PRACTICAL APPLICATION OF HAIR SHEDDING SCORES AND EPDS IN YOUR HERD

Dr. Jared Decker & Dr. Jamie Courter

MU Animal Genomics

BACKGROUND

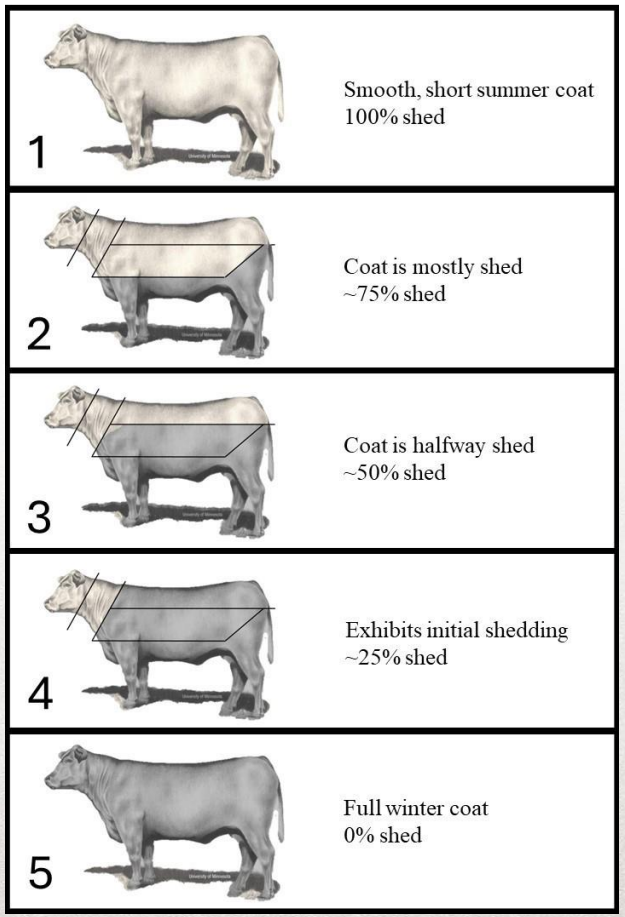
- Losses from **fescue toxicosis > $1 billion/year**
  - Losses from **heat stress** likely even greater (Hoveland 1993)
- Hair Shedding is an economically relevant trait
  - Previous work suggests early summer hair shedding affects **heat tolerance** (Gray et al., 2011)
  - Also correlated to calf age and weaning weight
- **Hair shedding is moderately heritable (0.35-0.42)**
  - WW $h^2 = 0.28$, MARB $h^2 = 0.48$
- Phenotype recording easy to implement
  - 1 to 5 scale
  - Can be performed chute-side or in the pasture

HAIR COAT VS HAIR SHEDDING

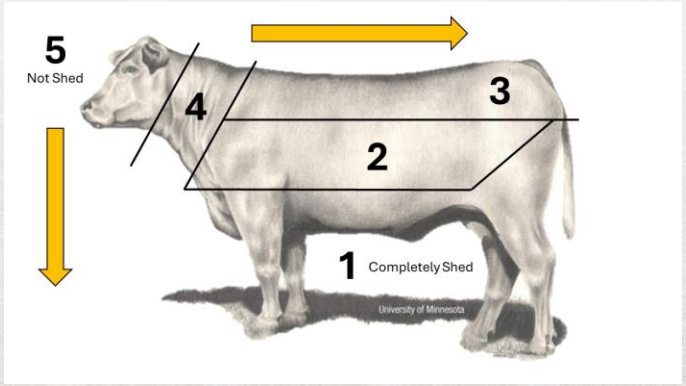
- **Hair Coat**
  - Scoring how short and smooth the summer hair coat is

- **Hair Shedding**
  - Scoring how early the winter hair is shed off

HAIR SHEDDING SCORES



- 5-point scale where 5 is 0% winter coat shed and 1 is 100% shed (Gray et al., 2011)
- Individual variation in pattern of shedding but generally consistent across mammals
  - Front to back
  - Top to bottom

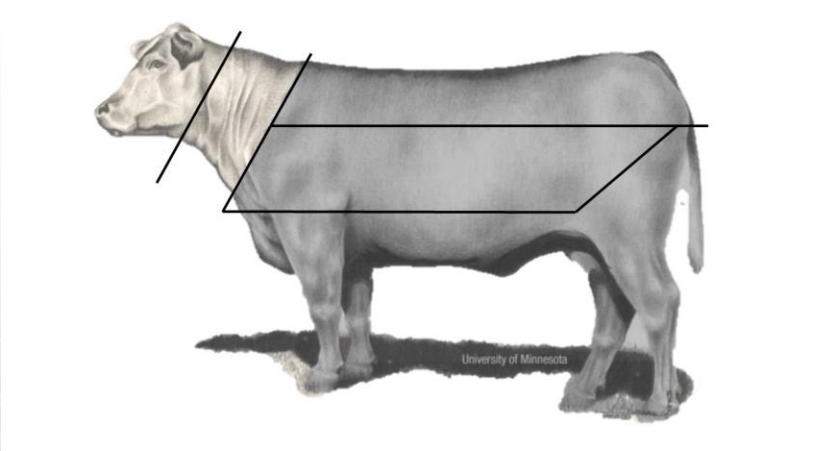


HAIR SHEDDING SCORES

- 5 - 0% shed, full winter coat

HAIR SHEDDING SCORES

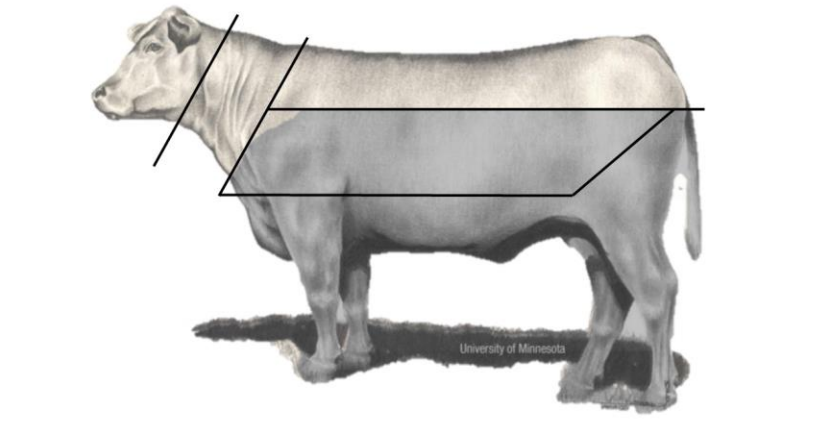
- 4 - 25% shed, exhibits initial shedding



