AGIL REPORT 2023

Milking Speed, Cloning, Age-Season-Parity Factors, & Planned Research

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USDA Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

MILKING SPEED:

Data Trends, Udder Health, & Preliminary PTAs

Asha Miles, Robert Fourdraine, Kristen Parker Gaddis, Steven Sievert, Jeffrey Bewley, Sophie Eaglen, Jay Weiker, Jana Hutchison, and Joao Dürr

U.S. Registered Holsteins FOR MAXIMUM PROFIT, Holstein Association USA, Inc. · NATIONAL DHIA · CDCB COUNCIL ON DAIRY CATTLE BREEDING · USDA Agricultural Research Service U.S. DEPARTMENT OF AGRICULTURE · NAAB · DRMS DAIRY RECORDS MANAGEMENT SYSTEMS

PROPOSED RESEARCH

OBJ. 1: Assemble a **high-resolution dataset pertinent to MS** representing different dairy breeds, equipment manufacturers, parlor types, and milking management strategies

OBJ. 2: Characterize MS for herds grouped by equipment manufacturer and parlor type and assess the impact of additional **system effects** on the phenotype

OBJ. 3: Characterize any **biological effects** that impact MS, especially concerning udder health

OBJ. 4: **Standardize** MS trait definition and estimate heritability to determine its suitability for selection

AVAILABLE DATA

DRMS
DAIRY RECORDS MANAGEMENT SYSTEMS

Demographics

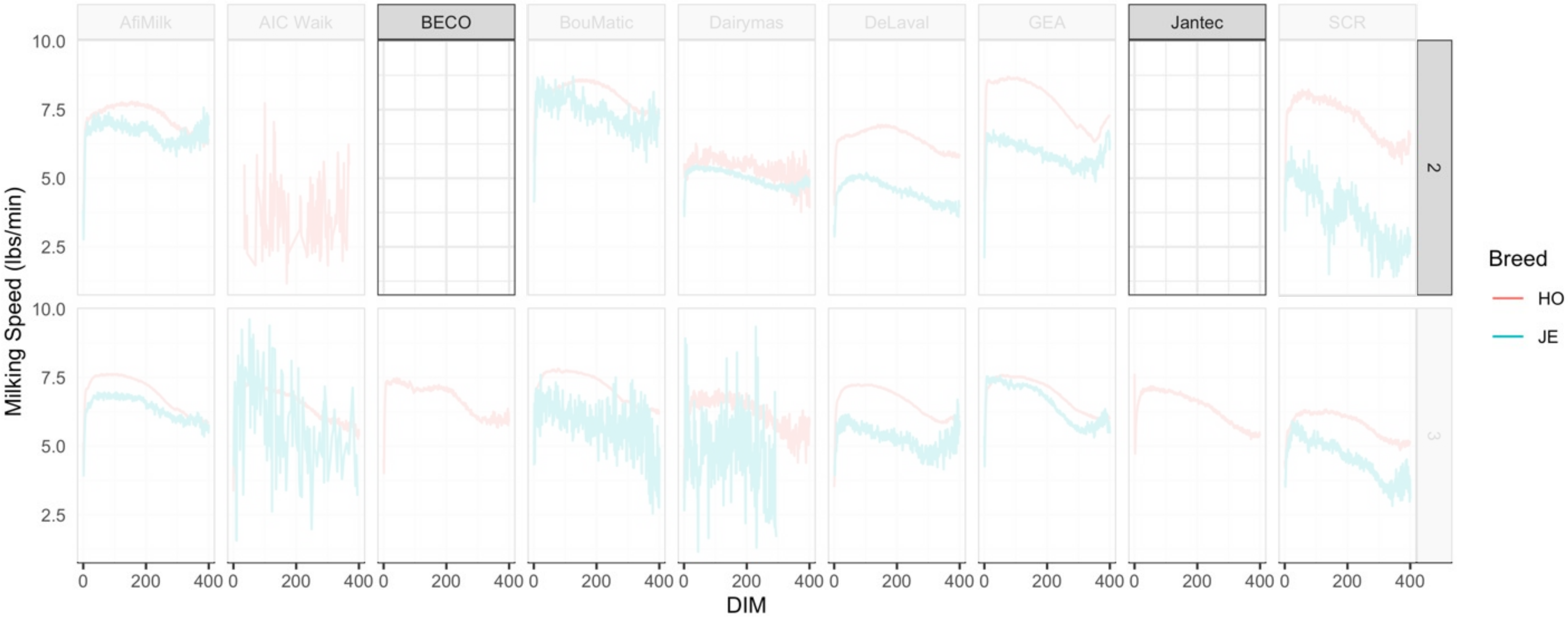
~300 herds
>230,000 cows
>300,000 lactations
>40 million observations

31 States
6+ Breeds
11 OEMs

DeLaval	80
GEA	75
Lely	47
Boumatic	46
AfiMilk	45
SCR	13
DairyMaster	10
AIC Waikato	5
AMS Galaxy	3
Jantec	2
Universal	2

