

Advances in Selection

Beef Improvement Federation – Calgary AB, July 5, 2023

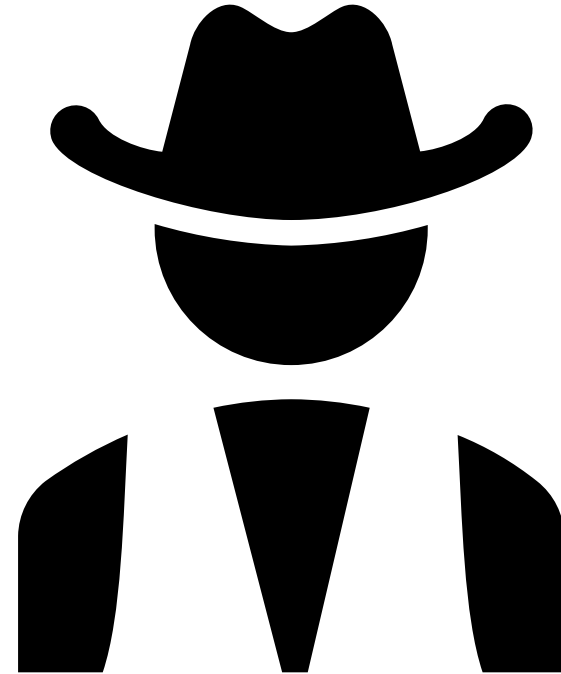
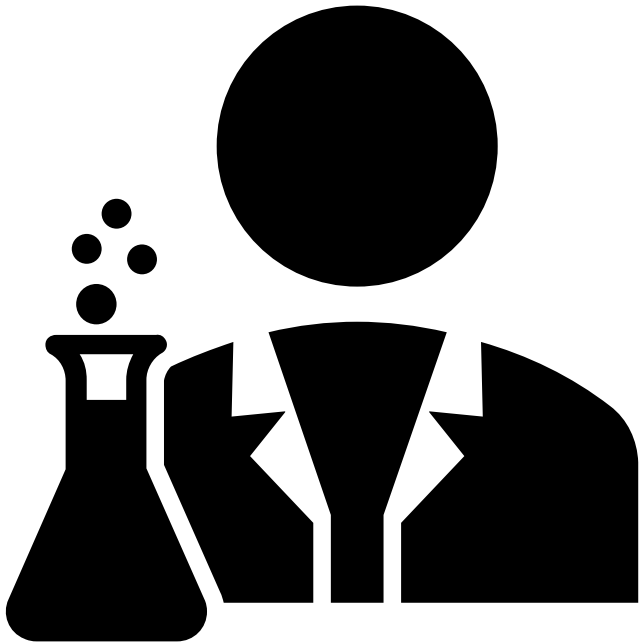
Steve Miller – AGBU, a joint venture of NSW Department of Primary Industries and University of New England, Armidale, Australia.



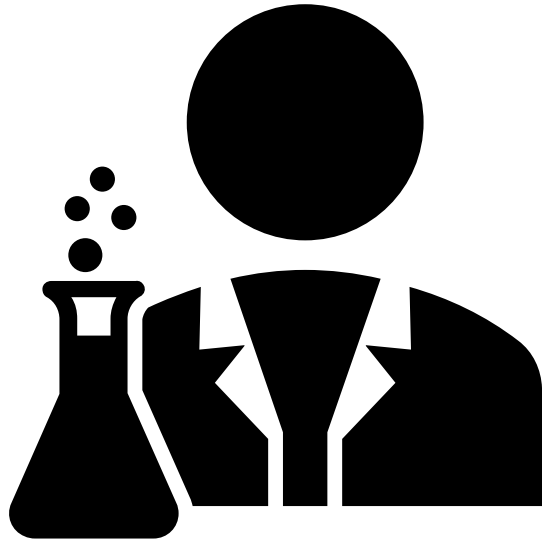
Advances in Selection

- Selection is a verb “the action or fact of carefully choosing someone or something as being the best or most suitable” Wikipedia

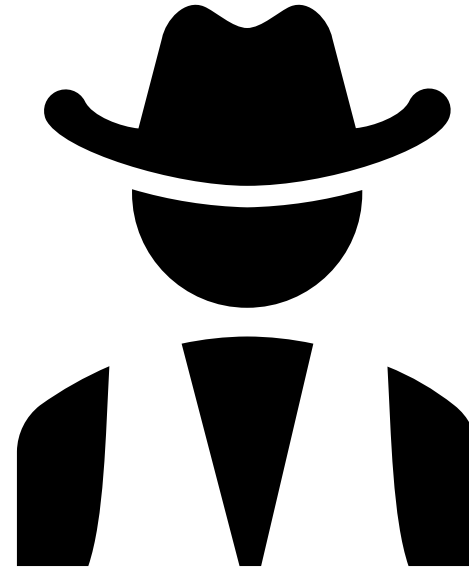
Who does selection?



Who does selection?



Owens no Cattle
Makes no decisions



Owens all the Cattle
Makes all the decisions

Tool or User?



Who is responsible for the home run?

The Batter or the Bat?

