



University of
New Hampshire

Carsey School of
Public Policy

CARSEY RESEARCH

National Issue Brief #100

Spring 2016

Was December Warm? Family, Politics, and Recollections of Weather

Lawrence C. Hamilton and Mary Lemcke-Stampone

Summary

In 2015 New Hampshire experienced its warmest December on record. The temperature exceeded twentieth century average temperatures by a wider margin than for any month in historical records dating back to 1895.

In February 2016, as part of an ongoing study of environmental perceptions, the Granite State Poll asked whether residents thought that New Hampshire's recent December had been generally colder, warmer, or about average. Only 63 percent recalled or guessed that this exceptional month had been warmer than average. Some said they did not know; others thought that December had been about average. Sixteen percent thought it had been colder than average.

December 2015 was 13.7 degrees Fahrenheit above the twentieth-century average; it topped the second-warmest December (2006) by 3.7 °F and the third-warmest (2001) by 4.6 °F.

January, February, and March temperatures were less extreme, but each ranked among the top fifteen warmest for that month, making the 2015–2016 cold season (December through March) overall the warmest on record. In April 2016, another Granite State Poll asked whether people thought that the winter just ending had been colder, warmer, or about average. Ground bare of snow through much of the season and the early arrival of spring (both in stark contrast to the snowy winter of 2014–2015) had been widely noticed,¹ and 73 percent recognized a warm winter.

KEY FINDINGS



December 2015 was New Hampshire's warmest December on record. But by February 2016, only 63 percent remembered that the month was warmer than average.

73%

The 2015–2016 cold season was the warmest on record for New Hampshire. By April 2016, 73 percent recognized that the winter had been warmer than average.



Political independents and Tea Party supporters, as well as people who do not believe that humans are changing the climate, were less likely to recall the warm temperatures.



These results suggest that, even for such immediate phenomena as recent local weather, climate-change beliefs exert some influence on perceptions.

But who recalled the unusual season and who did not? The two surveys found no significant differences in the accuracy of responses by men and women or by age groups. Nor did temperatures on the day of interview seem to matter. Married respondents, however, and people with children at home tended to be more aware of recent warmth. Awareness also was higher among those who agree with the scientific consensus on climate change. Connections between climate-change beliefs and perceptions about weather have been observed in other studies, although not with regard to such extreme and recent local events.

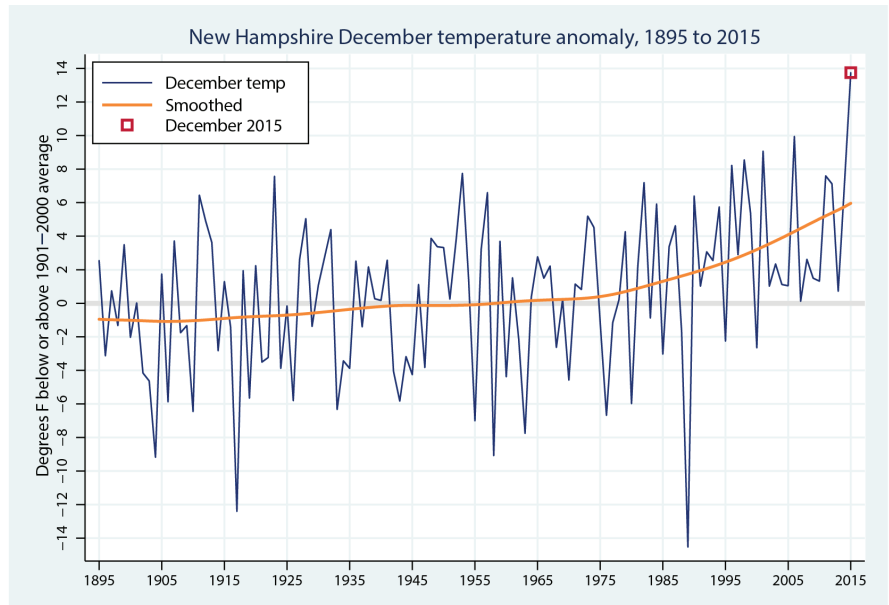
The Warmest December and Winter

Figure 1 graphs December temperature history in New Hampshire going back to 1895, the earliest year for which we have good records.² Although nine of the ten warmest Decembers occurred since 1980, the most recent year stands out: December 2015 was 13.7 degrees Fahrenheit above the twentieth-century average; it topped the second-warmest December (2006) by 3.7 °F and the third-warmest (2001) by 4.6 °F. Temperatures here are expressed as anomalies, or degrees above or below the twentieth-century average for this month, which is indicated by a gray line in the figure.

