



What's new in tunnel-ventilated broiler house hot weather management and equipment

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The University of Georgia

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1) Bird performance within a tunnel-ventilated houses is determined more by bird density than air temperature



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This is especially true in today's larger broiler houses

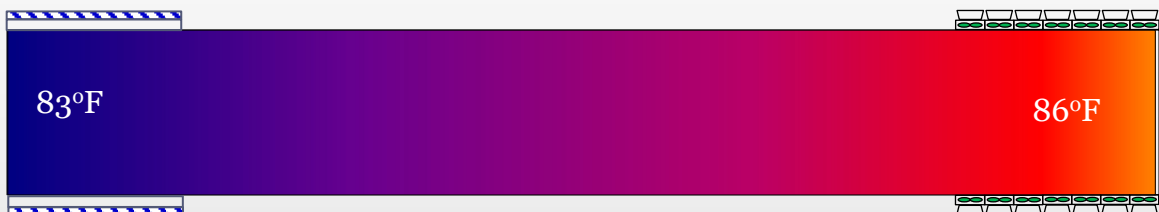


3

For instance, which birds are cooler?

Pad end

Fan end



- ▶ If they are “cooler” on the pad end of a house...
- ▶ then why almost all of the time are the lightest birds found near the pads?
- ▶ Because the density tends to be higher at the pads due to bird migration



4



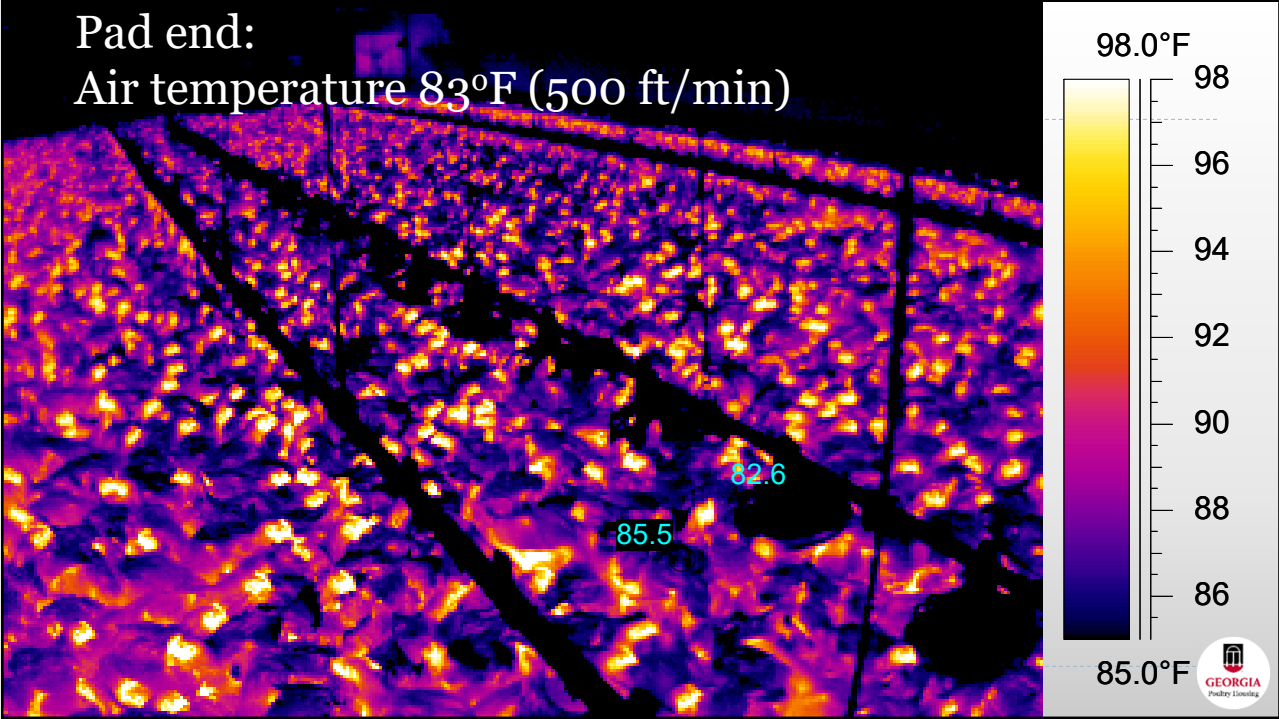
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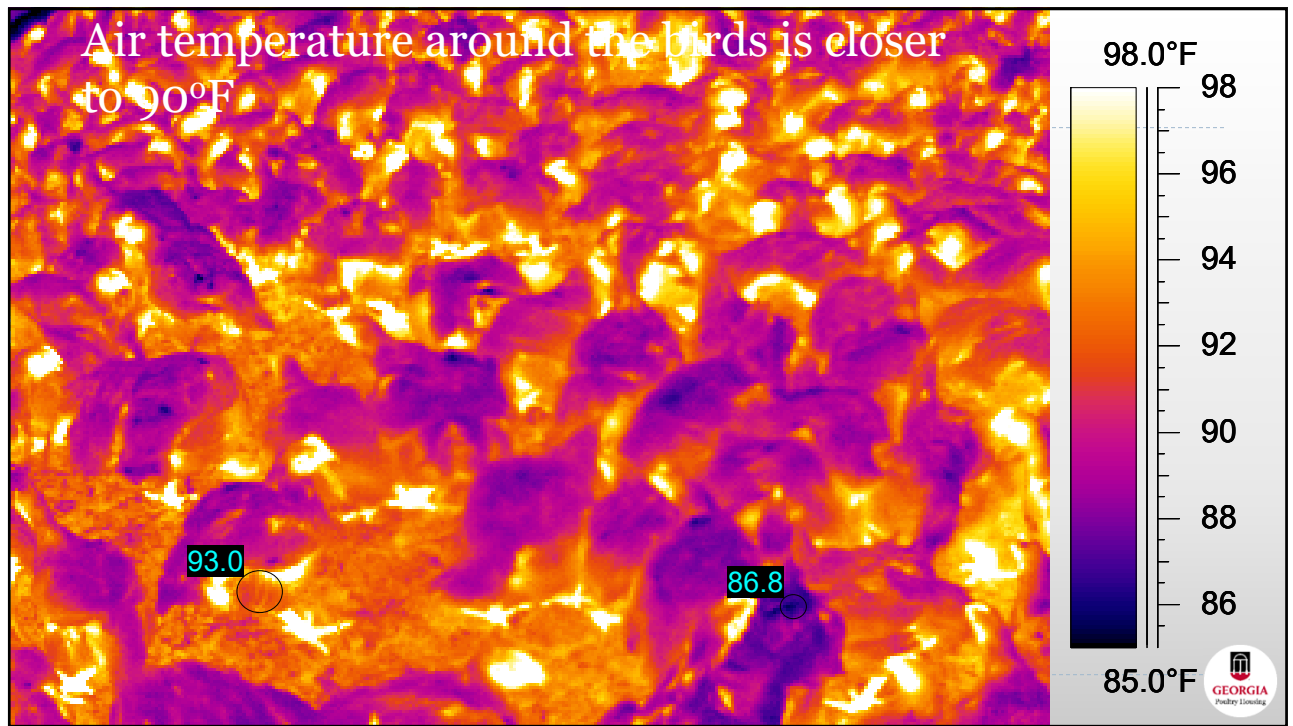
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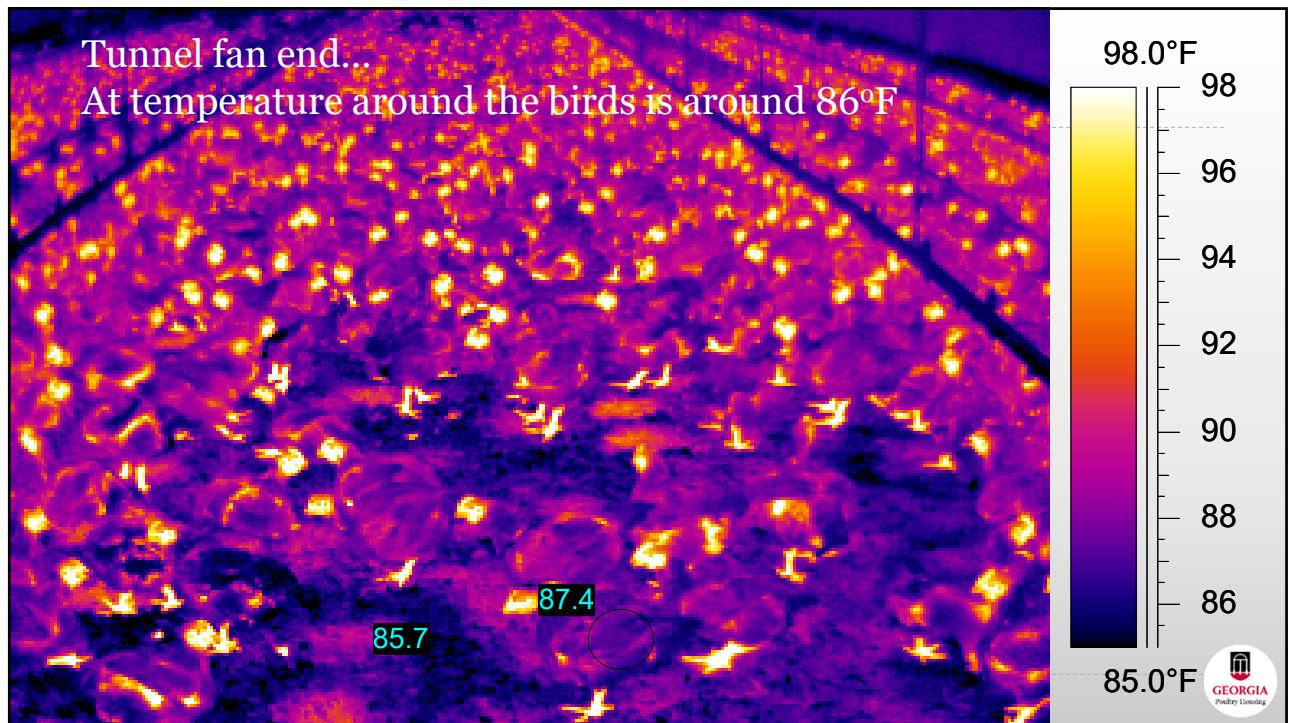
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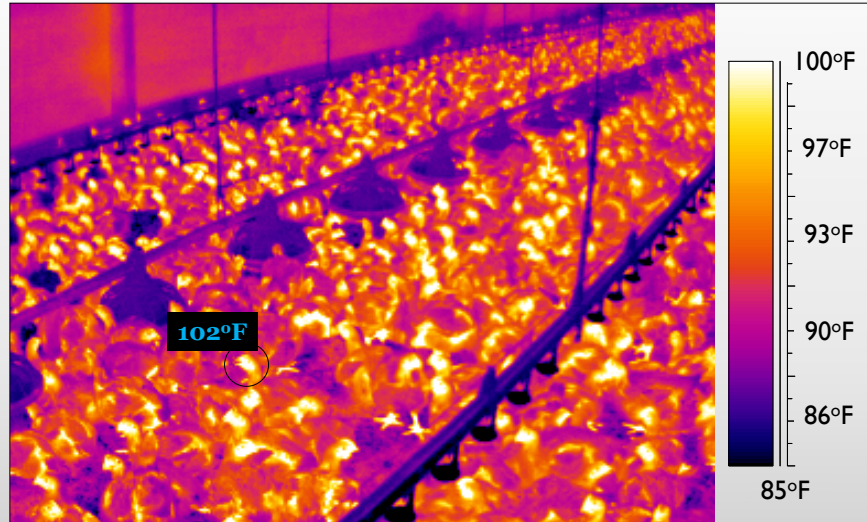


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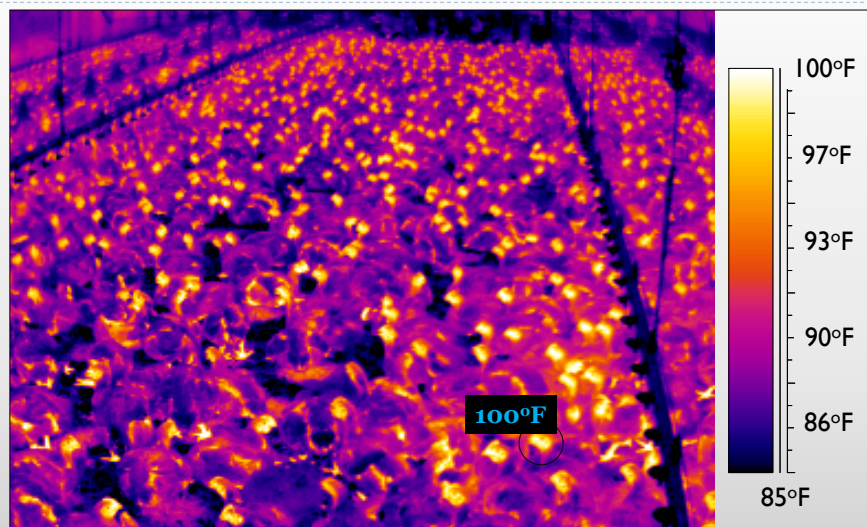
10

Another example (pad end):
85°F – 500 ft/min air speed



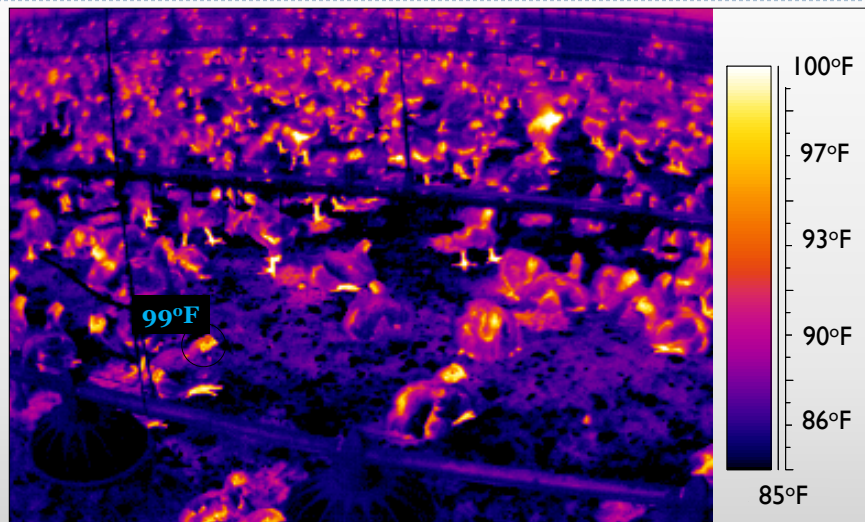
11

Another example (center of house):
86°F – 500 ft/min air speed



12

Another example (fan end):
87°F – 500 ft/min air speed



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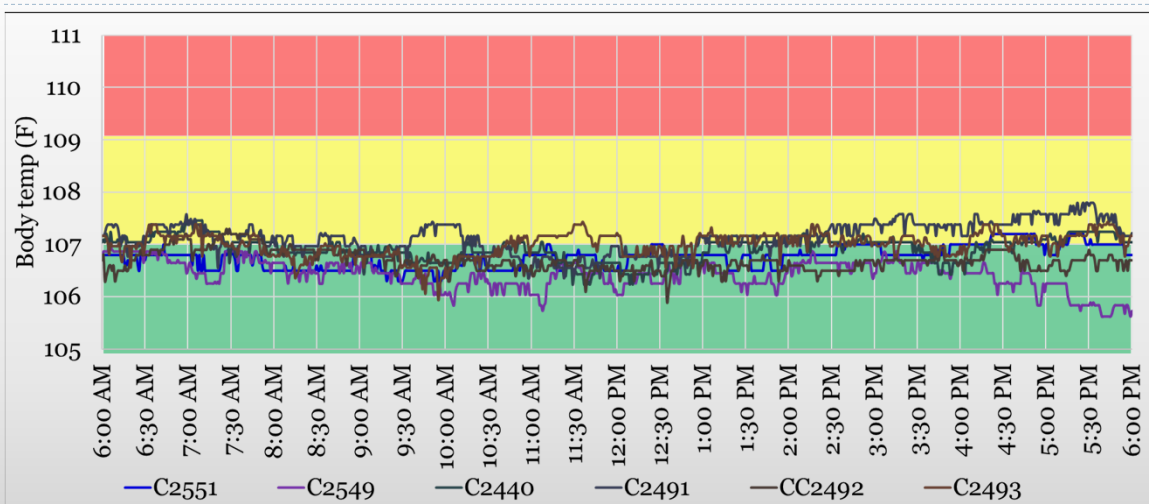
Bird density vs. effective temperature research (2015)

- ▶ Implanted temperature data loggers in approximately 6 lbs. broilers
- ▶ Placed the birds in pens at densities of:
 - ▶ 6 ft²/bird (1 lb/ft²) and
 - ▶ 0.8 ft²/bird (7.5 lbs/ft²)
- ▶ A room temperature of 73°F was maintained with no air movement
- ▶ Deep body temperatures were measured and recorded every minute



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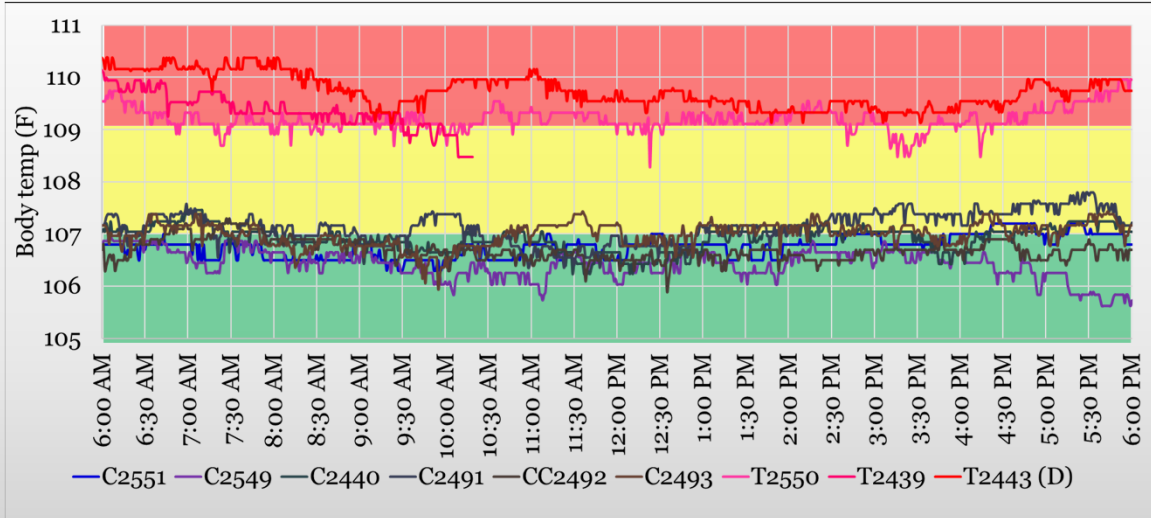
73°F
6 ft²/bird (1 lb./ft²)



16

73°F

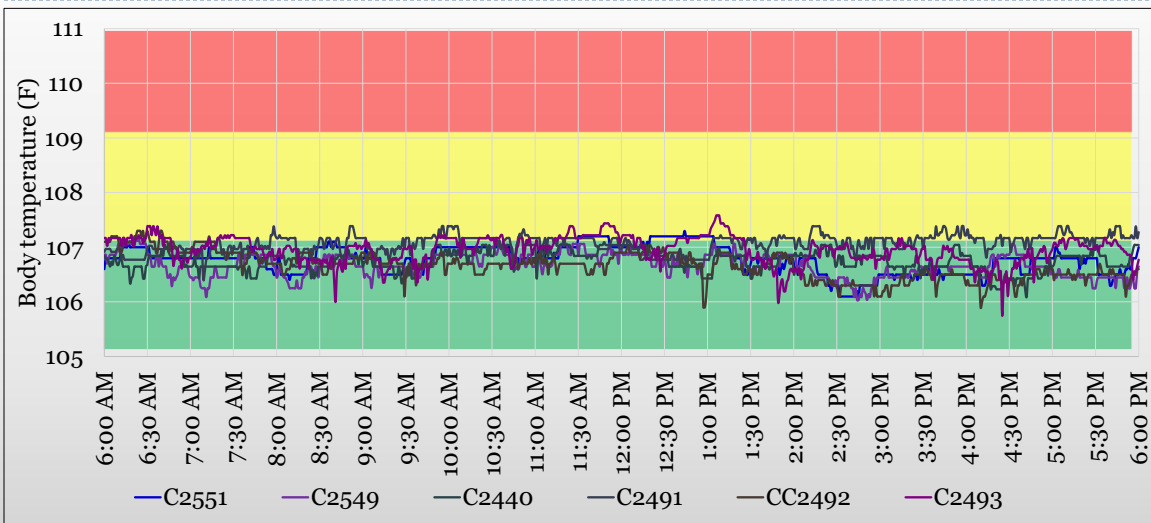
6 ft²/bird (1 lb./ft²) vs. 0.8 ft²/bird (7.5 lbs./ft²)



