BEEF ON DAIRY

Current use, outcomes, and implications for genetic evaluations

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TOPICS FOR DISCUSSION

- **Setting the stage**
  - What is USDA-ARS
  - Who AGIL is, what we do

- **Beef x Dairy**
  - Why crossbreeding
  - Breeding strategies
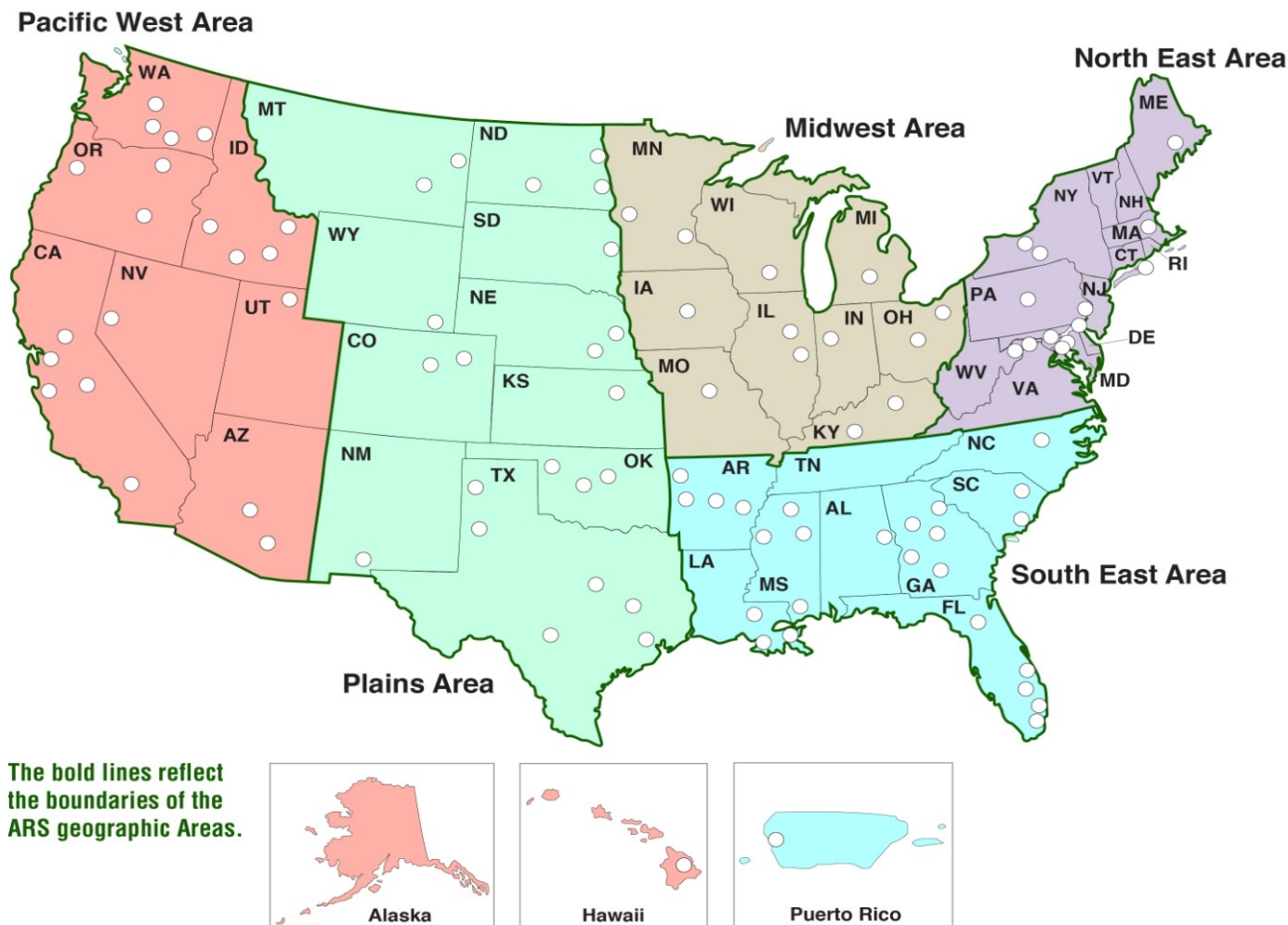 - Usage statistics
  - Implications
  - Needs moving forward

AGRICULTURAL RESEARCH SERVICE (ARS)

Mission:

ARS delivers scientific solutions to national and global agricultural challenges

USDA's largest intramural scientific agency

- 1,800 PhD scientists
- 8,000 employees
- ~670 research projects
- $1.5 billion budget

Pacific West Area
North East Area
Midwest Area
Plains Area
South East Area

The bold lines reflect the boundaries of the ARS geographic Areas.

Alaska Hawaii Puerto Rico

ARS NATIONAL PROGRAMS

Natural Resources & Sustain. Agric. Sys. (~19%)

- Water Availability & Watershed Management
- Soil & Air
- Grass, Forage & Rangeland Agroecosystems
- Sustainable Agriculture Systems Research

Crop Production & Protection (~38%)

- Plant Genetic Resources, Genomics & Genetic Improvement
- Plant Diseases
- Crop Protection & Quarantine
- Crop Production

Animal Production & Protection (~17%)

- Food Animal Production
- Animal Health
- Veterinary, Medical, & Urban Entomology
- Aquaculture

Nutrition, Food Safety & Quality (~26%)

- Human Nutrition
- Food Safety
- Quality & Utilization of Agricultural Products

BELTSVILLE AGRICULTURAL RESEARCH CENTER

ANIMAL GENOMICS & IMPROVEMENT LAB

Mission:
Discovers and develops improved methods for the genetic and genomic evaluation of economically important traits of dairy animals and small ruminants and conducts fundamental genomics-based research aimed at improving their health and productive efficiency.

Personnel (3 Projects):
- 10 SYs (NP 101). One SY position is currently vacant.
- 3 post-docs (additional post-doc being hired)
- 7 support scientists, 4 technicians, 1 administrative professionals, 1 IT specialist
  - 3 support scientist positions are vacant (two will be hired soon)

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ANIMAL GENOMICS & IMPROVEMENT LAB

Improving Dairy Animals by Increasing Accuracy of Genomic Prediction, Evaluating New Traits, and Redefining Selection Goals

Improving Feed Efficiency and Environmental Sustainability of Dairy Cattle through Genomics and Novel Technologies

Enhancing genetic merit of ruminants through improved genome assembly, annotation, and selection

FIRST, SOME HISTORY

1908 USDA Bureau of Animal Industry organized cow testing associations nationally

1915 Some bull associations calculated daughter-dam differences for their own bulls

1926 USDA calculated sire evaluations for 23 bulls and sent results directly to each bull's owner

Helmer Rabild, organizer of the first U. S. dairy herd-improvement association.
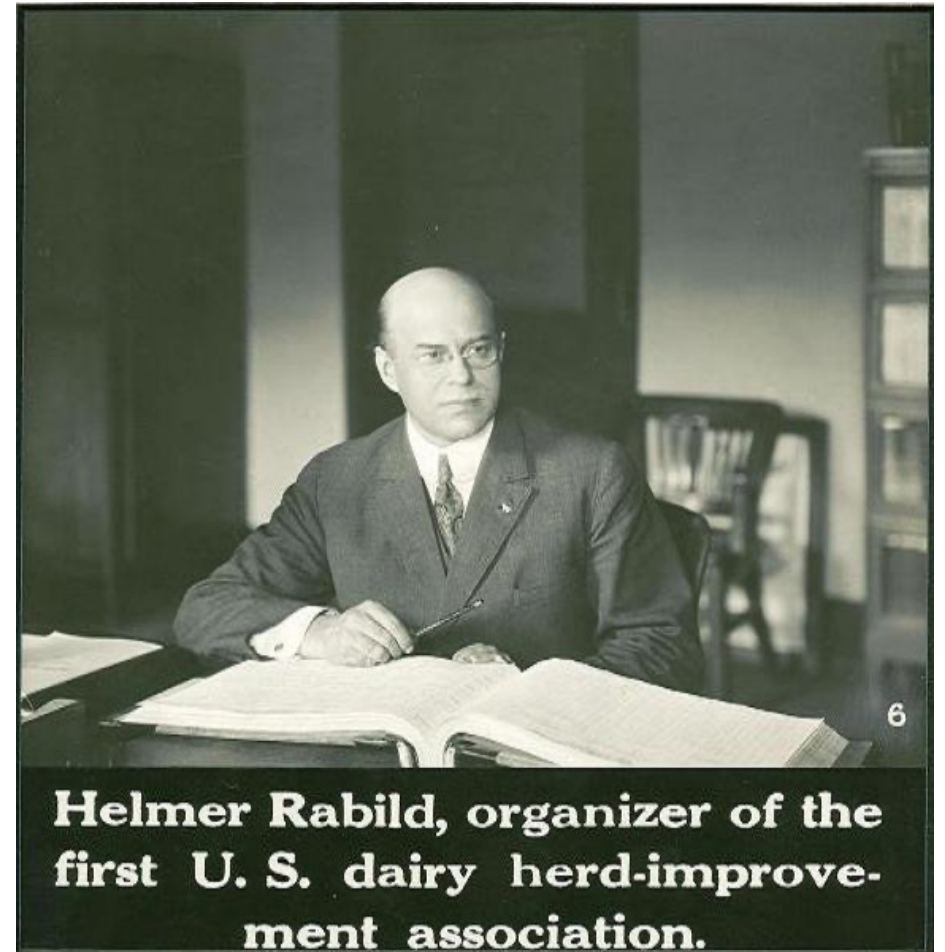
FIRST, SOME HISTORY

Sewall Wright

Year	Biography	Location
1889	Born	MA
1892	Raised	Galesburg, IL
1911	B.S.	Galesburg, IL
1912	M.S.	U. IL, Urbana
1915	PhD	Harvard U., MA
1916	USDA	Beltsville, MD
1926	Professor	Chicago, IL
1955	Retired	Madison, WI
1988	Died	Madison, WI

Year	Research discoveries at USDA
1917	Cattle color inheritance
1920	Heritability (h^2)
1920	Livestock breeding (75-page book)
1921	Systems of mating
1921	Multiple regression accuracy (R^2)
1921	Effective population size
1921	Correlation is not causation
1922	**Inbreeding coefficient (F)**
1923	Path coefficients
1925	Computing relationships and F

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FIRST, SOME HISTORY

Wright, S. 1922. Coefficients of inbreeding and relationship. The American Naturalist 56:330-338.

