

Refinement of U.S. Reproductive Performance Evaluations for the Modern Dairy Herd

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Reproductive Performance Traits

Daughter Pregnancy Rate (DPR → int)

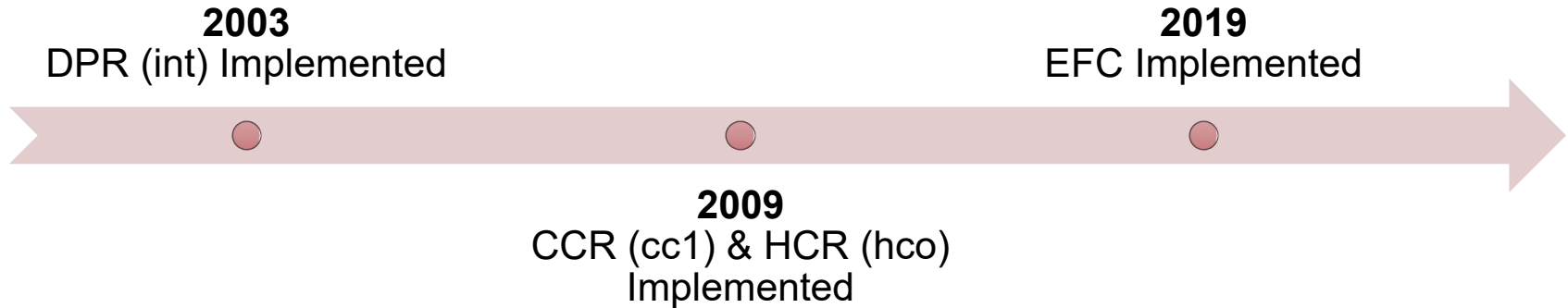
Cow Conception Rate (CCR → cc1)

Heifer Conception Rate (HCR → hco)

Early First Calving (EFC → -)

NEW

Why review reproductive evaluations?



- Reproductive management has changed substantially
 - Sexed semen, synchronization programs, beef semen in dairy herds, variation in voluntary waiting periods
- Unexpected trends observed

Objectives of the review

- Primary Objective
 - Identify causes of run-to-run variability in reproductive performance evaluations
- Secondary Objectives
 - Improve evaluation stability
 - Reflect modern reproductive management
 - Evaluate potential new trait

Daughter Pregnancy Rate (int)

- Predicts percentage of non-pregnant cows that will become pregnant in each 21-day cycle
- Days open to pregnancy rate through non-linear formula

$$int = \left[\frac{21}{\max(21, \max(DO, 71) - VWP_{herdyr-x-lactgrp})} * 100 \right]$$

↑ days open

↑ voluntary waiting period,
variable by herd-year and
lactation group
(1st lact, later lact)



Update #1

Cow Conception Rate (cc1)

- Predicts a lactating cow's ability conceive
- Proportion of inseminations that result in pregnancy
- Inseminations are pre-adjusted by:
 - Service sire breed
 - Mating type
 - Short cycle

Update #2

$$cc1 = \frac{\sum \text{adjusted inseminations}}{\text{total inseminations}} * 100$$

Update #3

- Model now includes covariable days-in-milk at first insemination

Heifer Conception Rate (hco)

- Predicts a maiden heifer's ability conceive
- Proportion of inseminations that result in pregnancy
- Inseminations are pre-adjusted by:
 - Service sire breed
 - Mating type
 - Short cycle

Update #2

$$hco = \frac{\sum \text{adjusted inseminations}}{\text{total inseminations}} * 100$$

Early First Calving (EFC)

- Predicts ability to alter female offspring's age at first calving
- Positive PTA = few days between birth and first calving
- Always treated as uncorrelated with other repro traits
 - Now moved into its own trait group, single-trait model

Update #4

$$EFC = (first\ calving\ date - birth\ date) * -1$$



New Trait: First Service to Conception (cc2)