17

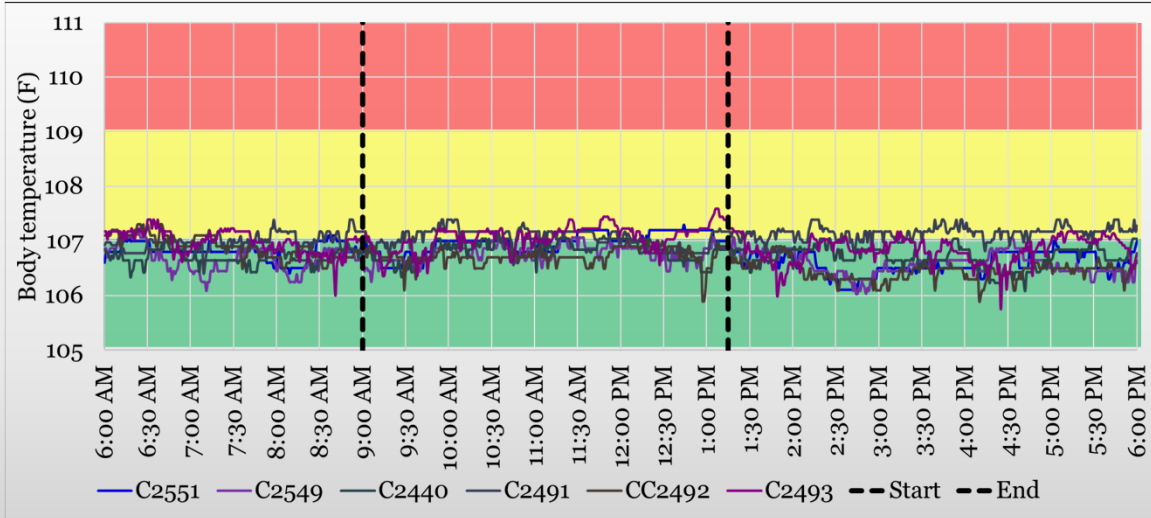
Increased temperature from 73°F to 78°F

6 ft²/bird (1 lb./ft²)



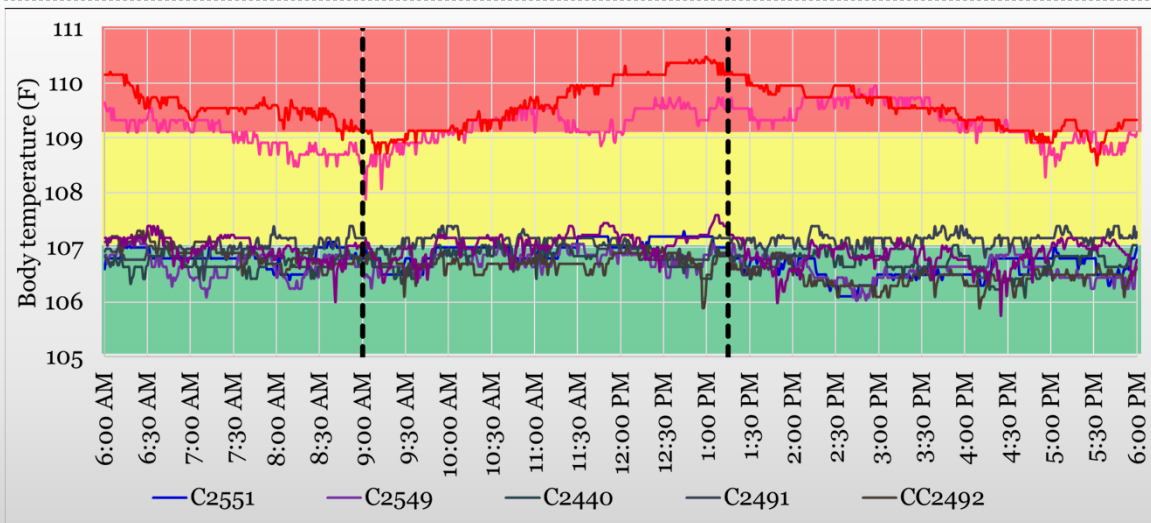
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Increased temperature from 73°F to 78°F
6 ft²/bird (1 lb./ft²)



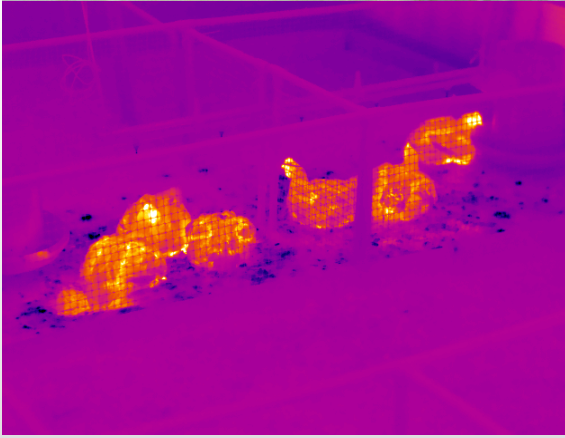
19

Increased temperature from 73°F to 78°F
6 ft²/bird (1 lb./ft²) vs. 0.8 ft²/bird (7.5 lbs./ft²)



20

We then expanded the study...



21

Examined the relationship between density and body temperature (6 to 7-week-old birds) at a range of air temperatures

▶ Room temperature 55°F – 85°F (no supplemental air movement)



0.8 lbs./ft²



3.8 lbs./ft²



6.1 lbs./ft²



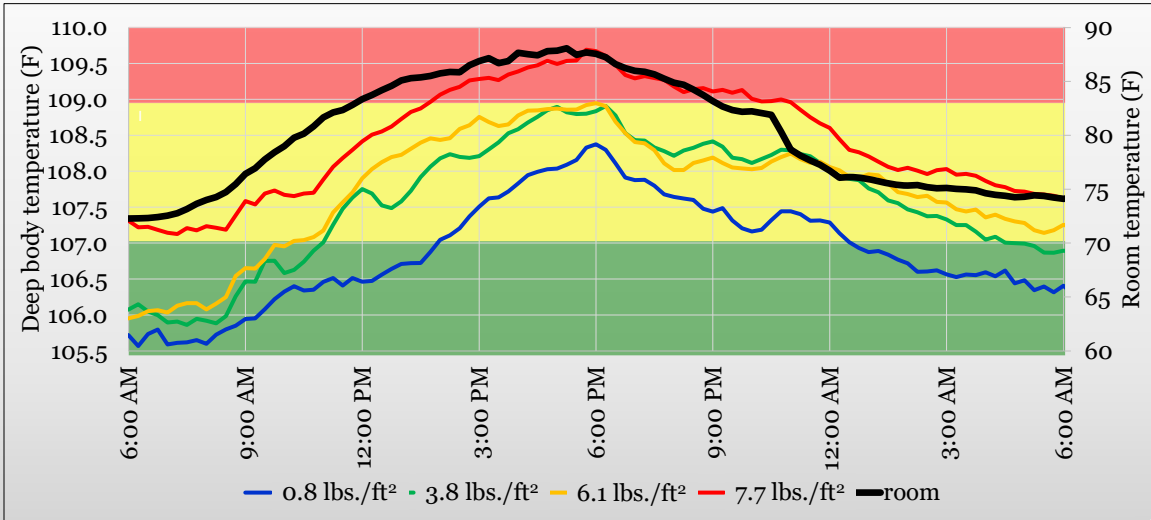
7.7 lbs./ft²

Ming Lin Teo – UGA (2017)



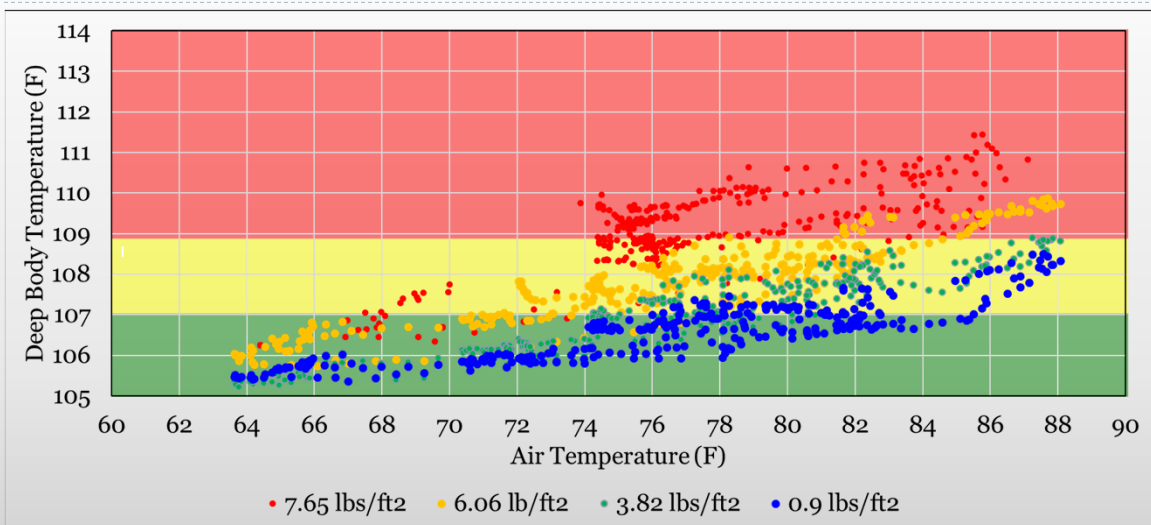
22

Average body temperatures over a 24-hour period



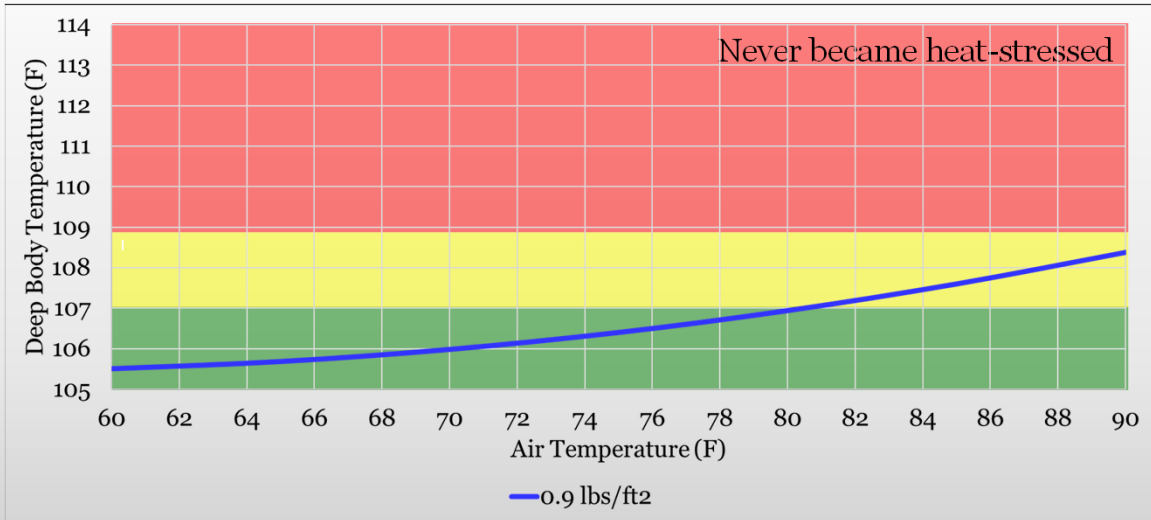
23

Body temperature vs. Air temperature



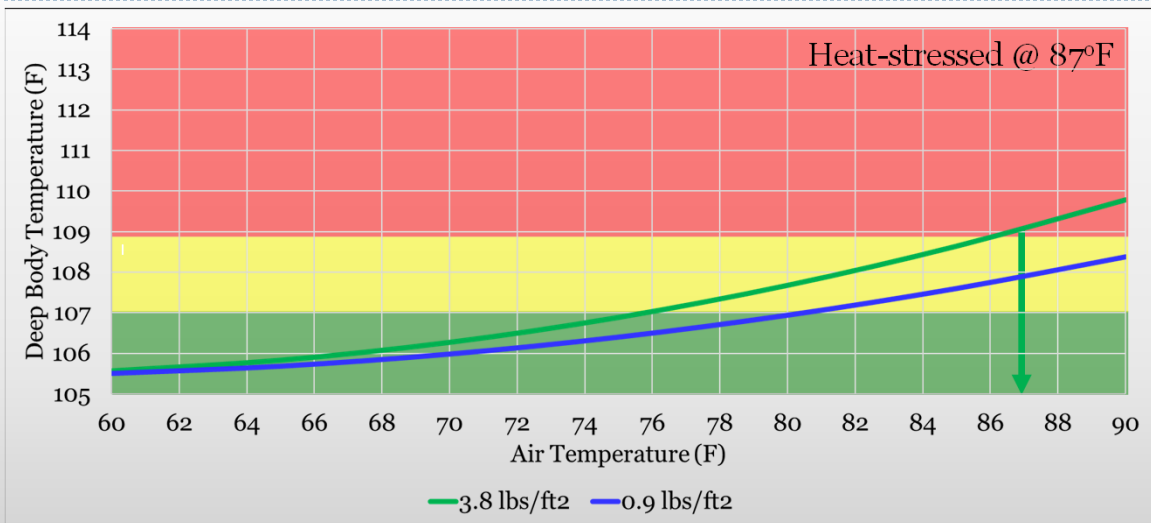
24

Body temperature vs. Air temperature



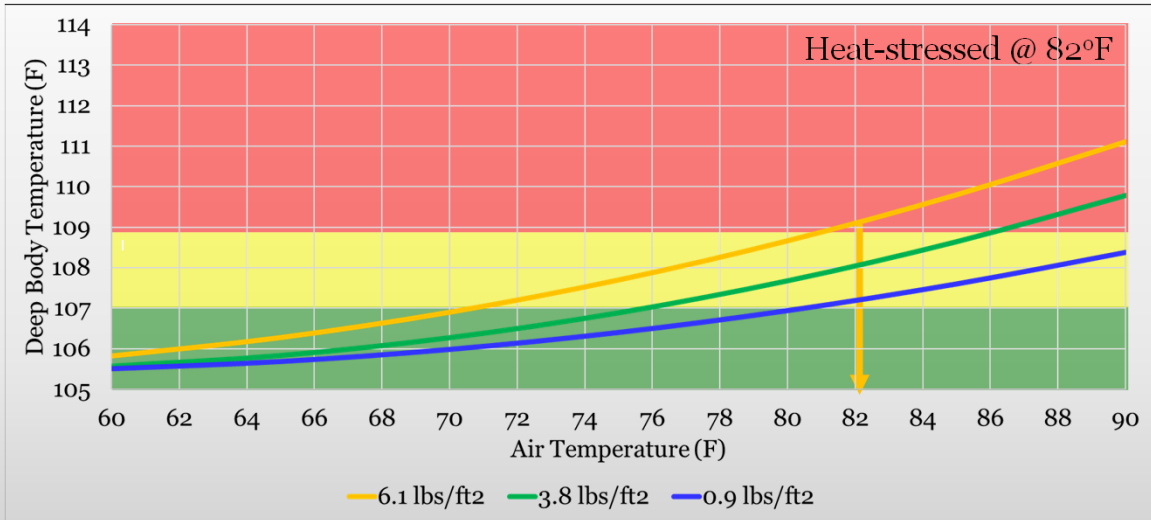
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Body temperature vs. Air temperature



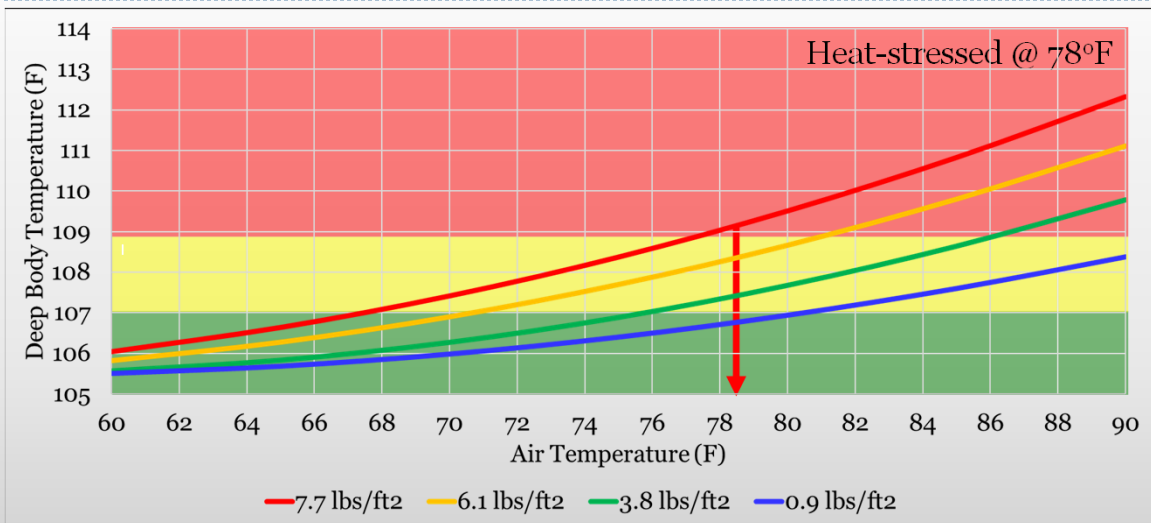
26

Body temperature vs. Air temperature



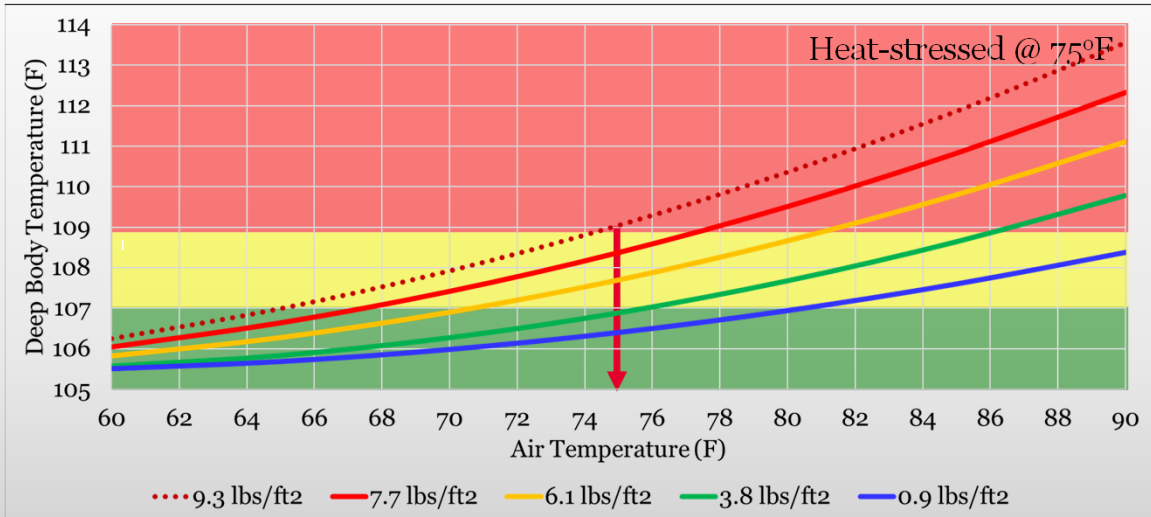
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Body temperature vs. Air temperature



28

Body temperature vs. Air temperature



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Rule of thumb for market age broilers at 75°F+ (with air movement)

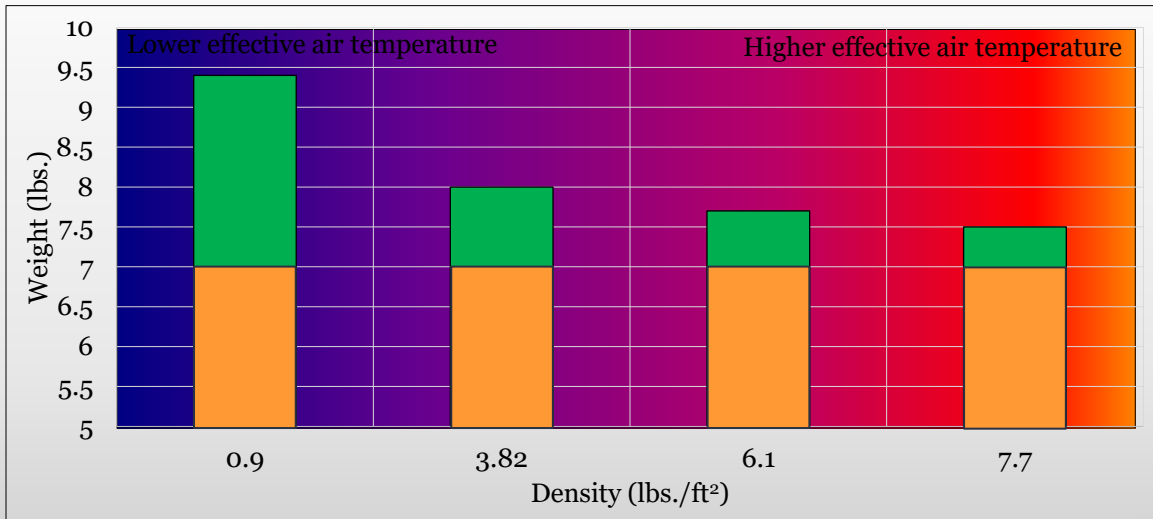


- ▶ Increasing density from:
 - ▶ 3.8 lbs./ft² to 6.1 lbs./ft² = 5°F increase in effective house temperature
 - ▶ 6.1 lbs./ft² to 7.7 lbs./ft² = 4°F increase in effective house temperature
 - ▶ 7.7 lbs./ft² to 9 lbs./ft² = 3°F increase in effective house temperature
 - ▶ 3.8 lbs./ft² to 9 lbs./ft² = 12°F increase in effective house temperature



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Bird performance (Day 43 to 52)?



