

New Traits, New Insights: August 2026 Genetic Evaluation Updates

Taylor M. McWhorter, Ph.D.

2026 CDCB Genomic Nominator and Laboratory Workshop



Overview

- New traits
 - **Calf Health:** Resistance to Respiratory Problems (**RSP**)
 - **Calf Health:** Resistance to Diarrhea (**DIA**)
 - **Reproductive Performance:** First Service to Conception (**FSC**)
- Updates to existing reproductive performance traits

Calf Health Traits

Resistance to Respiratory Problems (RSP)
&
Resistance to Diarrhea (DIA)

Collaborators

USDA Animal Genomics and Improvement Laboratory (AGIL):

Mahesh Neupane, Sajjad Toghiani, Asha Miles,
Jason Graham, Curt Van Tassell, Paul VanRaden

University of Maryland: Jeff O'Connell

Council on Dairy Cattle Breeding (CDCB):

Kristen Parker Gaddis, João Dürr, John Cole

*** Dairy Records Processing Centers**



Introducing Calf Health Traits

Raising replacement animals is one of the costliest aspects of dairy production, and calfhood disease can make it even more expensive. CDCB is implementing the first national selection traits to address calf health concerns with Resistance to Respiratory Problems (RSP) and Resistance to Diarrhea (DIA).

Resistance to Respiratory Problems (RSP)

RSP predicts the expected resistance of an animal's offspring to calfhood respiratory problems.

[RSP Trait Details](#) 

Resistance to Diarrhea (DIA)

DIA predicts the expected resistance of an animal's offspring to calfhood diarrhea.

[DIA Trait Details](#) 

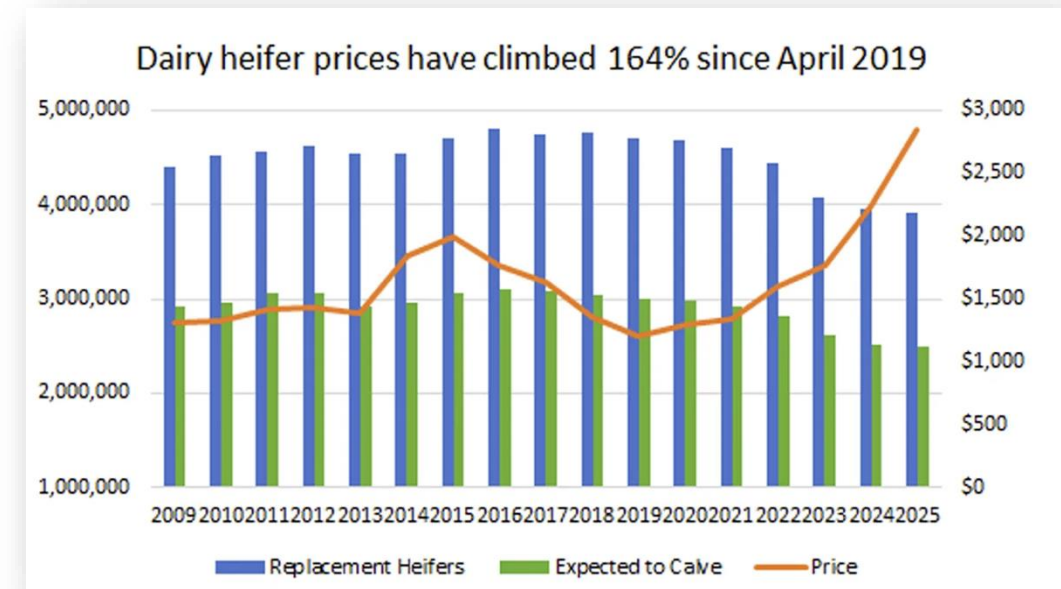
<https://uscdcb.com/august-2026-evaluations/>

Calf Health Traits

- Available for Holstein and Jersey
- Expressed in percentage points of resistance above or below the breed average
 - Positive (+) values are more favorable
- Neither trait incorporated into the lifetime merit indexes at launch

Why select for calf health?

- Calf health is critical for dairy sustainability and profitability
- 75% of **pre**weaned calf mortality is due to diarrhea (53% – 56%) and respiratory problems (21% – 23%)
- Respiratory problems account for 50% of **post**weaning mortality
- Dairy replacement prices are at record highs



Heritability

RSP: 2.2%

DIA: 2.6%

- Low, but expected for health traits
- Large datasets allow for meaningful genetic selection
- Progress may be slow, but cumulative



Reliability Averages (%)

Breed	Group	RSP	DIA
Holstein			
	Young genomic bulls	45	43
	Progeny-tested bulls	53	48
Jersey			
	Young genomic bulls	35	33
	Progeny-tested bulls	39	36

Cow Health Traits Reliability Averages (%)

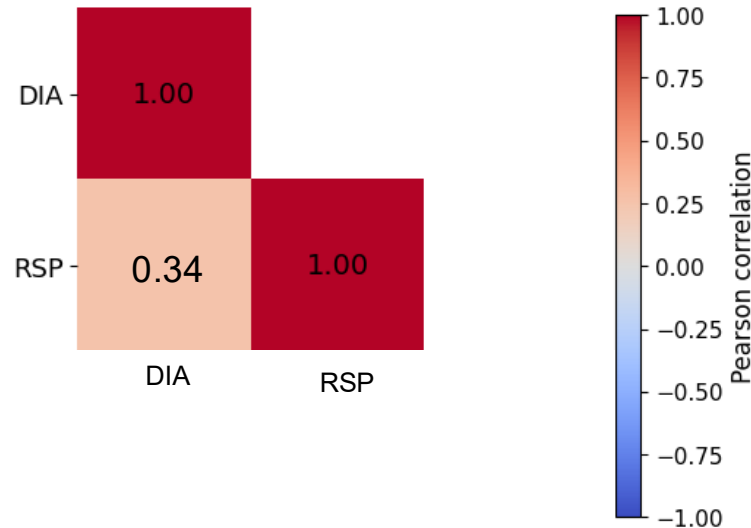
2018: HO only
 2023: HO, JE, & BS

	Bull Group	Milk Fever		Displaced Abomasum		Ketosis		Mastitis		Metritis		Retained Placenta	
		<u>2018</u>		<u>2018</u>		<u>2018</u>		<u>2018</u>		<u>2018</u>		<u>2018</u>	
Reliability													
	Young genomic	40		42		41		49		42		42	
	Progeny-tested	44		47		46		56		48		47	
Records													
	(in millions)	1.2		1.9		1.4		2.4		2.0		2.2	

Correlations

Correlations

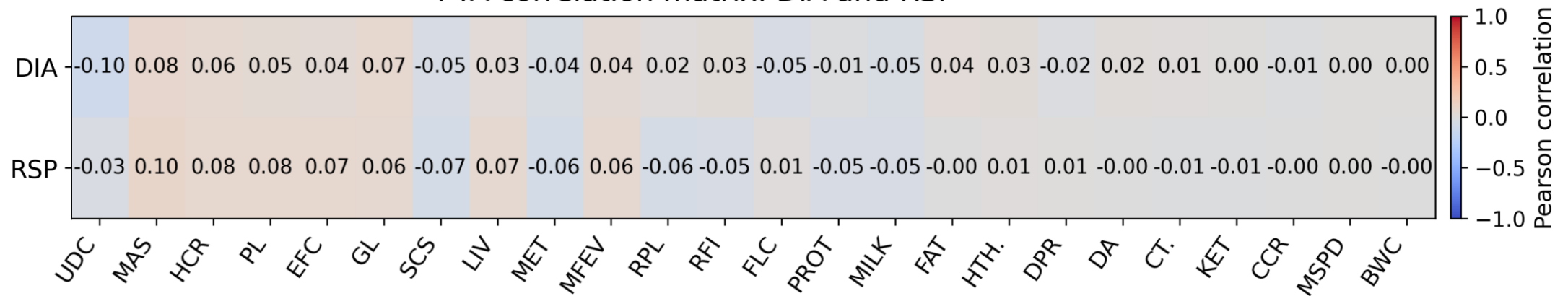
- +1 → traits positively influence by many of the same genes
- 1 → traits inversely influence by many of the same genes
- 0 → traits genetically independent



Heifer Livability (HLV)

PTA predicts the difference in female young offspring expected to remain alive between 2 days after birth and 18 months of age

PTA correlation matrix: DIA and RSP



Data growth: 2024 vs 2026

2024 TOTAL	2026 TOTAL	OVERALL GROWTH
889,343	1,551,866	+74.5%
DIA + RSP combined	DIA + RSP combined	+662,523 records

YEAR-ON-YEAR GROWTH BY TRAIT

DIA 207,602 → 275,451 +32.7% +67,849 records	RSP 681,741 → 1,276,415 +87.2% +594,674 records
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TOTAL RECORD COMPOSITION BY YEAR

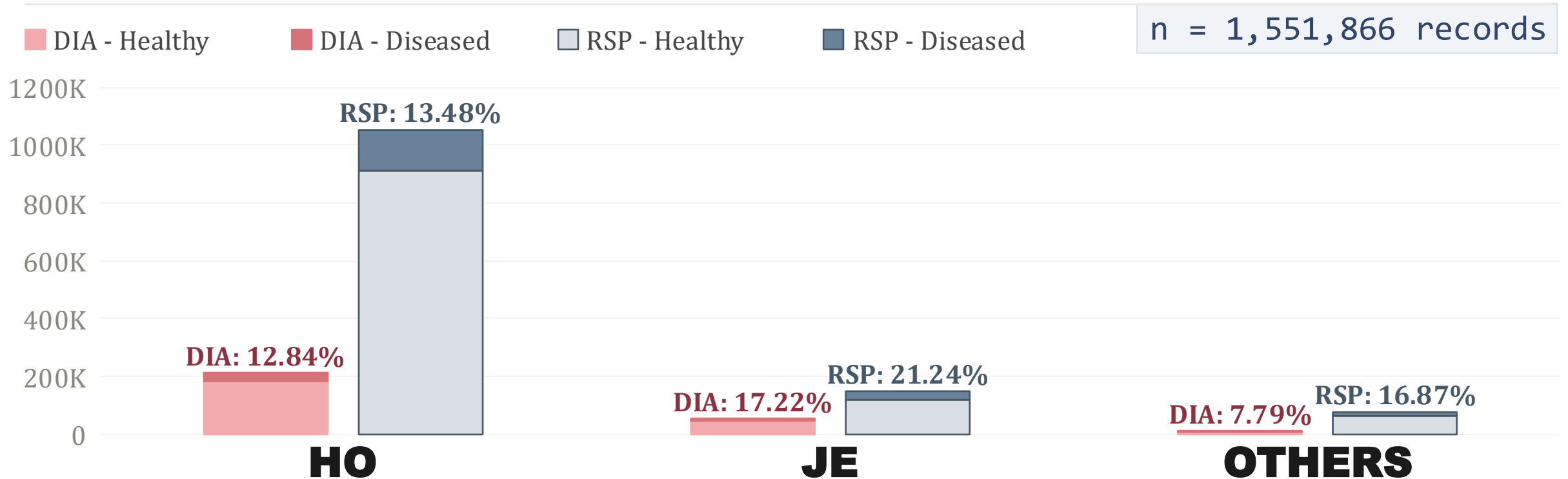
■ DIA diseased ■ DIA healthy ■ RSP diseased ■ RSP healthy



