American Angus Association's Functional Longevity EPD

Cow longevity drives profitability

- Ranked as a priority for R&D by Angus breeders
- Improve/add tools to improve maternal function
- Targeting reproduction/fertility
  - Heifer pregnancy is one tool in this area

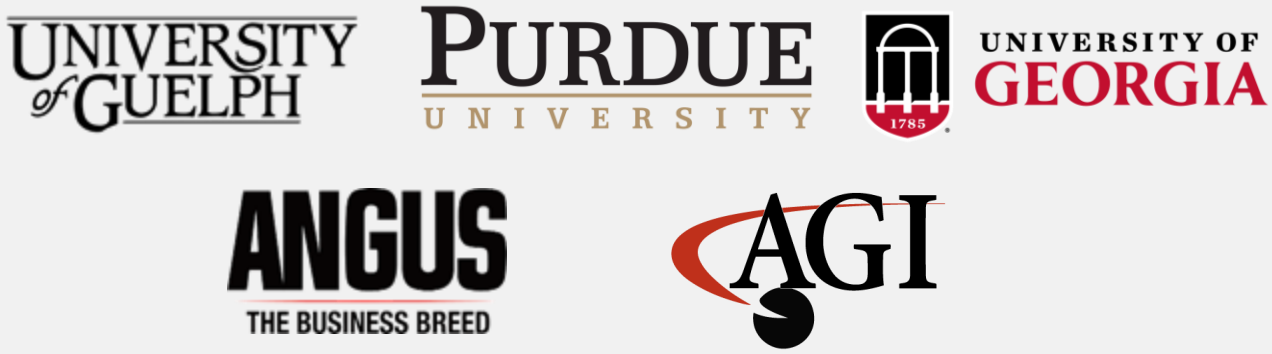
Maternal					
HP Acc % Daus	CEM Acc % Daus	Milk Acc %	MkH MkD	MW Acc % Prog	MH Acc % Prog

Fertility traits are challenging

- Usually lowly heritable ($h^2 < 0.2$)
- "Sex limited" (cow and bull fertility traits are not the same phenotypes)
- Difficult to obtain complete data for long periods
  - Good data recordkeeping
  - Faster generation turn over at the seedstock level
  - Capture data on commercial cow herds?

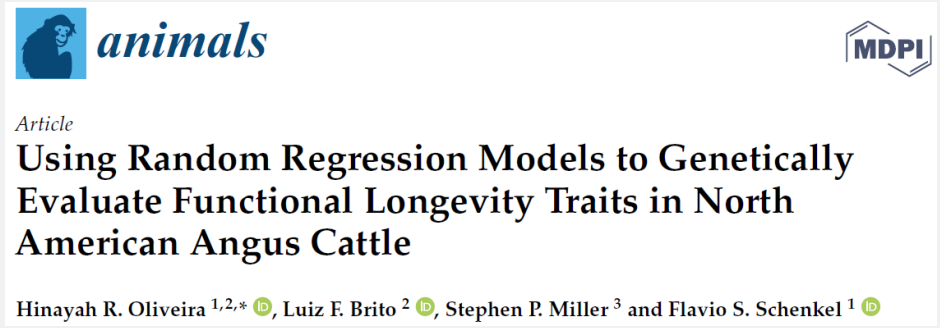
Functional Longevity journey at AAA

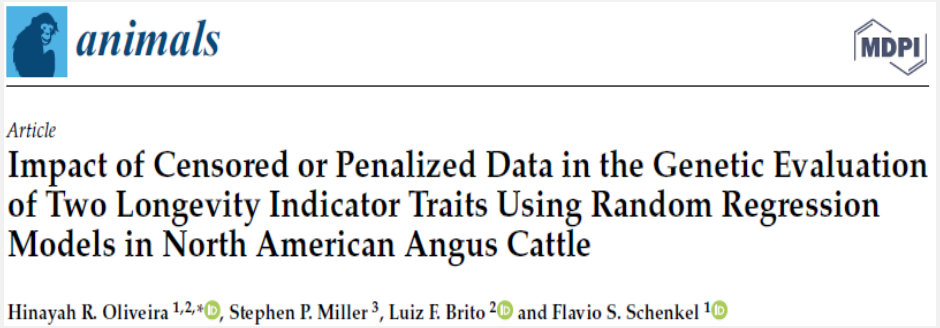
- Recent research started around 2018
- Data exploration
- Trait definition
- Modeling approach



Selection for cows that stay in the herd and produce a calf every year

- **Traditional longevity**: cows that stay in the herd
  - Binary phenotype: Was the cow in the herd?
- **Functional longevity:** cows that stay in the herd and produce a calf
  - Binary phenotype: Did the cow produce a calf?
- Animals with known cull reason





