

PRACTICAL APPLICATION OF HAIR SHEDDING SCORES AND EPDS IN YOUR HERD

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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


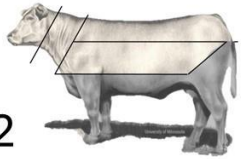
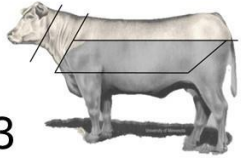
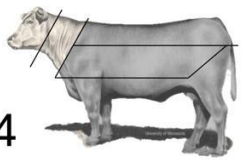



- **Hair Shedding**

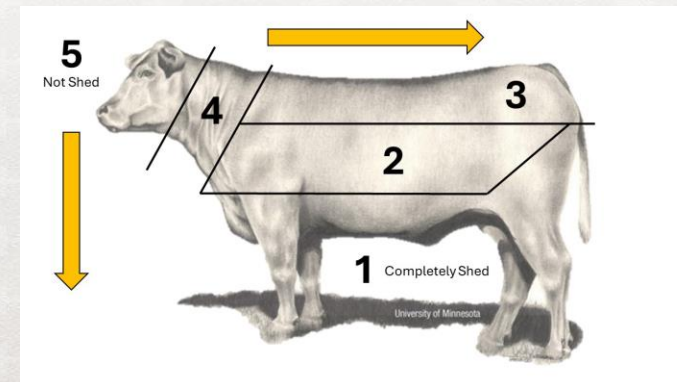
- Scoring how early the winter hair is shed off



HAIR SHEDDING SCORES

1		Smooth, short summer coat 100% shed
2		Coat is mostly shed ~75% shed
3		Coat is halfway shed ~50% shed
4		Exhibits initial shedding ~25% shed
5		Full winter coat 0% shed

- 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



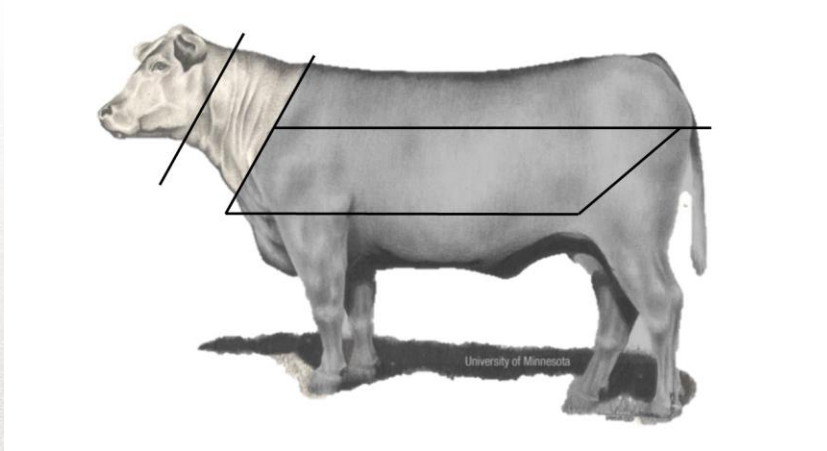
HAIR SHEDDING SCORES

- 5 - 0% shed, full winter coat



HAIR SHEDDING SCORES

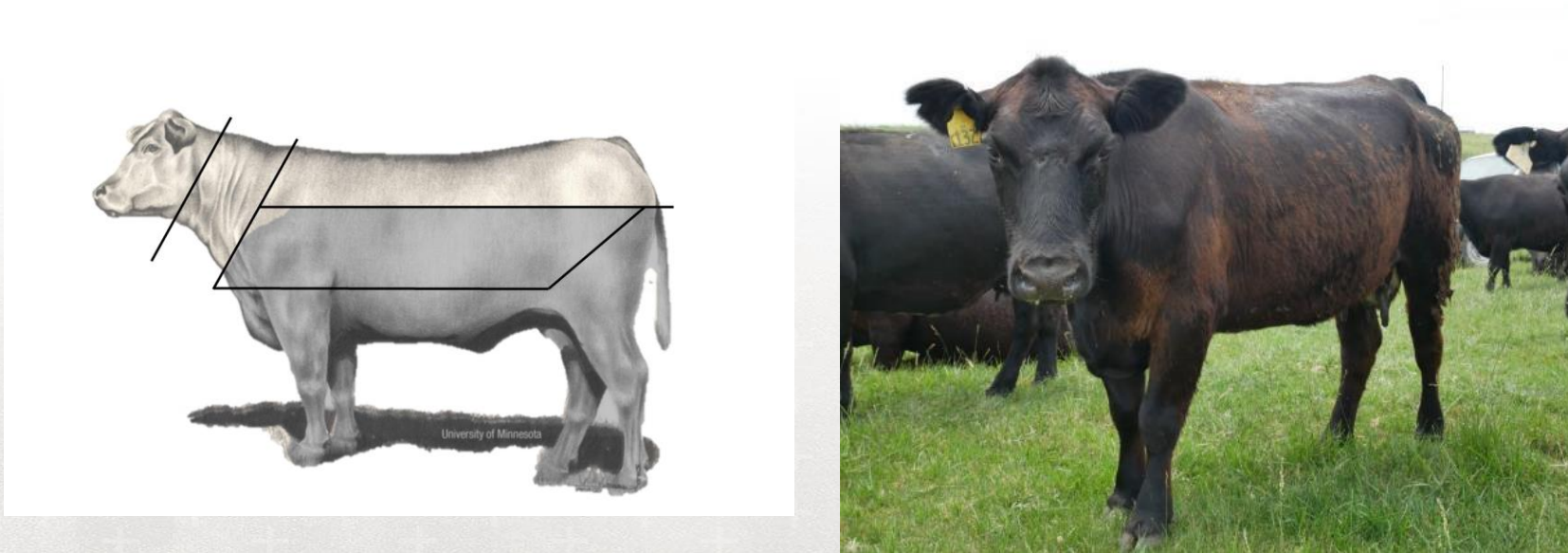
- 4 - 25% shed, exhibits initial shedding



