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The Changing Face of Winter

When scientists compare notes with forest users, all agree: winter isn't what it used to be

By David Sleeper and Geoff Wilson

The winter landscape is changing. This is particularly worrisome in our Northern Forest region because so many people live with economies and cultures oriented toward cold, snowy winters. Changes in winter climate affect everything from snowmobiling to logging, downhill skiing to ice fishing, wildlife populations to trail conditions. Even maple sugar making, the harbinger of spring, is tied closely to measures of the winter climate: snowpack levels, frozen soils, and air temperatures that fluctuate above and below the magic level of 32 degrees Fahrenheit.

Many of us recall that winters in the past were longer, colder and snowier, with many more days of frigid temperatures of 20 below zero and even colder. But do scientific measurements closely correlate with people's perceptions of climate change? Could our anecdotal evidence of climate change be faulty, as can happen when the very real annual variability in weather conditions obscures the longer-term trends in climate? And if the climate is truly changing, what can we do about it – can we adapt our ways of working and playing on the winter landscape?

A diverse group of ecosystem scientists, forest users, and land managers met in April 2012 at the Hubbard Brook Experimental Forest in the White Mountains of New Hampshire to begin exploring these and other questions relating to winter climate change. The group included researchers who study the biogeochemistry of frozen soils, forest hydrology, the abundance of wildlife populations, and the timing of bud break in sugar maple and other trees. Central to the scientists' perspectives were the long-term records from the Hubbard Brook Experimental Forest, in many cases spanning 55 years. Others included an array of forest users and land managers: the director of snowmaking at a ski area; a timberland owner; cooperative extension agents for forestry and agriculture; a sixth-generation maple sugar maker with more than 8,000 taps; a recreational climber who scales frozen waterfalls; and officials of the White Mountain National Forest, New Hampshire Fish & Game Department, and Appalachian Mountain Club. Many in the group had strong recreational ties to the winter landscape in addition to their professional interests.

Although scientists and land stewards often come from different cultures, with different reward systems and ways of communicating with their peers, the group quickly reached consensus on several key issues:

- Winter climate in the Northern Forest is changing, and these changes involve many winter characteristics central to the businesses and culture in the region.

- How we work and play on the winter landscape will be affected by these changes now and in the future.

- While some climate changes may be beneficial to natural communities and people, on the whole the effects to the Northern Forest economy will be detrimental, especially if we fail to anticipate and adapt to new conditions.

Discussions of the winter landscape focused on two areas: First, the long-term record of scientific observations at the Hubbard Brook Experimental Forest and what they tell us about winter climate trends. Second, what land managers and forest users are experiencing first hand in their day-to-day working lives. By sharing observations, the group sought to bridge the gap between anecdotal and scientific evidence. This was a first step in identifying how to communicate the scientific observations in ways that will help communities understand and adapt to a changing winter climate.

Observations by Scientists

Long-term records from the 8,000-acre Hubbard Brook Experimental Forest clearly demonstrate that many characteristics of the winter months have changed significantly over the past 50 years and that the direction of these changes is generally consistent with climate model projections of human-driven climate change for the 21st century. Among the key scientific findings and observations relating to winter climate:

- Air temperatures. Since 1955, winter temperatures at Hubbard Brook have warmed by 2.5 degrees F, and mid-winter thawing conditions have increased in frequency.

- Frozen soils. The timing of snowpack development influences soil freezing, with late-developing snowpacks allowing soil frost to develop. Soil freezing damages roots, especially sugar maples, and in turn leads to nutrient losses from the site. Long-term soil frost records indicate a slight increase in the extent of soil frost over time, which is consistent with the long-term reductions in snowpack.

- Snow levels. Maximum snowpack levels have declined by about 10 inches and there are 20 fewer days of snow cover at Hubbard Brook. Snow depth affects deer and moose populations, with lesser snow depths favoring deer over moose. Snow depth also can impact soil frost (a warmer world with less snow can cause frozen soils), which in turn can affect how quickly groundwater recharges.

- Ice cover. The duration of ice on Mirror Lake (which is one of the most studied lakes in the world) has decreased by 22.5 days in the past 45 years.

- Pests and pathogens. While some pests and pathogens such as Beech Bark Disease are already found at the Hubbard Brook Experimental Forest, others may spread to Hubbard Brook due to future changes in climate. Severe cold temperatures are thought to be a limit on some pests, such as the Hemlock Wooly Adelgid, which has been spreading north coincident with a reduction in severe cold temperatures.