COEFFICIENTS OF INBREEDING AND
RELATIONSHIP

DR. SEWALL WRIGHT   1889-

BUREAU OF ANIMAL INDUSTRY, UNITED STATES DEPARTMENT
OF AGRICULTURE

In the breeding of domestic animals consanguineous matings are frequently made. Occasionally matings are made between very close relatives—sire and daughter, brother and sister, etc.—but as a rule such close inbreeding is avoided and there is instead an attempt to concentrate the blood of some noteworthy individual by what is known as line breeding. No regular system of mating such as might be followed with laboratory animals is practicable as a rule.

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FIRST, SOME HISTORY

DAIRY HERD IMPROVEMENT RECORD

BUREAU OF DAIRY INDUSTRY, DEPT. OF AGRICULTURE

1935 Milk records available for ~2% of dairy cows

https://aipl.arsusda.gov/aipl/history/hist_eval.htm

FIRST, SOME HISTORY

~1908
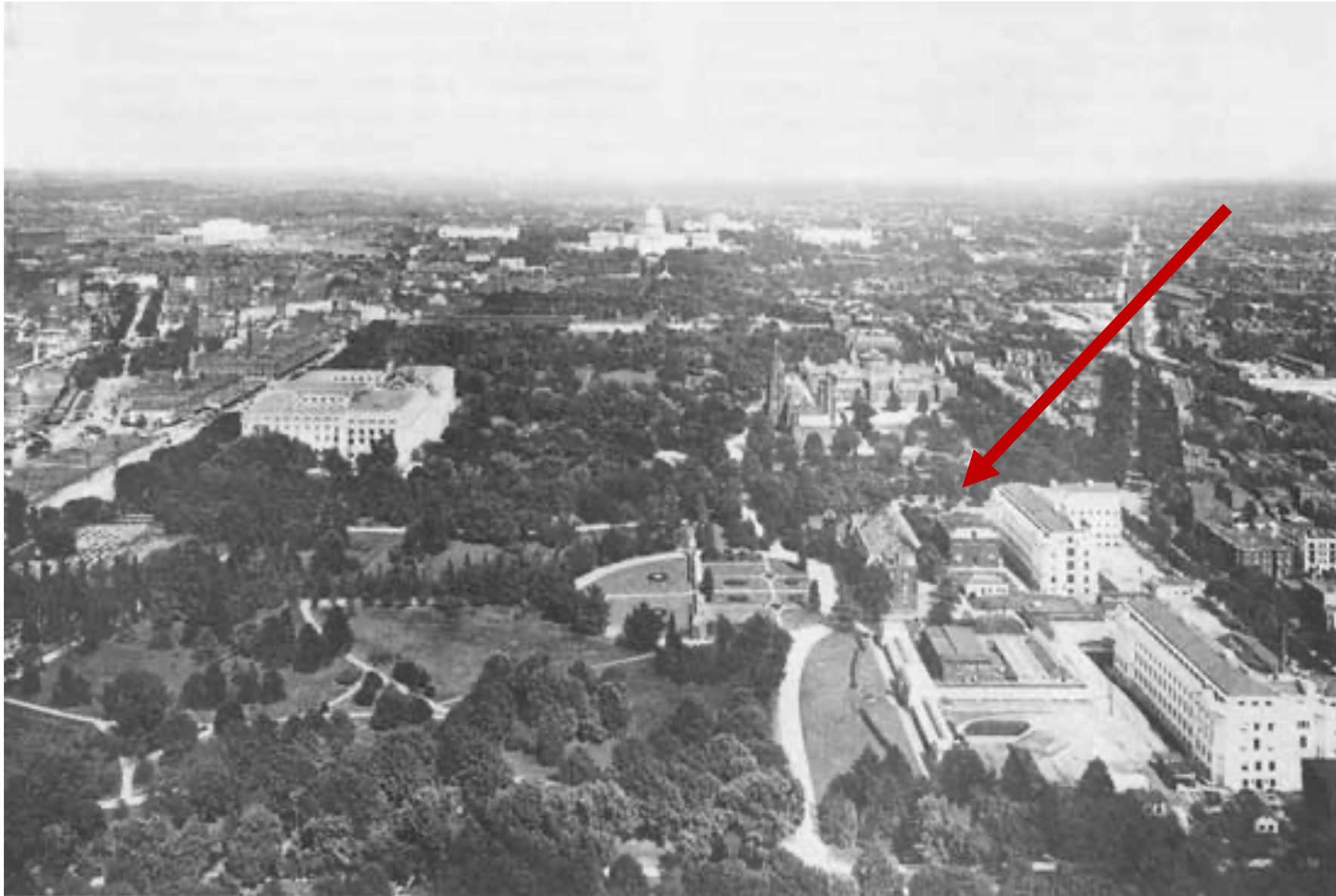
2020

FIRST, SOME HISTORY

1962 Sire evaluations computed with herdmate comparison

1964 National evaluations replaced regional processing center evaluations

1989 Animal model implemented considering relationships among all cows and bulls

2009 First official genomic evaluations

2013 Calculation and distribution of evaluations transferred to Council on Dairy Cattle Breeding

2022 NATIONAL EVALUATION SYSTEM

DRPCs

Lactation, Reproduction, Health, Calving, Test-day, Yearly Average, Herd Info

DRPCs

Lactation, Reproduction, Health, Calving, Test-day, Yearly Average, Herd Info

Breed Associations

Pedigrees, Conformation

Ayrshire

Brown Swiss

Guernsey

Holstein

Jersey

DRPCs

Lactation, Reproduction, Health, Calving, Test-day, Yearly Average, Herd Info

Breed Associations

Pedigrees, Conformation, Holstein

Interbull Centre

International Pedigrees, GMACE results

Interbull Centre

European Commission

Interbull

Swedish University of Agricultural Sciences

SLU

36 participating countries
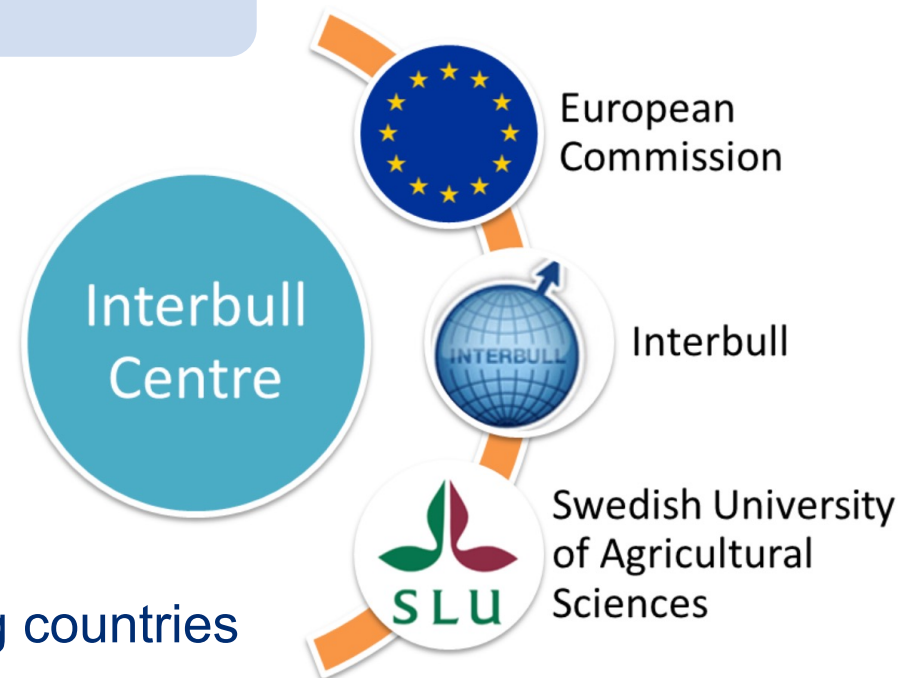
Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

DRPCs — *Lactation, Reproduction, Health, Calving, Test-day, Yearly Average, Herd Info*

Breed Associations — *Pedigrees, Conformation, Holstein*

Interbull Centre — *International Pedigrees, GMACE results*

NAAB — *NAAB AI codes, Bull Controlling*

NAAB®

DRPCs — *Lactation, Reproduction, Health, Calving, Test-day, Yearly Average, Herd Info*

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Genomic Nominators — *Genotyped Animals ID, Pedigree*

Genomic Laboratories — *Genotypes*

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Breed Associations: Pedigrees, Conformation, Holstein

Interbull Centre: International Pedigrees, GMACE results

NAAB: NAAB AI codes, Bull Controlling

Genomic Nominators: Genotyped Animals ID, pedigree

Genomic Laboratories: Genotypes

EDITS → National Cooperator Database — CDCB (Council on Dairy Cattle Breeding)

> 100 million LACTATIONS

> 90 million PEDIGREES

> 6 million GENOTYPES

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DRPCs
Lactation, Reproduction, Health, Calving, Test-day, Yearly Average, Herd Info