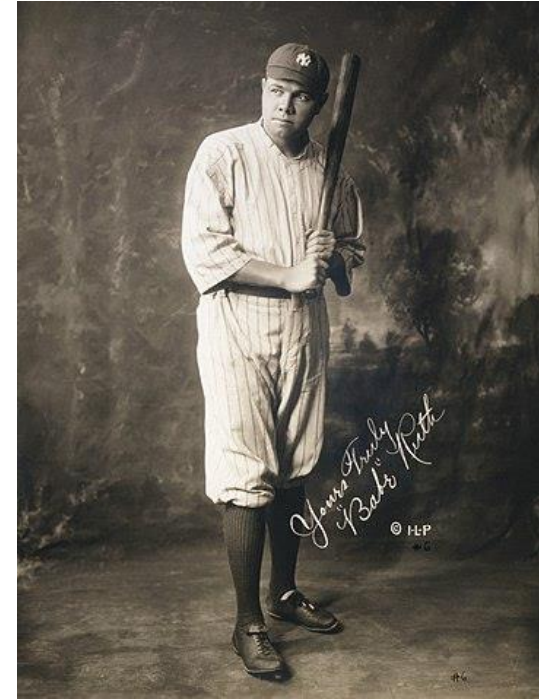
Home Run History



762
Barry Bonds
2007

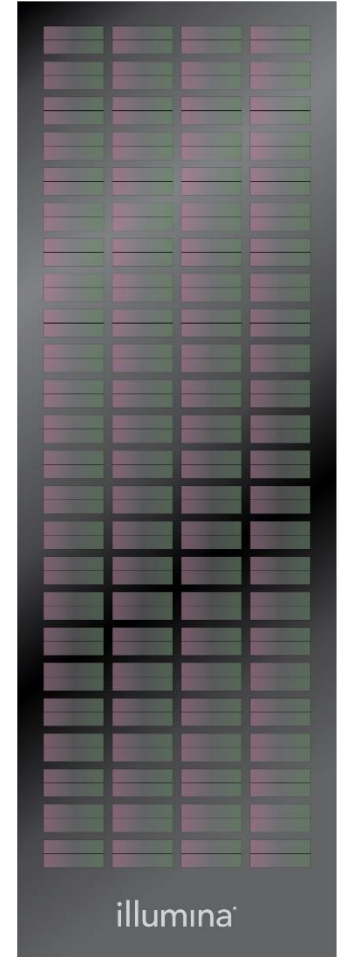
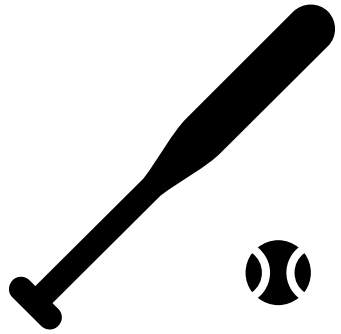


755
Hank Aaron
1976



714
Babe Ruth
1935

Changes in Technology





Agriculture
Canada

Agri-Food Development
Branch

Direction générale du développement
agro-alimentaire



Canadian beef sire evaluation program

Federal-provincial-industry
Record of performance
for beef cattle

Programme canadien d'évaluation des taureaux de boucherie

Programme
fédéral-provincial-industrie
Contrôle d'aptitudes
des bovins de boucherie



Spring 1994 Printemps

Canada

Knowing that the genetic material which will ensure the domestic and international competitiveness of Canada's livestock industries ... we are pleased to provide the facts on 2,862 proven bulls and 3,165 young bulls of 13 different breeds.

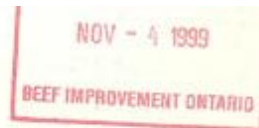
agbu

S.P. M
Composite Breeds To Use
Heterosis and Breed
Differences To Improve

Composites were the promise of the 1990's

Major conclusions from this experiment documented in this technical bulletin are:

- Composite breeds provide a simple procedure to use high levels of heterosis.
- Composite breeds provide a highly effective procedure to use breed differences or breed complementarity to achieve and maintain optimum breed composition for production and carcass traits.
- Composite breeds have the same uniformity for production and carcass traits as contributing purebreeds both within and between generations.
- Composite breeds offer herds of any size an opportunity to use high levels of heterosis and breed complementarity simultaneously.





United States Department of Agriculture

Agricultural Research Service

Technical Bulletin Number 1875

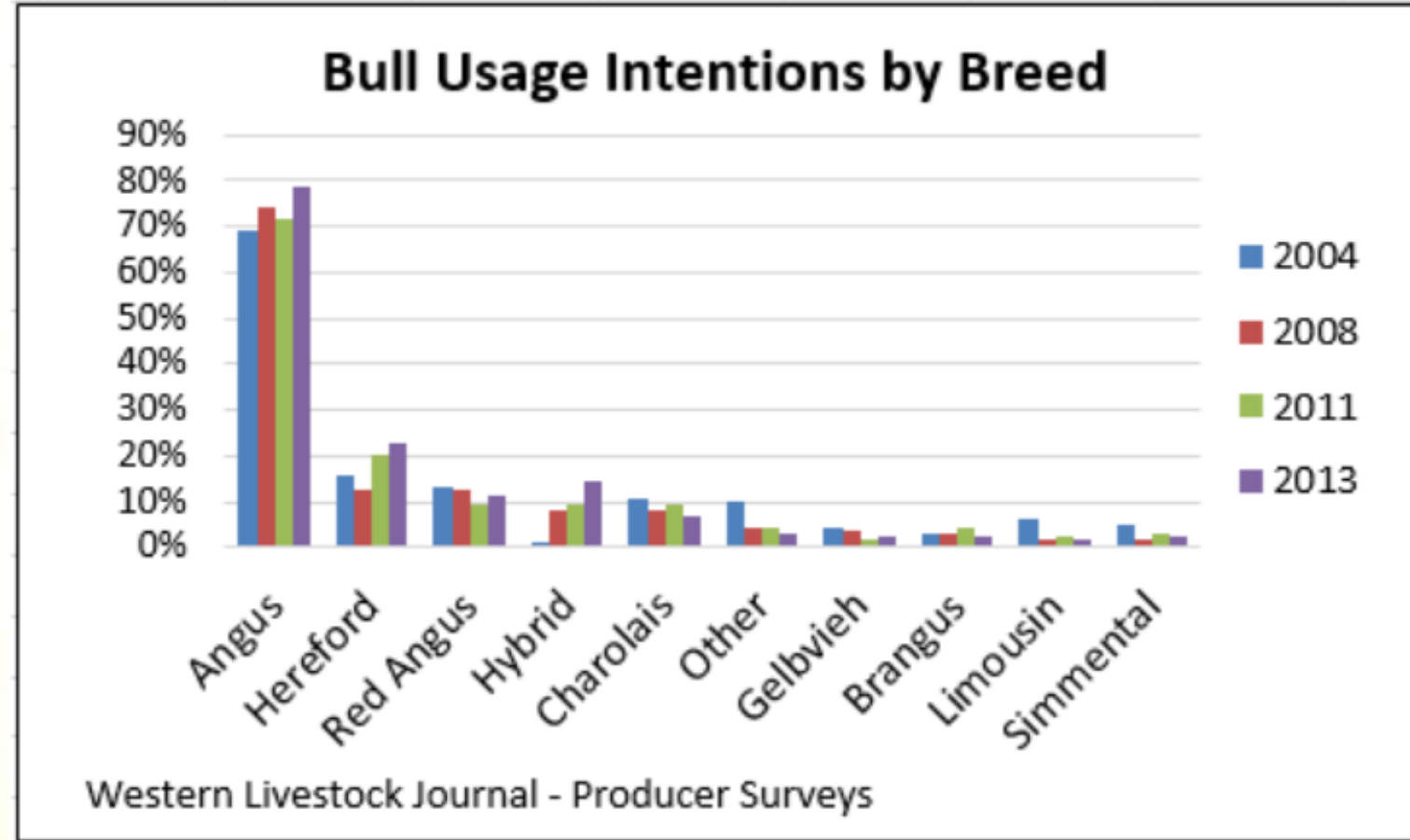
October 1999

S.P.M

Composite Breeds To Use Heterosis and Breed Differences To Improve Efficiency of Beef Production