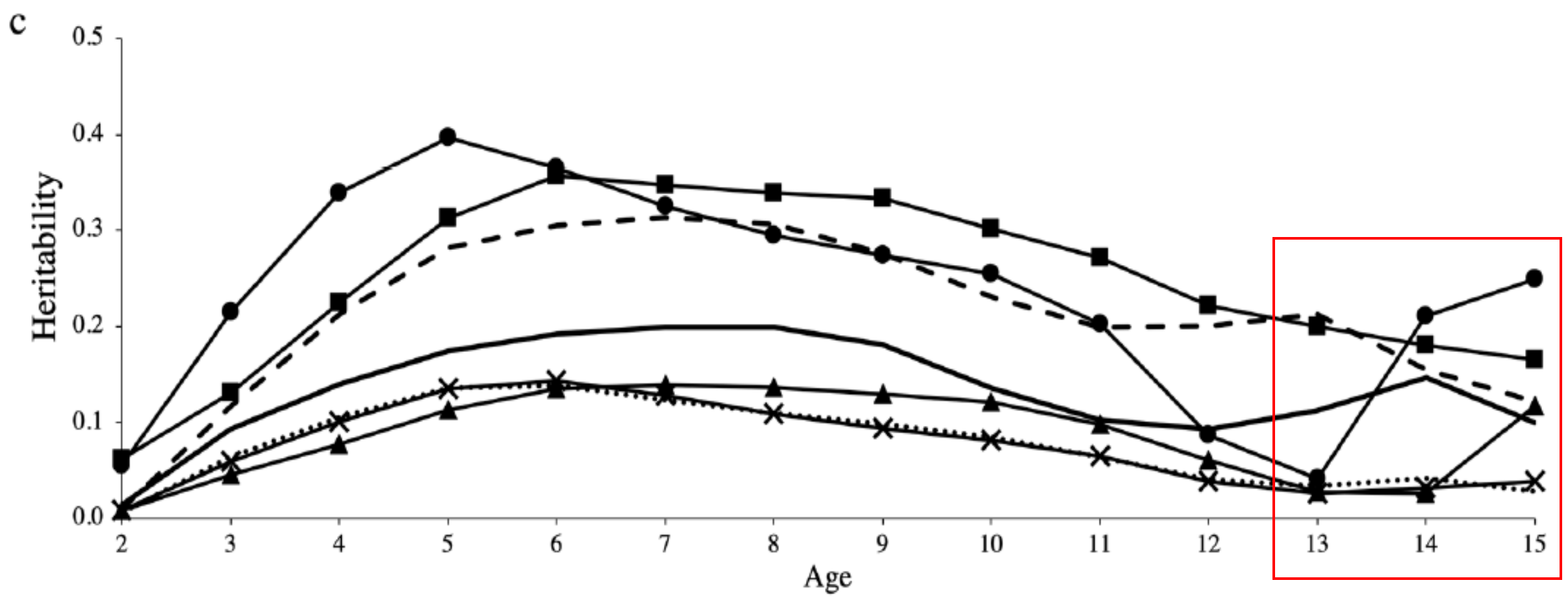
Exploring culling reasons and age ranges

Table 3. Average heritabilities (±SE) estimated considering all ages (i.e., from 2 to 15 years) and ages between 3 and 12 years-old, for all longevity definitions and culling reasons.

Ages	Culling Reason	Longevity Definition		
		[1]TL	[2]FL_a	[3]FL_b
All 2-15 years	Natural death	0.19 ± 0.02	0.15 ± 0.02	0.21 ± 0.02
	Structural problems	0.23 ± 0.04	0.17 ± 0.02	0.24 ± 0.03
	Disease	0.19 ± 0.03	0.19 ± 0.02	0.25 ± 0.02
	Fertility	0.07 ± 0.01	0.07 ± 0.01	0.08 ± 0.01
	Performance	0.10 ± 0.02	0.08 ± 0.01	0.10 ± 0.01
	Miscellaneous	0.08 ± 0.01	0.07 ± 0.01	0.08 ± 0.01
	All	0.11 ± 0.01	0.09 ± 0.01	0.13 ± 0.01

[1]TL: Traditional longevity. [2]FL_a: Functional longevity assuming 0 after the cow was culled or if the cow did not record a calf at the specified age. [3]FL_b: Functional longevity assuming 0 only after the cow was culled, and missing records when no calving information was found at the specified age.

Exploring culling reasons and age ranges
Heritability trajectories



Recent research focused on implementation

- Building on the early research
- Final trait definition
- Modeling
- Implementation for a weekly evaluation