Special thanks to Robert Fourdraine & John Clay

OEM, FREQUENCY, & DIM EFFECTS



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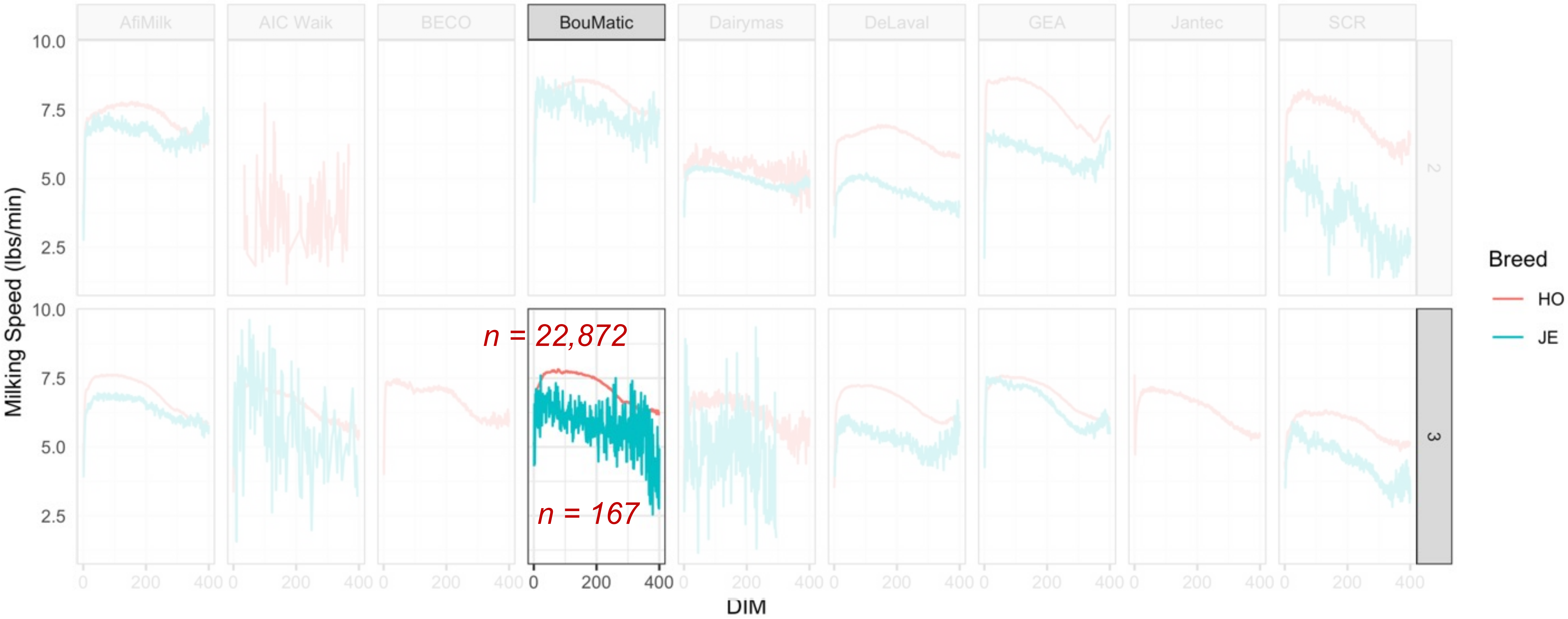

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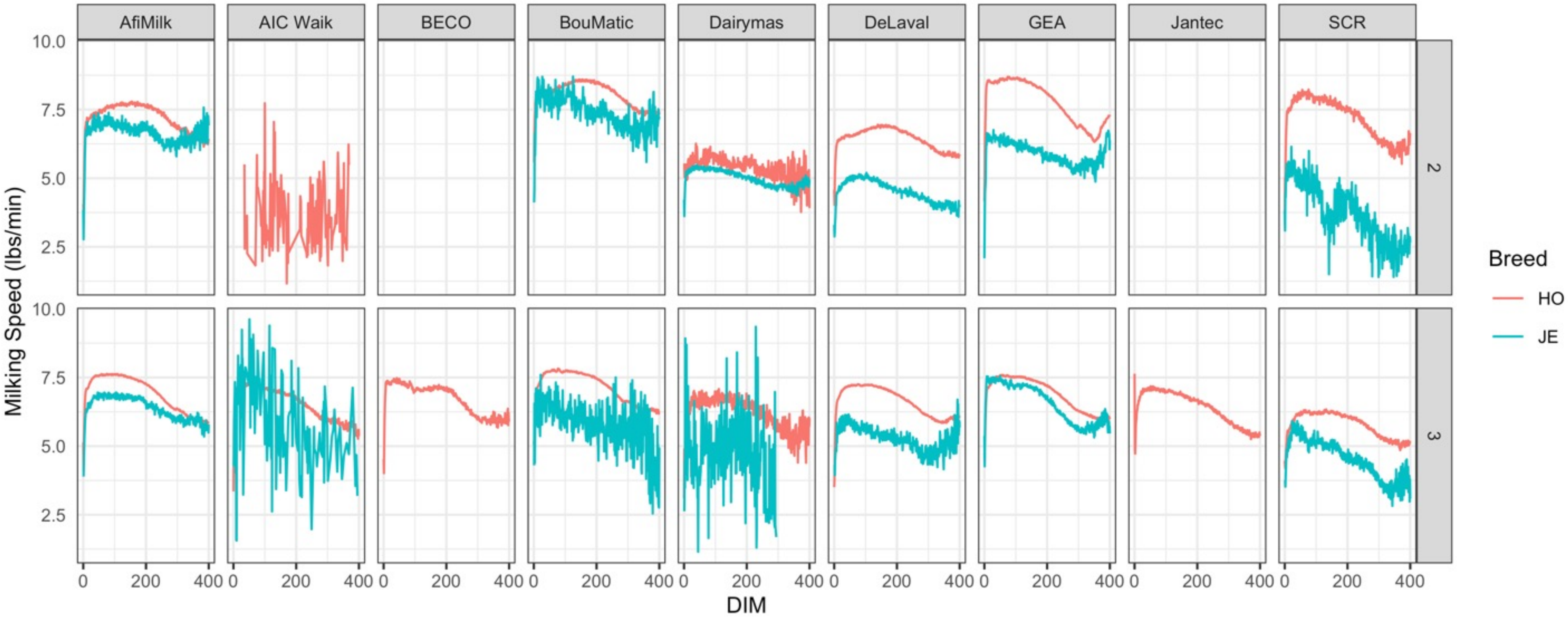
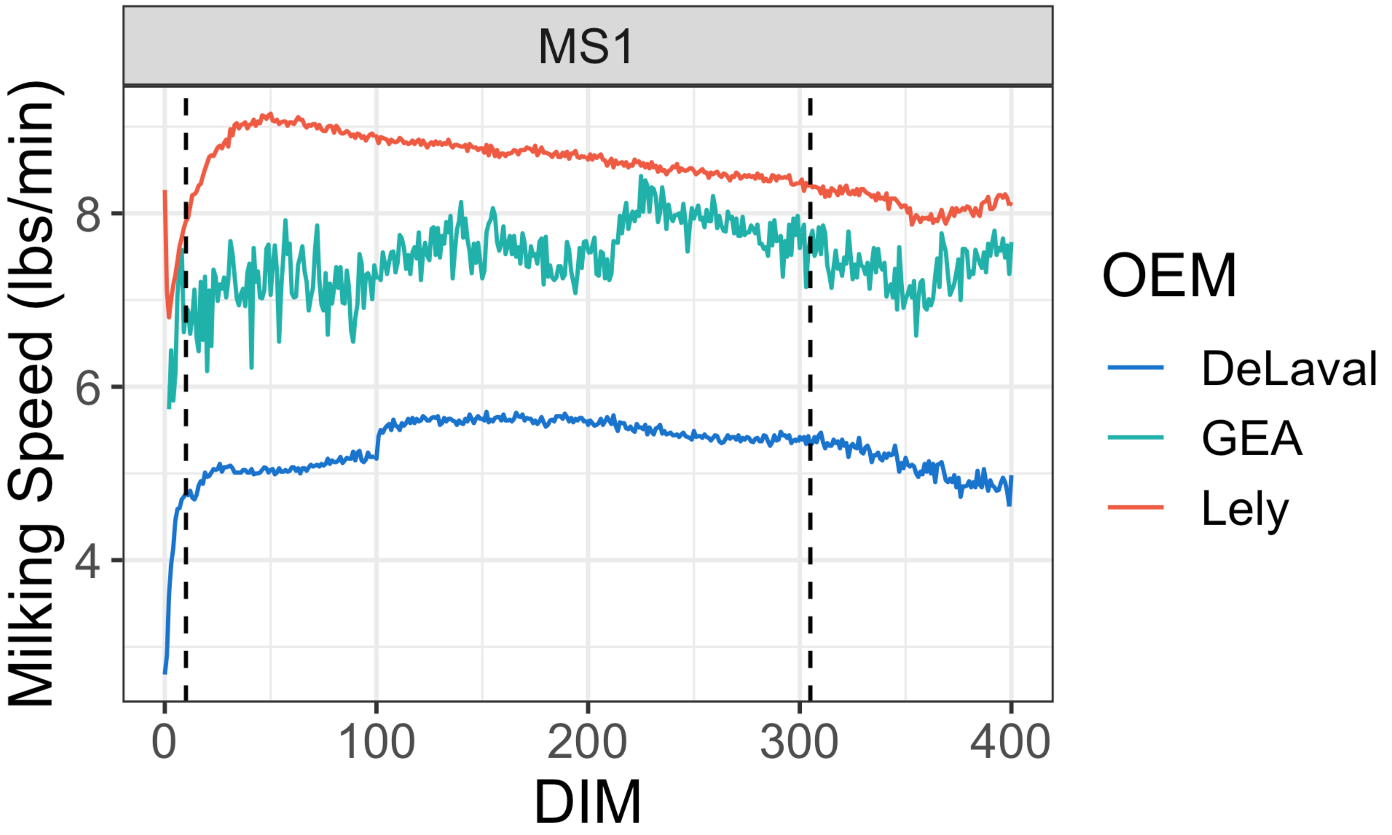