In cooperation with the Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln

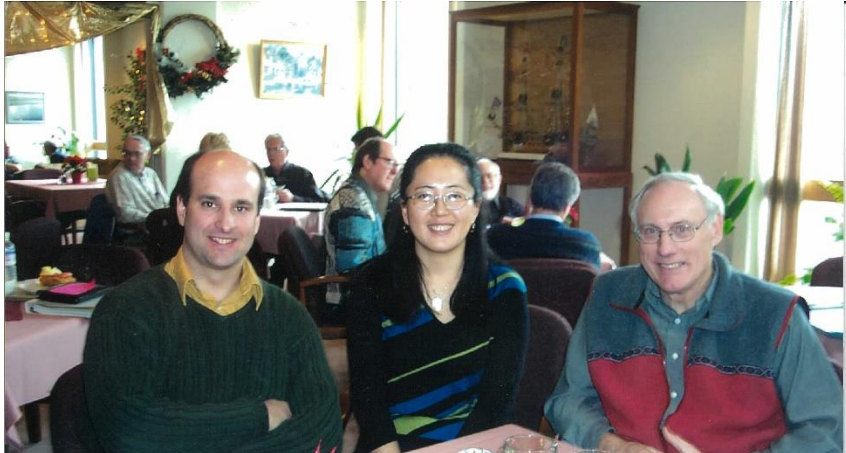
Composites were the promise of the 1990's



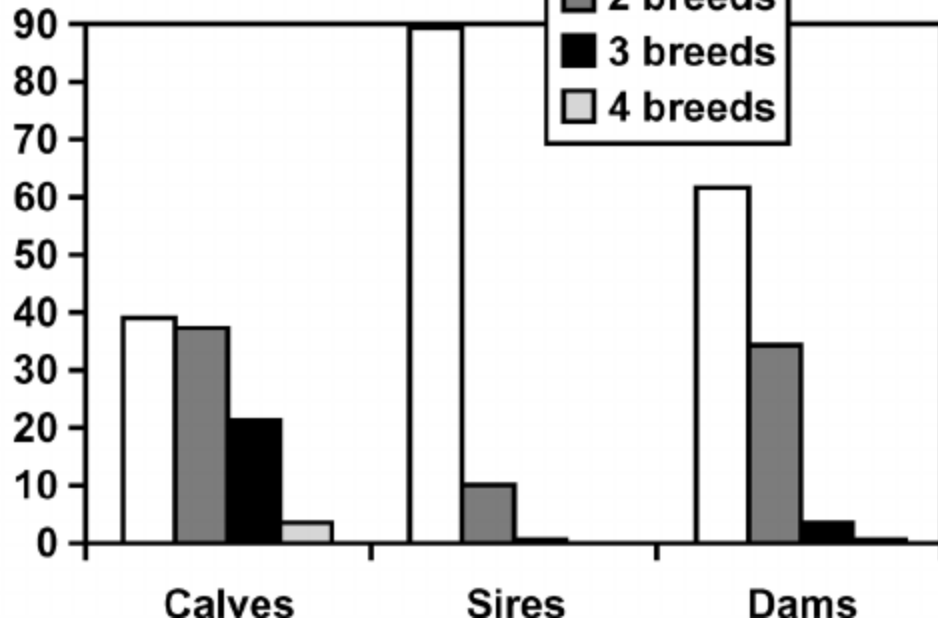
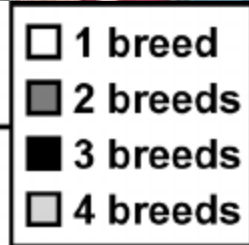
RECEIVED
NOV - 4 1999
BEEF IMPROVEMENT ONTARIO



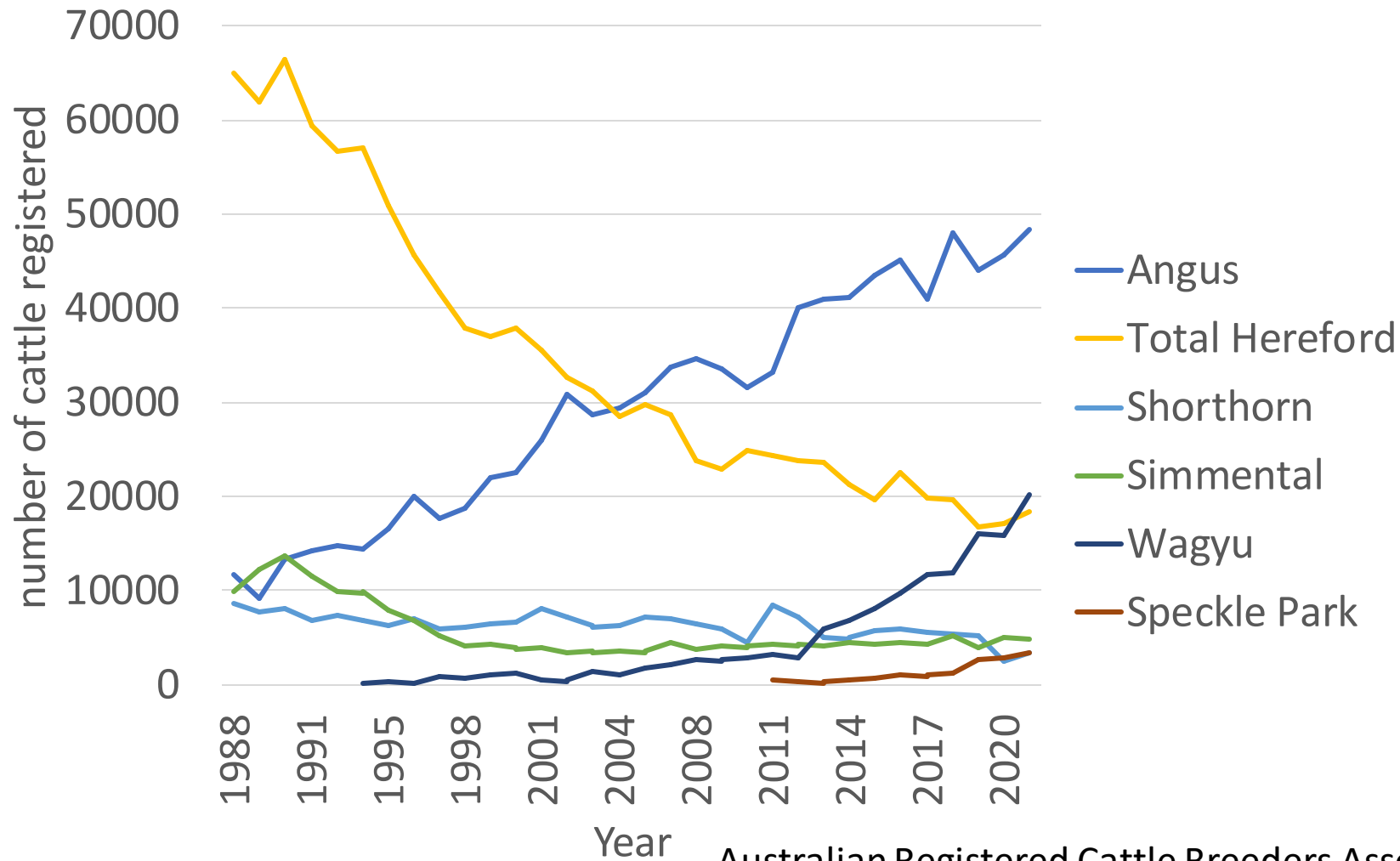
Cross-breeding research was hot in Canada as well



