

Human Health Impacts

Overview:

- Extreme heat is the greatest weather-related threat to public health. The frequency and severity of heat waves will increase under any realistic emissions scenario, but the number of days over 100°F is especially sensitive to future emissions.
- Many greenhouse gases contribute to poor air quality, both directly and indirectly in the form of rising temperatures.
- Allergies, infectious diseases, and injuries due to severe weather could all increase due to climate change.
- Access to and cost of health care on Martha's Vineyard presents challenges that will be difficult but essential to address in the face of climate change.

Extreme heat and air quality

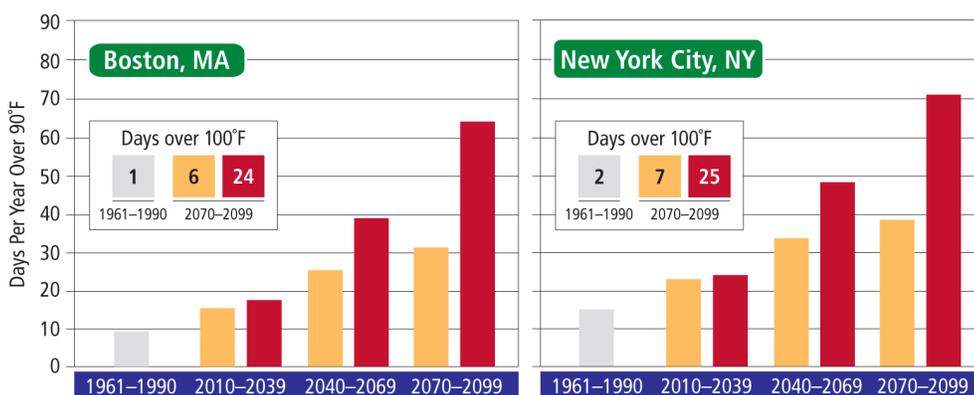
In the developed world, where societal wealth will mitigate the most tragic human impacts of climate change (famine, widespread displacement and refugee crises, violent conflict, etc.), the greatest threat to public health is simply heat. In the United States, heat waves – not severe storms – are the leading cause of weather-related deaths.

Across the Northeast, extreme heat – measured both as the number of hot days and the extremity of them – will rise in importance as a public health and safety issue. Even very modest increases in average annual temperature translate into significant increases in the

number of extreme heat days. The Northeast already experiences on average two more days per year above 90°F than we did in 1960, and the number of such days will more than double over the next 50 years. By the end of the century, under the high-emissions scenario Boston could see the equivalent of two months in excess of 90°F. Even larger relative increases in 100+ degree days are expected. Hundred degree days will remain rare on Martha's Vineyard for the near future, but 2012 did see six days above 90°F¹.

A close second in importance to extreme heat will be increased concerns about air quality. Many of the same gases that contribute to global warming also have direct impacts on the air we breathe. For example, one

of the worst dual offenders is the black carbon released by incomplete combustion of diesel, wood, and charcoal, which warms the planet by absorbing solar radiation as it reflects away from the Earth. Vehicle emissions and industrial gases also contribute to ground-level ozone (an important component of smog), which is strongly associated with lung damage and increased incidence of asthma. This effect is especially large in vulnerable populations and those who work outdoors (two categories well represented on our



Extreme Heat Rises in Northeastern Cities

The number of days per year over 90°F will rise more quickly under high emissions (red bars) than low (yellow), but the difference is most pronounced in days over 100°F. Under a high-emissions scenario, Boston could see 4 times as many of these days as compared to under lower emissions, and 24 times the historical average (Figure adapted from NECIA/UCS, pg. 93)

Island). Impacts to air quality are also a secondary risk factor in wildfires, which are already increasing due to warmer and droughty summers.