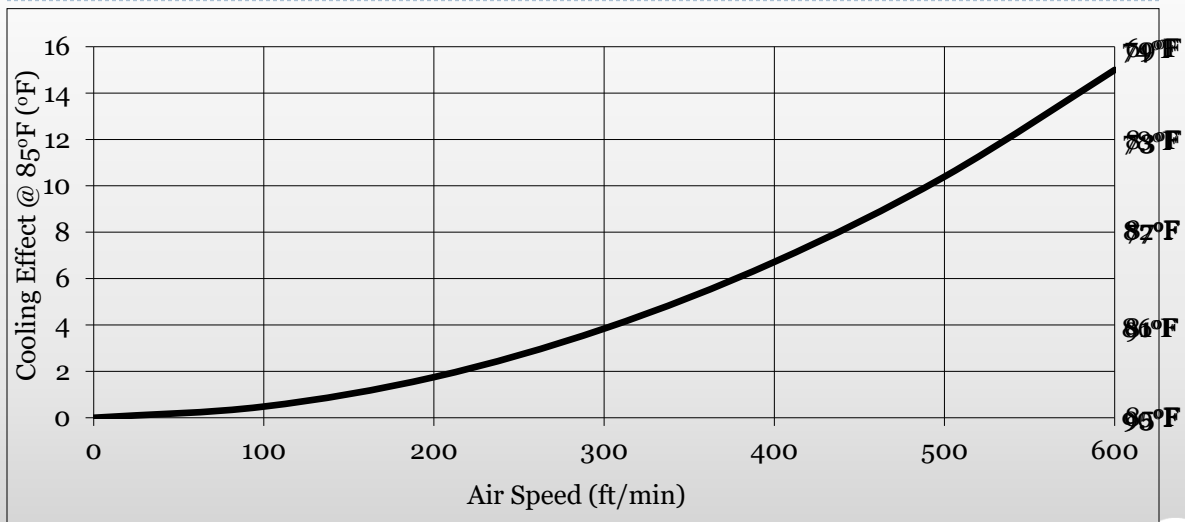
31

With air movement, we can of course dramatically lower the effective air temperature...improve performance



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The greater the amount of air speed the more we lower the effective air temperature (cooling effect at 85°F)



33

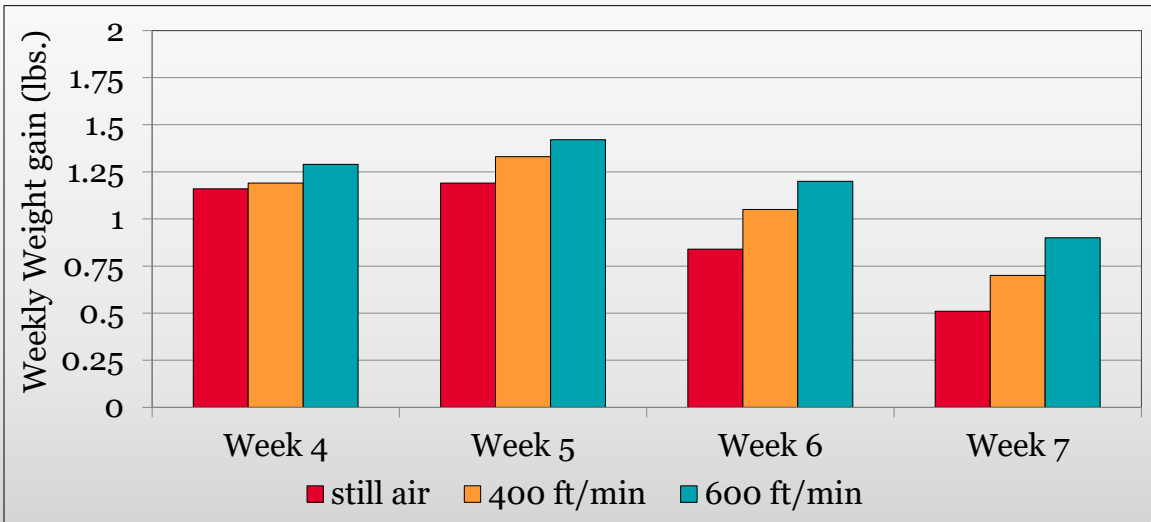
The lower the effective temperature the better the birds will perform



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Broiler weekly weights vs. Air speed

(77°F night – 86°F day)



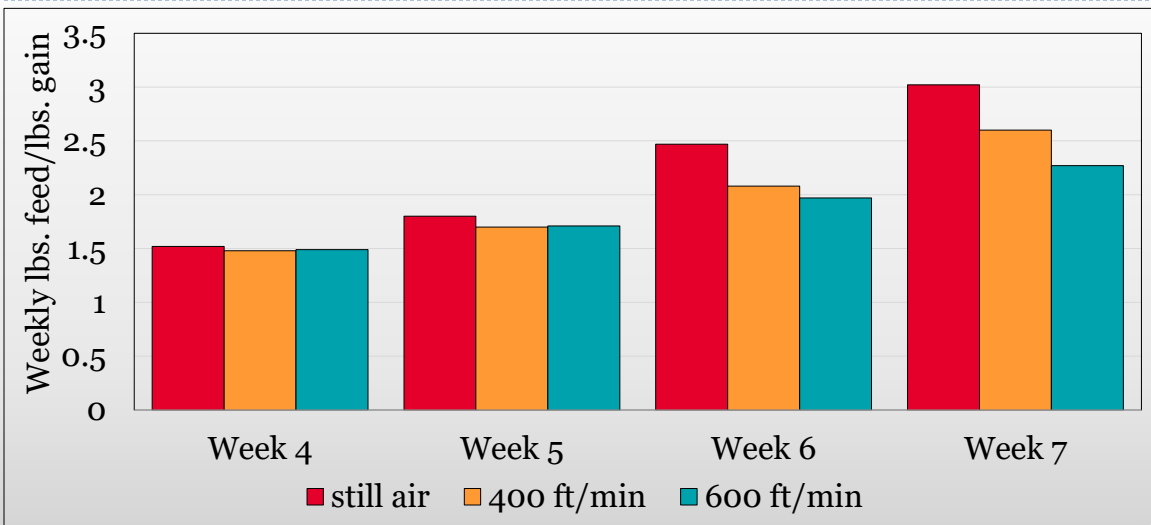
▶ USDA – Mississippi State (Lott)



35

Weekly feed conversions vs. Air speed

(77°F night – 86°F day)



▶ USDA – Mississippi State (Lott)



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How much air speed do we need?

- ▶ It is not bird age that determines the required air speed...
- ▶ It's actually lbs./ft²
- ▶ For instance...



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How much air speed does a house with 3.5 – 4 lb. birds need when the house temperature is 80°F?



38

How much air speed does a house with 3.5 – 4 lb. birds need when the house temperature is 80°F?



39

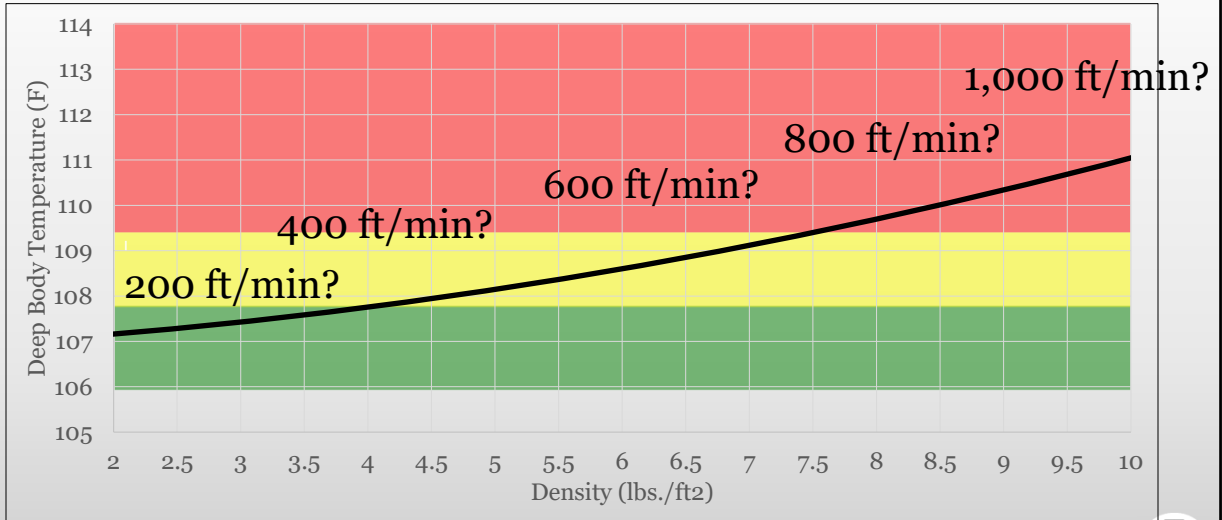
Two-day-old chicks....96°F



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The required air speed is determined by density...

Body temperature vs. Density at 80°F (no air movement)



41

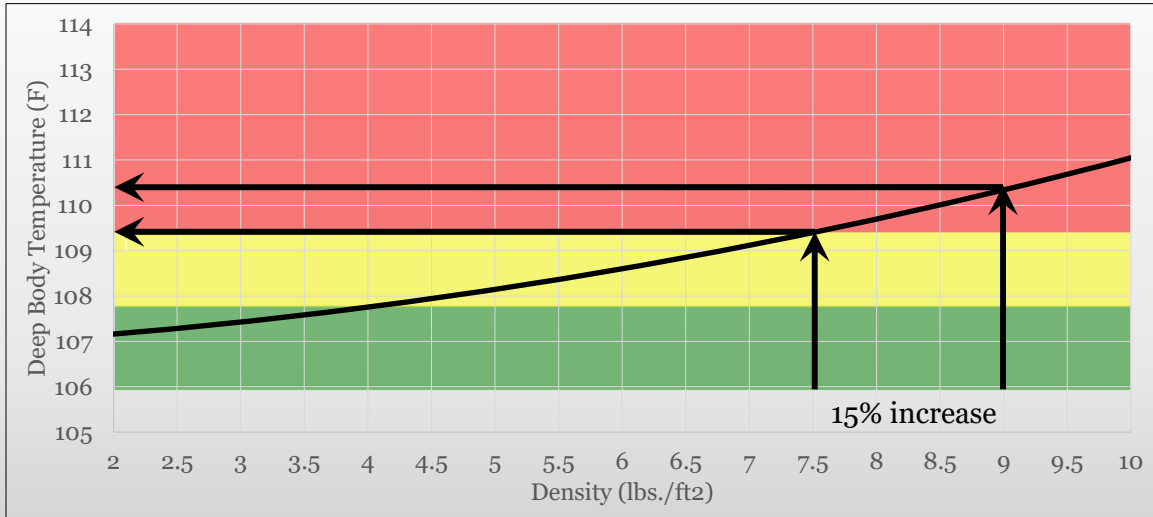
In many ways you can't control your average bird density...

- ▶ But you can control density uniformity



42

A 15% difference in bird density may not seem like much... but it can have a significant effect on bird body temperature



43

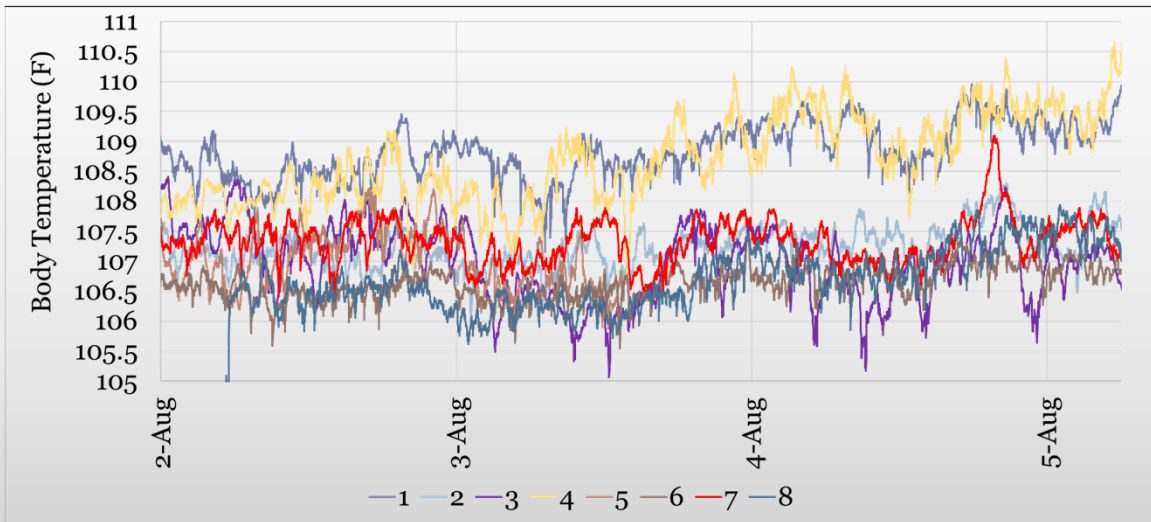
Field study – Weight gain Vs. Body temperature

- ▶ 35-day-old broilers - 0.75 ft²/bird – 5.6 lbs./ft² (final)
- ▶ 600 ft/min
- ▶ Ingested a temperature data logger and placed in a pen.
- ▶ The birds were caught five days later (weighed)



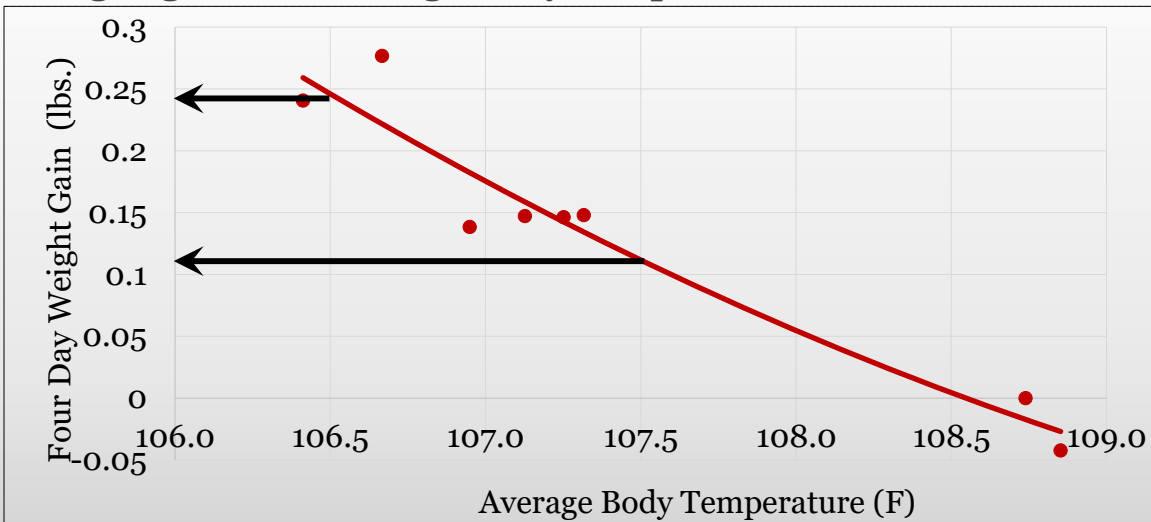
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Bird body temperatures



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Weight gain vs. Average body temperature



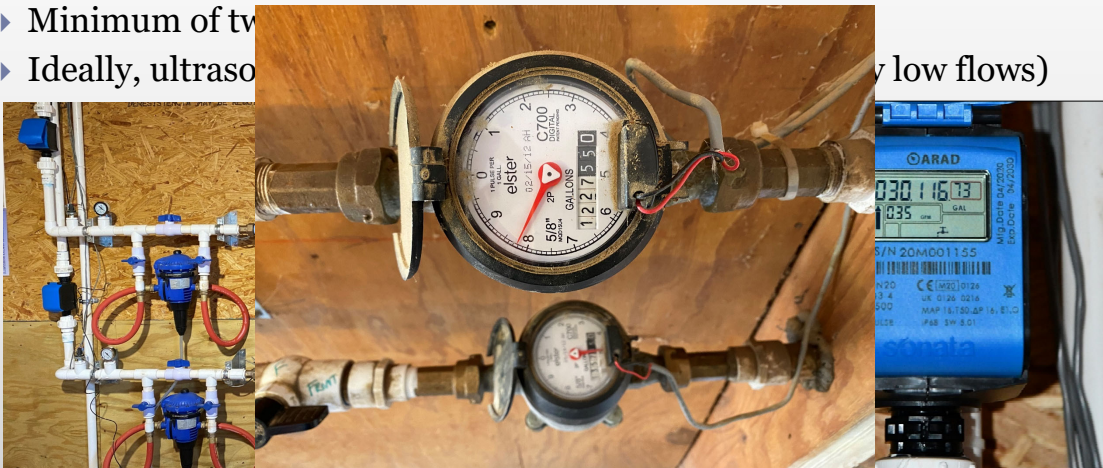
46



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How should we monitor bird density uniformity?