Roy Berg, a pioneer in the cattle industry, surrounded by animals that represented his passion. Roy Berg, a pioneer in the cattle industry, surrounded by animals that represented his passion. Photo: Courtesy Ruth Ball photo: Courtesy Ruth Ball

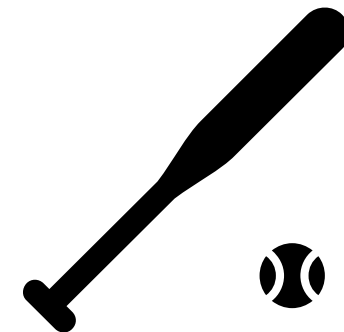


The Breeds they are a changin



Australian Registered Cattle Breeders Association 2023

- Do we provide good tools to help with this selection?



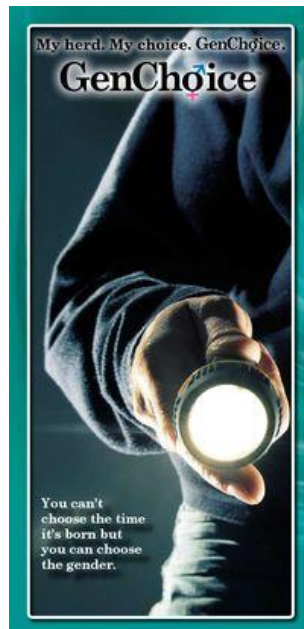


There is no clearer signal than at POS

Producers may not know what their true costs are, but they all know what they sell their calves for.

This influences selection

Everything old is new again



Everything old is new again



Beef Breed



Dairy Breed

Time to consider the other
 $\frac{1}{2}$ of the genome?

Everything old is new again



Where is the rest of the profit equation?

Such as Carcass ie. Marbling

Trait	Ayrshire	Holstein	Jersey
Milk	0.74	0.54	0.72
Fat	0.89	0.76	0.85
Protein	0.87	0.79	0.85
Conformation	0.36	0.43	0.10
Mammary System	0.31	0.49	0.16
Feet & Legs	0.40	0.27	-0.16
Dairy Strength	0.27	0.09	0.12
Rump	0.00	-0.03	-0.03
Methane Efficiency		0.06	
Feed Efficiency		0.06	
Body Maintenance Requirements		-0.22	
Herd Life	0.29	0.57	0.00
Mastitis Resistance	-0.09	0.35	-0.02
Metabolic Disease Resistance	-0.09	0.30	0.02
Lactation Persistency	0.28	0.19	0.42
Daughter Fertility	-0.09	0.41	0.20
Milking Speed	0.07	0.06	0.29
Milking Temperament	0.17	0.20	0.20
Calving Ability	0.19	0.38	-0.09
Daughter Calving Ability	0.11	0.61	0.22
Body Condition Score	-0.20	0.17	-0.30

Everything old is new again



Beef Breed



Dual Purpose Breed



Twice as good and twice as many



Theriogenology

Volume 31, Issue 1, January 1989, Page 206



The production of twins in beef cattle utilizing embryo transfer technology

W.H. Johnson¹, W.G. Etherington¹, E.P. de Rose², J.W. Wilton², N.C. Savage¹

¹ Department of Population Medicine University of Guelph Guelph, Ontario, Canada N1G 2W1

² Department of Animal Science University of Guelph Guelph, Ontario, Canada N1G 2W1

