Thank you for joining us.
This webinar is scheduled for
December 18th 2018 1:00pm – 2:00pm eastern

Impacts and Opportunities of Climate Change on Northeast Crops and Livestock:

Part 2: Climate change effects on livestock in the Northeast US and strategies for adaptation

Today's Presenters:

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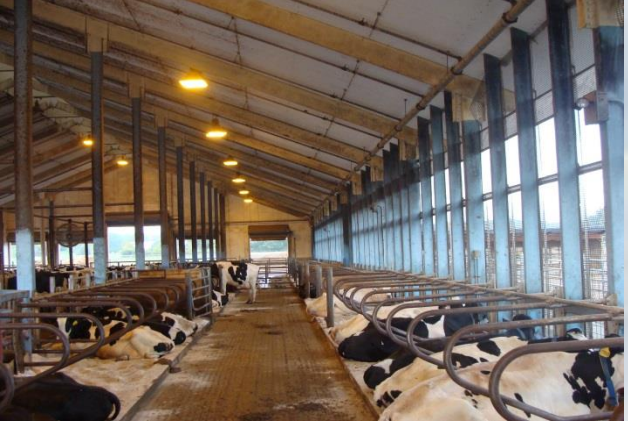

Climate change effects on livestock in the Northeast US and strategies for adaptation

A. N. Hristov, A. T. Degaetano, C. A. Rotz, E. Hoberg, R. H. Skinner, T. Felix, H. Li, P. H. Patterson, G. Roth, M. Hall, T. L. Ott, L. H. Baumgard, W. Staniar, R. M. Hulet, C. J. Dell, A. F. Brito, D. Y. Hollinger

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NE states included in the analysis

CONNECTICUT
DELAWARE
MAINE
MARYLAND
MASSACHUSETTS
NEW HAMPSHIRE
NEW JERSEY
NEW YORK
PENNSYLVANIA
RHODE ISLAND
VERMONT
WEST VIRGINIA

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Structure of the livestock industries in the NE US

- Dairy is the main livestock industry. Total milk and dairy product sales in the region exceeded $7.5 billion in 2014
  - Sales of dairy products represented 32% of all farm receipts
- Poultry production in the NE includes broiler chicken, egg, and turkey operations, providing $4.50 billion in cash receipts in 2015
  - Poultry and egg production in the region represents 9.4% of the total value produced in the USA
- Beef animals in the NE represent 3.7% of the national cattle inventory
  - 2% of the national cattle and calf farm receipts, at $1.69 billion in 2014
- The NE equine industry is an important segment of animal agriculture; the total value of horses in the NE is between $1.4 and $4.3 billion
  - The GDP impact of the region's horse industry is estimated at $7.5 billion, which is about 7.4% of the national impact of $101 billion in 2005
- Sheep, goats, and pigs are additional livestock sectors in the NE
  - The swine industry had a $362.5 million production value in the NE in 2013

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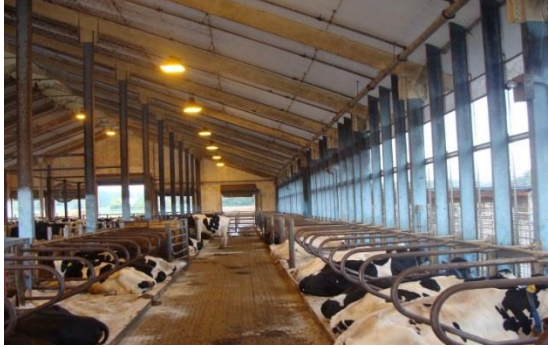

The NE dairy industry

- The dairy cow population in the NE is about 1.4 million with 80% on PA and NY dairies
- Current NE milk production is 13.8 billion kg/year, or 14.6% of the U.S. total
  - About 20% of the organic milk produced in the U.S. comes from the NE
- Farm size varied with 1.5% of herds having less than 30 cows, 26% at 500 or more and a median herd size of about 200 cows

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Poultry industry in the NE

- Poultry operations in the NE are CAFO with environmentally-controlled housing systems
  - Broiler farms with 100,000 birds or more in annual sales contribute about 98.6% of total broiler production and represent 30% of broiler farms in the NE
  - There are 235 medium and large layer farms with 20,000 layers or more representing less than 1% of layer operations in the NE, but producing 84% of the layer inventory
- Main broiler producing states MD, DE, PA, and WV
- Pennsylvania accounts for 64% of the layer inventory and 86% of the total egg production in the NE
- Pennsylvania and WV account for 96% of all turkey production