Observations by Forest Users and Managers

As winter conditions change, how we use and manage our forested landscape changes as well. Recreational users who once could count on snowy conditions starting soon after Thanksgiving and stretching through early spring, now must plan to take full advantage of each winter snow storm.

Organizations and agencies tasked with maintaining roads and trails must be vigilant for freezing and thawing conditions, or potentially dangerous icing. Sugarmakers may cheer lower snowpacks because it makes collecting sap easier, but lament a shortened season caused by warmer temperatures. The following observations suggest how winter climate change affects how we use our forests:

- Downhill skiing. Less natural snow, and shorter windows of cold weather, means that ski areas have needed to invest in significant new technologies to make artificial snow. One positive aspect is that artificial snow is made more efficiently now, with much less use of energy and water compared to the past. When southern New England sees a drop in snow cover, northern ski areas suffer economically (often called the "backyard syndrome," when people in Boston don't see snow out their back door, they tend not to travel to distant ski areas that enjoy natural or manmade snow). Some ski areas are adapting to poorer snow conditions by expanding other resort and recreational activities (including indoor water parks!), many of which are built on land leased from the U.S. Forest Service.

- Backcountry recreation. Winter adventure programs sponsored by groups like the Appalachian Mountain Club can be difficult to promote in low-snow years, and mild winters reduce options and shorten the season for climbing schools and climbing guide services. Snow conditions affect backcountry user groups in different ways, with winter hikers generally favoring less snow, yet all groups are challenged by mid-winter thawing conditions. Snowmobilers have suffered from variable conditions that can lead to significant icing that increases the probability of serious accidents. Low snow and warm temperatures close trails crossing wetlands, ponds, and lakes, limiting the connectivity of trails that is necessary for long snowmobile tours.

- Timber harvesting. Wet, exposed ground prevents logging operations because heavy machinery causes rutting and soil erosion, so the complex relationship between snowpack and frozen soils strongly affects the viability of winter logging operations. The length of the winter logging season is shortening; now the season generally runs from Christmas through April. Town roads are closed earlier to logging trucks for maintenance reasons. Midwinter thaws temporarily shut down operations as well.

- Maple sugar production. Maple sap yields vary widely from year to year, and are affected by a complex array of temperature and snow conditions. While these factors are changing, improvements in sugaring technology may compensate for reduced sap yields due to climate. While the beginnings and ends of the season have been variable for decades, some anecdotal evidence suggests that tapping now occurs in mid-February instead of around Town Meeting Day, which is the first Tuesday in March (in Vermont). Sugar maples are clearly affected by other environmental stresses as well, such as acid rain, which can cause dieback of tree limbs and reduced production.

- Agriculture. Warmer winter temperatures can increase the vulnerability of woody crops such as apples and blueberries to winter de-hardening in midwinter and earlier leaf-out in early spring. These conditions raise the risk of freezing damage, as was seen in the regional apple crop failure of 2010, which was caused by an early leaf out coupled with a hard frost in the spring. Agricultural pests and pathogens, such as late-blight disease, are often limited by winter conditions. As winters become milder, pests and pathogens may spread increasingly through forests, causing damage. Changes in snowpack and snowmelt have the potential to allow access to fields earlier, which could be positive as long as it is not coupled with water shortages in the growing season.

A Partnership of Forest Users and Forest Scientists

It's clear that data from long-term scientific monitoring support the many anecdotal observations that "winters ain't what they used to be." We must continue to make the connections between these changing winter conditions and our social and economic welfare.

While some changes may be positive economically, such as reduced costs of heating, and some clearly negative, such as a potentially shrunken ski or snowmobiling industries, most are complex. Understanding these nuances is the first step toward anticipating and adapting to the climate changes predicted for the present century.

We propose an enduring partnership involving ecosystem scientists, resource managers, extension services, and businesses and individuals with stakes in the winter environment. This partnership should do the following:

- Continue this dialogue between scientists and stakeholders.
- Connect the information collected as scientific research more closely with information collected by businesses and managers in order to better understand the relationships between environmental change and the communities in the region.
- Educate communities with regard to the connections between local economies and environmental change in order to foster informed decision making. Utilize existing networks, such as Cooperative Extension, the New Hampshire Maple Sugar Producers, timber groups, and outdoor recreation organizations, in order increase the reach of the insights developed by this partnership.