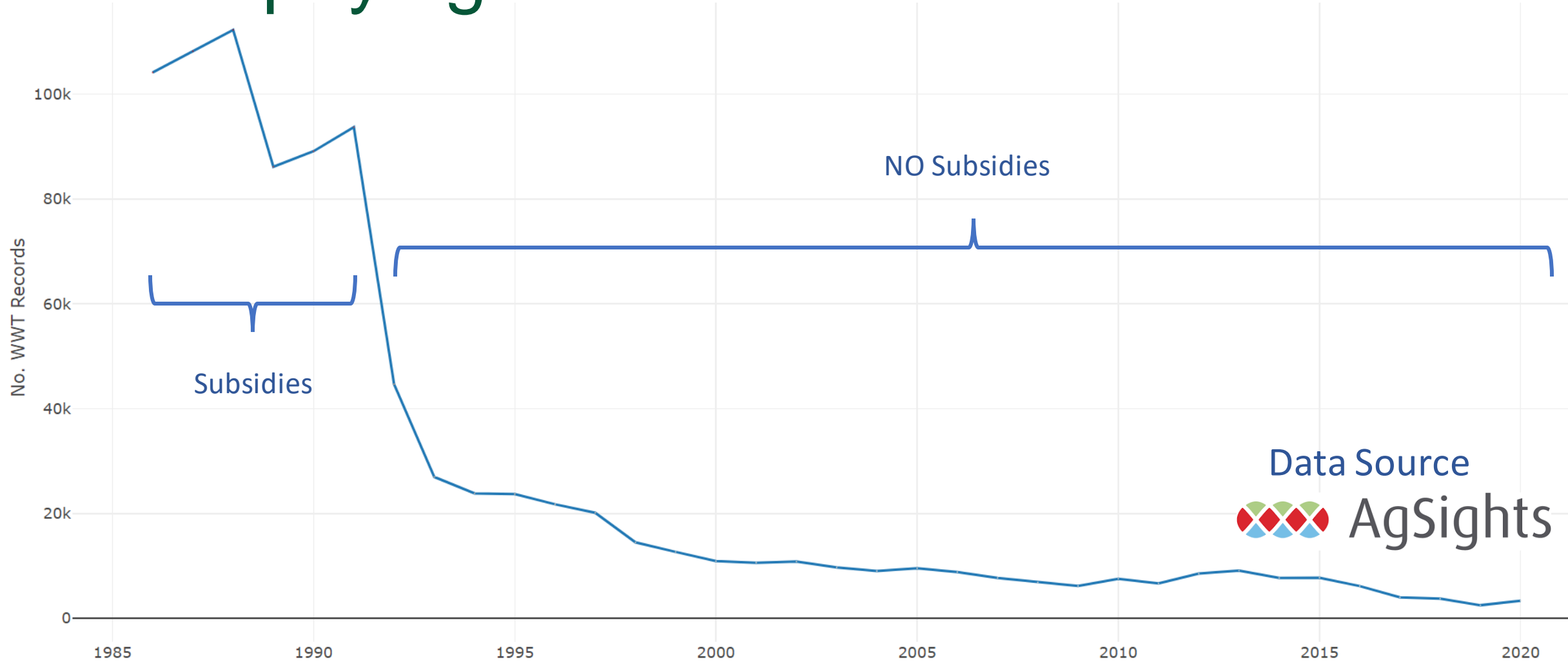
Dual Purpose Breed

Halve your Mothers
methane debt

A Career like Gump

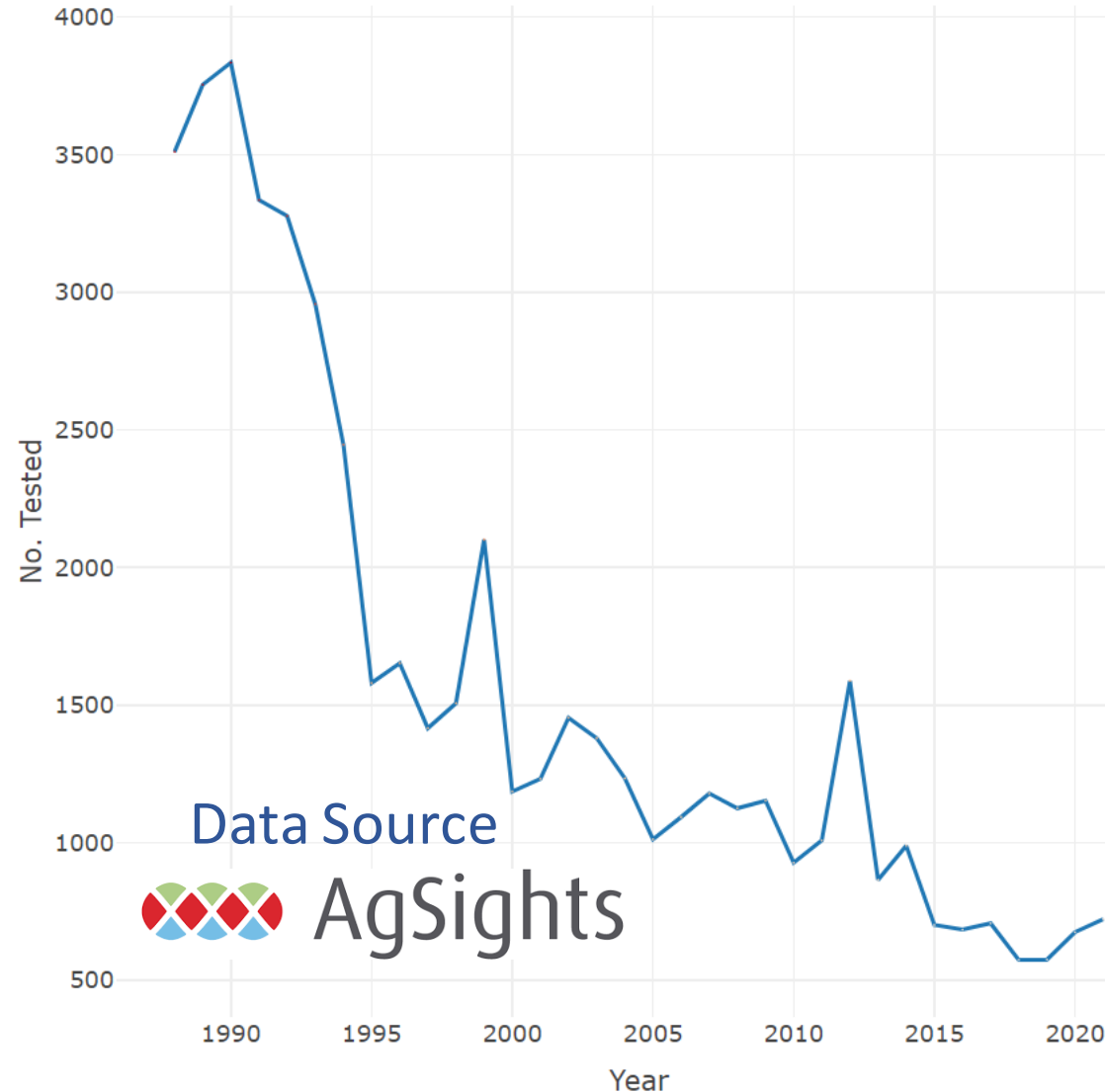


Does paying for measurements work?



Example of paying ON beef farmers to record weaning weights in the late 80s and early 90s

Paying for measurements post-weaning doesn't work either.



- Subsidies for Performance testing bulls did not have a lasting impact
- Ontario Bull Evaluation was world leading
 - Ultrasound
 - Feed Intake
 - Economic Indexes

AgSights

CREATING A Seamless Chain of Information FROM FARM TO FORK



Looking for the best way to increase productivity without increasing overhead?

Want to ensure food safety and consumer trust while adding value to your product?

AgSights

bioLinks is here to offer a simple end-to-end solution for all of your inventory and sales management needs!

What is bioLinks?

bioLinks is an anytime, anywhere, inventory and sales software system designed to help small to medium-sized retailers and meat processors add value by gaining more consumer trust, efficiencies and productivity



Promote food safety, information flow and grow your business.

Now a company that is more than just genetic improvement

The USA offers a significant market for Canadian breeders

Breeders wanted numbers comparable with the US market





\$Profit: A Game Changer in the Seedstock Industry

In today's cattle business, it's easy for producers to get overwhelmed with a large volume of data, some of it meaninglessly created under artificial seedstock conditions.

Lee Leachman had a mission to change that....to simplify the selection process, and create a set of indexes that take into consideration the factors that make an impact on the rancher's bottom dollar, economic factors, and now even genomic predictions.

