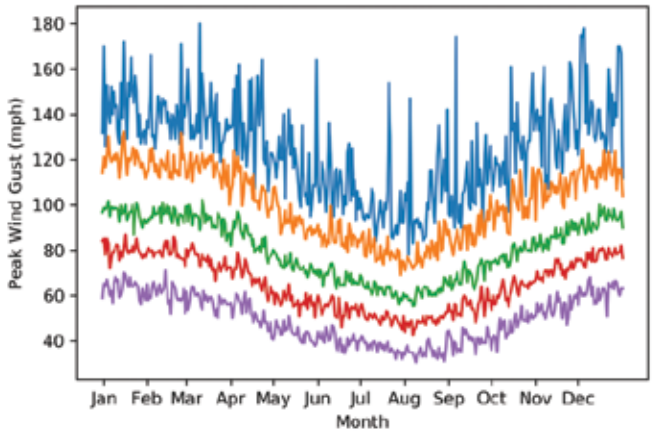


Figure 1: Maximum, 95th, 75th, 50th, and 25th percentile wind gusts for every day of the year between January 1, 1935 and July 25, 2024. Labels on the x-axis for each month correspond to the first day of that month. Notice that maximum wind gusts on many days often exceed the 5th highest gust on the same day by a substantial quantity. Note also the seasonal variation, with a pronounced plateau of high winds during the winter months between late November and late March, while winds bottom out in late July into early August. The summer months, though, still have dramatic spikes in daily maximums late in August into early September, usually associated with storms that have tropical origins.

The median value, or the 50th percentile, is also heavily used in this analysis and describes the middle value which splits the data in half, with half of the data greater than this value and half equal to or less than this value. This value is commonly used in statistics over an average because it is less susceptible to outlier values. If there are only a few very high values and many more lower values in a dataset, or in statistical terms 'positively skewed data,' the median will often be used it because it will be less sensitive to the high outliers and better represent data under study.

Figure 1 shows how the 25th, median or 50th, 75th, 95th percentiles, and daily maximum wind gusts vary over the course of the year. This graph clearly shows the seasonal variation in wind speeds on the summit. The windiest portion of the year occurs between late November and late March, with surprisingly little variation in all but the maximum wind gusts during this time period. The vast majority of days over this time frame have median gusts at or above hurricane force or 74 mph, with the "windiest" single day, according to the median, of an incredible 87 mph on January 17. Median wind speeds then decrease steeply in April, followed by a slower slide all the way to late July where they stabilize until about mid-August.

The single least windy day by this metric occurs on August 6, which has a median peak wind gust of only 42 mph. Wind speeds then gradually ramp up fairly continuously from late August into late November, with the amplitude between

the windiest winter months and the least windy summer months being roughly 30 mph between about 80 mph in January to about 50 mph in August.

One other thing to note about this graph is the spikiness of the maximum wind gusts on each day compared with the much more gradual trends shown in 95th percentile and below winds, with the 95th percentile corresponding to roughly a top 5 event for each day of the year over the roughly 90 years covered by this analysis. The maximum gusts, signifying outlying events, can be quite a bit higher than any other winds on particular days, and, even during the summer months, gusts well above a hundred miles an hour remain possible, only they are far less frequent than during the colder seasons. Many of the highest gusts from August to September have actually been found by prior research to be associated with the passage of tropical cyclones and/or their remnants, including the maximum wind gusts ever recorded in August (147mph, Isaias, on August 4, 2020) and September (174 mph, David, on September 6, 1979).

Another way to describe these winds is by the use of a table, similar to how you can reference our normals, means, and extremes page on our website. This is shown in Figure 2 below, with additional information related specifically to peak wind gusts. There is quite a bit of information displayed in the table; we'll step through from the left side of the table to the right looking at the values for January. The maximum wind gust ever recorded in January between 1935 and 2024 was 172 mph on January 16 of 1985 (column 1). The median maximum wind gust for all Januarys over the same time interval is 128 mph, meaning that at least 1 January day in 45 of the 90 Januarys had wind gusts greater than 128 mph (column 2). The median daily wind gust for any given January day is 80 mph, which means that the majority of recorded days in January have had wind gusts greater than hurricane force (74 mph) (column 4).

