Stiftung Tierärztliche Hochschule Hannover
University of Veterinary Medicine Hannover, Foundation

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Trend analyses revealed increasing heat stress situations in German regions with intensive turkey production

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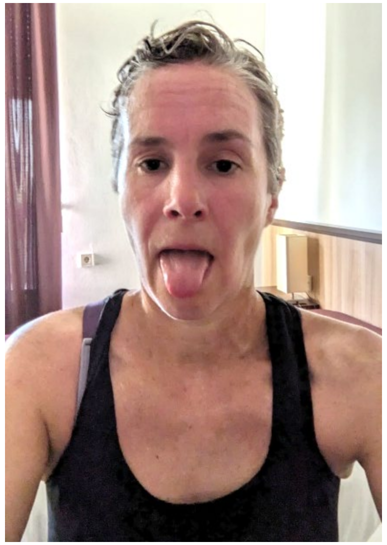
Heat stress

Climate change and global warming can affect the performance and health (of livestock) through the development of heat stress!



Symptoms of heat stress in poultry

- Try to release more body heat into the environment
- No sweat glands ⇨ loss of heat through skin and breathing
- Typical behaviours (e.g.) (Brown-Brandl et al., 1997; Gonzáles-Zapata et al., 2022)
  - High respiratory rate / panting
  - Increased water intake
  - Spreading of wings and feathers
  - Reduced mobility,

    greater distances between animals

Effects of severe heat stress in turkeys

- Reduced feed intake in particular (up to 30% in extreme cases) ⇩ Animal welfare & economic loss
- Stressed birds suffer from a weakened immune system ⇩ performance and meat quality
- Increased diseases incidence (e.g. *E. coli* infections, feather loss (neck moulting), stress-related behavioural disorders)
- Severe heat stress can lead to circulatory failure and thus to death

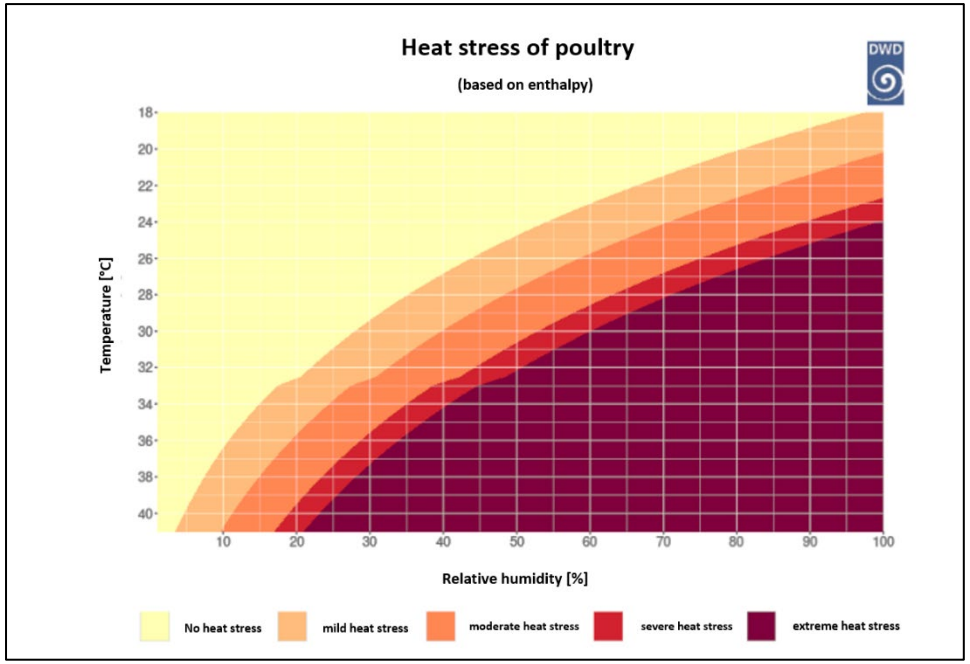
(Netzwerk Fokus Tierwohl, 2024)

