



“On the Chopping Block”

*The Impacts of Global Warming and Climate Change
on the Mid-Atlantic Allegheny Highlands*

**A Report from Friends of Blackwater's
Allegheny Highlands Climate Change Impacts Initiative**

Updated with a new scientific bibliography -- August 2016

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A. Introduction

The distinctive climate of the Mid-Atlantic Allegheny Highlands region, which runs along the highest ridges of the Appalachian mountain chain – and the regional ecology and economy that depend on that climate -- are "On the Chopping Block" from the impacts of global warming and climate change.

In West Virginia, the Highlands are home to the Monongahela National Forest, Canaan Valley, and the Blackwater Canyon. In Pennsylvania, the scenic Highlands region includes Mount Davis, the state's highest peak; in Maryland, the ski resorts at Deep Creek Lake are an important regional economic engine. And in Virginia, Shenandoah National Park and George Washington National Forest are among the finest public lands in the East.



In these rugged peaks, deep hollows, and sweeping valleys, filled with rushing streams and rivers, the year begins with deep, snow-clad winter -- followed by green, life-filled spring. Then come the long, warm days and cool, wind-blown nights of summer. To end the ancient seasonal cycle, autumn's bracing frosts and brilliant colors adorn the hills, preparing the Highlands for another wintry blanket.

For generations, an intricate web of life based on the Highlands' distinctive climate has supported a strong and sustainable regional forestry, agricultural, tourism, and outdoor recreational economy. But today, the scientific evidence is clear that the impacts of climate change and global warming – rising temperatures and heat waves; more intense precipitation, flooding and severe weather; changes to historic growing seasons; degraded streams and rivers; altered forests; and plant and animal extinction -- threaten the Highlands.

In June 2014 and October 2015, the West Virginia-based conservation group Friends of Blackwater hosted two public conferences at Blackwater Falls State Park in Davis, West Virginia, where a wide range of scientific experts discussed the impacts of global warming and climate change on the Highlands. More than three hundred people attended. This report, first published in 2015, summarizes the information presented at these conferences. A new scientific bibliography, containing links to a wide range of on-line sources, has been added. A list of the conference presenters is in the "Acknowledgments" section. We hope you find this report useful; your comments and suggestions are welcome.

-- Tom Rodd, Project Director, Allegheny Highlands Climate Change Impacts Initiative

B. Impacts on Temperature and Precipitation

The National Climate Assessment (Melillo et al. 2014) reports that temperatures in the region of the United States that includes most of the Allegheny Highlands have risen by about two degrees Fahrenheit over the past one hundred years. The average period of frost-free temperatures has moved about ten days forward in the spring and ten days backward in the fall. This frost-free period is projected to continue to expand by a month or more.

Under "business-as-usual" high-greenhouse-gas-emission scenarios, the number of days when temperatures in the Highlands fall below 10 degrees will continue to decline by 50 percent or more and cold periods that have historically lasted for a week or more will more likely last only a day or two. The number of "heat-wave" days where the temperature exceeds 95 degrees is expected to triple.

Warming temperatures intensify the water cycle. Between 1895 and 2011 average annual precipitation in the Northeast region has increased by approximately five inches or more than 10%. This figure is projected to increase by 40% by 2100 under high-emission scenarios. Climate change is also increasing the frequency and severity of very heavy precipitation events (defined as the heaviest 1% of all daily events) in the region. The Assessment reports that between 1958 and 2010 the Northeast Region experienced a greater increase in extreme precipitation than any other region in the U.S.; more than a 70% increase. This trend will increase as climate change impacts grow.

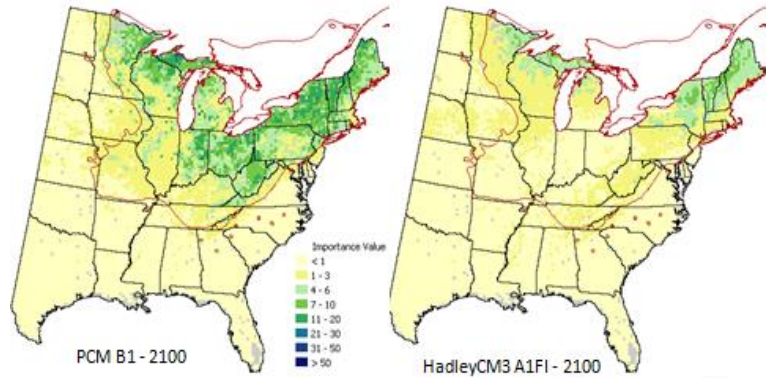


Warmer temperatures also cause the air to expand and increase rates of evaporation and evapotranspiration, leading to soils drying faster, especially in spring and summer. This increases stress on moisture-sensitive Highlands' ecosystems like peat bogs and aquatic habitats.