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Summary of climate trends in the NE

- More extremely warm nights (minimum temperature >21°C)
- Fewer extremely cold and cold nights (<−18°C and <0°C)
- Warmer average winter and summer temperatures
- More days with heavy rain (generally >5.0 to 7.6 cm events)
- Higher annual precipitation

Kunkel et al. (2013)

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Climate change effects on forage production

Table S2. Potential changes in forage crop productivity and quality associated with climate change. Projected changes will have both positive and negative effects		
Change in climate	**Change in forage productivity**	**Change in forage quality**
Elevated air temperature	**Perennial cool-season forages** will begin growth earlier in the spring and go dormant later in the fall **Increase productivity of annual and perennial forages** with longer growing season **Favorable for warm-season forage species because of longer growing season** and greater photosynthetic efficiency at temperatures > 29°C **"Summer slump"** associated with cool-season forages will be more pronounced	**Reduced digestibility associated with increased lignin deposition** in plant cell wall and lower leaf:stem ratios **Decrease in crude protein content** of forage
Decreased winter soil temperature (due to less snow cover)	**Increased winter damage to sensitive perennial forage species**. Result in possible species shift or stand loss, especially in northern areas of the region, and reduced production	

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Climate change effects on forage production

Table S2. Potential changes in forage crop productivity and quality associated with climate change. Projected changes will have both positive and negative effects		
Change in climate	**Change in forage productivity**	**Change in forage quality**
Less frequent but more intense precipitation	**Warm-season forage and weed species have competitive advantage** over cool-season species during long periods with limited soil moisture **Cool-season forages have competitive advantage** during wet and cool periods **Increased challenge to successful forage establishment** and early access of grazing animals to wet fields	**Warm-season weed encroachment** reduces forage quality **Reduced quality associated with "rained on" forage while drying** **Postponed harvest** may decrease forage quality
Elevated CO_2	**Increased productivity of cool-season (+30%) and warm-season (+10%) forage species**	**Elevated plant nonstructural carbohydrates, decrease in crude protein content, but no effect on forage digestibility**

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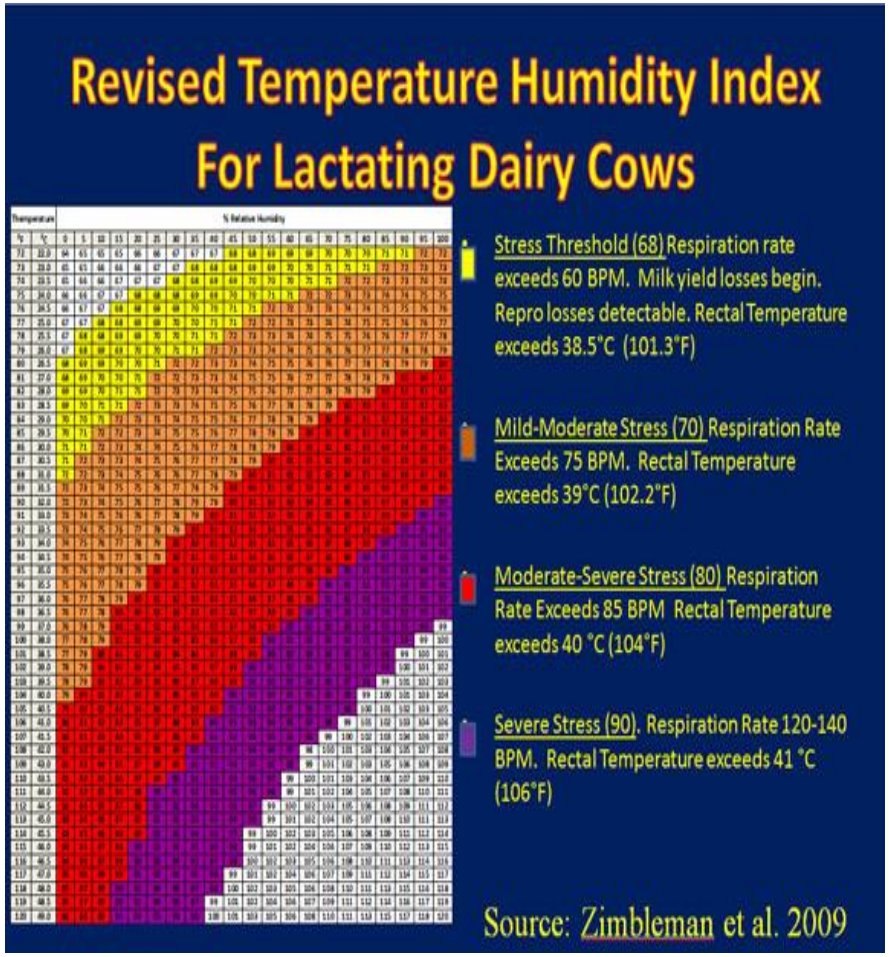
Forage production summary