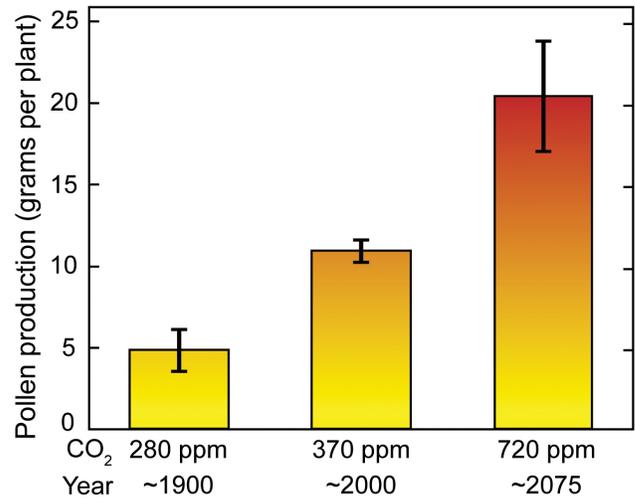
In addition to their direct effects on air quality, greenhouse gas emissions exacerbate air quality problems, as warmer, stagnant air masses foster the local accumulation of dangerous levels of ozone and other pollutants. Further, the weather conditions that lead to extreme heat and poor air quality often occur together, leading to especially dangerous circumstances. A French study found the simultaneous occurrence of a heat wave and high ozone event led to a 175% increase in mortality in Paris².

Local air quality is particularly sensitive to current and future emissions. While global temperatures will continue to rise to some degree under any realistic emissions scenario, ground-level ozone could actually decrease in the future under a low emissions scenario. While higher temperatures will, in and of themselves, contribute to poorer air quality, reductions in the release of black carbon and the precursors of smog could improve air quality fairly quickly; unlike greenhouse gases, these problems are local, on-the-ground (sometimes literally) and don't persist in the air for hundreds of years. Across an even shorter timeframe and more local in nature, though, an unfortunate reality is that increased summer heat will lead to greater demand for air conditioning, increasing the power plant emissions that contribute to poor air quality.

Locally, we will feel the effects of increased numbers of extreme heat days and poor air quality, but the impact will be relatively minor compared to much of the nation. We will still have fewer and less severe heat waves than the cities and suburbs of the Northeast, where extreme heat days are exacerbated by urban heat island effects. Also, the effects of global warming – higher temperatures and increased humidity – have been found to more greatly increase ozone where concentrations were already high³; therefore, as absolute air quality in nearby cities becomes increasingly unbearable, the difference between the Vineyard and those cities is likely to expand, increasing the appeal of the Island to seasonal residents and tourists. The greatest threat to our local air quality may be our location downwind of Brayton Point Power Station, the largest coal-fired power plant in the region, but even this compares reasonably well with the location of the Vineyard's primary tourist base, who are downwind of the entire industrial Midwest.

Allergies

Changes in the frequency and severity of allergy-related diseases will be complex and difficult to predict. On one level, a changing climate and continuing movement of invasive species will lead to a scrambling of the range and abundance of allergy-causing plants, with unknown winners and losers. However, there are some general trends. Earlier summers have been leading to earlier arrivals of the spring pollen season, and will continue to do so. Local allergists confirm that pollen counts have been up in recent years, and that oak (which will most likely benefit locally from climate change) is an important contributor to seasonal allergies⁴. Some notorious allergens, such as ragweed, respond to higher temperatures with accelerated growth and increased pollen. In addition, higher CO₂ levels directly boost pollen production, apart from their effect on global temperature⁵. In one experiment, poison ivy grew twice as fast when CO₂ levels were doubled, an increase nearly five times greater than that seen in trees⁶. Broadly speaking, then, it appears that climate change will increase the occurrence and severity of allergic symptoms.



