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Udderly Important: What's Changing in April 2025 Evaluations

Dr. Taylor M. McWhorter

CDCB Producer Exchange Genetics for Progressive Dairies | March 31, 2025

Overview

4 Changes to April 2025 Evaluation

- Base Change
- Lifetime Merit Indices Revisions
- New Reference Population for Annual BBR Update
- Type Trait Reliability Evolution

Female Fertility Traits Review In-Progress

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2025 Tri-Annual Evaluation Release Schedule

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https://www.uscdcb.com/genetic-evaluation-schedule/2025/

Base Change

Base Change

- The base is a reference point for measuring genetic progress
- After calculating PTA for entire population, average PTA of cows born in a specific year is shifted to 0
  - Starting line to measure genetic progress

Base Change

- Routine base adjustments allow new evaluations to be easily compared to previous evaluations
- An animal's PTA usually decreases when base is changed, but remains fairly constant between base changes

Base Change

$$\text{Average PTA (cows born in 2020)} - \text{Average PTA (cows born in 2015)} = \text{Base Change}$$

- Changes >0 indicate that younger cows (i.e., born 2020) have higher genetic merit than old cows (i.e., born 2015)
- April 2025 PTA will show **inverse** effect base change
  - Base change is population value
  - I.e., a **positive** milk base change value in the chart below will result in a **decrease** in milk PTA in April
- A bull or cow that previously met selection standards may not do so in April due to the base change

Why every 5 years?

- Genetic bases in US have been updated every 5 years since 1980
- Allows for PTA to reflect genetic improvement over time while still maintaining stability in evaluations

*additive genetic merit improvement (Apr. 2025)

2025 Base Change (*selected traits*)

Trait	Units	Ayrshire	Brown Swiss	Guernsey	Holstein	Jersey	Milking Shorthorn
Milk	Pounds	142	381	68	752	355	6
Fat	Pounds	3	9	0	44	16	-7
Protein	Pounds	5	14	2	29	14	-3
Somatic Cell Score	Log base 2 units	0.02	-0.04	0	-0.1	0.02	0.02
Productive Life	Months	0.08	0.9	0.72	2.31	1.61	0.37
Cow Livability	%	-0.86	0.47	-0.03	0.41	0.61	-0.04
Heifer Livability	%				0.46	0.18	
Daughter Pregnancy Rate	%	-0.99	-0.61	-0.45	-0.21	-0.39	-0.53
Cow Conception Rate	%	-1.15	-0.48	-0.85	0.45	0.05	-0.37
Heifer Conception Rate	%	-0.69	0.14	-0.32	0.94	1.41	-0.52
Early First Calving	Days	-0.25	0.66	0.23	2.37	1.93	-1.72
Ketosis	%				1.04	-0.06	
Mastitis	%		-0.01		0.7	-1.05	
Metritis	%				1.02	-0.02	
Residual Feed Intake	Pounds				-42.34		

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Additional factors

- Yield Trait Example:
  - Before base change applied to PTA
    - » Routine adjustment is applied to milk, fat, and protein phenotypes
  - Base animals are used to calculate this adjustment
  - Standardizes by breed and trait
- Genomic PTA Example:
  - Since 2006, USDA-AGIL / CDCB measures traits and genetic progress discounting *inbreeding depression*
  - PTAs are "discounted" by effective future inbreeding (EFI)
    - » Base estimates for inbreeding are also updated during base change

Inbreeding

- Inbreeding of mating
  - Based on two animals you choose to mate
  - Tells how inbred their calf will be
  - "**GenomicRelationships**" file distributed has inbreeding of genotyped AI bulls and cows
  - Can manage with smart mating decisions
- Inbreeding of animal
  - Describes how inbred a specific animal is
  - Could have impact of that specific animal's performance or health

- Effective Future Inbreeding (EFI)
  - Accounts for how an animal is **related to the population**, pedigree-based
  - How much inbreeding an animal might cause in future generations
  - Assumes animal is **mated randomly across the whole population**
  - Important when using bulls or cows widely in breeding
  - Assists in **maintaining long term genetic diversity**
  - **Accounted for in PTA on individual basis**

Where to find EFI?

- EFI by breed
  - Average of base animals (2015 base left; 2020 base right)
  - Updated every evaluation as our base animals can change from run to run

EVAL DATE December 2024

Export CSV

Breed	EFI
Ayrshire	7.1
Brown Swiss	7.1
Guernsey	7.9
Holstein	7.5
Jersey	7.9
Milking Shorthorn	4.5

EVAL DATE April 2025

Export CSV

Breed	EFI
Ayrshire	7.6
Brown Swiss	7.6
Guernsey	8.4
Holstein	9.4
Jersey	8.8
Milking Shorthorn	5.1

PTA Change for 1% Inb or Het

- Change in PTA by trait for every 1% of heterosis or inbreeding
  - Calculated every evaluation
  - Why we cannot direct subtract base change from animal's previous final December 2024 PTA

EVAL DATE December 2024

Export CSV

Regression	Mlk	Fat	Pro	PL	SCS	DPR	HCR	CCR	LIV	GL	MFV	DAB	KET
Heterosis	-156	13	4	0.16	0.04	1.27	0.50	1.00	0.02	0.00	0.00	0.00	0.00
Inbreeding	-73.6	-2.69	-2.13	-0.28	0.01	-0.23	-0.23	-0.33	-0.11	0.00	-0.01	0.01	0.02