DISEASE PREVALENCE

DIA 2024 14.46% 30,010 disease cases	DIA 2026 13.48% 37,132 cases -0.98 pp	RSP 2024 16.05% 109,412 disease cases	RSP 2026 14.59% 186,261 cases -1.46 pp
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Diseased vs. Healthy Prevalence by Breed



DIA cases by day of age

Days 3–60

TOTAL CASES

37,132

days 3 – 60

PEAK DAY

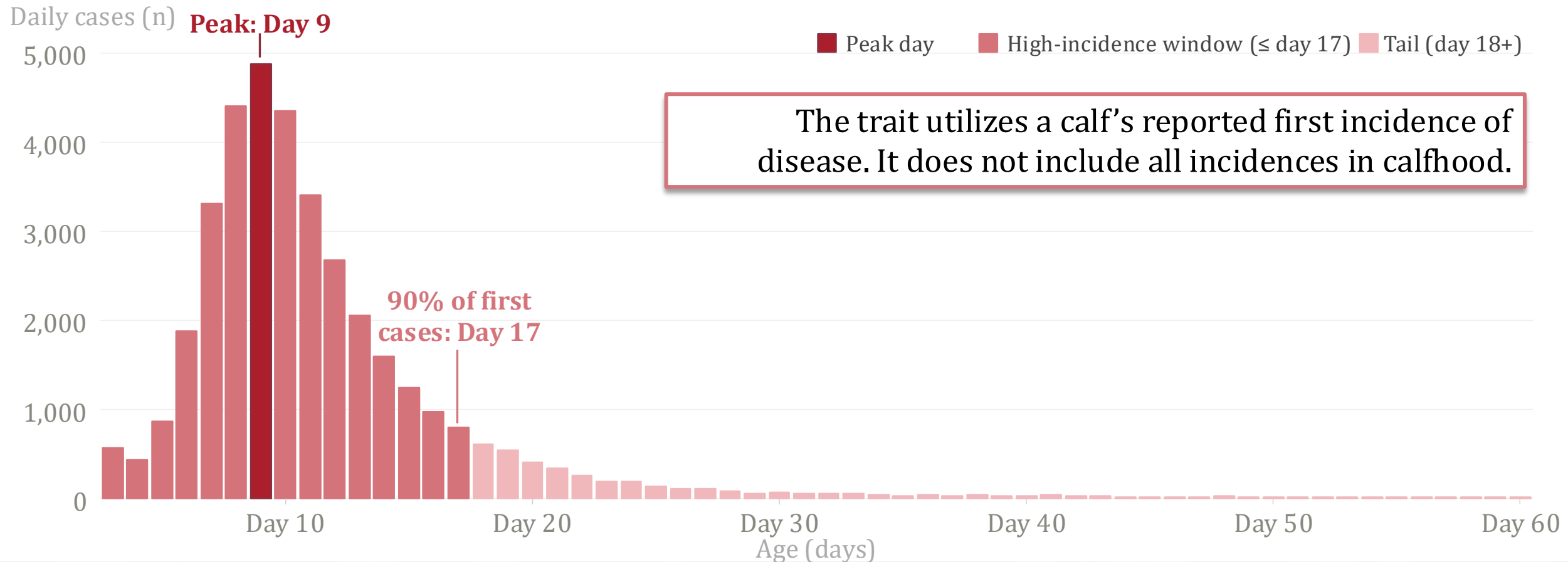
Day 9

4,880 cases

90% OF CASES BY

Day 17

33,404 cumulative



RSP cases by day of age

Days 3–365

TOTAL CASES

186,261

days 3 – 365

PEAK DAY

Day 9

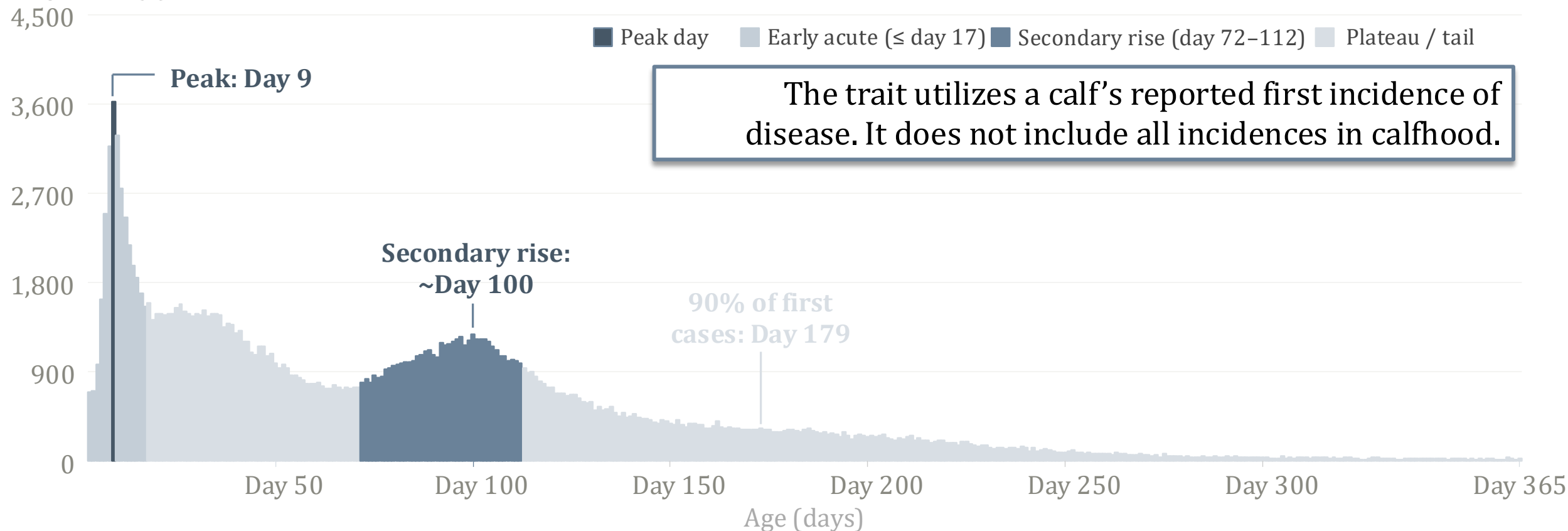
3,621 cases

90% OF CASES BY

Day 179

167,864 cumulative

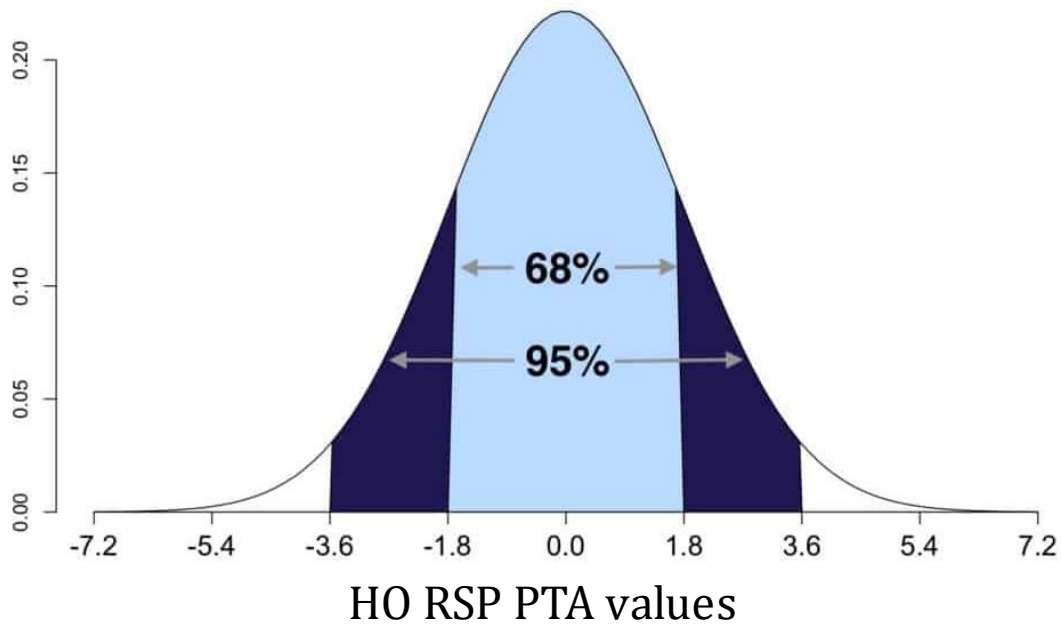
Daily cases (n)



Resistance to Respiratory Problems PTA

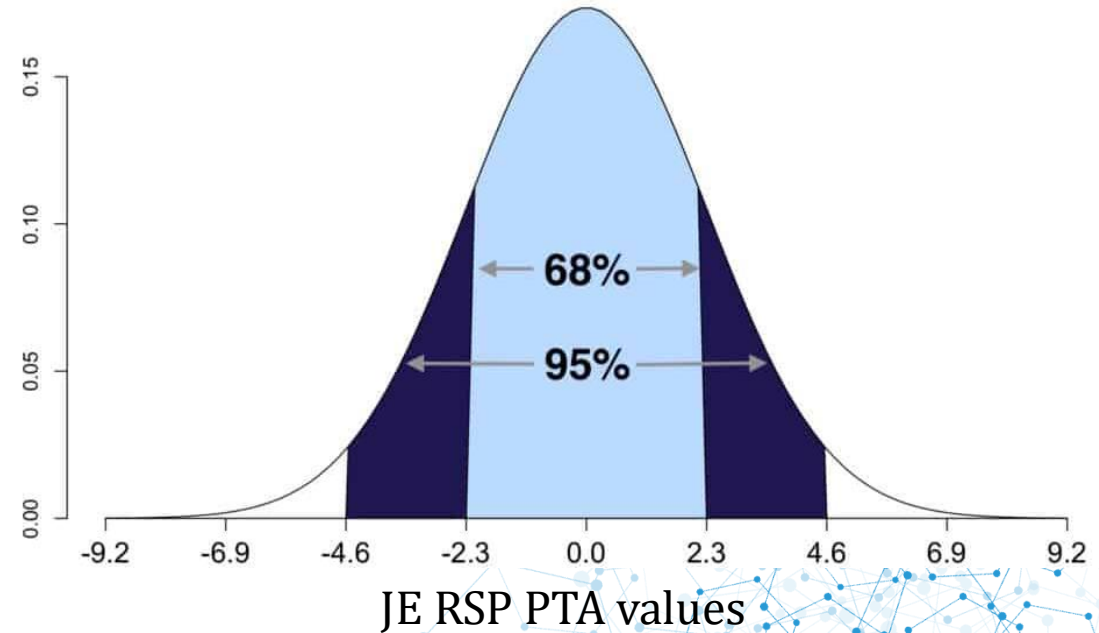
Holstein

- Standard Deviation: 1.8%
- 68% of HO bulls between -1.8 to +1.8%
- 95% of HO bulls between -3.6 to +3.6%



