Environmental adaptation & hair shedding

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About me

- B.S. Animal Science – Texas A&M University, 2016
- Ph.D. Genetics – University of Missouri Decker Lab, 2016 –present
  - Research includes **environmental adaptation**
    - **Hair shedding**
- Angus Genetics, Inc. intern

AGI

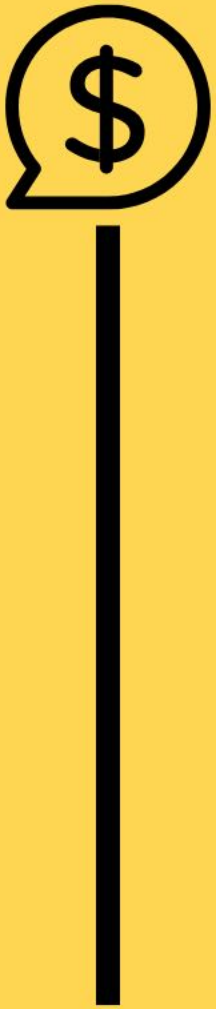
MU ANIMAL GENOMICS

Project 1: Hair shedding

- Background
- At Mizzou
- At Angus Genetics, Inc.

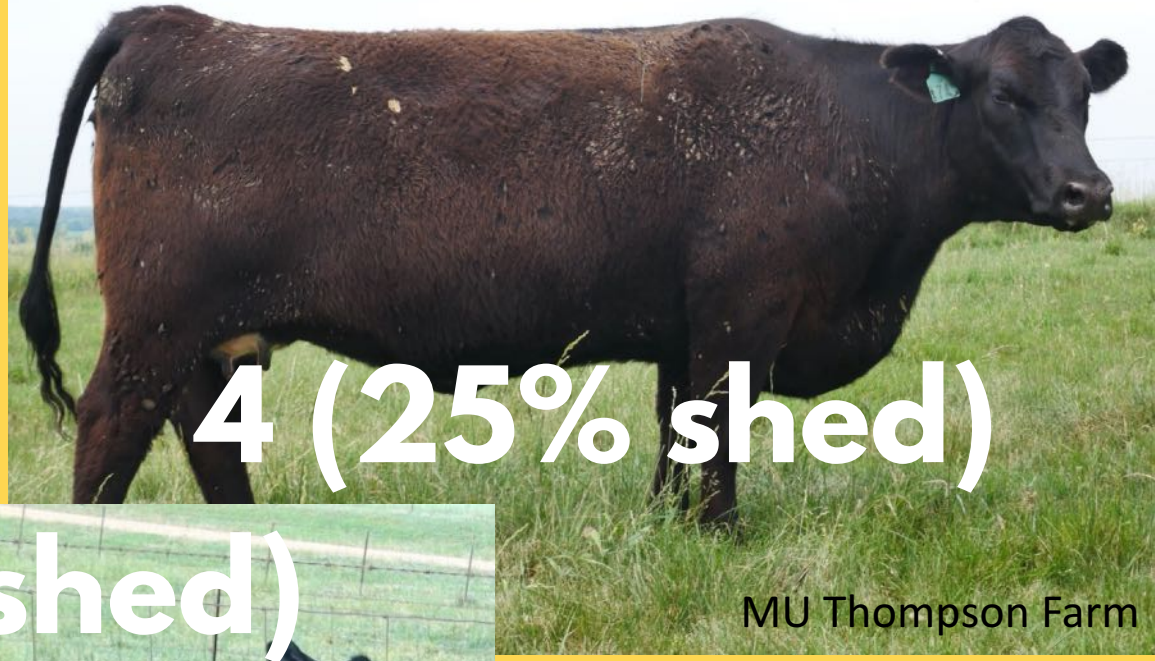
Project 2: Weaning weight across environments

Hair shedding background



- Losses from **fescue toxicosis > $ 600 million/year** & losses from **heat stress** likely even greater
- Possible to address from animal side
- Previous work suggests early summer hair shedding as an **indicator of tolerance to heat, fescue toxicosis**
- Easy to implement, multiple observations