EVAL DATE April 2025

Export CSV

Regression	Mlk	Fat	Pro	PL	SCS	DPR	HCR	CCR	LIV	GL	MFV	DAB	KET
Heterosis	-156	13	4	0.18	0.04	1.23	0.60	0.96	0.02	0.00	0.00	0.00	0.00
Inbreeding	-74.0	-2.79	-2.13	-0.28	0.01	-0.23	-0.23	-0.33	-0.11	0.00	-0.01	0.01	0.01

EFI and Impact to PTA Example

- Bull A is a purebred Holstein bull (no heterosis correction)
  - Genetic Merit for Milk
    - » December 2024 (genetic base 2015 cows): 1,400 pounds
    - » April 2025 (genetic base 2020 cows): 660 pounds
    - » Difference 740 pounds
  - Final PTA after EFI adjustment
    - » December 2024 (EFI adj. -440 pounds): 960 pounds
    - » April 2025 (EFI ad. -300 pounds): 360 pounds
    - » Difference 600 pounds

Similar to estimations for base change values

EFI adj. is result of how base change affects multiple parameters
Does not demonstrate lack / lessening concern to inb.

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Perspective: Can we actually do anything about inbreeding?

John B. Cole

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INTRODUCTION

Artificial insemination companies create elite genetics in the form of semen and embryos for use in dairy cattle genetic improvement programs. The most marketable bulls are those with the highest genetic merit (Hutchins et al., 2024), and, in addition to having hundreds or thousands of milking

Figures (1) Figure

Calving Traits Base Change

- Genetic base change was not applied to calving traits: (SCE, DCE, SSB, DSB)
  - An independent trait group, genetic evaluations are reported on an observed (phenotypic) scale
  - During run, after phenotypic and genetic base updates were applied, unanticipated results were observed
    - » Needed to be investigated further, but limited by tight production cycle
    - » Solution: calvings traits maintain previous base
  - **Target**: August 2025
  - Will not impact other traits and composites receiving base change

Base Change Conclusions

- Merit indices values and 45 individual traits and composites will be expressed with updated genetic base relative to dairy cows born **2020**
- PTA will change by base change, plus other routine factors

Lifetime Merit Indices

Lifetime Merit Indices Revision

- Net Merit $, Cheese Merit $, Fluid Merit $, and Grazing Merit $
- Adjusts weights for individual traits and composites given economic values
- 99.7% correlation between new April 2025 and previous formulas
  - A little reranking is expected

Lifetime Merit Indices Revisions

- Indices estimate difference in lifetime profit that each animal is expected to transmit to its progeny
  - Expressed as US $