Jersey

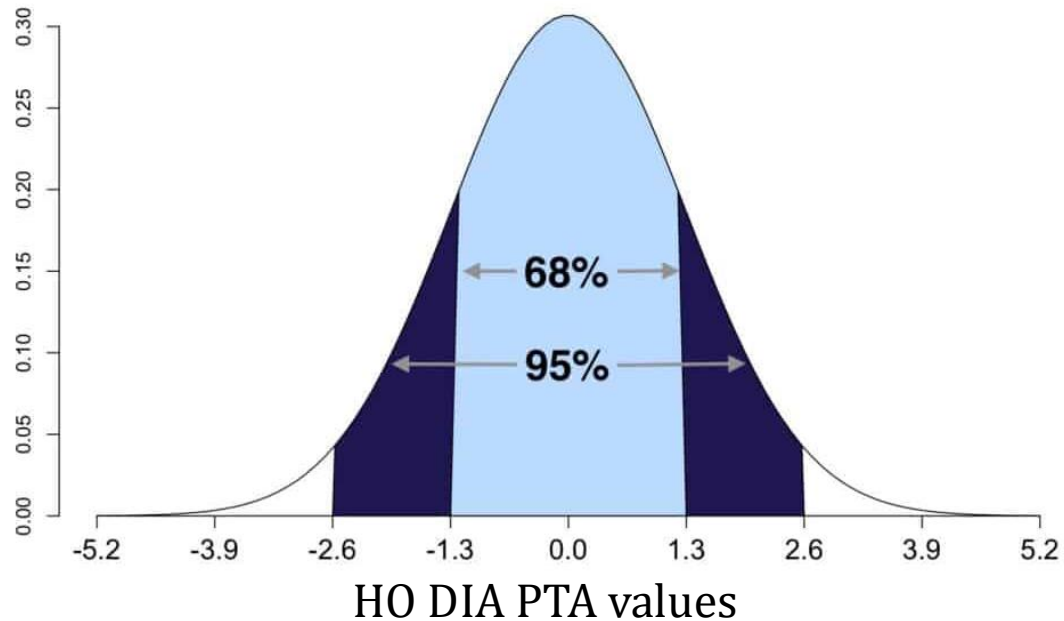
- Standard Deviation: 2.3%
- 68% of JE bulls between -2.3 to +2.3%
- 95% of JE bulls between -4.6 to +4.6%



Resistance to Diarrhea PTA

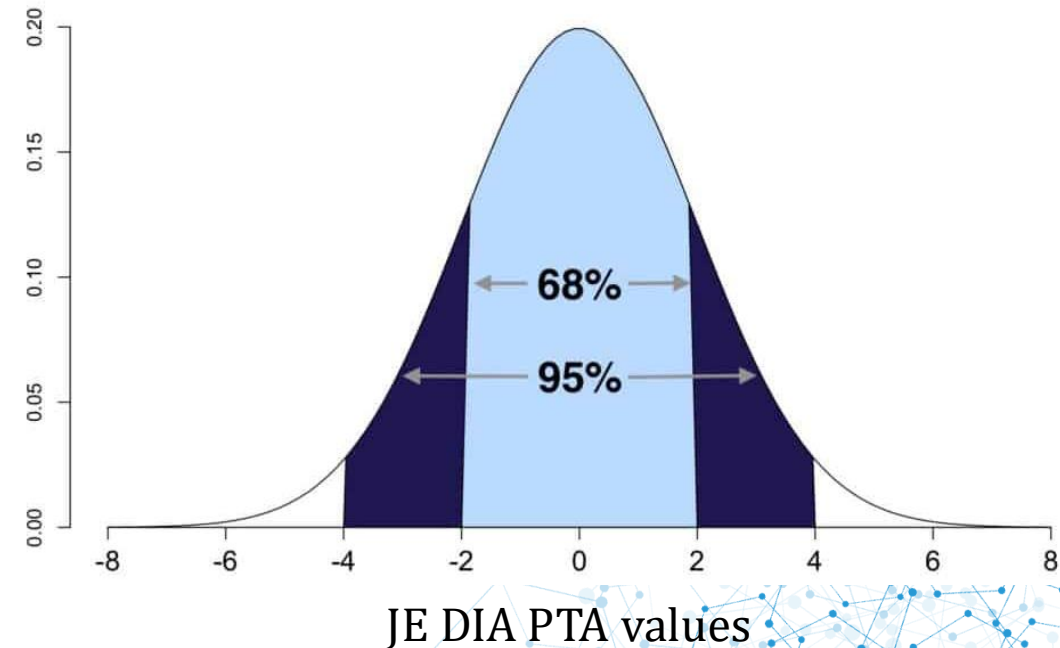
Holstein

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- 95% of HO bulls between -2.6 to +2.6%

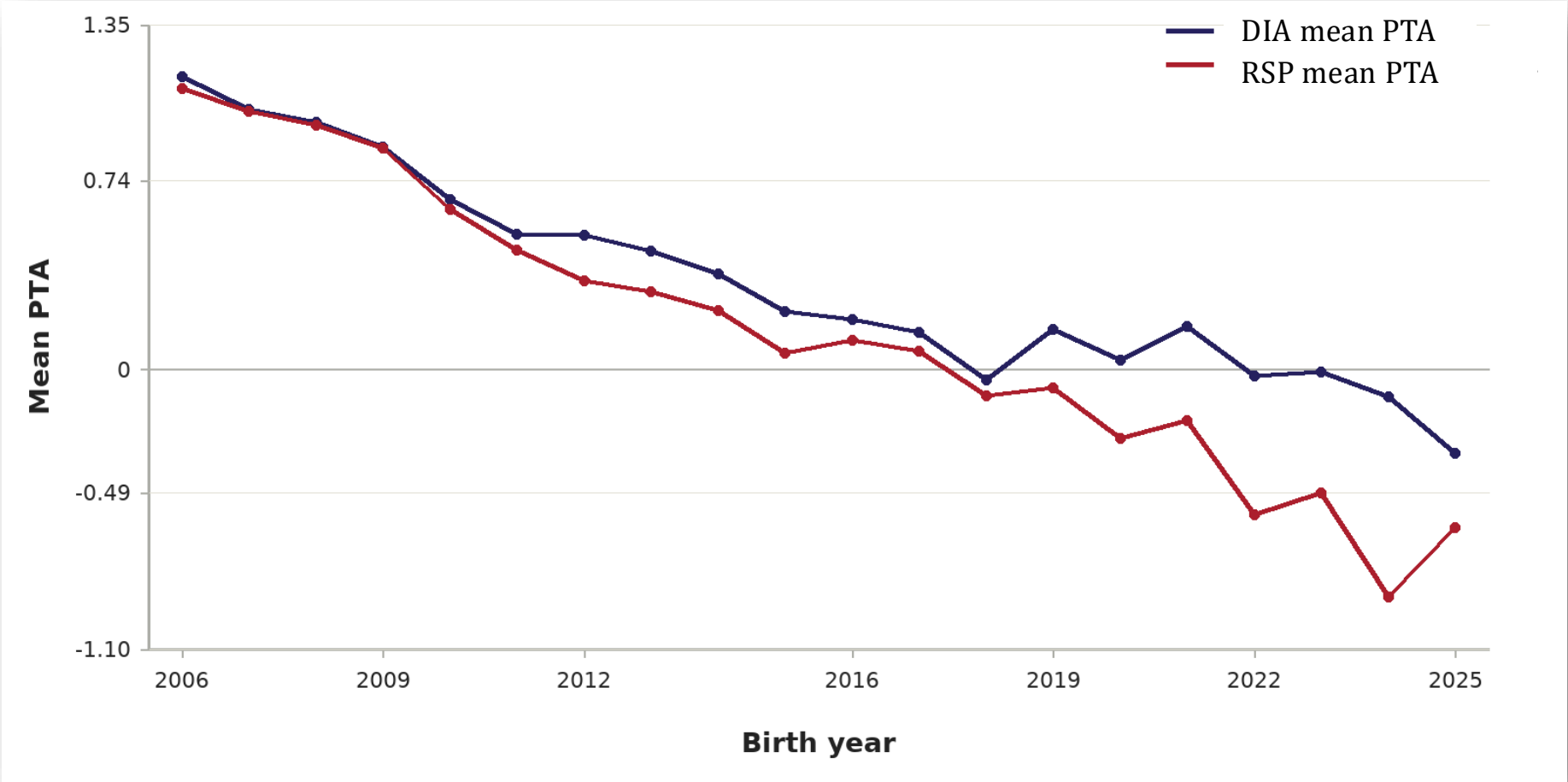


Jersey

- Standard Deviation: 2.0%
- 68% of JE bulls between -2.0 to +2.0%
- 95% of JE bulls between -4.0 to +4.0%



Resistance to Diarrhea and Respiratory Problems mean genomic PTA by birth year for bulls



Interpreting PTA of health traits

- PTA are interpreted as deviation in percentage points of resistance relative breed base
- **Example:** breed base of 13% incidence → 87% resistance
 - PTA 0
 - Expect animal's offspring to have resistance of 87% (breed base)
 - PTA +1
 - We expect animal's offspring to have resistance of 88% (87% base + 1%)