Erratic swings from year to year simply reflect *weather*, or short-term variability. For example, the cold Decembers of 1917 and 1989 were both followed by relatively warm Decembers the next year. The smoother curve in Figure 1, however, reflects *climate change*, or shifts in the longer-term average.³ Average temperatures warmed gradually in the early twentieth century, paused from the 1940s to early 1970s, then took off more steeply in the mid-1970s. This rise-pause-rise pattern is a signature of twentieth-century global change seen in many parts of the world.⁴

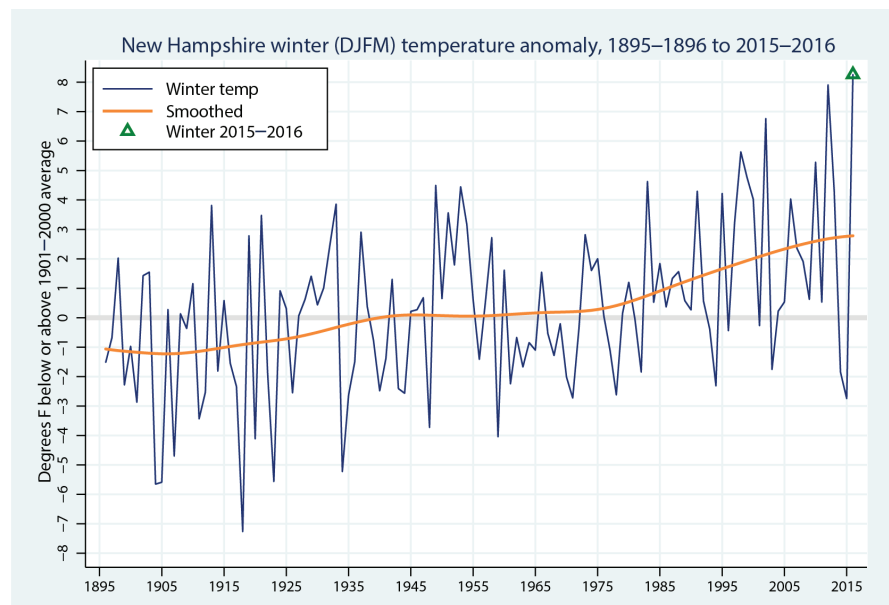
Figure 2 shows average temperature anomalies for New Hampshire cold seasons (December through March) from 1895–1896 to 2015–2016.⁵ Although the 2015–2016 anomaly was less extreme than December 2016 by itself, this was still the warmest winter in 121 years, and more than 8 °F above the twentieth-century average.

FIGURE 1: DECEMBER TEMPERATURES IN NEW HAMPSHIRE AS VARIATIONS FROM THE TWENTIETH-CENTURY AVERAGE, 1895–2015



Source: NOAA climate divisions data

FIGURE 2: WINTER (DECEMBER THROUGH MARCH) TEMPERATURES IN NEW HAMPSHIRE AS VARIATIONS FROM THE TWENTIETH-CENTURY AVERAGE, 1895–1896 TO 2015–2016



Source: NOAA climate divisions data

Weather Perceptions

The Granite State Poll, conducted by the Survey Center at the University of New Hampshire, carries out landline and mobile telephone interviews with random samples of New Hampshire residents about four times each year. Survey questions mostly focus on current issues and politics, but they also include questions on the environment and science.⁶ In February 2016, soon after the record December weather, the poll tested what people recalled:

Thinking back a couple of months, would you say that LAST DECEMBER, New Hampshire weather was generally colder, warmer, or about average?