Typically, only shed from the neck

HAIR SHEDDING SCORES

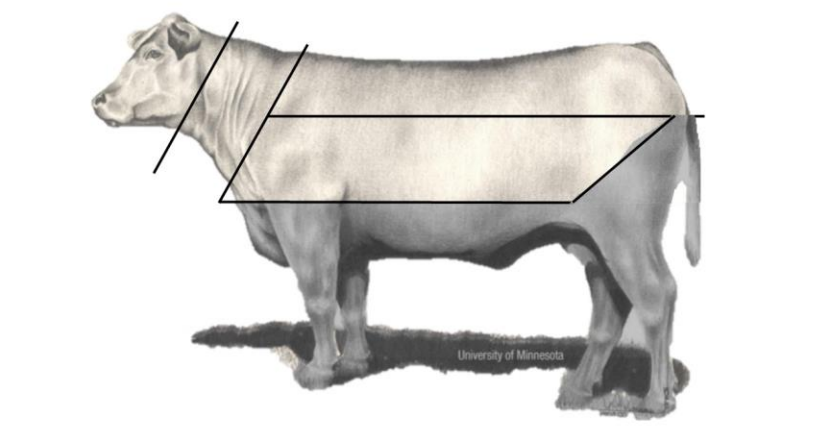
- 3 - 50% shed



Will include hair along the body, often in patchy spots

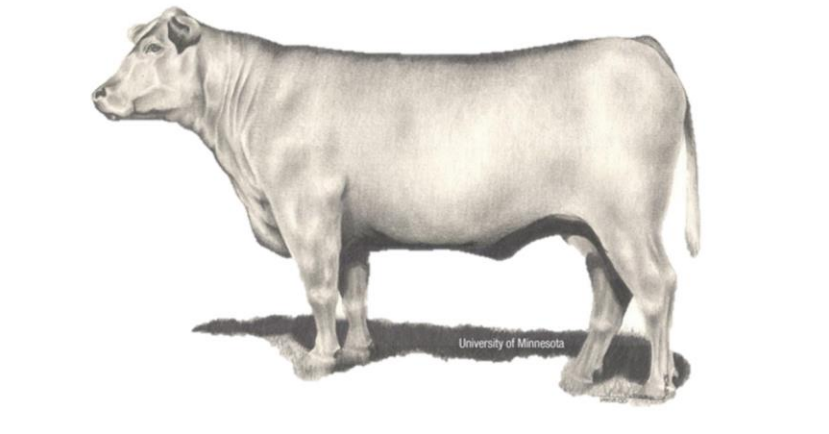
HAIR SHEDDING SCORES

- 2 - 75% shed, small amount remaining on flank and hindquarter



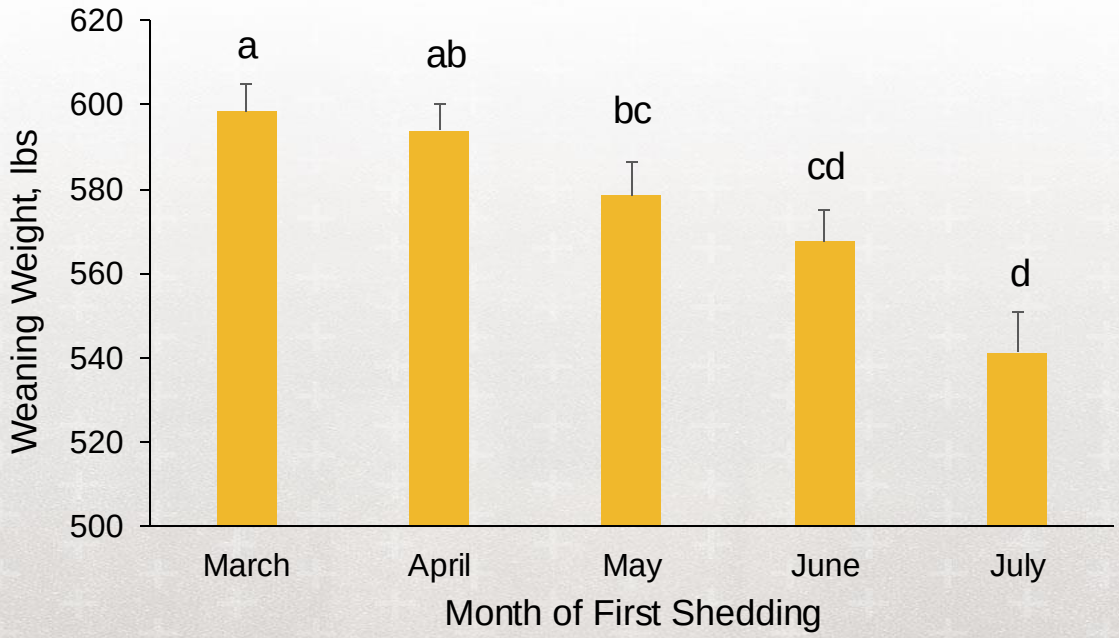
HAIR SHEDDING SCORES

- 1 - 100% shed, smooth, short summer coat remains



IMPACT ON PERFORMANCE

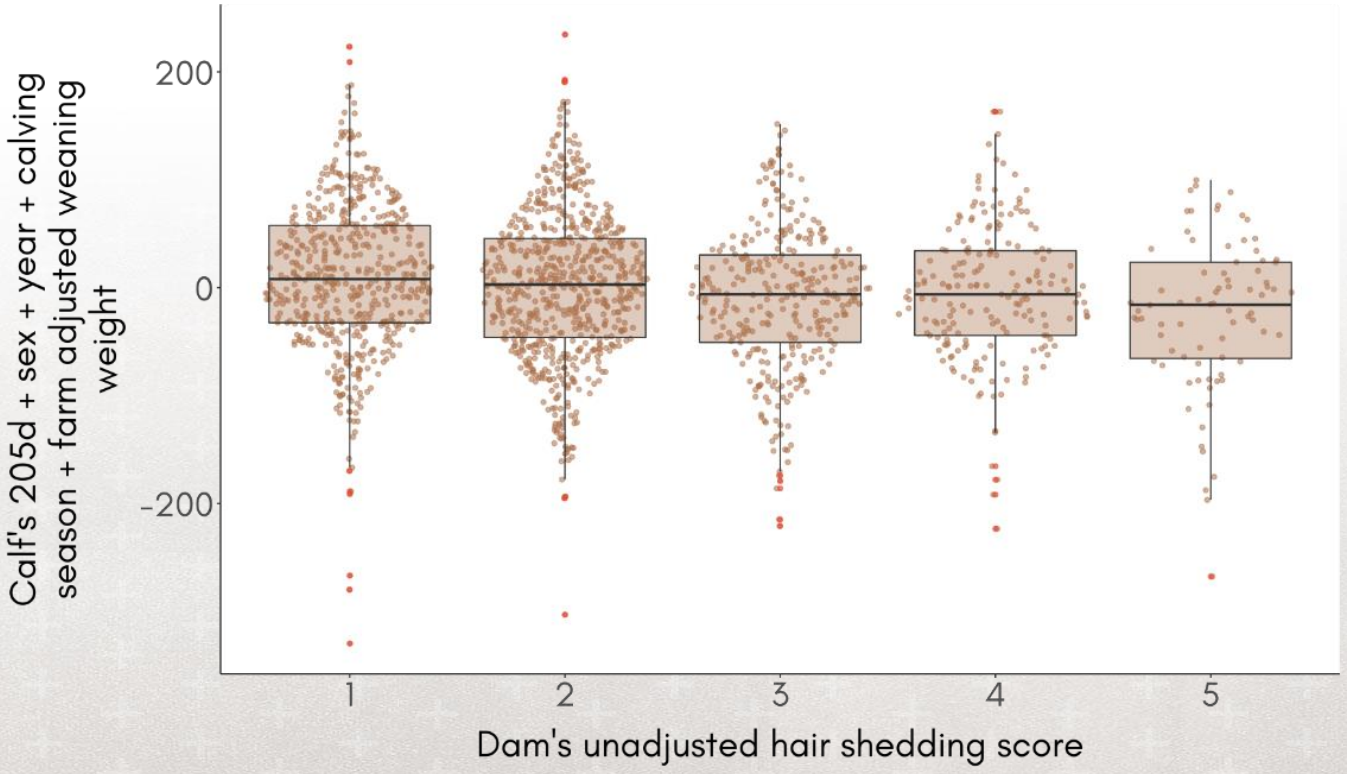
- Earlier shedding cows tend to wean an older, heavier calf



Grey et al., 2011

IMPACT ON PERFORMANCE

Hair shedding score of dam vs. calf weaning weight: ASA data (n = 1,830)



- **~11 lb** difference in WW per hair shedding score