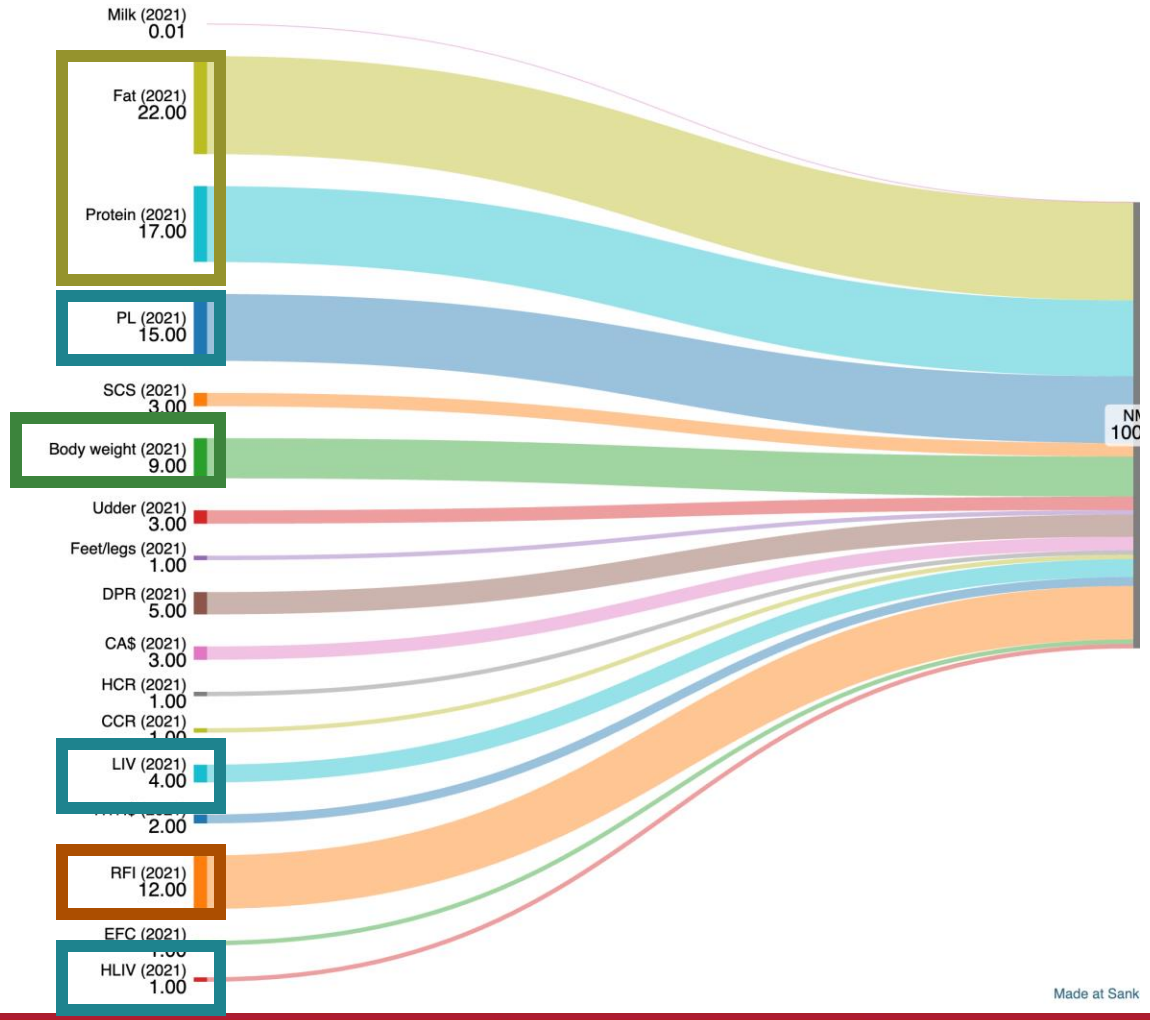
Use the right tool for the job

- Are you in a **component pricing system**?
  - » Use **Net Merit $**
- Are you paid mainly for **protein**?
  - » Use **Cheese Merit $**
- Are you paid principally for **milk volume**?
  - » Use **Fluid Merit $**