Colder than average for a New Hampshire December

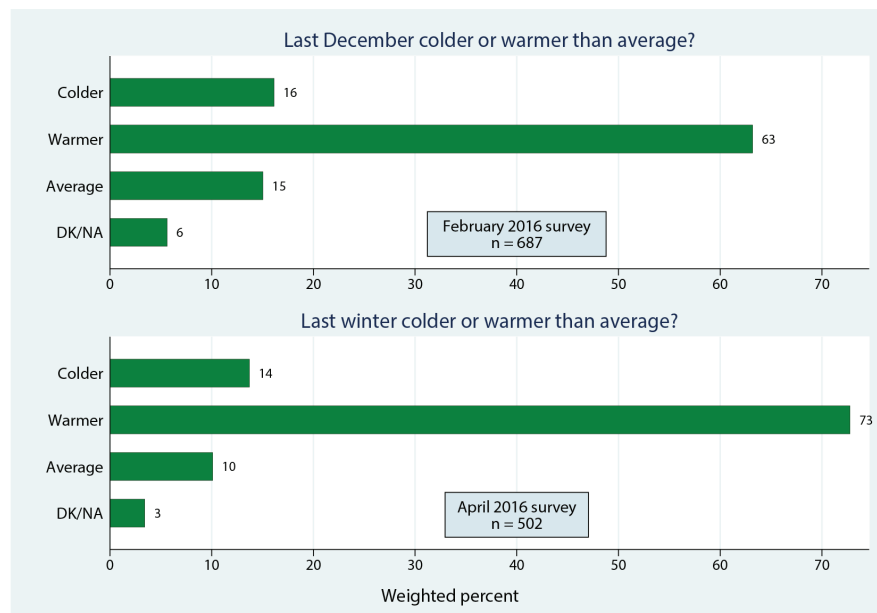
Warmer than average for a New Hampshire December

About average for a New Hampshire December

The top half of Figure 3 charts the results from 687 interviews. Although unusually warm temperatures and lack of snow had many impacts on everyday life and were widely discussed in weather reports and the news media, two months later only 63 percent of respondents recalled that December 2015 had been warmer than average. Fifteen percent thought it had been about average, and 6 percent said they did not know. Sixteen percent thought the month had been colder than average for a New Hampshire December.

A similarly worded question on the April 2016 survey asked about the winter as a whole.

FIGURE 3: WAS DECEMBER COLDER OR WARMER THAN AVERAGE? WAS WINTER COLDER OR WARMER THAN AVERAGE? RESPONSES FROM FEBRUARY AND APRIL SURVEYS



Source: Granite State Poll

Thinking back over the past few months, would you say that LAST WINTER, New Hampshire weather was generally colder, warmer, or about average?

Colder than average for a New Hampshire winter

Warmer than average for a New Hampshire winter

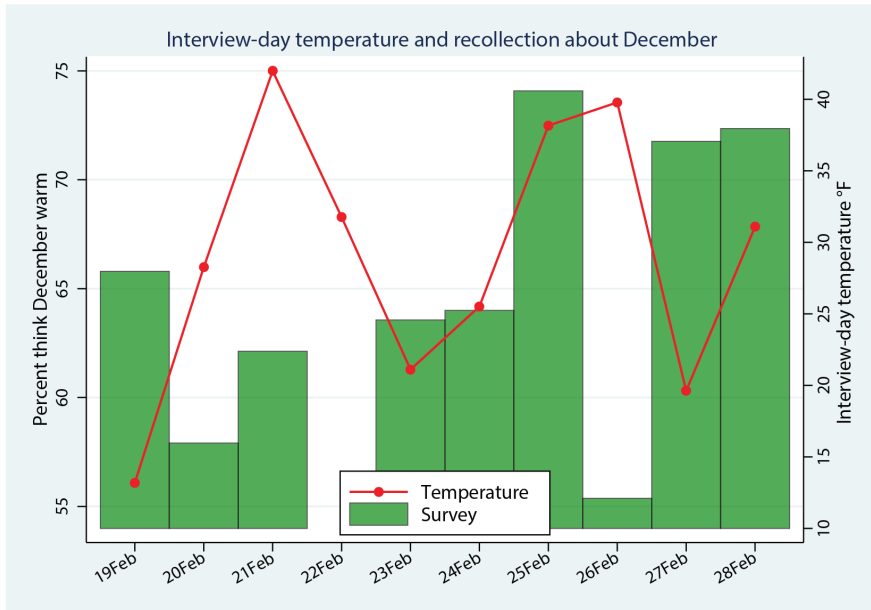
About average for a New Hampshire winter

As charted in the bottom half of Figure 3, the 502 April survey respondents did somewhat better with this question. Seventy-three percent accurately recalled that the winter just ending had been warmer than average. Only 10 percent thought it was average, and 14 percent said colder.

Who Recalls a Warm Season?