Month	1. Maximum Wind Gust and Date of Occurence	2. Median Monthly Maximum Gust	3. 75th percentile Daily Gust	4. Median Daily Gust	5. Average Monthly Wind Speed	6. Lowest Max Daily Wind Gust and Date of Occurrence	7. Days of Month with Max Wind Gust<100mph	8. Days of Month with Max Wind Gust>=140mph
January	172 on Jan. 16, 1985	128	97	80	45.6	126 on Jan. 3, 2011	0	19
February	171 on Feb. 25, 2019	127	96	79	44.6	125 on Feb. 7, 1941 & 1942	0	13
March	180 on Mar. 10, 1942	123	93	75	39.8	118 on Mar. 24, 1979	0	10
April	164 on Apr. 23, 1993	118	85	68	35.6	106 on Apr. 27, 1975	0	11
May	164 on May 31, 1945	98	73	58	29.6	90 on May 27, 1991	3	3
June	136 on June 9, 1941	89	68	54	26.8	89 on June 28, 1978	10	0
July	154 on July 20, 1996	83.5	62	50	25.5	85 on July 12, 1984	22	1
August	147 on Aug. 4, 2020	86	62	49	24.5	83 on Aug. 7, 1955	16	2
September	174 on Sept. 6, 1979	94	70	55	27.6	90 on Sept. 5, 1998	10	1
October	161 on Oct. 15, 1943	106	79	63	35.5	97 on Oct. 13, 1993	1	4
November	163 on Nov. 25, 1983	112	87	71	39.4	110 on Nov. 8, 2022; Nov. 10, 1936	0	8
December	178 on Dec. 4, 1980	121	94	78	44	119 on Dec. 6, 1958	0	15
ANNUAL	180 on Mar. 10, 1942	140	81	64	34.9	83 on Aug. 7, 1955	62	87

Figure 2: Monthly and annual peak wind gust data for Mount Washington between 1935 and 2024. All winds referenced in the above table are in miles per hour (mph). The data displayed in each column is described in the text. Some other notable tidbits that follow is that the first day of the year with a maximum wind gust below 100 mph is May 20th, which has a maximum wind gusts of 99 mph set on both 1935 and 1938. The last day with a maximum wind gust below 100 mph gust is October 13, which has a maximum wind gusts of 97 mph and was set in 1993. It is the only day in October with a maximum wind gust below 100 mph, with the previous date nearly 3 weeks earlier on September 25, 1941 (92 mph).

The top 25% of days, or, alternatively, 1 out of every 4 days in January have had winds of over 97 mph (column 3). The average monthly wind speed for January for all hours between 1991 and 2020, however is 45.6 mph (column 5). The lowest maximum daily gust for any of the 31 days in January occurs on January 3 at 126 mph. This means that throughout the 90 years included in this analysis, all other days in January have had at least a single wind gust greater than 126 mph (column 6). Finally, zero January days have had wind gusts of less than 100mph (column 7) and 19 separate days have had wind gusts equal to or greater than 140 mph (column 8).

From this table, numbers can be put to some of the trends noted in the first figure. While the median daily gusts between December and March are very close, January and February stand out slightly for the slightly higher maximum wind gusts. Median daily wind gusts then trend down substantially from late March to May. April, however, is notable for having the greatest difference between its typical maximum monthly gust (118 mph) and its median daily gust (68 mph) of 50 mph. Thus while wind speeds are generally trending down in April, its strongest storms tend to be nearly winter-like in their intensity on the summit.

Wind gusts then trend down more slowly toward their summertime minimum. Which month is the "least windy" depends on your chosen metric: August has the lowest average wind speed, the lowest daily maximum wind gust of any month (83 mph on August 7th), the lowest median daily gust of 49 mph, and the second lowest monthly maximum gust of any month 147 mph. July's median daily gust is only 1 mph higher, has the lowest median monthly maximum wind gust of any month at 83.5 mph, and, by some margin, has the most days without a recorded 100 mph wind gust (22). I would argue that the lower median monthly maximum winds and the many more days of lower peak wind speeds would outweigh the small differences in their daily average and median peak gust speeds, but your mileage may vary.

Winds then ramp up from September to December a bit slower than they ramped down in springtime, climbing steadily back to their winter-time maximum. Median monthly maximum gusts breach the triple-digit mark in October, with median daily gusts reaching back over hurricane force by December.

The last line of the table, named "annual," shows the same statistics over the entire year, which also shows some pretty compelling numbers. The median annual peak wind gust across the whole dataset is 140 mph, with a median daily gust of 64 mph. And finally, there are many more days that have maximum wind gusts at or over 140 mph (87) than there are days which have wind gusts under 100 mph (62)!

One of the things that prompted this analysis was to confirm the validity of a line we repeat during our tours; that we "see winds at or greater than hurricane force (74 mph) approximately every other day and winds at or above 100 mph about every fourth day" during the winter months. Looking at the table, four consecutive months (December through March) actually have winds greater than hurricane force about every other day, while the same four months have winds slightly lower than 100 mph every 4th day. So, the tour line, rounded to the nearest full day, is quite right.

Enhanced Infrastructure, Expanded Team, and New Technology Drive Continued Scientific Impact

BY **JAY BROCCOLO**

The summer and fall seasons at the Mount Washington Observatory have been a time of growth and innovation, with new projects, technological advancements, and careful preparation for the upcoming winter. From expanding our mesonet network to installing new storm windows, the summit's operations have seen significant developments that will keep the Observatory at the cutting edge of mountain weather observation and research.