Many custom indices are very similar to FM$

- Are you in a **seasonal production system**?
  - » Use **Grazing Merit $**

NM$ changes from 2021 to 2025 were small



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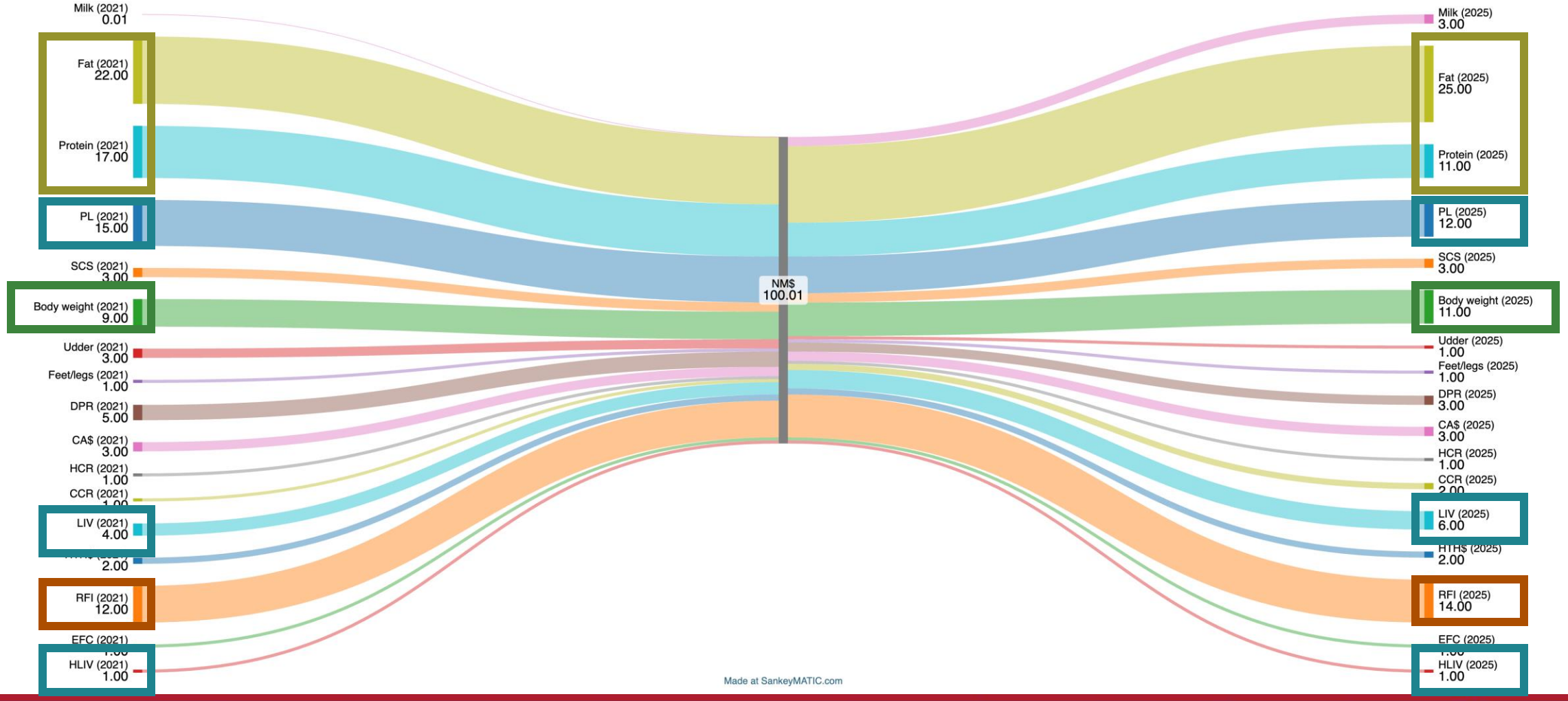
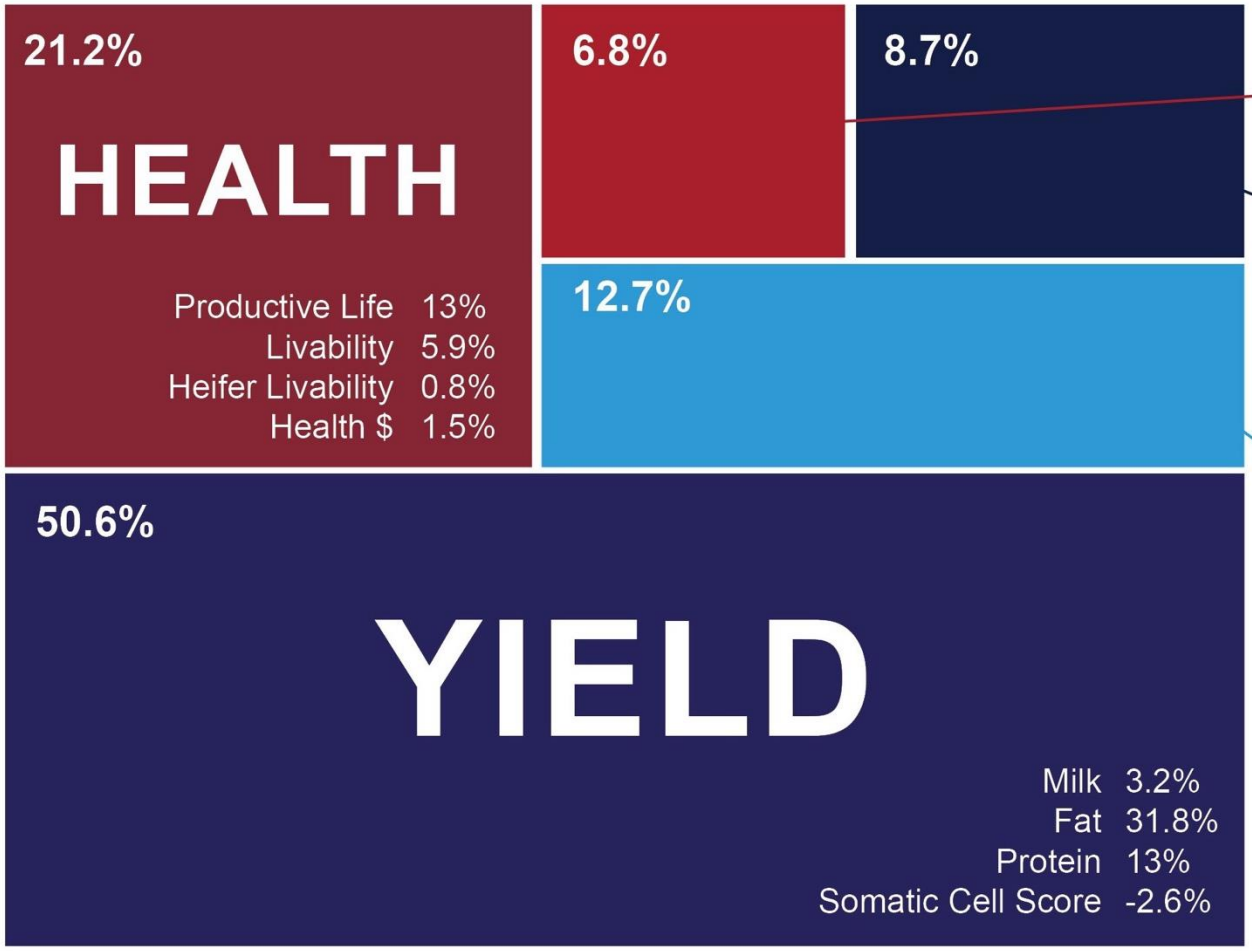