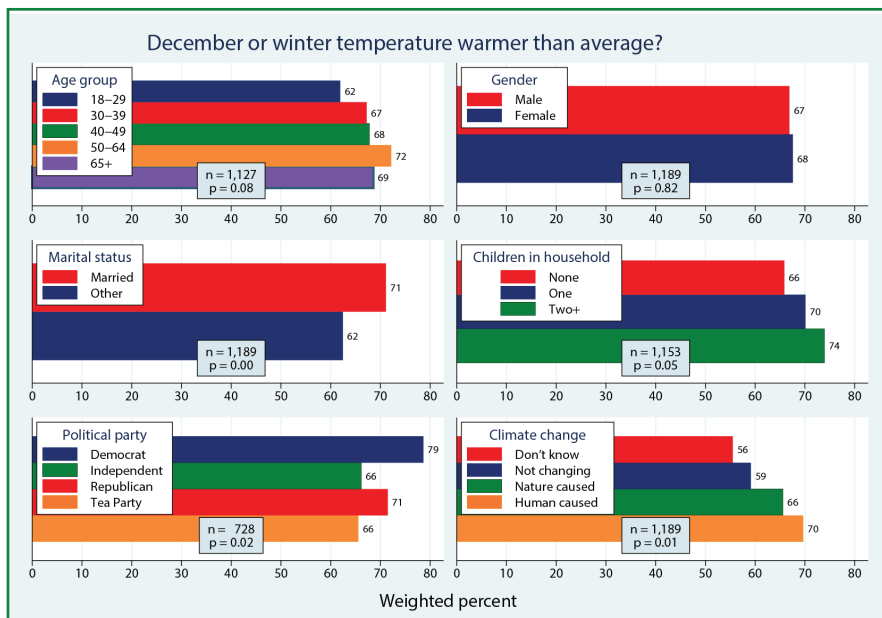
It seems reasonable to wonder whether temperature on the day of interviews influenced what people recall about past weather. Some previous studies have reported daily-temperature effects on beliefs about climate change, but no temperature effects on winter-weather recollections appear in these data.⁷ Figure 4 illustrates by graphing daily temperatures over the February survey dates, together with percentages responding that December had been warm.⁸ Average temperatures were well above freezing on three of the ten survey dates, but the percentage of “warm December” responses was not systematically higher on those days.

FIGURE 4: INTERVIEW-DAY TEMPERATURE AND THE PERCENTAGE WHO THOUGHT DECEMBER HAD BEEN WARM (FEBRUARY SURVEY)



Source: Granite State Poll

FIGURE 5: PERCENTAGE OF ACCURATE RESPONSES (DECEMBER OR WINTER WAS WARMER THAN AVERAGE) BY RESPONDENT'S BACKGROUND CHARACTERISTICS



Note: Notes within each panel give the number of observations (n) for that analysis, which vary because of nonresponse on some items or, in the case of political party, because that question was not included on all surveys. Each panel also notes the probability (p) from a test of statistical significance. Probabilities below 0.05 indicate that the relationship between those two variables (for example, warm/not warm response, and political party) is statistically significant.

Source: Granite State Poll

Figure 5 looks at other variations in the rates of accurate responses.⁹ Bars depict percentages of people who thought that either December or the winter had been warmer than average. To show general patterns, February and April surveys are combined in this graphic.

Eighteen- to 29-year-olds were less likely to recall the warm month or season, although age-group differences fall short of statistical significance.¹⁰ Men and women appear virtually tied. Recollections of recent warmth appear stronger among married people, and respondents who have children living at home. Perhaps parents noticed more often because the weather affected outdoors activities and there were fewer school cancellations.

The two lower panels in Figure 5 show impacts from political orientation and climate-change beliefs. These differences are modest in size (13 or 14 percentage points) but statistically significant, and go in directions consistent with other research on perceptions about climate and local weather. Political independents and Tea Party supporters less often thought that December 2015 or winter 2015–2016 had been warmer than average. Respondents who agree with the scientific consensus that climate is changing due to human activities were more likely to recall the warm season.¹¹

Weather and Climate

As average temperatures rise, the frequency of unusually warm conditions rises and the frequency of unusually cold conditions declines.¹² During the era of steeper warming since 1975, only eleven New Hampshire winters (December through March) were below the twentieth-century average, whereas thirty-one were above it. The rising proportion of warm winters is another sign that New Hampshire climate is changing along with global climate.¹³

Figure 6 compares the smoothed trend of global temperatures with that of New Hampshire winters.¹⁴ Both curves exhibit the pattern of early twentieth-century warming, mid-century pause, and post-1975 takeoff, which is a signature of global change. But New Hampshire winters have warmed since 1975

New Hampshire winters have warmed since 1975 at more than twice the global rate, with broad consequences for everything from winter recreation to forest ecosystems and insects.

at more than twice the global rate, with broad consequences for everything from winter recreation to forest ecosystems and insects.