New Mesonet Stations on the Mount Washington Cog Railway

One of the major milestones this season has been the successful launch of three new mesonet stations along the Mount Washington Cog Railway, with two more set to come online. These stations represent a significant leap forward in our ability to monitor weather conditions across the mountain. Keith Garrett, our Director of Technology, has played a pivotal role in launching these stations, ensuring the mesonet provides increased resolution and coverage, benefiting both summit operations and regional forecasting.

Winter Preparations: Storm Windows and the New Tractor

As we prepare for the harsh conditions that winter brings, winterization efforts are well underway. The Summit Operations Task Force, made up of dedicated supporters of the Observatory, has worked in collaboration with New Hampshire State Parks to secure new, specially made storm windows from Granite State Glass. These windows are designed to withstand

Jon Powers working on window installation on August 30th.

Mount Washington's extreme weather while providing better visibility than the old "weathered" ones. This improvement ensures our infrastructure remains protected and functional, even in the worst conditions.

Additionally, Jon Powers, our Transportation Coordinator, has been leading the effort to ensure our transportation fleet is ready for winter. Thanks to Congressionally Directed Funding, a new tractor is arriving this winter to replace our aging vehicle. This new tractor will enhance our ability to transport personnel and equipment to and from the summit during the challenging winter months.

Summit Staffing, Training, and New Leadership

We're fortunate to have a steady team of experienced observers, and this has been essential in supporting our growing operational needs. At the same time, we've expanded our projects and are continuing to explore new opportunities in product testing and research. On top of that, I'm excited to announce that **Mike Carmon** has returned to the Observatory as our new Summit Weather Operations Manager. Mike, who worked on the summit for nearly 10 years prior to 2018, brings a wealth of experience and will work closely with me to manage summit operations and our team of 8 certified observers.

In addition, Jon Powers organized essential CPR and First Aid training for our staff with help from SOLO North Conway and the Conway Fire Department. This training ensures that our team can handle emergencies on the summit and assist New Hampshire State Parks if needed.

Technology Upgrades and Successful Weather Station Tours

We've also focused on upgrading our technology this year. We began a yearly rotation of upgrading computers to ensure our systems remain up to date and capable of supporting both science and observations. This has also improved the interaction between staff and visitors through enhanced visual displays.

Moreover, this summer's weather station tours were a great success! Expanding the tours to include sign-ups with the Cog Railway and Auto Road and promoting on-the-spot tours through our interns, has allowed us to connect with more visitors than ever before.

Looking Ahead

While this season has been marked by significant achievements, we're also looking ahead to exciting new developments. As you may have read in the science and research section, we're preparing for the arrival of the Vaisala WindCube Atmospheric Scanning LiDAR in the spring, which will greatly enhance our ability to map wind fields and improve forecasting on the summit.

As we head into the winter season, our preparations on the summit have ensured that we are ready to meet the challenges ahead. From new mesonet stations and infrastructure upgrades to an expanding team, we're well-positioned to continue providing valuable weather data and insights, supporting the Mount Washington Observatory's mission and its broader scientific impact.

Partnerships in Science & Research Advancement

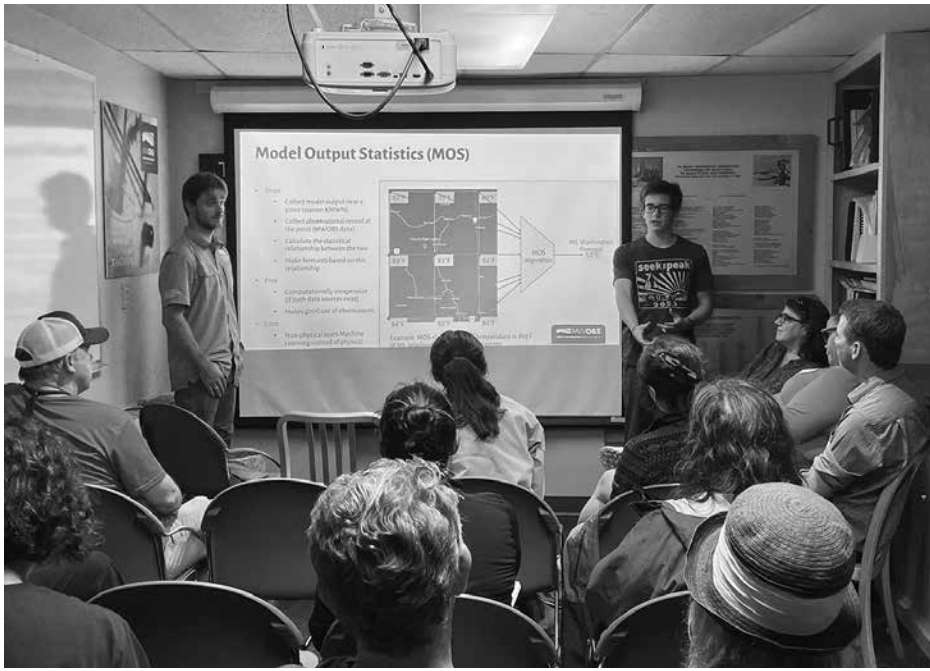
BY **JAY BROCCOLO**

This summer has been a season of exciting scientific discoveries at Mount Washington Observatory, thanks to the dedication and hard work of our interns and the success of several new research collaborations. These efforts have not only expanded our understanding of the unique weather patterns atop Mount Washington, but have also provided critical insights that will shape future forecasting efforts and operational improvements.