The research has been published



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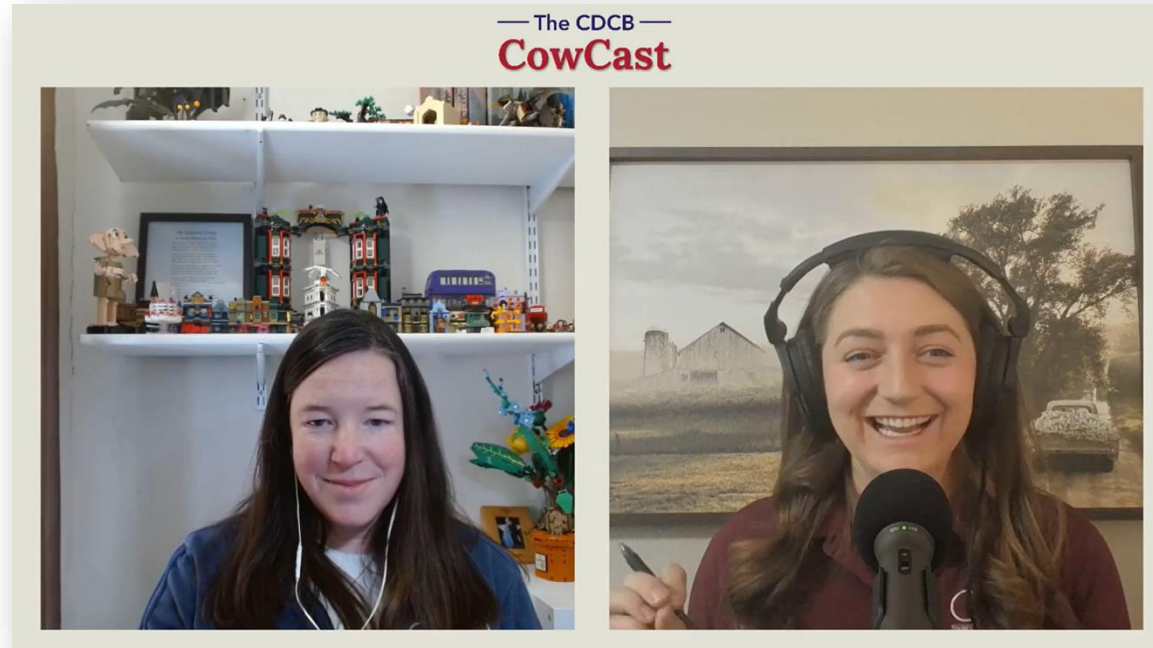
Improving dairy calf health through inclusion of diarrhea and respiratory health data into a US national genetic evaluation

Mahesh Neupane,^{1*} Kristen L. Parker Gaddis,² Sajjad Toghiani,¹ Asha M. Miles,¹ Jason R. Graham,¹ Javier F. Burchard,² João W. Dürr,² John B. Cole,^{2,3,4} Jeffrey R. O'Connell,⁵ Curtis P. Van Tassell,¹ and Paul M. VanRaden¹

- Future work to focus on evaluating potential advantages of multi-trait approach

For more info

- **Website:** <https://uscdcb.com/august-2026-evaluations/>
- **CDCB CowCast** (Ep. 1): *Healthier Calves From the First Breath* with Dr. Kristen Parker Gaddis and Katie Schmidt



- Dr. John Cole's *2025 Industry Meeting: Genetic Tools for Healthier Calves*

Reproductive Performance Traits

Collaborators

Council on Dairy Cattle Breeding (CDCB):

Taylor McWhorter, Simone Savoia, Andres Legarra, Ashley Ling, Ezequiel Nicolazzi

USDA Animal Genomics and Improvement Laboratory (AGIL):

Jason Graham, Paul VanRaden



Reintroducing Female Reproductive Performance Traits

<https://uscdcb.com/august-2026-evaluations/>

Explanation of Changes

Dive deeper into the research process, key findings, details about the ten changes and how to interpret the revised traits

[Summary Document](#)

First Service to Conception (FSC) – NEW TRAIT!

FSC addresses the need for a selection trait calculated independently of VWP. It predicts the expected difference, in days, from first breeding to conception in an animal's daughters relative to the breed base. Positive PTAs represent fewer days to conception.

[FSC Trait Details](#)

Daughter Pregnancy Rate (DPR)

DPR predicts the expected difference, in percentage points, in pregnancy rate of an animal's daughters relative to the breed base.

[DPR Trait Details](#)

Cow Conception Rate (CCR)

CCR predicts the expected difference in conception rate of daughters as lactating cows relative to the breed base.

[CCR Trait Details](#)

Heifer Conception Rate (HCR)

HCR predicts the expected difference in conception rate of daughters as maiden heifers relative to the breed base.

[HCR Trait Details](#)

Early First Calving (EFC)

EFC predicts the expected difference, in days, in age at first calving of an animal's daughters relative to the breed base.

[EFC Trait Details](#)



New Trait: First Service to Conception (FSC)

- FSC: number of days from the cow's first breeding to conception

$$FSC = \text{Date of successful insemination} - \text{Date of first insemination}$$

- If cow **conceives after 200 days**, FSC is capped at **200**
- If cow **never conceives**, FSC is set to **230**
- FSC PTA predicts the expected difference (in days) from first service to conception in an animal's daughters relative to the breed base
 - Positive PTA is favorable!
 - Represents fewer days to conception

Breed Bases

- FSC is measured in days
- PTA of 0 represents:

Breed	Breed Mean (days) *
Ayrshire	63.44
Brown Swiss	
Guernsey	
Holstein	
Jersey	
Milking Shorthorn	

HO BULL A

FSC PTA: +5.0 (days)
Expected daughter average:
 50.60 days

JE BULL A

FSC PTA: +5.0 (days)
Expected daughter average:
 47.04 days

HO BULL B

FSC PTA: 0.0 (days)
Expected daughter average:
 55.60 days

JE BULL B

FSC PTA: 0.0 (days)
Expected daughter average:
 52.04 days

HO BULL C

FSC PTA: -5.0 (days)
Expected daughter average:
 60.60 days

JE BULL C

FSC PTA: -5.0 (days)
Expected daughter average:
 57.04 days

First Service to Conception (FSC)

- Available for Ayrshire, Brown Swiss, Guernsey, Holstein, Jersey, and Milking Shorthorn (MS traditional only)
 - Like other reproductive performance traits
- Not incorporated into the lifetime merit indexes at launch

Heritability

FSC: 3.2%

- Low, but typical for reproductive performance traits
- ~3% of the observed variation is explained by additive genetic differences



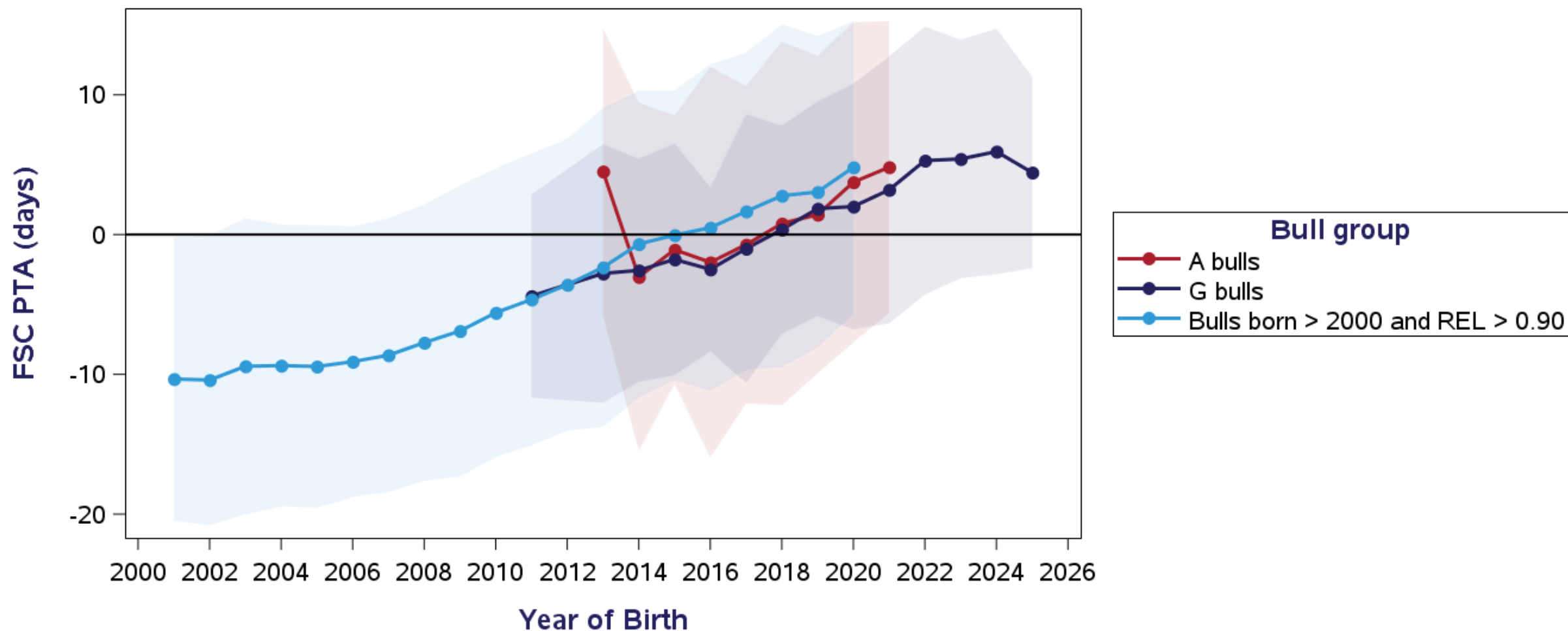
Reliability ranges for Active AI bulls

Breed	Reliability Range
Ayrshire	31% to 98%
Brown Swiss	49% to 99%
Guernsey	38% to 93%
Holstein	31% to 99%
Jersey	58% to 99%
Milking Shorthorn	52% to 90%

High-REL bulls already available despite FSC being a new trait

Bull genetic trend for FSC PTA (days) - Holstein

Groups: G bulls, A bulls, and bulls born > 2000 with REL > 0.90



FSC PTA Range of Bull Populations

	Active A.I. Bulls ("A" Status Bulls)			Genomic Bulls ("G" Status Bulls)		
	PTA Range	Mean PTA	SD	PTA Range	Mean PTA	SD
Holstein	-24.8 to +20.7	+2.13	6.13			
Jersey	-12.5 to +15.2	+0.20	5.68			

*All breed values for bull groups can be found in your handout

** Cow numbers will be available on website

Reintroducing Female Reproductive Performance Traits

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Dive deeper into the research process, key findings, details about the ten changes and how to interpret the revised traits

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[EFC Trait Details](#) 

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Summary Document

- Contains details for all 10 updates, traits sheets, new trait



Reintroducing Reproductive Performance Traits

August 2026 Updates

Since 2003, the U.S. national evaluation system has produced traits that predict female reproductive performance. In 2024, a foundational review of this trait portfolio began. This document outlines the research and its results: revisions to the four established traits and a new trait producers can add to their reproductive toolbox. All five traits are available for Ayrshire, Brown Swiss, Guernsey, Holstein, Jersey, and Milking Shorthorn males and females as of August 2026.