- ▶ With water meters
- ▶ Minimum of two
- ▶ Ideally, ultrasonic



(for very low flows)



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Longer houses... ideally three or four water meters



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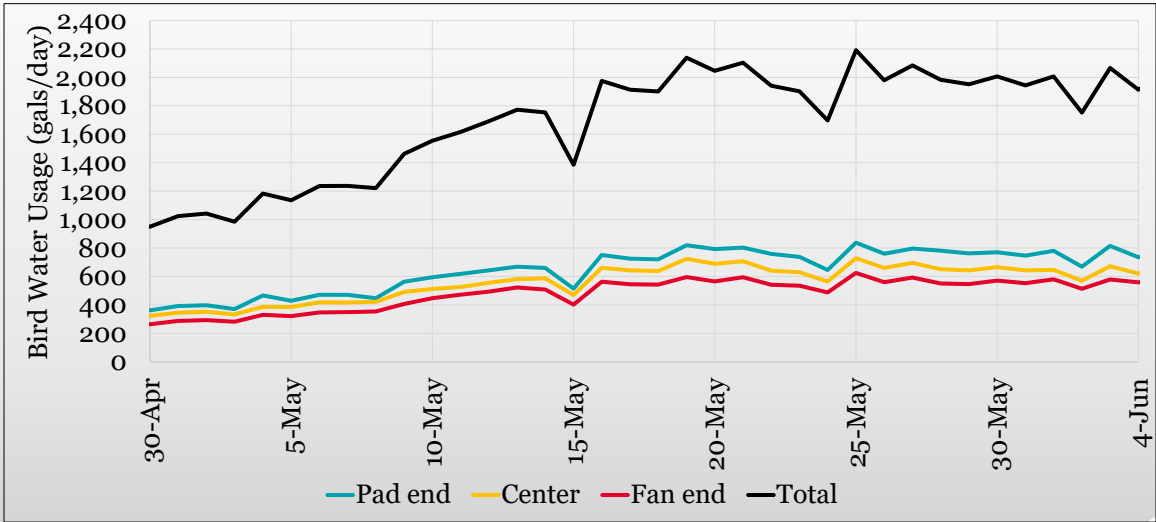
For example...50' X 600' house with three water meters

- ▶ Density = 1 ft² per bird
- ▶ Last 35 days of the flock



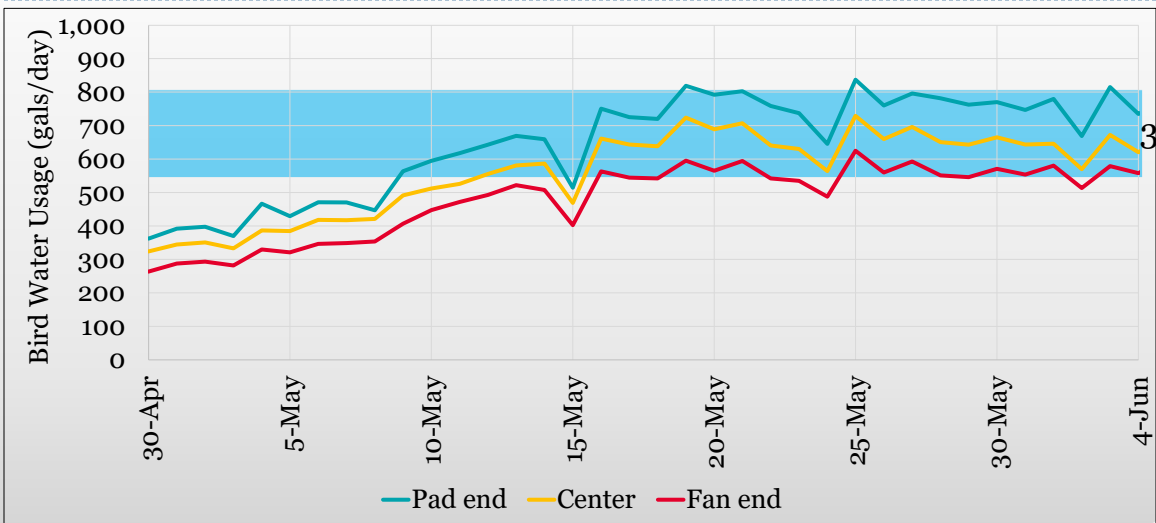
50

50' X 600' Broiler house



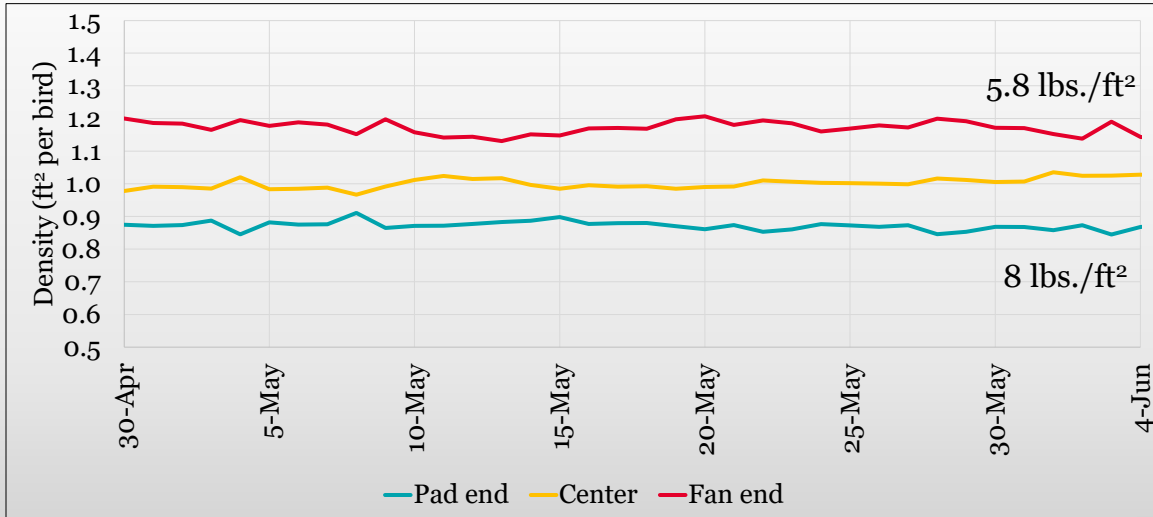
51

50' X 600' Broiler house



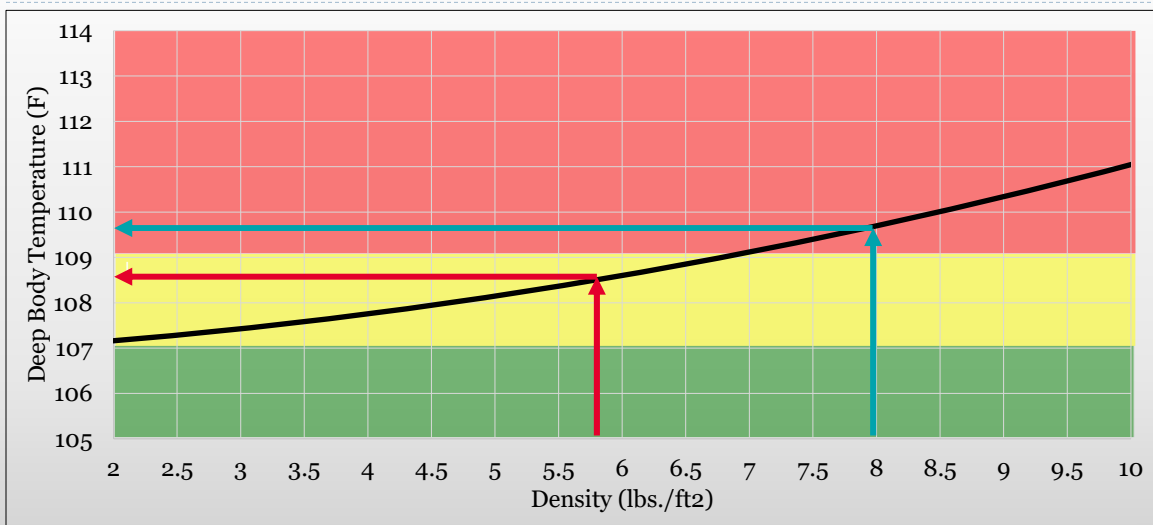
52

Estimating density from water usage



53

Body Temperature vs. Density at different air temperatures



54



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56

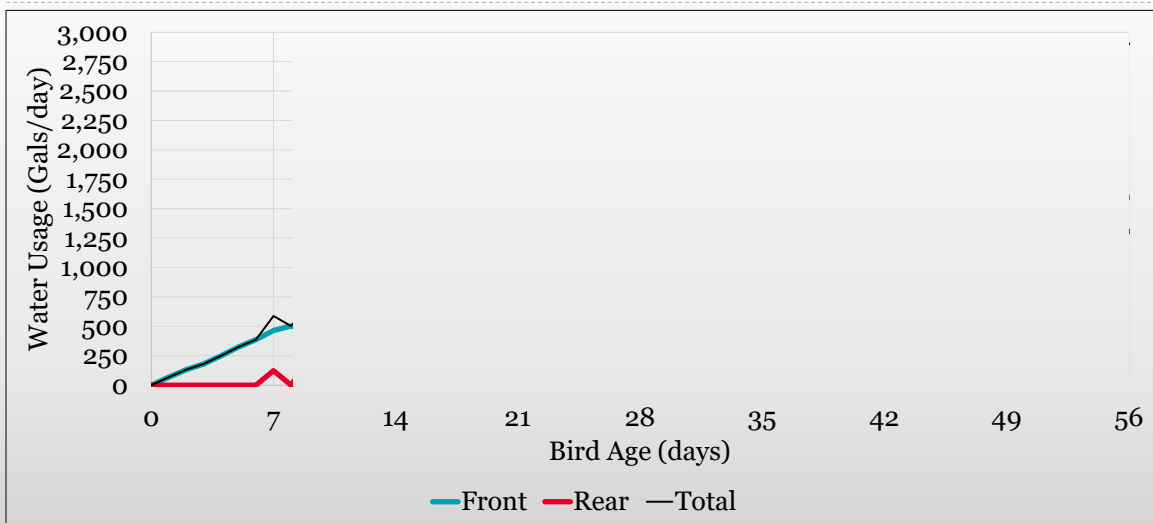
How does bird density differences affect broiler weights?

- ▶ 54' X 500' Broiler house equipped with two water meters
- ▶ Growing 9 lb. male broilers



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Daily water usage during partial house brooding



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Day 14 – fences were installed

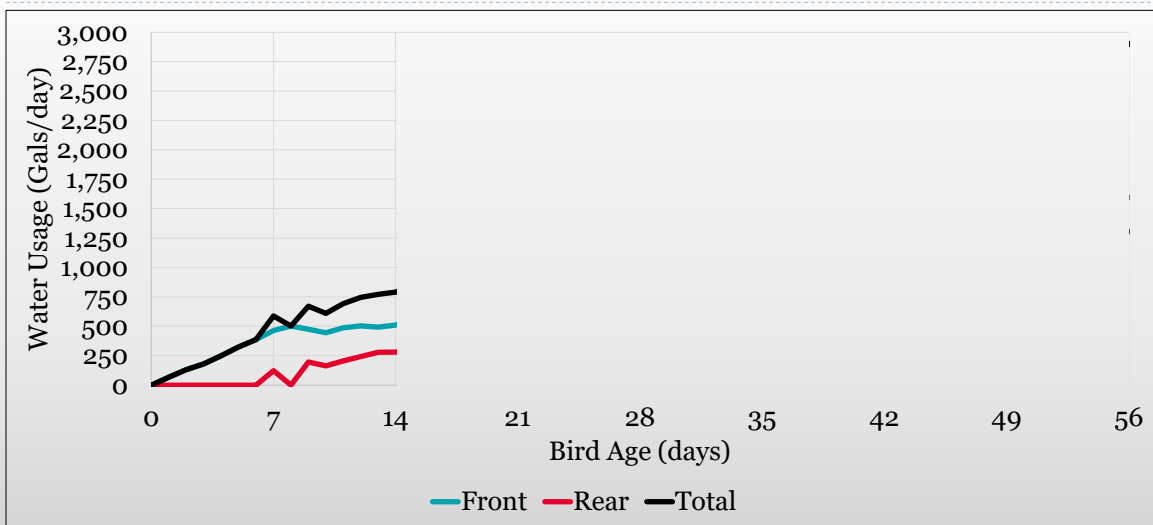
Rear

Front



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Daily water usage – Day 0 to Day 14



60

Day 14

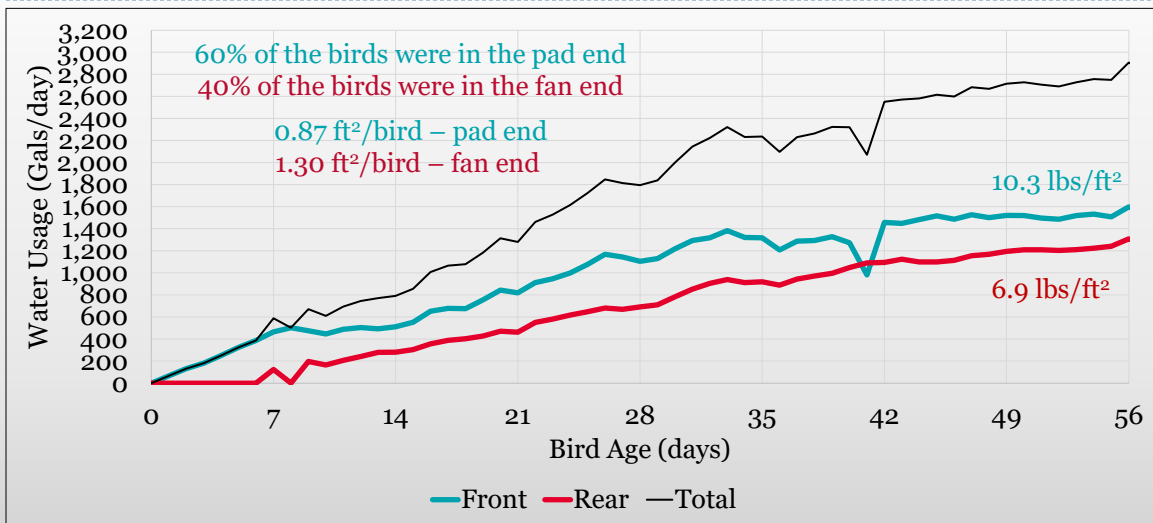
Rear

Front



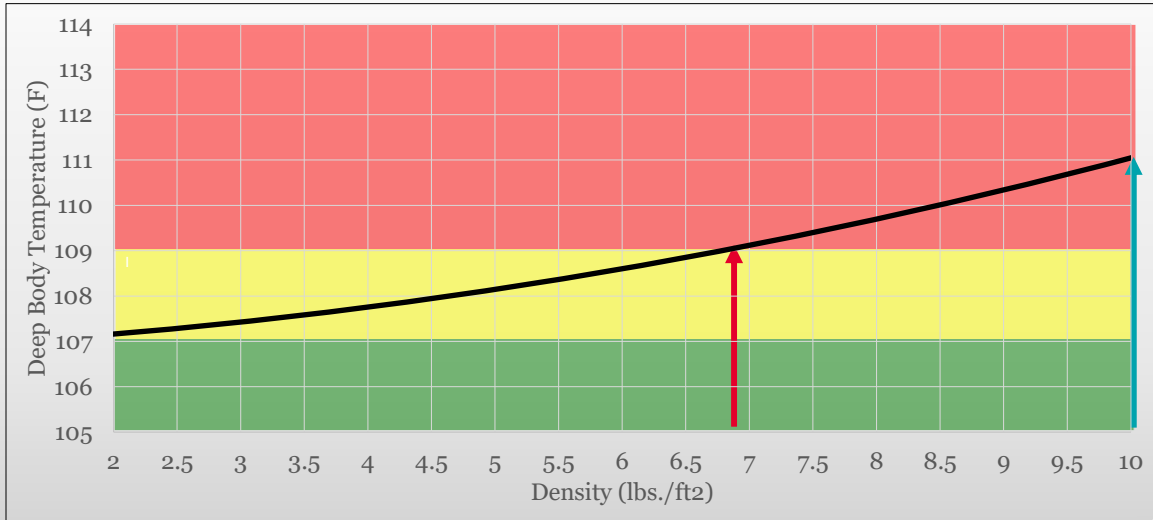
61

Daily water usage



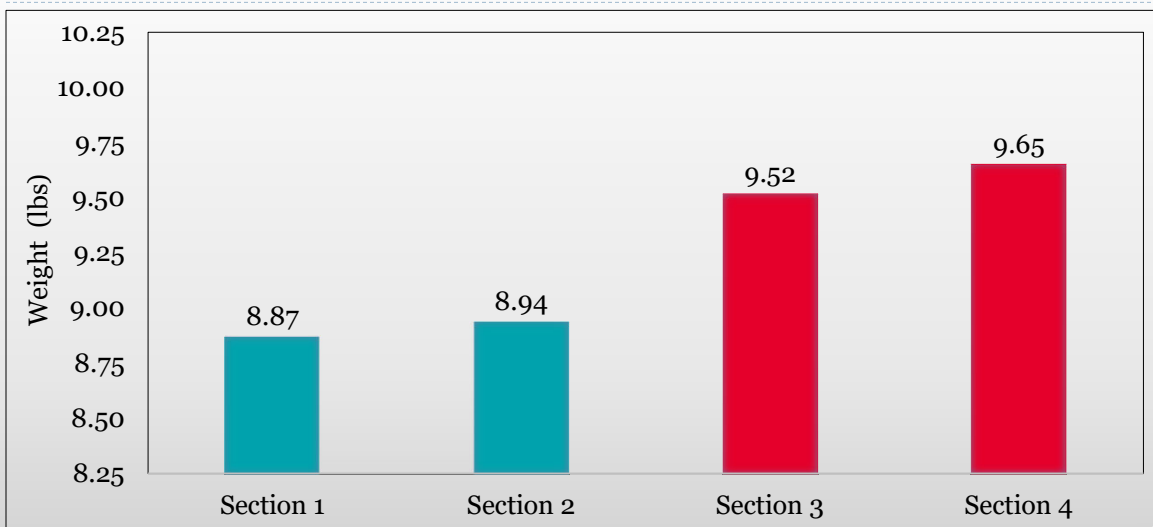
62

Body temperature vs. Density at different air temperatures



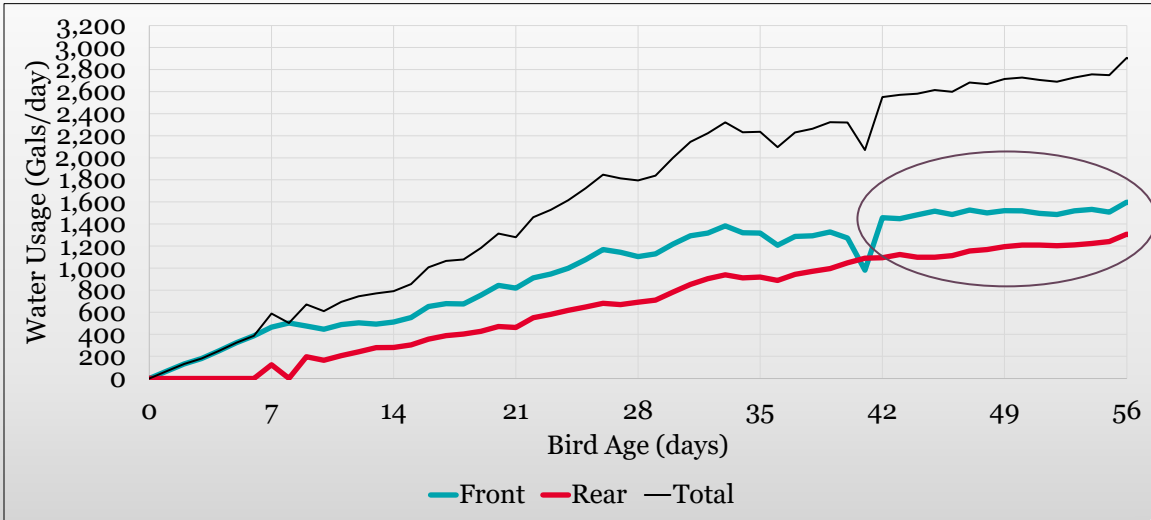
63

Weights



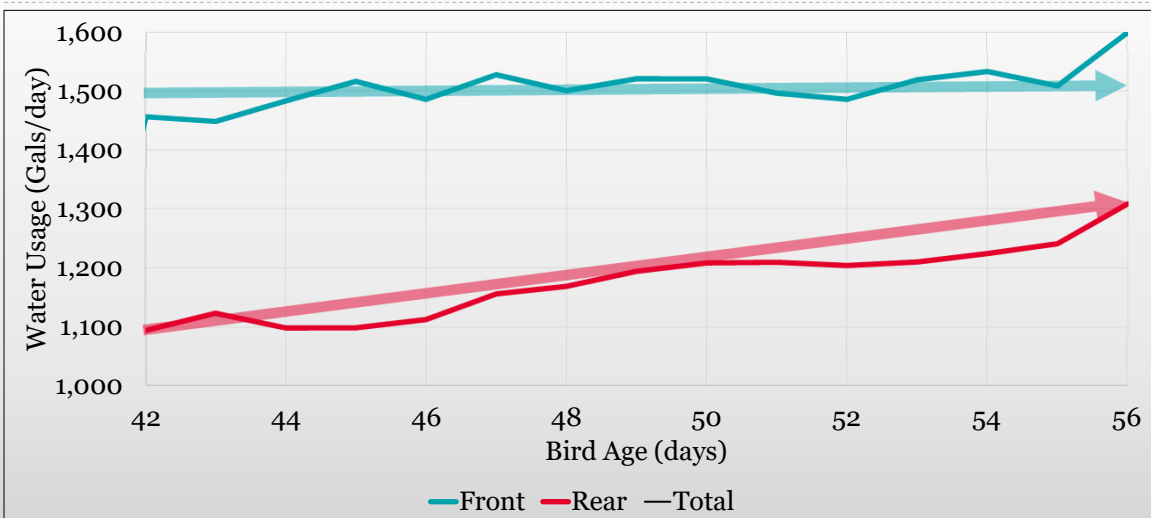
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Daily water usage