AMS & OEM EFFECTS

Holstein Only



AMS & OEM EFFECTS

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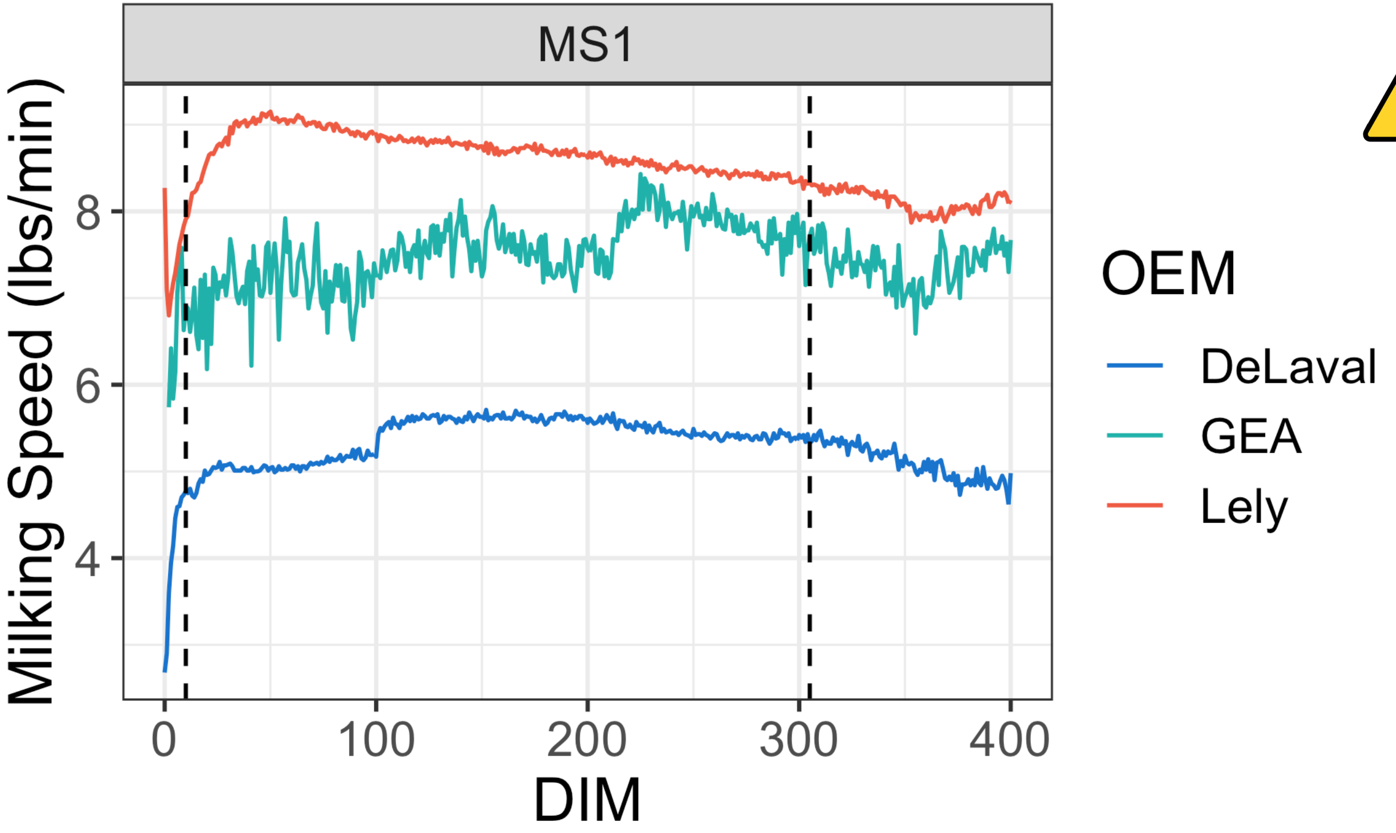

