



CLIMATE CHANGE AND HEALTH IN MAINE

Human-induced global climate change is well-studied and documented. Northern hemisphere average temperatures have already increased by 1.4°F in the past 100 years. In the Northeast U.S., the pace of warming has been even faster, especially during winter months in which average temperatures have increased by 3°F since 1970. G8 nations have agreed to limit warming to 3.6°F by 2050. At just over one-third of this average warming, major impacts on human health have already occurred and, as warming progresses, can be expected to increase. This document provides an overview on how climate change affects the health of Maine residents and has been reviewed by Harvard Medical School faculty who specialize in the health impacts of global environmental change and hold degrees in medicine and public health.

KEY FINDINGS FOR MAINE: CLIMATE CHANGE AND HEALTH

- 1) Heat waves will become increasingly common in Southeast Maine, where almost 40% of the state's population lives, over the coming decades, resulting in more illness and death from heart and lung disease.
- 2) Sea level will continue to rise along the coast of Maine up to at least 1 to 2 feet, and perhaps as much as 6 feet, by 2100. Higher sea level risks salinization of groundwater upon which more than half of Mainers rely for drinking water.
- 3) Maine's economic base, including tourism, forestry and agriculture, is vulnerable to a warming climate, and as temperatures warm, the state can expect job losses in these industries and associated mental health problems including anxiety, depression and stress-associated illness.

CLIMATE CHANGE RESEARCH RELEVANT TO HEALTH OUTCOMES IN MAINE

Increased greenhouse gas concentrations in the atmosphere have already, and will continue to, change the climate in Maine.

- » Temperatures have already risen across the state over the past 3 decades, with the Northern most part of the state most affected, having warmed overall by roughly 1.6°F since 1980. Warming has been greater during winter months (3°F since 1970). Coastal Maine has warmed by nearly a full degree Fahrenheit in the same period (Frumhoff 2007).
- » Without significant reductions in greenhouse gas emissions, winters in the Northeast could warm by 8 - 12°F and summers by 6 - 14°F (Frumhoff 2007).
 - » By 2100, the climate of Maine will be similar to that of present day Maryland (UCS 2007).
- » Nighttime and winter temperatures are increasing twice as fast as daytime high temperatures.
- » Heat waves are projected to become more frequent, longer and more widespread.
- » The water cycle will continue to intensify, with more frequent heavy precipitation events and intervening drought.

MAJOR HEALTH EFFECTS OF CLIMATE CHANGE IN MAINE

More respiratory disease, heart disease and death from heat waves are projected.

- » Between 1949 and 1995, heat wave frequency already increased by roughly 20% in the Northeast U.S. (Gaffen 1998).
- » An estimate for Concord, NH, the closest city for which data are available, suggests that temperatures there will

be 100°F or more 25 days each summer by the end of the century (Frumhoff 2007).

- » Heat stress can induce serious medical conditions, including heat stroke, and cause death, particularly among the elderly (15% of Maine's population is over 65) and persons with chronic medical conditions.
 - » Those with hypertension on diuretic medications (about one in four adults in Maine have high blood pressure), or who are obese (25% of the population), are particularly at risk (Maine CDC 2008).
 - » Heat stroke can cause permanent neurologic damage.
- » Heat fuels the production of ground-level ozone which triggers heart and lung disease.
- » Heat waves are more deadly with climate change because there is less night-time cooling.

Sea level rise will continue to put freshwater supplies used for drinking and irrigation at risk and increase the potential for coastal flooding.

- » Sea level has already risen 8" since 1912 in Portland (Jacobson 2009).
- » About half of Mainer's public water consumption comes from groundwater for drinking water (Schmitt 2005). Rising seas that seep into Maine's coastal groundwater will make drinking water salty for most Mainers, and may raise their blood pressure, a consequence of particular concern for pregnant women and those with heart disease.

The trend towards more precipitation over shorter intervals will continue and increase the chances for outbreaks of water borne diseases. Interval droughts and associated water shortages are already apparent and will likely become more common.