- Reduced snow cover could increase exposure to extremely cold temperatures by reducing the insulating effect of snow
- Impacts of climate change on the predominant annual forages such as whole-crop corn and small grains should generally be positive
- Forage yields of small grain crops should increase due to elevated atmospheric CO_2 levels and air temperatures
- A trend toward warmer temperatures may allow better success with no-till and cover crop establishment in northern portions of the region

Climate change effects on livestock

- Animals have a Thermo-Neutral Zone (TNZ)
  - as an example, for dairy/beef cattle TNZ is between 5 and 25°C
- Below the TNZ, animals will require extra energy to maintain body functions and have to increase feed intake
- Above the TNZ, animals are under heat stress of various severity
  - **A major effect of heat stress is decreased DMI**



The main effect of climate change in the dairy industry will be through decreased DMI

- DMI loss estimation:
  - $DMI_{Loss} = 0.0345 \times (THI_{max} - THI_{threshold})^2 \times D$

- THI_{max}:
  - THI_{max} = 0.8 × maximum ambient temperature in °C + [(minimum humidity ÷ 100) × (maximum ambient temperature in °C - 14.3)] + 46.4

St-Pierre et al. (2003)

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Other potential effects of heat stress in dairy cattle

- Studies have shown decreased milk protein yield
- Increased mortality, increased incidences of diseases, decreased reproductive performance, and decreased heifer feed intake and daily gain
  - Heat stress reduces fertility by affecting the ovaries, uterus, and the hormones regulating their function
- The physiological responses to heat stress in dairy cattle include altered hormonal status, reduction in rumination and nutrient absorption, suboptimal immune function, and increased maintenance requirements

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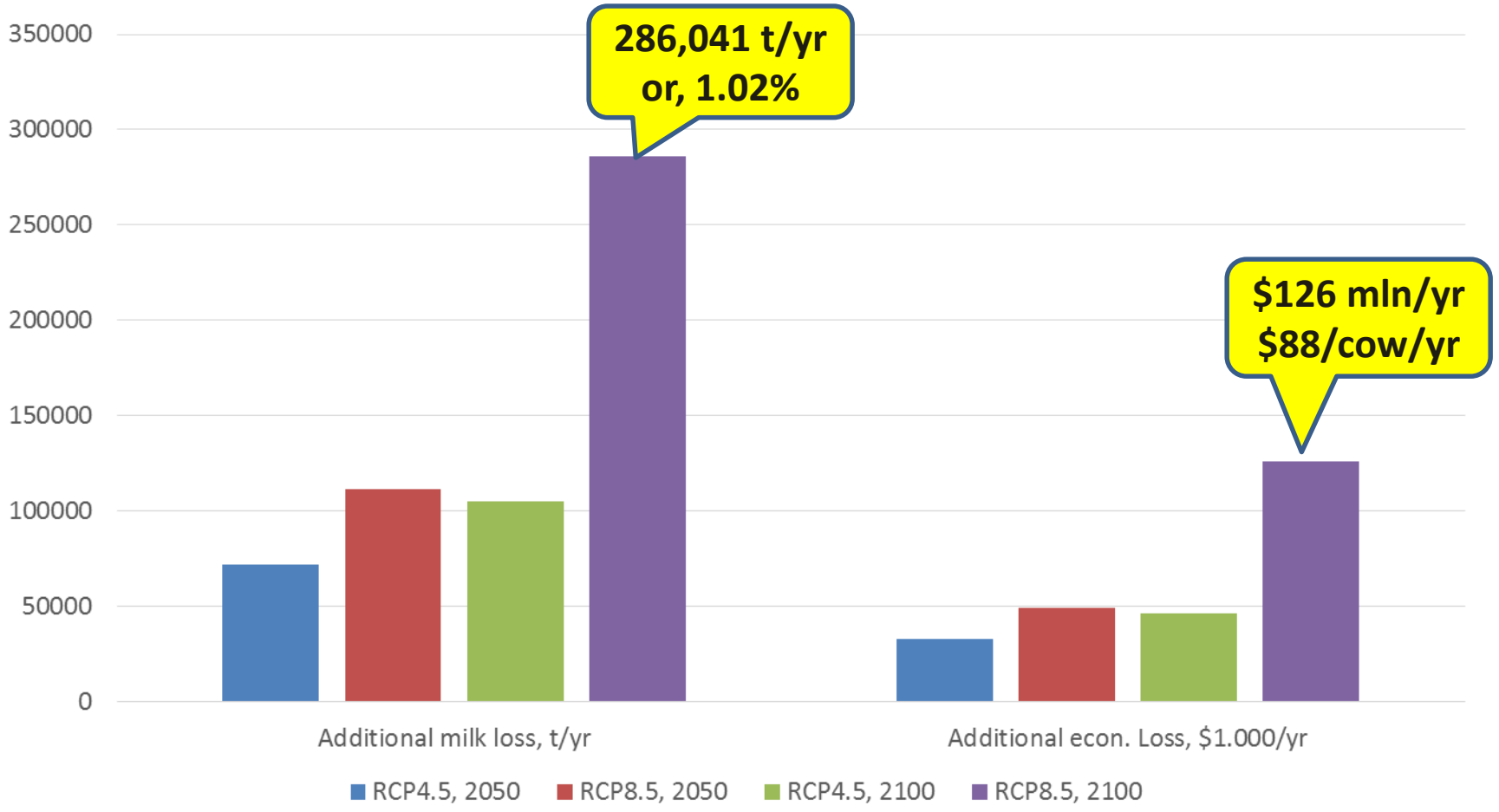
Example effects of climate change on the dairy industry: NE