5 (0% shed)
Eldon Cole

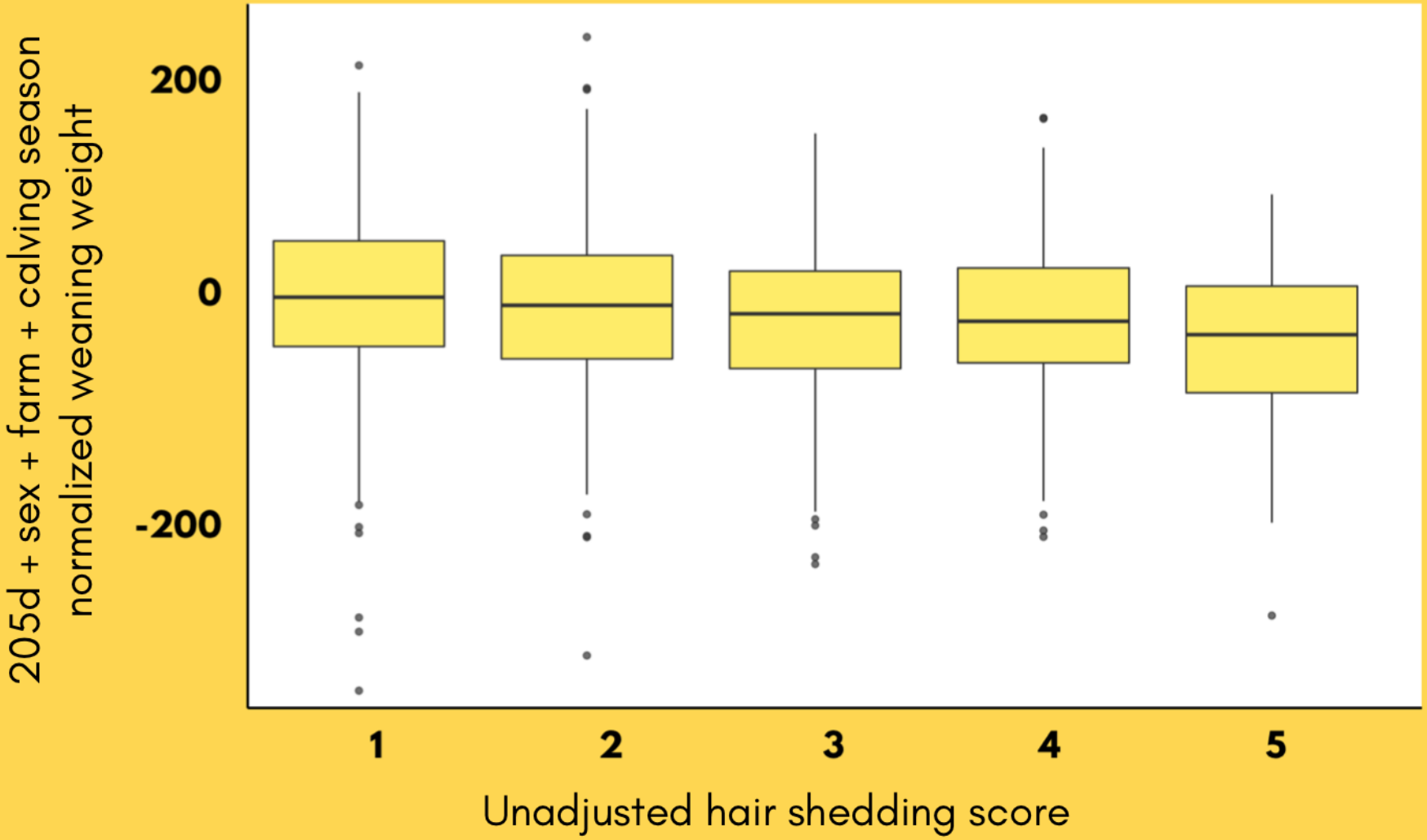

4 (25% shed)
MU Thompson Farm


2 (75% shed)
Trent Smith


MU Thompson Farm
3 (50% shed)


1 (100% shed)
Gibbs Farms

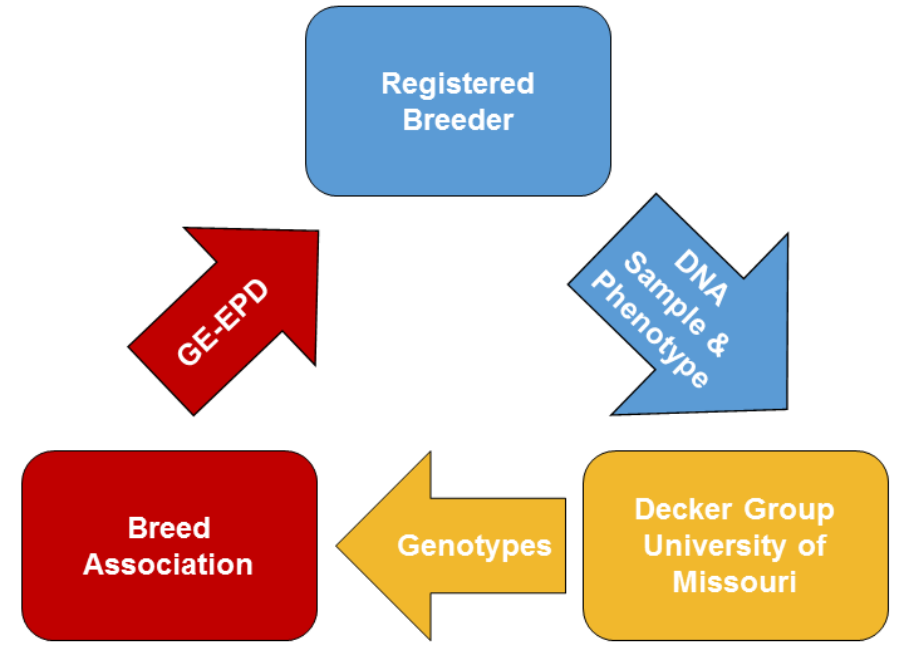
Hair shedding score of dam vs. calf weaning weight: 2016 & 2017 American Simmental Association data (n = 1,704)