Informative SNP identified across Canada

Polymorphisms in the bovine leptin promoter associated with serum leptin concentration, growth, feed intake, feeding behavior, and measures of carcass merit

J D Nkrumah¹, C Li, J Yu, C Hansen, D H Keisler, S S Moore

Affiliations + expand

PMID: 15583038 DOI: [10.2527/2005.83120x](https://doi.org/10.2527/2005.83120x)

Abstract

Leptin is the hormone product of the obese gene synthesized and secreted predominantly by white adipocytes. It functions as a lipostatic signal regulating BW, food intake, energy expenditure, reproduction, and certain immune system functions. Although previous studies have identified

The leptin arg25cys affects performance, carcass traits and serum leptin concentrations in beef cattle

F. C. Buchanan¹, A. G. Van Kessel¹, Y. R. Boisclair², H. C. Block¹, and J. J. McKinnon¹

¹Department of Animal and Poultry Science, 51 Campus Drive, University of Saskatchewan, Saskatoon, Saskatchewan, Canada S7N 5A8 (e-mail: fiona.buchanan@usask.ca); and ²Department of Animal Science, Cornell University, 259 Morrison Hall, Ithaca, NY, 14853-4801 USA. Received 10 August 2006, accepted 24 January 2007.

Buchanan, F. C., Van Kessel, A. G., Boisclair, Y. R., Block, H. C. and McKinnon, J. J. 2007. **The leptin arg25cys affects performance, carcass traits and serum leptin concentrations in beef cattle.** *Can. J. Anim. Sci.* **87**: 153–156. A single nucleotide polymorphism (SNP) in the bovine leptin gene has been associated with carcass traits and elevated gene expression. To examine the relationship between leptin genotype with serum leptin concentration and carcass traits, blood samples were collected 24 h prior to slaughter in 89 head of cattle. Cattle were predominantly of Angus ($n = 26$), Hereford ($n = 31$) and Charolais ($n = 32$) breed types with approximately half homozygous for the T allele or the C allele. Cattle were limit fed to achieve 1 kg d^{-1}

Association of a single nucleotide polymorphism in the calpastatin gene with carcass and meat quality traits of beef cattle

F S Schenkel¹, S P Miller, Z Jiang, I B Mandell, X Ye, H Li, J W Wilton

Affiliations + expand

PMID: 16424255 DOI: [10.2527/2006.842291x](https://doi.org/10.2527/2006.842291x)

Abstract

Calpastatin (CAST) is a naturally occurring protein that inhibits the normal tenderization of meat as it ages postmortem. A SNP was identified in the CAST gene (a G to C substitution) and genotyped on crossbred commercially fed heifers ($n = 163$), steers ($n = 226$), and bulls ($n = 61$) from beef feedlots, and steers ($n = 178$) from a University of Guelph feeding trial. The association of the CAST SNP with carcass and meat quality traits was studied. Carcass traits included fat, lean, and bone yield; grade fat; LM area; and HCW. Meat quality traits included marbling grade; i.m. fat content of LM; tenderness evaluation of LM (Warner-Bratzler shear force) at 2, 7, 14, and 21 d of postmortem aging; and tenderness evaluation of semitendinosus muscle at 7 d of postmortem aging. The mixed model used

Disruptive Innovation

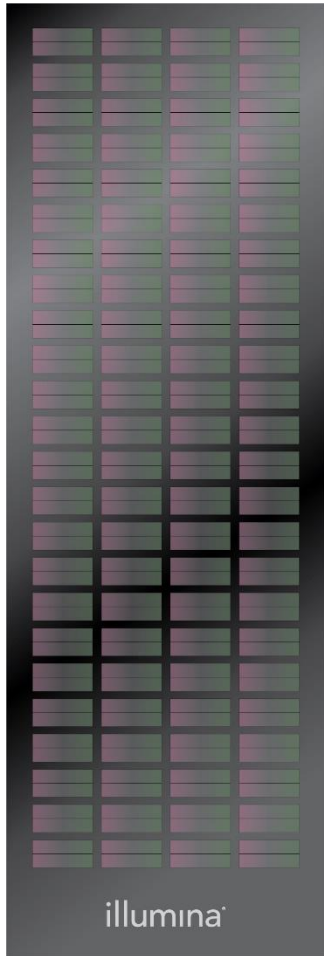


image provided by Illumina

The chip that changed the game

- 2005 – Can we make genomic selection work in livestock?
- 2009 – Can beef experience the genomic selection success seen in Dairy?
- 2023 - The above is history

Predicted a Doubling in Rate of Genetic Change

> [J Anim Breed Genet. 2006 Aug;123\(4\):218-23. doi: 10.1111/j.1439-0388.2006.00595.x.](#)

Strategy for applying genome-wide selection in dairy cattle

L R Schaeffer ¹

Abstract

Animals can be genotyped for thousands of single nucleotide polymorphisms (SNPs) at one time, where the SNPs are located at roughly 1-cM intervals throughout the genome. For each contiguous pair of SNPs there are four possible haplotypes that could be inherited from the sire. The effects of each interval on a trait can be estimated for all intervals simultaneously in a model where interval effects are random factors. Given the estimated effects of each haplotype for every interval in the genome, and given an animal's genotype, a 'genomic' estimated breeding value is obtained by summing the estimated effects for that genotype. The accuracy of that estimator of breeding values is around 80%. Because the genomic estimated breeding values can be calculated at birth, and because it has a high accuracy, a strategy that utilizes these advantages was compared with a traditional progeny testing strategy under a typical Canadian-like dairy cattle situation. Costs of proving bulls were reduced by 92% and genetic change was increased by a factor of 2. Genome-wide selection may become a popular tool for genetic improvement in livestock.