- Predicts a lactating cow's ability to conceive, expressed in days
- Positive PTA = fewer days between first insemination and conception

$$cc2 = \begin{cases} 230, & \text{if not pregnant} \\ 200, & \text{if } (DOC - DOFS) > 200 \\ DOC - DOFS, & \text{if } (DOC - DOFS) \leq 200 \end{cases}$$

DOC = date of conception

- for phenotype definition purposes, the date of the successful insemination is treated as the date of conception

DOFS = date of the first service/insemination

Trait	Records	Cows/Heifers
DPR (int)	93.6 M	37.0 M
CCR (cc1)	45.3 M	19.1 M
HCR (hco)	14.1 M	14.1 M
EFC	34.6 M	34.6 M
FSC (cc2)	45.3 M	19.1 M

Variance component estimates

- EFC:
 - AI REML within BLUPF90+
- int/cc1/hco/cc2
 - Multi-trait model using GIBBSF90+
 - Highly correlated traits across multiple lactations
 - Bayesian MCMC approach more stable for complex models
- Computational considerations
 - ~200M records and >106M pedigree animals
 - Five representative subsets (~200K records each)
 - Final estimates selected based on stability and biological plausibility



10 Implemented Updates

Genetic Correlations

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

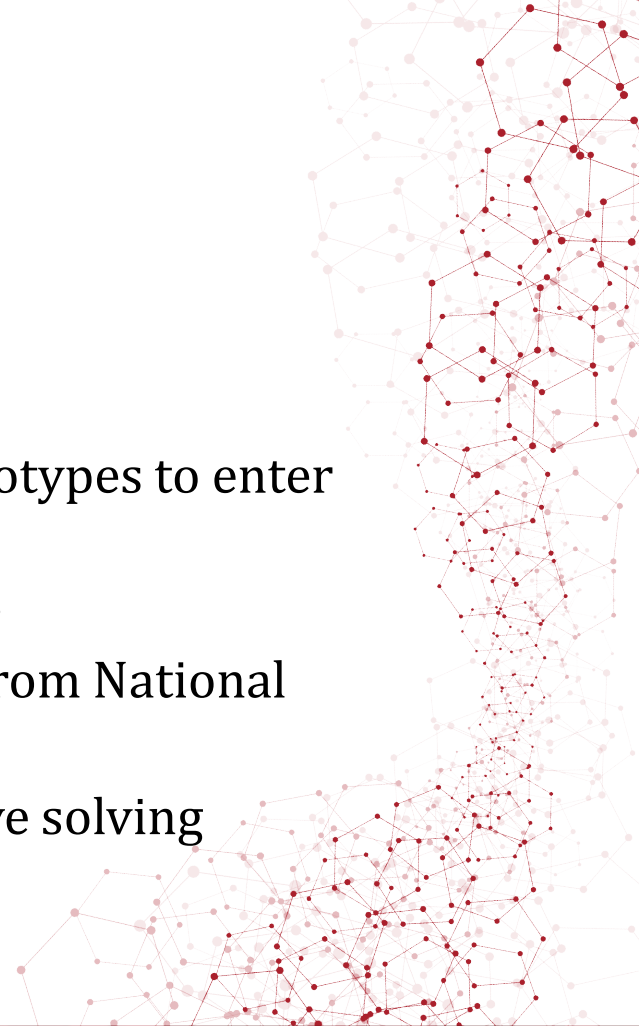
+1 = Traits are positively influenced by many of the same genes