Evaluating heat stress

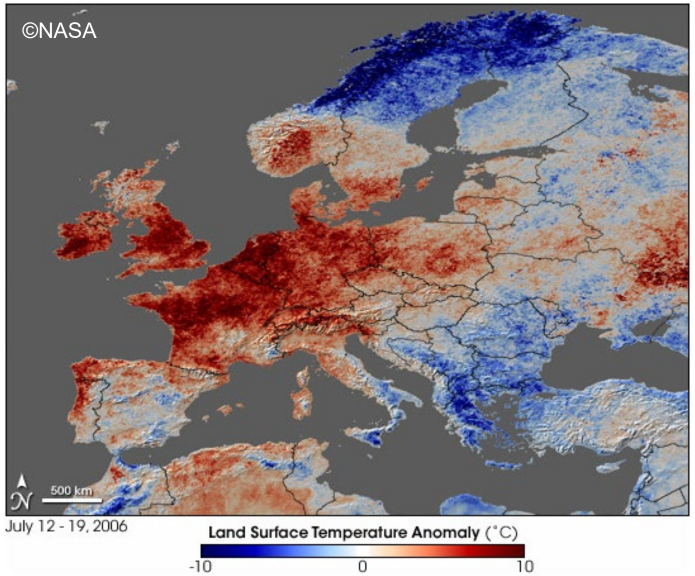
- To assess heat stress in farm animals:

  Specific enthalpy of air (H)

  - Indicates total heat /energy content of the outer air (air and water vapor enthalpy)
  - Usually expressed in kilojoules (kJ) per kilogram (kg)



(German Meteorological Service, DWD)



Aim of the study

Analysing trends of heat stress (HS) in German regions of dense turkey populations using enthalpy values calculated from weather data of the past 50 years.

Data collection

- Yearly data from 15 weather stations from 1973 to 2022

  (German Meteorological Service, DWD)

- Summer period: from May 1st to September 30th
- Enthalpy (H) daily maximum values categorized to HS classes:
  - HS0: < 50 kJ/kg = no HS
  - HS1: 50 - < 58 kJ/kg = mild HS
  - HS2: 58 - < 67 kJ/kg = moderate HS
  - HS3: ≥ 67 kJ/kg = severe and extreme HS

Map of Germany with its 16 federal states. The locations of the weather stations in the 15 different districts with large turkey populations are marked with reds dots.

Data collection & evaluation

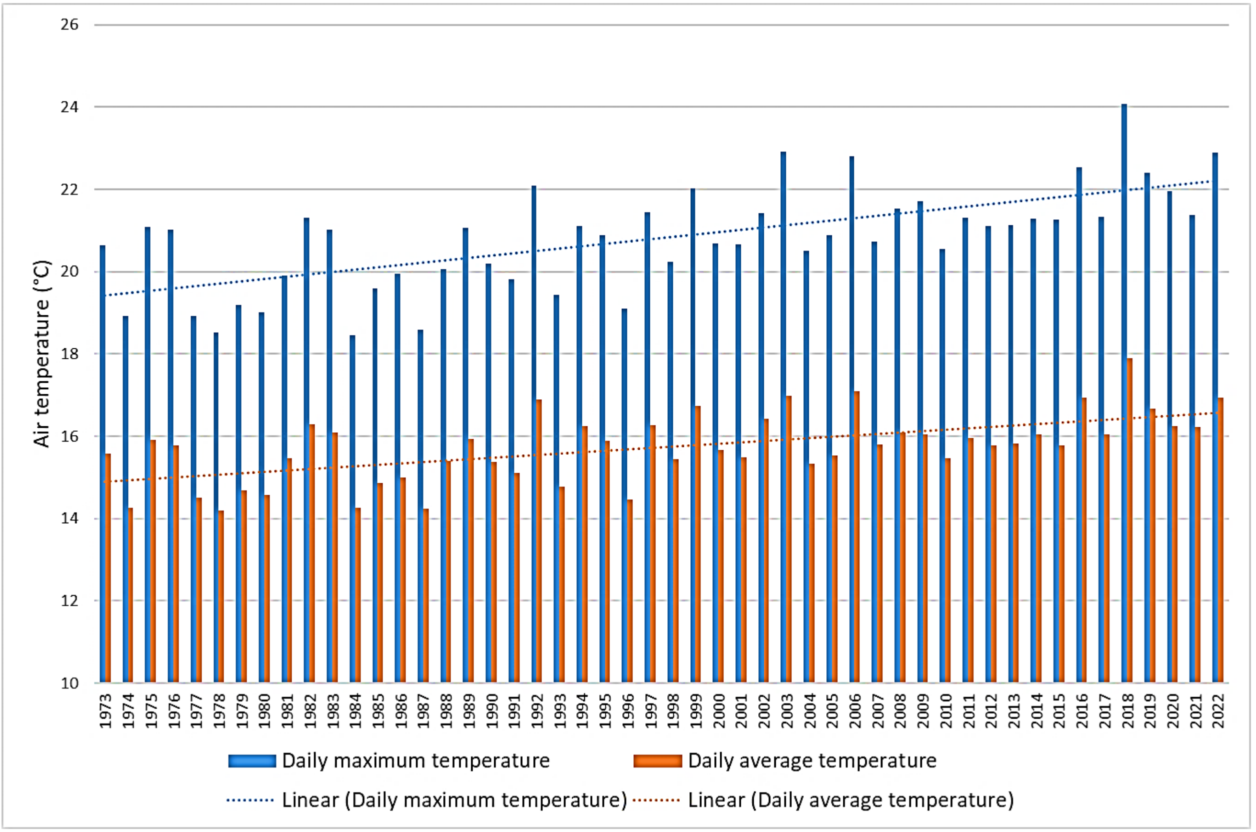
- Frequencies of HS classes determined
- HS trend lines created, their gradients specified