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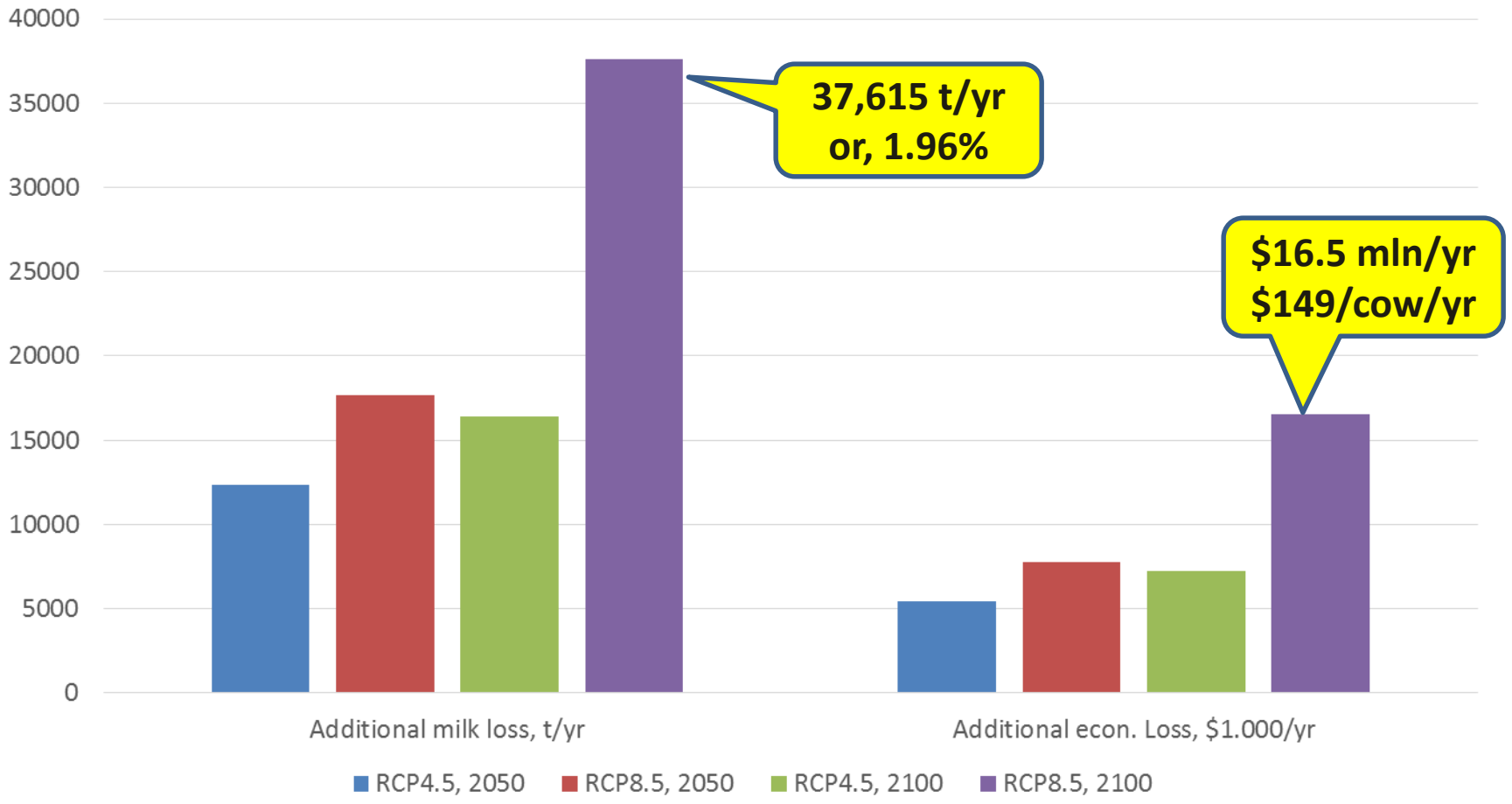
Example effects of climate change on the dairy industry: Lancaster County, PA