Breed Associations
Pedigrees, Conformation, Holstein

Interbull Centre
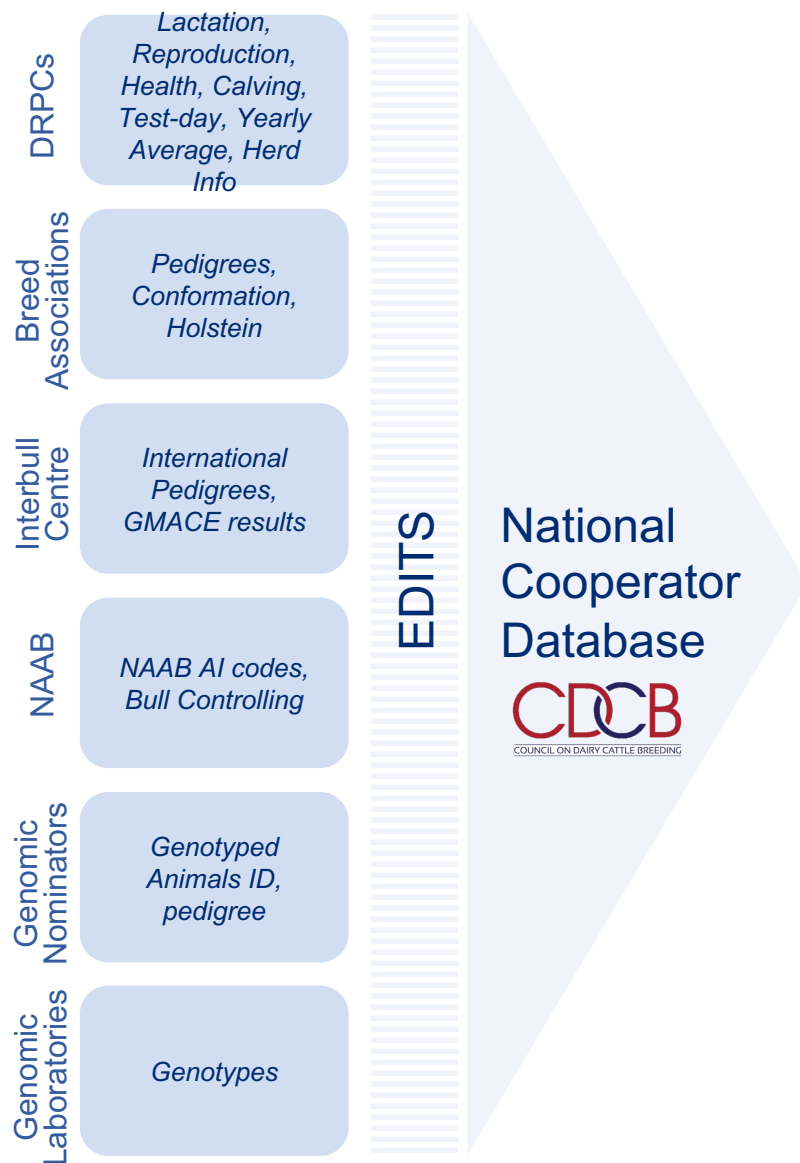*International Pedigrees, GMACE results*