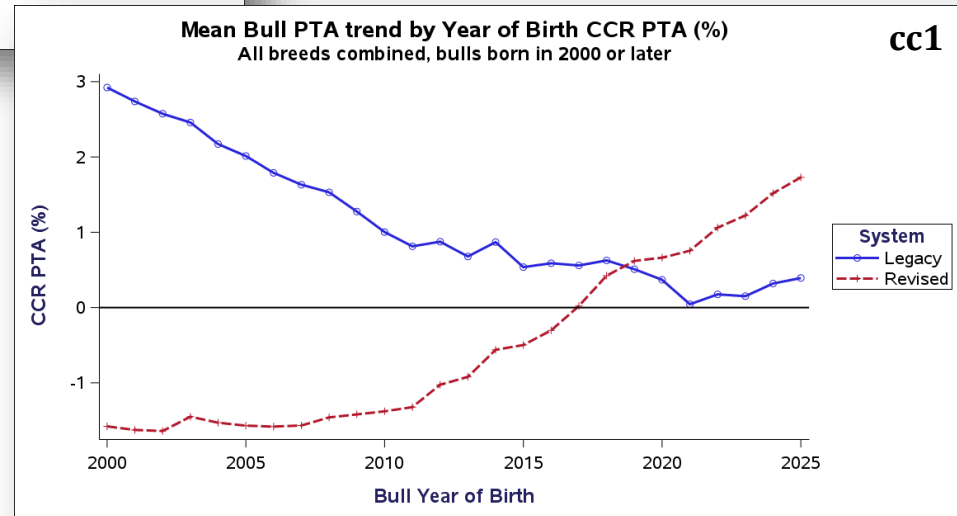
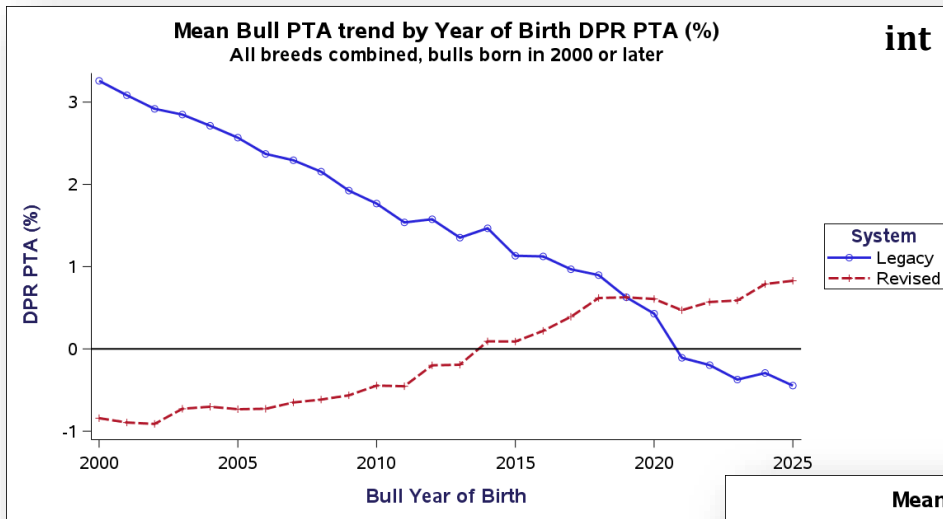
-1 = Traits are inversely influenced by many of the same genes