Dr. Larry Schaeffer - CGIL

DATA NOTE

Open Access



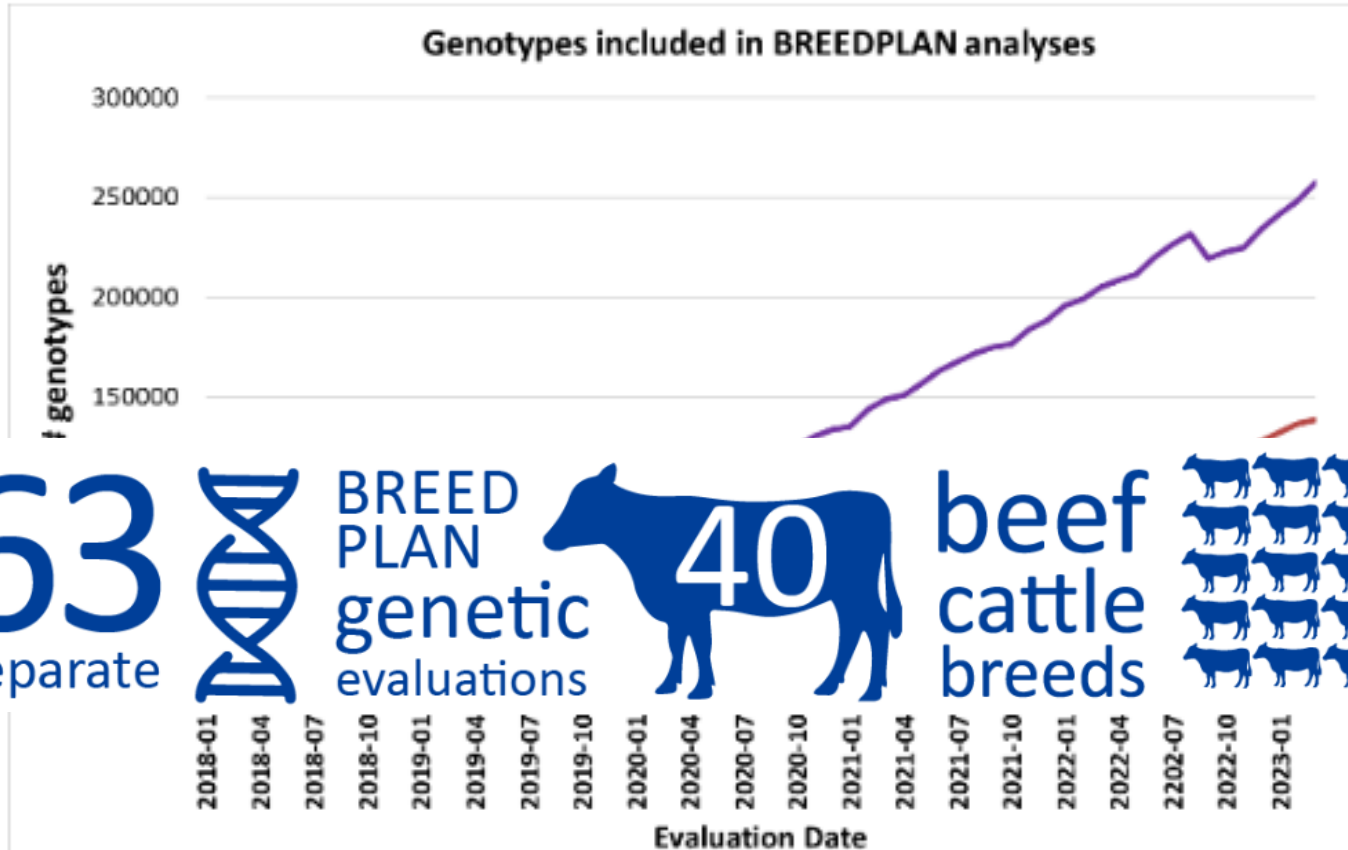
A large and diverse collection of bovine genome sequences from the Canadian Cattle Genome Project

Paul Stothard^{1*}, Xiaoping Liao^{1,2}, Adriano S. Arantes¹, Mary De Pauw¹, Colin Coros³, Graham S. Plastow¹, Mehdi Sargolzaei⁵, John J. Crowley¹, John A. Basarab^{1,6}, Flavio Schenkel⁵, Stephen Moore^{1,4*} and Stephen P. Miller^{1,5,7*}

Abstract

Background: The Canadian Cattle Genome Project is a large-scale international project that aims to develop genomics-based tools to enhance the efficiency and sustainability of beef and dairy production. Obtaining DNA sequence information is an important part of achieving this goal as it facilitates efforts to associate specific DNA differences with phenotypic variation. These associations can be used to guide breeding decisions and provide valuable insight into the molecular basis of traits.