NAAB
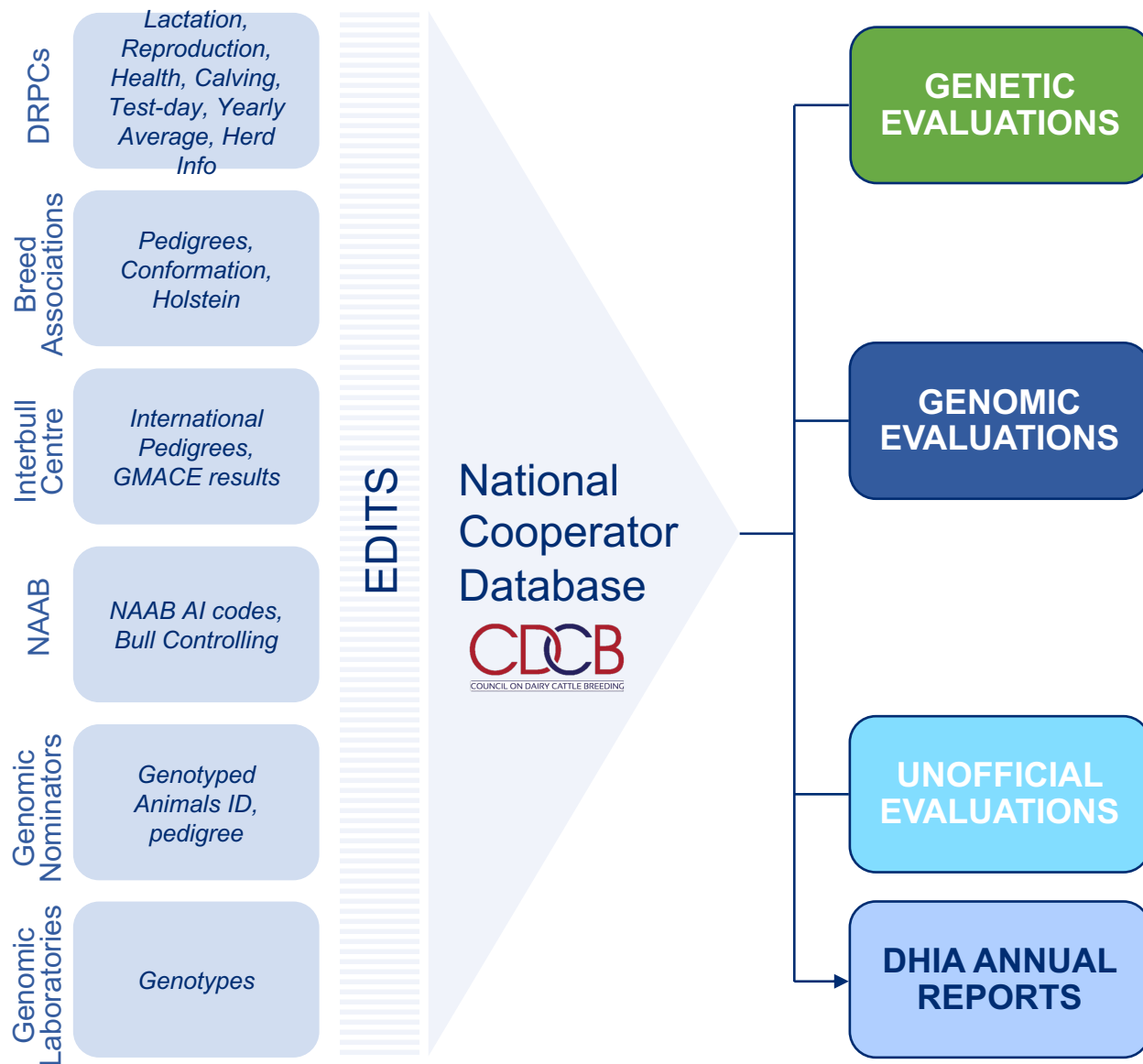*NAAB AI codes, Bull Controlling*
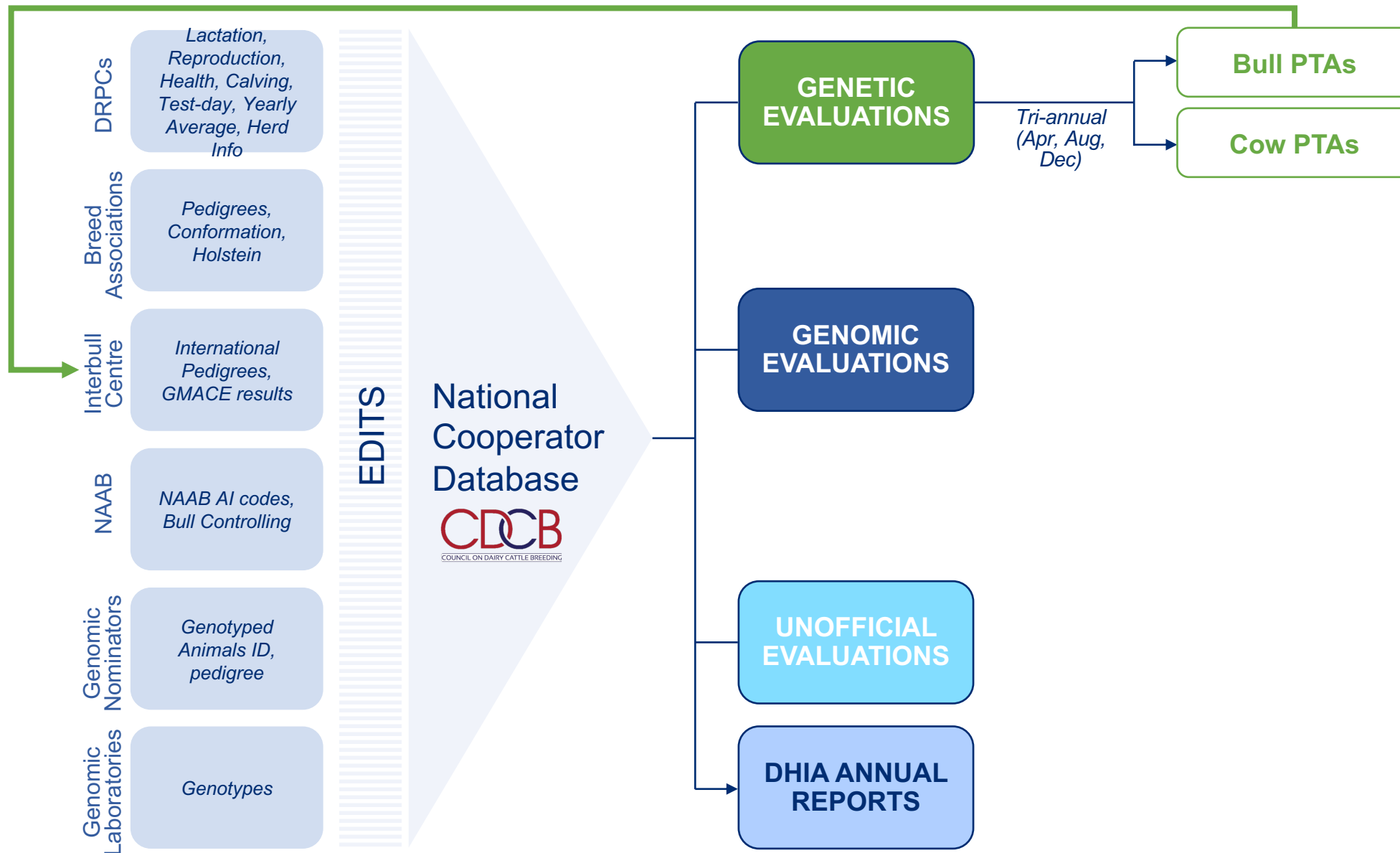
Genomic Nominators
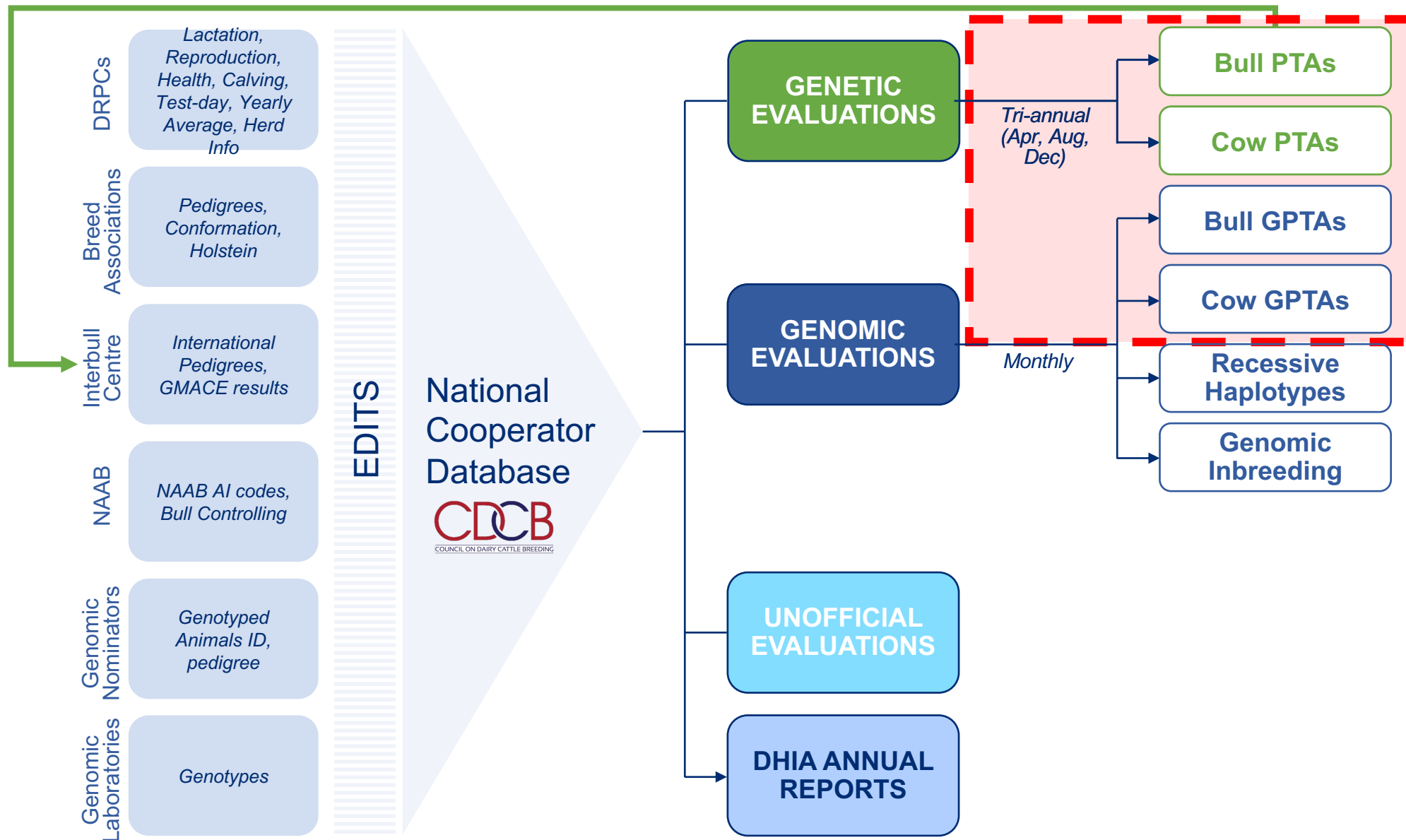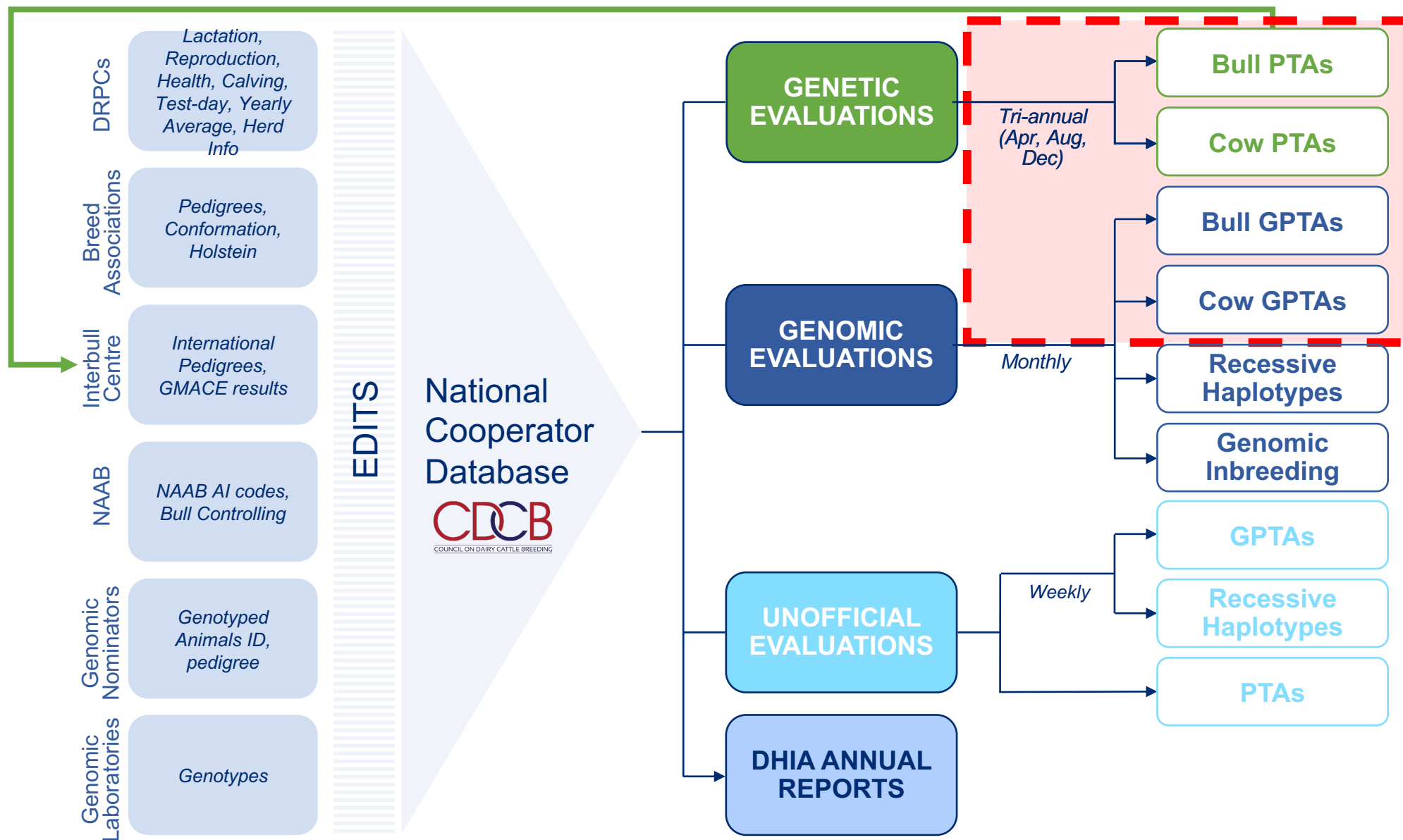*Genotyped Animals ID, pedigree*

