CLIMATE CHANGE FACTS FROM HUBBARD BROOK

October 2019

HUBBARD BROOK

Background

- Acid rain was first discovered in North America in New Hampshire's 2nd Congressional District.
- It was discovered at the Hubbard Brook Experimental Forest, established in 1955 by the U.S. Forest Service for studying forest/water interactions.
- The acid rain discovery led to the 1990 Clean Air Act Amendments that protect our air and water quality.
- Hubbard Brook has been a world-leader in ecosystem science and a resource for environmental decision-making for more than six decades.
- Long-term ecosystem studies like Hubbard Brook are pulse-points for environmental health in the U.S.

Climate Change Indicators

Based on **more than 50 years of continuous ecosystem monitoring,** this is what we know about climate change at Hubbard Brook.

- **The air is warming.** Average annual air temperature has increased by 2.6°F.
- **Winters are warming faster than other seasons.** Average annual winter air temperature has increased by 3.5°F.
- **Air temperatures are rising in the mountains**. Summer temperatures today at 3,000 feet of elevation now match what they were 50 years ago at 2,200 feet.
- **We are getting more precipitation**. Annual precipitation has increased by 12 inches.
- **More precipitation is falling in heavy bursts.** We have 7.5 more days per year with heavy rainfall (i.e., ¾ of an inch or more in a day).
- **Rain is becoming more frequent in winter.**
- **Stream flows are increasingly variable.** Climate change is causing higher highs and lower lows.
- **We have fewer cold days.** There are 10 fewer days per year when the maximum air temperature is below 32°F.
- **Snowpack is getting smaller.** Average annual snow depth has decreased by 12 inches. Duration of snowpack has decreased by 24 days—nearly one more month per year without snow on the ground.
- **Lake ice is disappearing.** The number of days per year with lake-ice cover has declined by 25—nearly one more ice-free month each year.
- **Seasons are changing.** Spring leaf-out is occurring earlier. Leaf-fall is occurring later.

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Connections to Our Economy, Health, and Culture

- We are losing snow-making opportunities, particularly in the early ski season. According to a recent analysis of snow-making conditions over 50 years in the White Mountains, eight days of snow-making opportunity have been lost. Seven of these days occur before the holidays, representing a 20% reduction in snow-making conditions during the early ski season, a crucial period in a winter recreation economy.
- Smaller ski operations without large-scale snow-making infrastructure have disappeared. Ski operations that make snow now use more water over shorter periods to establish and maintain snowpack. This requires additional investments in equipment and access to substantial water reserves.
- The snowmobiling industry is struggling with the loss of snowpack and lake ice.
- There are fewer opportunities for timber harvesting on snowpack. Snowpack protects against soil disturbance and erosion.
- Without insulating snowpack, maple tree roots are damaged by more frequent soil freezing. This has a negative effect on forest growth and carbon sequestration.
- Changing winter conditions may lead to lower maple yield and shorter sugaring seasons.
- Shrinking snowpack is causing dramatic declines in beetle diversity and abundance, an essential food source for forest birds.
- Climate-related shifts in bird breeding seasons are reducing survival in some migratory species.
- Dramatic stream flow fluctuations are killing salamanders during metamorphosis, leading to declines in the number of breeding adults that may affect population viability.
- Rain falling on snow and frozen soil can cause runoff. This increases the risk of flooding and contributes to the pollution of downstream water supplies.
- A warming climate is allowing the northward advance of the hemlock woolly adelgid, an invasive insect from Asia that is now within 30 miles of Hubbard Brook. This insect kills eastern hemlock, which is one of our longest-lived tree species and is particularly abundant along stream corridors.
- Some ticks, mosquitos, and invasive insect pests thrive in the absence of cold temperatures that previously suppressed them. Winter ticks can kill moose. If ticks and mosquitoes expand their ranges and become more abundant, people will be at increased risk of Lyme disease and other illnesses, including eastern equine encephalitis.
- Interactions between scientists and leaders from the ski, snowmobiling, maple, and timber industries can support business adaptation to climate change.

Need for Further Study

Our forest ecosystems will be affected by changing air temperatures, precipitation patterns, stream flows, snowpack, lake ice, and the distribution and abundance of pests. Long-term research is needed to understand, respond to, and prepare for these changes.

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