C. Impacts on Forests

The Highlands ecosystem is characterized by forest scientists as the Appalachian Hemlock Northern Hardwood Forest, and is classified as "highly vulnerable" to climate change. A major driver of the vulnerability of the Highlands forest ecosystem to climate change is decreasing precipitation in summer and fall, and increasing temperatures and reduced soil moisture.

The dominant species of this region – American Beech, Eastern Hemlock, Sugar Maple, Tulip tree, Black Cherry, White Ash, Yellow Birch, and Red Spruce – are projected to decline substantially as a result of changes in the atmosphere that are already in place. Under high-greenhouse-gas emissions scenarios, suitable habitat for important tree species like the sugar maple and red spruce disappears. To replace these species, heat-tolerant trees like the loblolly pine, now abundant in States like Georgia, are expected to become prominent in the Highlands.



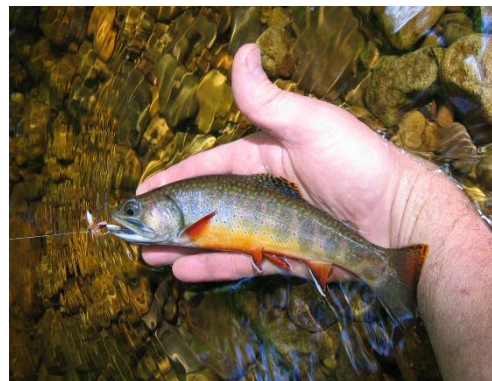
Sugar maples in the Highlands decline dramatically with continued warming.

The Pennsylvania Climate Assessment, prepared by experts at Penn State University in 2009 and updated in 2013 and 2015 (Ross et al. and Shortle et al. 2009, 2013, 2015), projects that forest product manufacturers and consumers may benefit from lower costs as more dying trees are harvested due to a changing climate, but forest landowners will likely be losers. The study says that the future outlook for one forest product, maple syrup, “looks bleak.” Additionally, with invasive species like the hemlock wooly adelgid already a major problem, climate-related threats to forest health in the Highlands from pests and disease are growing.

D. Impacts on Aquatic Life

Stream temperatures in the Allegheny Highlands have steadily increased over the past forty years as a result of global warming. These rising temperatures pose a severe threat to stream ecology and biodiversity.

For example, an upper stream temperature range of 68-77 degrees Fahrenheit is a critical zone for the Eastern Brook Trout, or "Brookie," which is the state fish of Pennsylvania, Virginia, and West Virginia. Summer stream temperatures in the Highlands are increasingly in that zone of caution. A summer heat wave may increase water temperature over 74°F for a week or more. While such a temperature spike might have a small impact on a stream’s annual average water temperature, it can cause the local extirpation of species that are impaired by waters warmer than 70°F.



Today, Eastern Brook Trout are gone from a third of their former homes in Appalachia’s cold-water streams. The Virginia Climate Modeling and Species Vulnerability Assessment

(Kane et al. 2013) projects that under high-emission greenhouse gas scenarios, suitable habitat for brook trout will disappear from the Highlands in this century.

E. Impacts on Wildlife

In 2011 the West Virginia Division of Natural Resources ("DNR") assessed 185 wildlife species for their vulnerability to the impacts of climate change (Byers 2011). The DNR classified 8 amphibian species, 4 bird species, 11 fish species, 6 mammal species, 2 reptile species, 18 mollusk or shellfish species, 12 crayfish species, 20 insect species, and 21 plant species as "extremely vulnerable" to "moderately vulnerable" to the impacts of climate change.

One species classified by the DNR as highly vulnerable is the West Virginia Northern Flying Squirrel, or "Ginny," as she is called by people who are working to protect her. There are less than 1,000 of "Ginny's" species in the entire world, all in just seven counties in the Allegheny Highlands.

Today, one of Ginny's prime habitat locations is the Blackwater Canyon, which Friends of Blackwater works to protect. But preserving the Blackwater Canyon will not save "Ginny" from extinction, unless we rein in the global warming that is destroying her habitat.