Typically, only shed from the neck

HAIR SHEDDING SCORES

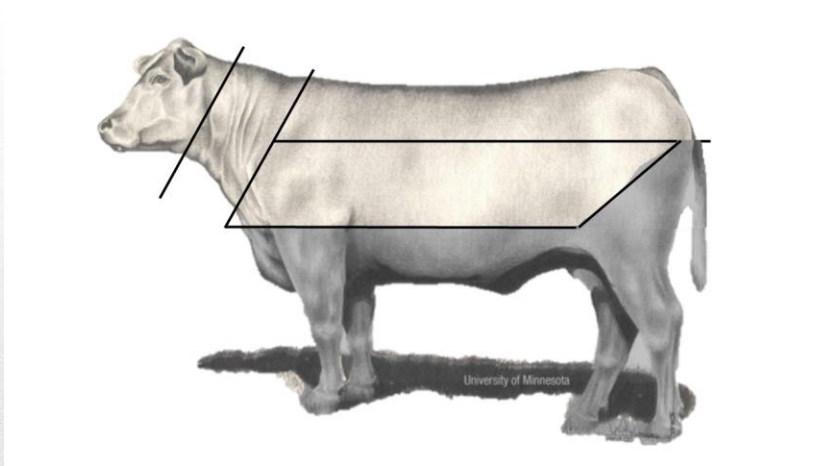
- 3 - 50% shed



Will include hair along the body, often in patchy spots

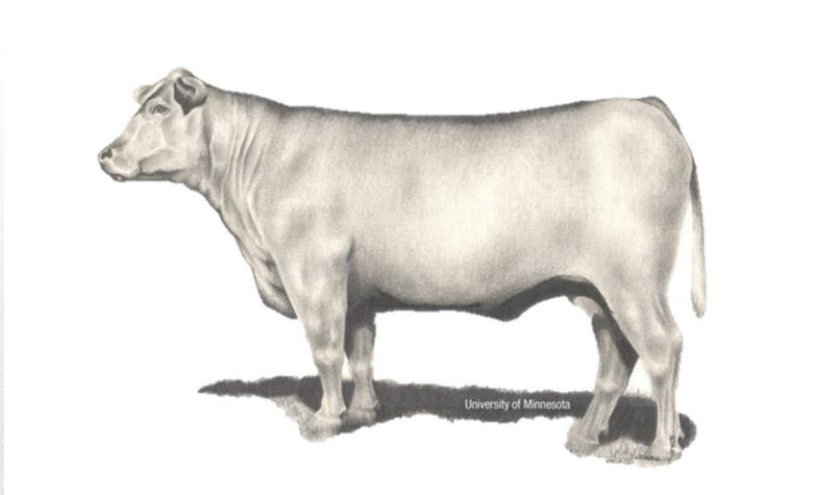
HAIR SHEDDING SCORES

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



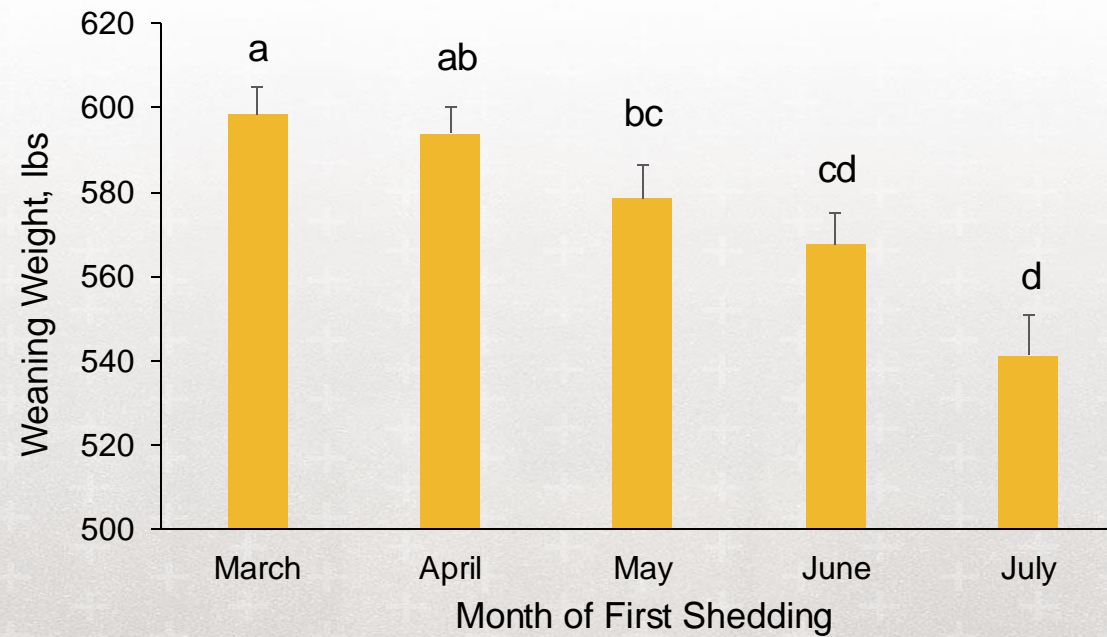
HAIR SHEDDING SCORES

