



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 during each 21-day estrous cycle. This trait utilizes a VWP that is now calculated on a herd-year and lactation group (first lactation only and later lactations) basis. DPR PTA predicts the expected difference in pregnancy rate of an animal's daughters, expressed in percentage points, relative to the breed base.

First Service to Conception (FSC) - NEW!

Predicts a lactating cow's ability to conceive, expressed in days

FSC is a new trait that coincides with revisions to current reproductive performance traits. FSC PTA predicts the expected difference, in days, from first service to conception in an animal's daughters relative to the breed base. A positive PTA represents fewer days to conception. FSC is not a function of a VWP, which allows it to account for individual cow management independently of VWP changes.

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 base. The CCR model now also includes a covariable for days-in-milk at the first insemination.

Heifer Conception Rate (HCR)

Predicts a maiden heifer's ability to conceive

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

Early First Calving (EFC)

Predicts ability to alter female offspring's age at first calving

Introduced in 2019, EFC is calculated as the number of days between a heifer's birth and her first calving. EFC PTA predicts the expected difference, in days, in age at first calving of an animal's female offspring relative to the breed base.

Trait	Expressed In	PTA Range of Active A.I. Bulls ¹	Application of Trait
Daughter Pregnancy Rate (DPR)	Percent (%)	Holstein: -5.3 to +5.7 Jersey: -3.6 to +5.0 Brown Swiss: -1.6 to +3.0	Informational for producers who use a voluntary waiting period on a herd level and want cows to cycle, get bred, and become pregnant quickly, regardless of the number of services.
Cow Conception Rate (CCR)	Percent (%)	Holstein: -8.3 to +7.3 Jersey: -4.1 to +5.1 Brown Swiss: -3.6 to +2.9	Best for a producer who wants to improve conception rate success per service, since this trait reflects how many inseminations are needed.
First Service to Conception (FSC)	Days	Holstein: -24.8 to +20.7 Jersey: -12.5 to +15.2 Brown Swiss: -7.8 to +9.2	Useful for producers who select voluntary waiting periods on a cow basis and want cows to get pregnant as quickly as possible after the first breeding without focusing on how many services it takes.

¹ - Values produced in a test run scenario. Some variation is expected in August 2026 as more phenotypic records are added and the list of Active A.I. bulls is updated.

Research Overview

Reproductive performance was first available for direct selection for dairy cattle in 2003 with the introduction of DPR. Six years later, CCR and HCR were added to the portfolio, and in 2019, EFC was introduced. Over these 20 years, reproductive management has changed substantially – synchronization programs, sexed semen, beef semen in dairy herds, and variation in VWPs all impact a cow's reproductive performance.

Observations Triggering the Review

1. Seasonal fluctuation between official triannual evaluations
2. Large changes between December and April evaluations
3. Young bull PTAs declining in subsequent evaluations (PTAs are expected to move both upward and downward as daughter information is added)
4. Genetic trends moved in unexpected directions for traits heavily selected for on-farm

Objectives of the Review

1. Identify causes of consistent fluctuations in reproductive performance evaluations
2. Enhance evaluation stability
3. Reflect modern reproductive management
4. Evaluate potential new traits

Research Timeline

2024

February – July: Data investigation and thorough documentation of legacy system

August – December: Initial testing of proposed solutions including a new trait, First Service to Conception (FSC)

2025

January – July: Continued research and testing to refine approaches identified in initial testing

August – December: Testing all updates across seven consecutive triannual evaluations

2026

January – February: Interbull validation passed for 10 updates to existing traits and introduction of FSC

August: Implementation of trait revisions and new FSC trait.