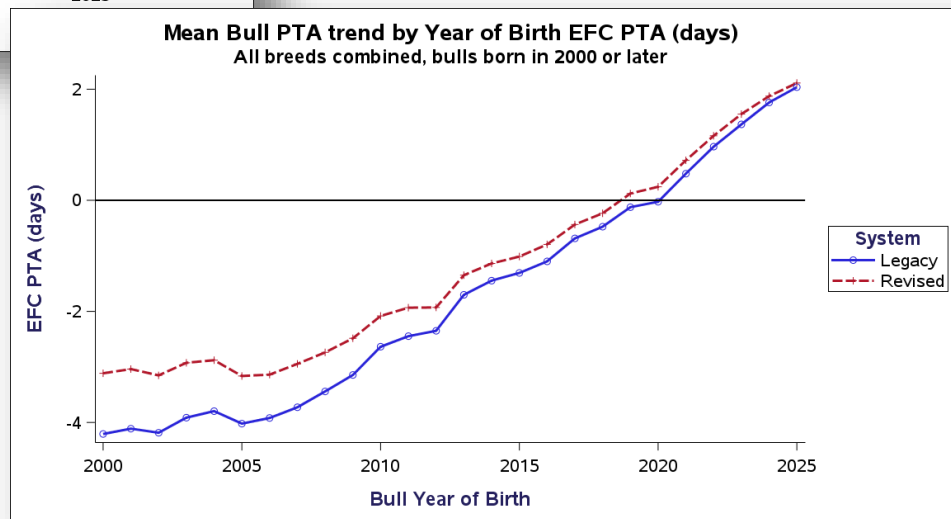
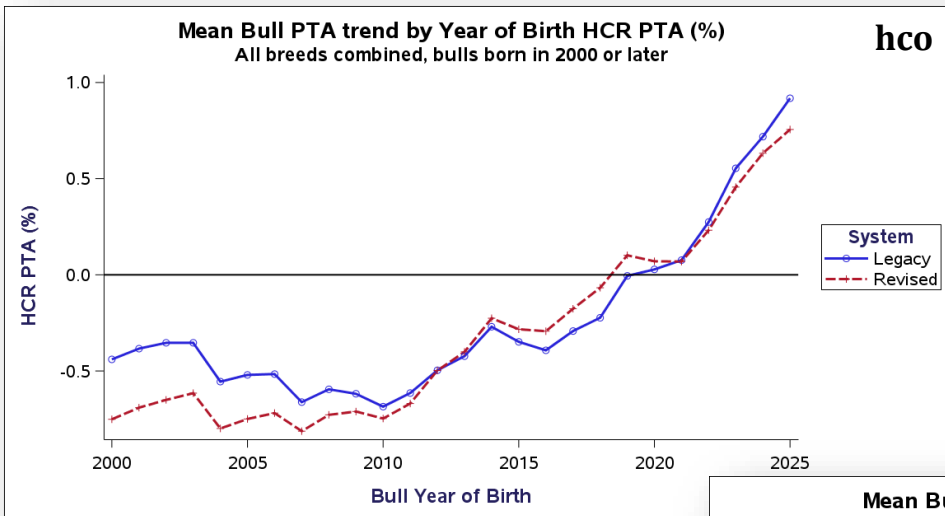
0 = Traits are genetically independent

Additional updates

- Data edits
 - Including 36-month requirement for cow phenotypes to enter cow trait evaluations
 - Contemporary groups required of observations
- Update to our system programs that extract data from National Performance metrics
- Employ stricter convergence criteria in the iterative solving procedure