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



IMPACT ON PERFORMANCE

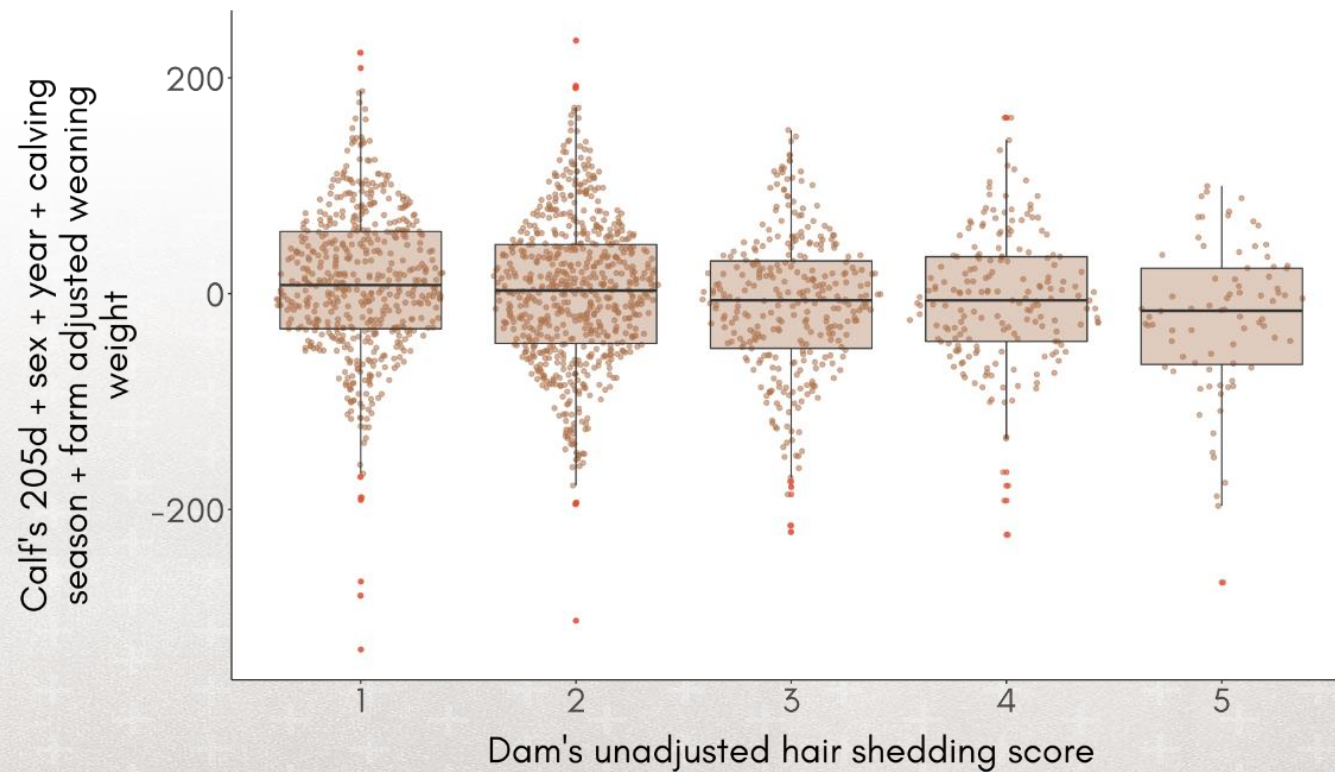
- Earlier shedding cows tend to wean an older, heavier calf



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

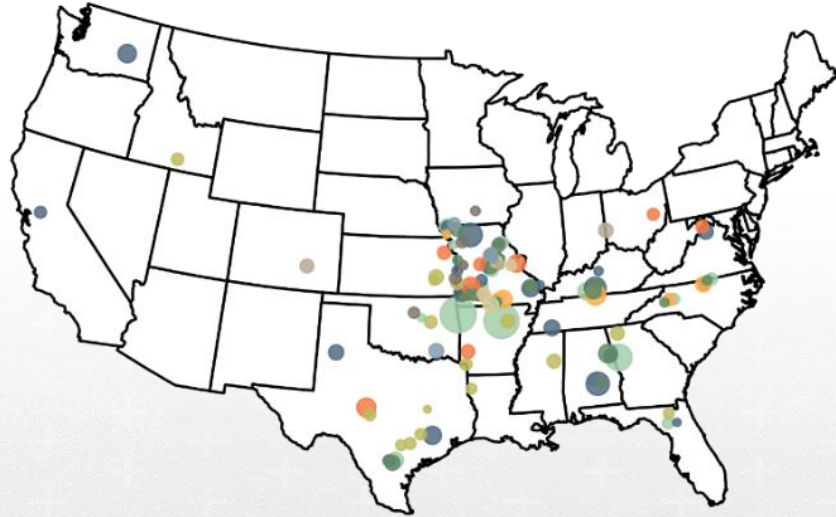


Dataset	σ_A^2	σ_{PE}^2	σ_P^2	h^2	r
Not grazing toxic fescue	0.30	0.00	0.90	0.34	0.34
Grazing toxic fescue	0.38	0.05	0.95	0.40	0.45