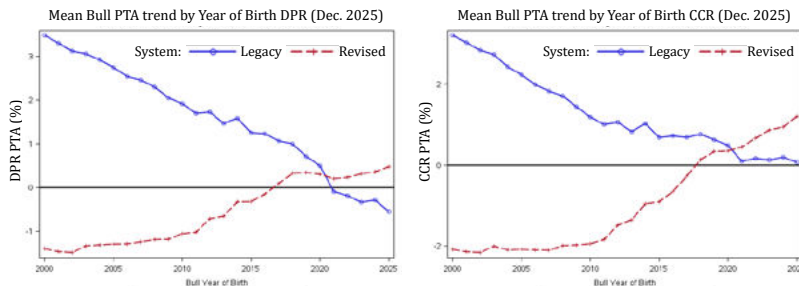
Research Team

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Key Findings

#1: Genetic trends reflect on-farm observations

The genetic trends for these traits now align with producer-observed reproductive performance and selection pressure. These graphs depict genetic trends (DPR left; CCR right) using mean traditional PTA of bulls from all evaluated breeds in the legacy system (blue) and the revised system (red).



#2: Young bull PTAs behave more regularly

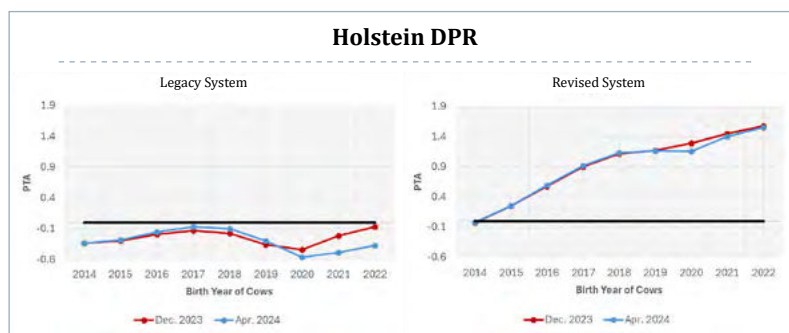
As daughters are added to evaluations, it is expected that approximately equal numbers of bulls will have decreasing and increasing PTA values between triannual evaluations. In the legacy system, more than 55% of bulls showed constant declining PTA at each run from December 2023 to December 2024. The revisions help equalize these fluctuations and reduce the persistent negative trend observed for a majority of bulls.

#3: Proven bulls remain stable

While young bulls are expected to change with new daughter information, older proven bulls with large daughter numbers who are now inactive should remain stable over time. This continues to occur in the revised system.

#4: Average trends over time show less variation

Average sire PTA of cows by birth year reflects the genetic merit of the bulls used to produce cows with reproductive performance phenotypes. When comparing Holstein DPR in the December 2023 and April 2024 evaluations, the revised system shows a clearer upward trend and smaller average differences between evaluations, indicating more consistent genetic progress.

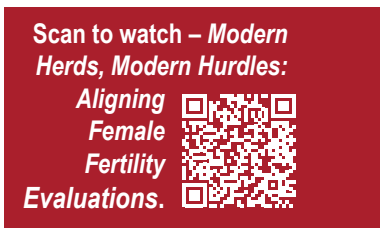


#5: Interbull validates evaluations

Interbull is an international organization that offers third-party review and validation of genetic evaluations calculated by national evaluation centers like CDCB. The revised reproductive performance traits and the new FSC trait passed this validation confidently.

Summary of Updates to Reproductive Performance Traits

Throughout the two-year review of the performance of these evaluations, numerous solutions were tested to refine the reproductive performance traits. The 10 implemented updates, including the introduction of a fifth trait, are outlined below. These revisions were tested over seven consecutive triannual evaluation runs for stability in predictions. Prior to launch, this comprehensive trait package also passed the international validation process, conducted by Interbull, and was reviewed by CDCB's Genetic Evaluations Methods Group and the Dairy Evaluation Review Team.



Update 1: Utilize herd-year and lactation group-specific VWP 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.

Update 2: Implement First Service to Conception (FSC)

First Service to Conception (FSC) is an interval trait measured in days and is not affected by VWP. It is the number of days from the first insemination to conception.

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 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.

Update 5: Apply stricter data edits to raw data

An edit to remove cows with a missing sire has been added to DPR and included in FSC. This data edit is already applied to CCR, HCR, EFC, and other traits.

More data availability for DPR eliminates the need for predictions on some of the missing data. Records with missing calving dates or missing days open were removed.