Only by collaborating can we reach the best understanding possible of climate change and its effect on forested ecosystems, and put this information into the hands of people positioned to facilitate the adaptation of local communities to changing winter conditions.

David Sleeper is Executive Director of the Hubbard Brook Research Foundation (HBRF) and Geoff Wilson is HBRF's Hubbard Brook Site and Program Director. For more information about HBRF's education, policy, and outreach programs, visit www.hubbardbrookfoundation.org. The Hubbard Brook Research Foundation's work on winter climate change is supported with grants from the USDA Forest Service's Northeastern States Research Cooperative and the National Science Foundation (Award No. 0949558).

Appendix 1 / Participants in HBRF's project on winter climate change, which included interviews and a roundtable held at the Hubbard Brook Experimental Forest, Woodstock, NH, April 23, 2012

Karen Bennett
Forest Resources Specialist, UNH Cooperative Extension, Durham, NH

Putnam Blodgett /
Landowner and Northeast Regional Tree Farmer of Year, Lyme, NH

Emily Brunkhurst
Wildlife Biologist, NH Fish and Game Department, Concord, NH

Heather Bryant / UNH Cooperative Extension Educator, Agricultural Resources, Grafton County, North Haverhill, NH

John Campbell
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Lynn Christenson
Assistant Professor of Biology, Vassar College, Poughkeepsie, NY

Brian Eisenhauer
Interim Director, Center for the Environment, Plymouth State Univ., Plymouth, NH

Mark Ellingwood / Wildlife Programs Administrator, NH Fish and Game, Concord, NH

Jim Fadden / Owner, Fadden's General Store & Maple Sugarhouse, North Woodstock, NH

David Falkenham / UNH Cooperative Extension Educator, Grafton County Forester, N. Haverhill, NH

Susan Frankenstein / Research Civil Engineer, Cold Regions Research and Engineering Laboratory, Hanover, NH

Sarah Garlick / Northeast Regional Coordinator, American Alpine Club, Intervale, NH

Peter Groffman
Microbial Ecologist, Cary Institute of Ecosystem Studies, Millbrook, NY

Pamela Hunt /Avian Conservation Biologist, New Hampshire Audubon, Concord, NH

Ken Mack / Snowmaker, Loon Mountain, Lincoln, NH

Lindsey Rustad
Forest Ecologist and Hubbard Brook Team Leader, U.S. Forest Service, Cumberland, ME

Roger Simmons
Natural Resources Staff Officer, U.S. Forest Service, White Mountain National Forest, Campton, NH

Michael Snyder
Commissioner, Vermont Department of Forests, Parks & Recreation, Waterbury, VT