THIS DOES NOT SUGGEST COWS MILK MORE SLOWLY ON A DELAVAL SYSTEM

It is an artifact of how each OEM measures milking duration

UDDER HEALTH; MILK COMPONENTS

HOLSTEIN

	SCS	FAT %	PROTEIN %
2X	-0.02*	0.10***	0.13***
3X	-0.04***	0.04***	0.06***
AMS	-0.18***	-0.27***	-0.29***

JERSEY

	SCS	FAT %	PROTEIN %
2X	-0.13***	-0.07†	-0.24***
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- Average MS for all milkings on a test day
- Correlated with SCS, Fat, and Protein on respective test day
- No statistically significant association with clinical mastitis
- Linear correlations may mask trends for extremes (very slow, very fast)

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WHAT'S NEXT?

PTAs/HERITABILITIES

1. **Average MS (lbs/min) over all available data**
   a) ***Fixed effects: breed, parity, lactation length, OEM***
   b) ***n = 20,000 cows with complete lactations (1 year)***

PRELIMINARY RESULTS

$h^2 = 0.37$

Genetic Correlations

SCS	0.39
Milk Yield	0.14
NM$	0.08

Mean REL 0.67

Special thanks to Paul VanRaden and Sajjad Toghiani for their contributions to this research

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   a) ***Fixed effects: breed, parity, lactation length, OEM***
   b) ***n = 20,000 cows with complete lactations (1 year)***
2. Average MS (lbs/min) from test-days only
3. Primiparous cows only

PRELIMINARY RESULTS

h^2 = 0.37

Genetic Correlations

SCS	**0.39**
Milk Yield	**0.14**
NM$	**0.08**

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Modeling identical animals and clones in genetic evaluations

For December 2023 Implementation

Paul VanRaden, Gary Fok, Sajjad Toghiani, and Ezequiel Nicolazzi

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HOW ARE CLONES REPORTED?

- **Multiple birth codes:**
  - 4,762 pairs of natural identical twins (code 2 and verified by genotype)
  - 1,776 split embryos (code 4)
  - 530 nuclear transfer clones from embryos, calves, or adults (code 5)
- **Clones make up ~0.1% of genotyped animals (~7 million)**

Code	Birth description
1	Single
2	Multiple birth (not from embryo transfer)
3	Birth from embryo transfer
4	Split embryo (artificially)
5	Clone from nuclear transfer
6	Embryo pedigree (implantation date stored as birth date)

CLONES MULTIPLY THEIR CONTRIBUTION

Apple – 2011 World Dairy Expo

Photo by Nina Linton
Apple had 361 progeny.

Apple-3 – 2013 World Dairy Expo

Malcolm, D. 2019. [KHW Regiment Apple-Red-ET – Everything and more.]
Photo by The Bullvine. **Apple's 9 clones added 325 more progeny.**

CHANGES IN HOW WE MODEL CLONES

- Previously, pedigree matrix treated clones as full sibs
- New model stores a "source animal" for each identical group, then switches dam/sire ID to source ID
- Keeps separate permanent environment effect for each clone

Example results:

- Calf born in 2020 (HO840003218920809)
  - Maternal great grandsire was a clone of the paternal 2nd great grandsire (ManOMan and ManOMan2)
  - Pedigree inbreeding of 9.8% corrected to 10.6%
  - Genomic inbreeding was 13.5%

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STANDARDIZING LACTATION YIELDS

Age-parity-season-region corrections for fair comparisons across individual cows & environments

For December 2023 Implementation

Asha Miles, Paul VanRaden, Jana Hutchison, Gary Fok, Mike Schutz

USDA Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

University of Minnesota

HOW DO WE COMPARE YIELDS?

PARTIAL YIELDS → DAILY YIELDS → LACTATION YIELDS → 305-MEs

- **Genetic selection changes maturity patterns (Norman et al 1995)**
- **Mature Equivalent factors last estimated in 1994**
  - **Corrected for parity, age, season of freshening, previous days open, geographical region, and 2X milking**

ESTIMATING NEW FACTORS

DATA

Lactation Records
- Milk: 101.5 million
- Fat: 100.5 million
- Protein: 81.2 million