Stricter criteria is also applied for contemporary groups to be included in the phenotype file. If records belong to a contemporary group with less than four observations, the group and all observations within it are removed.

Update 6: Improve programs extracting raw data from the National Cooperator Database

Update 7: Include days-in-milk at first insemination covariable in CCR and FSC models

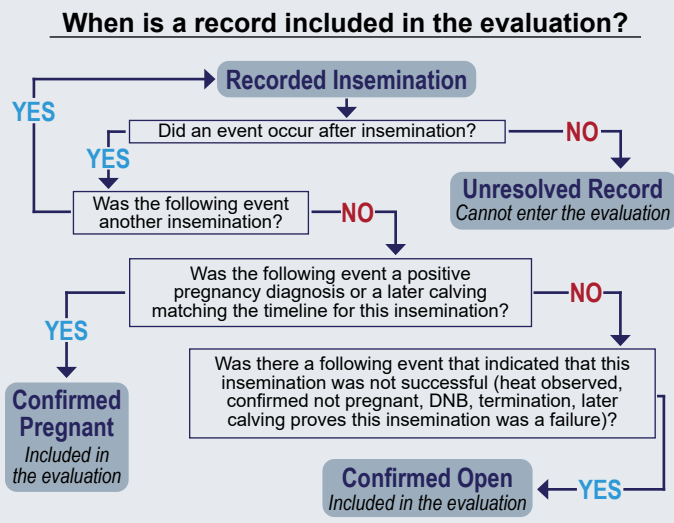
Update 8: Calculate CCR, HCR, DPR, and FSC in a multi-trait model and EFC in a single-trait model

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.

Update 9: Employ stricter convergence criteria in the iterative solving procedure to ensure a more complete model convergence

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

	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

Understanding the Differences In Traits

BE ON THE LOOKOUT!

The August 2026 revisions to reproductive performance traits do not affect the emphasis of traits in the lifetime merit indexes. This is because the weights on traits in these indexes are based on economic values, which are not being updated.

These revisions will have an impact on selection indexes – both those calculated by CDCB (NM\$, CM\$, FM\$, GM\$) and those calculated throughout the industry due to changes in PTA values. Productive Life will also see variation.

Daughter Pregnancy Rate (DPR)

- Evaluates the ability of an animal's daughters to become pregnant after calving
- Derived from days open (calving to conception), which is transformed into a pregnancy rate and scaled to represent the probability that a non-pregnant cow becomes pregnant in each 21-day estrous cycle
- Incorporates voluntary waiting period (VWP) on a herd-year and lactation group level to account for management decisions affecting when cows are first bred
- Captures overall reproductive performance during lactation, including when cows are first bred, how many cycles are required to conceive, and how long cows remain open
- DPR reflects both biological fertility and management factors affecting breeding timing

First Service to Conception (FSC)

- Evaluates how quickly a cow conceives after the first insemination and is expressed in days
- Reflects fertility once breeding has started rather than the full calving-to-pregnancy interval
- Removes the management component associated with VWP, focusing on conception following the first service
- Positive PTA indicates fewer days from first service to conception

Cow Conception Rate (CCR)

- Probability that an individual lactating cow becomes pregnant at each insemination
- Calculated from insemination outcomes for up to the first seven services after calving
- Focuses on insemination success in lactating cows, reflecting fertility during lactation

Heifer Conception Rate (HCR)

- Probability that a maiden heifer becomes pregnant at each insemination
- Calculated from insemination outcomes for up to the first seven services before first calving
- Focuses on insemination success in heifers, reflecting fertility before first calving

Early First Calving (EFC)

- Age at first calving for daughters
- Positive PTA indicates fewer days to first calving relative to the breed base

Reading Reproductive Performance Evaluations

The revisions to these four traits will have impacts on the PTA ranges seen in active bulls and the mean PTA of that population. Additional analysis of PTA ranges, reliabilities, and standard deviations for each trait are available on individual trait pages.