- 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



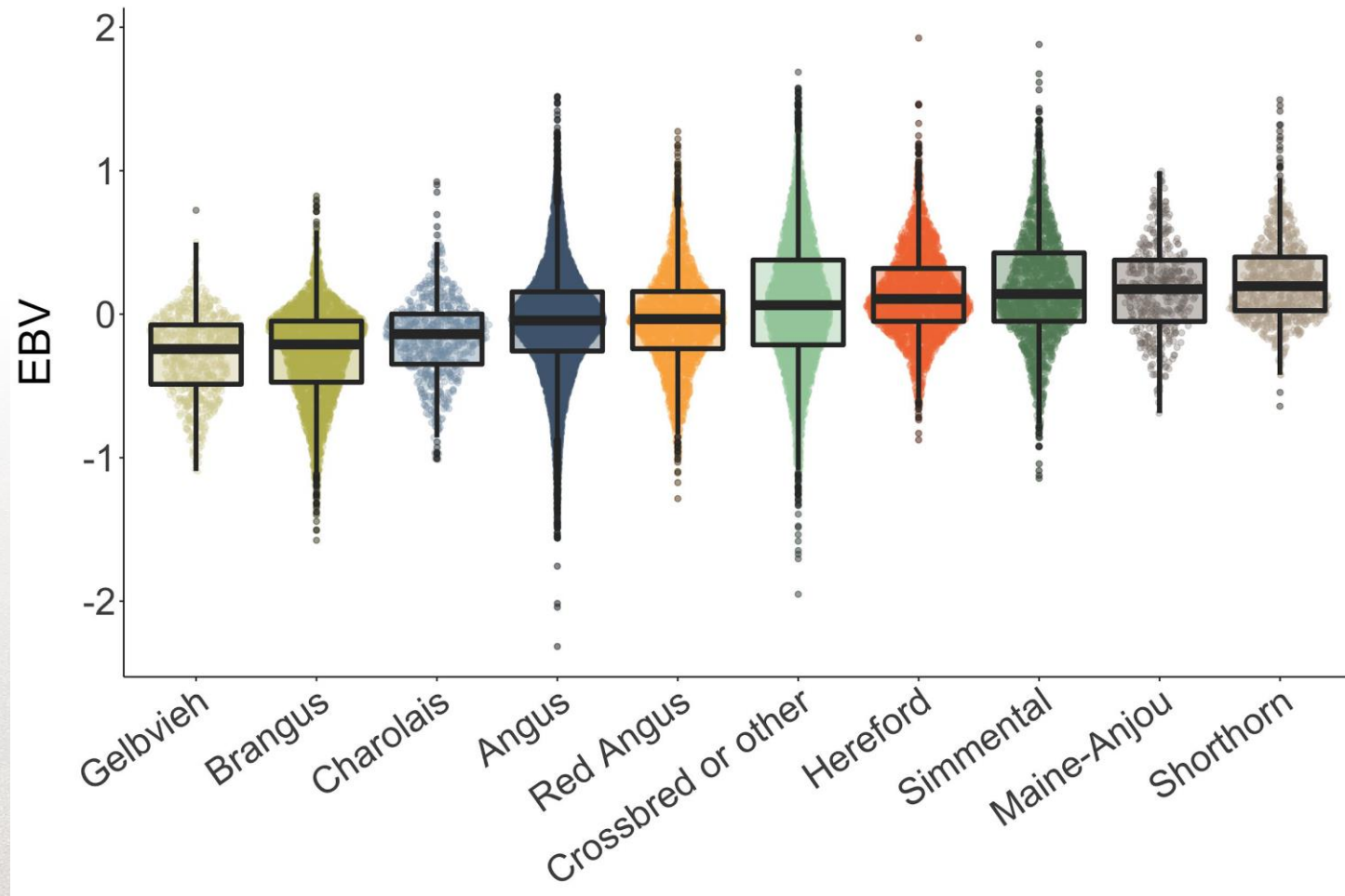
● Crossbred or other: 14,986	● Simmental: 2,288	● Shorthorn: 489
● Angus: 10,222	● Brangus: 1,918	● Maine-Anjou: 263
● Hereford: 2,993	● Gelbvieh: 748	
● Red Angus: 2,316	● Charolais: 676	