LIFETIME NET MERIT $

Relative Emphasis of Traits - April 2025 Update



FEED EFFICIENCY

Residual Feed Intake -6.8%

FERTILITY & CALVING

Calving Ability $ 3.3%
Daughter Pregnancy Rate 2.1%
Cow Conception Rate 1.8%
Heifer Conception Rate 0.5%
Early First Calving 1%

CONFORMATION

Udder Composite $ 1.3%
Body Weight Composite $ -11%
Foot and Leg Composite $ 0.4%

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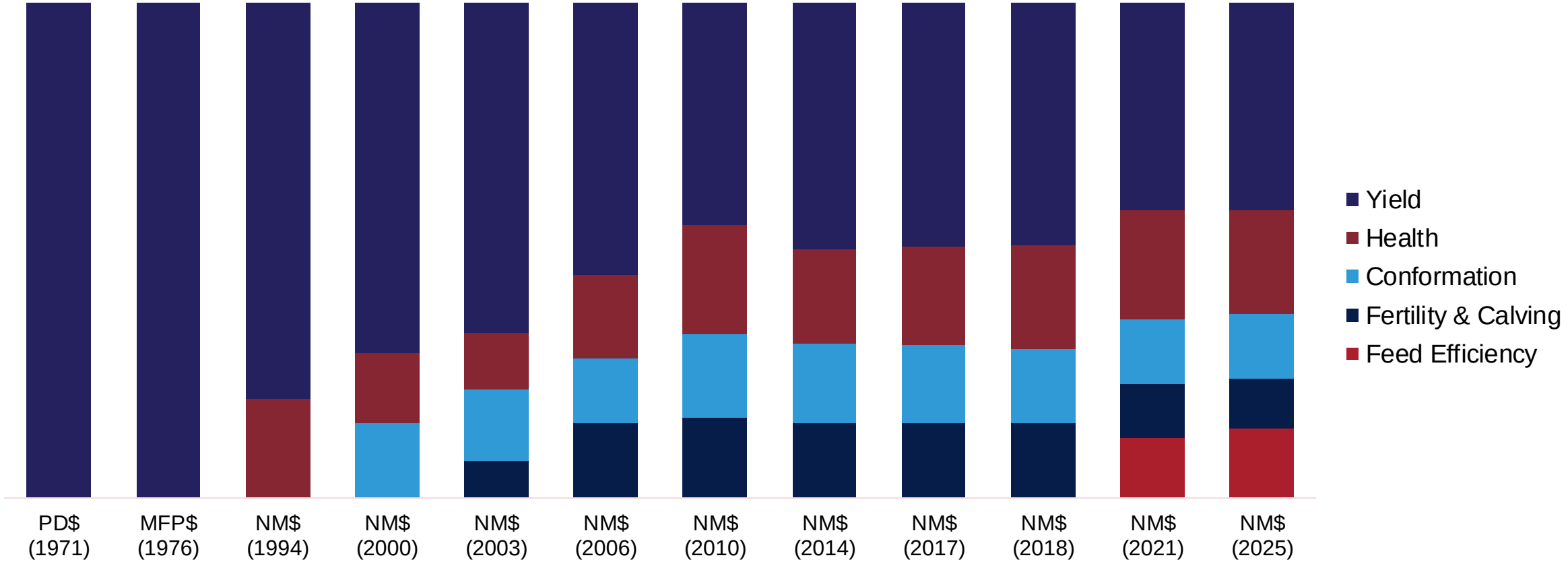
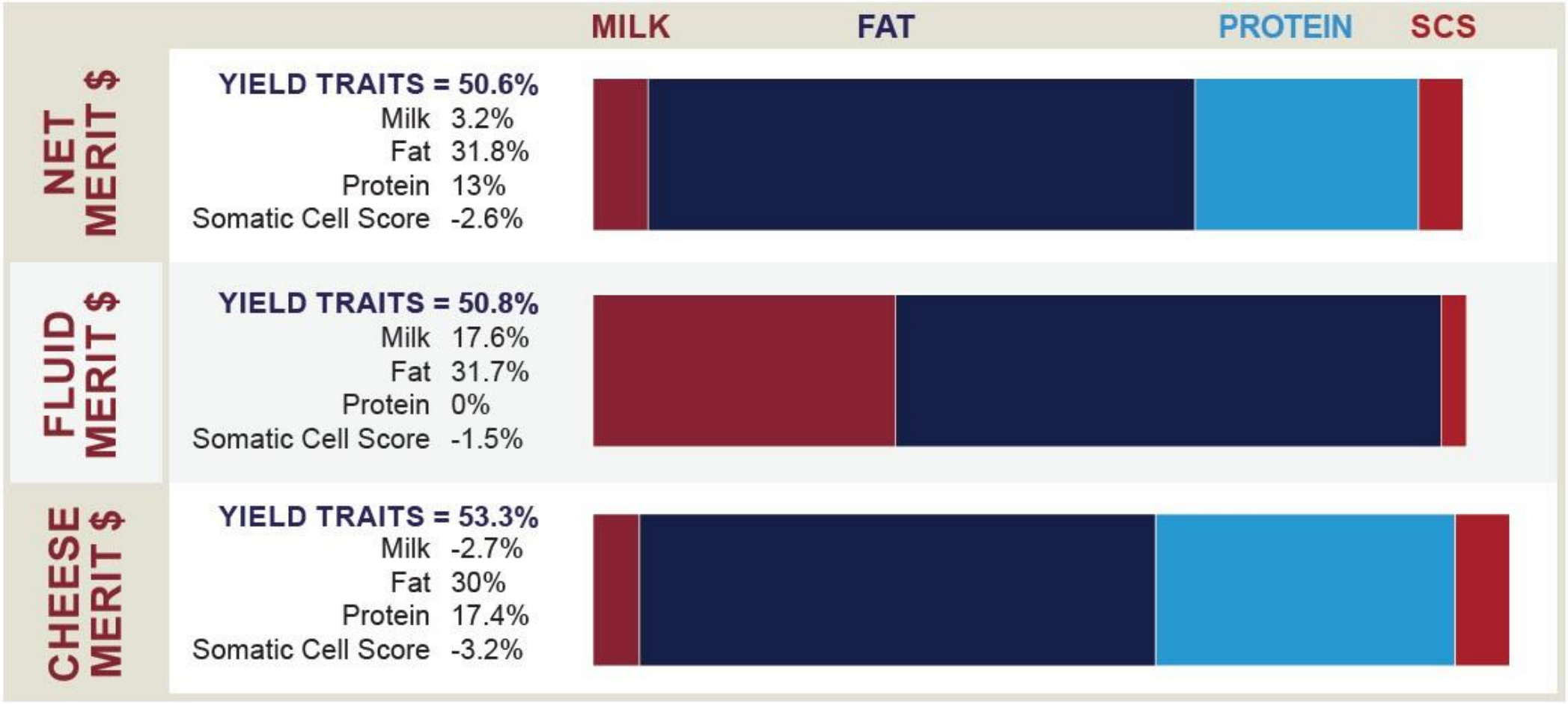
Net Merit $ Change Over Time by Trait Group