UNCHANGED

2X Milking Frequency
Previous Days Open

IMPROVED

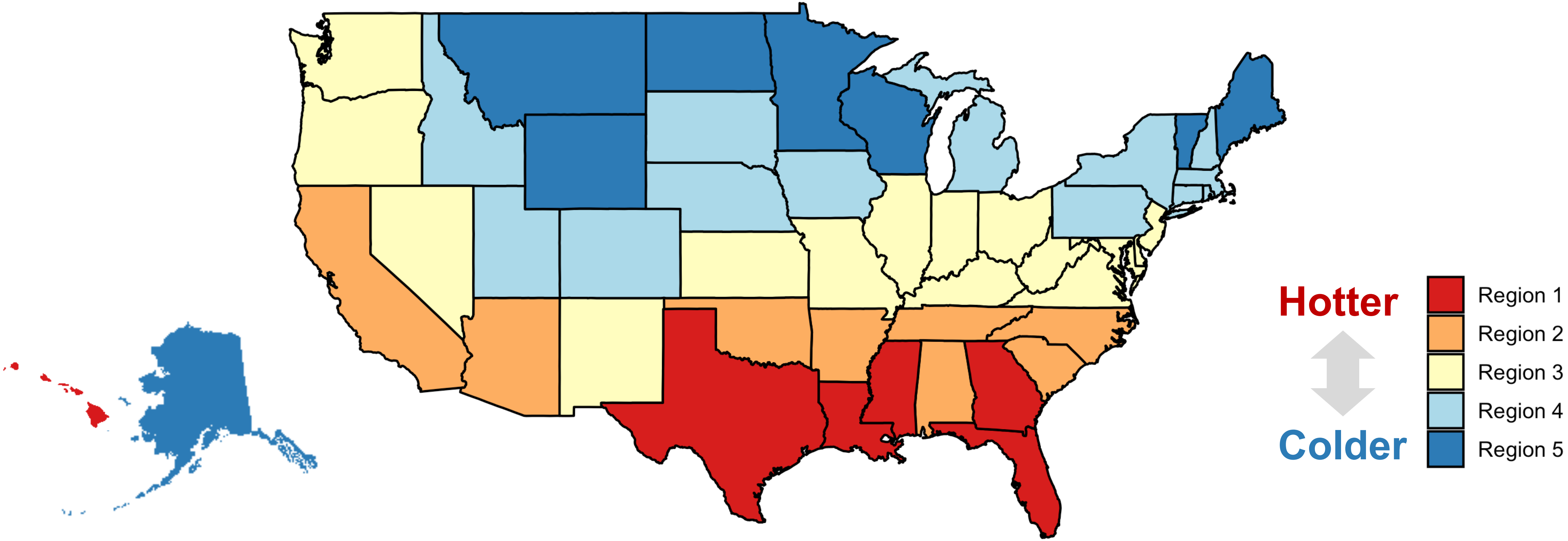
SEASON-REGION

~~3 Geographical Regions~~ → **5 Climate Regions**
~~Within Breed~~ → **Across Breed**

AGE-PARITY

~~Age Groups~~ → **Age in Months**
~~Mature Age~~ → **Average Age (36mo)**

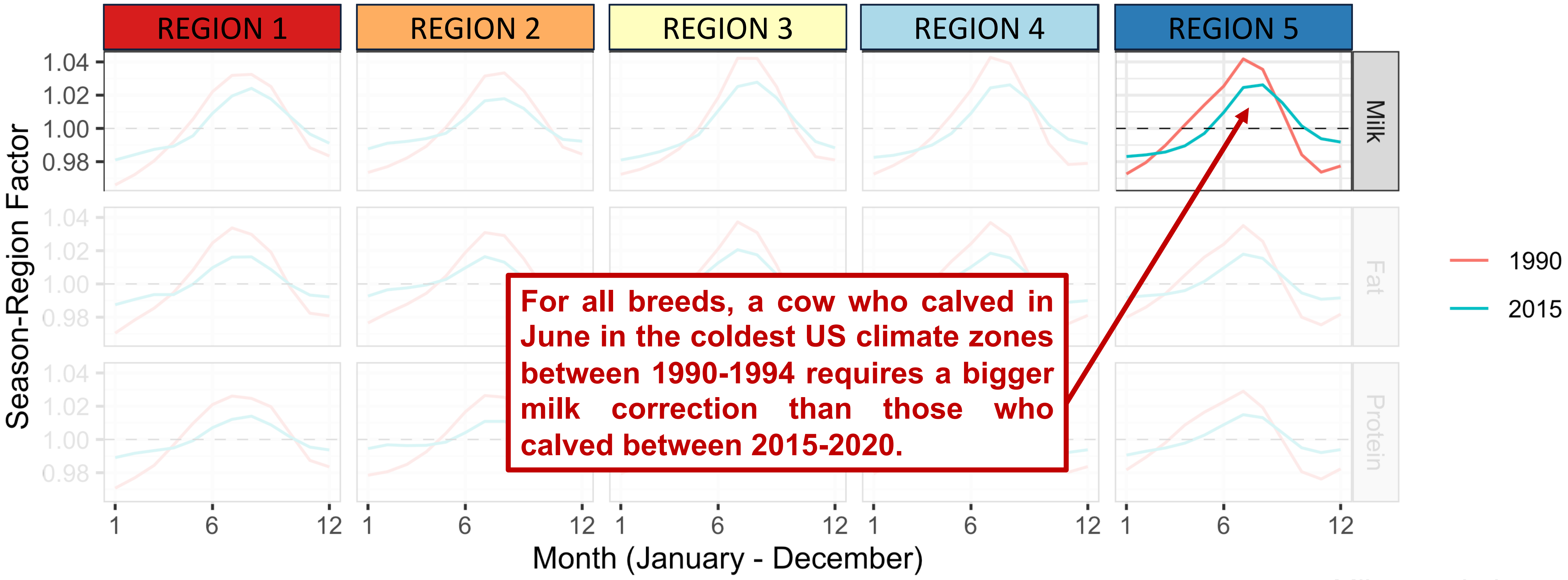
NEW CLIMATE-BASED REGIONS



International Energy Conservation Code (IECC). 2021.
https://codes.iccsafe.org/content/IECC2021P2/chapter-3-ce-general-requirements