Pollen production of ragweed grown in the laboratory under different CO₂ concentrations corresponding to historic levels, the recent past, and the future under a high-emissions scenario. (Figure from USGCRP pg. 96, Ziska and Caulfield, 2000)

Vector-borne disease

Impacts on vector-borne infectious disease are similarly hard to predict, but likely harmful on balance. The projected changes to our local climate – hotter summers with more drought conditions, interspersed with

heavy rains – are associated with outbreaks of West Nile virus, which has now been detected in several Massachusetts towns, including West Tisbury⁷. Given the diversity of habitats and lifestyles of mosquito species, and the wide and growing distribution of those that carry West Nile and Eastern equine encephalitis (*Aedes aegypti* and *Aedes albopictus*), there will likely be at least one dangerous disease spreading mosquito that will thrive in any future climate. In contrast, there is some hope that Lyme disease – vectored primarily by deer ticks, which prefer cooler summers – could actually decline⁸. However, our most notorious disease is expanding its range in all directions, including to the more Southerly locales to which our future climate will more closely resemble. Further, the ticks also prefer mild, wet winters, so while summer populations may decline, Lyme disease and the deer tick are here to stay.

Severe weather and other health effects

The health threat posed by severe weather events, while overemphasized by the media in comparison to heat waves and poor air quality, is obviously very real and of greater local importance due to the number of Vineyarders who live and work on the water. It hardly needs to be stated, but in the absence of sufficient mitigating safety measures, any increased severity of tropical depressions and nor'easters in the future will lead to more injuries and fatalities. During a hurricane, when important infrastructure and resources (roads, bridges, emergency vehicles and supplies) are already under severe stress, the expected higher sea levels and more powerful storms call extra attention to questions about the location of the new hospital.

Other health issues possibly affected by climate change are often caused or exacerbated by weather events. Infectious diseases other than those vectored by animals could increase; for example, *Salmonella* food poisoning is most common within one to six weeks of the highest temperatures of the year, and waterborne illnesses such as *Giardia* increase following downpours and are more of a threat if the local drinking water has been

Bright Skies Ahead: Stratospheric Ozone Depletion and Skin Cancer

While ground-level ozone contributes to poor air quality and respiratory disease, ozone in the stratosphere (more than five miles above the surface) plays an important beneficial role by absorbing a large amount of the shorter-wavelength ultraviolet radiation that causes skin cancer. A disease of growing significance across the nation, skin cancer is an even greater concern locally: seasonal and full-time Vineyarders alike show an increased incidence of skin cancer compared to the national average⁹. This can be expected to rise further due to destruction of stratospheric ozone caused by release of industrial chemicals.

Stratospheric ozone depletion is not, strictly speaking, part of climate

change. But it is an analogous process, and one of the few reasons to be optimistic that problems caused by global emissions with diffuse and long-term consequences can be addressed successfully, even when it involves international cooperation and difficult politics. Following the growing understanding of the severity of the issue in the 1980s, restrictions on emissions of ozone-depleting chemicals were put in place in 1987 (the Montreal Protocol) and tightened throughout the 1990s. Because of the long residency time of these chemicals, ozone depletion continues today and UV exposure is expected to peak around 2020; however, due to the actions taken to cut emissions, scientists expect a full recovery of stratospheric ozone by mid-century¹⁰.

compromised. Psychiatric disorders, such as depression and anxiety, should be expected to increase following severe weather events that cause losses or disruption of home life.

Health care on Martha's Vineyard

Independent of the impacts of climate change, access to (and cost of) quality health care on Martha's Vineyard presents challenges, and these will only grow more pressing in the future. A 2008 economic analysis predicts that "by 2020, more than 22% of Islanders will be senior citizens" and that health care expenditures will be the most rapidly growing aspect of our cost of living¹¹. As stated in the Martha's Vineyard Commission's Island Plan, our population is already older than the state average and will further diverge as seasonal residents reach retirement age and come to settle here year-round; the MVC envisions the Baby Boomer cohort leading to a tripling of residents over 70 years of age in coming years.

Further, this increased demand will be taxing a rather uncertain supply. An analysis conducted in 2007 of economic "leakage" (i.e., the amount of economic activity lost to off-Island competition) found that there were 163 fewer full-time jobs in the health care sector than should be expected¹²; this represents both

an unrealized source of good-paying, stable jobs, but also a shortage of health care professionals here in the present, only to be worsened by our changing demographics. There is already a perceived shortage of primary care providers on the Island, though this situation may be improving and/or overstated according to recent surveys¹³. With the nation facing a shortage of primary care physicians, and recruitment of health care professionals to rural areas being difficult everywhere, improvement in our local supply is welcome but tenuous at best.