Intern-Led Research Initiatives

Our summer interns tackled a variety of important projects, all aimed at enhancing our understanding of Mount Washington's extreme weather and improving forecasting accuracy.

- **Joshua Elms** compared Model Output Statistics (MOS) and the National Blend of Models (NBM) against summit observations to assess forecast reliability. His findings have helped identify strengths and weaknesses in these models, offering opportunities to refine our forecasts.
- **Jacob Garside** expanded on this by conducting case studies on outlier weather events that models struggle to predict. His research provides a deeper understanding of forecast anomalies and how to manage them more effectively.
- **George Mousmoules** examined late-season snowfall trends, uncovering patterns that improve our forecasting and safety measures during these critical periods.
- **Maya Hartley** focused on historical wind patterns, offering fresh insights into the dynamics of summit winds, which are vital for both research and operations.
- Finally, our Fall intern**, Ingrid Miller**, is investigating long-term precipitation trends using our dataset, with the goal of providing a more complete understanding of summit precipitation over time. Intern **Andrew Sullivan** will be looking at icing events through an aviation lens.



Interns Jacob Garside (left) and Joshua Elms (right) present research on Model Output Statistics during a media visit in collaboration with the Appalachian Mountain Club.

New Collaborations and Research Initiatives

We're also diving deeper into new collaborative research efforts. Our ongoing work with Fairfield University has received crucial data, which we'll be analyzing in the lead-up to the American Meteorological Society (AMS) conference in January. This research, which examines extreme snowfall events, will pair well with our ongoing collaborative work with the Appalachian Mountain Club (AMC) and the U.S. Forest Service's Hubbard Brook Experimental Forest. Together, we are studying how winters are changing in terms of snow depth and fewer cold days—a shift that is critical to understanding the broader impacts of climate change in our region.

Congressionally Directed Funding and Future Technology

In a major step forward for the Observatory, we successfully secured Congressional Directed Funding to support several critical research and operational advancements. One of the most exciting acquisitions on the research side is the Vaisala WindCube Atmospheric Scanning LiDAR. This cutting-edge technology will allow us to map wind fields in complex terrain with unprecedented

accuracy. The ability to measure wind speeds and directions at multiple levels will be invaluable for both our research efforts and operational forecasting, especially in the rugged terrain surrounding Mount Washington. Keith Garrett, MWOBS Director of Technology and I will begin training on the WindCube this winter, preparing for its arrival next spring when we can fully integrate it into our ongoing studies.

Additionally, we've made strides in expanding our mesonet network. Keith has already launched three of the five new mesonet stations along the Mount Washington Cog Railway, with the final two set to go online. These new stations will allow us to better understand the flow of weather systems through the mountain's complex terrain, providing increased resolution and coverage across the entire mountain. With this enhanced network, we'll gain a clearer picture of the localized weather patterns that define Mount Washington's extreme conditions.

Looking Ahead: AMS Conference and Future Internships

As we look to the future, these summer research projects and new collaborations have laid a strong foundation for ongoing scientific inquiry. We are excited to share these findings with the broader meteorological community at the upcoming AMS conference in January. At AMS, George Mousmoules will present his snowfall research through Plymouth State University, and Weather Observer & Research Specialist Charlie Peachey will discuss his study of Rain on Snow events. Additionally, we'll showcase our collaborative efforts with Fairfield University on extreme snowfall events and future comparisons with CMIP6 climate models.

Beyond AMS, we're also looking ahead to exciting opportunities with our joint internships, including new **Climate Research and Climate Communications positions** with the AMC and Hubbard Brook Research Foundation. These internships will play a pivotal role in creating a new *White Mountains Climate Almanac*. This almanac will compare the past year's climate data to various 30-year climatologies, linking atmospheric climate data with biological climate data to provide a more complete picture of the changing climate in the White Mountains.

We're also excited for the return of our joint internship with the Mount Washington Avalanche Center (MWAC)/USFS, which will provide hands-on experience in both weather and avalanche forecasting, with an emphasis on meteorological observations and snowpack analysis.

We're gearing up for a winter season filled with new opportunities for learning and collaboration, and we can't wait to see the insights and innovations that will emerge from these projects.

Watts Up?

BY **KEITH GARRETT**

The Cog Railway Vertical Profile is nearly online. Currently, three new stations have been brought online. The first is at 2,620 feet, in an open grassy area next to the pond at Marshfield Station at the base of the Cog Railway. The next is at 3,430 feet along the tracks, close to an area called Cold Springs. Continuing uphill, the third station will be installed at 3,850 feet attached to the top of Waumbek Station.