PTA is expressed as the difference from the breed average for animals born in the base year. The unit of measurement varies. DPR, CCR, and HCR are expressed as percentages while FSC and EFC are expressed in days.

Daughter Pregnancy Rate (DPR)

Predicts percentage of non-pregnant cows that will become pregnant in each 21-day cycle compared to the breed base

DPR is calculated as a function of days open and voluntary waiting period (VWP). Days open is calculated as the number of days from calving to conception. Days open is transformed into a pregnancy rate using the VWP and scaled to represent the probability that a non-pregnant cow becomes pregnant

Cow Conception Rate (CCR)

Predicts a lactating cow's ability to conceive

CCR is defined as the proportion of inseminations that result in pregnancy for an individual cow, based on outcomes from up to the first seven inseminations. First implemented in 2009, CCR PTA predicts the expected difference in conception rate of daughters as cows relative to the breed

10 Implemented Updates

Update 1: Utilize herd-year and lactation group-specific VWPs in DPR calculation

DPR calculation now includes a variable that accounts for VWP by specific herd-year and lactation group. The previous formula assumed a fixed 50-day VWP with a 20-day grace period. This update accounts for herd-level changes in VWP and differences between lactation groups.

Daughter Pregnancy Rate (DPR)

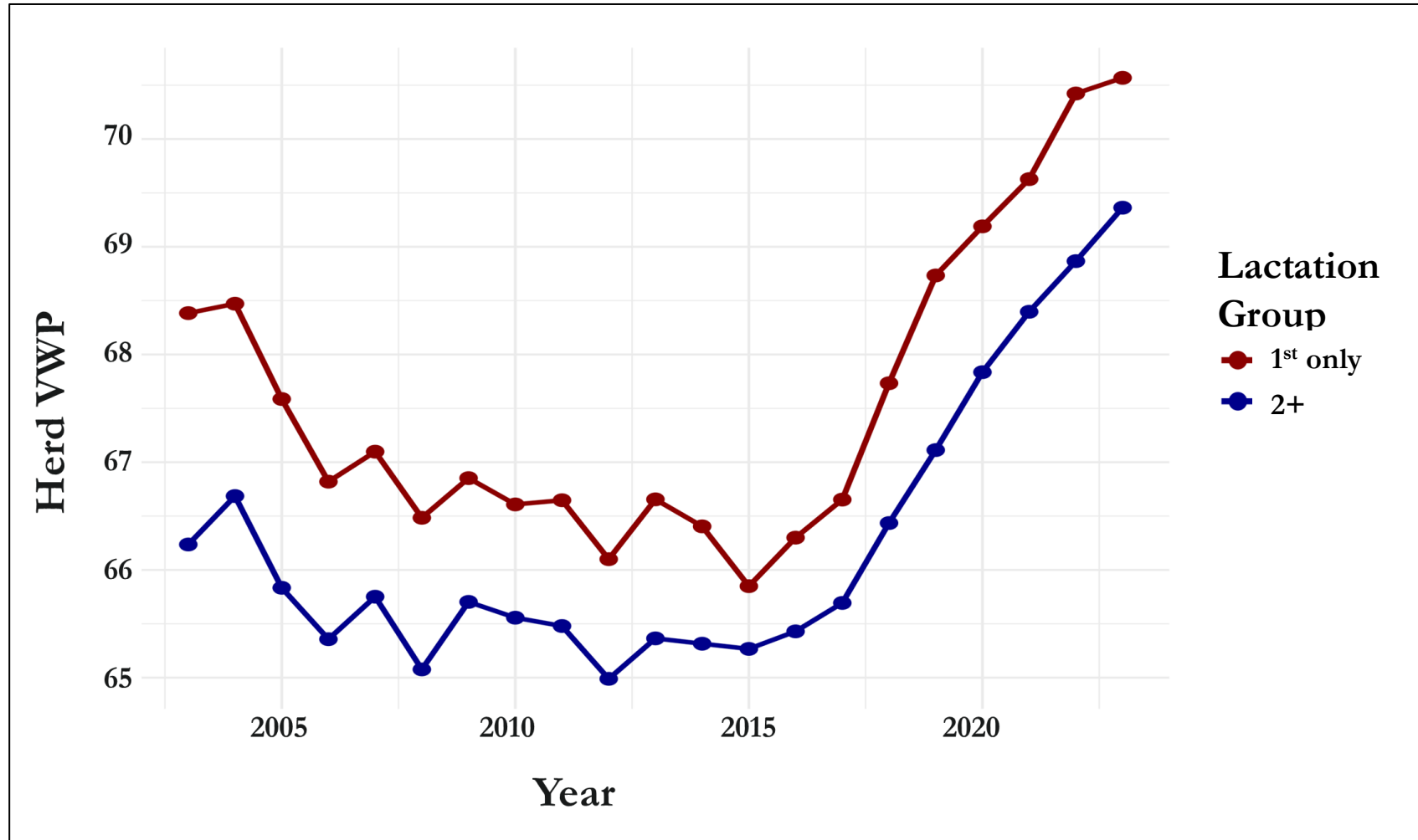
- Days open to pregnancy rate through non-linear formula:

$$DPR = \left[\frac{21}{\max(21, \max(\underset{\substack{\uparrow \\ \text{days open}}}{DO}, 71) - \underset{\substack{\uparrow \\ \text{Voluntary Waiting Period (VWP)} \\ \text{variable by herd-year and lactation} \\ \text{group (1}^{\text{st}} \text{ lact, later lact)}}}{VWP}_{herd\text{yr}-x-lactgrp})} * 100 \right]$$

How to calculate herd-year VWP

- VWP estimated from when cows in a herd typically begin breeding
 - Calculated using the 20th percentile of DIM at first breeding
- Missing herd-year values replaced with default VWP of 50 DIM
- Adjusted separately for first vs later lactations

VWP by herd-year and lactation group in National Cooperators Database



10 Implemented Updates

Update 3: Account for service sire breed, mating type, and short cycling in CCR and HCR

CCR and HCR now account for service sire breed in addition to mating type and short cycling. Mating type includes gender selected semen, conventional semen, natural, or unknown. Short cycling refers to an insemination that takes place 10 to 17 days after the previous insemination.

Update for pre-adjustments to CCR and HCR

- Predict a lactating cow's (CCR) or maiden heifer's (HCR) ability to conceive
 - Proportion of inseminations that result in pregnancy
- Inseminations are pre-adjusted by:
 - Service sire breeding*
 - Mating type
 - Short cycle*

$$CCR \text{ or } HCR = \frac{\sum \text{adjusted inseminations}}{\text{total inseminations}} * 100$$

10 Implemented Updates

Update 4: Reduce data-driven bias in young bulls' PTAs

Daughter data is not included until 36 months after the birth of the cow for DPR, CCR, and FSC. This edit provides additional time for both high and moderate-to-low reproductive performance daughters to enter the evaluation closer together, producing a fairer and more stable genetic estimate. This modification results in bulls requiring one or two additional triannual evaluations before data from their first crop of daughters impacts these traits.

Why delay daughter inclusion?

- Legacy system
 - High reproductive performance daughters enter evaluations sooner
 - Young bulls initially appeared inflated
- Updated system
 - Daughter records included after 36 months
 - More complete reproductive opportunity
- Result
 - Reduced data driven bias
 - More stable young bull PTA*

10 Implemented Updates

Update 8: Calculate CCR, HCR, DPR, and FSC in a multi-trait model and EFC in a single-trait model

CCR, HCR, and DPR remain in a multi-trait model with the addition of the new trait, FSC. However, EFC, which was already treated as an uncorrelated trait, has been moved to a single-trait model for computational efficiency.

10 Implemented Updates

Update 10: Determine new variance component estimates

Both heritabilities and genetic correlations are obtained from variance component estimates. A genetic correlation shows how the genes affecting one trait are related to the genes affecting the other.