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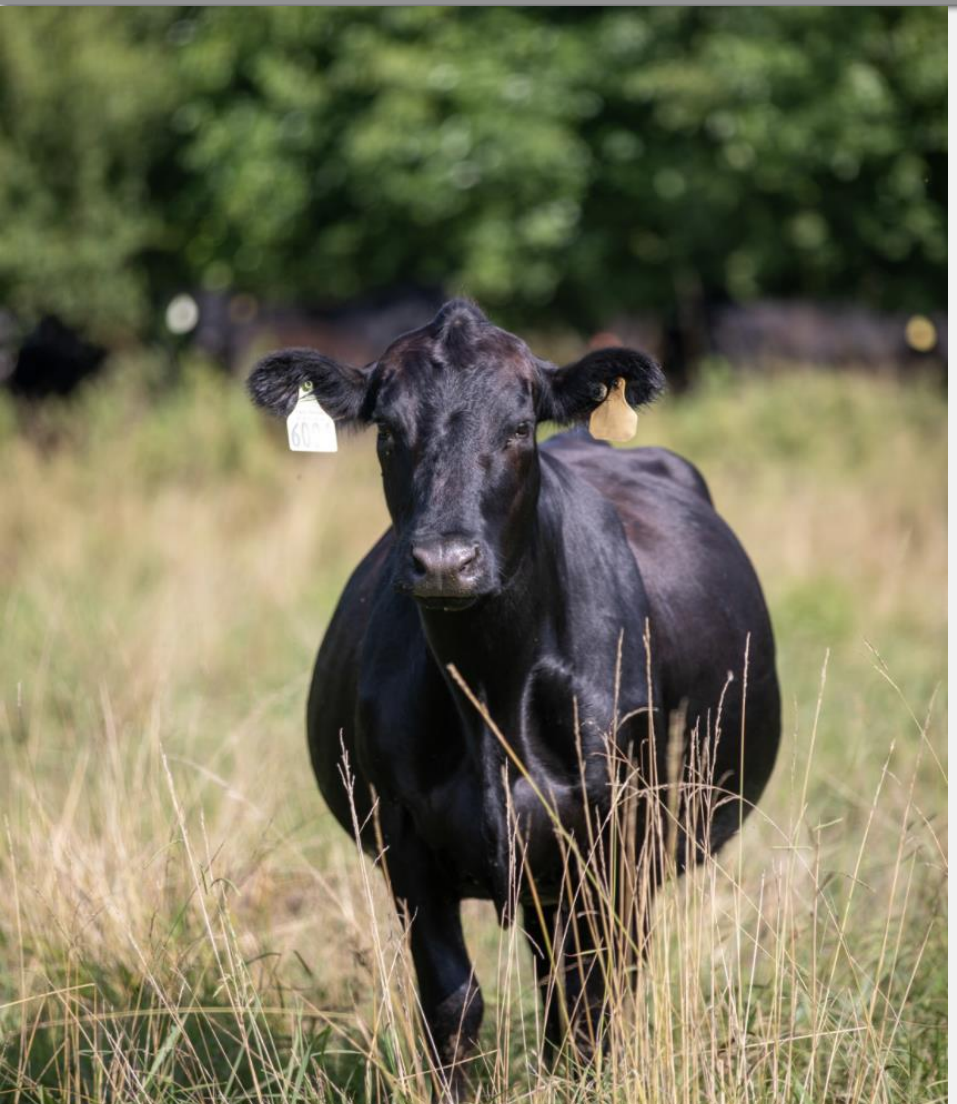
Functional Longevity



- Cows that stay in the herd and produce a calf every year

Definition: on average, number of calves a sires daughters are predicted to produce by 6 years of age compared to other sires daughters

Data: calving and culling records

Functional Longevity research EPD

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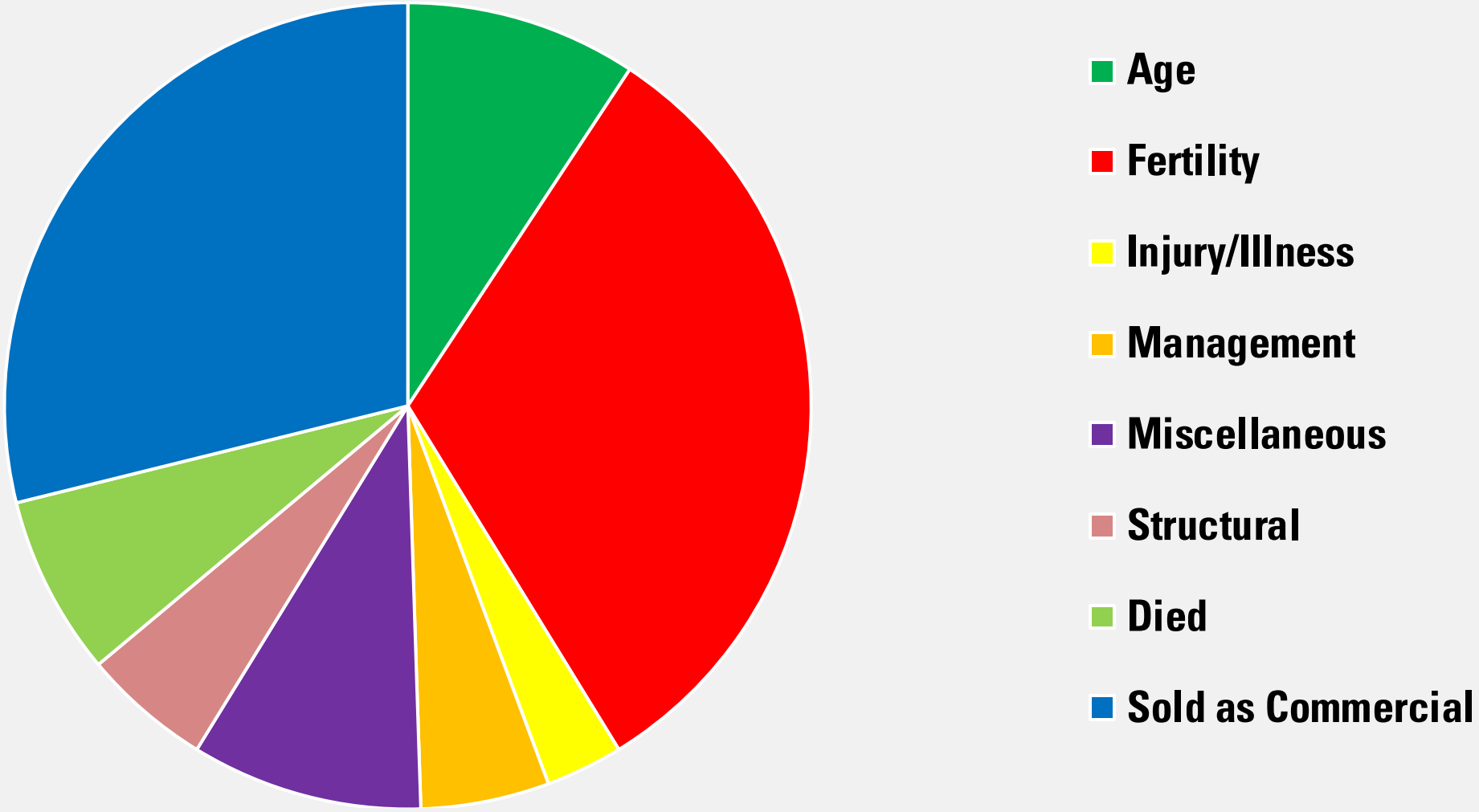
Release: Oct 25 2023