Half Way house is next, coming in at 4,465 feet, which is being completely replaced with all new instrumentation. Finally, the last station before you reach the summit is Skyline, located at 5,556 feet and is also fully operational.

These new stations will allow for research to compare weather on both the east side (The Mount Washington Auto Road) and this new vertical profile on the west side of Mount Washington(Mount WashingtonCog Railway).

This project is the first part of our Northern Borders Regional Commission grant to expand our mesonet from the White Mountains northward to the Canadian border.

The sun will shine, and the batteries will charge. We shall see which survive their first Mount Washington winter.

The stations at Marshfield, Cold Springs, and Skyline are already online, recording wind speed and direction, temperature, relative humidity, station pressure, solar radiation, and soil moisture as well as electrical conductivity. Each station is solar powered, and communicates via microwave radio to an access point between 7 and 9 miles away.

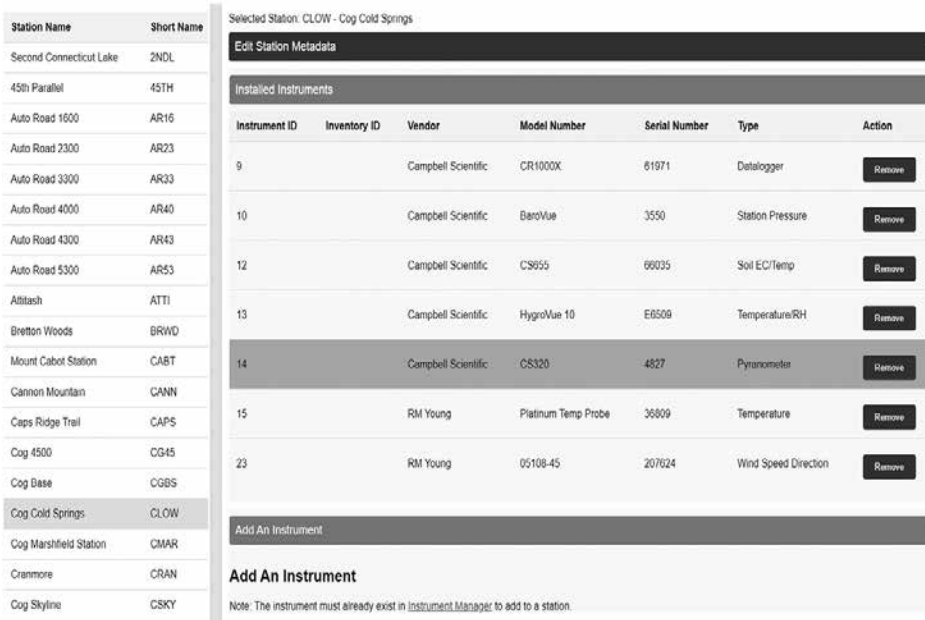
Many remote automated weather stations use solar and battery storage to power their sensors, datalogger, and data transmission systems. The average station uses a 50 watt solar panel with a 100 amp hour battery. These stations use a single 90 watt panel, and have 500 amp hours of 12 volt AGM

Skyline Mesonet station installation on September 3, 2024.

battery capacity. Currently, we can't charge lithium iron phosphate(Lifep04) efficiently with the weather on Mount Washington, but we are running a few tests with some 100 amp hour Lifep04 batteries with different internal heater configurations. Off the shelf 12v heated batteries require about 10 amps coming from the solar array to turn on, which would require two panels operating near peak efficiency- nothing like attaching a large sail to a device located in one of the windiest locations on the planet!

A week was spent optimizing power consumption of a completed station, with a goal of a station being able to operate for up to 30 days without sunlight. As many of you are aware, winters are dark, and each station is expected to be covered with snow and ice for long periods. When these stations are just taking measurements, their idle draw is 1 watt. Every 20 minutes, the radios are powered on and data is sent to our systems, during which the power draw increases to about 7.5 watts. This window can be shortened, but it takes 1 minute 22 seconds for the radio to boot, and our systems for these new stations poll 1 time per minute, leaving close to two minutes of wasted power-on time. A future revision of our management code will address this, letting the station power on the radio and quickly push out stored measurements, then immediately power off the radio. There are less power-hungry communication options available, but for the future equipment we expect to be added to these locations, these microwave radios were preferred over bandwidth limited cellular and serial communications.