- 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

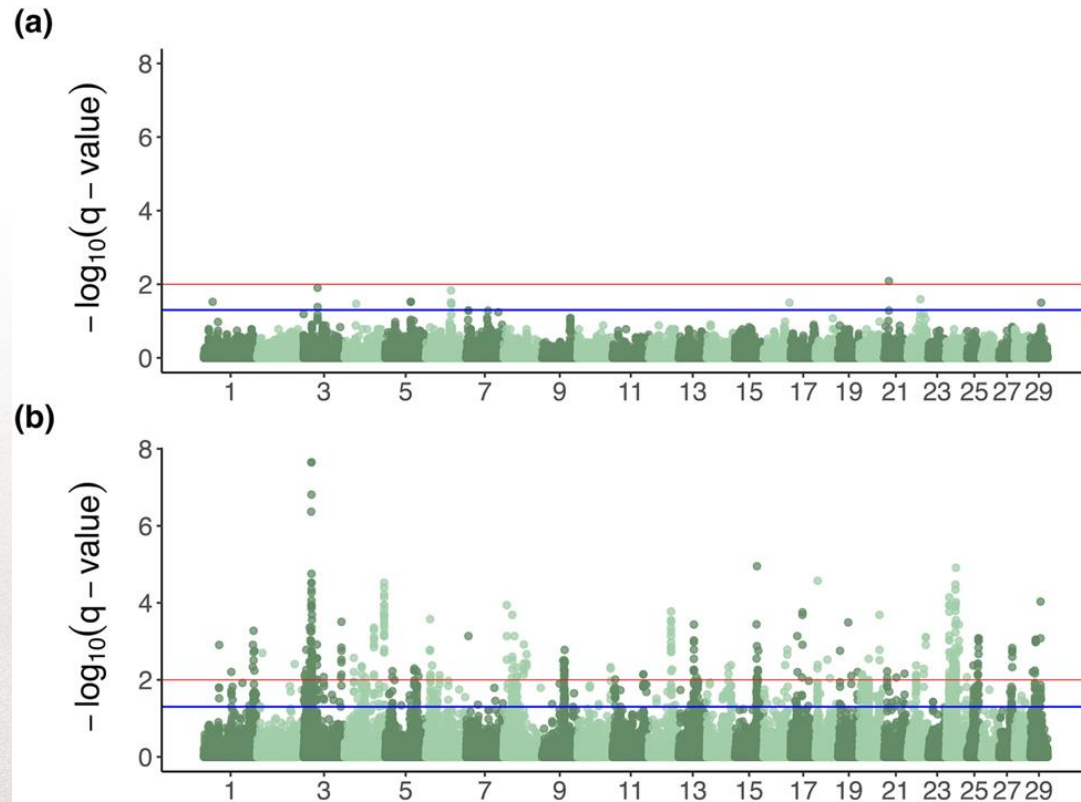
HAIR SHEDDING SCORE IS MODERATELY HERITABLE

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



HAIR SHEDDING AND ENVIRONMENTAL ADAPTABILITY

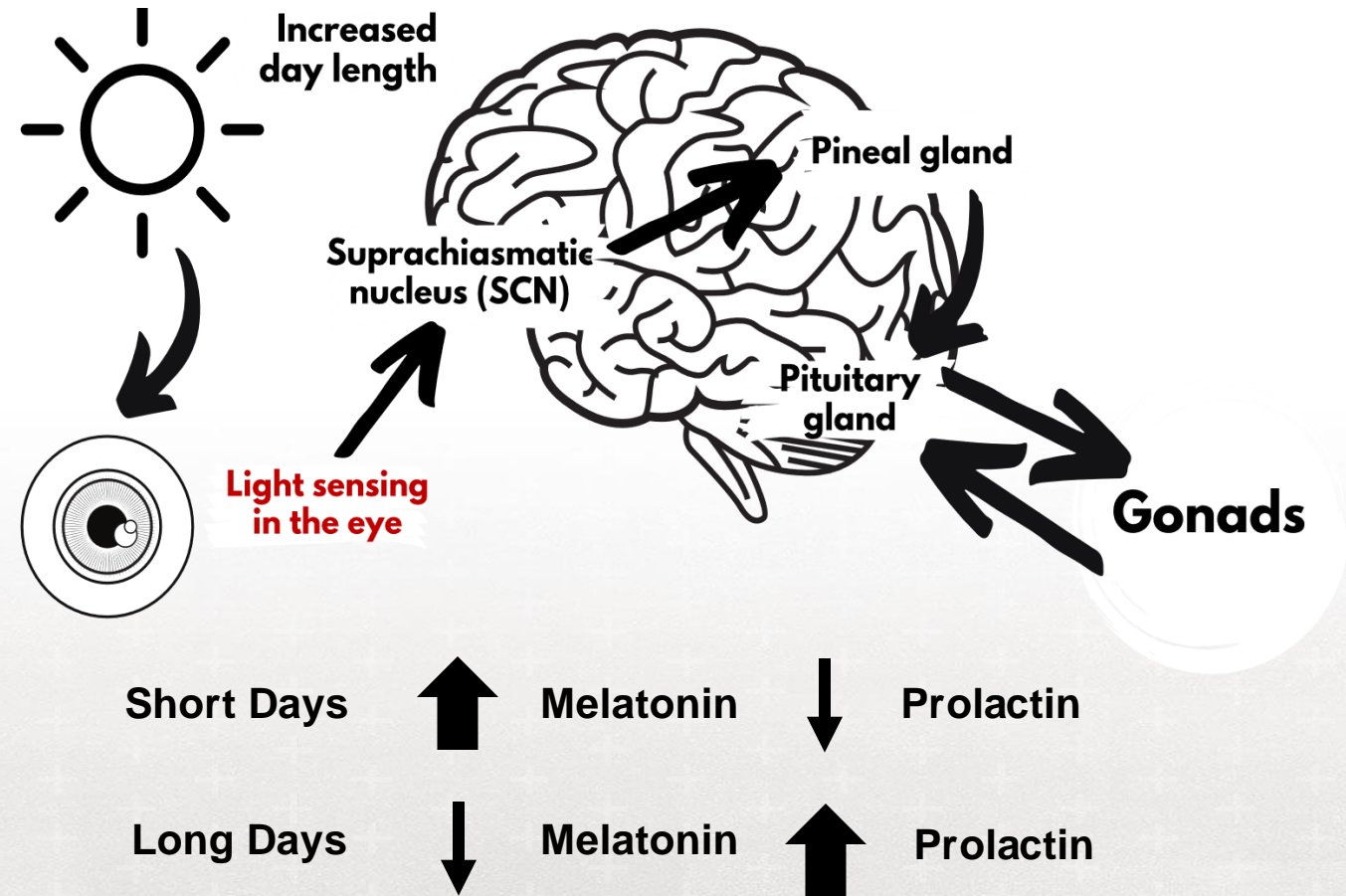


- Hair shedding not just an economically relevant trait...
- Relationship between hair shedding score and **length of daylight**, temperature and nutrition
- Lots of genotype-by-daylight interactions
 - GWAA identified 1,040 SNP
 - Most related to metabolism and light sensing
- This same study identified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