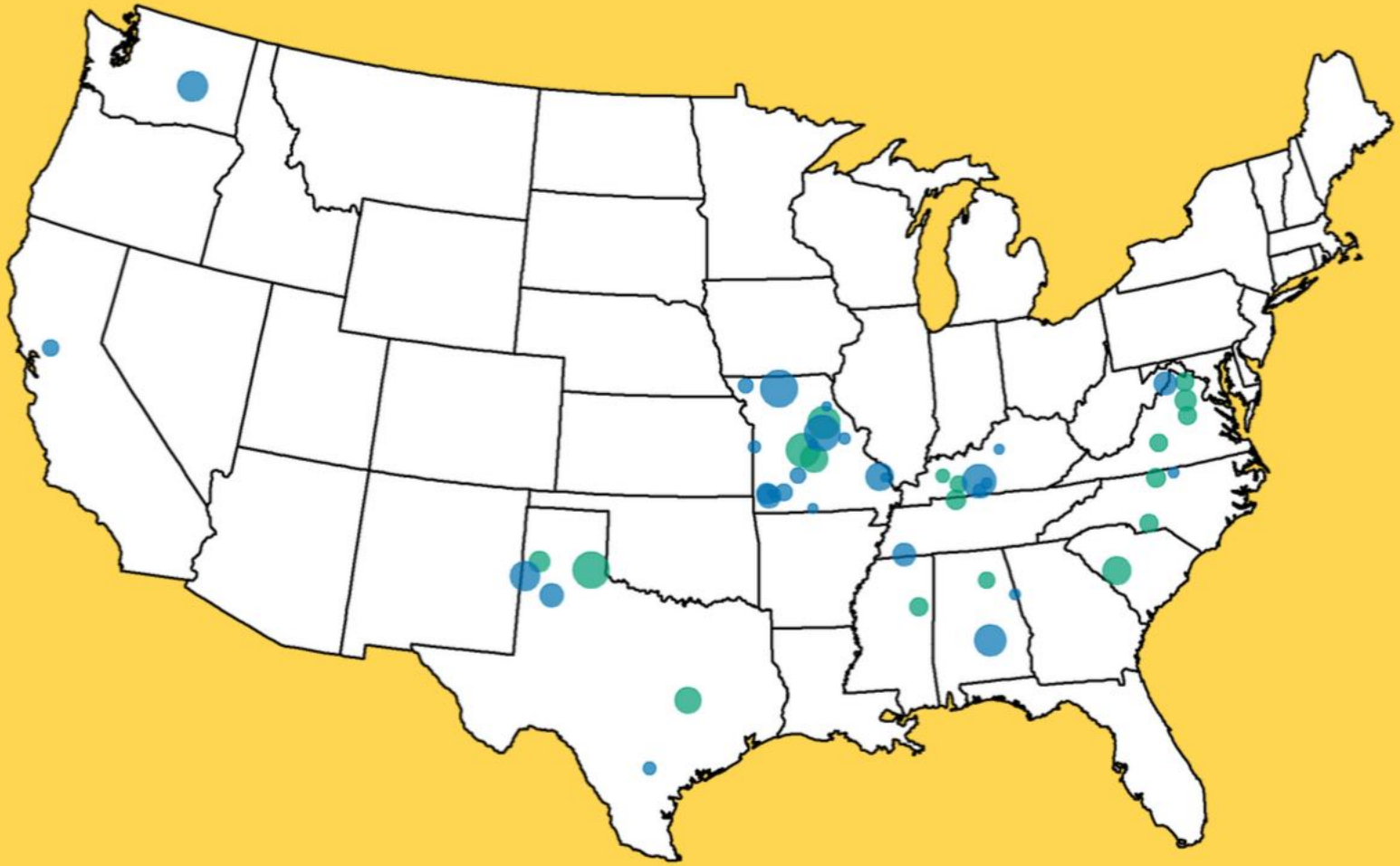
- **~12.00** lb. difference on average per hair shedding score
- **~48 lb.** difference between score 1 (best) and score 5 (worst)

Mizzou Hair Shedding Project

- 2016-present
- **Goal:** aggregate multi-breed hair shedding scores → generate selection tools for hair shedding
- **25,272** total hair shedding scores on **12,604** cattle from **11** breeds
  - **10,697** genotyped through the project
- **77** participating producers from **20** states, most in the fescue belt and/or heat stressed environments



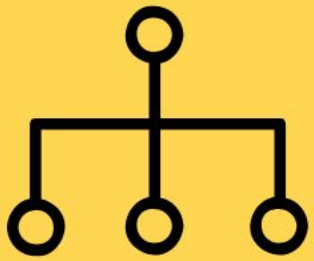
Combined Angus hair shedding data set: 14,465 scores from 8,642 animals



University of Missouri data (n = 8,041 scores)

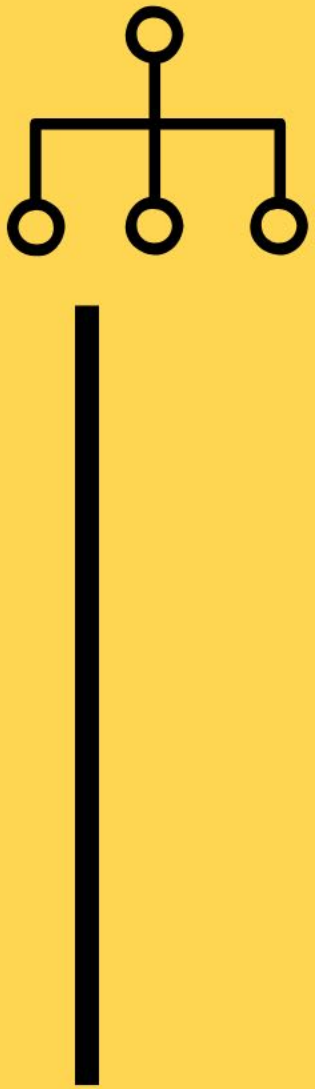
Legacy AGI data (n = 6,374 scores)

Hair shedding goals @ AGI



- Question: What variables matter when modeling hair shedding EPD?
  - **Age classes:** yearling heifers, 2-year olds, mature cows, old cows
  - **Score when variability is highest** in the herd
- Question: Heritability (h^2)?
  - **0.44 h^2**
    - Weaning weight h^2: 0.28, Marbling h^2: 0.48
  - Recommend 3 years of scores
- Question: Should hair shedding on vs. off fescue be treated as different traits?
  - **No, ~98% genetic correlation**