Trait	Unit	PTAs of Active Bulls (HO)		PTAs of Active Bulls (JE)		PTAs of Active Bulls (BS)	
		Range	Mean	Range	Mean	Range	Mean
DPR	%	-5.30 to +5.70	+0.06	-3.60 to +5.00	+0.13	-1.60 to +3.00	+0.47
FSC	days	-24.80 to +20.70	+2.13	-12.50 to +15.20	+0.20	-7.80 to +9.20	+0.19
CCR	%	-8.30 to +7.30	+0.61	-4.10 to +5.10	+0.15	-3.60 to +2.90	+0.55
HCR	%	-5.30 to +4.60	+0.48	-3.40 to +4.20	-0.03	-5.60 to +3.70	-0.02
EFC	days	-16.90 to +8.40	+0.74	-13.30 to +10.10	+0.67	-9.40 to +8.90	+0.70

Interpreting PTAs is reliant on understanding the breed mean they are measured from. While DPR and FSC are highly genetically correlated, the expression of these traits is different. FSC is measured and expressed in days; DPR is measured and expressed as a percentage. A previous USDA study determined that a DPR +1.0% PTA equates to four fewer days open.

Trait	Unit	Breed Mean (What PTA "0" Indicates)					
		AY	BS	GU	HO	JE	MS
DPR	%	25.29	24.55	23.44	32.19	34.98	28.62
FSC	days	63.44	71.94	79.50	55.60	52.04	47.66

These values are calculated using data from the December 2025 run.