- **~45 lb** difference in WW between score 1 (best) and 5 (worst)

Mizzou Data

IMPACT ON PERFORMANCE

- Using weaning weight data on ~50,000 AAA registered dams and their calves
  - Treated WW as a trait of the dam
  - Investigated hair shedding maternal, weaning weight direct, and weaning weight maternal (milk)
- The genetic correlation between hair shedding score and weaning weight: -0.19

	Weaning Weight (direct)	Weaning weight (maternal)
Hair shedding	-0.03 (0.055)	**-0.19** (0.0666)
Weaning Weight (direct)		-0.43 (0.050)

Durbin et al., 2020

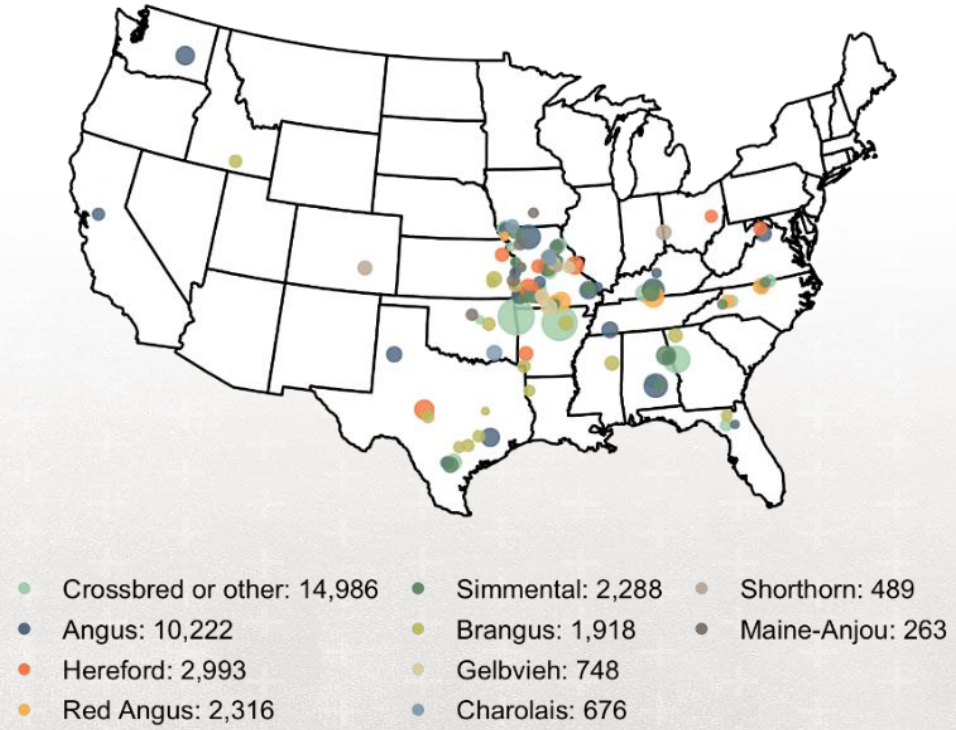
HAIR SHEDDING AND FESCUE

Dataset	σ^2_A	σ^2_{PE}	σ^2_P	h²	r
Not grazing toxic fescue	0.30	0.00	0.90	0.34	0.34
Grazing toxic fescue	0.38	**0.05**	0.95	0.40	**0.45**