Moving forwards



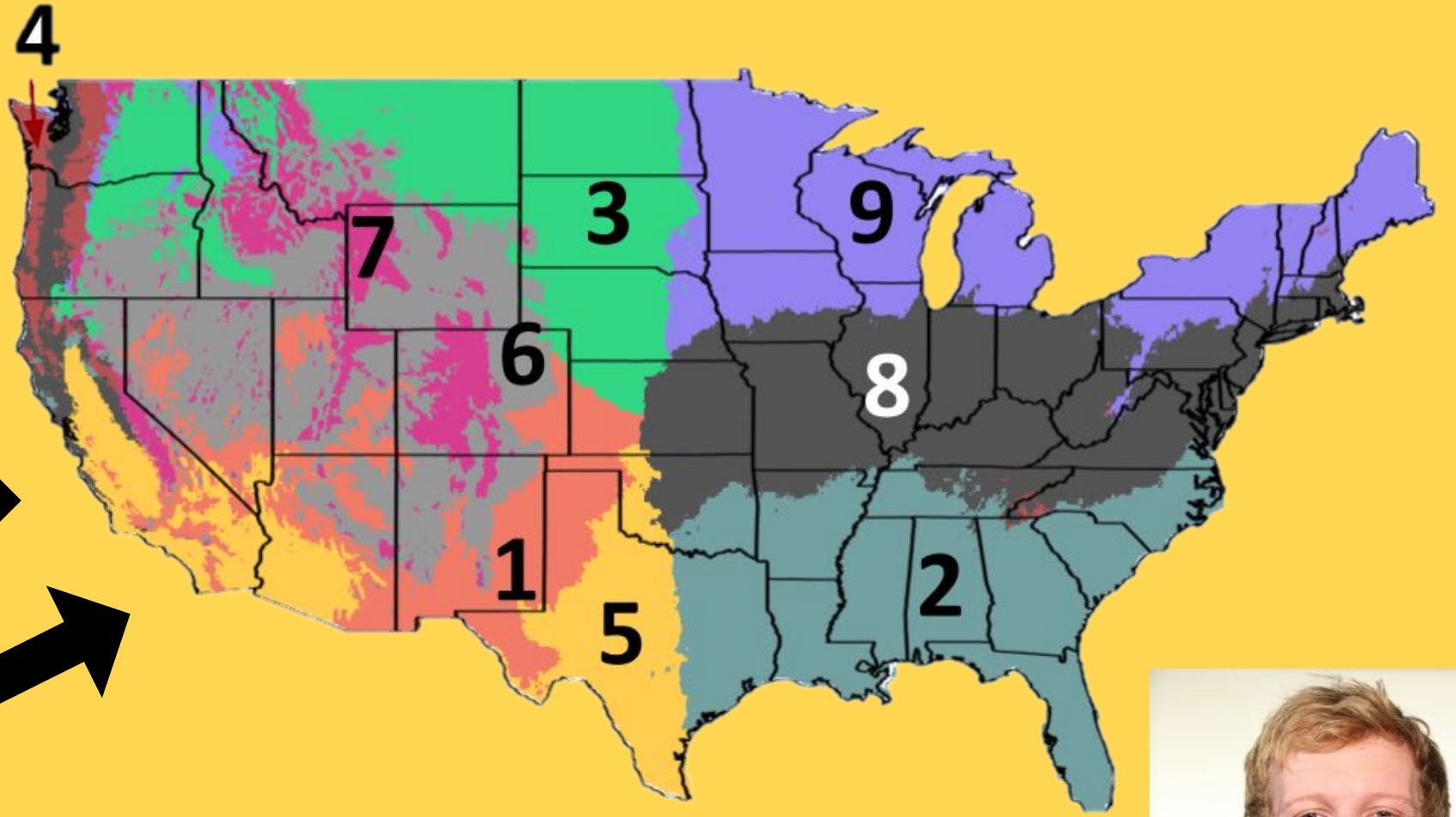
- Angus research EPD released 2020
- Relationship between hair shedding & other traits
  - *Fertility:* stayability/longevity, heifer pregnancy
  - *Growth:* birth weight & weaning weight of calf vs. hair score of dam
- **Selection index**
- **What DNA variants contribute to differences in hair shedding?**

Environmental regions

Elevation data

Temperature data

Rainfall data



Troy Rowan

7,080,318 weaning weight records retained for analysis

High Plains (region 3): 2,339,491

Fescue Belt (region 8): 1,928,930

Upper Midwest & Northeast (region 9): 865,800

Forested Mountains (region 7): 770,670

Southeast (region 2): 718,349

Arid Prairie (region 5): 263,737

Desert (region 1): 193,341

Phenotype

Management

Nutrition

=

Environment

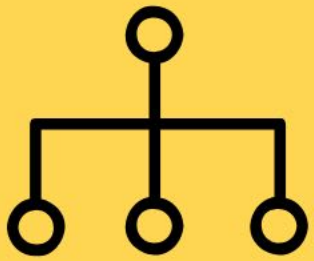
+

Birth type (ET vs. natural)