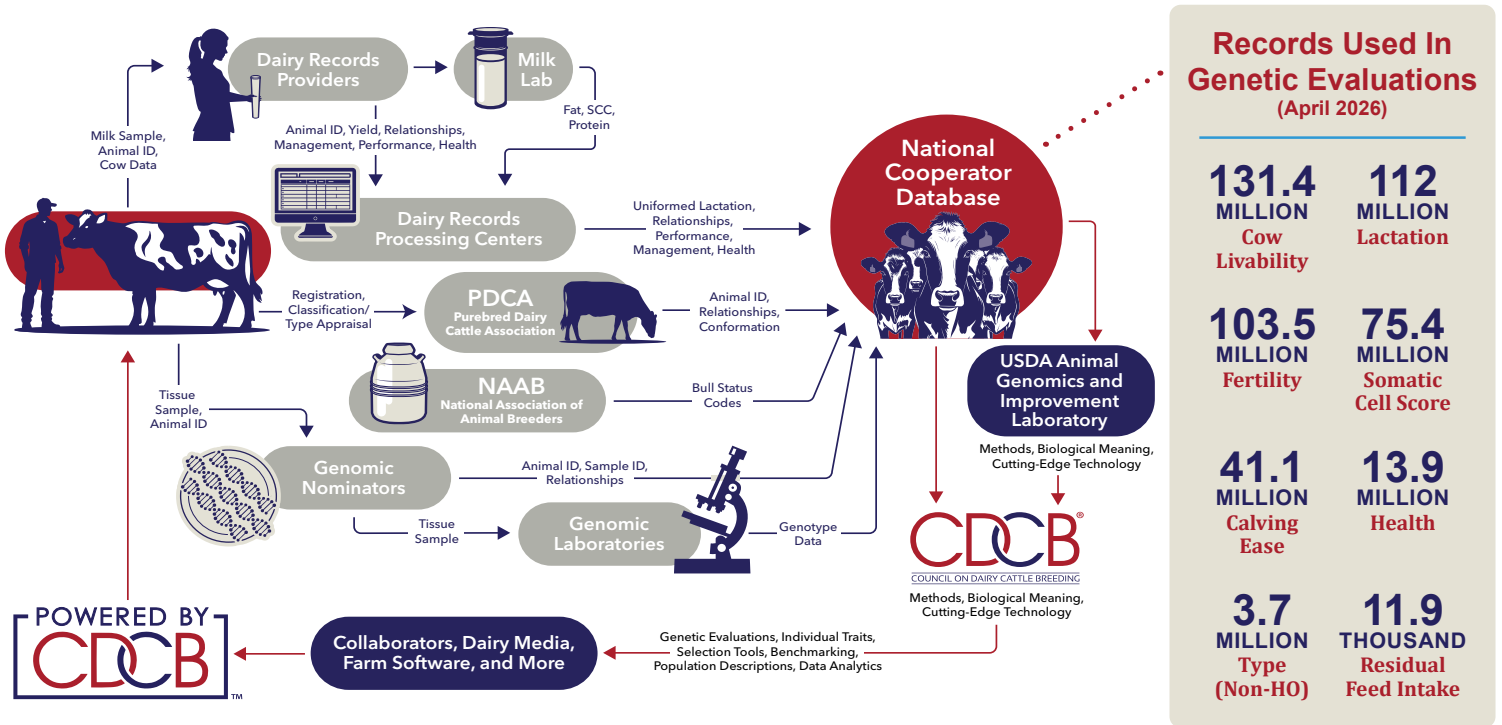
Resources and Research

Details on individual traits, published research supporting the traits, and more information about the 2026 reproductive revisions is available by scanning this QR code.

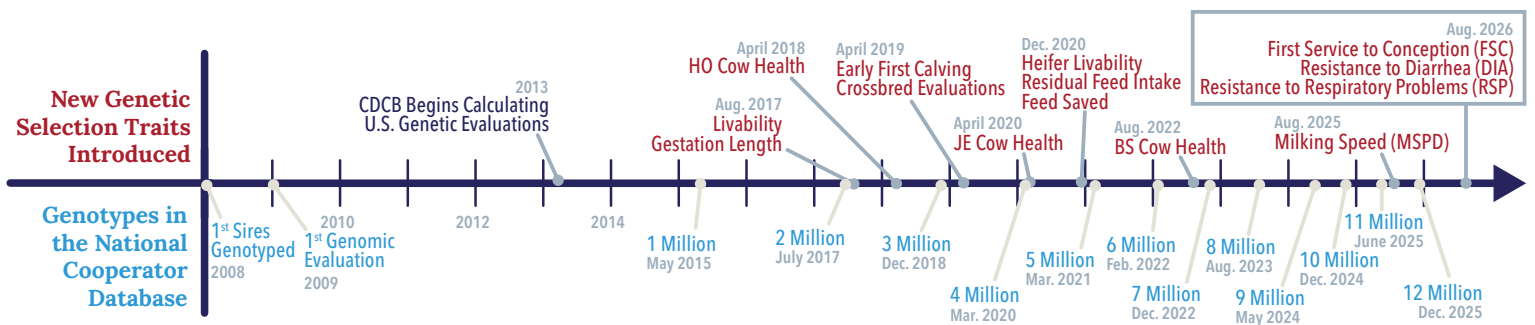


How CDCB Functions in the Dairy Ecosystem

In 2013, the Council on Dairy Cattle Breeding assumed service responsibilities from USDA's Animal Genomics and Improvement Laboratory and the role as steward of the National Cooperator Database. As depicted in the graphic below, CDCB functions in a collaborative system that is supported by more than 60 dairy organizations in the U.S. and abroad. Through this framework, performance data from nearly four million cows is added to the national database on an annual basis. This real-world information is used to support 50 individual genetic selection traits and four selection indexes. It is the continued participation of nearly 10,000 herds across the U.S. that have built the reputation for U.S. genetic evaluations as the global standard. Today, genetic evaluations produced using information stored in the National Cooperator Database are recognized as Powered by CDCB – the industry collaboration designed to serve dairy producers.



The continual flow of cow performance information into the National Cooperator Database not only makes it possible to calculate existing selection traits but also research new tools. Since CDCB began providing evaluation services to the industry, new tools have been added to address cow and calf health, feed efficiency, fertility, and milking speed. Research is ongoing to develop traits for hoof health and mobility.



Beginning in 2008, the National Cooperator Database began storing genotypes for the calculation of genomic evaluations. This data type continues to grow exponentially as farmers rely on genomic evaluations to make both management and genetic decisions.