65

Daily water usage



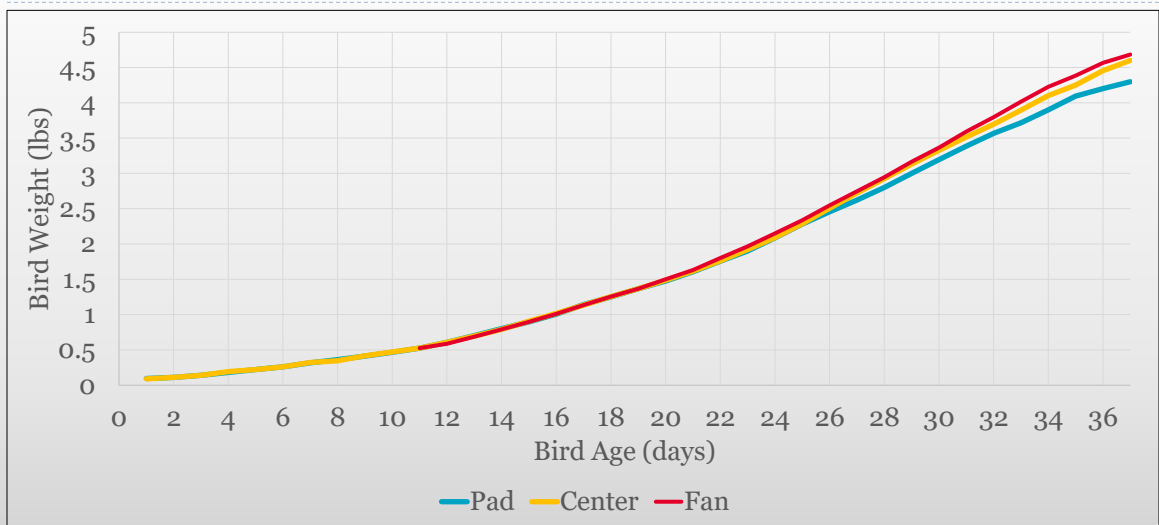
66

Doesn't just happen with large broilers



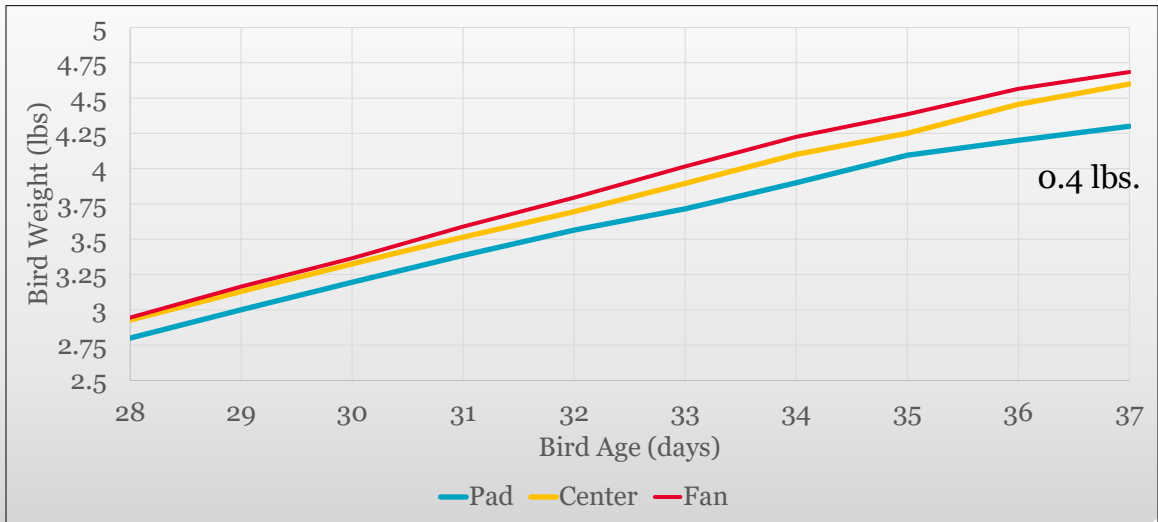
67

Bird weights (near pads, center of house, near fans)



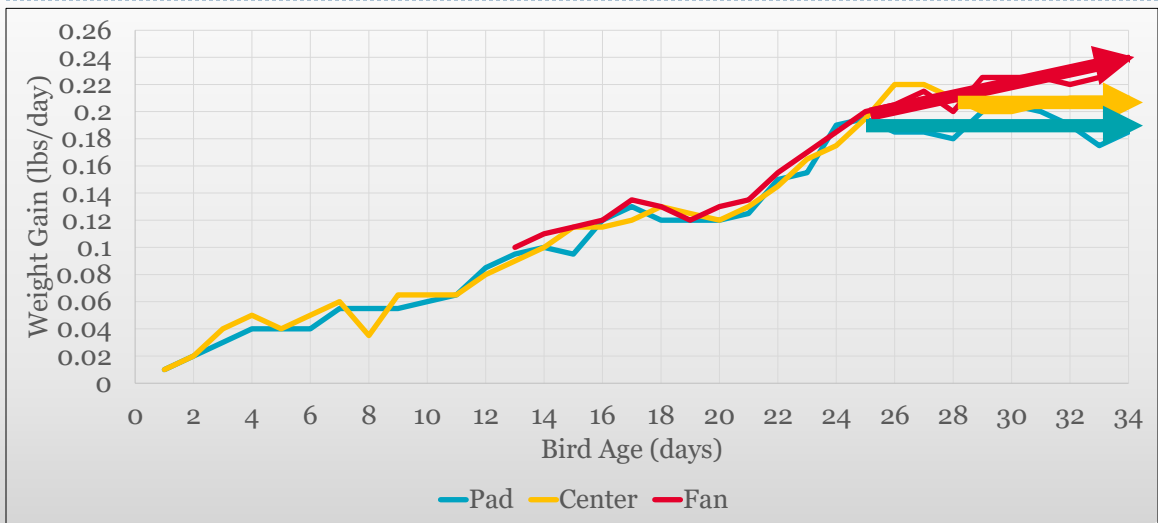
68

Bird weights (near pads, center of house, near fans)



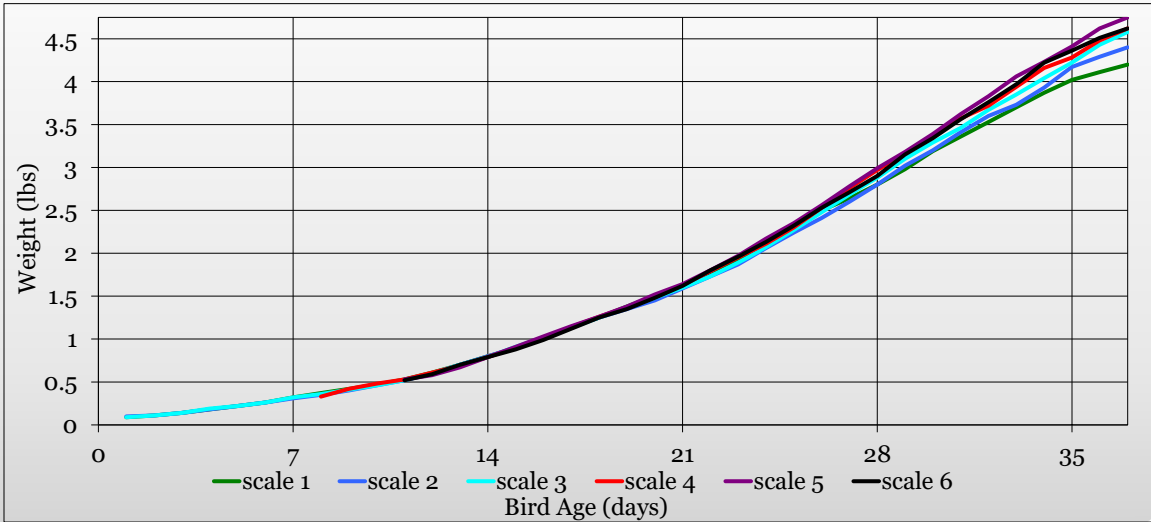
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Daily weight gain (near pads, center of house, near fans)



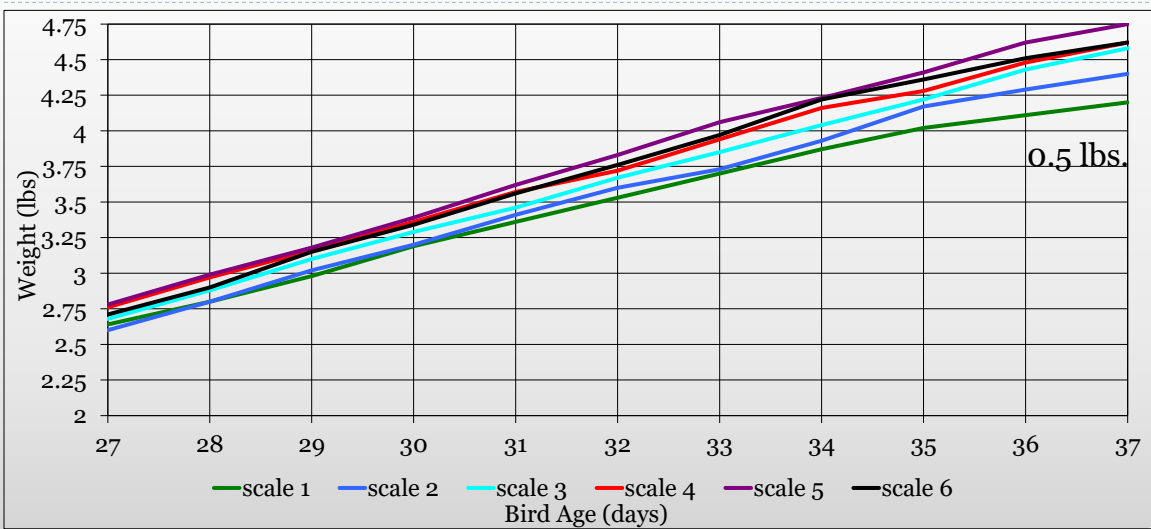
70

Small bird house with six scales



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Small bird house with six scales



72

2) How does bird “activity” affect body temperatures during hot weather?

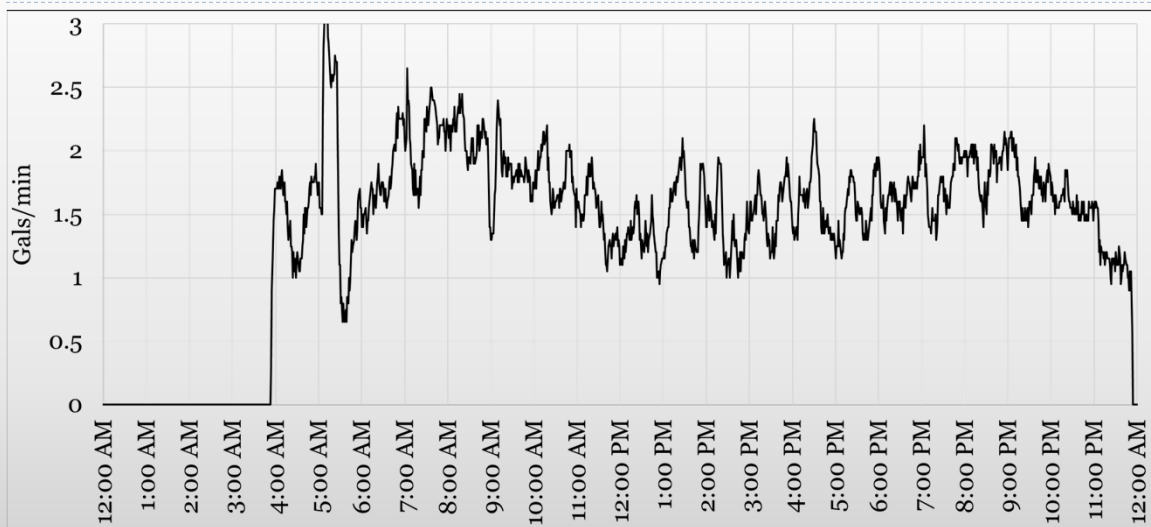


- ▶ Sprinkler study (2016)
 - ▶ Monitored bird water usage as an indicator of bird activity and feed consumption



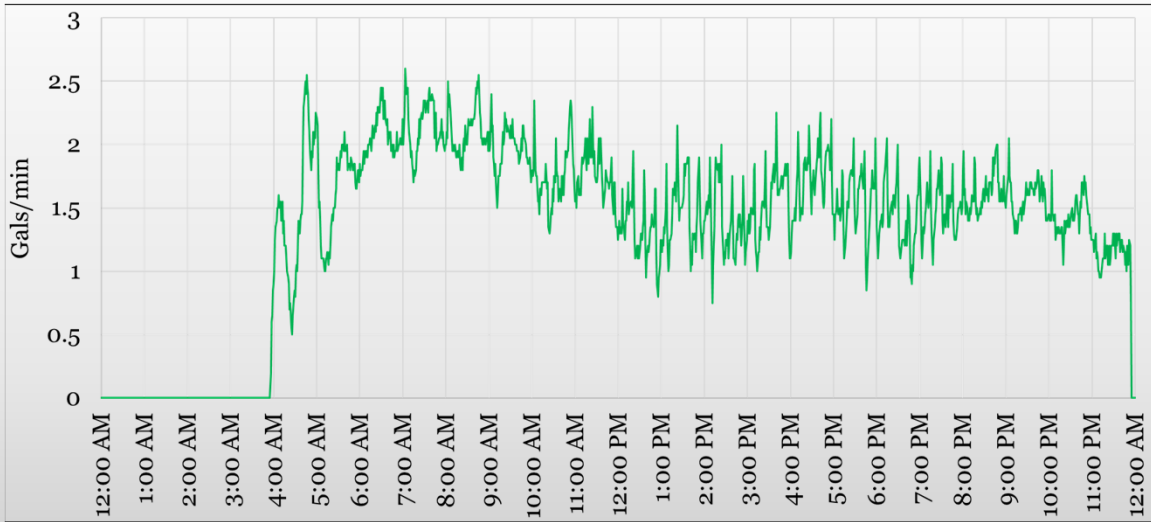
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Bird water usage without sprinklers



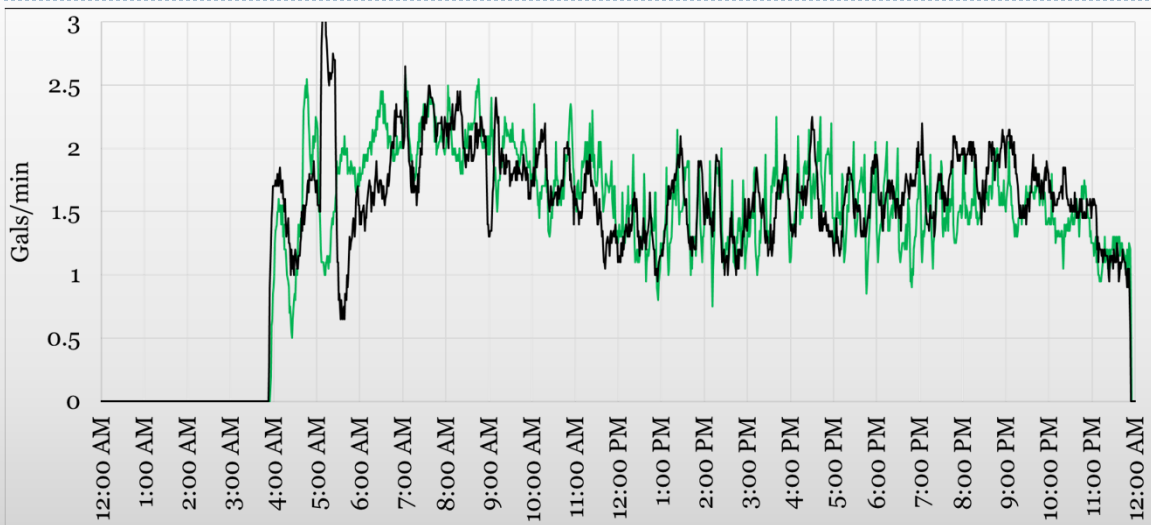
74

Bird water usage **with** sprinklers (15 minute cycle)



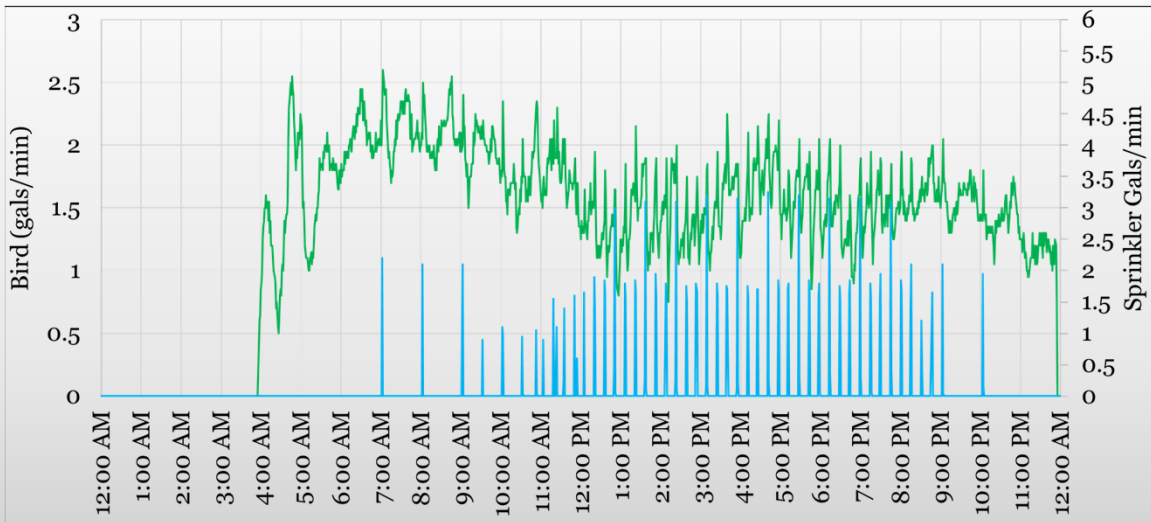
75

Bird water usage **with** and without sprinklers



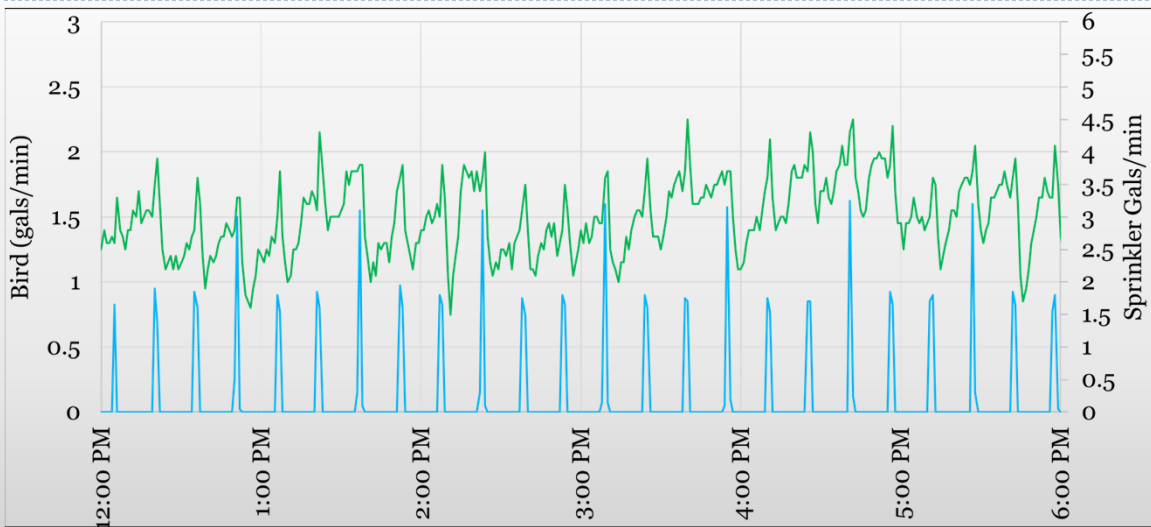
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Sprinklers operating every 15 minutes