The new Martha's Vineyard Hospital, just opened in 2010, is itself in a tenuous position, perched aside the water on relatively high ground but accessed by roads that in the next 50 years may be inundated during rather ordinary nor'easters and tropical storms. While there will surely be little appetite to build a new hos-

pital for quite a few years, in the interim costs will only be magnified by the combined impact of increased emergency care and accessibility issues during severe flooding events.

Though the M.V. Hospital rates well in patient surveys¹⁴, costs are already a concern. A survey conducted by Harvard Pilgrim Health Care, one of the largest insurers in Massachusetts, found the hospital to be the 5th most expensive (out of 72) in the state¹⁵. A separate analysis of state data by the *Vineyard Gazette* found the cost of various procedures to often be double to four times the state median¹⁶. Further, the impact of relatively high costs of care will be heightened by the large number of uninsured workers (many seasonal), independent contractors, and small business owners on our island.

Notes

1. Mark Alan Lovewell, *Vineyard Gazette* (Dec. 27, 2012), "Something to talk about: the weather"
2. Filleul et al. (2006), The relation between temperature, ozone, and mortality in nine French cities during the heat wave of 2003. *Environmental Health Perspectives*, 114(9): 1344-7.
3. Bell et al. (2007), Climate change, ambient ozone, and health in 50 U.S. cities. *Climatic Change*, 82(1-2), 61-76.
4. The Point with Mindy Todd, WCAI Radio (May 20, 2011).
5. Ziska and Caulfield (2000), Rising CO₂ and pollen production of common ragweed (*Ambrosia artemisiifolia* L.), a known allergy-inducing species: implications for public health. *Australian Journal of Plant Physiology*, 27(10), 893-898.
6. Mohan et al. (2006), Biomass and toxicity responses of poison ivy (*Toxicodendron radicans*) to elevated atmospheric CO₂. *Proceedings of the National Academy of Sciences*, 103(24), 9086-9089.
7. Olivia Hull, *Vineyard Gazette* (Aug. 1, 2013), "West Nile virus detected in West Tisbury mosquito"
8. Liz Durkee, *Vineyard Gazette* (Oct. 7, 2011), "Holding human health over the coals"
9. Charles Silberstein and Diane Becker (2006), *Martha's Vineyard: The Health Conditions and Health Status Report*.
10. World Health Organization, *Stratospheric ozone depletion, ultraviolet radiation and health* (website)
11. John J. Ryan (2008), *Martha's Vineyard Economic Profile*. Prepared for Martha's Vineyard Commission.
12. Michael H. Shuman and Doug Hoffer (2007), *Leakage Analysis of the Martha's Vineyard Economy: Increasing Prosperity through Greater Self-Reliance*. Prepared for Martha's Vineyard Commission.
13. Sara Brown and John Kennedy, *Vineyard Gazette* (Aug. 9, 2012), "Health care checkup: access to primary care improving"
14. See, for example, www.medicare.gov/hospitalcompare
15. Mike Seccombe, *Vineyard Gazette* (March 18, 2010), "Hospital ranks fifth in cost"
16. Mike Seccombe, *Vineyard Gazette* (July 30, 2009), "Island Hospital Fees Are High"

Much of the background information used in this report is drawn from three large synthesis reports that represent the scientific consensus regarding global climate change. Factual statements without individual endnotes are drawn from one or more of these reports: *Advancing the Science of Climate Change* (National Academy of Sciences), *Global Climate Change Impacts in the United States* (US Global Change Research Program), and *Confronting Climate Change in the U.S. Northeast* (Northeast Climate Impacts Assessment Team, a collaboration of the Union of Concerned Scientists and other independent scientists). See the first section, Emissions Scenarios and Global Climate Change for further explanation.