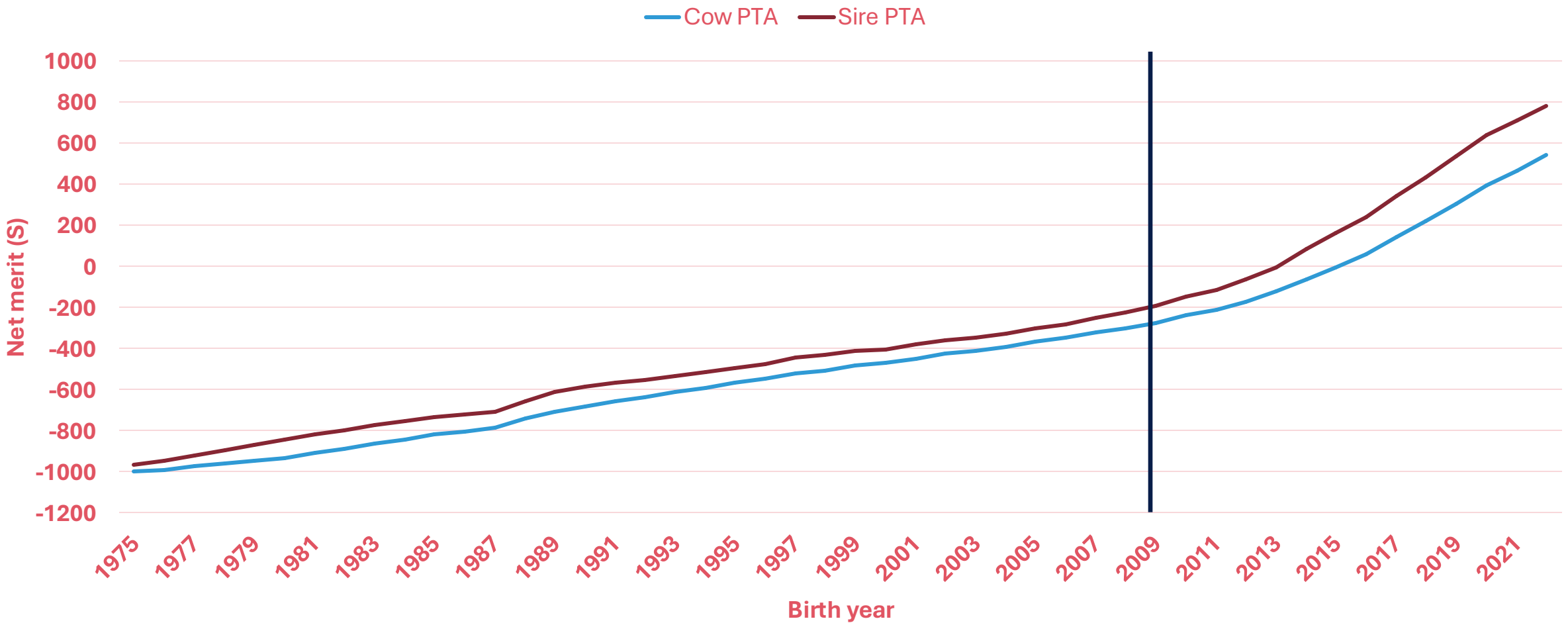


Measured by relative value of traits

Which index matches your milk check?



Genetic trend for NM$ is strong!



BBR Reference Population

What is BBR?

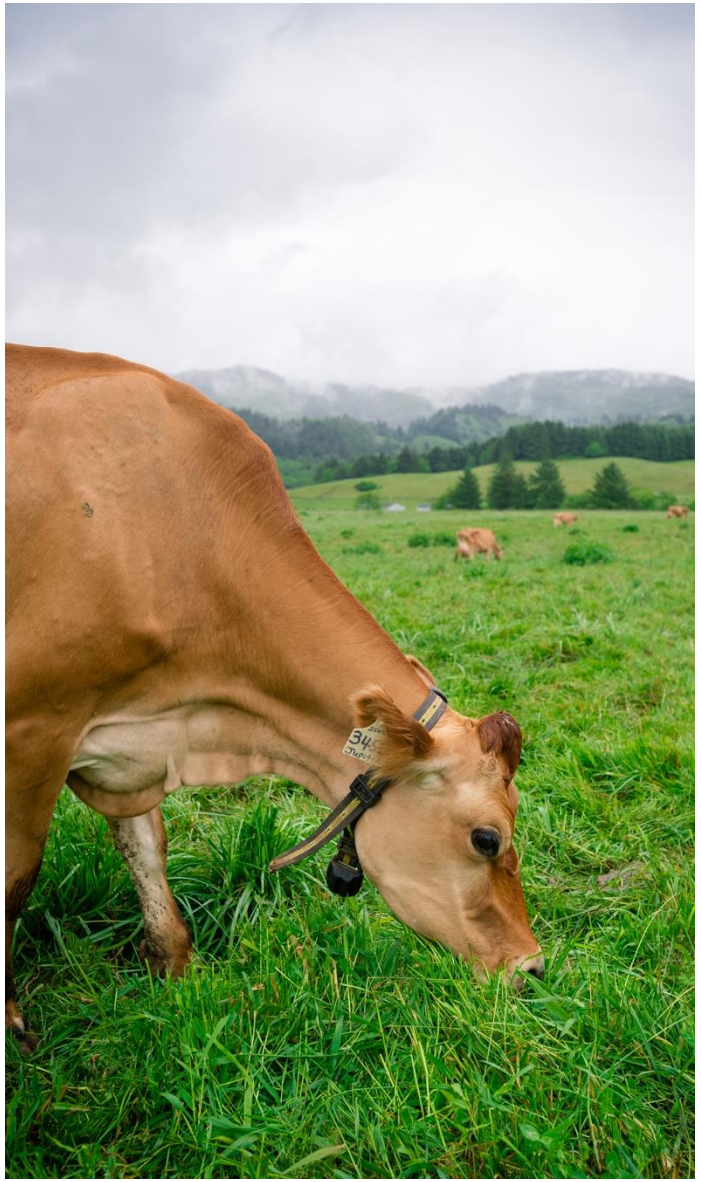
- Breed Based Representation

23andMe

embark

basepaws
PET GENETICS

- …but for cows
- Determines single-breed vs. multi-breed status
- Update annually usually every April