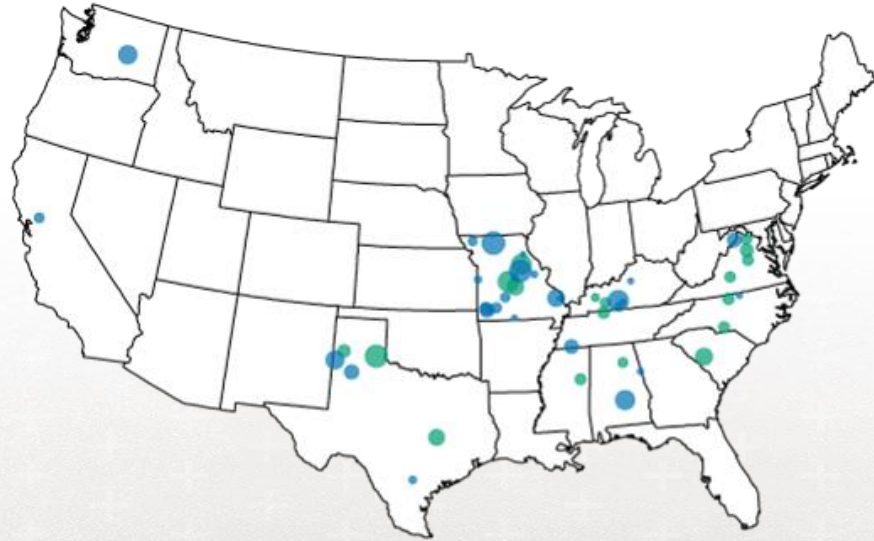
More than 'heat tolerance'

- 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

*Talk to your
genetic service
provider today!*

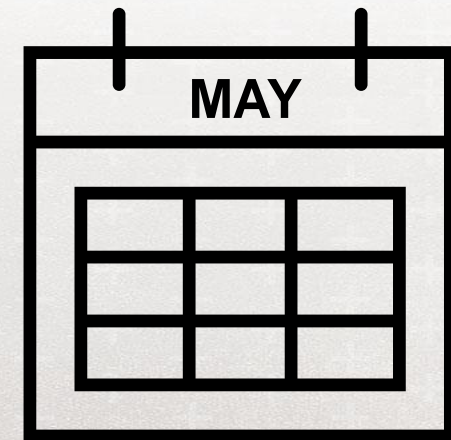
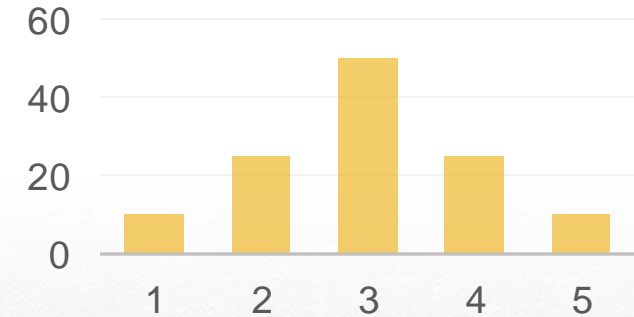
CONSIDERATIONS AND BEST PRACTICES