Metadata Metadata Metadata! Metadata is additional information stored along with measurements. These



Station Name	Short Name
Second Connecticut Lake	2NDL
45th Parallel	45TH
Auto Road 1600	AR16
Auto Road 2300	AR23
Auto Road 3300	AR33
Auto Road 4000	AR40
Auto Road 4300	AR43
Auto Road 5300	AR53
Attitash	ATTI
Bretton Woods	BRWD
Mount Cabot Station	CABT
Cannon Mountain	CANN
Caps Ridge Trail	CAPS
Cog 4500	CG45
Cog Base	CGBS
Cog Cold Springs	CLOW
Cog Marshfield Station	CMAR
Cranmore	CRAN
Cog Skyline	CSKY

A backend view of the mesonet manager showing metadata from various stations.

include but are not limited to GPS coordinates, elevation, installation information such as height above ground for a sensor, instrument serial numbers, sensor calibration information, land use, vegetation type- the list goes on. Our metadata storage and dissemination system has been brought up to current standards, and we are now using an in-house developed software package that tracks changes across our network of automated stations, as well as summit instrumentation. Instruments are added, their history is tracked as they move from location to location either while being repaired, or calibrated. Station work history is logged, potential errors in data are flagged, and a comprehensive site history is kept for each location. This type of metadata is required for quality control of research grade data. This new system generates all necessary or requested information dynamically for dissemination in JSON, XML, and KML formats, which any data scientist can assimilate for their needs.

Watts next? After getting the final two stations for this vertical profile online (in addition to another station-not-yet-to-be-named as part of another collaboration), someone will have to enter all of the hundreds of instruments and dozens of stations into this fancy new system. I also heard something about changes to the current summit conditions page, but that could be just a rumor. The sun will shine, and the batteries will charge. We shall see which survive their first Mount Washington winter.

The Cog Railway

It's a mountain, right– shouldn't there be a view?

Author and philosopher G.K. Chesterton is reputed to have said something like "the tourist sees what he's told to see, the traveler sees what she sees." Maybe it's an appropriate response to an unfulfilled visitor bemoaning the occasionally obscured 5-state, 90-mile view, maybe not. We all know our beloved Rockpile's fickle, fascinating weather is what this part of the world is all about, but it's a mountain, right– shouldn't there be a view?

Over the past year, our 155th, we've been celebrating the spirit of vision, stewardship and innovation that birthed, maintains and continues to grow our historic operation. We've even added a few new things to see, just in time for the fall and winter seasons. Tourists and travelers alike are now greeted by a grand entry arch, designed and fabricated right here, by us. Expanded amenities like lighting, heat and power will improve the wintry experience at Waumbek Station. And they'll stare in disbelief at a unique piece of vintage track-clearing equipment now on static display. Little more than a repurposed Pratt and Whitney jet engine on wheels, our Snow–Jet was a sight to see but a fright to deploy.

Whether through rain, wind, snow or shine, there's always something to see on Mount Washington, especially when seen from the world's first mountain-climbing cog railway!

For more information, visit us at ***www.thecog.com***.

The Eventful Life of Camden Cottage

BY **PETER CRANE**

A 1937 photo of Camden Cottage, with the thermometer shelter visible, and the "new" Observatory under construction in the background.

Over the years there have been many buildings atop Mount Washington, but one important structure that is sometimes forgotten is Camden Cottage. Camden Cottage – not much more than a sturdy shack -was built in 1922. It was named to honor Patrick Camden, longtime roadmaster of the Mount Washington Cog Railway. It was erected by the owners of the Summit House hotel as a refuge for winter hikers. Before you think that those hotel owners were entirely altruistic in providing a refuge for climbers in need, the principal motivation for the small structure was to allow winter shelter so that hikers would not be tempted to break into the Summit House to escape the mountain's harsh weather. It doubtless saved many lives during its service.

An observer at work in Camden Cottage. Behind the desk are graffitied bunks used by winter climbers.

Camden Cottage was not used in summer, and so it became available in the mid-1930's for use by the Observatory crew when it became evident that their use of the summit Stage Office as a weather station was no longer practical in the busy summer season. (Records are not consistent, but suggest that the Observatory used Camden Cottage in the summers of 1935, 1936, and 1937.) With the building of a new weather station in 1937, Camden again became seasonally vacant, and later suffered the ignominious fate of being moved to the Summit House to be transformed into a visitor restroom, a sad fate for a once noble structure. It was razed, along with the rest of the Summit House, in 1980.

While circumstances have removed Camden Cottage from atop Mount Washington, the passage of time cannot erase its place in the mountain's history.

Fall Projects & Seek the Peak Wrap-up

BY **LINDA AND HANK DRESCH**

STP 2024 Valley Volunteers and staff. Back row: Drew Bush, Sandy Kurtz, Wendy Almeida, Gary MacDonald, Hank Dresch, Mark Asaro, Peter Fisk. Middle row: Joan Kurtz, Kim Henry, Linda Denis, Karen Franke, Dennis Maiorino, Peter Crane. Front row: Marie Kapsar, Charlie Buterbaugh, Linda Dresch.

It has been an interesting summer season here in the Mount Washington Valley, with some extremely hot days, periodic heavy rains, and unseasonably cool nights.