Genomic Laboratories
Genotypes

EDITS

National Cooperator Database

CDCB
COUNCIL ON DAIRY CATTLE BREEDING

GENETIC EVALUATIONS

GENOMIC EVALUATIONS
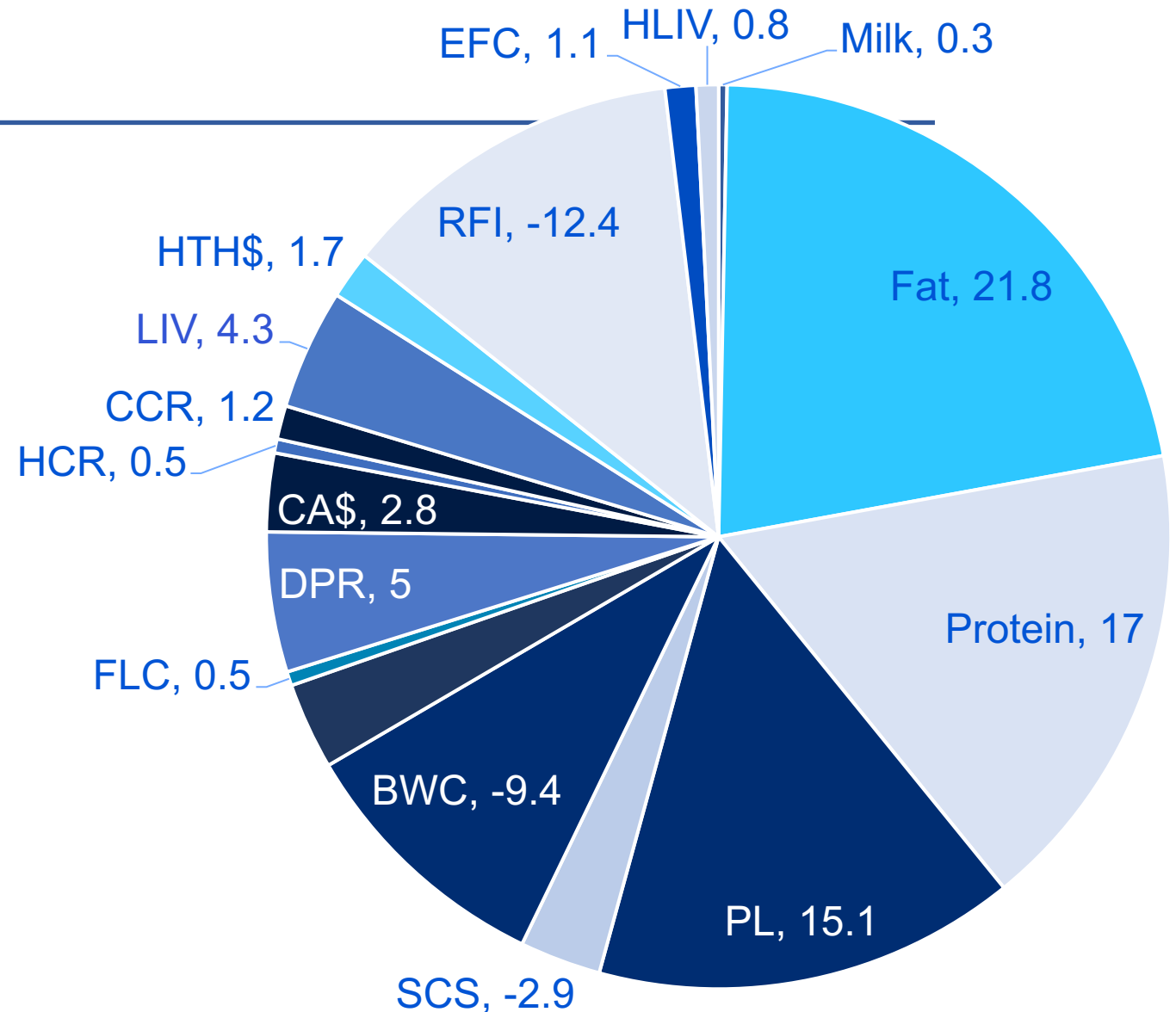
UNOFFICIAL EVALUATIONS
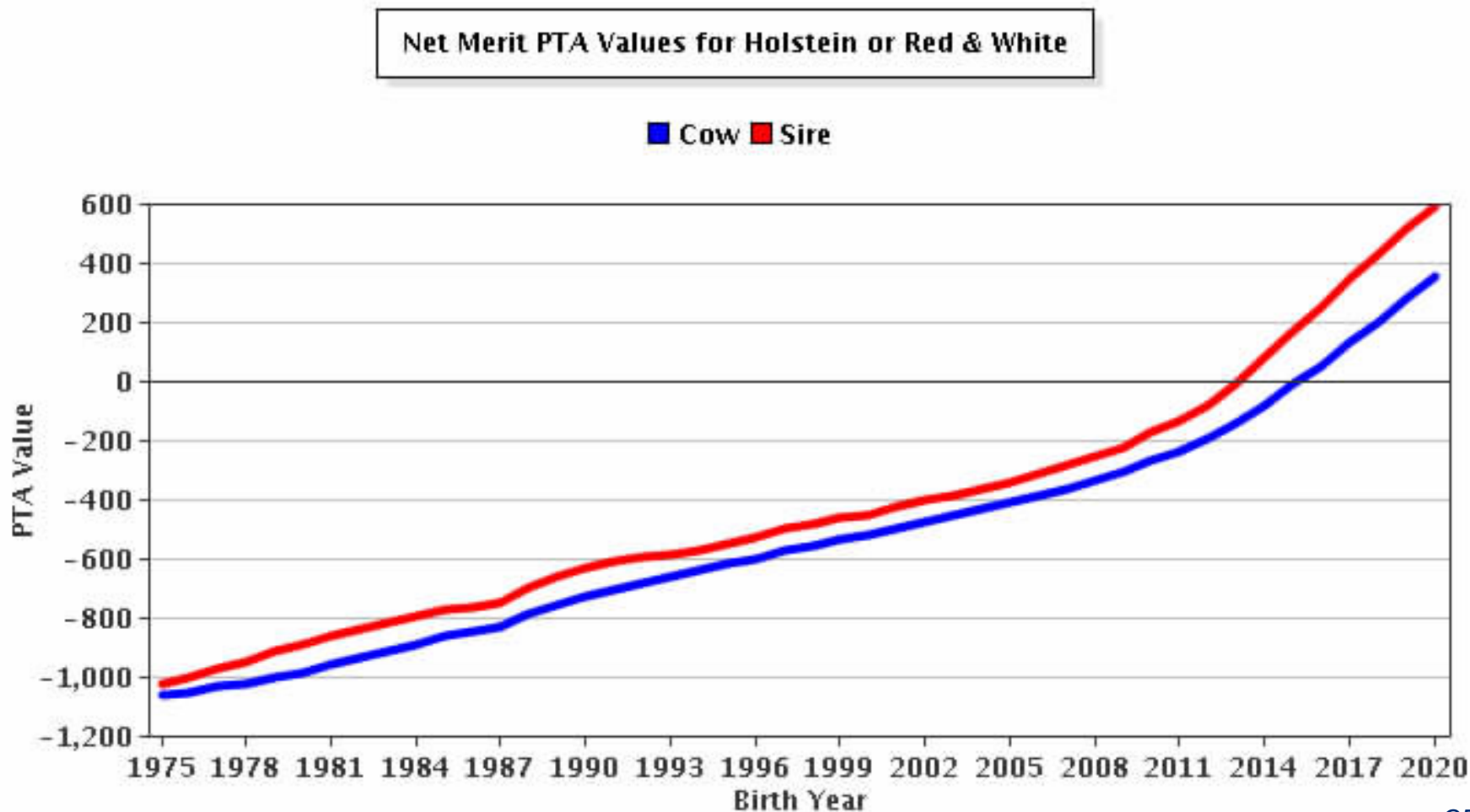
DHIA ANNUAL REPORTS

NET MERIT (NM$)

Relative values in 2021 NM$ for each:

Yield Traits
Productive Life
Somatic Cell Score
Body Weight Composite
Udder Composite
Feet/Legs Composite
Daughter Pregnancy Rate
Calving Ability
Heifer Conception Rate
Cow Conception Rate
Livability
Health Traits
Feed Saved
Early First Calving
Heifer Livability

Pie chart labels:
EFC, 1.1
HLIV, 0.8
Milk, 0.3
Fat, 21.8
RFI, -12.4
HTH$, 1.7
LIV, 4.3
CCR, 1.2
HCR, 0.5
CA$, 2.8
DPR, 5
FLC, 0.5
BWC, -9.4
SCS, -2.9
PL, 15.1
Protein, 17

NET MERIT (NM$)

CDCB, Bovine Genetic Trends
https://queries.uscdcb.com/eval/summary/trend.cfm?R_Menu=HO.nm#StartBody

GENETIC SELECTION IN A CHANGING WORLD

POLITICO

AGRICULTURE

Got milk? Yes, actually, U.S. has too much.

Some parts of the nation have seen localized spikes in milk prices. But most of the nation is facing an oversupply of milk — a challenge policy makers have been struggling to address.

DAIRY GLOBAL

Surviving high North American feed prices

19-08-2021 | Nutrition | Article

npr
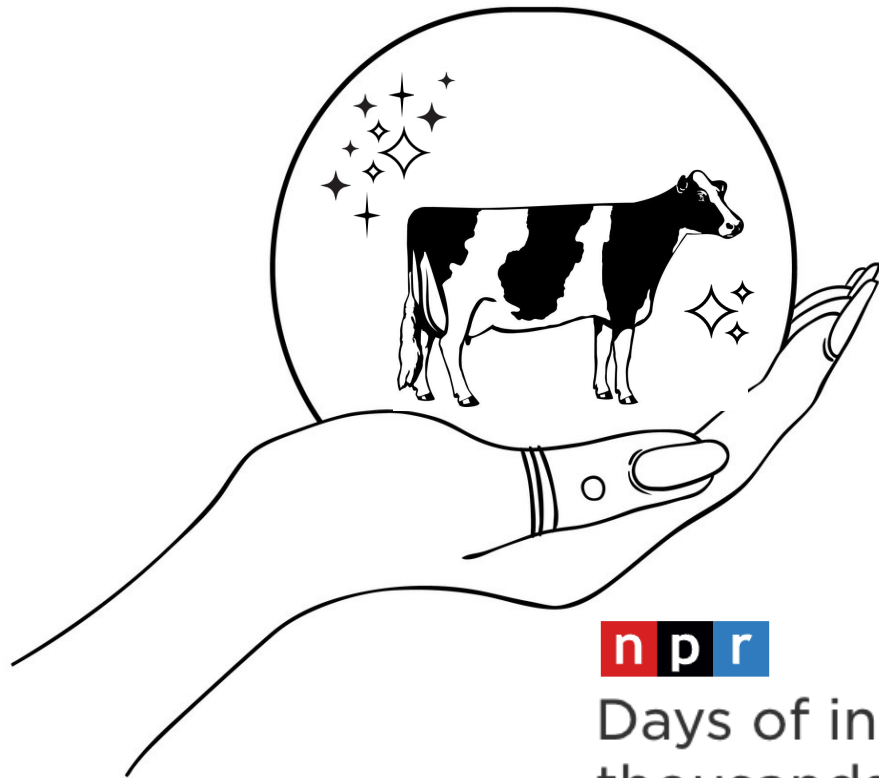
Days of intense heat have killed thousands of cattle in Kansas

June 16, 2022 · 12:39 PM ET

EMERGENCE OF BEEF x DAIRY

PROGRESSIVE DAIRY

Beef x dairy: The merging of two paradigms

Cathy Bandyk   November 8, 2021

HIGH PLAINS JOURNAL

EDITOR'S PICK

'Beef on dairy' breeding sweeps dairy industry

By David Murray   May 27, 2022 Updated Jun 1, 2022   💬 0

Dairy Herd Management

Mating Decisions for Beef x Dairy Crosses Just as Important as Conventional

WESTERN Farmer-Stockman

Why beef on dairy?