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Climate change effects in the poultry industry

- Projections in the NE for warmer winter and summer temperatures and fewer extreme cold nights would benefit broiler production by reducing fuel usage and disease challenges through better ventilation and an improved housing environment
- Future housing will most likely require greater insulation and greater ventilation fan capacity to offset warmer temperatures
  - Some of the added cost (i.e., increased ventilation and cooling) will be offset by energy savings during warmer winters
- Heat stress can reduce pullet growth, egg production, and the quality of eggs
  - Heat stress also reduces shell thickness leading to a greater percentage of cracked or broken eggs and economic loss

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Climate change effects in the beef industry

- Overall, based upon average temperature increases ranging from 3.9 to 6.5°C, impact of climate change on beef cattle and beef production losses in the NE should be minimal
- Increased moisture in the region may have an impact on beef cattle grazing operations
  - Housing is not generally considered necessary for grazing cattle; however, increased winter precipitation may reduce pasture stocking rates and increase housing needs for grazing beef

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Climate change effects in the equine industry

- Overall, predicted climate changes for the NE are likely to have an economic impact on the horse industry through:
  - additional management of land and forage resources
  - building of shelters
  - climate monitoring and heat abatement at equine events
- The horse industry is composed of a great diversity of operations making any realistic estimate of an economic impact due to climate change beyond the scope of this report

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Climate change effects on manure management

- Using current manure handling methods, projected climate changes in the NE may increase ammonia losses 20% by midcentury and up to 39% by 2100
- With wetter and warmer conditions, nitrous oxide emissions are projected to increase about 12% by midcentury and 24% by 2100 on NE dairy farms
- Increases in precipitation and storm intensity are projected to increase P losses as much as 40% by midcentury and 87% by 2100
- Projected climate changes may increase methane emissions from manure management by about 4% by midcentury and 8% by 2100
- Warmer temperatures and a longer growing season may allow more time for manure handling, tillage, and planting of crops
- Thus, the net effect of climate change on these operations may be minor or difficult to predict

Summary/Conclusions

- Overall, increased average maximum temperatures, days with temperatures exceeding 25°C, higher annual precipitation in the NE, and increased atmospheric CO_2 concentration are expected to either increase or decrease forage productivity depending on the crop, and may decrease protein content and forage digestibility
- In the dairy sector, additional loss in milk production due to decreased feed intake is estimated to be up to 1% of the projected annual milk production through 2100
  - Increased temperatures may reduce fertility in dairy cattle and heat stress-induced inflammation may limit energy available for productive functions
- Broiler production in the region may benefit from warmer winter and summer temperatures
  - Providing adequate housing and ventilation to offset climate changes will be important for both the broiler and layer industries and may increase the price of eggs
- The effects of climate change on the beef industry in the NE are expected to be minimal
- Climate change is expected to have an economic impact on the horse industry
- Increased temperatures and more intense storms will likely increase nutrient losses and gaseous emissions from animal manure
- Continued animal health monitoring is necessary to address responses of host animals, pathogens, and disease vectors to climate change


2134
Control
1940
Control
2082
2026
1997
1725
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1940
GREENFEED

QUESTIONS?

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Impacts and Opportunities of Climate Change on Northeast Crops and Livestock

Presenter contact information:

Part 1: Challenges and Opportunities for Northeast Crop Production in a Changing Climate

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