The 24th annual Seek the Peak in July was a success, thanks to the long-term planning of the staff and in very great part to the Observatory's newly hired Membership & Events Coordinator, Wendy Almeida. Wendy jumped in almost at the last minute it seems, took over the reins and pulled it off in a superb way. The weather cooperated and provided the best day we have ever experienced. Of course, an event such as STP could never have been possible without a core of experienced Valley Volunteers supplemented by Observatory Trustees, and many enthusiastic new volunteers. On to STP 25!

One traditional follow-up to Seek the Peak is the very important thank you letters and acknowledgments to all participants and donors. These, combined with our August Membership Mailing, brought the total number of letters to over 1,300. We had a small but good crew for the mailing and completed all the work that morning. Our mailings take place at 9:00 a.m. on the second Thursday of every month, and we are always pleased to have folks join us. We were also saddened when our "Manchester girls" Jean Sweeny and Judy Meagher advised us they had sold their Conway camp and would no longer be available to volunteer on a regular basis.

The gardens at the North Conway Observatory's office continue to put on a spectacular display thanks to the efforts of Barbara Althen and Bill Ofsiany, assisted at times by Donna Gray, Peter Crane,

August Mailing. Pictured (left to right): Ava Honan, Marie Kapsar, Charlie Buterbaugh, Wendy Almeida, Karen Franke, Peter Crane

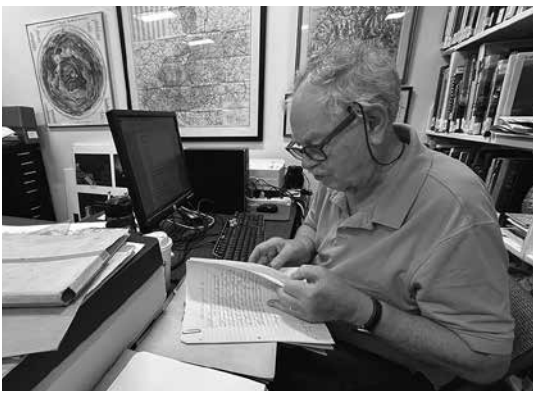
and staff member Greg Fitch.

We also support the Observatory's weather observation and reporting activities in North Conway by supplementing the staff primarily on weekends and holidays. Daily readings are taken of temperatures, barometric pressure, precipitation, and cloud cover which are then reported to the National Weather Service in Gray, Maine. Observations and reporting takes less than 15 minutes in the summer, but can be longer when contending with ice and snow during the winter season. Anyone interested in helping should contact Brian Fitzgerald directly.

The fabulous volunteers who have helped us over these past months with our normal activities as well as STP include:

Barbara Althen
Mark Asaro
Ed Boyle
Mark Bunker
Peter Crane
Linda Denis
Hank & Linda Dresch
Donna Dunn
Peter Fisk
Karen Franke
Donna Gray
Kim Henry
Ava Honan
Marie Kapsar
Joan & Sandy Kurtz
Karen & Gary MacDonald
Dennis Maiorino
Bill Ofsiany
Jane & Ken Rancourt

The MWOBS community is saddened to share of friend Floyd Corson's passing in September. A longtime volunteer and former Valley Volunteer Coordinator, Floyd contributed much time and care during his involvement and was a pleasure to be with. The Observatory sends condolences to Floyd's loved ones at this time; he will be greatly missed.



Alexander A McKenzie III assisting Curator Dr. Peter Crane in the Gladys Brooks Memorial Library. Thank you, Sandy, for donating your time to assist with vital archival work!

As we reflect on the success of this year's Seek the Peak event, we are reminded that it simply would not have been possible without the incredible dedication of our volunteers. From early morning setup to assisting participants throughout the day, these individuals stepped up in countless ways to ensure everything ran smoothly. Their time, energy, and enthusiasm made all the difference, and we are truly grateful for their support in making the event a success.

2024 Seek the Peak Volunteers

Adam Gill
Beth Newhouse
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Elizabeth & Rich MacKeen
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Holly Zschetzsche
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Jenny Beatty
Jill Powers
Joan & Sandy Kurtz
Joe Powers
Joyce Rodriquez
Karen MacDonald
Karen Moore
Karen & Mark Rohssler
Karen Umberger
Ken Jones
Ken Rancourt
Kim Henry
Kris Zuidema
Laura Begin
Linda Denis
Lourdes Aviles
Lucia Almeida
Marie Kapsar
Marie Koski
Mark Asaro
Meredith Doyle
Mike Bergeron
Mike & Patty Matty
Nathan Jones
Peter Fisk
Rob Kirsch
Rose Lundy
Sandra Imbrogna
Sarah Daly
Shelby Peavey
Sinead Koski
Teri & Tom Cosentino
Terri Bowers

MEMBER MILESTONES

Half a Century of Commitment: Skip and Pauline Vass Celebrate 50 Years with Mount Washington Observatory

BY **WENDY ALMEIDA**

Skip and Pauline Vass have forged their connection to the mountains and the Mount Washington Observatory through the region's ever-changing weather. Over 50 years of membership, the couple reflects on decades of adventures, and one thing is clear: the ever-changing conditions of the White Mountains have kept their passion for the mountains alive.