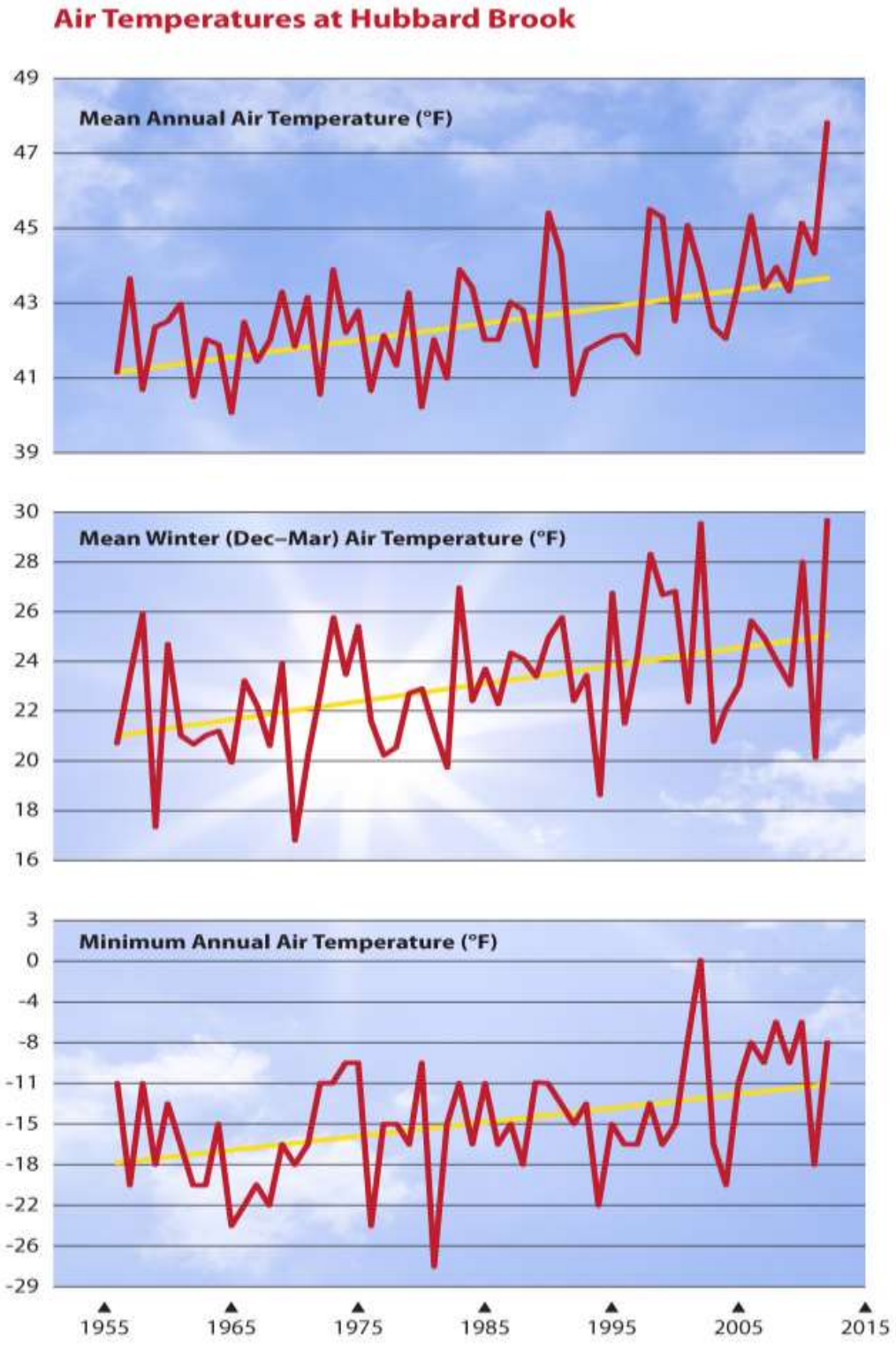
David Sleeper
Executive Director, Hubbard Brook Research Foundation, Quechee, VT

Pamela Templer
Associate Professor of Biology, Boston University, Boston, MA

Chris Thayer / Director of North Country Programs and Outreach, Appalachian Mountain Club, Sugar Hill, NH