Genetic correlations

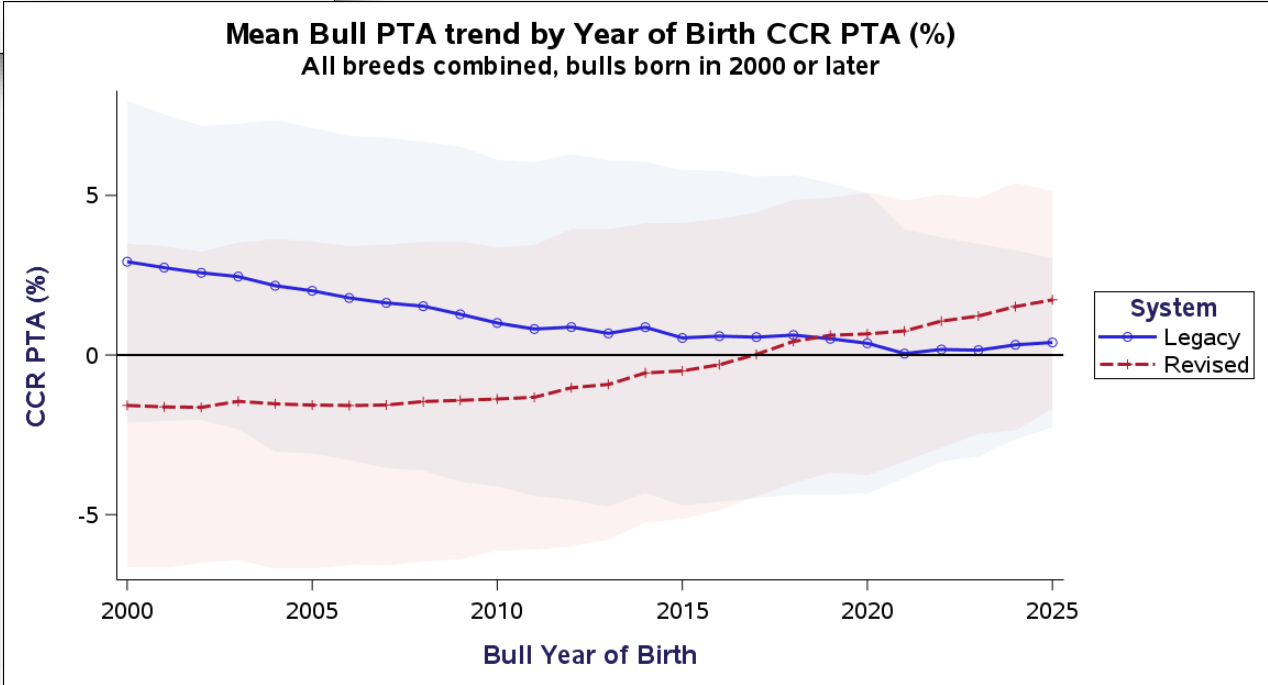
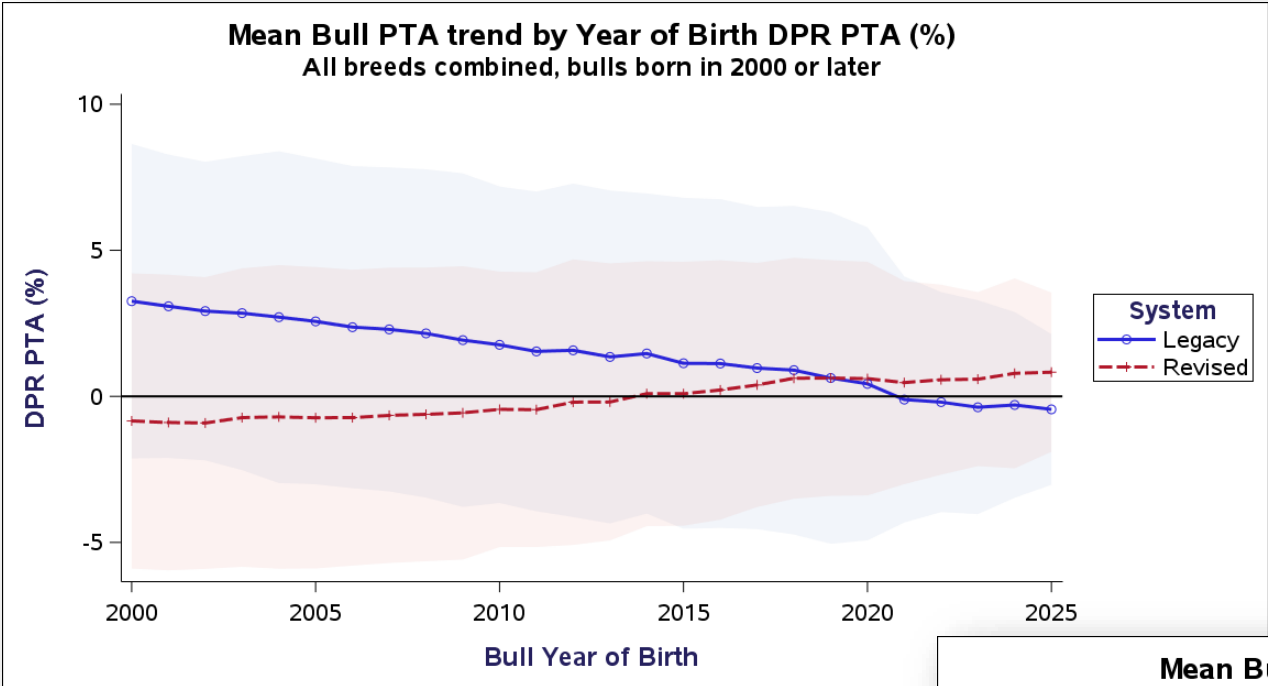
- High genetic correlation does not mean traits are identical
- Traits capture different aspects of reproductive performance
- Correlations < 1.0 indicate unique information remains
- Multi-trait evaluation improves stability and prediction

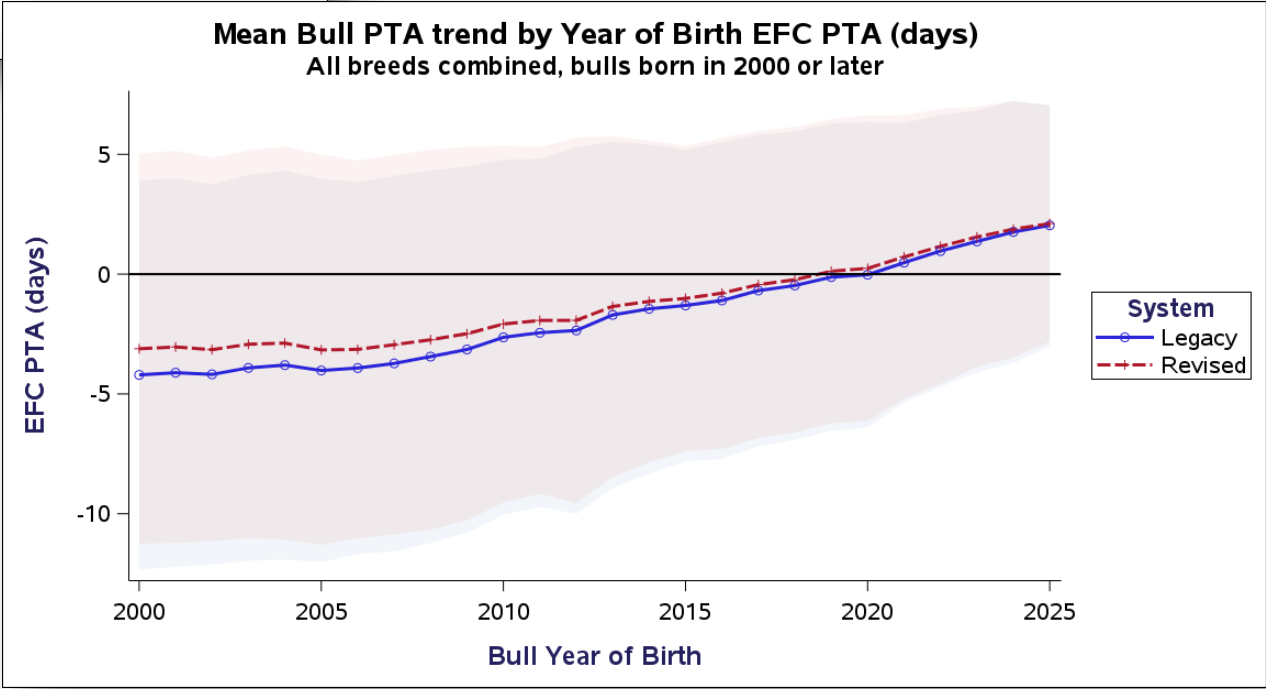
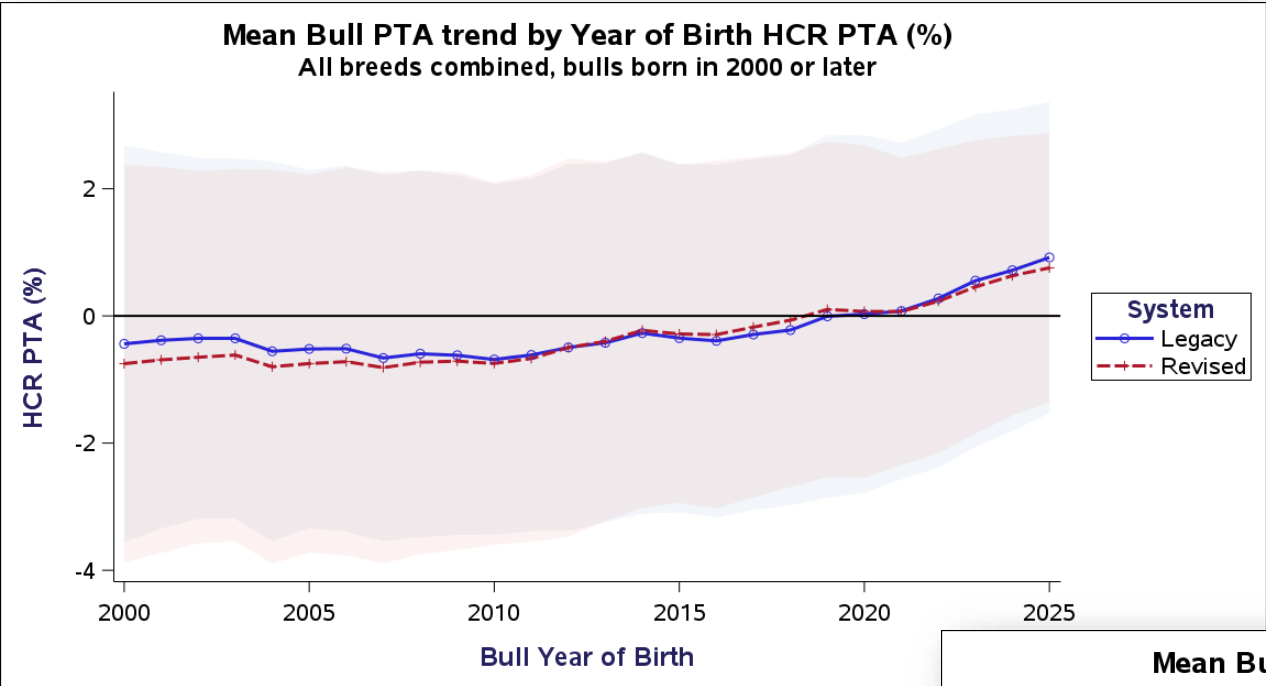
	Updated	Previous
DPR-CCR	+0.94	+0.86
DPR-HCR	+0.56	+0.36
CCR-HCR	+0.52	+0.45
CCR-FSC	+0.98	-
DPR-FSC	+0.96	-
HCR-FSC	+0.46	-