- **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

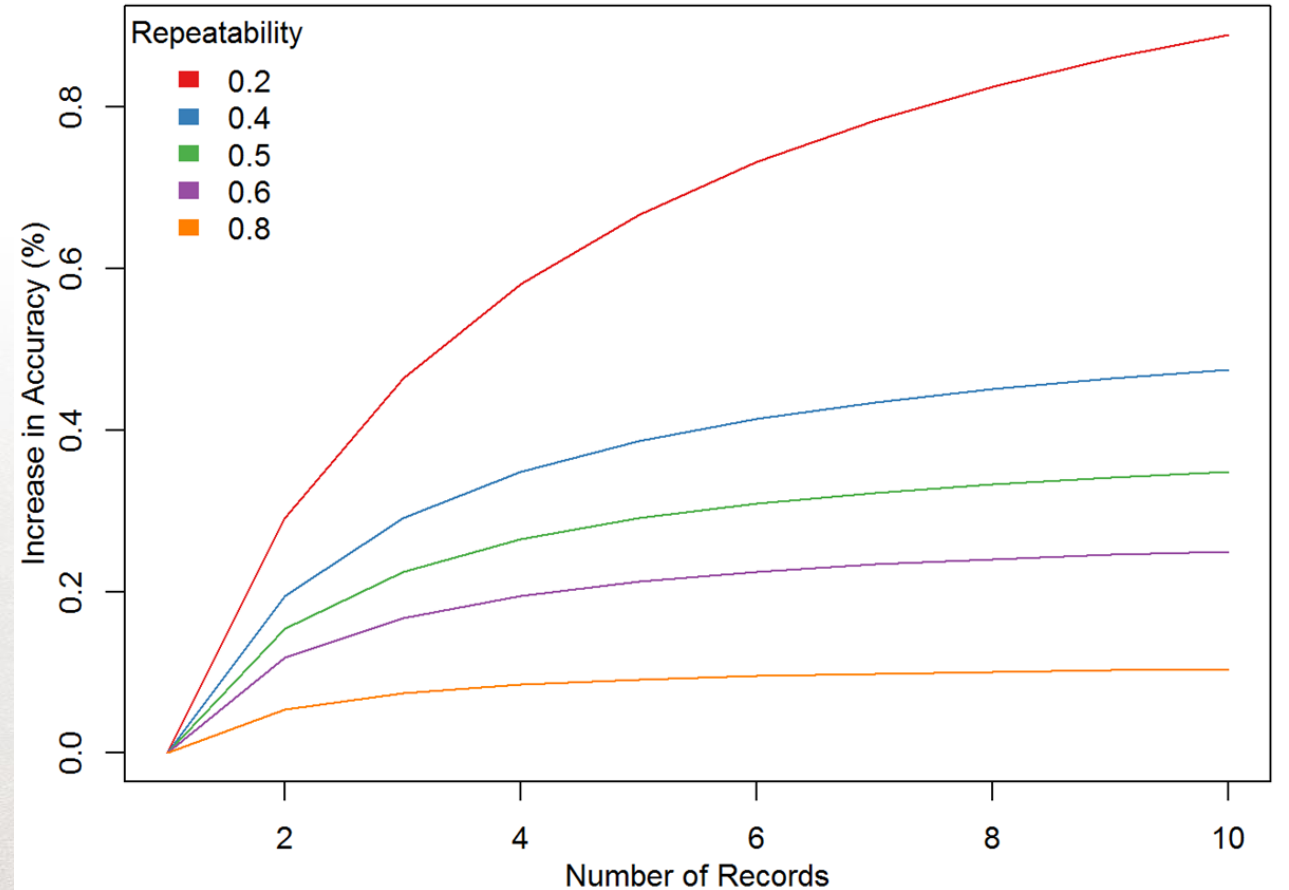
- **Males begin shedding earlier than females**
 - Score herd bulls or pens of bulls at least 2 weeks prior to females

Hair Shedding Scores



CONSIDERATIONS AND BEST PRACTICES

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

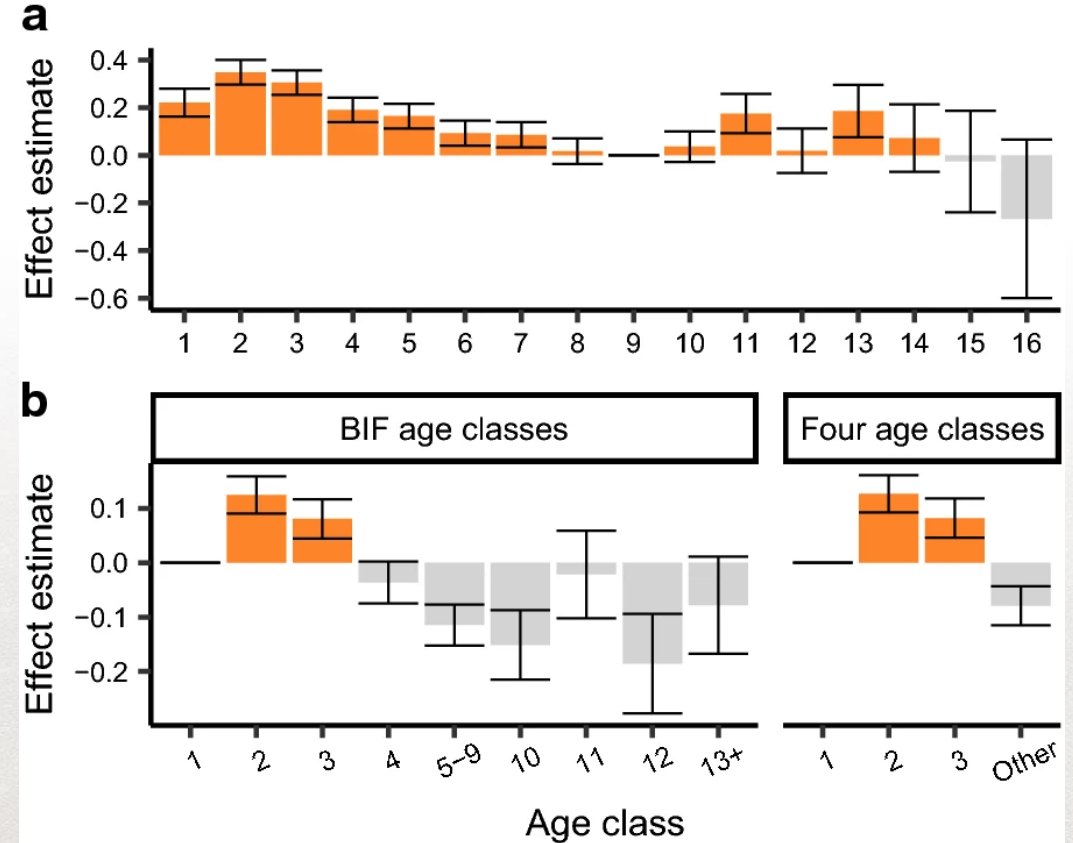


Mizzou Data

CONSIDERATIONS AND BEST PRACTICES

- How does age affect hair shedding?