Statistical analyses (SAS 9.4)

- Data tested previously for autocorrelation (PROC AUTOREG)
- Increases in HS trend line gradients over 50 years analysed using the Mann-Kendall test (PROC CORR)

Weather data (all locations)

	Ø all years	Min	Max
Temperature max.	20.8	18.4 (1984)	24.1 (2018)
Temperature mean	15.7	14.2 (1978)	17.9 (2018)
Humidity	76.1	68.8 (2018)	79.8 (1987)
Enthalpy	42.5	38.3 (1978)	46.5 (2018)

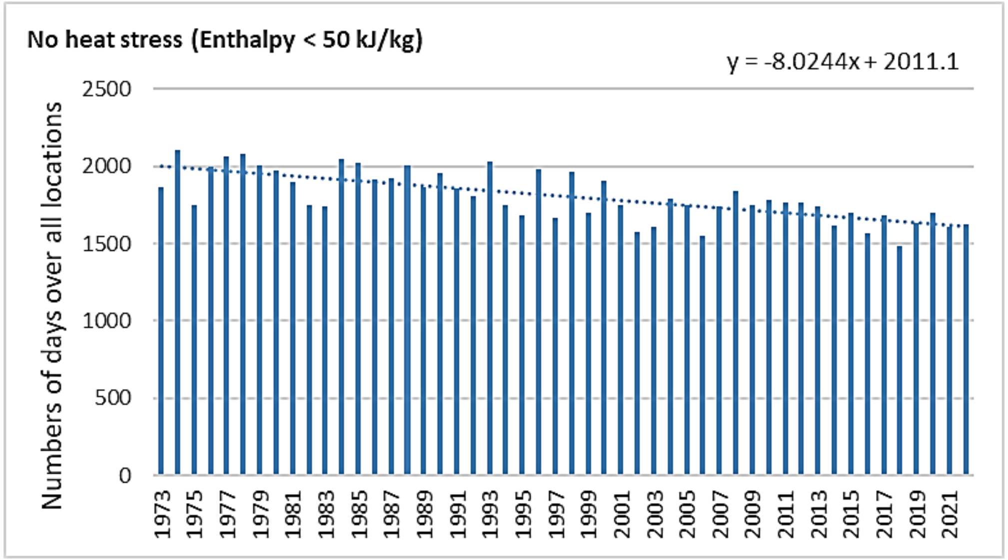


Heat stress classification

- Over all locations, H values between 11.8 and 83.6 kJ/kg were recorded
- Classification into HS levels (over all locations and years):

HS0: 61.6 %
HS1: 24.2 %
HS2: 12.3 %
HS3: 1.9 %

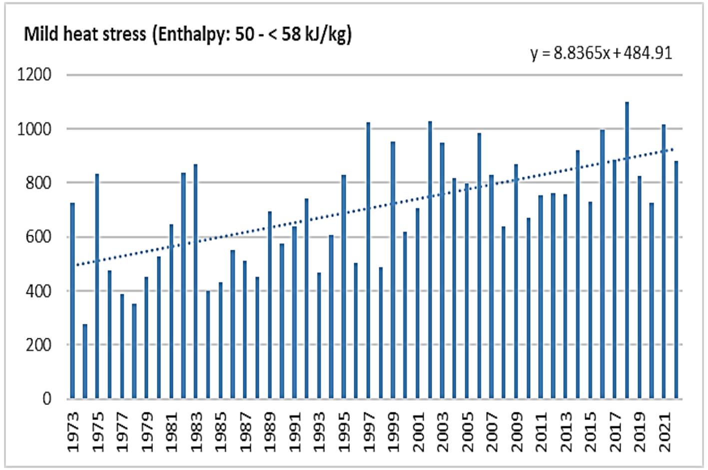
Class of no heat stress (Enthalpy < 50 kJ/kg)



