

# Managing Dairy Heat Stress

in the Northeast's Rapidly Changing Climate

Keeping cows cool in the summertime is a major concern for dairy farmers, even in the relatively moderate climate of the Northeast.

During humid heatwaves, temperature and humidity levels can rise above a cow's comfort zone, leading to heat stress. When heat stress occurs, dairy cows will typically eat less food, have difficulties with calving, and produce less milk. Reduced milk production with heat stress is concerning given the dairy industry's economic value to agriculture in the Northeast. In the abnormally hot summer of 2005, for instance, dairy heat stress reduced milk production on some New York dairy farms by as much as 20%<sup>1</sup>. Across the Northeast, temperature and humidity levels continue to rise with climate change, and these trends are expected to adversely affect dairy production in the near future<sup>1</sup>. Indeed, many northerly locales are already seeing heat stress occur with greater regularity. If the frequency and severity of humid heat waves increases as expected toward the end of this century<sup>2</sup>, farmers in the Northeast may even need to adopt cooling strategies for their dairy herds.

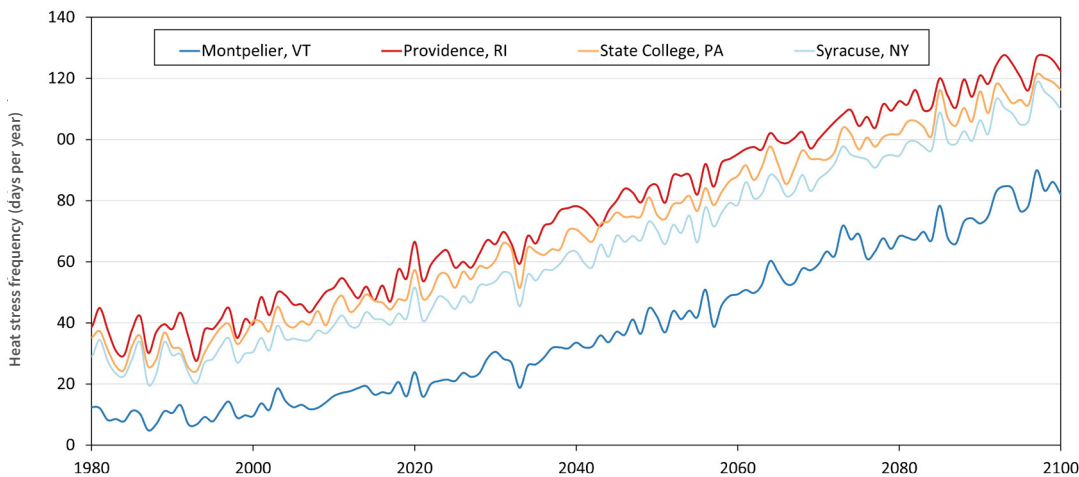


Figure 1 | Heat Stress Frequency

Trends in heat stress frequency for four representative dairying locations in the Northeast from 1980–2100. Predictions of heat stress frequency are based on climate model output that assumes a business-as-usual (a.k.a. high) emissions scenario for greenhouse gases. Heat stress frequency was estimated as the number of days each year when the temperature-humidity index exceeded 70.



Fairhill Farms in Chestertown, Maryland utilizes open barns with fans and night grazing to keep cows cool when temperatures get too hot during the day.

In a recent publication, a team of scientists from USDA's Agricultural Research Service, Auburn University, and Texas Tech University sought to determine how dairy heat stress could be managed in a rapidly warming climate. To estimate heat stress in dairy cows, the team used the temperature-humidity index, which combines air temperature and relative humidity values into a simple measure of apparent temperature, like the well-known heat index. Heat stress in dairy cows typically occurs when the temperature-humidity index rises above 70. Using climate model forecasts out to the year 2100, the team estimated heat stress frequency as the number of days each year when the temperature-humidity index exceeded 70. This was done for 36 locations in major dairying areas of the U.S.

The team also assessed the ability of different cooling strategies to lower the temperature-humidity index and reduce the frequency and intensity of heat stress. Four increasing levels of cooling were considered<sup>3</sup>, including: (1) minimal cooling with an open barn, (2) moderate cooling using an open barn equipped with fans, (3) high cooling using an open barn furnished with fans and misters, and (4) intense cooling using an air conditioned barn. The team then conducted a simple cost-benefit analysis to determine when such strategies might become economical.