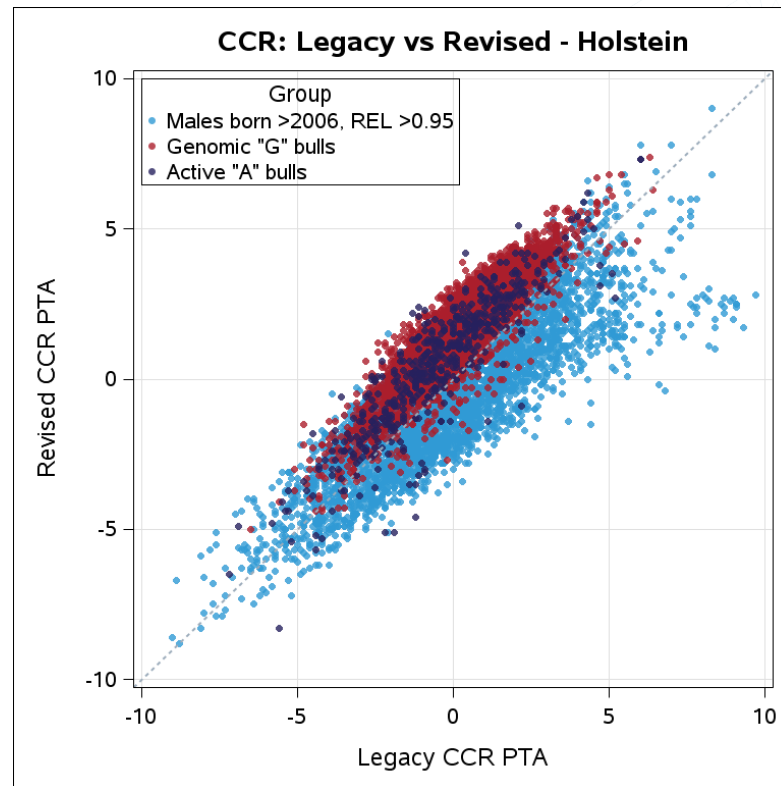
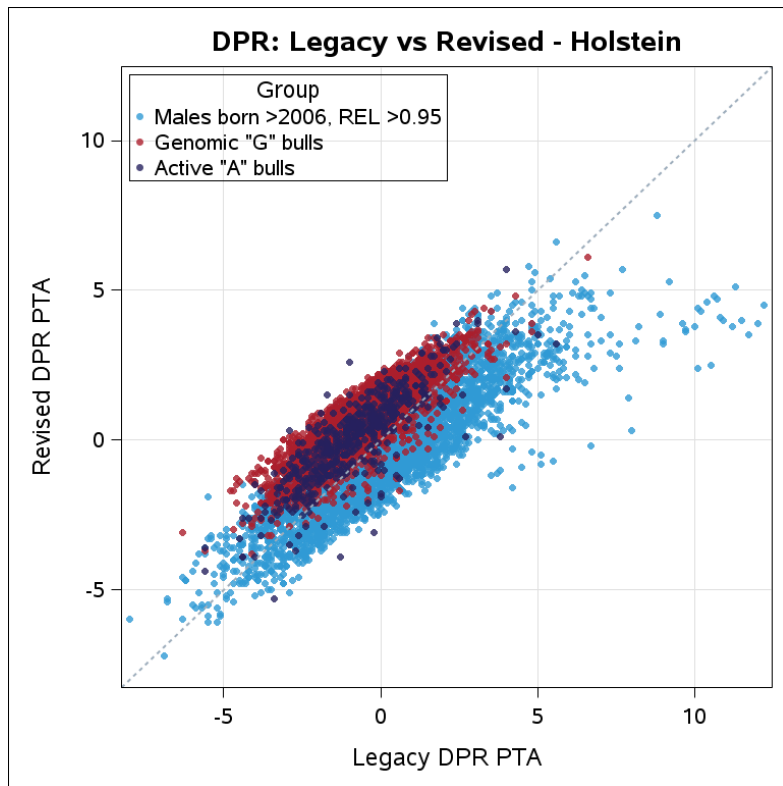