Updated: Feb 15 2024

Dive into the Data

Why do females leave the herd?



How much data is in the FL evaluation

- FL data includes American Angus Association and Canadian Angus Association data

- 1.9M cows with records
  - 8.3M records total
- 1.5M genotyped animals
- 4M animals in the pedigree

Majority of the data is outside our IR program

Program	N cows	N records
IR or MP	276K	1.2M
Not in IR or MP	1.7M	7.1M
Total	1.9M	8.3M

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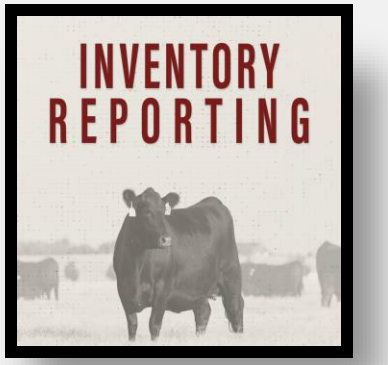


What records are used?

Animal ID	No. of calves	Dam Age
Cow 1	1	2
Cow 1	2	3
Cow 1	3	4
Cow 1	4	5
Cow 1	5	6
Cow 1	6	7
Cow 1	7	8
Cow 1	8	9
Cow 1	9	10
Cow 2	1	2
Cow 2	1	3
Cow 3	1	2
Cow 3	1	3
Cow 3	2	4
Cow 3	3	5
Cow 3	3	6
Cow 3	4	7
Cow 4	1	2
Cow 4	1	3
Cow 4	2	4
Cow 4	2	5
Cow 4	3	6

- Inventory Reporting data
- Calving and culling records since 1990
- Must calves as a two-year-old female
- Ages 2-10 (9 possible calving events)

- Phenotype is number of calves

- Model
  - Random regression model

Animal ID	No. of calves	Cow Age
Cow 1	1	2
Cow 1	2	3
Cow 1	3	4
Cow 1	4	5
Cow 1	5	6
Cow 1	6	7
Cow 1	7	8
Cow 1	8	9
Cow 1	9	10