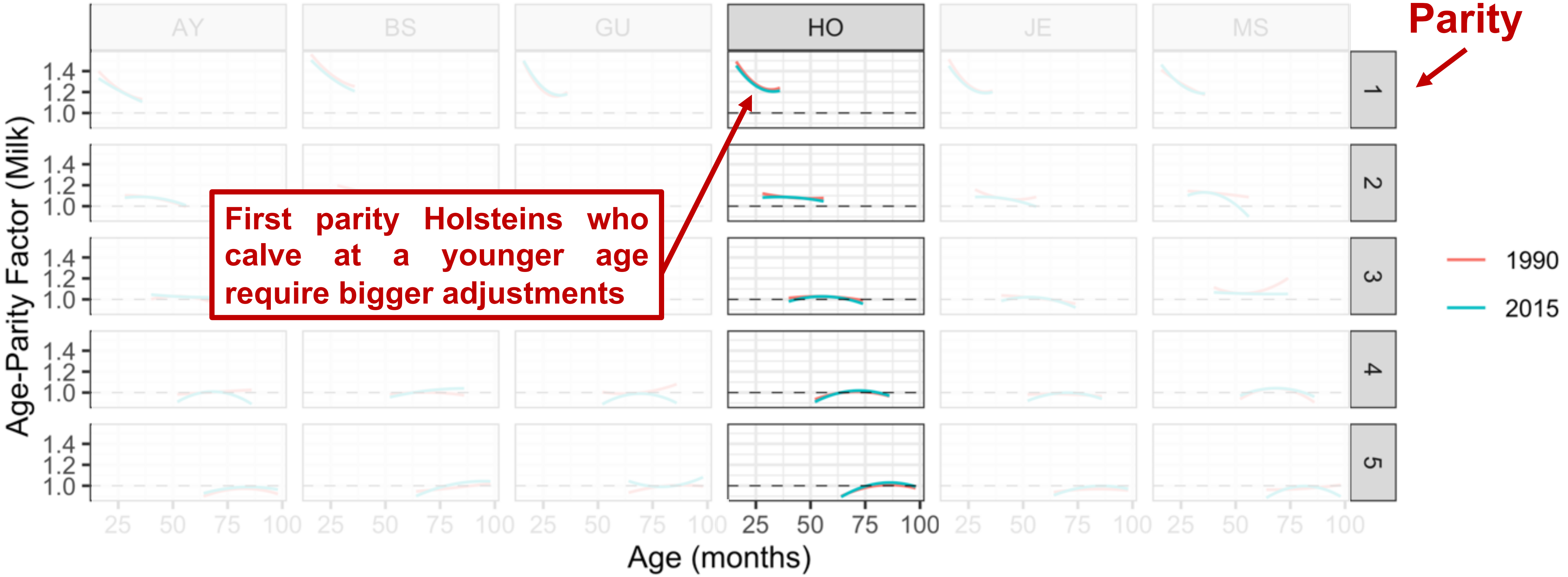
Miles et al., in prep

NEW SEASON-REGION FACTORS



Miles et al., in prep

NEW AGE-PARITY FACTORS



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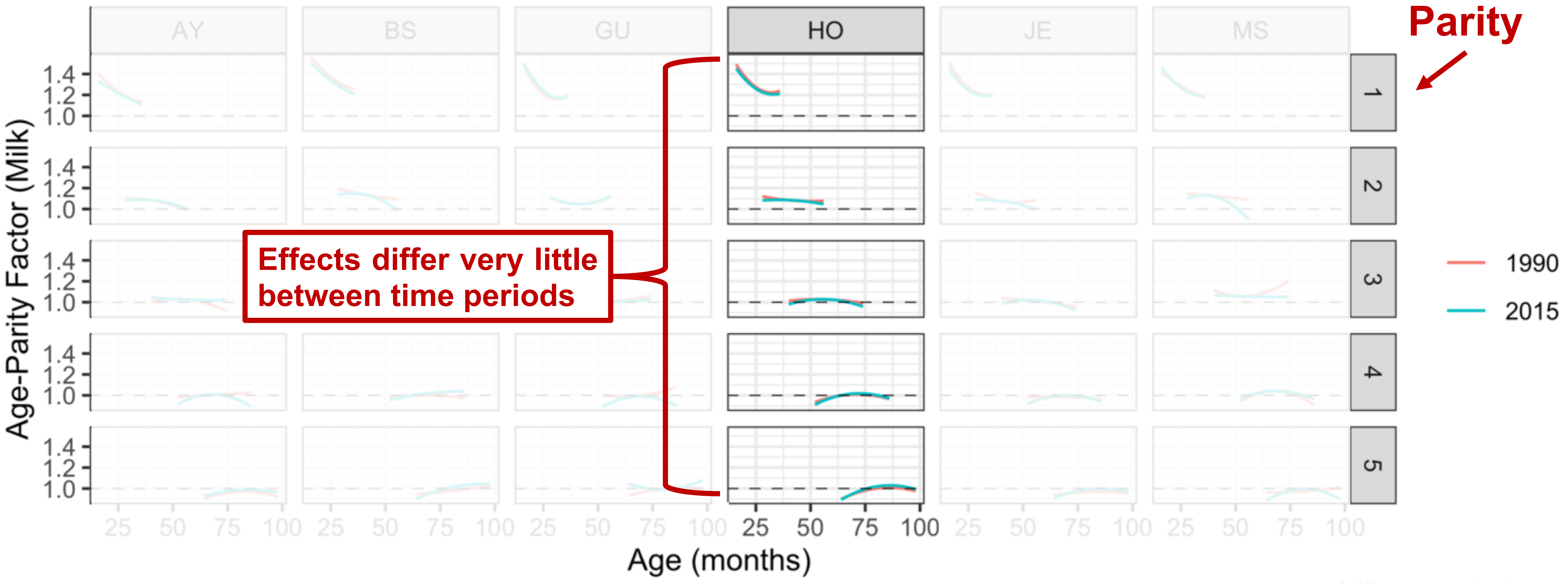

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NEW SOFTWARE IS AVAILABLE

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At this Location

- Programs and Projects

newfactors.f90 **Apply new factors for age, parity, season, and previous days open to compare cows more fairly within herds**

DOWNLOAD	Programs, example files, and executable	
INPUT	ageparityfactors1	from Jana Hutchison's ageparityfactors.sas as input for aiplage2.c
	SeasonFactors2023.txt	from Paul VanRaden's agefactor.sas as input for aiplage2.c
	PrevDOfactorsHO	from Paul VanRaden's maindcr.f90 as input for aiplage2.c
	ClimateRegions	defined by Asha Miles as input for aiplage2.c