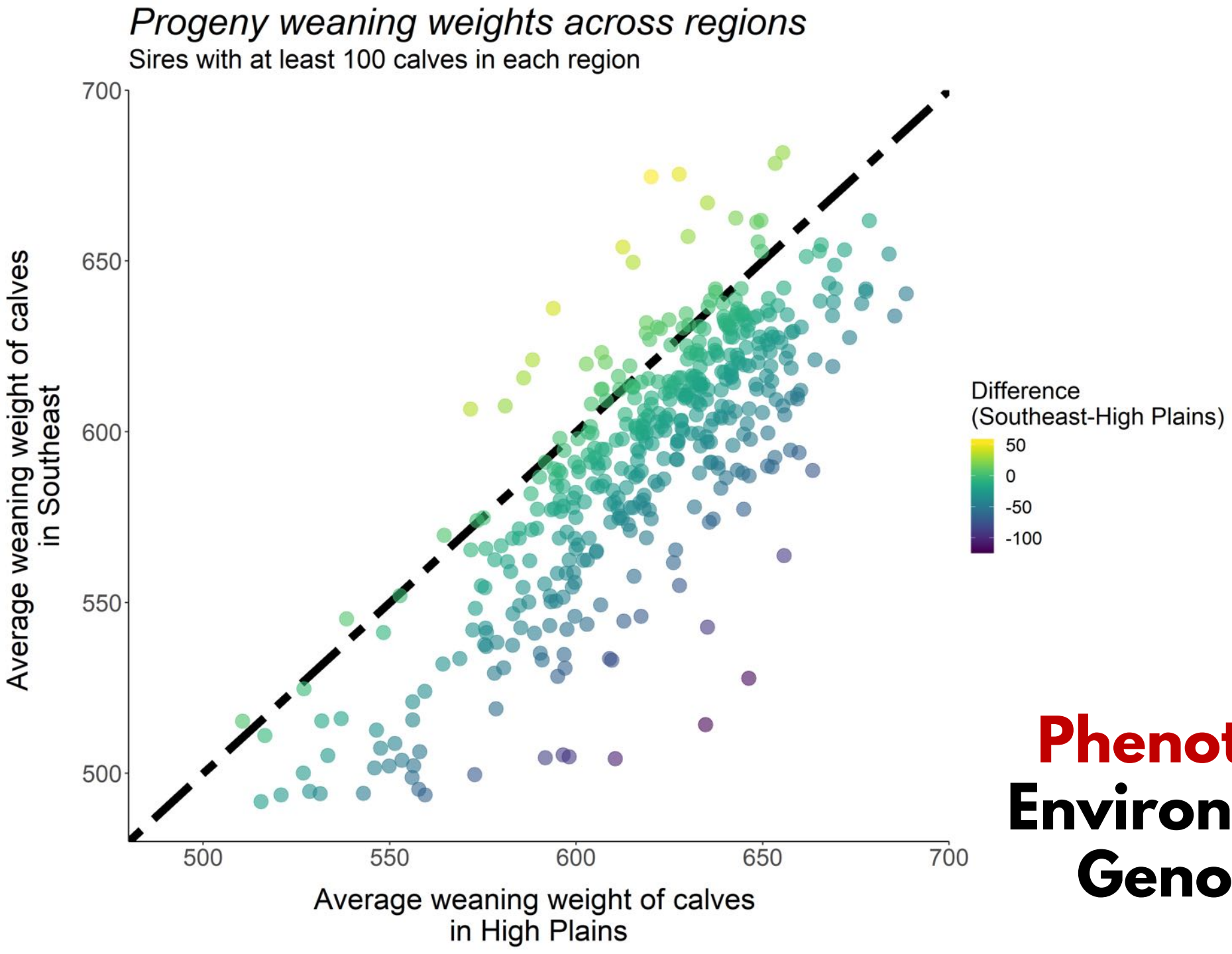
Weather/climate

Genotype

Environmental region questions @ AGI



- How much does weaning weight differ between environmental regions?
- How much of the difference is due to genetics vs. the environment?
- How much re-ranking of EPDs across regions?



Phenotype = Environment + Genotype

Phenotype

Management

Nutrition

=

~~Environment~~

Birth type (ET vs. natural)