Cow 1

- 10 years of age
- 9 records
- 9 calves

Cow 2

- 3 years of age
- 2 records
- 1 calf

Cow 3

- 7 years of age
- 6 records
- 4 calves

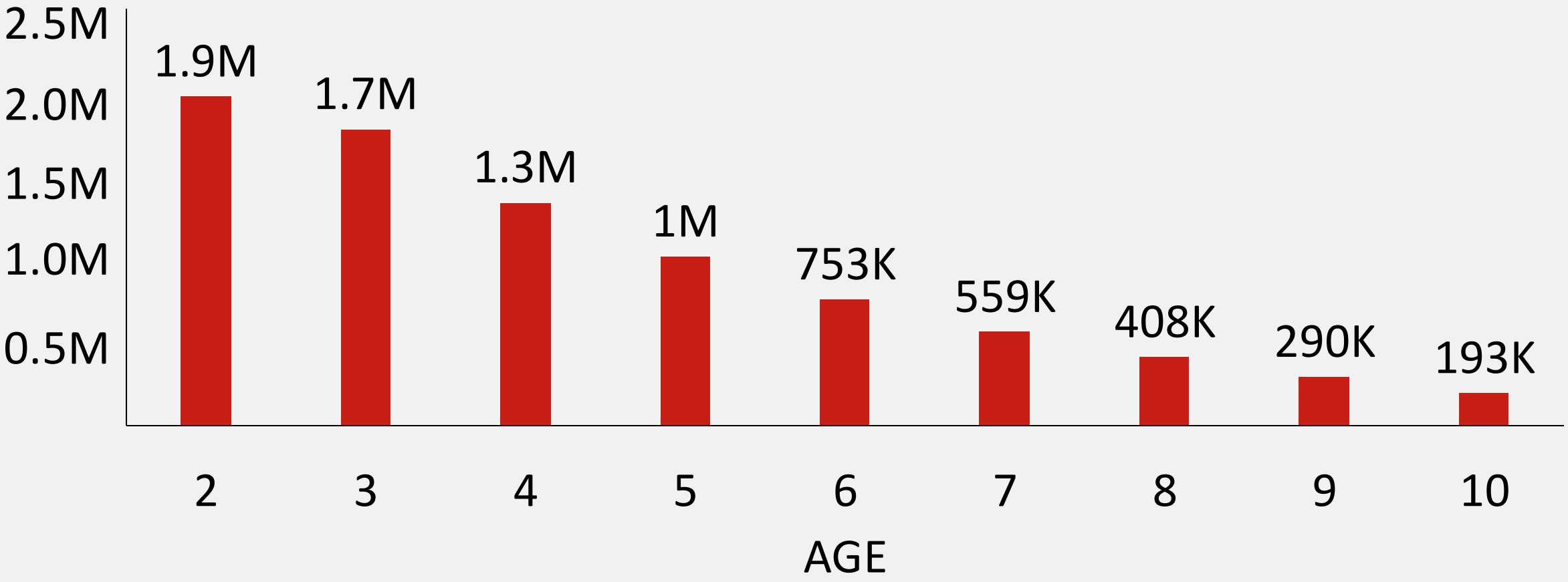
Cow 4

- 6 years of age
- 5 records
- 3 calves

Distribution of Age, N records and N calves

	Average	Min	Max	SD
Age	6	2	10	2.5
N records	5	1	9	2.5

Distribution of cows with records by age



Number of calves by age distribution

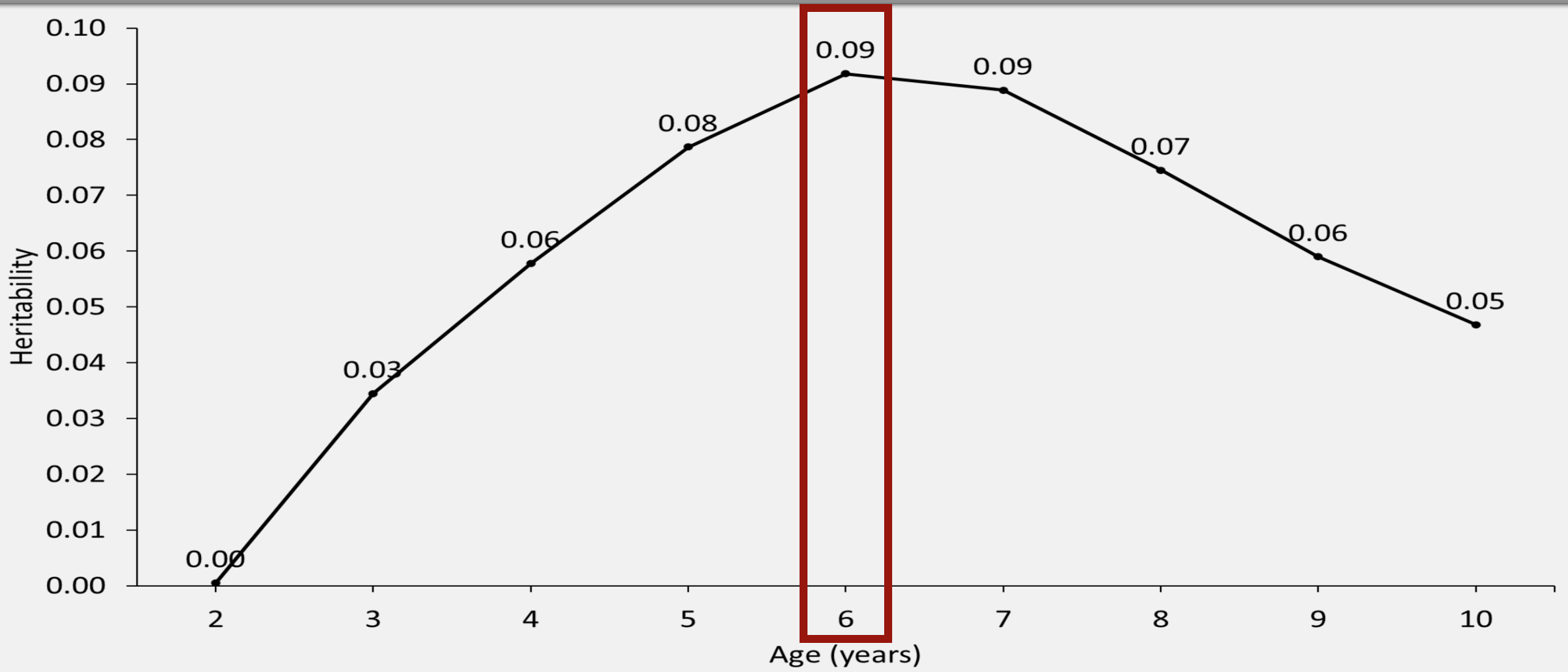
		Number of calves								
Age	N cows	1	2	3	4	5	6	7	8	9
2	1.9M	100%								
3	1.7M	27%	73%							
4	1.3M	4%	31%	65%						
5	1M	0%	10%	30%	59%					
6	753K	0%	2%	13%	30%	55%				
7	559K	0%	0%	4%	14%	30%	52%			
8	408K	0%	0%	1%	6%	15%	30%	48%		
9	290K	0%	0%	0%	2%	7%	16%	30%	44%	
10	193K	0%	0%	0%	1%	3%	7%	16%	32%	42%