BEEF x DAIRY VALUE ADDED

Better G:F Ratio

↑ Average Daily Gain
↑ Dry Matter Intake

Better Boxed Beef Value

↑ carcass weights
↑ dressing percentage
↑ backfat thickness
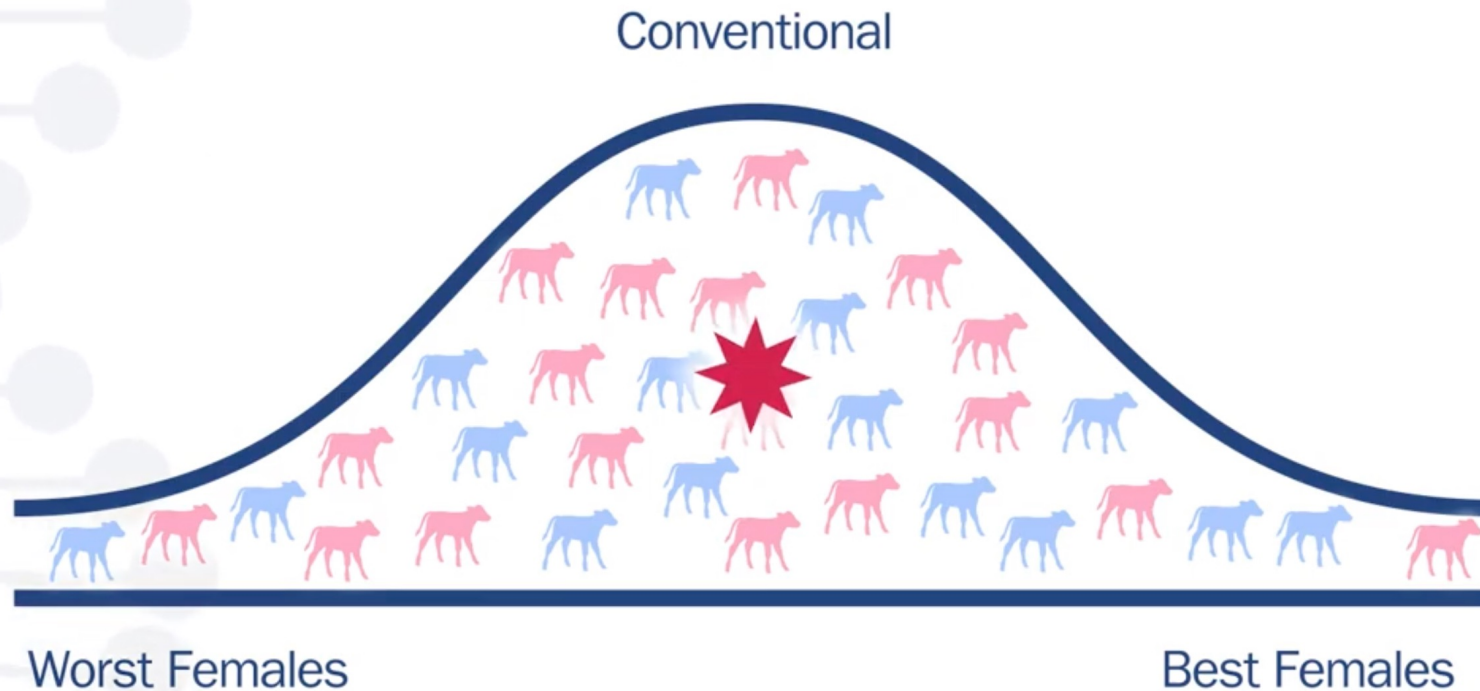↑ marbling score
↑ red meat yield

Jersey x Angus Ribeye

https://www.canr.msu.edu/news/crossbreeding-jersey-cows-with-a-beef-sire-increases-the-value-of-crossbred-jersey-calves-compared-with-purebred-jersey-steers-when-raised-for-beef-production
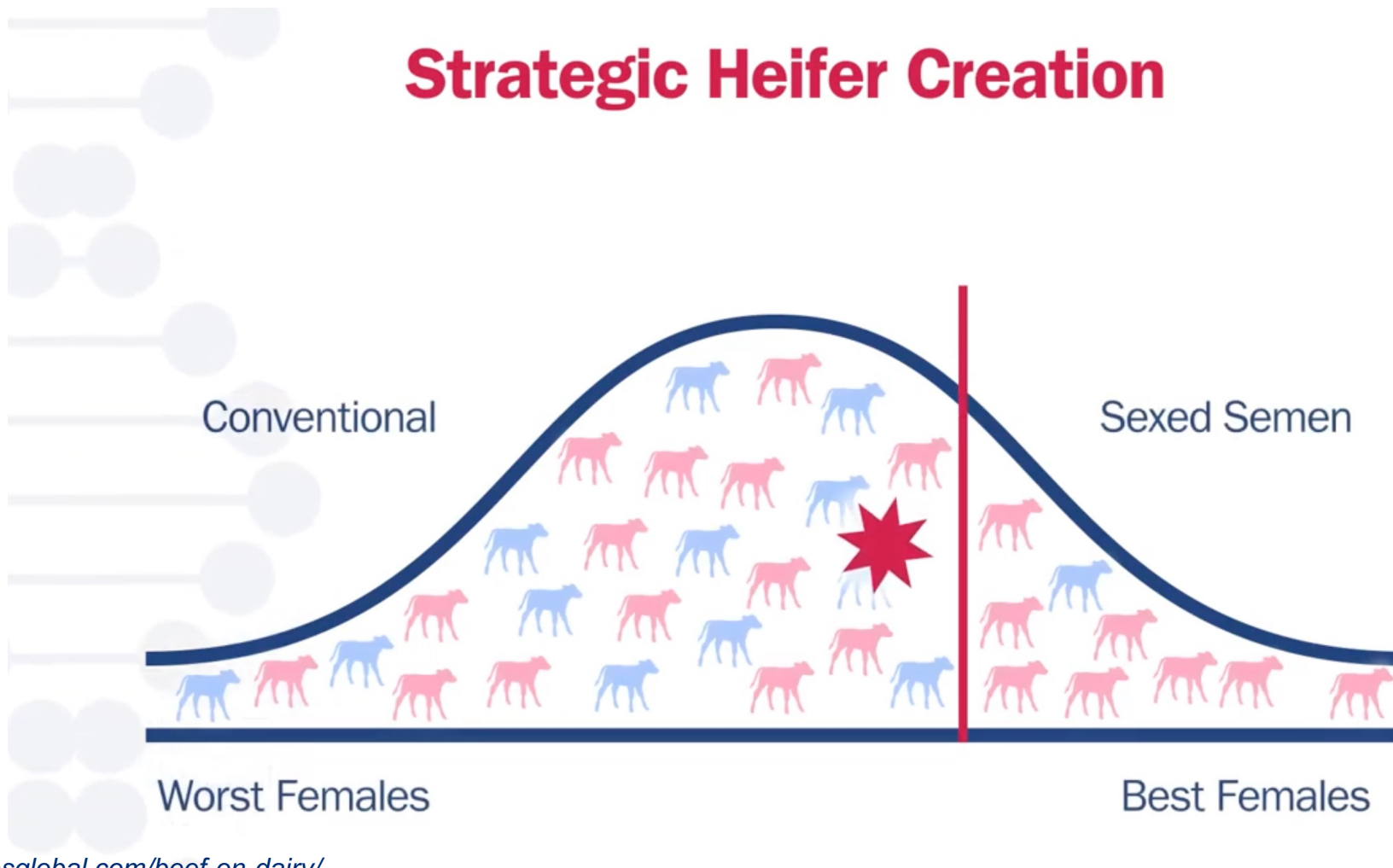
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DAIRY BREEDING STRATEGIES