"The weather can change very quickly in the mountains," Skip recalls. "Over the years, I think we've encountered just about every weather condition you can

imagine - heat, rain, sleet, wind - but that's what makes the mountains intriguing and a challenge."

The Vass family learned to adapt to the shifts in weather, never underestimating its force. Pauline recalls, "There would be beautiful sunshine, and the next day, we'd wake up to an ice storm. We were always prepared for the unexpected."

"In the early days, we always checked the weather reports [from the Observatory] at Pinkham Notch. We always registered the family name and what trails we were hiking," she added.

Their preparedness for nature's surprises led to a pivotal moment in 1974. Skip recounts, "We were at the Lake of the Clouds Hut when a representative from the Observatory made a presentation. It was then that we first became members of the Observatory." That initial introduction became a lifelong commitment to supporting the organization and continued learning about the weather.

Their children also grew up appreciating the mountains and the Observatory. Vickie, their daughter, fondly remembers the family's Easter traditions: "We would spend Easters at Joe Dodge Lodge and hike into Tuckerman's Ravine. There were even Easter egg hunts around Pinkham Notch."

The family has accessed the summit of Mount Washington to visit the Observatory by foot, snowcat, the Cog Railway, and the Auto Road. The Vass family's experience with the Observatory extended

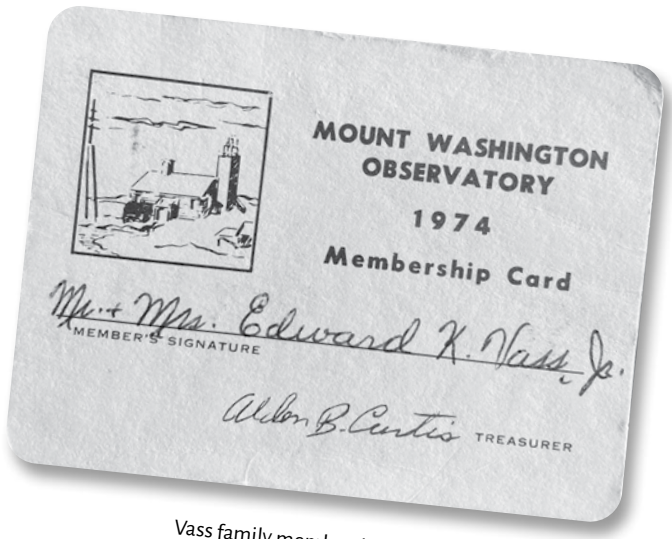
Pauline and Skip Vass on top of tower.

beyond hiking as they embraced new programs, including the early EduTrips. Pauline reminisced, "In 1993, we were invited to stay overnight at the Observatory as part of a program called Sunrise on the Summit, now known as EduTrips. We were invited to come up and see if it would be an offering for the Observatory to roll out." They both recall enjoying many learning experiences, even bringing their daughters along.

Though their hiking days are behind them, Skip and Pauline stay connected to the mountains through the Observatory's Science in the Mountains programs. "It helps keep us connected to the mountains, and we learn so much," Pauline said. And every edition of Windswept is eagerly read cover to cover before being passed along to their daughter, ensuring

the family's connection to the mountains continues.

After half a century, Skip and Pauline's dedication to the Observatory has been a testament to their passion for the mountains and belief in the Observatory's mission.



Vass family membership card.

The Vass family's journey is just one of the many that reflect a deep connection with the Mount Washington Observatory. Through our members' dedication, the Observatory ensures the safety of those exploring the mountains and fosters a deeper understanding of the alpine environment for future generations, supporting vital research for our scientific and meteorological partners.

To our 50-year members, your enduring commitment is truly appreciated. It empowers the Observatory to continue advancing weather science and encourages others to explore and cherish the unique wonders of Mount Washington. We're grateful to have your support.

50 YEAR MILESTONE MEMBERS

George Radcliffe

Jed and Fran Davis

Robert and Dona Eaton

Theron W. Peck Jr.

Edward K. (Skip) and Pauline Vass Jr.

Joan Rising

Peter J. Crane

...Thank you!

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Museum and Retail Attendants Corbin Tate (left) and Kelly Pedersen (right). Thank you for a great 2024 season!

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Events:

- Help with our Annual Seek the Peak event
- Other events throughout the year

Education:

- Assist with programs at area schools
- NCON3 daily weather reporting
- Extreme Weather Museum docents

Other opportunities:

- Helping with mailings & phone calls to donors
- Organizing archival materials & collections
- Sorting & fulfillment for retail (seasonally)
- Gardening at valley office (seasonally)

To learn more, contact Wendy Almeida, Membership & Events Coordinator:

walmeida@mountwashington.org

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