Heritabilities

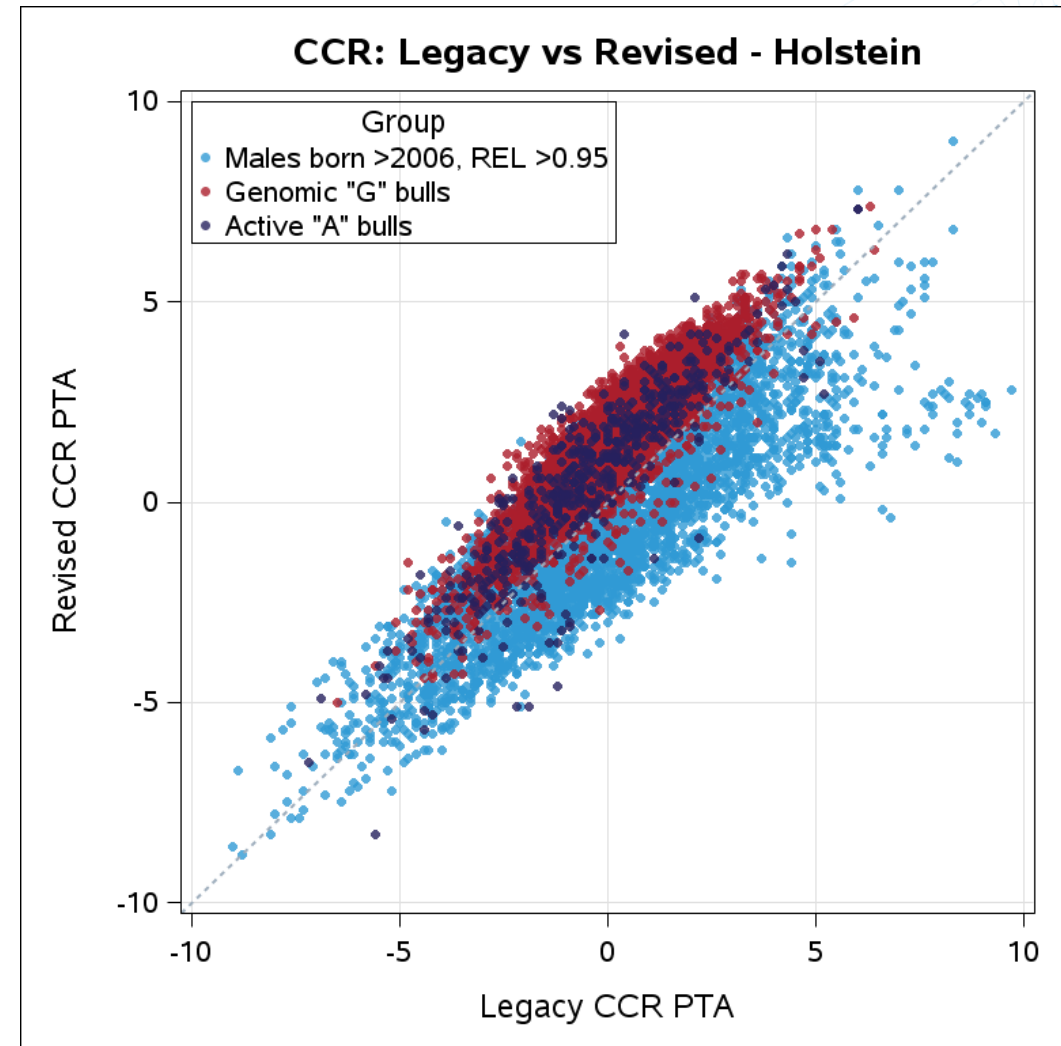
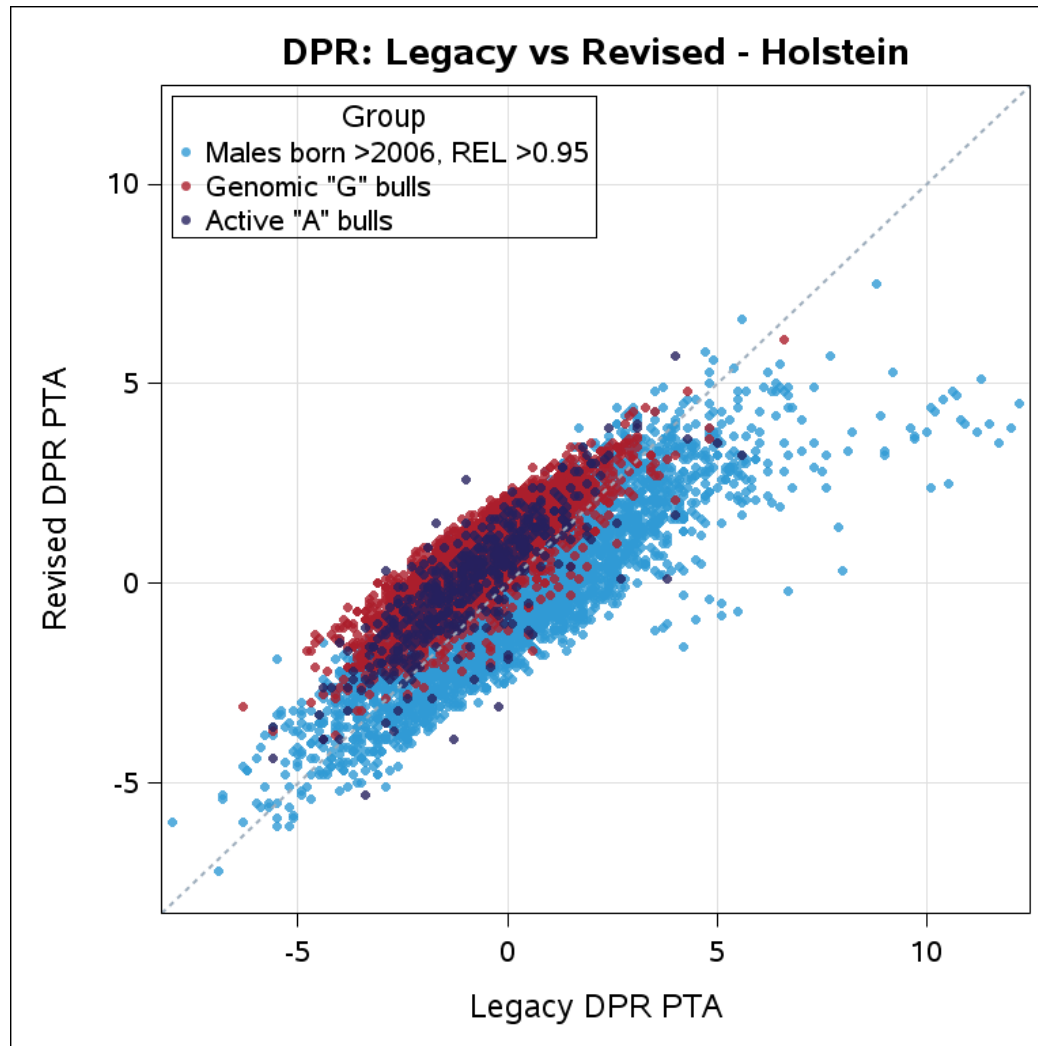
- Updated models captured more additive genetic variation
- Traits remain lowly heritable, as expected
- FSC heritability similar to other cow traits

	Updated	Previous
DPR	2.9%	1.4%
CCR	2.9%	1.6%
FSC	3.2%	-
HCR	1.4%	1.0%
EFC	6.0%	2.7%

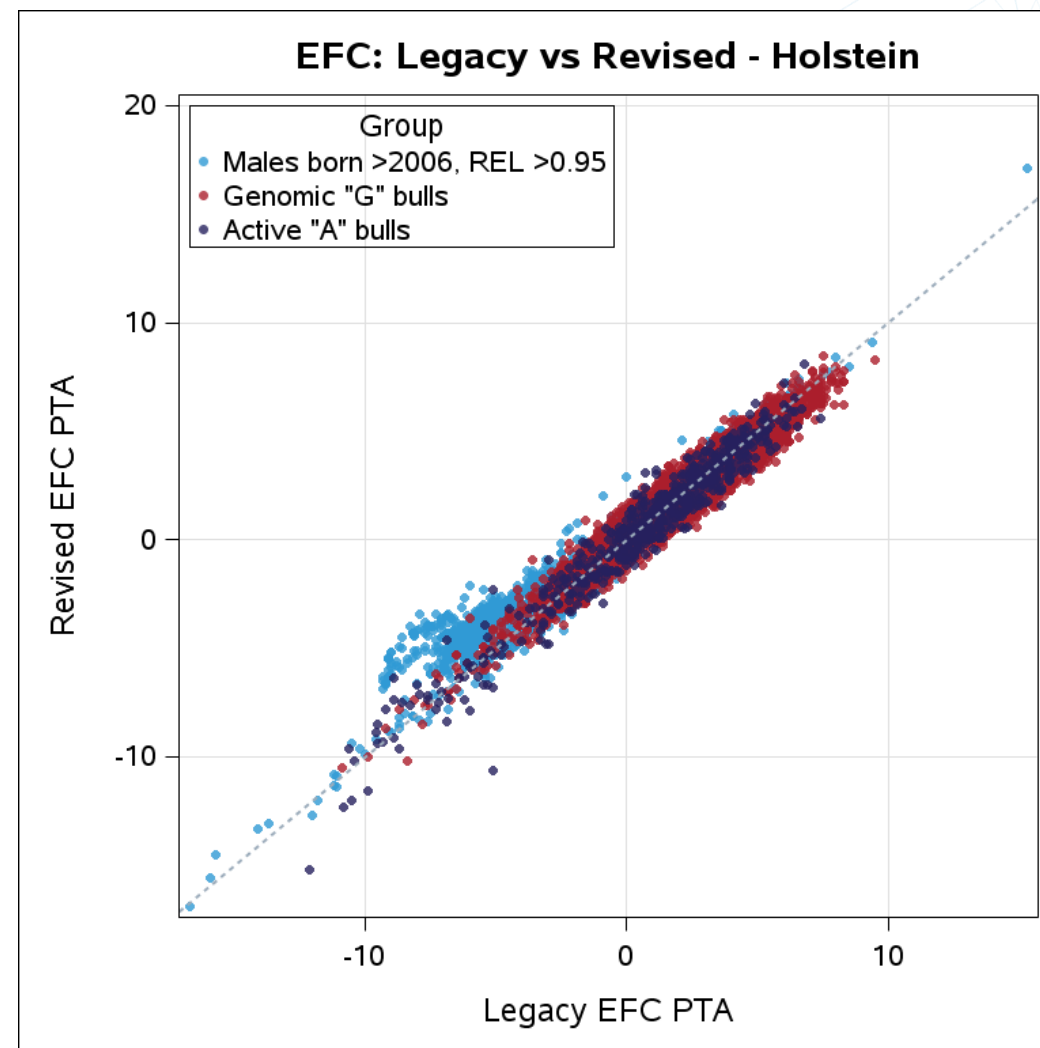
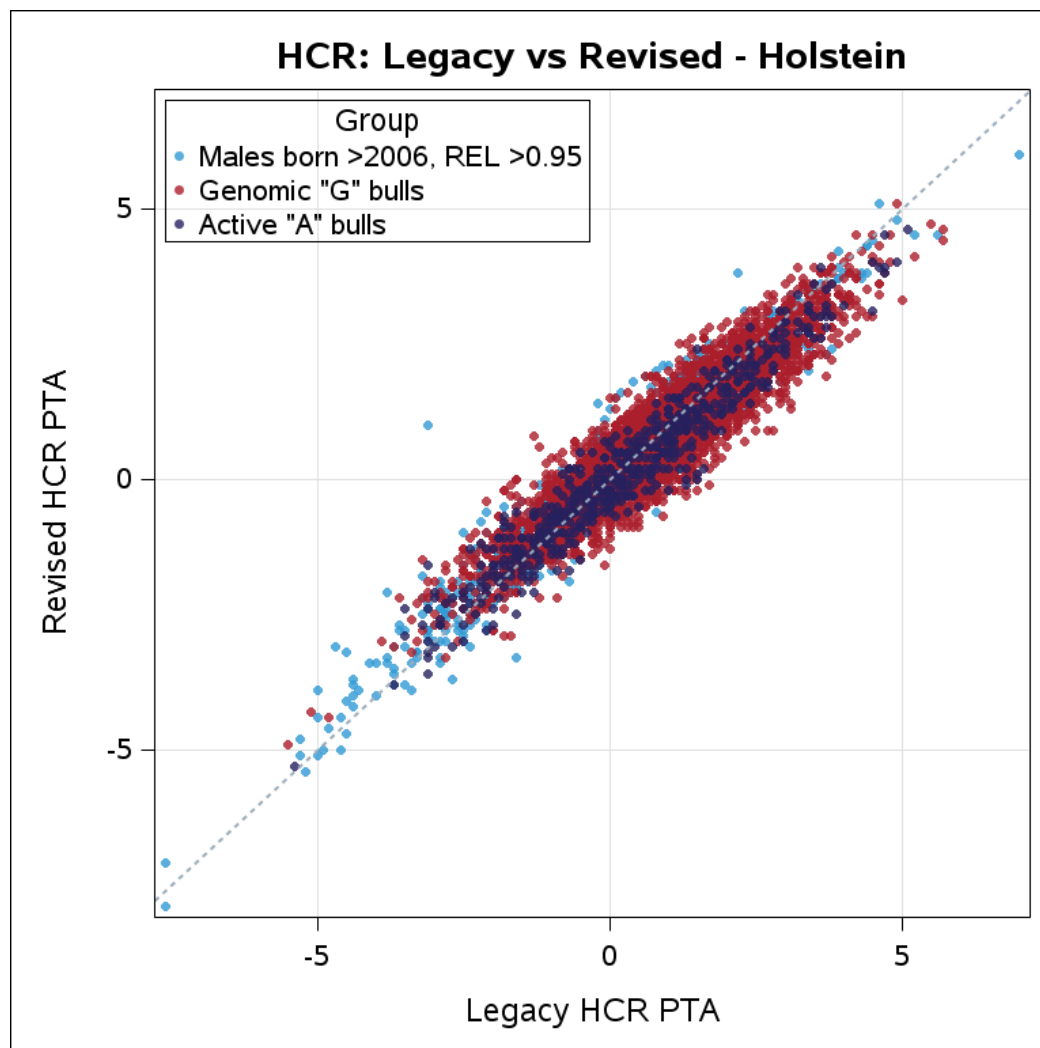