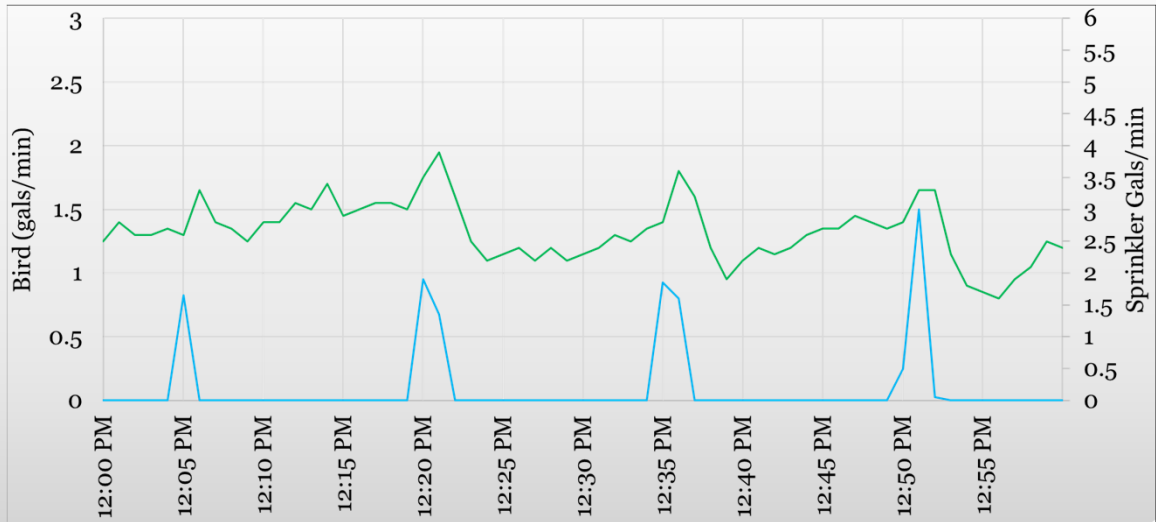
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Sprinklers operating every 15 minutes



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Sprinklers operating every 15 minutes



79

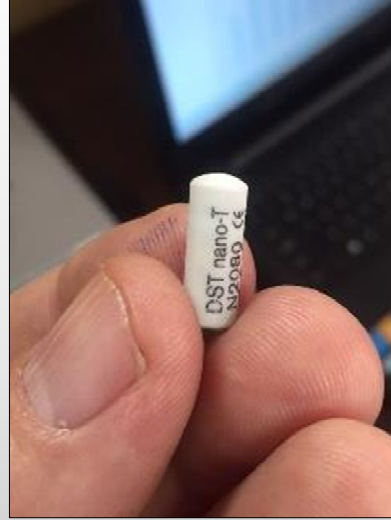
No difference in daily water consumption was found

- ▶ Since feed consumption follows water consumption...



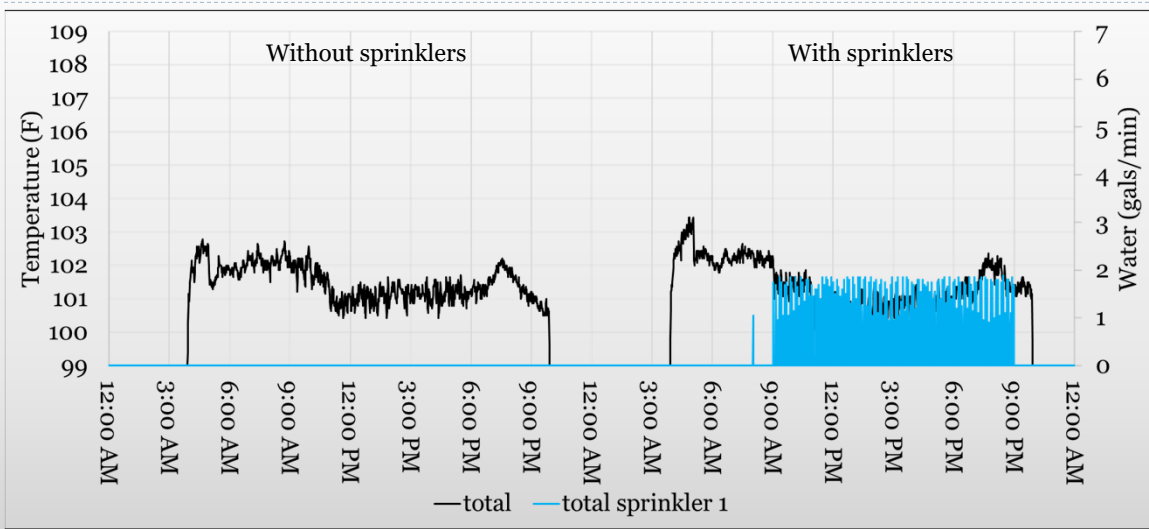
80

Deep body and subcutaneous breast temperatures were also monitored in a few birds in each house...



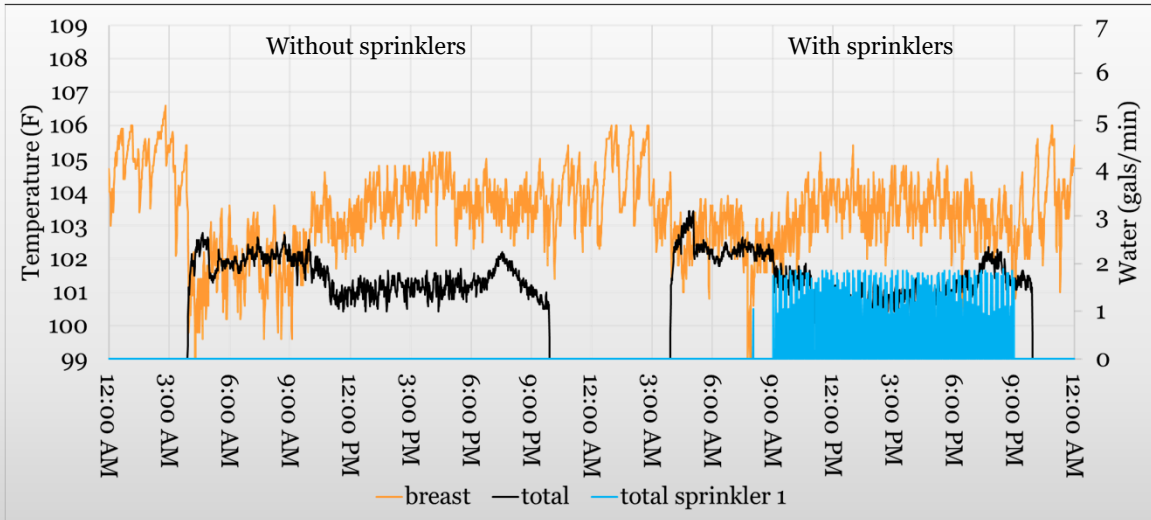
81

Bird and sprinkler water usage



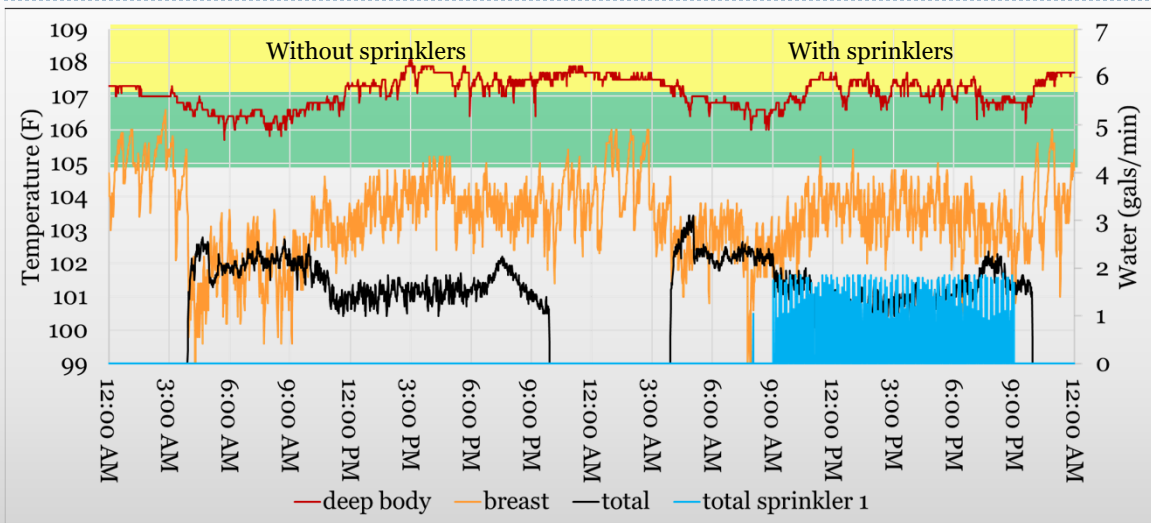
82

Subcutaneous breast temperature



83

Deep body temperature



84

No significant difference in subcutaneous or deep body temperatures were found during the study

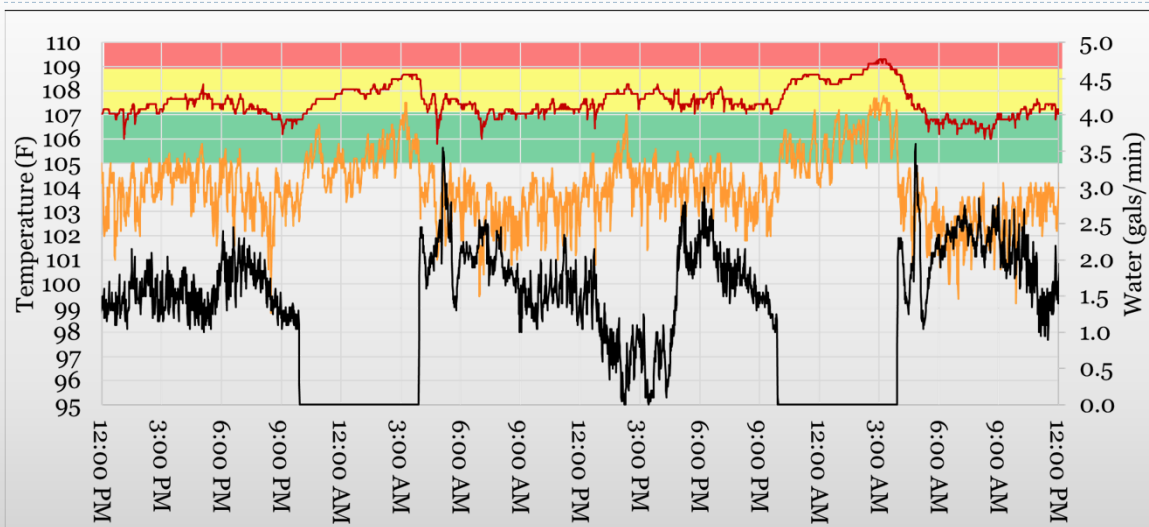


▶ But, we did see some other very interesting trends...



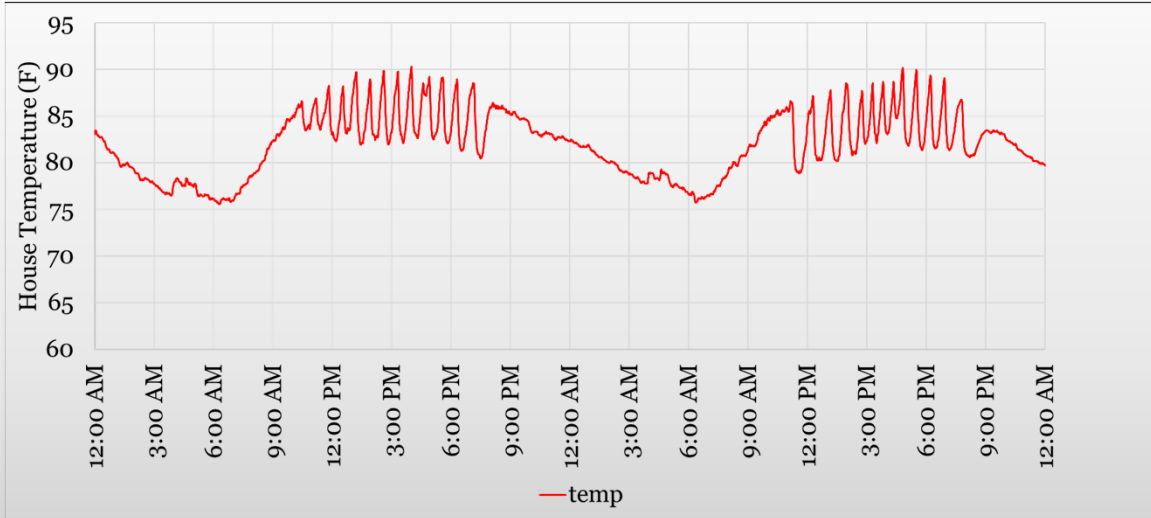
85

As with other studies, we found body temperature peaks during periods of minimal bird activity...when the lights go off