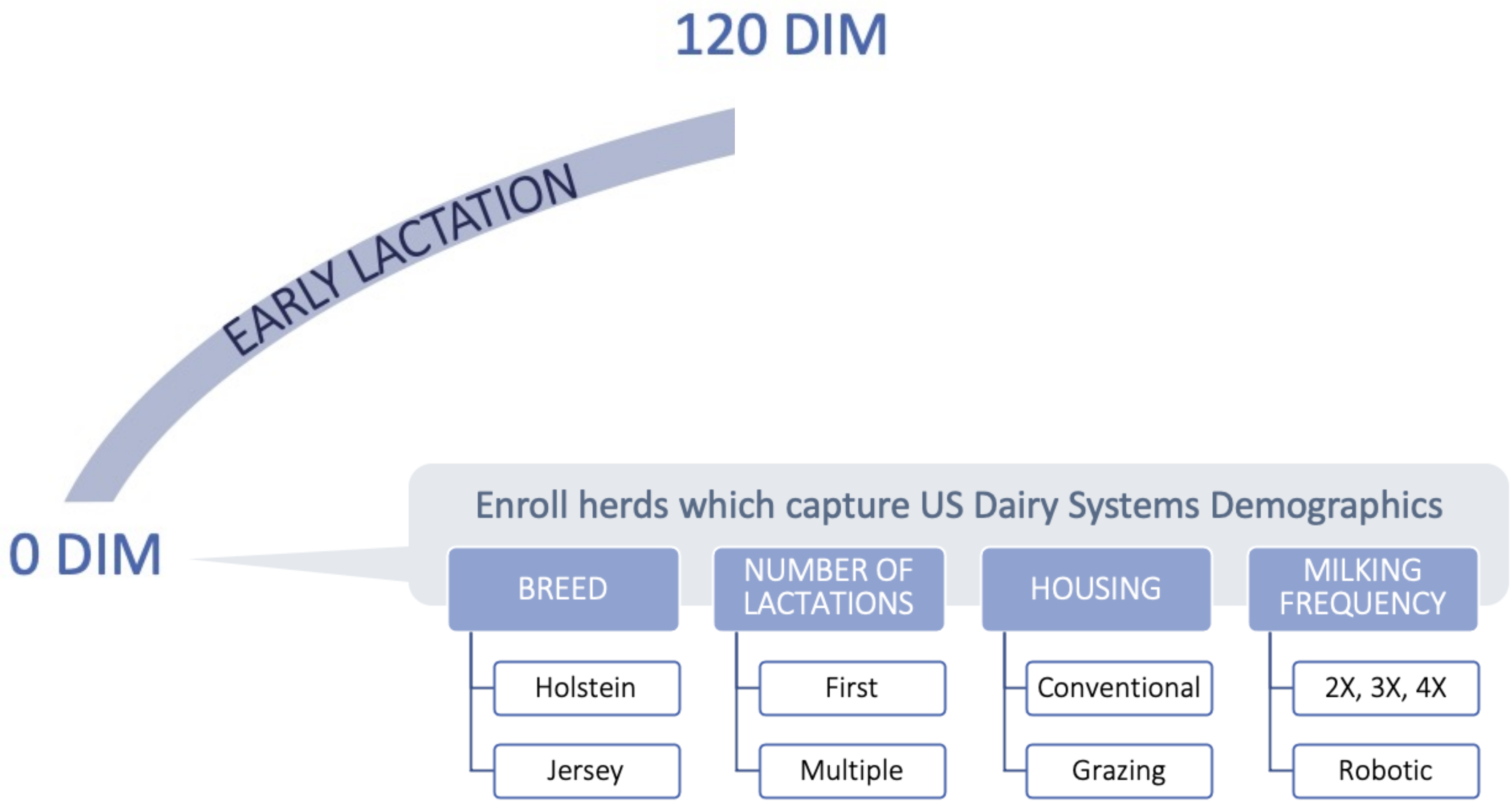
https://tinyurl.com/new-factors

WHAT'S NEXT?

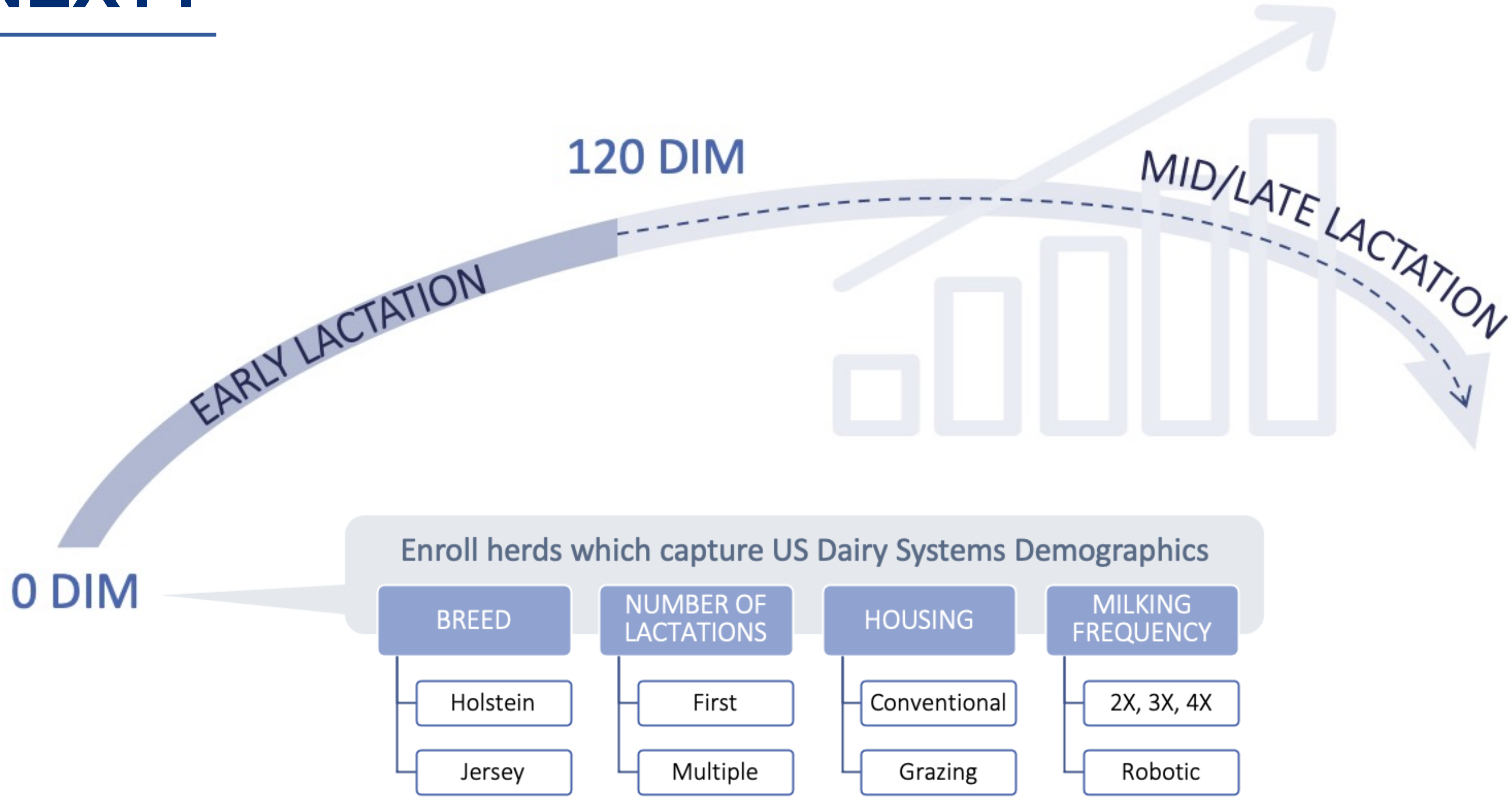
PARTIAL YIELDS → DAILY YIELDS → LACTATION YIELDS →

- 305-MEs
- 305-*36mo*

WHAT'S NEXT?