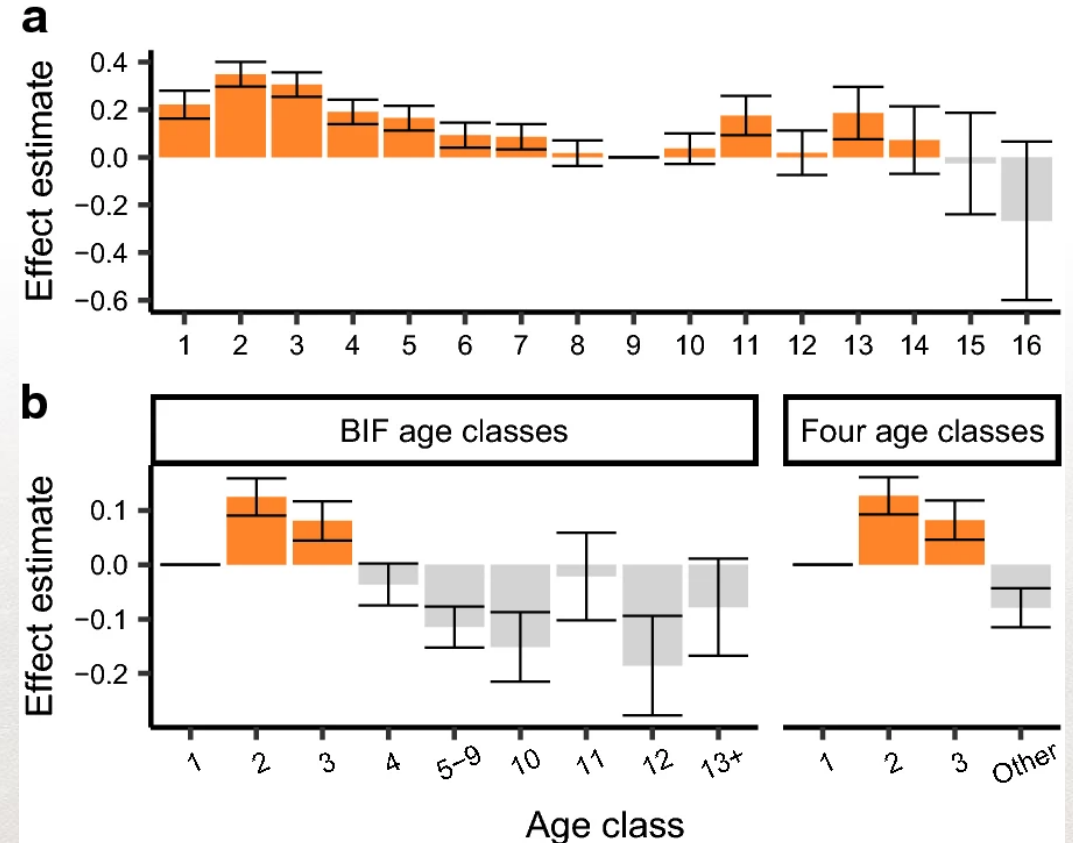
- Yearlings and first calf heifers tend to have higher hair shedding scores
- Older cows with higher scores fall out?



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!**

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Hair Shedding Scores: A Tool to Select Heat Tolerant Cattle

Responsible beef breeding requires matching cattle genetics to production environment. This is necessary for at least three reasons: Profitability, animal well-being and improved environmental impact. Cattle that are well-suited to their environment are more profitable. Not only are well-adapted cattle more productive, but they also require fewer inputs and interventions. It is estimated that cattle suffering from fescue toxicosis and heat stress alone cost the beef industry over a billion dollars a year.

Cattle that are adapted to their environment suffer less stress. This improves the animal's well-being, which is important to cattle producers, beef consumers, and society. One of the greatest environmental challenges for beef producers in many parts of the U.S. is heat stress. This is especially true in the Southeast where relatively high humidity levels intensify hot temperatures in which cattle must cope to remain comfortable and productive.

Cattle whose genetics better match their environment are more effective at utilizing resources. Typical indications of cattle whose genetics do not match their environment are decreased calf weaning weights and/or failure to rebreed. By improving the efficiency of the cow, the overall efficiency of natural resource use for beef cattle production is improved. Therefore, selecting cattle (anatomical and physiological) that make them better equipped to deal with heat stress. Farmers and ranchers must also consider performance levels and marketability of their cattle when deciding to what extent to utilize *Bos indicus*-influenced cattle or other tropically adapted breeds in breeding programs.

An alternative approach is to select cattle that are better adapted to heat stress from more commonly used British and Continental breeds. The amount of the winter coat shed by a set date during spring or summer is an effective predictor of a cow's ability to cope with heat stress. Earlier shedding can be an indication of improved productivity and adaptation to the production environment. Hair shedding likely has a direct effect on heat loss; however, it is also an indicator of other factors (e.g., nutrition or immune status).

Early research into hair shedding indicated large portions of the variation was due to genetic differences (high heritability estimate, $h^2 = 0.63$). In this early research, a strong genetic relationship between hair shedding and growth rate was observed in British cattle (but not detected in Brahman cattle). More recent estimates of hair shedding score heritability are more moderate ($h^2 = 0.35$).

In hot and humid environments, cows that shed their

THANK YOU!

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