F. Impacts on the Outdoor Recreation and Hospitality Industry

Climate change impacts like increasing temperatures and heat waves, more intense precipitation and flooding, periodic drought, rain replacing snow, the loss of historic forests and changing weather patterns, extirpation of high-value sporting species like the brook trout – these impacts threaten the Highlands's distinctive outdoor recreation and hospitality industry.

The Pennsylvania Climate Assessment forecasts that ski season length in the Highlands region under a high-emissions greenhouse gas scenario would decrease by as much as 50 percent. The study says that it "is questionable whether [ski] resorts would be economically viable with such short seasons." This conclusion about the future of a signature regional economic engine is troubling.



G. Choices

What can we do to best protect the Highlands from the impacts of climate change? What climate-smart choices can we make?

One smart choice is to learn and talk about what climate change is and what it means – so that we better understand what's at stake and what's at risk. Another smart choice is to plan and prepare for the impacts of climate change that we cannot avoid. Just as communities in Virginia and New Jersey are building seawalls and infrastructure to reduce the harm of sea-level rise, people who care for the Allegheny Highlands can increase their preparedness and their resilience to climate change impacts.

Planners and builders can strengthen bridges, roads, and buildings in the Highlands to reduce harm from flooding and severe weather. Landowners and managers can build wildlife corridors and preserve critical landscapes to help endangered species find refuge from rising temperatures. Scientists can devise remedies to hold back climate-related diseases and pests.

Another smart choice is to support local, national, and global policies that will reduce global greenhouse gas emissions, to prevent the most dangerous impacts of global warming and climate change. It will take the efforts of scientists, businesses, people and governments all around the world to address the problem of climate change.

"Ginny," the West Virginia Northern Flying Squirrel, and all her Highlands friends, are counting on us!



H. Bibliography

The entries in this bibliography contain a wide range of scientific information about the impacts of global warming and climate change on the Mid-Atlantic Allegheny Highlands region. Here are some examples:

A West Virginia Division of Natural Resources study (Byers et al. 2011) discusses climate change vulnerability for dozens of animals and plants in the Highlands. In a state that takes pride in being "Wild and Wonderful," this paper is a wake-up call for conservation lovers! Another excellent resource is an interactive website operated by the U.S. Forest Service (Landscape Change Research Group 2014), where the user can select particular tree or bird species and see how their range and survival are affected by climate change.

To look at the bigger picture, the National Climate Assessment (Melillo et al. 2014) discusses how the United States and its regions, including the Allegheny Highlands, are being affected by climate change. The user can explore topics such as insect infestations; extinction for vulnerable animals; increased stream temperatures; intense weather events; and changes in winter weather. Another source, the US National Phenology Network (USPN 2011), contains information on how climate change is affecting when trees bloom and when birds migrate. Finally, Penn State scientists have completed several comprehensive studies (Ross et al. and Shortle et al. 2009, 2013, 2015) that describe the present and future impacts of climate change on the region.

Thanks to the dedicated scientists who discovered, compiled, and published this important information. And thanks to the reader for your interest!

-- Lauren Payne, B.S., Environmental Economics, West Virginia University, AmeriCorps VISTA Volunteer

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"I have pictured the mountain flanks as a fortress and the spruce sentinels on the ramparts as they seem to be watchmen over their realm. . . . They seem to be calling me to come up higher, where the air is clear and cool, to climb from the valley and brush among their boughs where mountains rise to no greater heights."

– J. Lawrence Smith, *The High Alleghenies*, 1982

"To deny the mounting science of climate change is to stick our heads in the sand."

– *Robert C. Byrd, former United States Senator (D-WV), 2011.*

"To those who say climate risk is a far off problem, I can tell you that I have hunted the same woods my entire life and climate change is happening now – I see it in the summer droughts that kill the trees, the warm winter nights when flowers bloom in January, the snows that fall less frequently and melt more quickly."

– *Richard Trumka, former President, United Mineworkers of America, current President, AFL-CIO, 2012.*

"It's not just what the models are predicting for the future, but it's what we've actually seen, the trends that we've observed over the last 50 years — or longer than that, really. The rate of change is accelerating. For the younger people here, you're going to be around in 2050, and the changes by that time are going to be quite severe. It's a long-term problem, but we have to start changing today. We're creating those future problems through the actions that we're doing today."

– *Dr. Marc McDill, Associate Professor of Forest Resource Management, Penn State University, Blackwater Falls State Park, June 2014*