- Larger repeatability among cattle grazing toxic fescue
- Hair shedding on & off fescue can be treated as the same trait
  - Genetic correlation of traits: 0.93
- Minimal re-ranking of animals when EBVs are compared on or off fescue
  - EBV correlation = 0.99

Durbin et al. 2020

MIZZOU ANIMAL GENOMICS HAIR SHEDDING PROJECT



- Total of **36,899** hair shedding scores on **13,364** cattle between 2016 and 2020
- Genotypes available on **11,560** phenotyped cattle and relatives imputed to **~850K** SNPs

HAIR SHEDDING SCORE IS MODERATELY HERITABLE

Dataset	# HS Records	# Animals	Avg. Scores per Animal	h^2	r
AGI Prototype	14,465	8,642	1.67	0.40	0.44
Full Mizzou	36,899	13,364	2.76	0.37	0.45
Angus Mizzou	8,674	3,653	2.19	0.37	0.42
Brangus Mizzou	1,829	984	1.92	0.40	0.40
Hereford Mizzou	2,857	1,235	2.31	0.32	0.40
IGS Mizzou	10,996	4,713	2.33	0.41	0.48

HAIR SHEDDING EPDS ARE VARIABLE WITHIN BREED

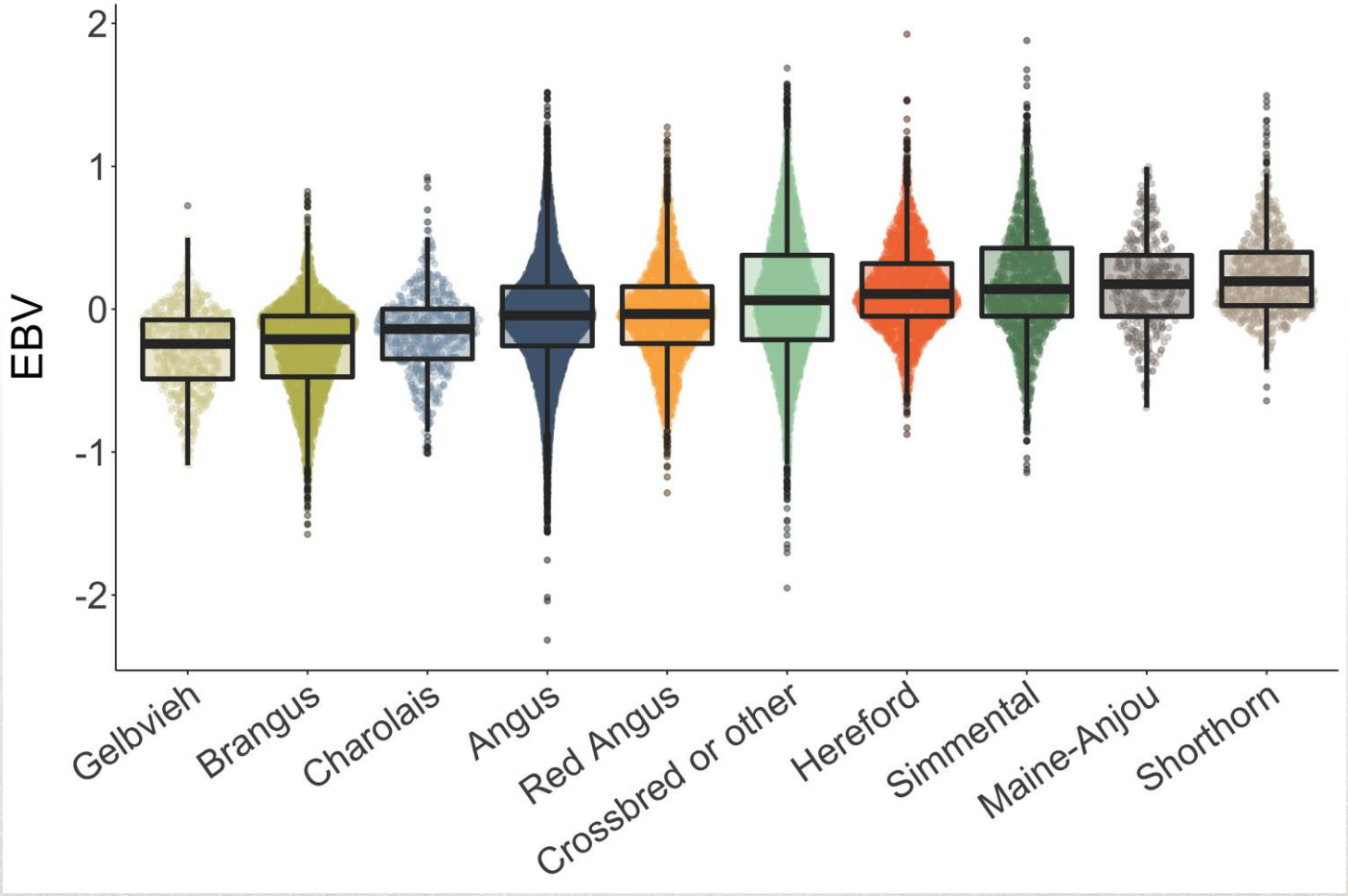
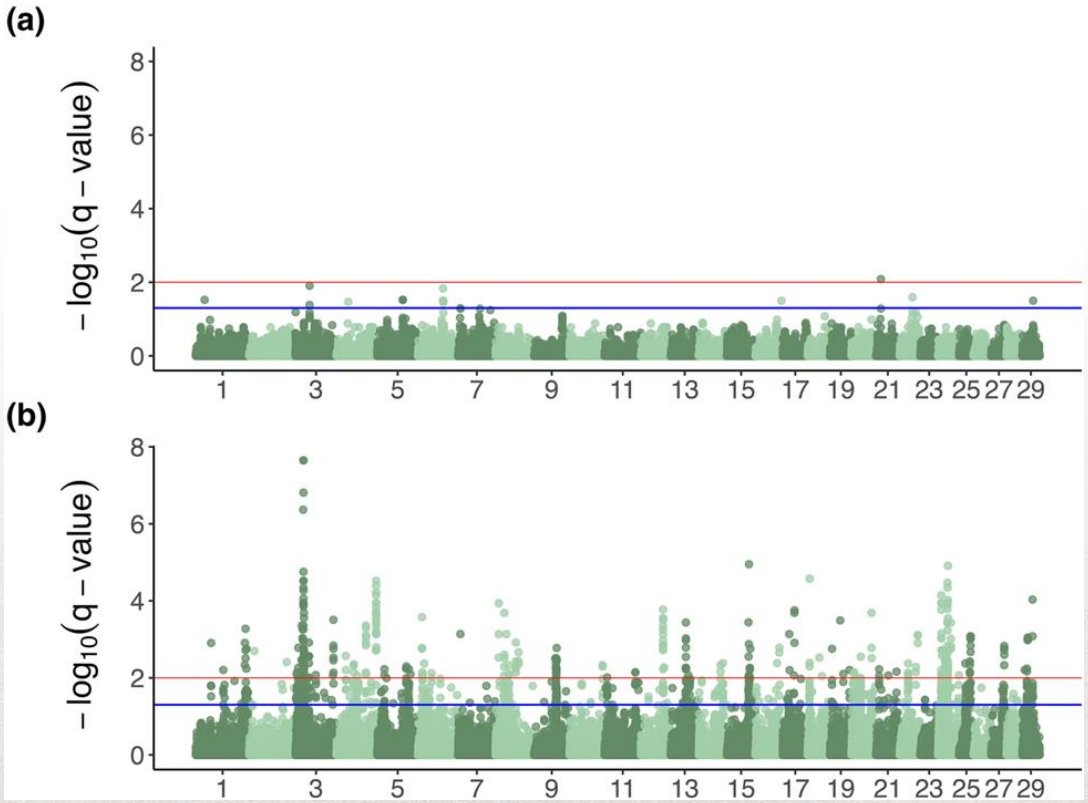