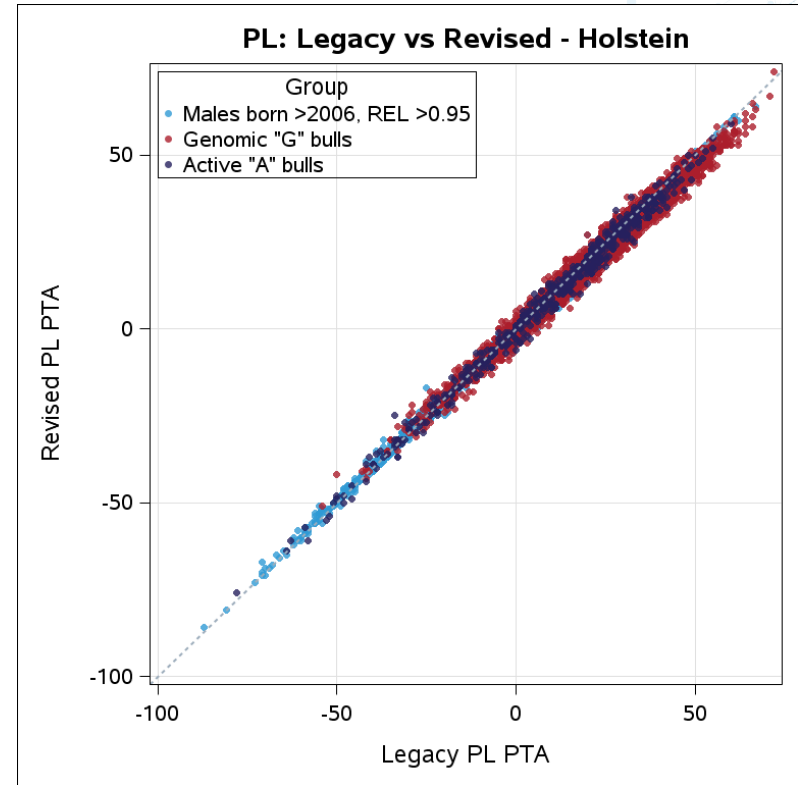
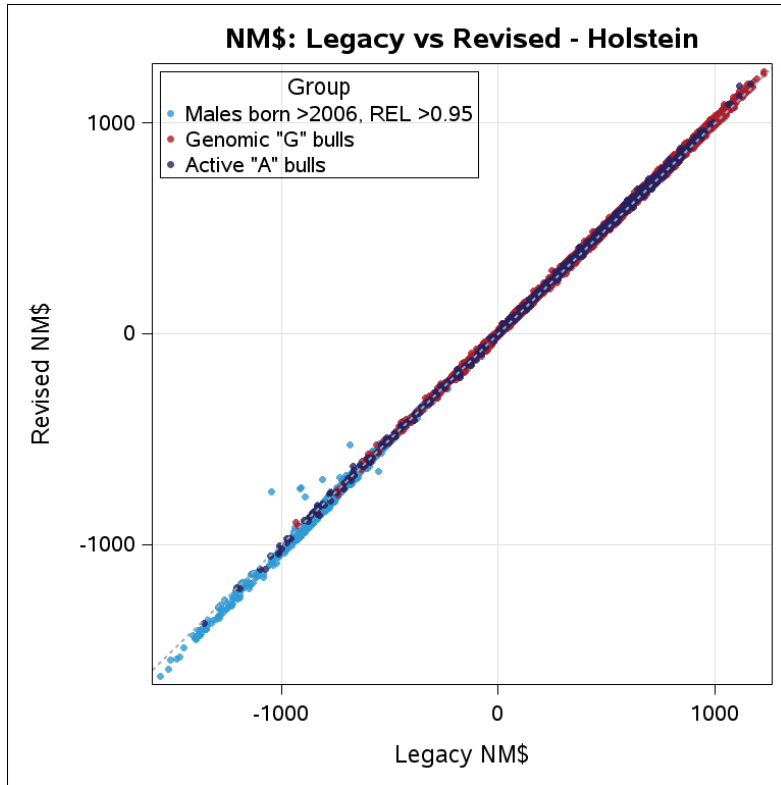
Key results

- Revised evaluations produced smoother and more biologically plausible trends
- Younger cohorts improved as expected under selection
 - Existing system showed unexpected downward drift in some traits
- Updated system aligned better with observed industry selection response

int (left) & cc1 (right) legacy vs. revised



NM\$ (left) & Productive Life (right) legacy vs. revised



Conclusions

- U.S. reproductive performance evaluations were comprehensively updated
- cc2 successfully integrated into reproductive performance framework
- Revised system reduced data-driven bias in bulls
- Run-to-run updates now behave more consistently with biological expectations
- Updates support continued modernization of national dairy evaluations

For more info

- <https://uscdcb.com/august-2026-evaluations/>
 - Contains comprehensive summary and individual trait sheets
 - The CDCB CowCast podcast

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](#) 



Thank you for your attention

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