120 DIM
EARLY LACTATION
0 DIM
Enroll herds which capture US Dairy Systems Demographics
BREED
Holstein
Jersey
NUMBER OF LACTATIONS
First
Multiple
HOUSING
Conventional
Grazing
MILKING FREQUENCY
2X, 3X, 4X
Robotic

WHAT'S NEXT?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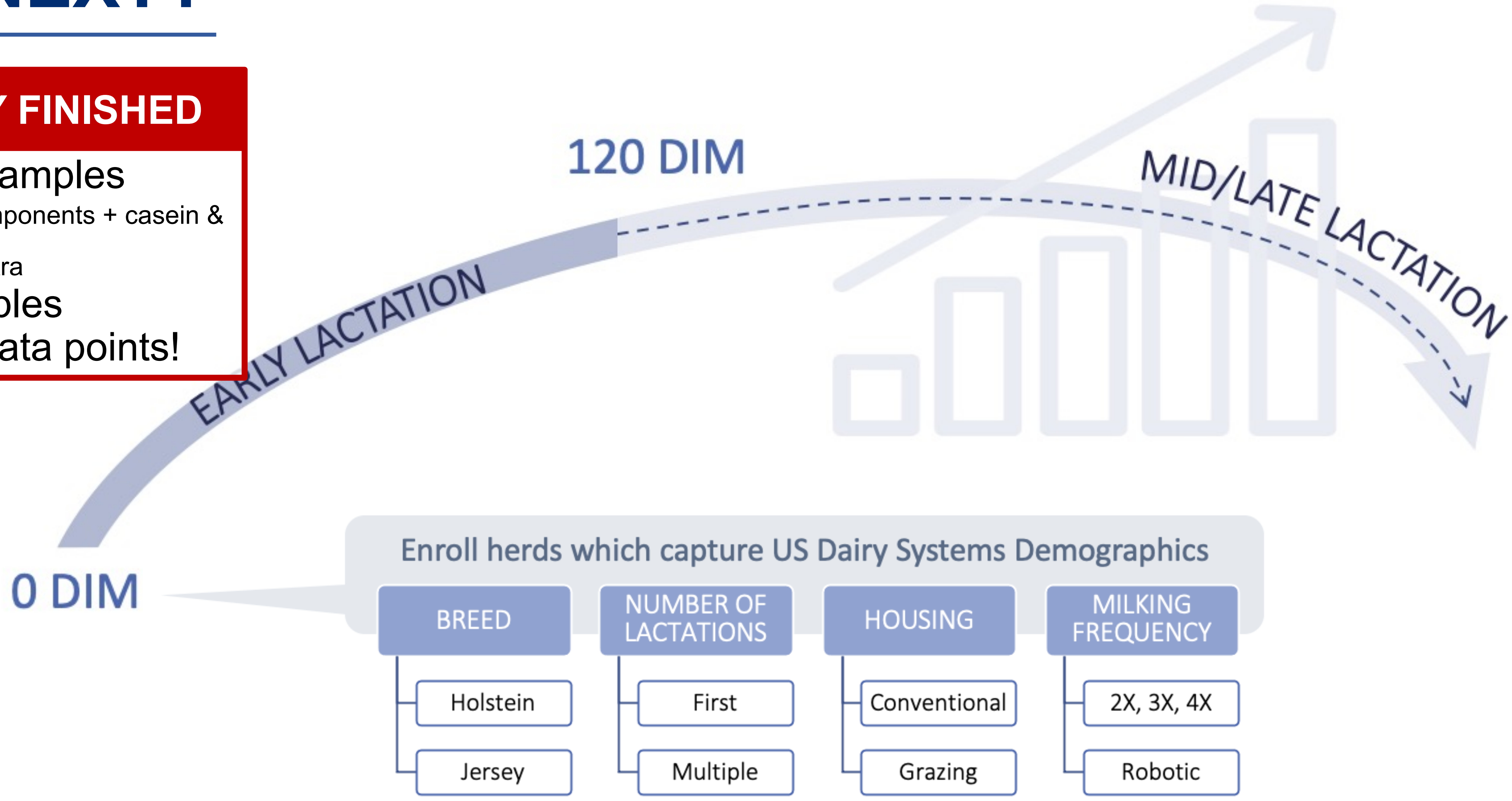
WHAT'S NEXT?

FARM 1 WEEKLY FINISHED

- 63,562 milk samples
  - traditional components + casein & fatty acids
  - raw MIR spectra
- 54 TMR samples
- 68.3 million data points!



OTHER ONGOING RESEARCH

- Beef x Dairy
- Heat-Stress GxE
- Methane Emissions
- Heat Stress & Microbiome
- Colostrum Microbiome
- Johnes Disease
- GPTA Validation for Cows
- Hoof Health & Lameness
- Inbreeding & Diversity
- Energy Efficiency & Metabolism
- Single-Step GBLUP
- F_{ST} SNP Selection for Faster Computation

iYOTAH SOLUTIONS | NATIONAL DHIA | CDCB COUNCIL ON DAIRY CATTLE BREEDING | CATTLE EYE | UCONN | UNIVERSITY OF GEORGIA | NC State | UF UNIVERSITY of FLORIDA | IOWA STATE | WISCONSIN UNIVERSITY OF WISCONSIN–MADISON | Penn State | CORNELL UNIVERSITY FOUNDED A.D. 1865 | UNIVERSITY OF MARYLAND 1856 | MICHIGAN STATE | UNIVERSITY OF MINNESOTA

THANK YOU

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