Figure S5, Durbin et al. 2024

HAIR SHEDDING AND ENVIRONMENTAL ADAPTABILITY

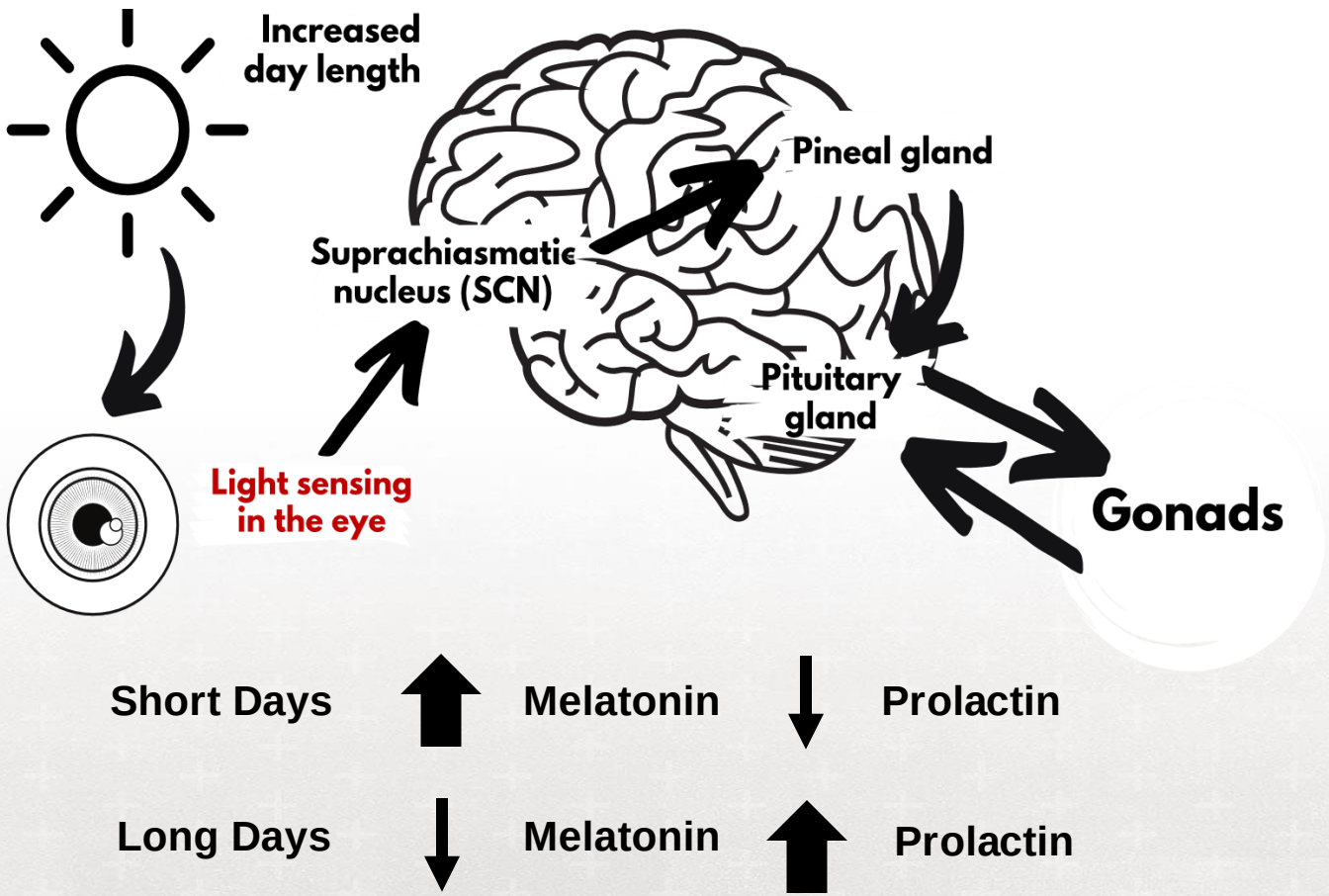


- Hair shedding not just an economically relevant trait…
- Relationship between hair shedding score and **length of daylight,** temperature and nutrition
- Lots of genotype-by-daylight interactions
  - GWAA identified 1,040 SNP
  - Most related to metabolism and light sensing
- This same study identified only 17 SNP related to genotype-by-temperature

Durbin et al., 2024 *G3 Genes|Genomes|Genetics*, Volume 14, Issue 2, February 2024, jkad279

HAIR SHEDDING AND DAYLIGHT

- Winter – Spring – Summer
- Increased daylight hours triggers hormonal response that decreases melatonin production
- Melatonin inhibits prolactin
- Increased prolactin triggers seasonal hair shedding



Hair shedding is an indicator of an animal's ability to sense change in daylight, or their ability to **respond to their environment**