From: https://www.absglobal.com/beef-on-dairy/

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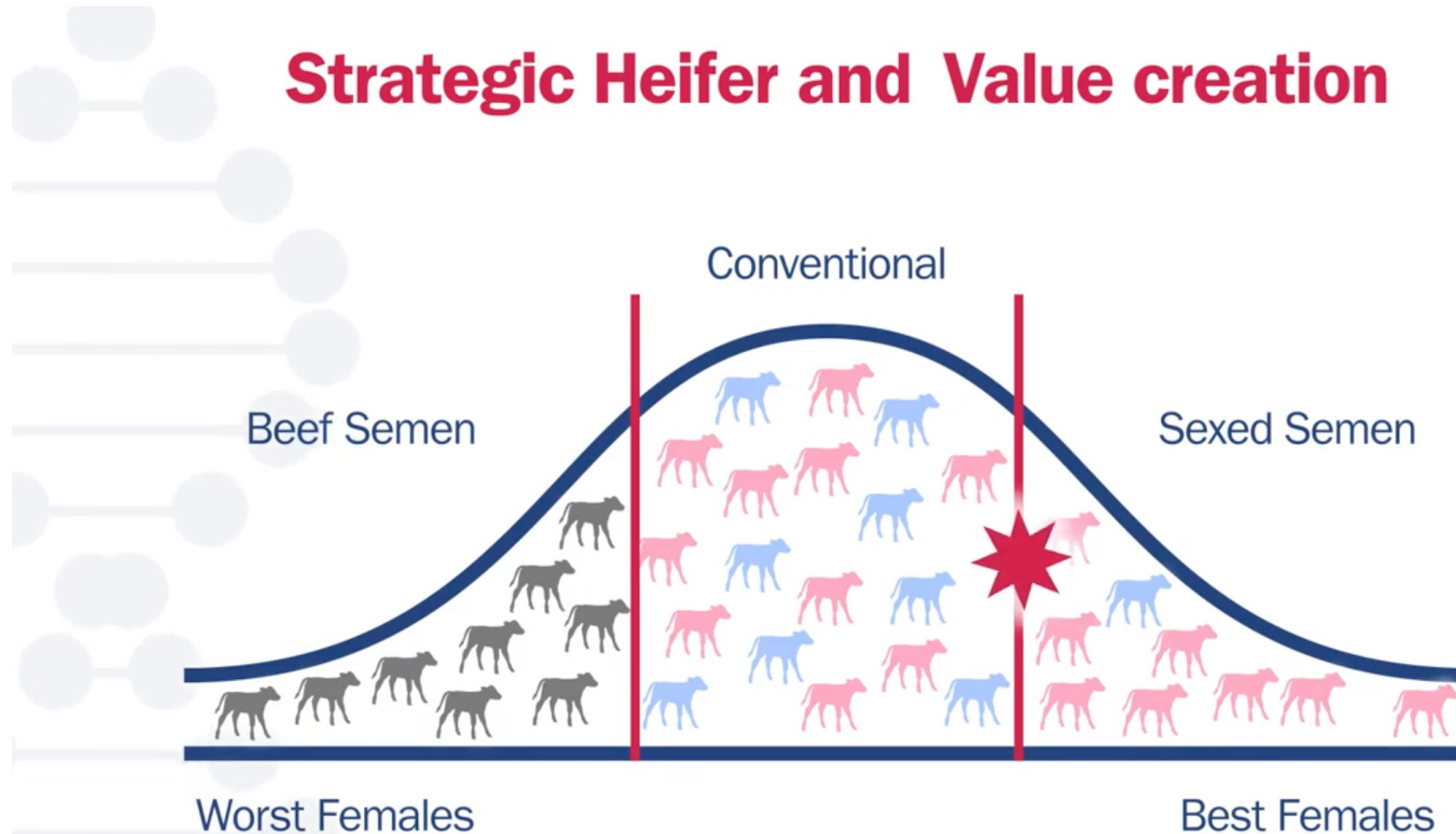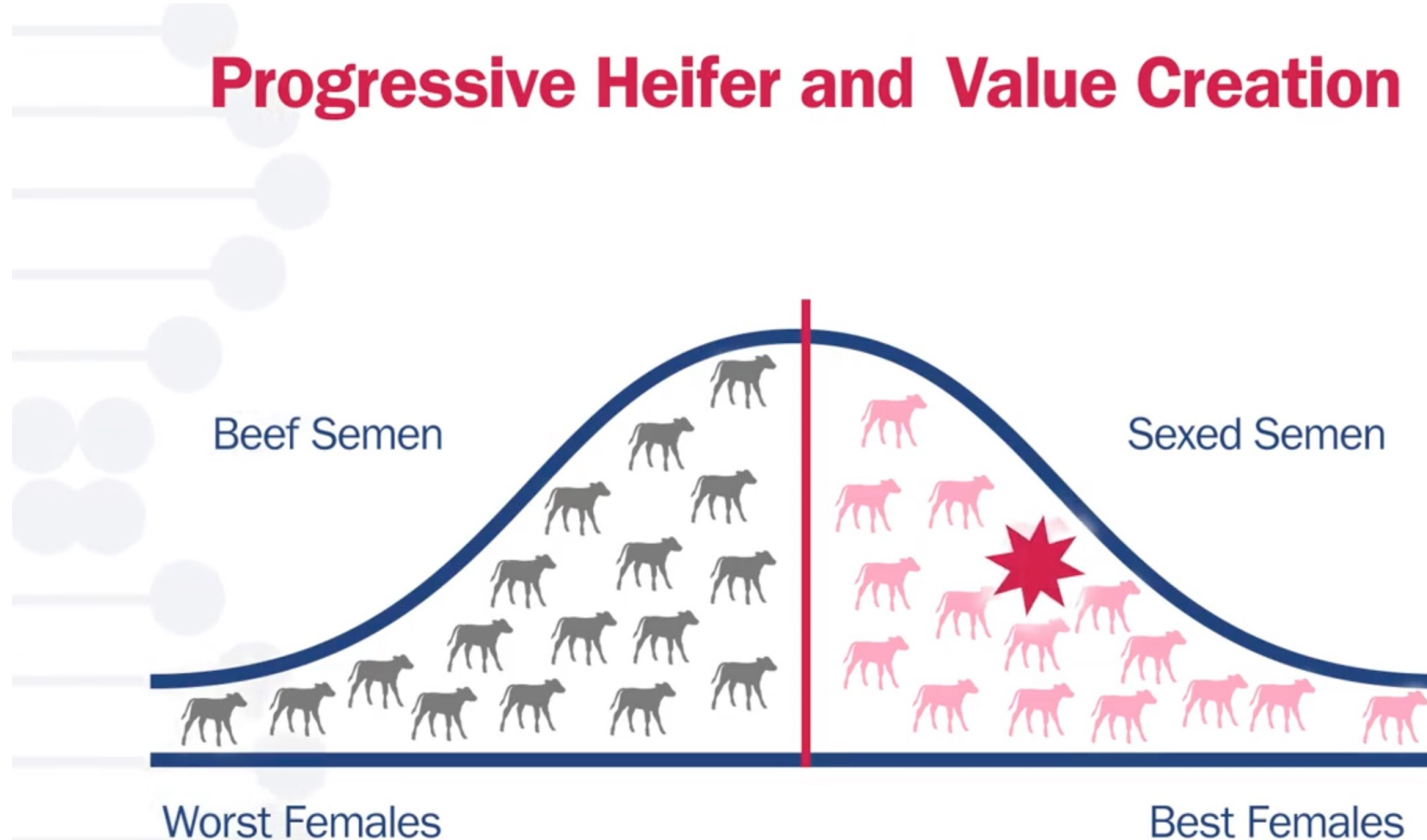
DAIRY BREEDING STRATEGIES

Genetically Superior Heifer Creation

Beef Semen + Embryo Recipients

Sexed Semen

Embryo Donors

Worst Cows

Best Cows

ABS

From: https://www.absglobal.com/beef-on-dairy/
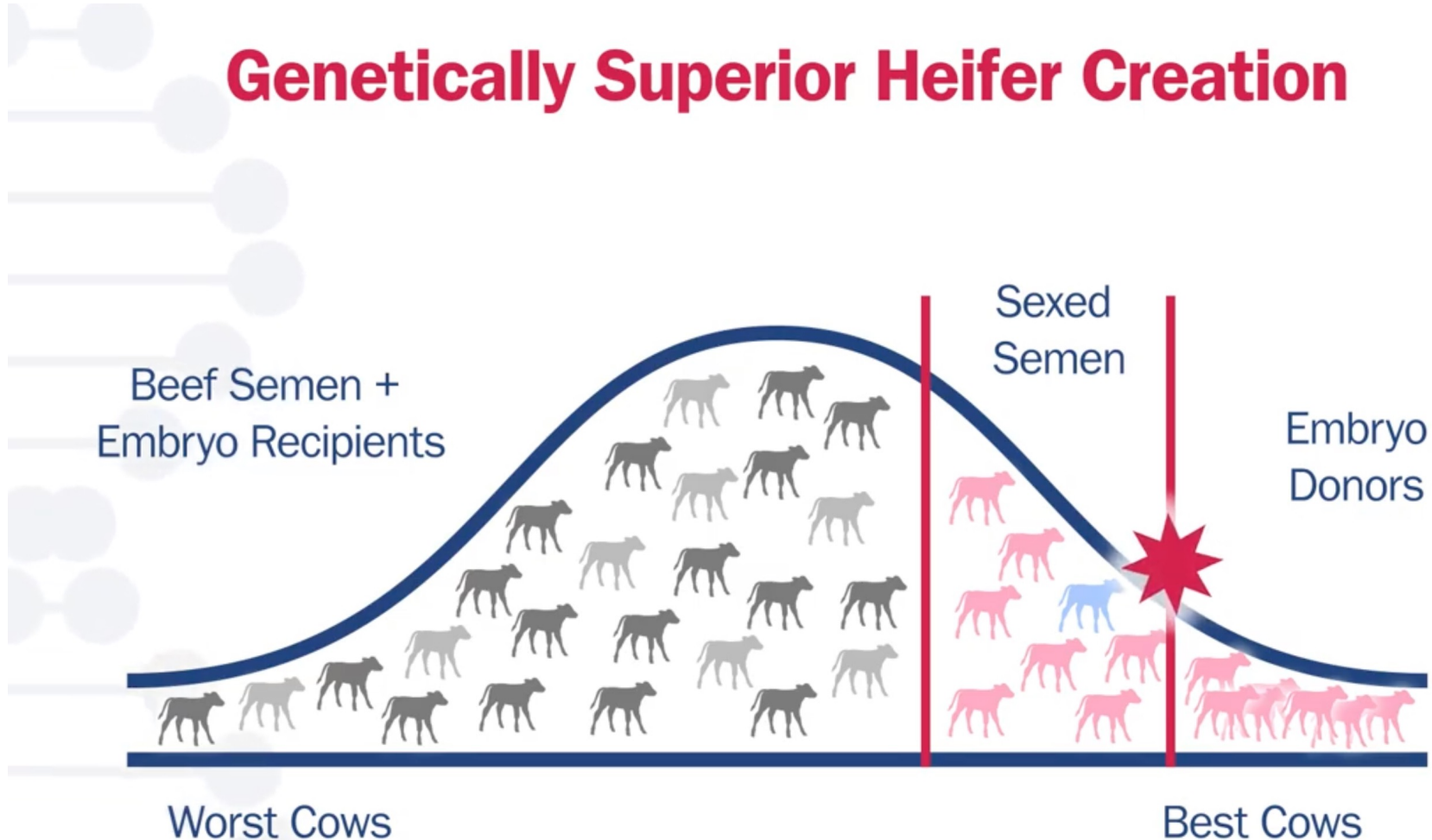
DAIRY SEMEN SALES ARE DOWN