In the Northeast, heat stress was not much of an issue under the current climate, but was expected to worsen with future climate.

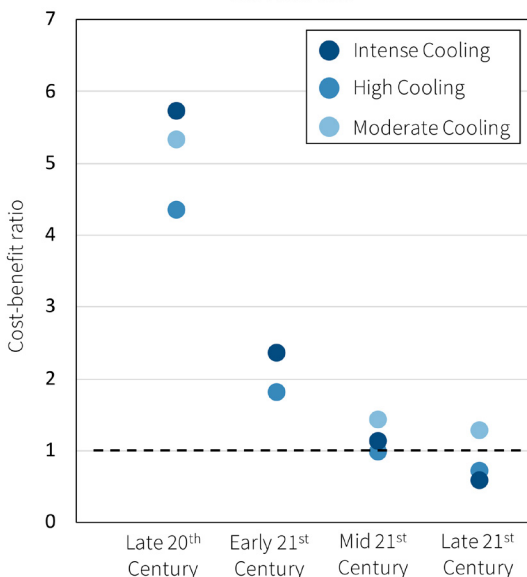
Across four key dairying locations in the Northeast, heat stress averaged about 27 days per year under late-twentieth century (1981–2000) climate conditions. In warmer regions to the south, heat stress conditions were up to five times more frequent, averaging as much as 140 days per year. As a result, investing in added cooling measures did not appear to make economic sense for most dairy farmers in the Northeast. By the middle and latter portions of this century, heat stress frequency was expected to rise significantly in the Northeast, with each decade seeing roughly 8 more days of heat stress than the decade before. These increases in heat stress occurrence were notably faster than many of the southerly regions where heat stress is already a common problem. By the end of this century, study results suggested that the frequency of heat stress in the Northeast could resemble present-day heat stress conditions in southern regions of the U.S. If these trends were to hold, then additional cooling interventions may be warranted.

Findings from the study suggested that dairy farmers could minimize milk production losses by adopting cooling strategies for their dairy herds. The team found that high, and in some cases, intense cooling strategies may become necessary to ease longer stretches of heat stress that are likely to occur later this century. Simple cost-benefit analyses also indicated that high and intense levels of cooling could potentially be economic for some dairy farmers to implement. In sum, while climate warming is expected to bring increasing challenges to dairy farmers in the Northeast, there is great potential to mitigate some of these challenges with various cooling measures.

Learn more: <https://bit.ly/nedairyheatstress>

Figure 2 | Northeast Cooling Level Cost-Benefit

◀ Images showing the four different cooling levels that were modeled (left, top).  
 ▼ The cost-benefit ratios for moderate, high, and intense cooling for early (2015–2034), middle (2045–2064) and late (2081–2100) twenty-first century (left, bottom). Cost-benefit ratios weighed the marginal profit that was gained from each level of cooling (benefits) against the costs of implementing that level of cooling (costs). Cost-benefit ratios that were equal to or less than one were considered economical.



### Citations

- <sup>1</sup> Frumhoff, P.C., McCarthy, J.J., Melillo, J.M., Moser, S.C. and Wuebbles, D.J., 2007. *Confronting climate change in the US Northeast. A report of the northeast climate impacts assessment.* Union of Concerned Scientists, Cambridge, Massachusetts, pp.47-61.
- <sup>2</sup> Coffel, E.D., Horton, R.M. and de Sherbinin, A., 2017. *Temperature and humidity based projections of a rapid rise in global heat stress exposure during the 21st century.* *Environmental Research Letters*, 13(1), p.014001.
- <sup>3</sup> St-Pierre, N.R., Cobanov, B. and Schnitkey, G., 2003. *Economic losses from heat stress by US livestock industries.* *Journal of dairy science*, 86, pp.E52-E77.

### Research Brief of:

Gunn, K.M., Holly, M.A., Veith, T.L., Buda, A.R., Prasad, R., Rotz, C.A., Soder, K.J. and Stoner, A.M., 2019. *Projected heat stress challenges and abatement opportunities for US milk production.* *PloS one*, 14(3).

Written by Dr. Anthony Buda, USDA-ARS

USDA is an equal opportunity provider, employer, and lender.

April 2020