Upward trends tell one part of the story, but New Hampshire's gradual warming is not the only thing that made December 2015 so extreme. Other factors contributed too, in ways that should become clearer as we gain perspective over the next few years. Unusually warm conditions occurred in many parts of the world in late 2015 and were partly attributed to El Niño, the warm phase of an

ocean-atmosphere oscillation.¹⁵

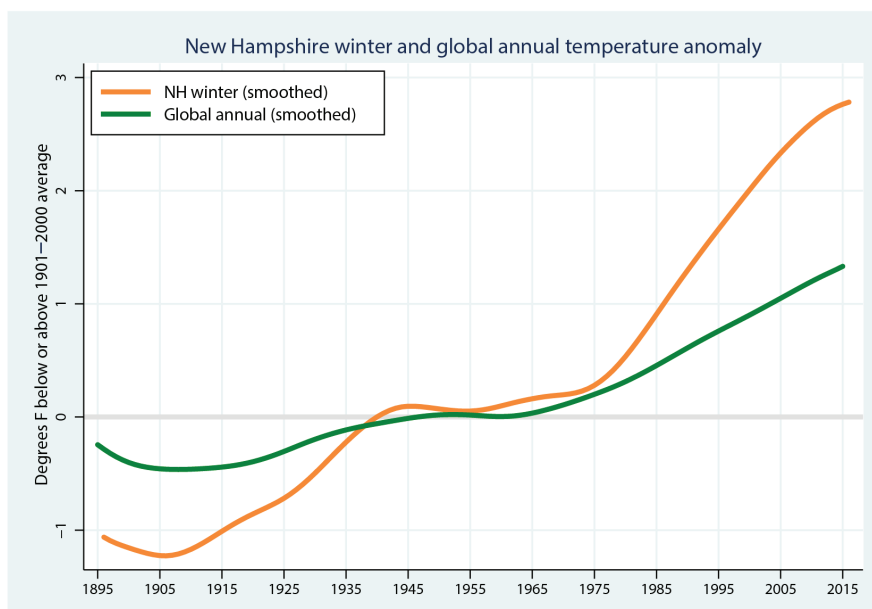
In 2015–2016, the El Niño effects were added to those of global warming, and the combination helped set new global records. Correlations between El Niño and New Hampshire temperatures are not clear-cut, however. There are no significant differences in average New Hampshire temperatures during El Niño, La Niña, and neutral winters (climatologically defined as December through February). For example, globally stronger El Niño conditions occurred around 1982–1983 and 1997–1998 without extreme Granite State weather.

Discussion

Although research has convinced most active scientists that humans are changing Earth's climate,¹⁶ many politicians, political commentators, and a large fraction of the U.S. public reject this conclusion. Climate-change questions prove to be some of the most politically divisive items on surveys.¹⁷ Over the seven years that we have been asking such questions in New Hampshire, public agreement that human-caused climate change is real has risen gradually, from the low 50s in 2010 to about 65 percent in April 2016.¹⁸ Ideological divisions have narrowed somewhat, although they still remain wide. Directly experienced shifts in the weather, such as the growing frequency of warm rather than cold winters, may play a role in persuading nonscientists that climate is indeed warming.

Many studies have noted correlations between political orientation and climate-change beliefs.¹⁹ Political orientation and climate beliefs also affect perceptions about climate-related physical realities, whether these are scientific measurements

FIGURE 6: SMOOTHED NEW HAMPSHIRE WINTER AND GLOBAL ANNUAL TEMPERATURE ANOMALIES



Source: NOAA climate divisions data

such as CO₂ levels²⁰ or personally experienced events like weather.²¹ These studies often take a long-term perspective, appropriate for the study of climate. Our study, in contrast, simply asked about the warmth or coldness of a past month or season, just after both set records. Most respondents accurately recalled the recent warmth, but statistically significant differences in accuracy occurred with respect to marital status, parenthood, political orientation, and climate-change beliefs. The marital and parenthood effects might be practical, reflecting such things as heightened awareness from participating in outdoors activities.