+

Weather/climate

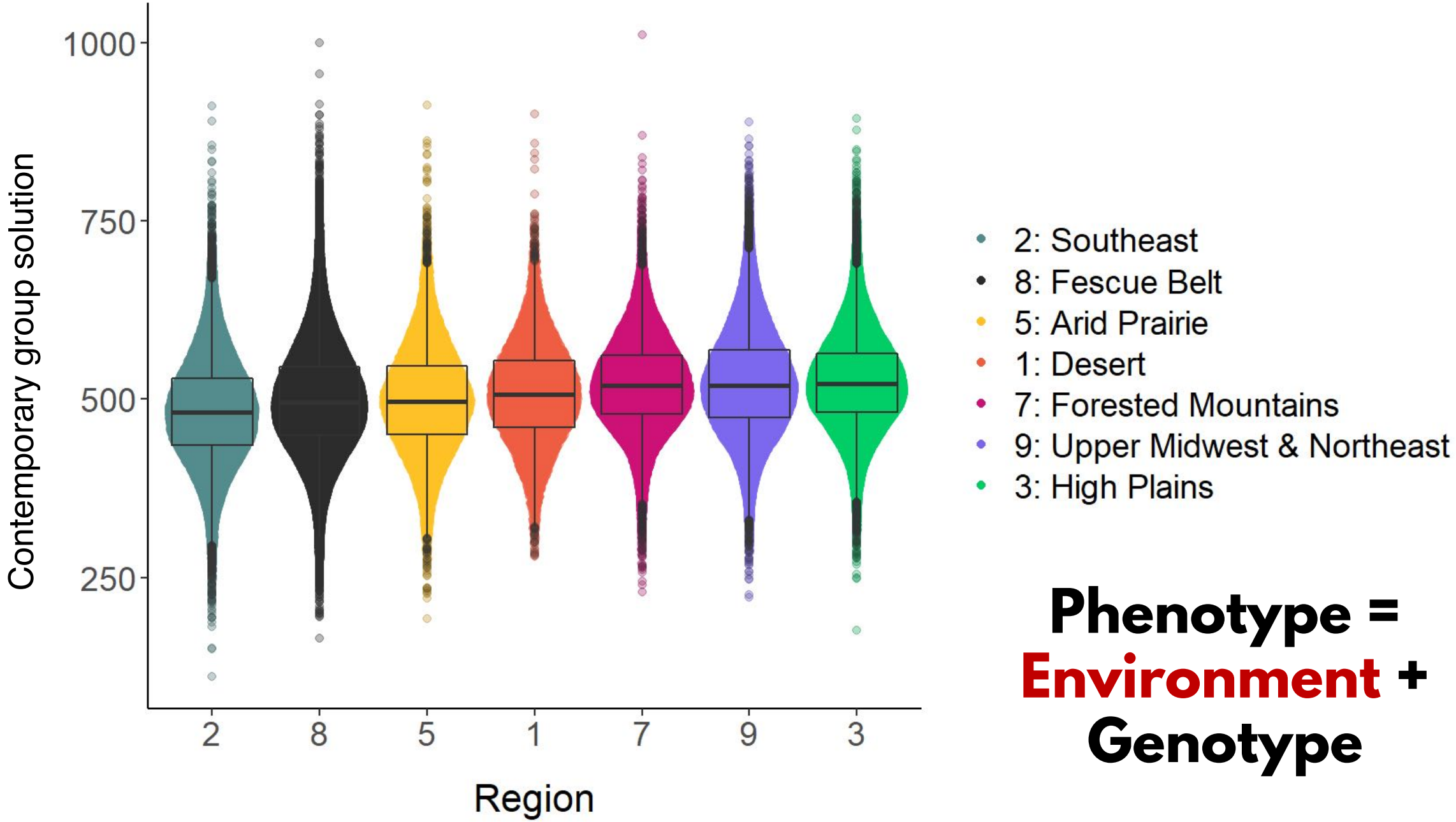
Genotype

The *E*: contemporary groups

"A contemporary group is a set of animals that have had an equal opportunity to perform: same sex, managed alike, and exposed to the same environmental conditions and feed resources."

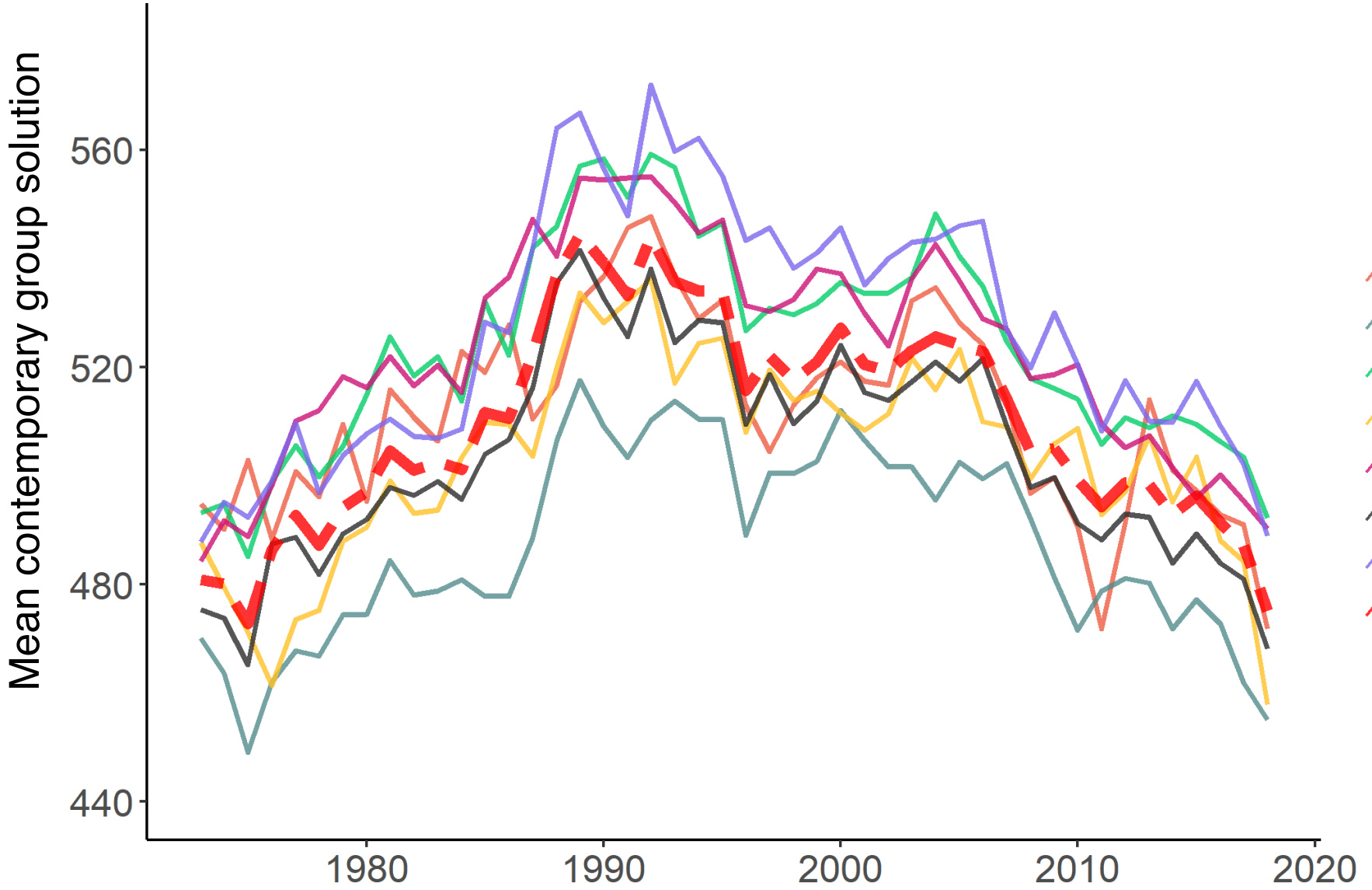
- Used to estimate the **E** of **P = E + G**
- **"Contemporary group solution":** effect of environment that is subtracted out when calculating an EPD

