The effect of outdoor stocking density and weather on the behavior of broiler chickens raised in mobile shelters on pasture

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Introduction

- Outdoor access can help promote diverse behaviors, and is required for broiler chickens raised under organic and some welfare certification programs in the USA.
- *Quality* and *quantity* of outdoor space is at the forefront of stakeholder minds since current organic standards are too vague and are misinterpreted.
- Studies (Dawkins et al. 2003; Fanatico et al. 2016; Stadig et al. 2017) demonstrated that the *quality* of outdoors increases ranging.
  - E.g. outdoor temperature, forages, solar intensity, trees/structures providing shelter, and vegetation.
- No studies confirm whether the *quantity* of outdoor space affects behavior and ranging.

The aim of this study was to examine the behavior, and the relationship between weather and behavior, of broilers raised in mobile shelters with two amounts of pasture access.

Materials and methods

Experimental design

- University of Minnesota, West Central Research and Outreach Center; Jun to Oct 2018
- Randomized complete block study design with repeated measures

Broilers
- Straight-run (mixed sexes) of Freedom Ranger breed (**Fig 1**) (Welp Hatchery©)
- Housed in a floorless mobile shelter (**Fig 2**) divided into 2 pens from 4 to 11 wk of age
- Pasture access from 0900 to 2100

Treatments
- 50 birds were randomly allocated to one of the treatment group pens in the shelter:
  1. **High density**: 0.46 m^2 per bird of outdoor space
  2. **Low density**: 2.5 m^2 per bird of outdoor space
- Based on *Free-range* and *Pasture-raised* labels for layers (American Humane Certified™)
- Experiment was replicated 3 times with different birds (150 total birds)

Fig 1. Fed once nightly (0.15 kg [20% CP]) with ab lib grit and water

Fig 2. The shelter (Iva Manufacturing©) was divided into 2 equal-sized pens of 3.66 x 1.83m (0.27 m^2 per bird), and was moved every 2 to 8 d to maintain an outdoor vegetative cover greater than 50%

Data collection

Observations
- 48 per bird/pen from 5 to 11 wk of age
  - Twice daily (morning and afternoon)
  - 4 times per wk
- 2 cross-validated observers

Behavior data
- Ten designated focal birds per pen (**Fig 3**)
- 1 min durations (Animal Behaviour Pro© app)
  - States recorded as durations
  - Events recorded as binary outcomes

Pasture use data
- Scan sampled prior to observations
- Recorded proportion of flock outside shelter

Weather
- Recorded every 15 min (Morris Weather Station)
  - Humidity, %
  - Solar radiation, Watts/m^2
  - Temperature, ^{o}C
  - Wind speed, m/s

Calculations
- Heat index: effects of temperature and humidity

Fig 3. Focal birds were identified with livestock paint

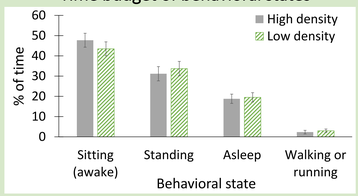
Statistical analysis

- Multiple linear and logistic (for aggression behaviors) mixed regression
- PROC GLIMMIX of SAS/STAT® software
  - Fixed effects
    - Factors: week + treatment + week*treatment interaction
    - Continuous predictors: time + time*week interaction + heat index + heat index*treatment interaction
  - Random effects: treatment nested in replicate + replicate
  - Repeated effect: week
- Week 10 was reference category for graphs showing the effects of weather
- Results presented as least squares means and standard errors

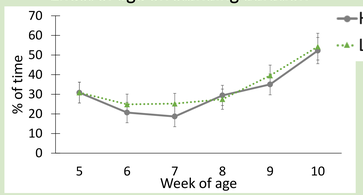
Results

Behavioral states

Time budget of behavioral states

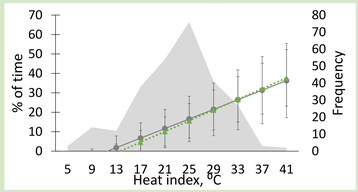


Effect of age on standing duration



Age had the greatest effect ($P < 0.0001$) on standing durations

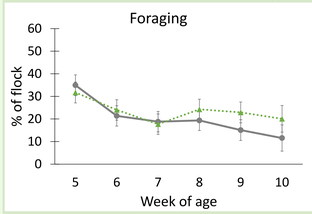
Effect of heat index on sitting (awake) duration

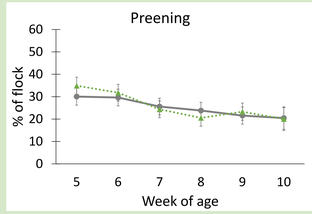


Heat index had a positive effect ($P < 0.0001$) on sitting (awake) durations

Behavioral events

Effect of age on behavioral events





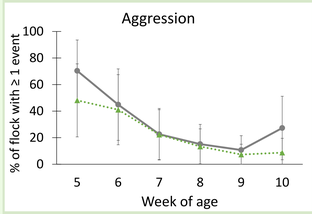
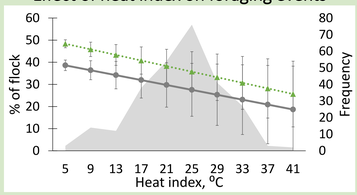


Fig 4. Aggression was the sum of chase, disturb, fight, leap, peck, standoff, and threat behaviors

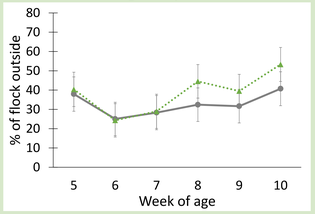
Effect of heat index on foraging events



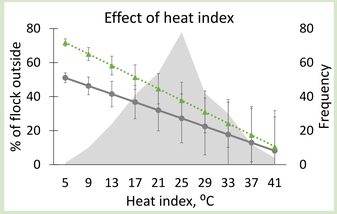
Heat index had a negative effect ($P < 0.05$) on foraging events

Pasture use

Effect of age on pasture use



Effects of weather climate on pasture use



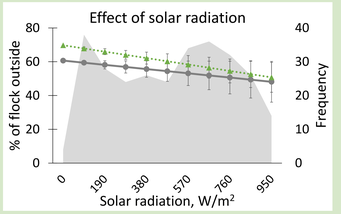


Fig 5. More birds were outside when solar intensity and heat were low

Conclusions

Outdoor space allowance had no effect on broiler behavior or pasture use, and increased heat and solar radiation resulted in less activity and ranging behavior.

Behavioral states
- Birds spent the majority of their time *sitting*
  - Decreased with age
  - Heat index had a positive effect

Behavioral events
- Foraging, preening, and aggression decreased with age
- Heat index had a negative effect on foraging

Pasture use
- Increased with age
- Heat index and solar radiation had a negative effect (**Fig 5**)

Acknowledgments

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