DPR (left) & CCR (right) legacy vs. revised

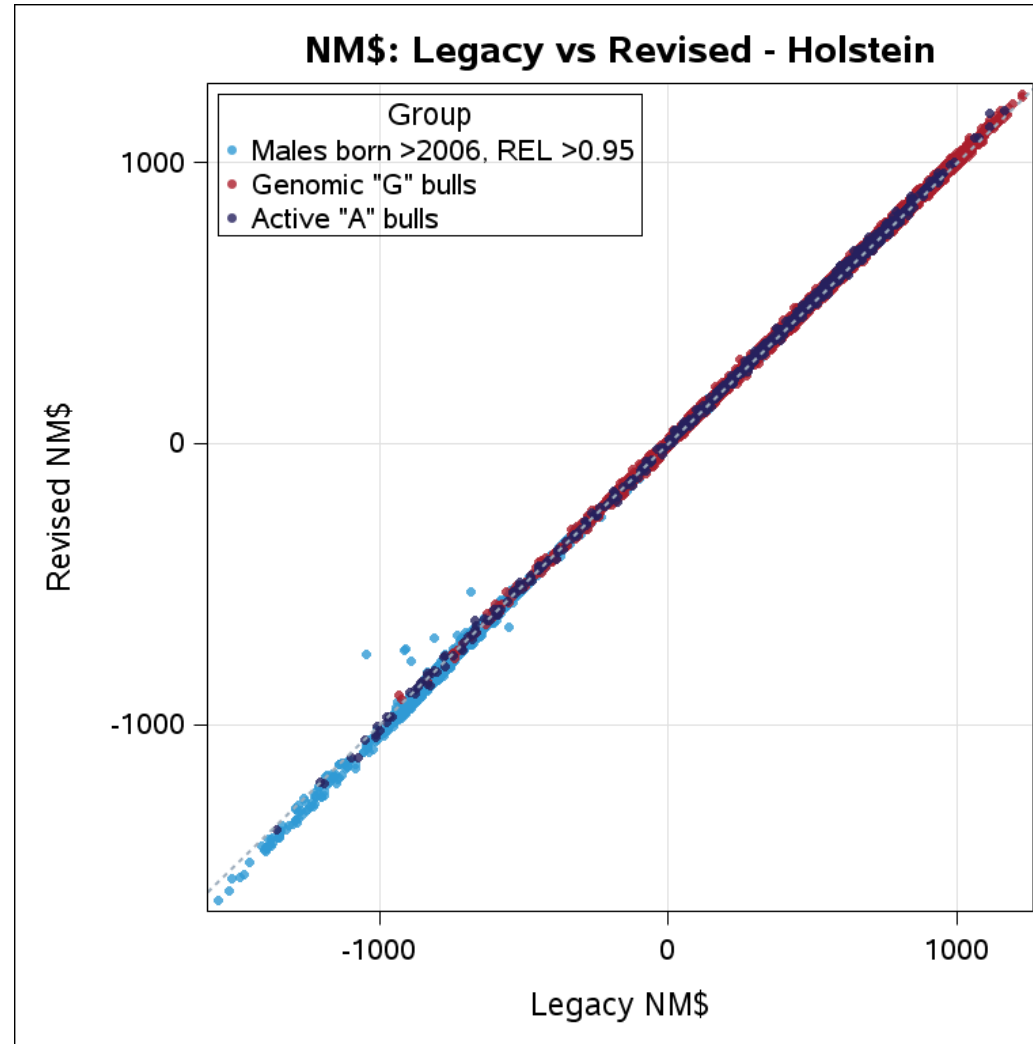


HCR (left) & EFC (right) legacy vs. revised



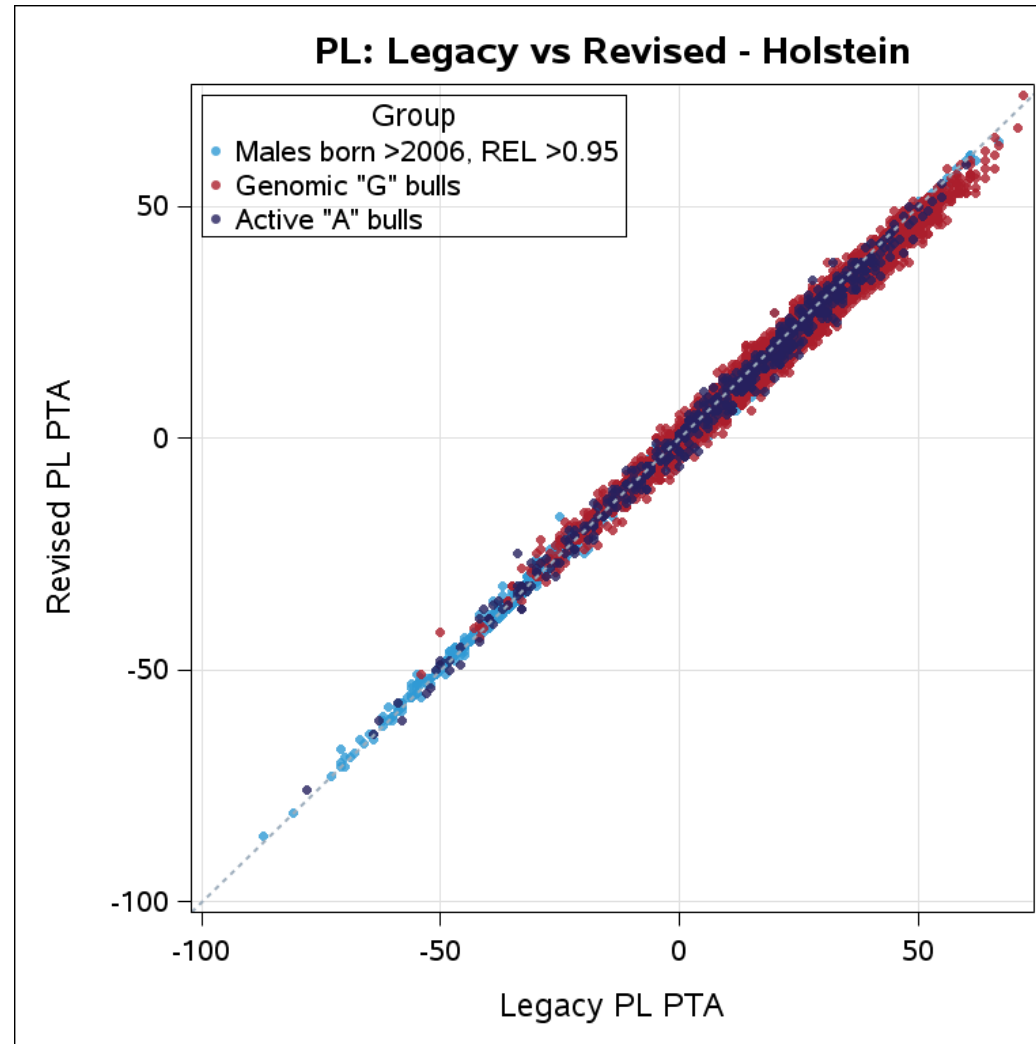
NM\$ legacy vs. revised

- Relative emphasis within NM\$ was unchanged, but revised reproductive PTA contribute updated values to the index



Productive Life legacy vs. revised

- PL predicts the time that female offspring are expected to remain in milking herd before removal by culling or death
- Calculated with info from PTA of other traits



Conclusions

Conclusions

- 3 new traits will be available in August 2026 triannual evaluations
- Reproductive Performance Traits
 - 10 updates are applied to the existing traits
 - During the initial transition from the current Legacy to the new Revised system:
 - The greatest change will be seen in DPR and CCR
 - Some change for HCR and EFC
 - Even less, but some change for NM\$ (other indexes) and PL



Thank you for your attention

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