Weaning weight contemporary group solutions



Phenotype = Environment + Genotype

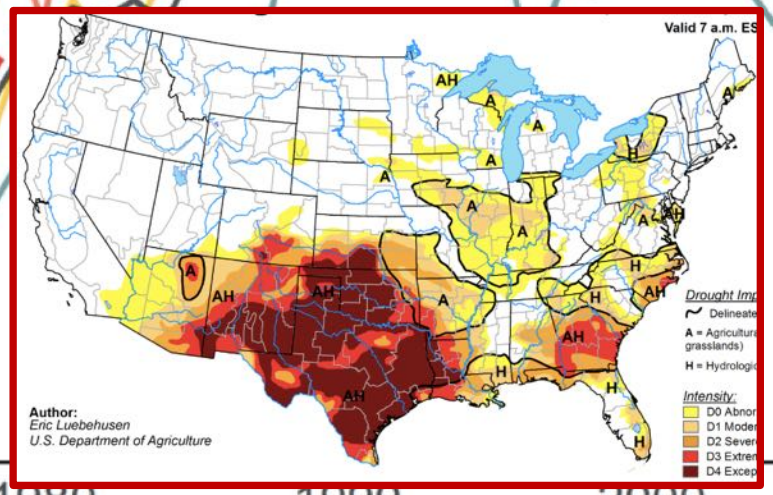
Weaning weight contemporary group solutions reflect year-to-year environmental trends



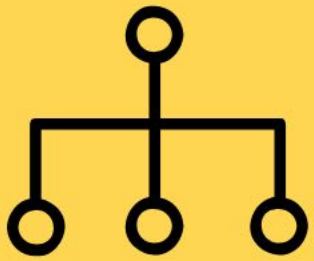
1: Desert
2: Southeast
3: High Plains
5: Arid Prairie
7: Forested Mountains
8: Fescue Belt
9: Upper Midwest & Northeast
National average

Phenotype = Environment + Genotype

Weaning weight contemporary group solutions reflect year-to-year environmental trends



Phenotype = Environment + Genotype



How much of the difference is due to genetics?

- Treat weaning weight in the Southeast & weaning weight in the High Plains as separate traits
  - ~ 100,000 records from each region
- Genetic correlation is only **~ 0.69** between regions for weaning weight direct and **~0.63** for milk

Are certain DNA variants beneficial in some environments but not others?

Phenotype = Environment + Genotype

Acknowledgements

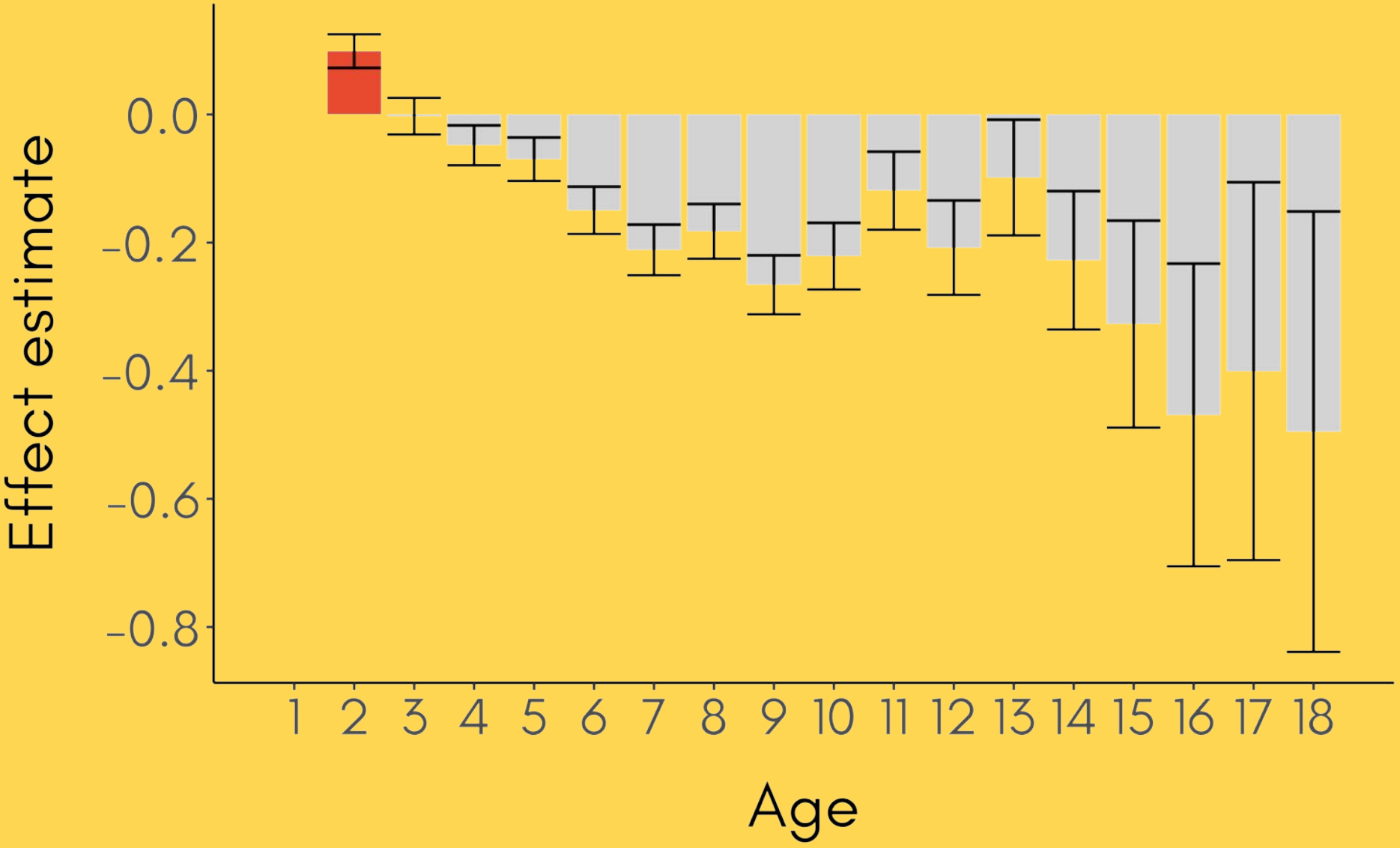
- AGI team
  - Dr. Steve Miller
  - Dr. Duc Lu
  - Dr. Dan Moser
  - Kelli Retallick
  - Lou Ann Adams
  - Jason Kenyon
- MU team
  - Dr. Jared Decker
  - Dr. Bob Schnabel
  - Helen Yampara-Iquise
  - Troy Rowan