The political and climate-belief effects on winter recollections seen in Figure 5 are significant but not large. Much larger gaps, but in similar directions, have been observed by other studies that asked about longer-term trends. Questions about multidecade trends more clearly evoke people's thoughts about climate change, whether the topic is global, such as Arctic sea ice,²² or local, such as fire-season warming in eastern Oregon²³ or flood damage in New Hampshire.²⁴ Responses to our very short-term December/winter weather questions suggest that even on such an immediate, local, and directly experienced scale, beliefs exert some influence on perceptions.

Endnotes

1. The first blooms began the second week of March in southern New Hampshire.
2. Statewide New Hampshire temperature anomalies here are defined from the unweighted average of National Oceanic and Atmospheric Administration (NOAA) climate divisions 1 and 2, which together cover the whole state. Such calculations can easily be replicated, or performed for other regions, using data from the NOAA website: <http://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php>. A more nuanced calculation could use area-weighted averages, which yield slightly different numbers but support the same general conclusions.
3. The smoothed curve is calculated by lowess regression, a statistical technique often used to reveal patterns in rapidly varying data. For an explanation see L.C. Hamilton, *Statistics with Stata*, Version 12 (Belmont, CA: Cengage, 2013).
4. Intergovernmental Panel on Climate Change, *Climate Change 2013—The Physical Science Basis: Summary for Policy Makers* (Geneva, Switzerland: IPCC, 2013).
5. Climatologists ordinarily define northern winter as the months of December, January, and February. In New Hampshire the cold season, often with snow on the ground, generally lasts through March as well. Because this longer cold season is what most New Hampshire residents understand and experience as winter, we employ the term “winter” in this brief to mean the months of December through March.
6. L.C. Hamilton, “Do You Trust Scientists About the Environment? News Media Sources and Politics Affect New Hampshire Resident Views” (Durham, NH: Carsey School of Public Policy, 2014), <http://scholars.unh.edu/carsey/213/>; L.C. Hamilton, “Conservative and Liberal Views of Science: Does Trust Depend on Topic?” (Durham, NH: Carsey School of Public Policy, 2015), <http://scholars.unh.edu/carsey/252/>.
7. L.C. Hamilton and M.D. Stampone, “Blowin’ in the Wind: Short-Term Weather and Belief in Anthropogenic Climate Change,” *Weather, Climate, and Society* 5, no. 2 (2013):112–19, doi: 10.1175/WCAS-D-12-00048.1; L.C. Hamilton and M. Lemcke-Stampone, “Arctic Warming and Your Weather: Public Belief in the Connection,” *International Journal of Climatology* 34 (2014):1723–28, doi: 10.1002/joc.3796.
8. New Hampshire average daily temperatures are approximated for Figure 4 by taking the average each day from the stations of record, which are at Durham, Keene, Hanover, and First Connecticut Lakes. In any given part of the state, temperatures could have been colder or warmer, but they probably followed a similar up and down pattern.
9. A standard question about Tea Party support was not asked in some of the February interviews, so those are not counted for the political party analysis; Significance tests for Figure 5 are based on *F* tests from probability-weighted logit regression of warm/not warm responses on the independent variable (age, gender, party, etc.) in each chart.
10. Respondent ages are grouped to make a readable bar chart in Figure 5, but the grouping does not affect basic conclusions. Even in continuous form, from 18 to 96 years, age does not significantly influence responses about the warm weather.
11. The climate question asks whether people think that climate change is happening now, caused mainly by human activities; happening now but caused mainly by natural forces; not happening now; or they just don't know.
12. National Academies of Sciences, Engineering, and Medicine, *Attribution of Extreme Weather Events in the Context of Climate Change* (Washington, DC: National Academies Press, 2016), doi: 10.17226/21852, <http://www.nap.edu/catalog/21852/attribution-of-extreme-weather-events-in-the-context-of-climate-change>.