Qualifying for BBR Reference Population

- In April 2025, a new reference population defined for BBR

Reference Populations

- A group of individual that serve as a standard or comparison
  - **Evaluation** reference population of animals for PTA calculations
  - Reference population of bulls for **BBR estimates**

Qualifying for BBR Reference Population

- In April 2025, a new reference population defined for BBR
  - Progeny-tested bulls (min. 10 daughters)
  - Genotyped
  - Enrolled in NAAB cross-reference (excludes C & N status)
  - Complete Pedigree
    - » Ancestors identified for four generations
    - » No construct IDs
  - Classified as purebred within each breed of evaluation
    - » Pedigree-based heterosis of <1%

Exceptions for qualifying

- Pedigree Completeness *(All breeds except Jersey)*
  - If <4 generations are recorded:
    - » HO bulls born pre-2000 and >1,000 daughters are included
    - » Other breeds bull born pre-2000 and >200 daughters are included
  - Accommodates older, influential bulls with partially complete pedigrees
- "JX" animals *(Jersey only)*
  - All animals with "JX" are automatically disqualified from reference population
- Intergenomic Bulls *(Brown Swiss only)*
  - Intergenomic bulls with MACE proofs are treated equivalently to enrolled progeny-tested bulls

BBR Threshold

0%	to	<90%	Classified as multi-breed (**MB**) animal
90%	to	94%	Recognized as a single-breed (**SB**) animal, but not included in the **evaluation reference** population
>94%	to	100%	Single-breed (**SB**) animal included in the **evaluation reference** population

Impact

- Changes in BBR values across breeds
- Some animals may now be excluded from the evaluation reference population and/or purebred evaluations
- PTA may change
  - When an animals is removed from the reference population
  - Or when the BBR drops below 90% threshold required to use single-breed SNP effects (switches to multi-breed eval)

Test Run Results

- 98.5% of 58,000 genotyped bulls retained BBR value
- Largest impact observed in Jersey animals
- **Minimum impact on AI bulls**
- Old animals and those with loose connections to US evaluation may experience larger (downward trends)

Type Trait Reliability Evolution

Type Trait Reliability Evolution

- Non-Holstein breeds impacted
- Type evaluations historically used a multi-trait model, while reliabilities were calculated as single-trait model
- Growing volume of appraisal data
- Recommended by USDA AGIL to align processes

Type Trait Reliability Evolution

- Traditional PTA unchanged
- Reliabilities for more traits will increase
- Traits with limited data benefit from genetic correlation with other type traits
- Genomic PTA will see more noticeable impact
  - Reliability adjustments affect SNP solutions and weighting factors used in final calculations
  - Variation across traits linked to amount of change in reliability
- PTAT least affected; uncorrelated trait

Female Fertility Traits Review

Female Fertility Traits Review

- A review of existing traits and exploration of potential new trait is underway
- End of 2023: Industry Feedback
  - Request was made for a full review of fertility traits by NAAB's Dairy Sire Evaluation Committee (DSEC)
- Early 2024: Passed Interbull Validation of Fertility Traits
  - Some stats show room for improvement
  - Provided objective measurement of what DSEC observed in field

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Daughter Pregnancy Rate (DPR)

Est. 2003

Daughter Pregnancy Rate is a female fertility trait that predicts the percentage of non-pregnant cows that will become pregnant during each 21-day period compared to the breed base.

Cow Conception Rate (CCR)

Est. 2009

Cow Conception Rate is a female fertility trait predicting the lactating cow's ability to conceive, defined as expected percentage to become pregnant at each insemination in comparison to the breed base.

Heifer Conception Rate (HCR)

Est. 2009

Heifer Conception Rate is a female fertility trait predicting the maiden heifer's ability to conceive, defined as expected percentage to become pregnant at each insemination in comparison to the breed base.

Early First Calving (EFC)

Est. 2019

Early First Calving indicates the animal's genetic ability to alter their female offspring's age at first calving, defined in days compared to the breed base.