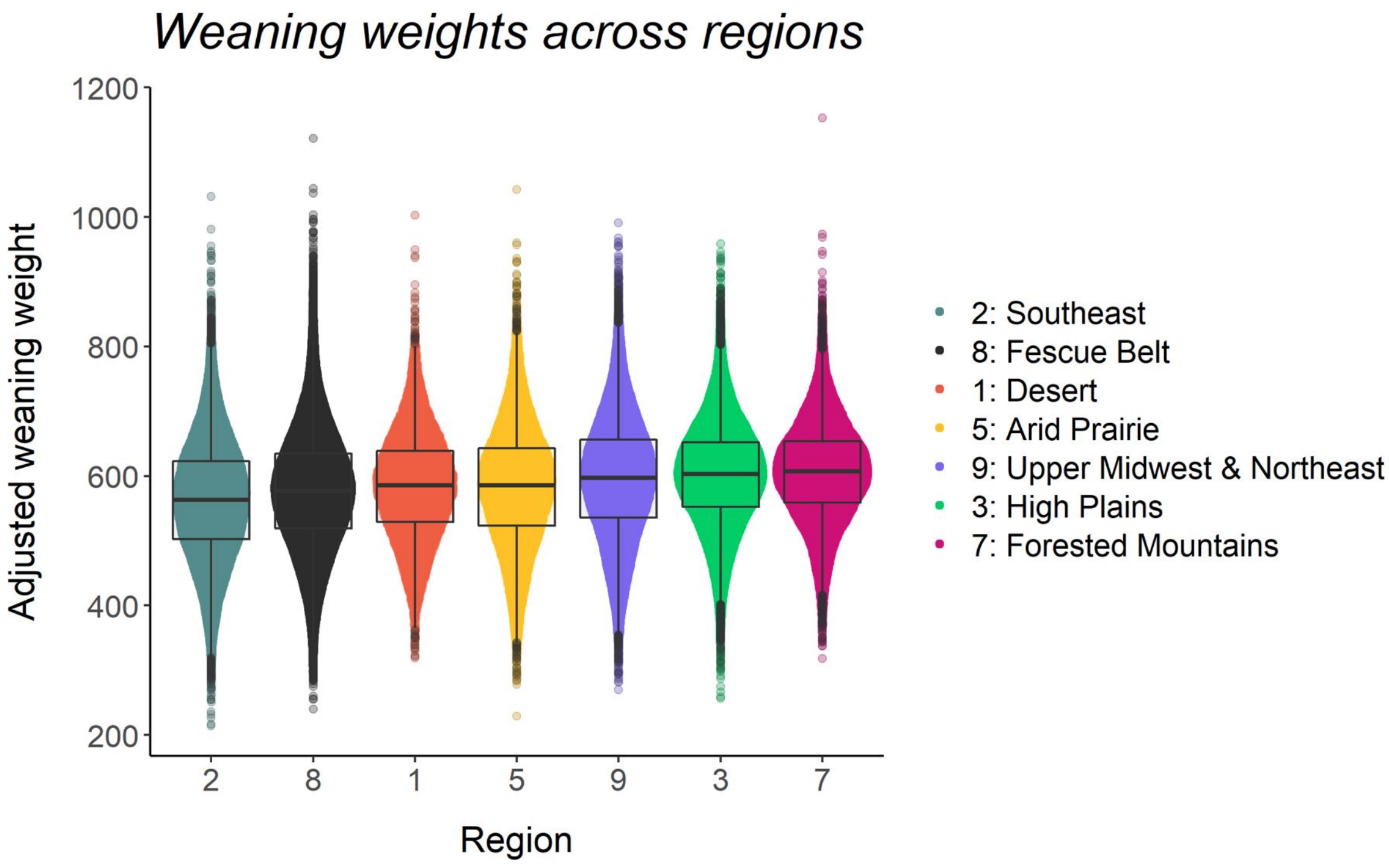
Many thanks to producers who have participated the in hair shedding project!!

At MU, I'm funded by USDA grant MOC00051167, "Identifying local adaptation and creating region-specific genomic predictions in beef cattle."

"Yes ... I believe there's a question in the back."

Yearlings and first calf heifers tend to have higher hair shedding scores




Weaning weights across regions
Adjusted weaning weight
1200
1000
800
600
400
200
2
8
1
5
9
3
7
Region
2: Southeast
8: Fescue Belt
1: Desert
5: Arid Prairie
9: Upper Midwest & Northeast
3: High Plains
7: Forested Mountains