13. C.P. Wake et al., *Climate Change in Northern New Hampshire: Past, Present, and Future*, Climate Solutions New England Report (Durham: Sustainability Institute at the University of New Hampshire, 2014a), <http://sustainableunh.unh.edu/sites/sustainableunh.unh.edu/files/images/northernclimateassessment2014.pdf>; C.P. Wake et al. *Climate Change in Southern New Hampshire: Past, Present, and Future*, Climate Solutions New England Report (Durham: Sustainability Institute at the University of New Hampshire, 2014b), <http://sustainableunh.unh.edu/sites/sustainableunh.unh.edu/files/images/southernclimateassessment2014.pdf>.
14. The smoothed trends are calculated by lowess regression; see note 3.
15. National Oceanic and Atmospheric Administration, El Niño Theme Page (2016), <http://www.pmel.noaa.gov/tao/elnino/nino-home.html>.
16. J. Cook et al., “Consensus on Consensus: A Synthesis of Consensus Estimates on Human-Caused Global Warming,” *Environmental Research Letters* 11, no. 4 (2016), doi:10.1088/1748-9326/11/4/048002.
17. Hamilton (2014).
18. Updated from L.C. Hamilton et al., “Tracking Public Beliefs About Anthropogenic Climate Change,” *PLOS ONE* 10, no. 9 (2015): e0138208, doi:10.1371/journal.pone.0138208.
19. S.T. Marquart-Pyatt et al., “Politics Eclipses Climate Extremes for Climate Change Perceptions,” *Global Environmental Change* 29 (2014): 246–57, doi: 10.1016/j.gloenvcha.2014.10.004.
20. L.C. Hamilton, “Did the Arctic Ice Recover? Demographics of True and False Climate Facts,” *Weather, Climate, and Society* 4, no. 4 (2012): 236–49, doi: 10.1175/WCAS-D-12-00008.1.
21. M.J. Cutler, “Seeing and Believing: The Emergent Nature of Extreme Weather Perceptions,” *Environmental Sociology* 1, no. 4 (2015): 293–303, doi: 10.1080/23251042.2015.1085117; P.D. Howe and A. Leiserowitz, “Who Remembers a Hot Summer or a Cold Winter? The Asymmetric Effect of Beliefs About Global Warming on Perceptions of Local Climate Conditions in the U.S.,” *Global Environmental Change* 23, no. 6 (2013): 1488–1500, doi: 10.1016/j.gloenvcha.2013.09.014; W. Shao, “Are Actual Weather and Perceived Weather the Same? Understanding Perceptions of Local Weather and Their Effects on Risk Perceptions of Global Warming,” *Journal of Risk Research* (2015), doi: 10.1080/13669877.2014.1003956.
22. L.C. Hamilton, “Polar Facts in the Age of Polarization,” *Polar Geography* 38, no. 2 (2015): 89–106, doi:10.1080/1088937X.2015.1051158.
23. L.C. Hamilton et al., “Wildfire, Climate, and Perceptions in Northeast Oregon,” *Regional Environmental Change* (2016), doi: 10.1007/s10113-015-0914-y.
24. L.C. Hamilton et al., “Flood Realities, Perceptions, and the Depth of Divisions on Climate,” *Sociology* (2016), doi: 10.1177/0038038516648547.

About the Authors

Lawrence C. Hamilton is professor of sociology and a senior fellow at the Carsey School of Public Policy at the University of New Hampshire (<https://carsey.unh.edu/person/lawrence-hamilton>).

Mary Lemcke-Stampone is the New Hampshire State Climatologist and associate professor of geography at the University of New Hampshire (<http://cola.unh.edu/faculty-member/mary-stampone>).

Acknowledgments

Questions about science and the environment in the Granite State Poll have been supported by a grant from the National Science Foundation (New Hampshire EPSCoR EPS-1101245). The authors thank Michael Ettlinger, Curt Grimm, Amy Sterndale, Michele Dillon, Laurel Lloyd, and Bianca Nicolosi at the Carsey School of Public Policy and Patrick Watson for editorial contributions.



University of New Hampshire
Carsey School of Public Policy

The Carsey School of Public Policy at the University of New Hampshire is nationally recognized for its research, policy education, and engagement. The school takes on the pressing issues of the twenty-first century, striving for innovative, responsive, and equitable solutions.

Huddleston Hall • 73 Main Street • Durham, NH 03824
(603) 862-2821
TTY USERS: DIAL 7-1-1 OR 1-800-735-2964 (RELAY N.H.)

carsey.unh.edu