- » Water borne disease outbreaks from *E. coli* and *Cryptosporidium* are much more likely after heavy precipitation and/or flooding.
 - » Nationwide, roughly two-thirds of waterborne disease outbreaks occur following months in which precipitation is 80% of historical maximums (Curriero 2001).
 - » Across the U.S., between 1950 and 2007 the number of very heavy rainfall events, defined as the heaviest 1% of all events, has increased 67% (Groisman 2004).
 - » Precipitation has been increasing in Maine by approximately 1 inch/decade since 1980 (Frumhoff 2007).
 - » Average rainfall is expected to increase across the state by about another 10% in the winter and spring by 2100 (Frumhoff 2007).
- » 75% of public water withdrawals in Maine, providing drinking water to half a million people, come from surface waters, such as lakes and rivers. During droughts, evaporation from surface waters can markedly reduce water availability from these sources.
 - » The 2001 drought in Maine resulted in water shortages and restrictions throughout the state, and in particular along the coast, as increased demand for water by tourists outstripped supply (Schmitt 2005).
- » Additional stress on water supplies will come from earlier snowmelt. Data collected in 6 major river basins in Maine has shown that, across the state, stream flows are peaking earlier and declining earlier in the year. The date of ice break-up on lakes is already 2 weeks earlier today than it was in the 19th century (Jacobson 2009).

Climate change has the potential to spread vector borne diseases, such as Lyme disease and Eastern equine encephalitis.

- » Warmer temperatures allow insects to survive in areas not previously possible and to reproduce more often.
- » Models indicate that cases of Lyme disease, which have grown exponentially in Maine in the past decade from less than 100 cases per year in 2000 to more than 500 in 2007, will continue to expand its geographic reach northward (Maine Center for Disease Control).
- » Eastern equine encephalitis, which is spread to humans via mosquitoes and kills 50-75% of those infected, has been expanding its range northward with the first case in New Hampshire reported in 2005. Children are particularly susceptible and survivors often suffer from chronic disabilities.

CLIMATE CHANGE: MAINE'S ECONOMY AND HEALTH

Maine's economy is vulnerable to climate change as it relies heavily upon climate-sensitive businesses such as tourism, forestry and agriculture. Financial stress and job loss are major contributors to depression and anxiety disorders and may worsen certain physical diseases including diabetes, ulcers, heart disease and rheumatoid arthritis.

- » 1 in 5 jobs in Maine is supported by tourism. Climate change has the potential to drain Maine's tourist industry by harming the state's natural beauty.
- » Days with snow cover over most of the state have already decreased substantially since 1965 across most sites studied in Maine (loss is roughly 1 to 6 days per decade) and will continue to decline over the course of this century. Skiing, worth \$300 million dollars to the state economy and snowmobiling, also worth several hundred million dollars to the state's economy, will be adversely affected (Frumhoff 2007).
- » Tree species that produce the most impressive displays of autumn colors – beech, maple and birch – will likely be largely absent from Maine's southern forests by mid-century (Jacobson 2009).
- » Warming enables the spread of pests:
 - » The Asian Long Horn beetle, already present in Massachusetts, is a threat to half of Maine's 17.7 million acres of forest, and is projected to spread north with warming.
 - » The Hemlock Woolly Adelgid is already present in the southern Maine and forecast to spread throughout the state by 2100 (Jacobson 1999).
 - » Hemlocks adjacent to rivers significantly cool river water and enable the spawning and survival of freshwater fish. Loss of hemlocks, combined with lower stream flows from more evaporation in a hotter world, will likely adversely affect fish populations in Maine's freshwater bodies.
- » The forest industry supports about 19,000 jobs and represents \$1.4 billion of the state's GDP and will be increasingly vulnerable as the climate warms (UCS 2007).
 - » In the West, Pacific Northwest and southern Alaska, pine trees have been devastated by the spread of mountain pine beetles, as milder winters allow the bark beetles to move to higher latitudes and altitudes, and reproduce more successfully.
 - » The Spruce beetle, native to Maine, is a growing threat to white and red spruce along the coast of Maine. Stressed and weakened trees, such as from drought, are more susceptible to the beetle.
 - » With higher average temperatures, mid- to late-century Maine forests will look much like those in Pennsylvania and Maryland today.
- » Maple syrup production may also suffer.
 - » New England producing states have lost 60% of their market share since the early 1920s, largely to Canadian producers as climate conditions have favored the growth of maple forests further north, and ice storms and pests have become more common in New England (Rock 2001).
 - » Maine produces about 4 million dollars of maple syrup products each year. Based upon business as usual models of greenhouse gas emissions, maple trees will be pushed to the northern rim of Maine by as early as 2075 (Rock 2001, Prasad/USDA 2007).

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Full references are available at <http://chge.med.harvard.edu>, "Policymaker Education"