DOMESTIC DAIRY SEMEN SALES (1)
UNITS OF SEMEN

BREED	2021	2020	%+/-
HOLSTEIN	13,781,519	14,909,469	-7.57%
JERSEY	2,690,868	2,835,675	-5.11%
R&W/RED HOLSTEIN	253,451	261,598	-3.11%
HOLSTEIN-RED CARRIER	159,462	163,652	-2.56%
BROWN SWISS	71,659	102,143	-29.84%
AYRSHIRE	28,301	29,063	-2.62%
GUERNSEY	19,428	22,690	-14.38%
MILKING SHORTHORN	11,813	14,202	-16.82%
OTHER DAIRY	138,294	45,989	200.71%
TOTAL	17,154,795	18,384,481	-6.69%

From: NAAB Domestic Semen Sales Report 8/5/2022

BEEF SEMEN SALES ARE UP

DOMESTIC BEEF SEMEN SALES (1)
UNITS OF SEMEN

BREED	2021	2020	%+/-
ANGUS	4,601,465	3,696,283	24.49%
SIMMENTAL	1,178,912	1,150,684	2.45%
LIMOUSIN	653,508	664,944	-1.72%
CHAROLAIS	597,673	381,103	56.83%
RED ANGUS	126,178	127,903	-1.35%
WAGYU	108,613	69,343	56.63%
POLLED HEREFORD	90,340	89,489	0.95%
HEREFORD	9,230	13,297	-30.59%
HEREFORD (BLACK)	9,121	60	15101.67%

*truncated table

INSEMINATION FREQUENCIES (2021)

	AY	BS	GU	HO	JE
[same dairy breed]	**3,617**	**16,358**	**5,318**	**2,285,706**	**123,842**
Angus	1,468	627	128	1,017,436	107,632
XB	12	100	6	172,551	10,544
Limousin	32	146	18	147,622	26,095
Simmental	35	297	2	120,368	49,371
Charolais	4	159	2	50,797	54,310
Wagyu	1	37	11	46,478	15,911

AVERAGE DYSTOCIA (2021)

Reported on scale 1 -5
averages shown below

	AY	BS	GU	HO	JE
[same dairy breed]	**1.39**	**1.35**	**1.4**	**1.37**	**1.38**
Angus	1.38	1.39	1.37	1.38	1.44
XB	1.5	1.73	1	1.39	1.38
Limousin	1.31	1.49	1.56	1.41	1.38
Simmental	1.37	1.32	1.5	1.37	1.33
Charolais	1.25	1.4	2.5	1.39	1.4
Wagyu	1	1.35	1.18	1.35	1.39

AVERAGE 305-actual MILK (2021)

	AY	BS	GU	HO	JE
[same dairy breed]	21,378	22,519	20,995	24,015	20,530
Angus	23,920	22,994	22,319	24,284	22,018
XB	24,277	22,470	20,954	24,840	20,985
Limousin	20,985	23,160	25,455	24,771	22,358
Simmental	20,503	21,998	19,899	25,020	19,147
Charolais	21,242	21,704	23,603	23,323	21,165
Wagyu	18,462	24,676	25,393	25,632	22,150

HOW ARE BEEF SERVICE SIRES CHOSEN?

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U.S. DEPARTMENT OF AGRICULTURE

BEEF X DAIRY CONCEPTION RATE

Angus Bulls

Holstein Bulls

Holstein Cows

McWhorter et al 2020

BEEF X DAIRY CONCEPTION RATE

McWhorter et al 2020

Key Messages

$W Weaned Calf Value

$F Feedlot Value

$B Beef Value

$C Combined Value
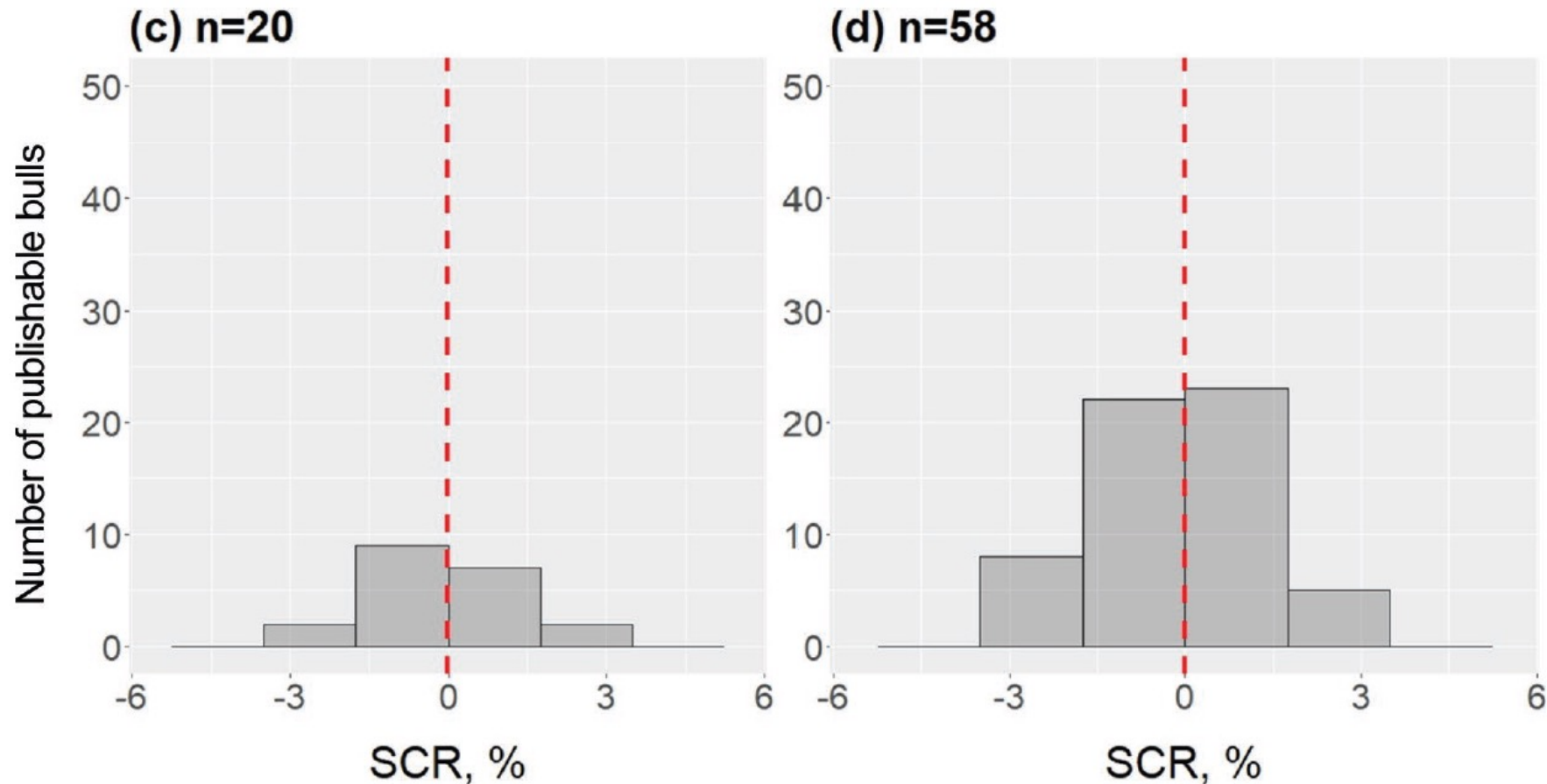
ANGUS
THE BUSINESS BREED
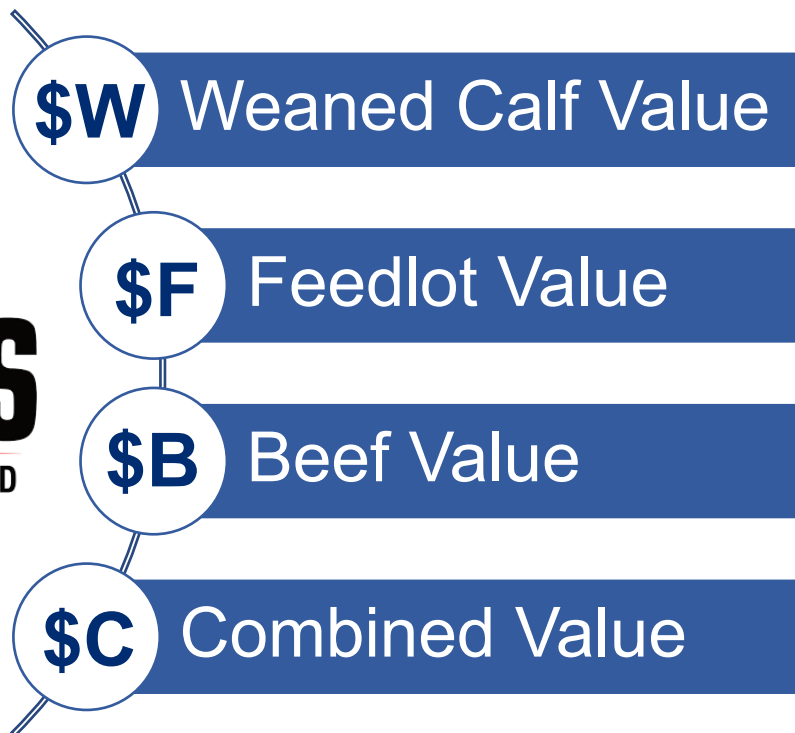
Beef indexes have not yet been tested with beef x dairy crosses

- Dairy producers need tools to select the best beef bulls for crossbreeding

- Beef economic indexes are built around assumptions related to beef breeds only

- Many producers are choosing cheap semen that will yield a black calf; this does not guarantee CAB premiums or address adverse effects on dairy dam

THANK YOU

Contact: asha.miles@usda.gov