MORE THAN 'HEAT TOLERANCE'

- Hair shedding in cattle is becoming a relevant selection criteria for more than just the Southeastern United States
- Breeders all across the globe should be hair shed scoring

PROVIDING THE RIGHT BULL

More than ‘heat tolerance’

- Breeders all across the globe should be hair shed scoring
  - **Customer service** to commercial bull buyers in other parts of the United States and the world
  - Trait for environmental adaptability

HOW TO IMPLEMENT HAIR SHEDDING INTO A SELECTION PROGRAM

1. Select bulls with lower HS EPD

HAIR SHEDDING RESEARCH AT AGI

University of Missouri data (n = 8,041)

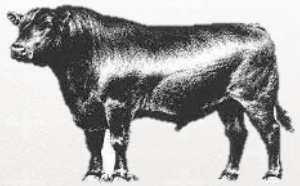
AGI legacy data (n = 6,374)

- Total of **14,465** hair shedding scores on **8,642** animals between 2011 and 2019
  - **3,893** genotyped at 50K level or higher
- Research EPD published in 2020
- Now, published EPD on the weekly evaluation!
- Today, AGI reports a total of **36,500** hair shedding records!

HAIR SHED EPD

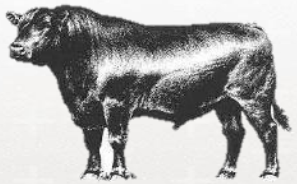
"Expressed in units of hair shed score, with a lower EPD being more favorable indicating a sire should produce progeny who shed their winter coat earlier in the spring."

Bull A



HS EPD
+ 0.25

Bull B



HS EPD
+ 0.75

Even though not expressed in half scores, we would expect, on average, progeny of Bull A to receive hair shedding scores 0.5 points lower than those of Bull B. In other words, they would shed their winter coats faster.

HOW TO IMPLEMENT HAIR SHEDDING INTO A SELECTION PROGRAM

1. Select bulls with lower HS EPD

2. Moderately high heritability and repeatability means that phenotypic assessment for culling and replacement heifer selection will create genetic change

HOW TO IMPLEMENT HAIR SHEDDING INTO A SELECTION PROGRAM

1. Select bulls with lower HS EPD

2. Moderately high heritability and repeatability means that phenotypic assessment for culling and replacement heifer selection will create genetic change

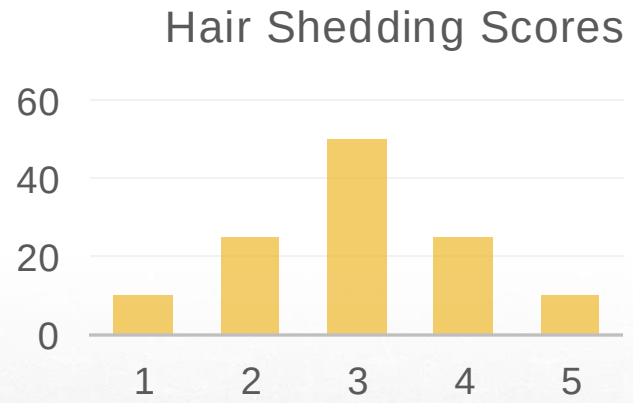
3. Report hair shed scores to your genetic service provider for incorporation into the genetic evaluation

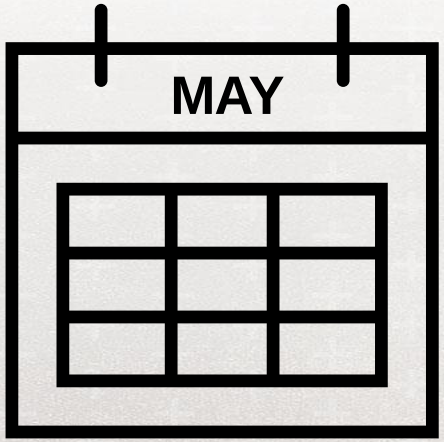
HAIR SHED EPD

CONSIDERATIONS AND BEST PRACTICES

- **When do you score animals?**
  - Climate dependent: score when variability is highest
  - Bell curve, a few 1's and 5s, a lot of 3s
    - Late April – early June
    - Sometime in May will be best for most herds
  - Best to do the whole cow herd on the same day

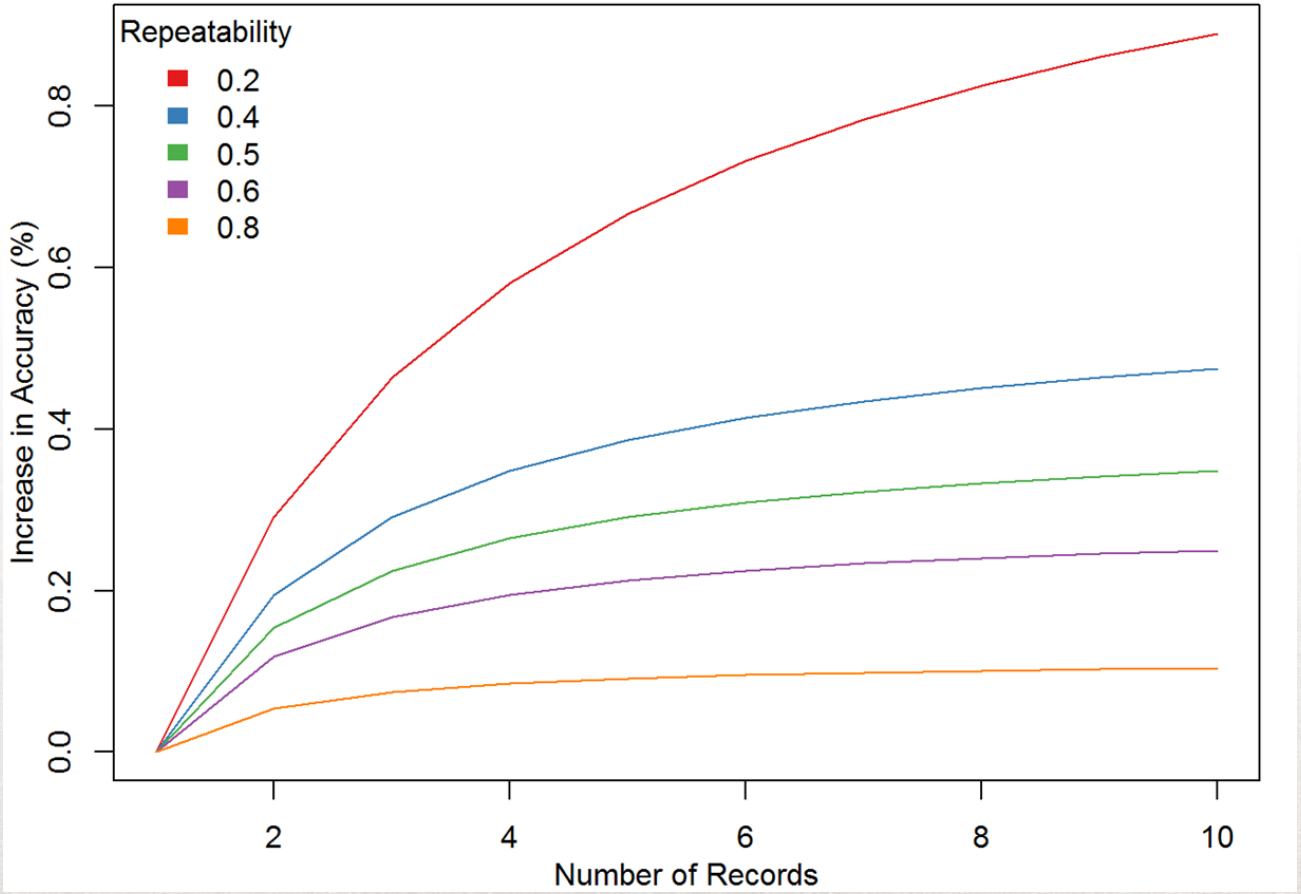
  - **Males begin shedding earlier than females**
    - Score herd bulls or pens of bulls at least 2 weeks prior to females