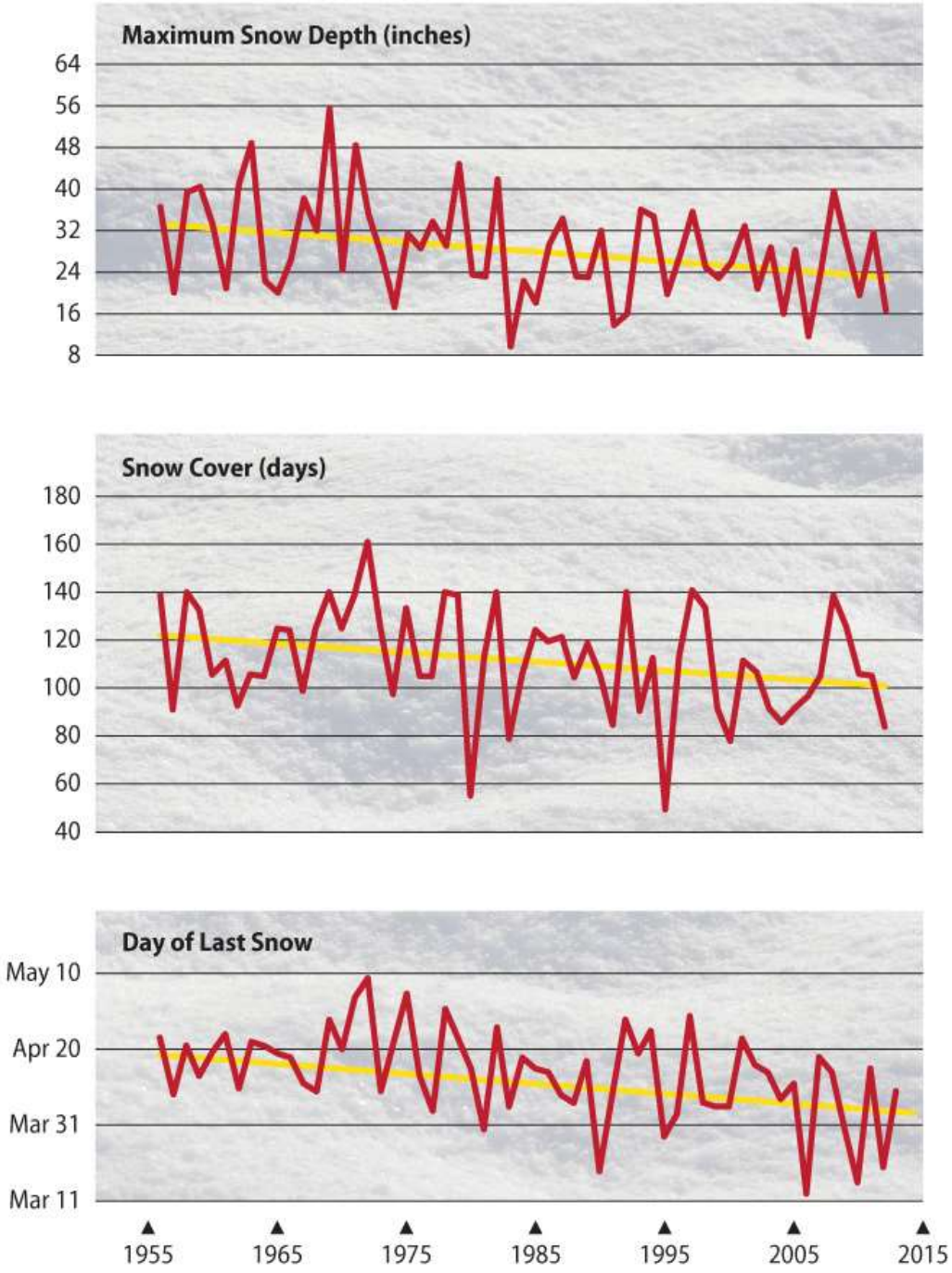
Geoff Wilson
Site & Program Director, Hubbard Brook Research Foundation, Thornton, NH

Appendix 2 / Winter-related measurements from Hubbard Brook Experimental Forest



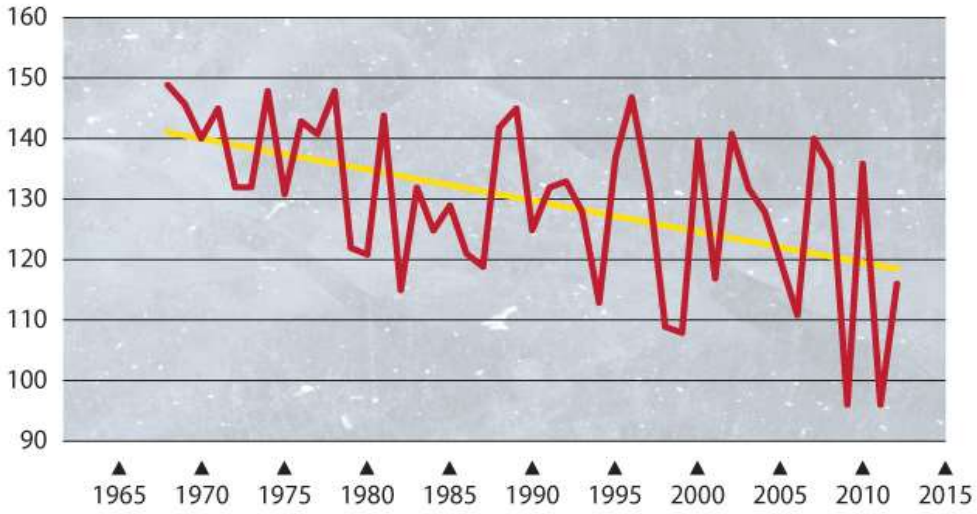
All temperatures recorded at Station 1, Hubbard Brook Experimental Forest. Courtesy USFS.

Snow Trends at Hubbard Brook



Data provided by USFS and Nina Lany.

Ice Cover on Mirror Lake (days)



Data provided by Dr. G.E. Likens NSF-LTREB.

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