Female Fertility Traits

DPR-CCR:	+0.86
HCR-CCR:	+0.45
DPR-HCR:	+0.36

- Multi-trait, animal model
  - DPR/CCR/HCR are correlated
  - EFC is treated as uncorrelated
- All breeds and crossbred cows evaluated together
  - Adjusted to within-breed bases
- Heritabilities:
  DPR = 1.4%, CCR = 1.6%, HCR = 1.0%, EFC = 2.7%

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Female Fertility Traits Review

- Full review includes:
  - Raw data ingested
  - Editing and data extraction system
  - Phenotypic pre-corrections
  - Models
  - Variance components estimates
- Development of potential new trait
- Development of edit for DPR based on VWP

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Potential New Trait: FSC

- First Service to Conception (FSC)
  - The number of days from the first insemination until the last insemination that results in a pregnancy
  - Apply penalty to cows that never conceive
- Initial research estimated promising heritabilities

Breed	Heritability
AY	2.7%
BS	2.5%
GU	6.6%
HO	3.1%
JE	2.9%

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Variable Herd-Year VWP and DPR

- DPR was developed with Voluntary Waiting Period (VWP) to be 50 days + 20-day grace period
  - VWP = intentional number of days between calving and the first insemination
- DPR currently does not include to adjust for recent management changes of variable VWP
  - **Research** to include VWP by herd-year in calculations is **in-progress**

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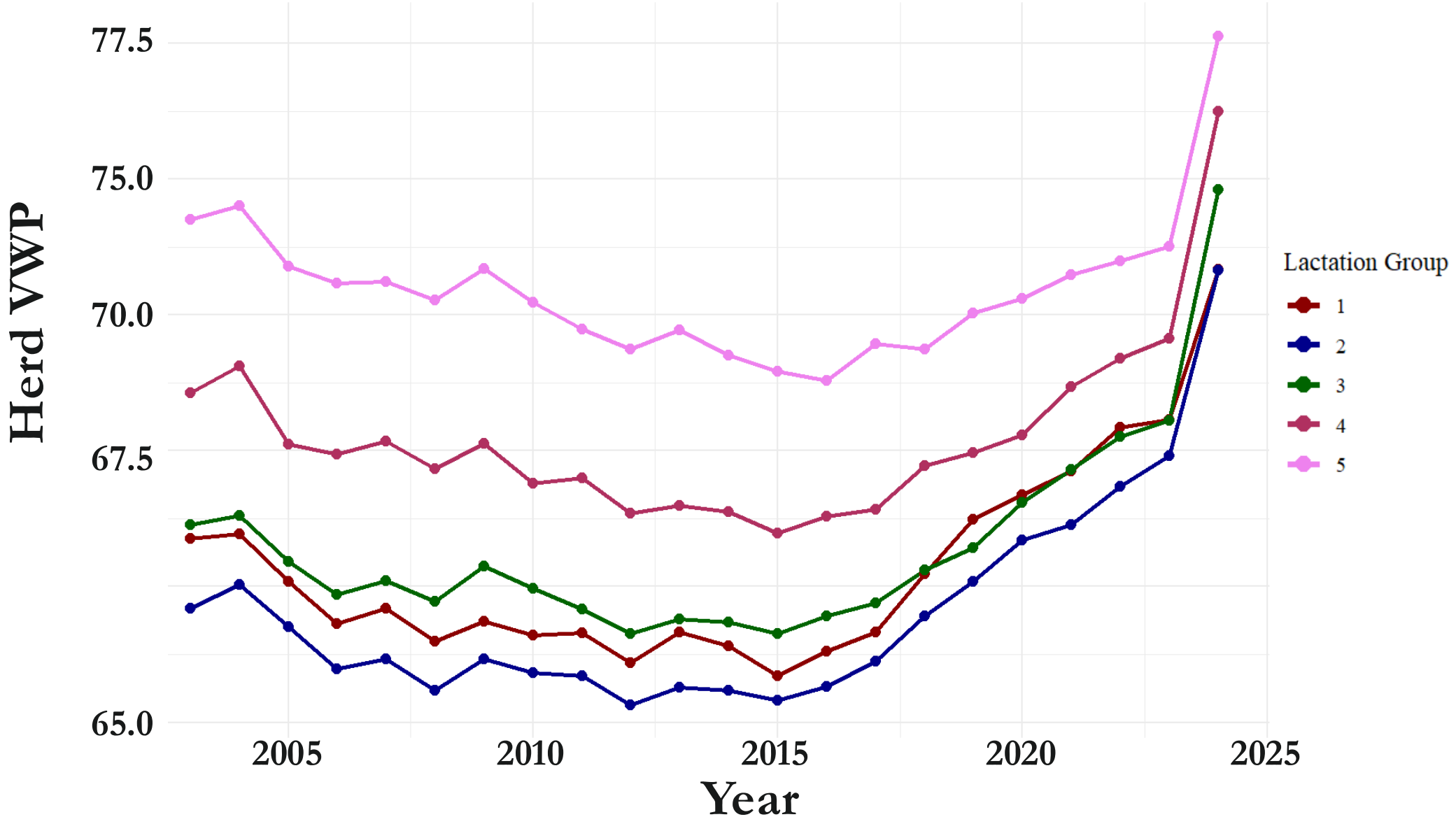
Herd-Year VWP by Lactation



Conclusions

Conclusions

- Base change values for individual traits were similar to previous changes
- Changes from 2021 to 2025 Lifetime Merit Indices were small
- Net Merit $, Cheese Merit $, Fluid Merit $, and Grazing Merit $ remain an economic indices whose weights are driven by incomes and expenses
- New reference population for BBR applies stricter criteria and results
  - Some previously SB animals may drop below 94% or 90% thresholds

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Conclusions Continued

- Animals strongly connected to foreign animals may experience additional variation
  - Other countries had many changes to their evaluations
- Non-HO type traits' reliability was calculated with multi-trait model
- Female fertility traits review, new trait, and DPR edit are in-progress

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Acknowledgements

- U.S. dairy producers
- Member sectors and collaborators
- USDA AGIL
- CDCB staff

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THANK YOU FOR YOUR ATTENTION

https://www.uscdcb.com

taylor.mcwhorter@uscdcb.com

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