CONSIDERATIONS AND BEST PRACTICES

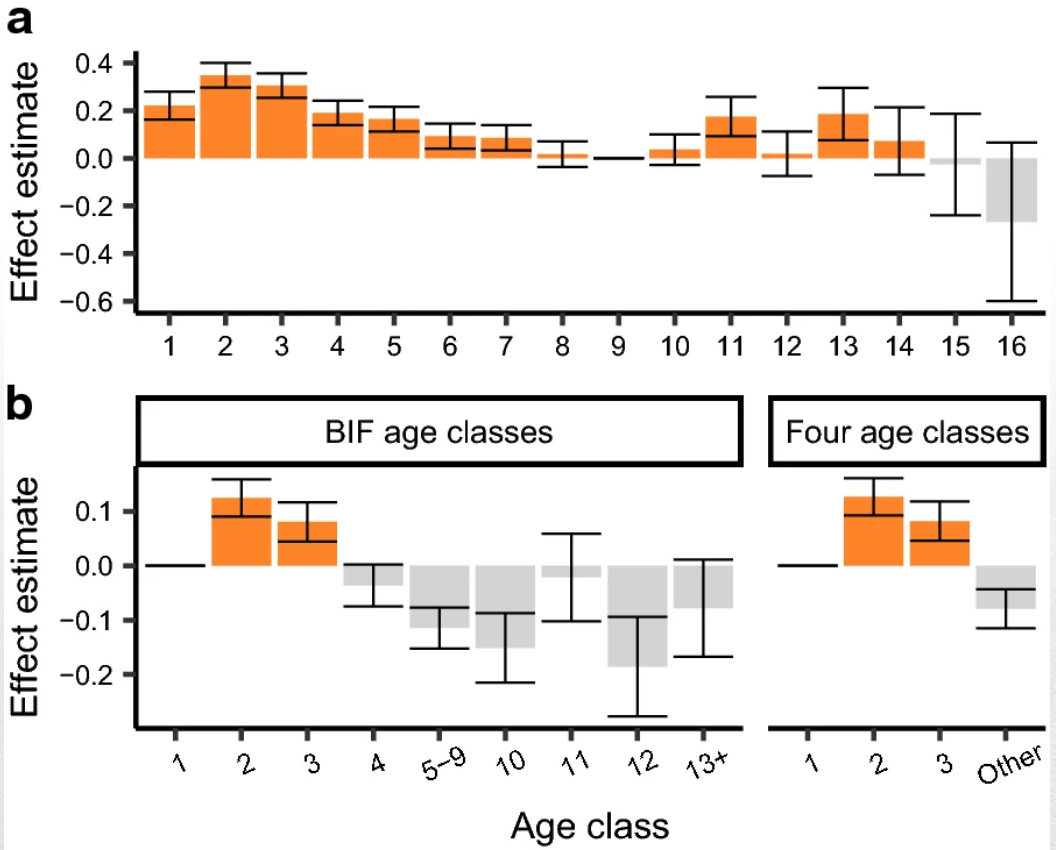
- **How many years of data?**
  - Based on estimated heritability/repeatability, at least 3 years of data is ideal