At age 6, there are a few cows with only 2 calves reported

More inventory reporting data will help us drill down these relationships

Heritability and genetic correlations across ages

Functional Longevity heritability is 0.09



EPD are highly correlated after age 6

Age	3	4	5	6	7	8	9	10
3	**0.03**	0.99	0.97	0.94	0.90	0.84	0.79	0.73
4		**0.06**	0.99	0.97	0.94	0.91	0.86	0.81
5			**0.08**	0.99	0.98	0.95	0.91	0.87
6				**0.09**	0.99	0.98	0.95	0.92
7					**0.09**	0.99	0.98	0.96
8		*symmetric*				**0.07**	≥0.99	0.98
9							**0.06**	≥0.99
10								**0.05**

Predicting the EPD at 6 years of Age

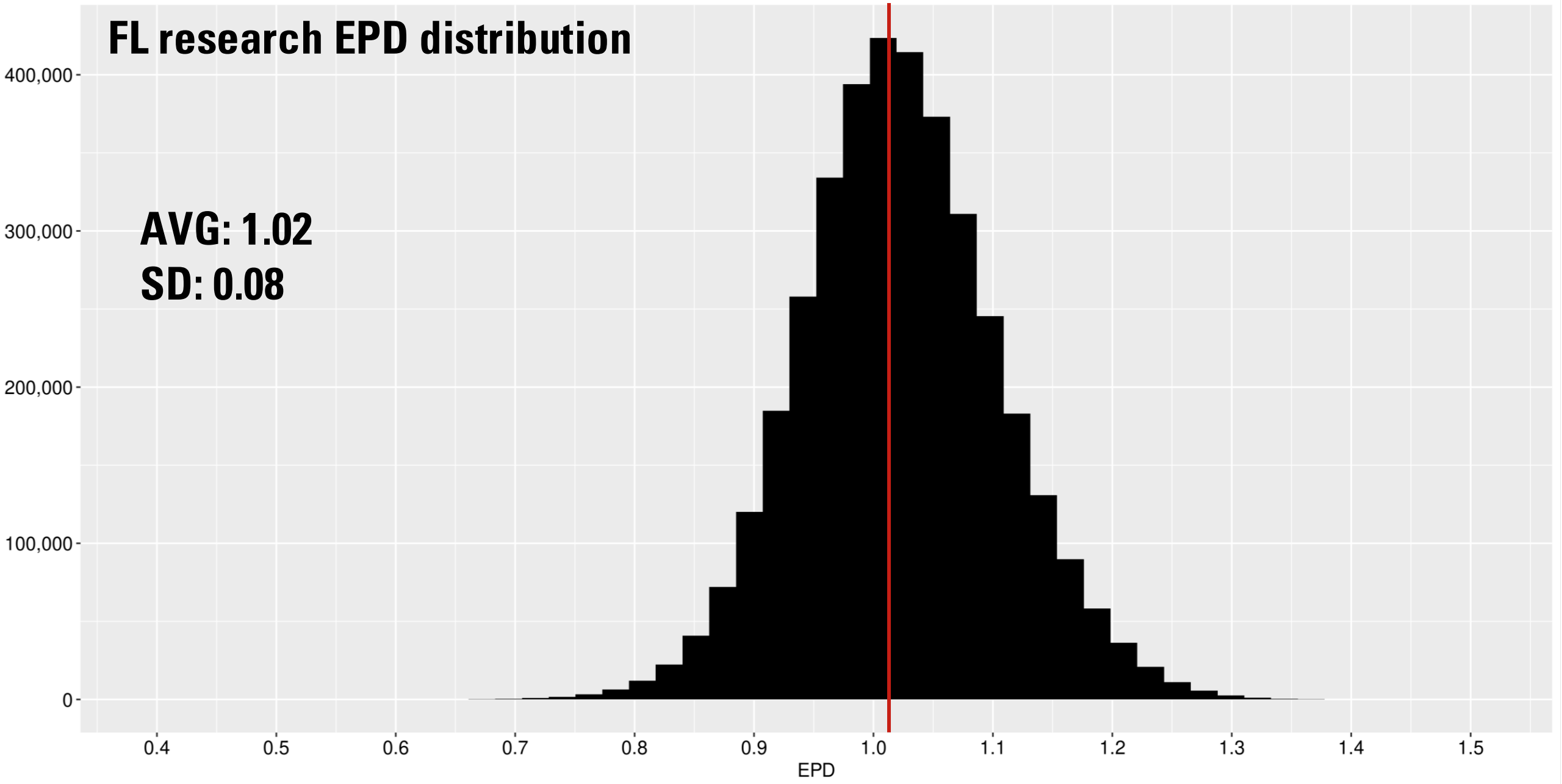
- Heritability is maximized at Age 6 (0.09)
- Genetic correlations are high >0.90 for ages 6-10
  - Same trait at ages 6-10
  - Minimal re-ranking of sires
- Data still included from 7-10 years to add accuracy