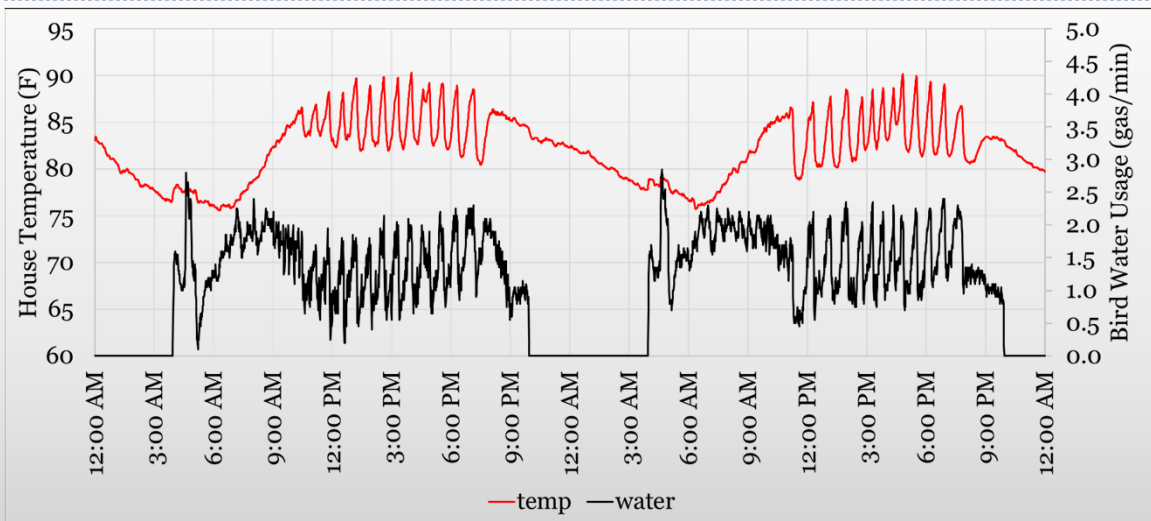
86

We also found that bird activity tended to vary with cool cell cycling



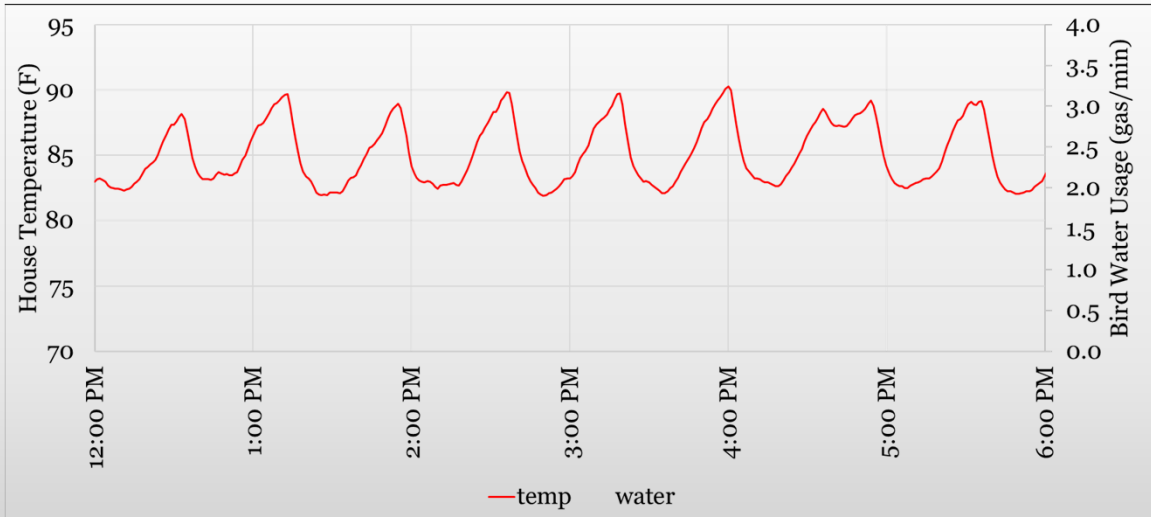
87

We also found that bird activity tended to vary with cool cell cycling



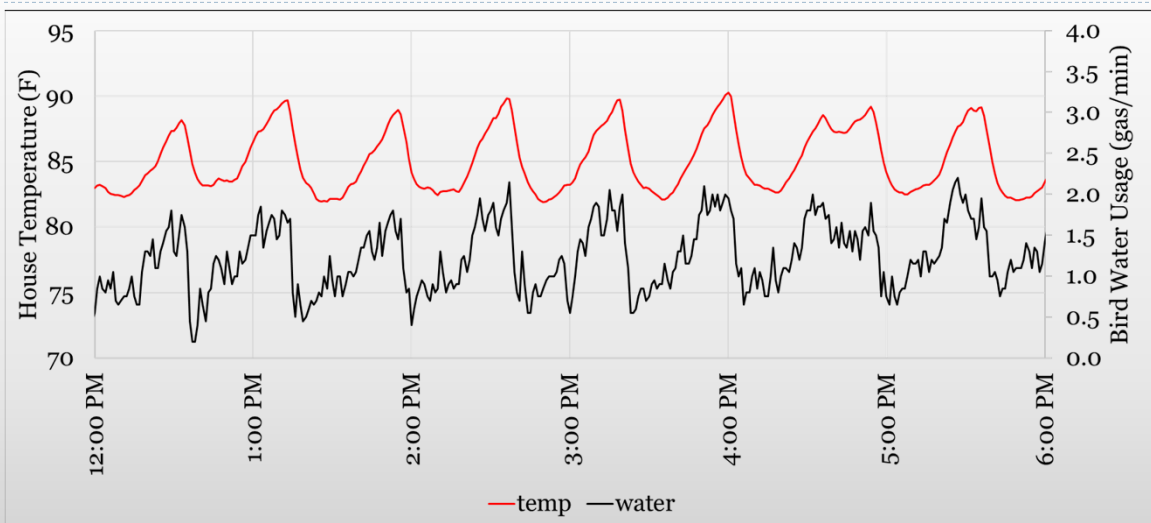
88

House temperature



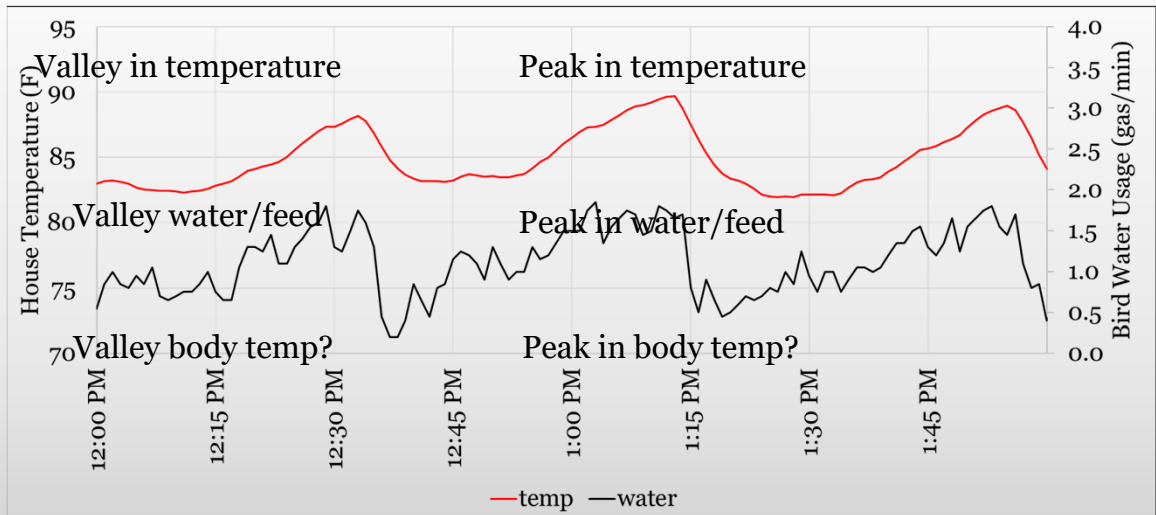
89

House temperature and water usage



90

45 minute cycle length



91

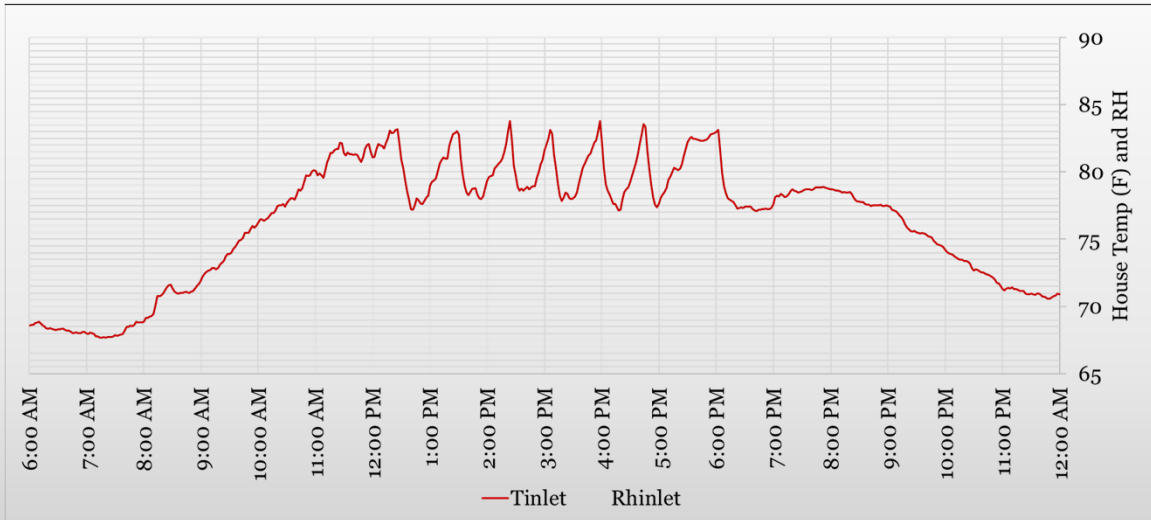
Latest study...

- ▶ Monitoring bird body temperatures in commercial broiler houses during hot weather.



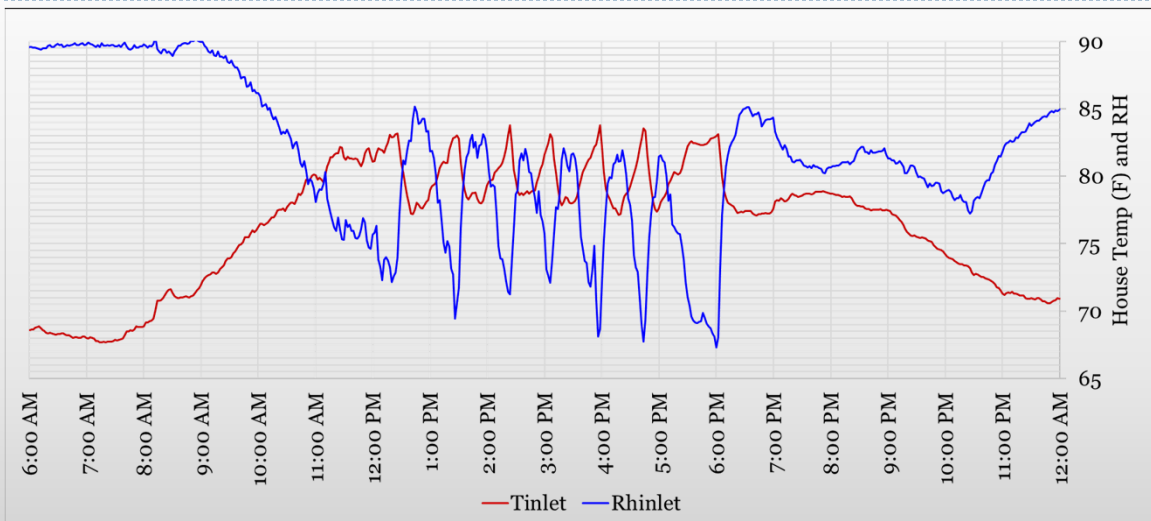
92

House temperature and RH



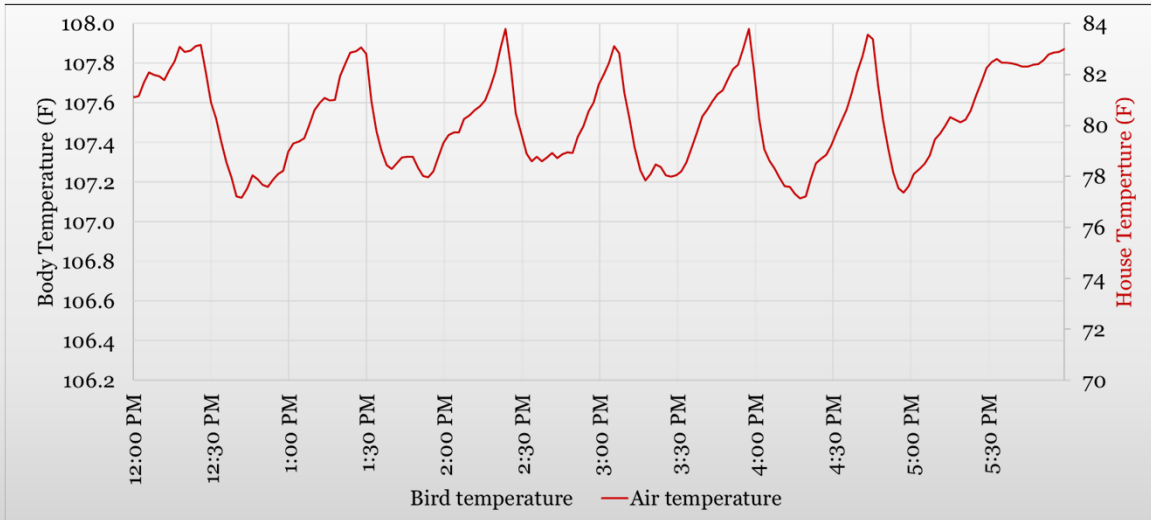
93

House temperature and RH



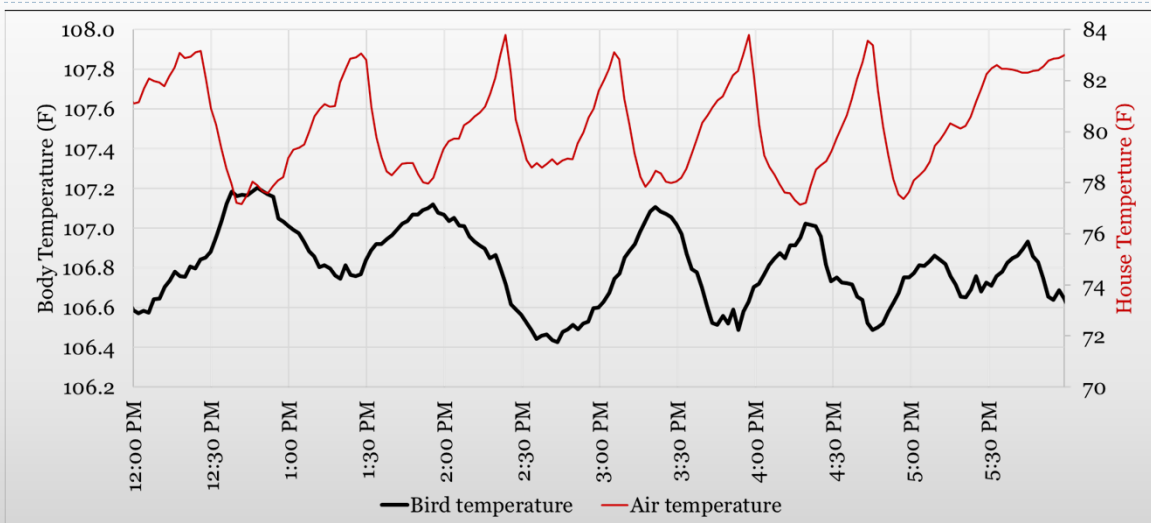
94

Tunnel inlet end



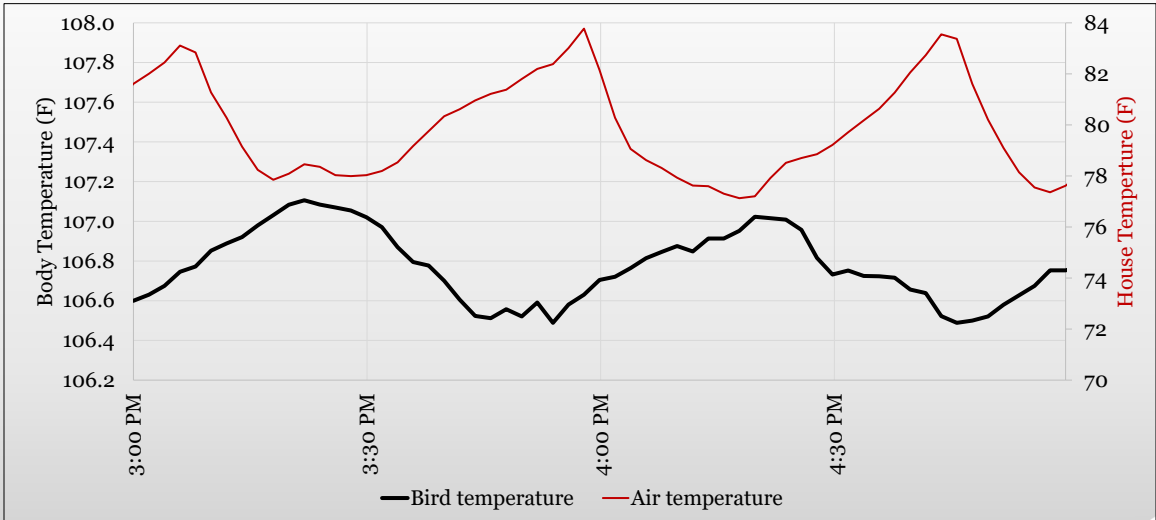
95

Tunnel inlet end



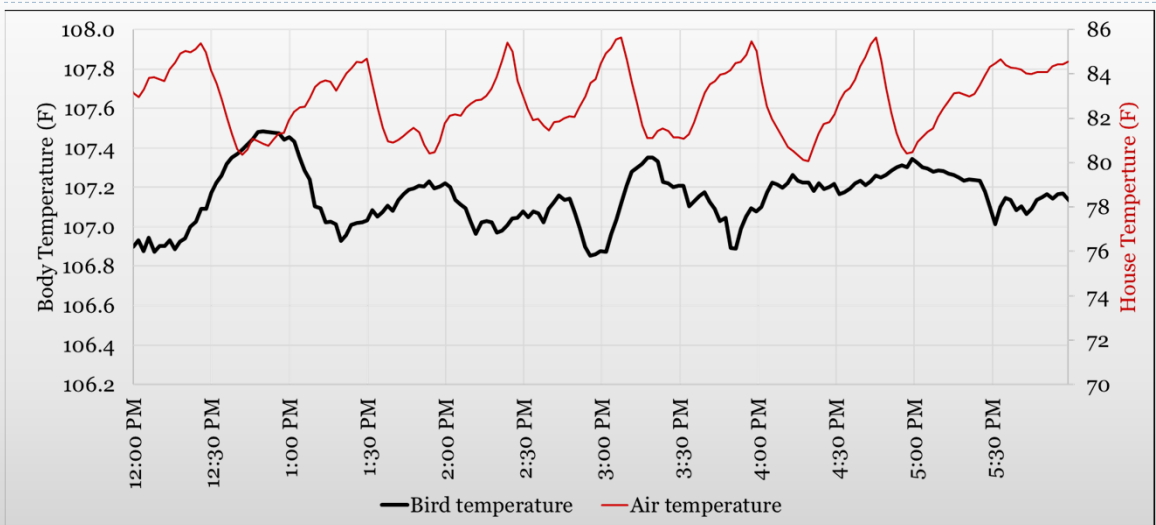
96

Tunnel inlet end



97

Tunnel fan end



98

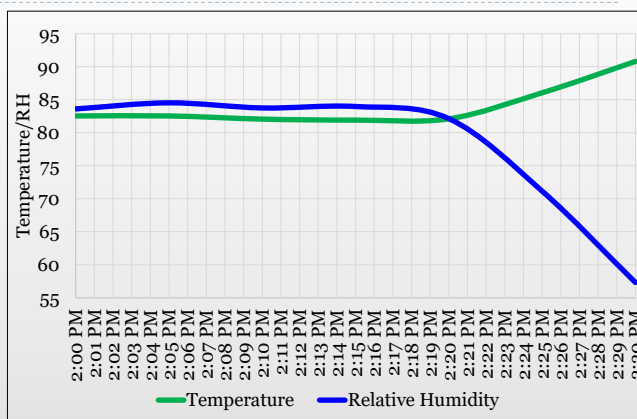
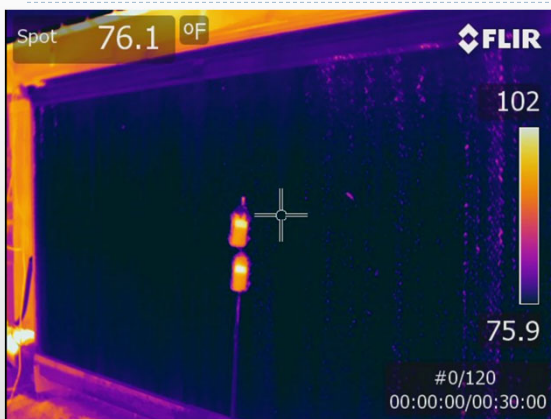
What does this mean?

- ▶ Birds have to stand up for a while (10 min+) for their body temperatures to lower
- ▶ Cyclic house temperatures caused by evaporative cooling pads wetting and drying could help the birds during hot weather.
 - ▶ Ten-minute timers do not result in significant pad drying.



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Evaporative cooling pad system circulation pump turned off at 2:00 pm



100

Plastic evaporative cooling pads



101

Plastic pads will fit into existing six-inch paper pad systems

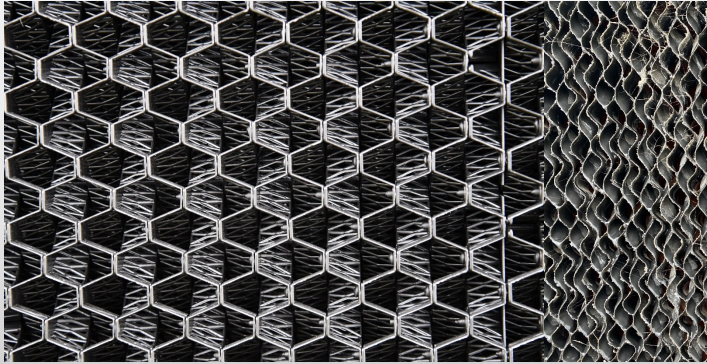
- ▶ Similar design velocity,
 - ▶ 350-375 ft/min
- ▶ Similar static pressure
 - ▶ 0.05" – 0.06"



102

Primary differences:

- ▶ Made of plastic,
- ▶ Two feet wide,
- ▶ Flutes are larger,



103

Primary differences:

- ▶ Made of plastic,
- ▶ Two feet wide,
- ▶ Flutes are larger,
- ▶ Instead of angled flutes, have “U-shaped” or “V-shaped” flutes



104



105

Objectives:

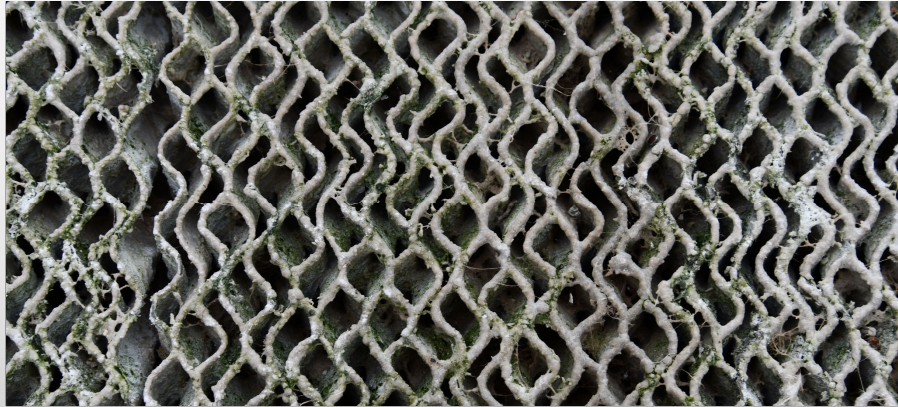
- 1) Compare pad cooling/humidity of plastic vs. paper
 - ▶ High flow water distribution system (Barku)
 - ▶ Conventional “low flow” water distribution systems (Reeves)



106

Objectives:

- 2) Explore ways to minimize mineral build-up on pads
- 3) Explore ways of removing mineral build-up from pads



107

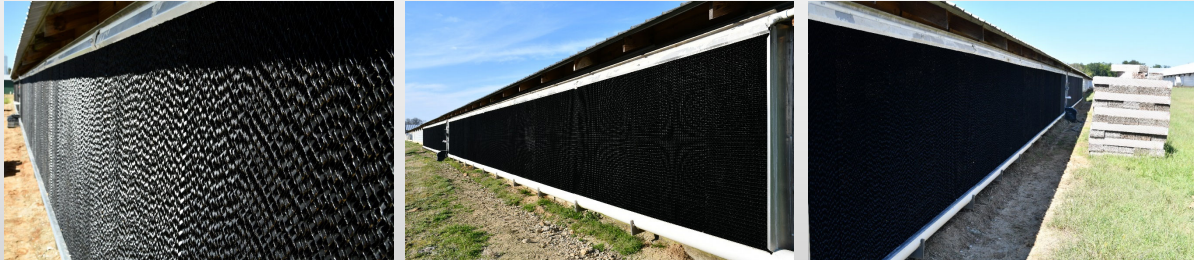
On the study farm the pads were essentially turned into stone in about six years.