Mizzou Data

CONSIDERATIONS AND BEST PRACTICES

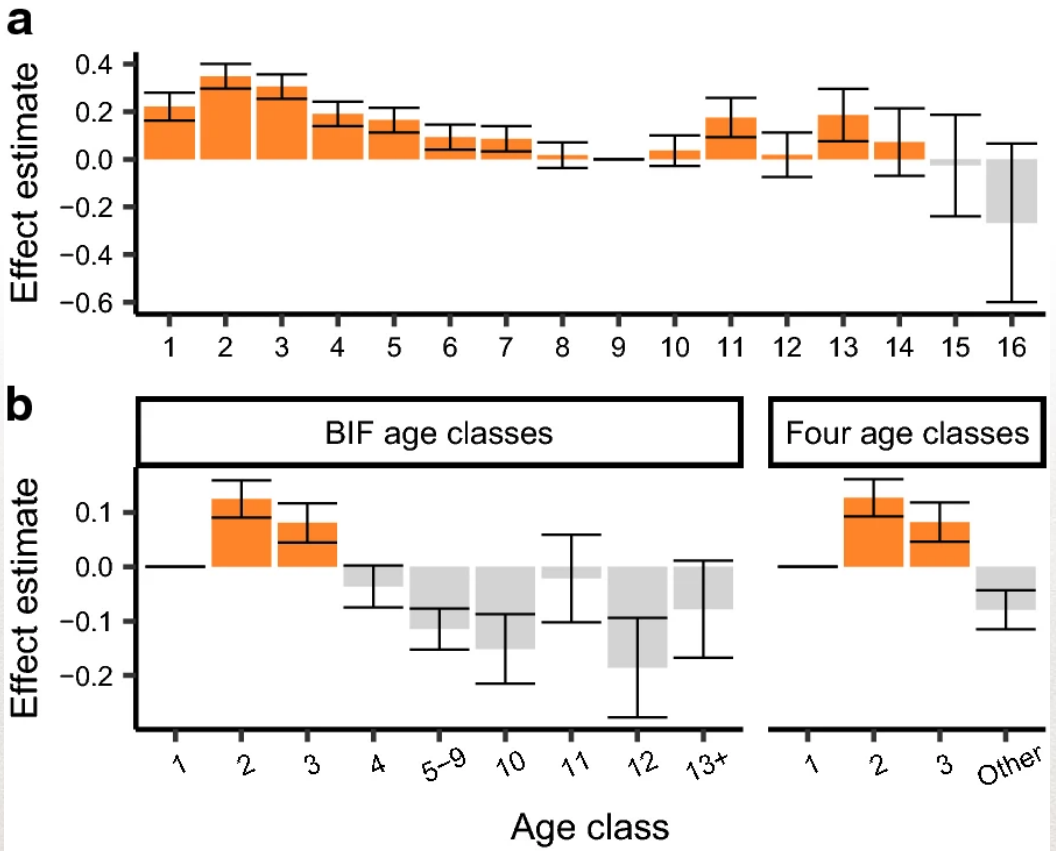
- **How does age affect hair shedding?**
  - Yearlings and first calf heifers tend to have higher hair shedding scores
  - Older cows with higher scores fall out?



Data from Durbin et al. 2020

CONSIDERATIONS AND BEST PRACTICES

- **How does management affect hair shedding?**
  - Genetic variants associated with hair shedding have functions related to metabolism
  - Youngest cows are most nutritionally stressed



Data from Durbin et al. 2020

CONSIDERATIONS AND BEST PRACTICES

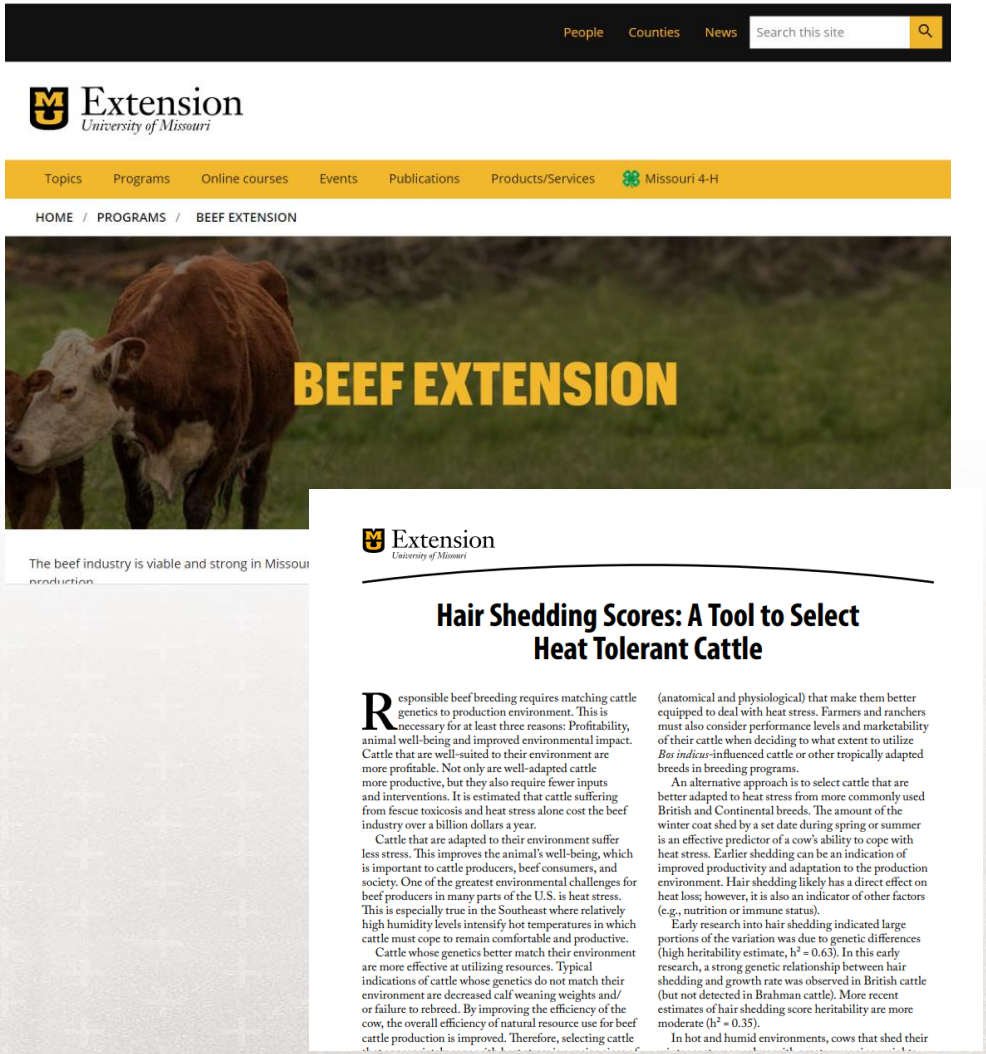
- ***How does hair shedding affect management?***

UNANSWERED QUESTIONS

- Investigate the relationship between hair shedding and other traits
  - Functional Longevity
  - Heifer Pregnancy
- Continue to investigate GxE of hair shedding

ANSWERED QUESTIONS

- Educational materials available at extension.missouri.edu
  - Hair Shedding "How-To" and FAQ – ***NEW!***
  - Hair Shedding Scores: A Tool to Select Heat Tolerant Cattle (G2014)
  - Hair Shedding Scores: More than Heat Stress – ***NEW!***



THANK YOU!

Jamie Courter, Ph.D.

jcourter@missouri.edu

531-220-6955

Jared Decker, Ph.D.

576-819-0837