Practical Application

Preliminary research EPD and ACC distribution

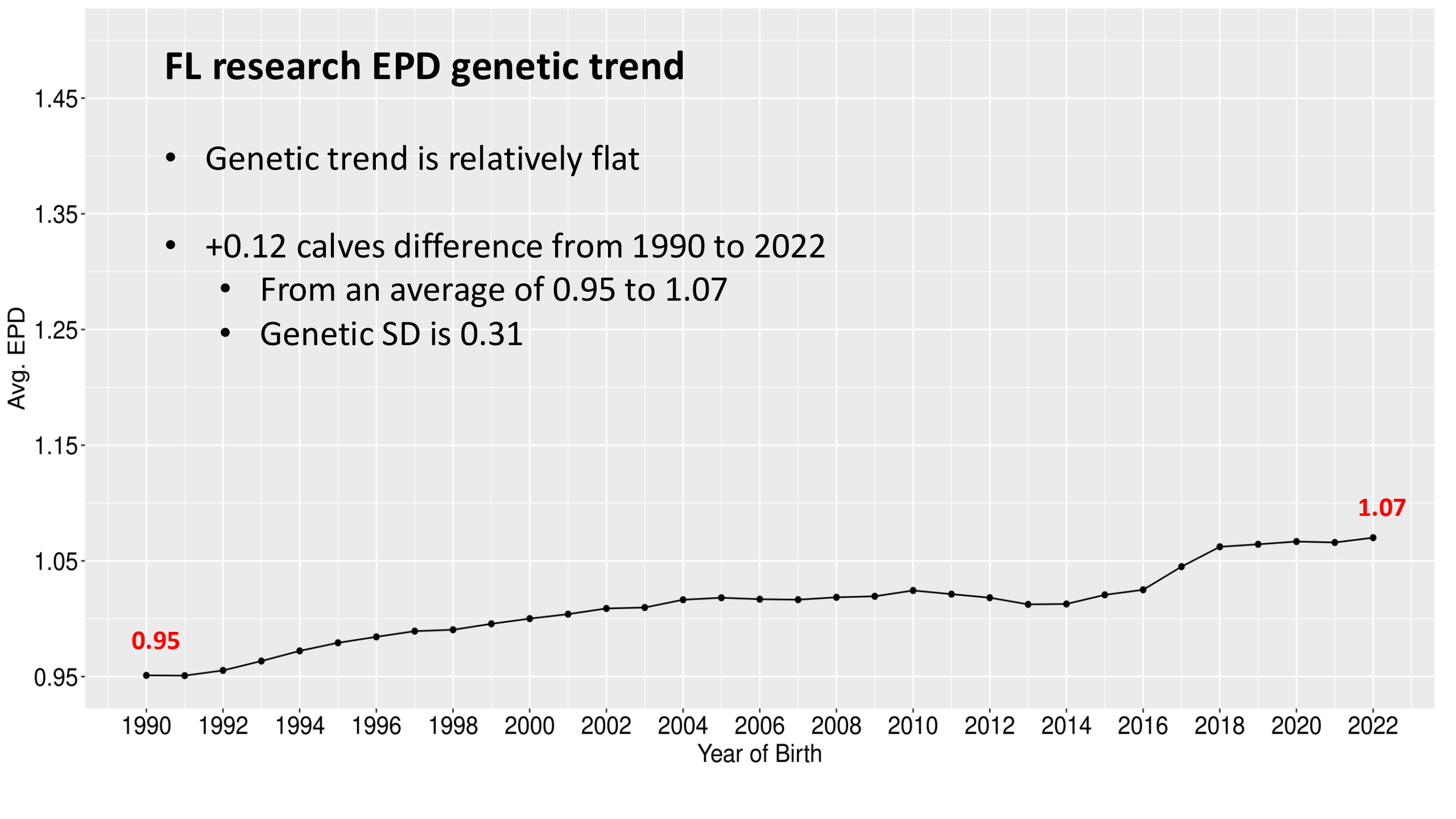
	Number of animals	Average	Min	Max	SD
EPD	3.8M	1.01	0.39	1.48	0.08
ACC	3.8M	0.21	0.05	0.95	0.10

- Difference from highest EPD to lowest EPD is ~1.0 calf


FL research EPD distribution
AVG: 1.02
SD: 0.08
400,000
300,000
200,000
100,000
0
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
EPD

FL research EPD genetic trend

- Genetic trend is relatively flat
- +0.12 calves difference from 1990 to 2022
  - From an average of 0.95 to 1.07
  - Genetic SD is 0.31



FL Units: number of calves by 6 years of age

Sire	FL EPD
A	1.5
B	0.5
Difference	**1.0**

- **On average**, sire A's daughters are expected to produce 1 more calf by age 6 compared to sire B's daughters

- If the breeding goal is to increase the number of calves produced, a sire with a higher FL EPD is more desirable compared to a sire with a lower FL EPD

Checking our predictions

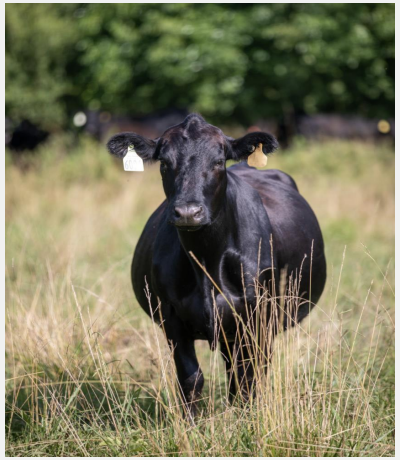
Higher ranked sires produce more calves on average

Sires born before 2010 with at least 10 daughters with 10 years of records.