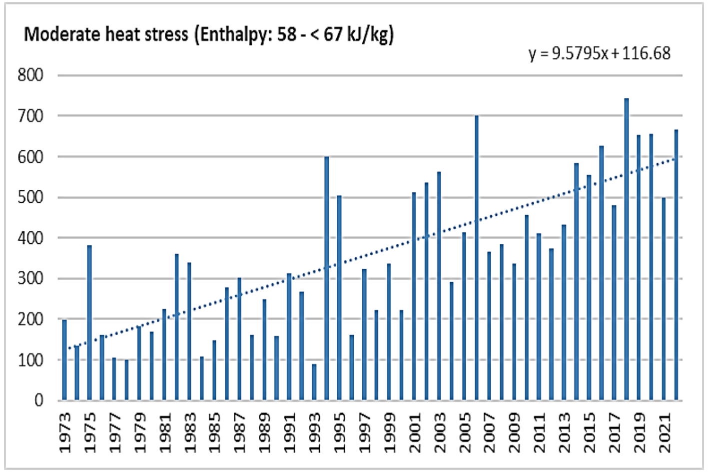
Mann-Kendall's Tau: -0.55 ($p<0.0001$)

Classes showing heat stress

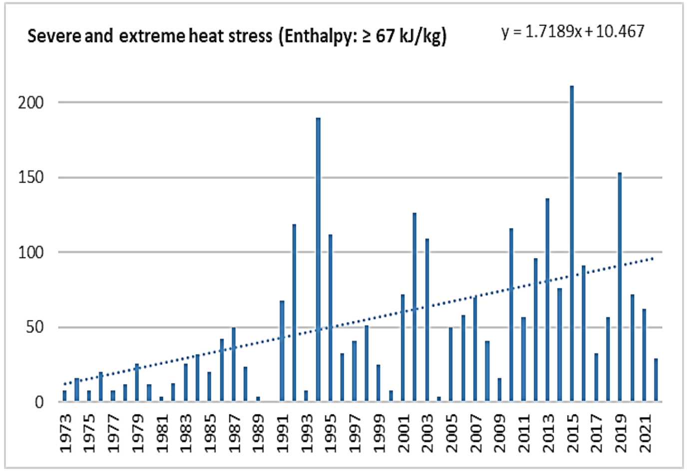
Numbers of days over all locations



Mann-Kendall's Tau: 0.44 (p<0.0001)



Mann-Kendall's Tau: 0.57 (p<0.0001)



Mann-Kendall's Tau: 0.42 (p<0.0001)

- Gradient of all trend lines positive (over all locations)
- Mann-Kendall test showed that all gradients of the respective trend lines in the HS classes were significant

DISCUSSION

- Unequal distribution of selected weather stations in Germany
- Mann-Kendall test: robust non-parametric test for time series trends (Frimpong et al., 2022)
- Possible measures to reduce heat stress:
  - Available cool drinking water (even during night) (Netzwerk FokusTierwohl, 2024)
  - Feeding strategies (Farghly et al., 2018)
  - Reducing stocking density (Jankowski et al., 2015)
  - Supplemental cooling (Uemura et al., 2023)

- For higher efficiency equipment with (Alexander, 2019)
  - Fogger system
  - Spray cooling
  - Cool cells

☝ Microbiologically non-contaminated water

☝ Systems should not damp litter in the barn

☝ No activation of systems when humidity in the barn is >80% (Mailyan et al., 2019)

CONCLUSION

- Climate change not only increases temperatures but also enthalpy of air (in regions with moderate to high relative humidity)
- Study showed that the trend towards periods without HS (HS0) led to fewer days from year to year and in the HS classes with at least mild HS (≥HS1) a significant increase was predicted

⇨ Therefore, it can be expected that turkey production (in the analysed regions) will face greater challenges in coping with HS in future

⇨ Management measures and technical solutions can help to face these challenges

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Thank you for your attention!

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Sake, B., Volkmann, N., Kemper, N., Schulz, J. (2024): Heat stress trends in regions of intensive turkey production in Germany—a challenge in times of climate change.

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