108

Six house farm – Study conducted in four of the houses

- ▶ New Paper Pad – Old Reeves System (conventional flow)
- ▶ Barku Plastic Pad – Barku System (high water flow)
- ▶ Barku Plastic Pad – Old Reeves System (conventional flow)
- ▶ Big Dutchman Plastic – Old Reeves System (conventional flow)



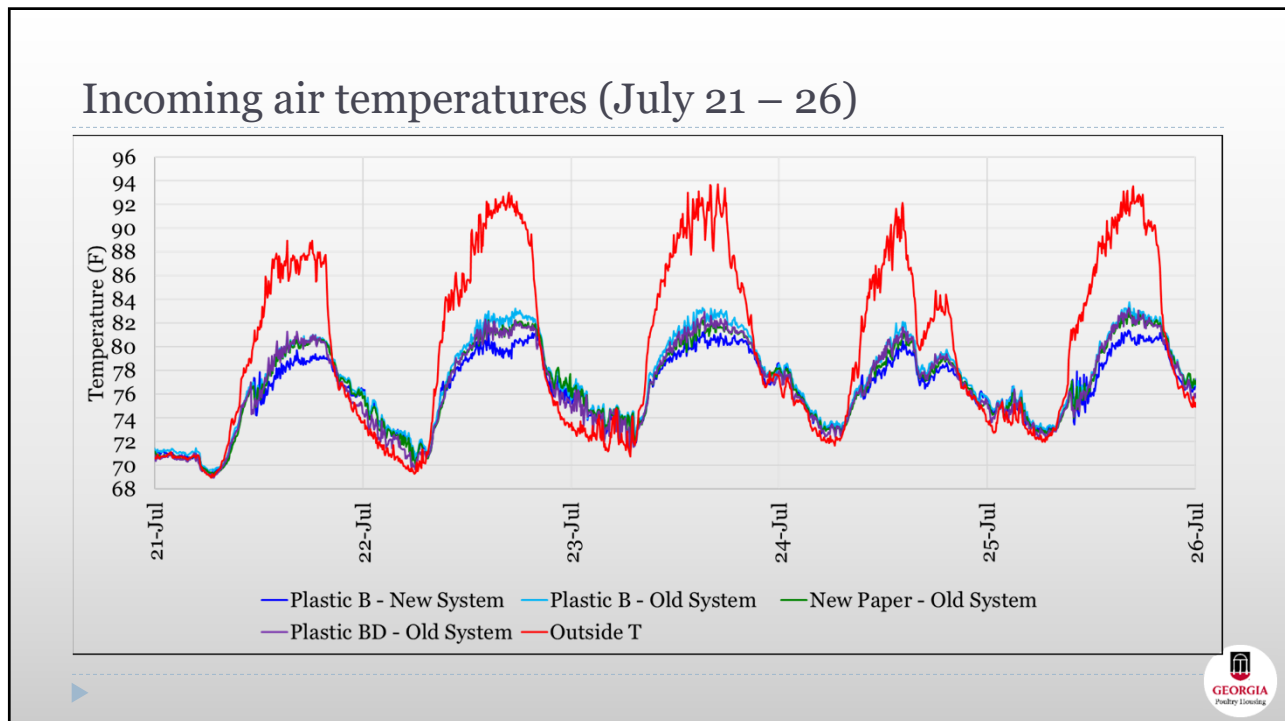
109



110

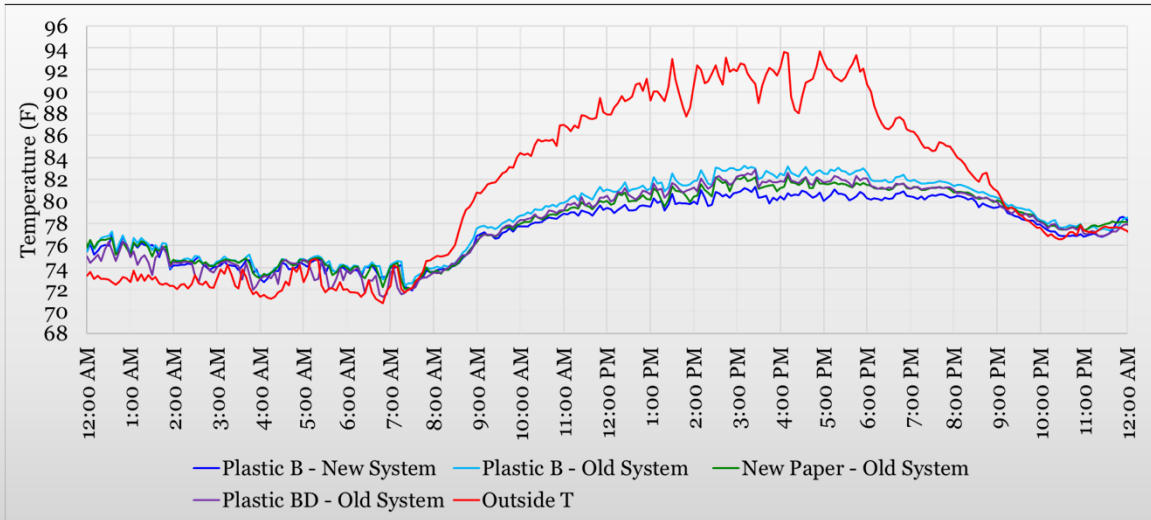


111



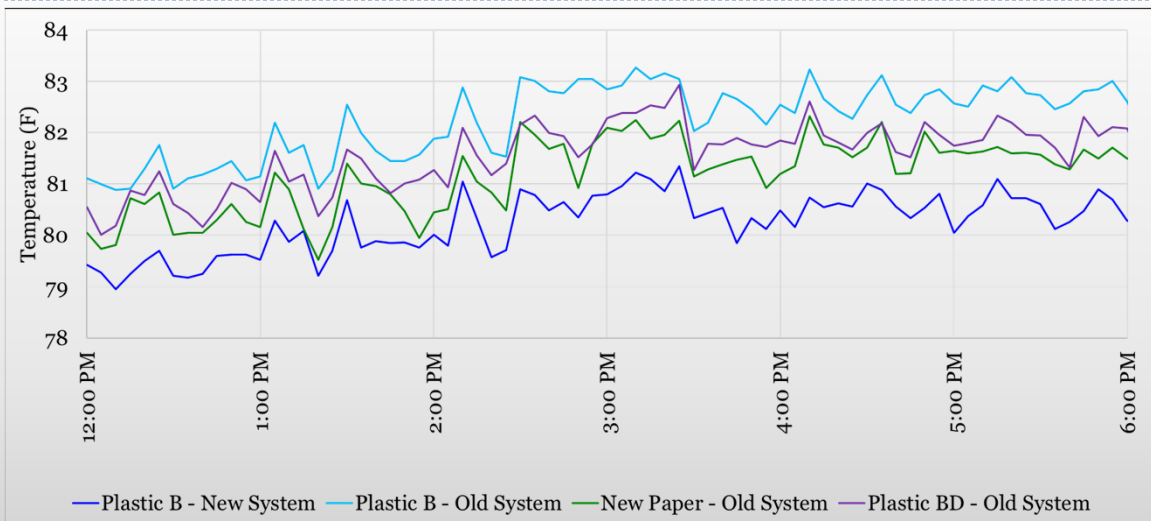
112

Incoming air temperatures (July 23)



113

Incoming air temperatures(12 pm – 6 pm)



114

Cooling comparison (last ten days of the flock)

Location	Temperature (F)	Relative Humidity (%)
Outside	84.2	74.8
New Paper – Old System	78.4	87.6
Plastic B – New System	77.7	88.2
Plastic B – Old System	79.1	88
Plastic BD – Old System	78.6	87.8



115

Differences between plastic and paper pads:

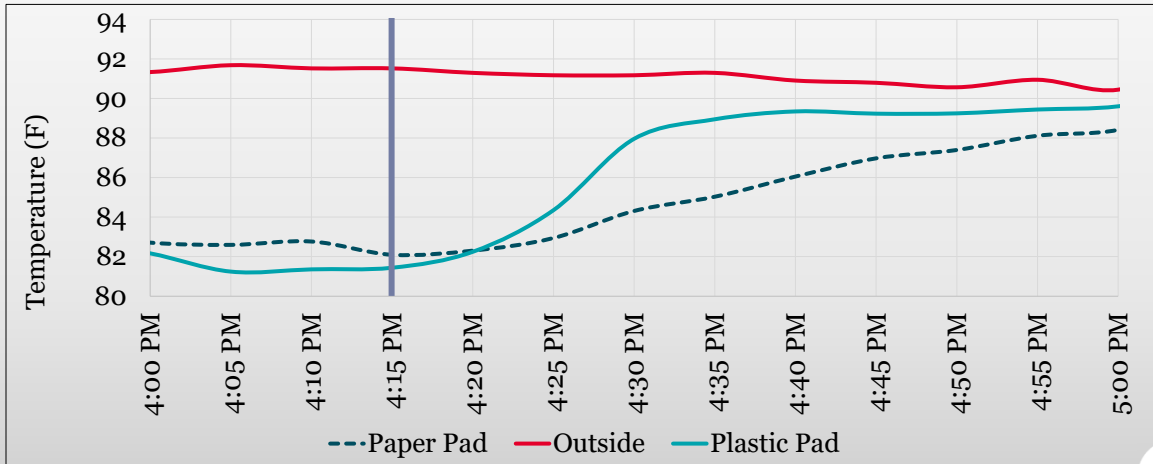
- ▶ Plastic pads are much more difficult to fully wet
 - ▶ Most existing systems are not capable of putting enough water on plastic pads



116

Differences between plastic and paper pads:

- ▶ Plastic pads dry out faster than paper pads



117

Differences between plastic and paper pads:

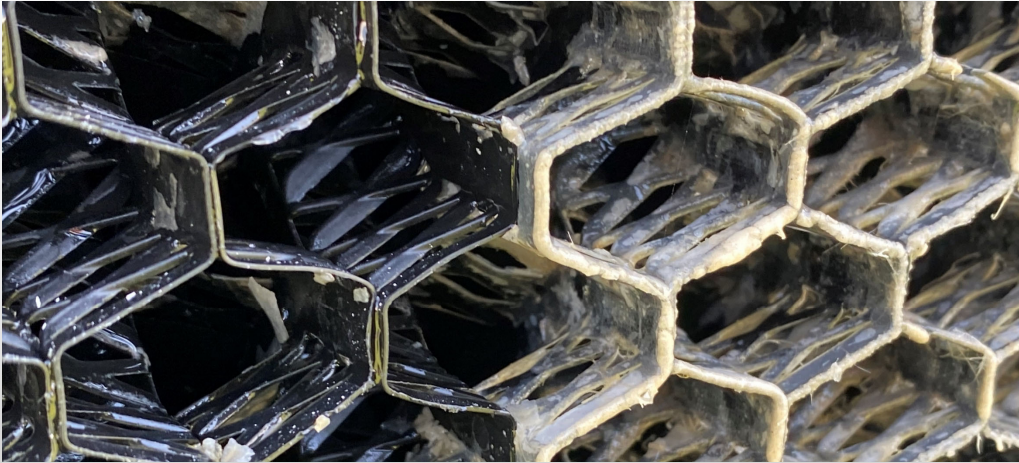
- ▶ Plastic pads are more likely to carry water into pad rooms
 - ▶ Must have pad rooms to obtain maximum cooling



118

Differences between plastic and paper pads:

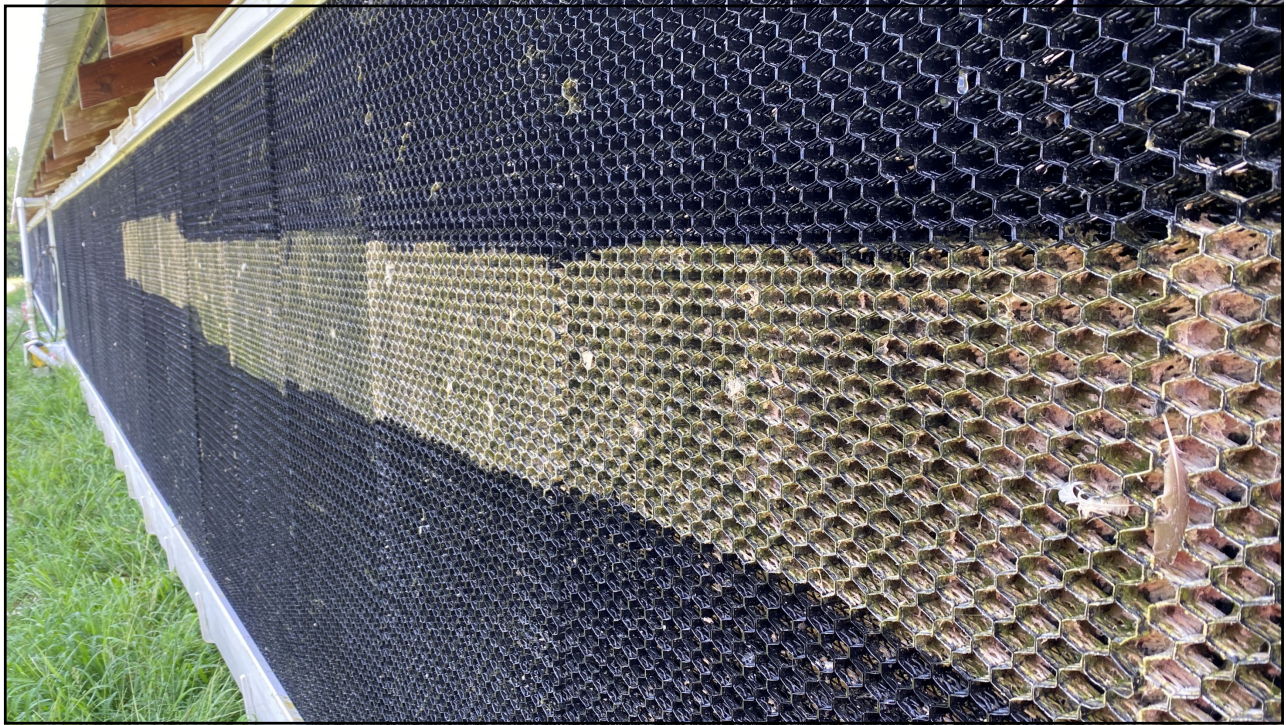
- ▶ Plastic pads are much easier to clean than paper pads



119



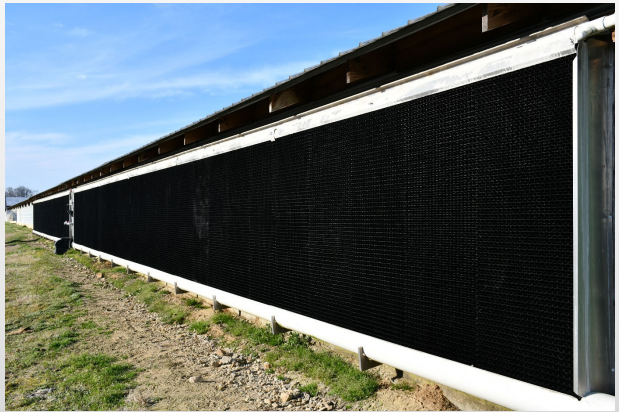
120



121

Differences between plastic and paper pads:

- ▶ Plastic pad cost twice as much



122

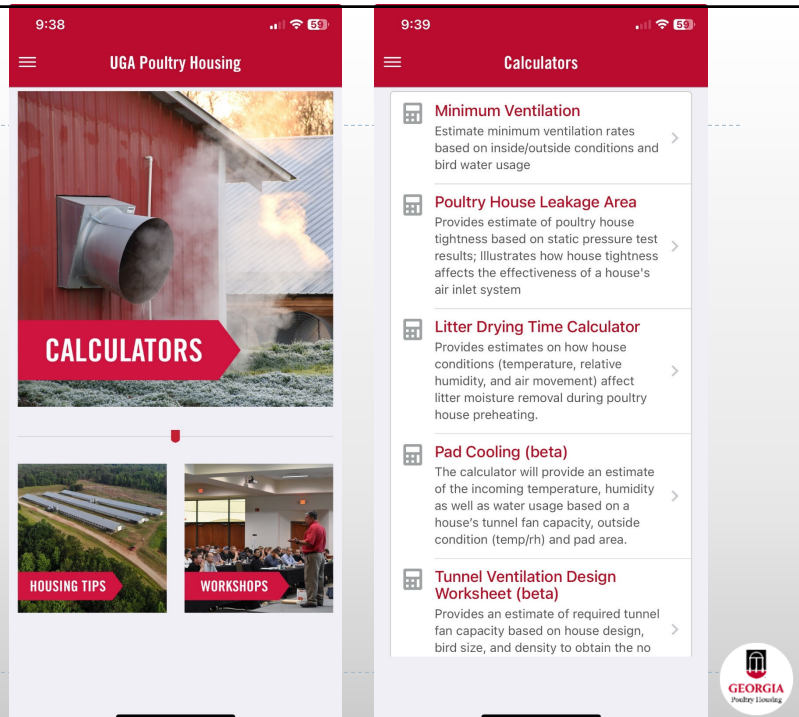
Conclusions:

- ▶ If you have good water quality, it is probably best to stick with paper pads.
- ▶ You might have to replace your circulation system to obtain maximum cooling from plastic pads.
- ▶ The use of interval timers may be problematic.
- ▶ Plastic pads tend to be “messy”
 - ▶ If you reduce water flow over the pads, cooling will decrease significantly



123

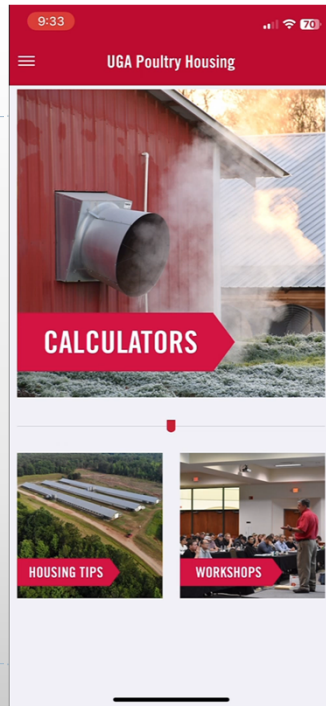
3) Poultry411 App



124

Evaporative Cooling App

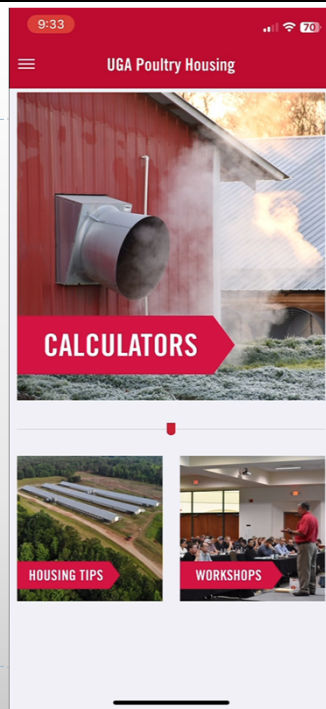
- ▶ 250,000 cfm of tunnel fan capacity
- ▶ 95 F outside
- ▶ 60% RH
- ▶ 5' pad X 80' X 2 sides



125

Evaporative Cooling App

- ▶ 250,000 cfm of tunnel fan capacity
- ▶ 95 F outside
- ▶ 30% RH
- ▶ 5' pad X 80' X 2 sides



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