FL EPD percentile	N sires	Avg. N calves reported	Difference (N calves)
1%	255	4.6	1.4
99%	352	3.2	

Maternal traits have lower heritability

- FL h^2 is 0.09
- Even more important to collect data
- Individual cow record is largely influenced by the environment
- EPD is the best tool to identify animals with superior genetic merit



Next steps on FL at AAA

Continued research

- Stay in a research for the next several months
  - Continue updating research EPDs as more data comes in
- Estimate genetic correlations with other traits
- Model functional longevity into Maternal Weaned Calf Value ($M)
- Inventory reporting vs non-inventory reporting data

AGI Summer interns to continue the work

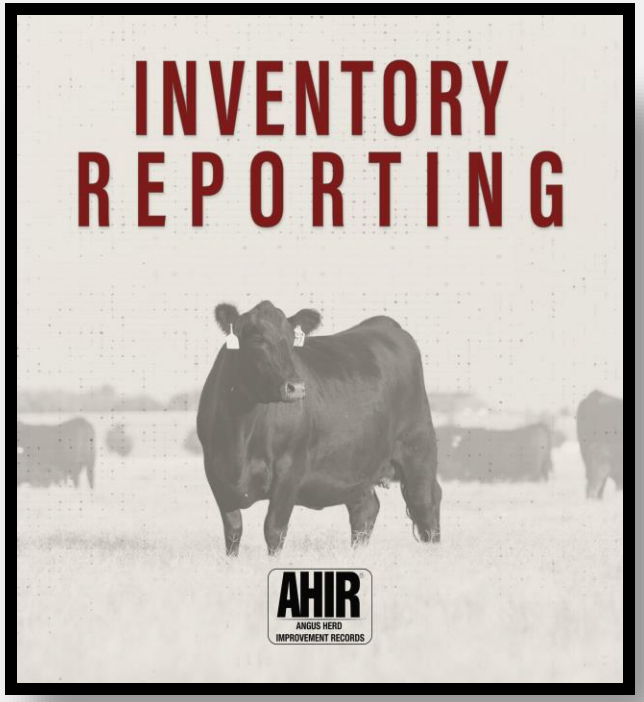
Zuleica Trujano
PhD student
University of Georgia

Hui Wen
PhD student
Purdue University

- Genetic correlations between FL and other traits

Complete data reporting is vital

- It is important to know when she had a calf
- Even more important to know when she did not and why
- Enable future research and development of new tools
- Angus Breeders are encouraged to participate on AHIR® Inventory Reporting
  - Enrolment from Nov 1st to Jan 15th and from May 1st to July 15th



More information available

BY THE NUMBERS

by Kelli Retallick-Riley, Angus Genetics Inc.

Staying Power

American Angus Association released Functional Longevity research EPD Oct. 25, 2023.

BY THE NUMBERS

by Andre Garcia, Angus Genetics Inc.

Functional Longevity Research EPD

A welcome addition to the selection toolbox.

American Angus Association®
Functional Longevity (FL) Research Report
Updated October 25, 2023

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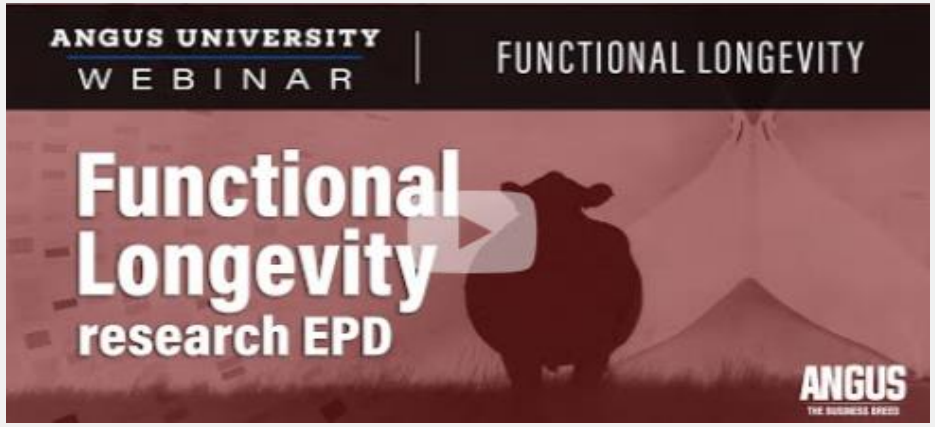
Background

Profitability and sustainability of beef cattle production depend on many factors and cow longevity is certainly one of them. Angus breeders have ranked cow longevity as a priority, along with associated research and the development of new tools and programs, within the American Angus Association.



Thank you

Andre Garcia

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