Over 500,000 genotypes in BREEDPLAN analyses



approximately

63
separate



BREED
PLAN
genetic
evaluations



beef
cattle
breeds



14
million
animals

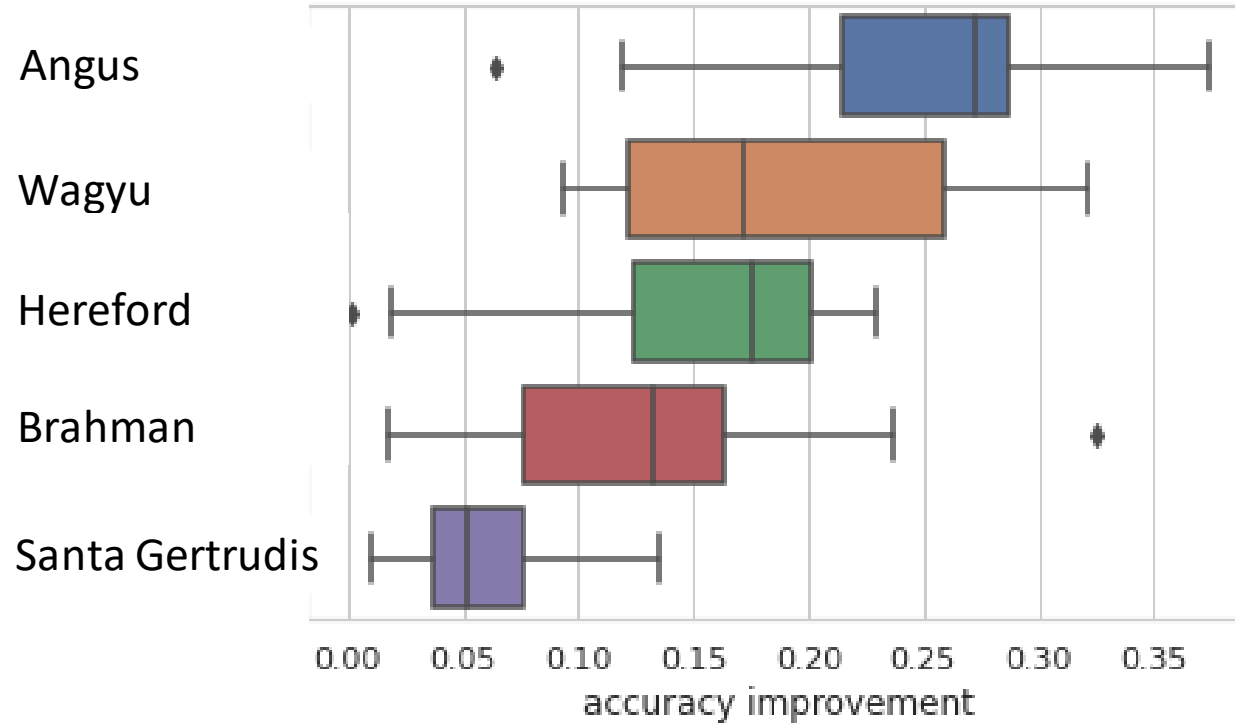


across
14
countries

— Angus — Brahman — Hereford — Wagyu — Santa

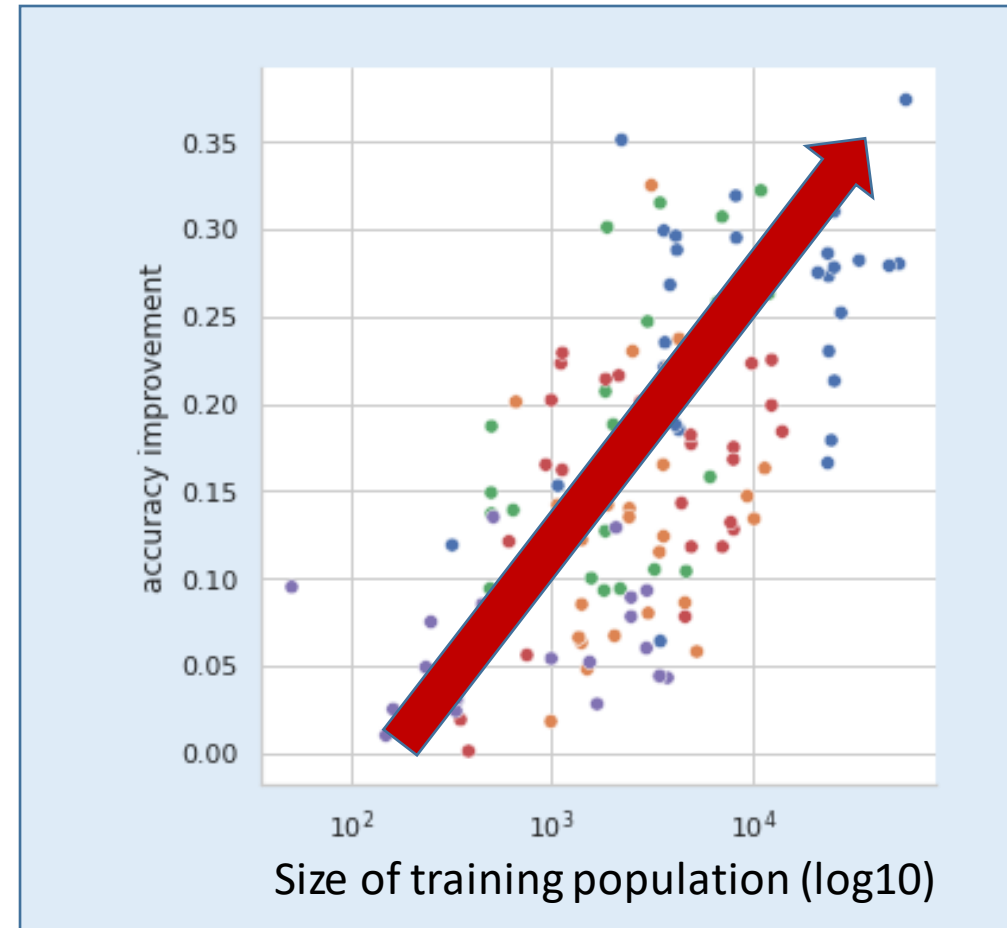
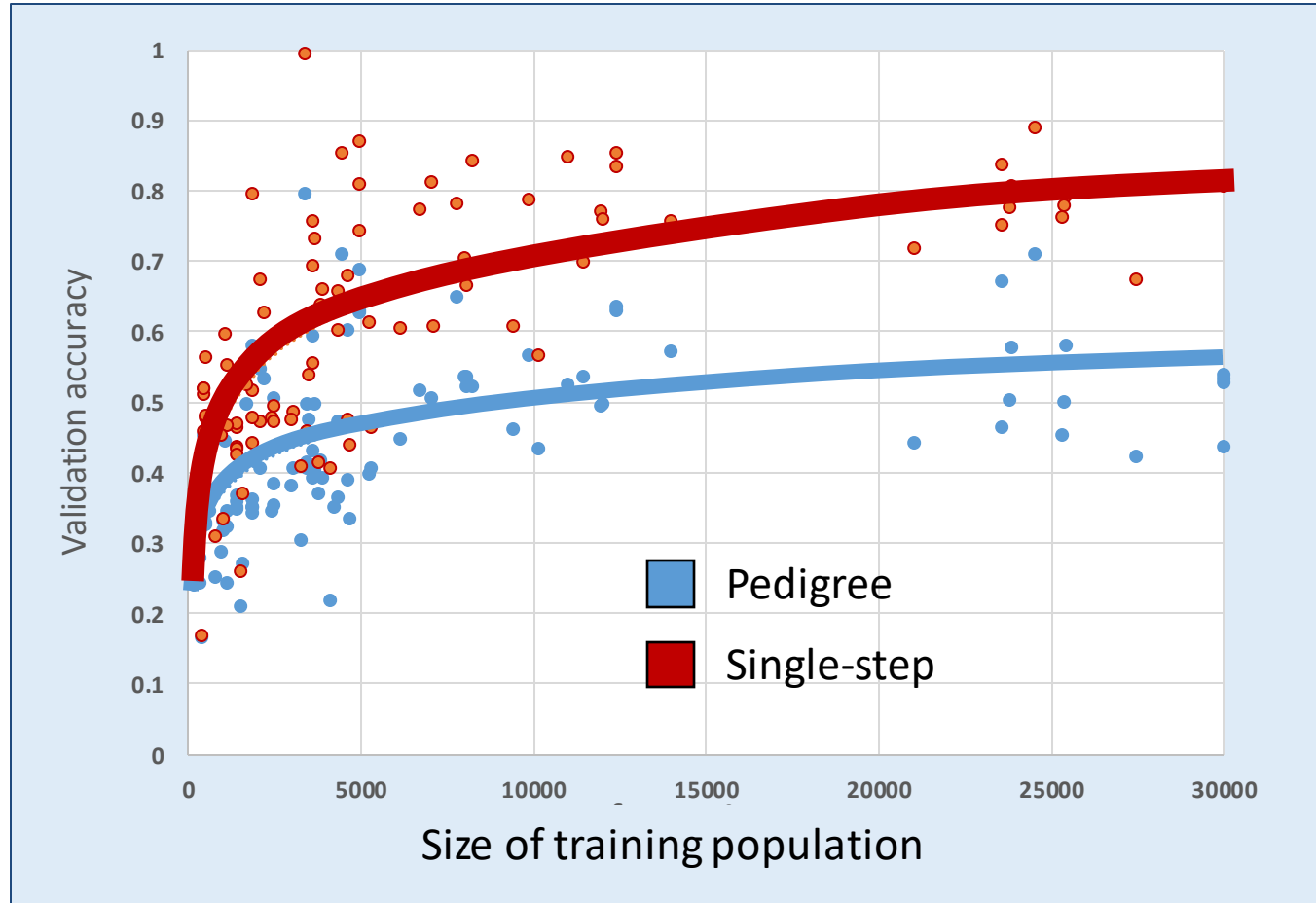


Average selection accuracy - all breeds & EBVs



single-step increasing EBV accuracies all breeds

Size of genomic reference – all breed & EBVs

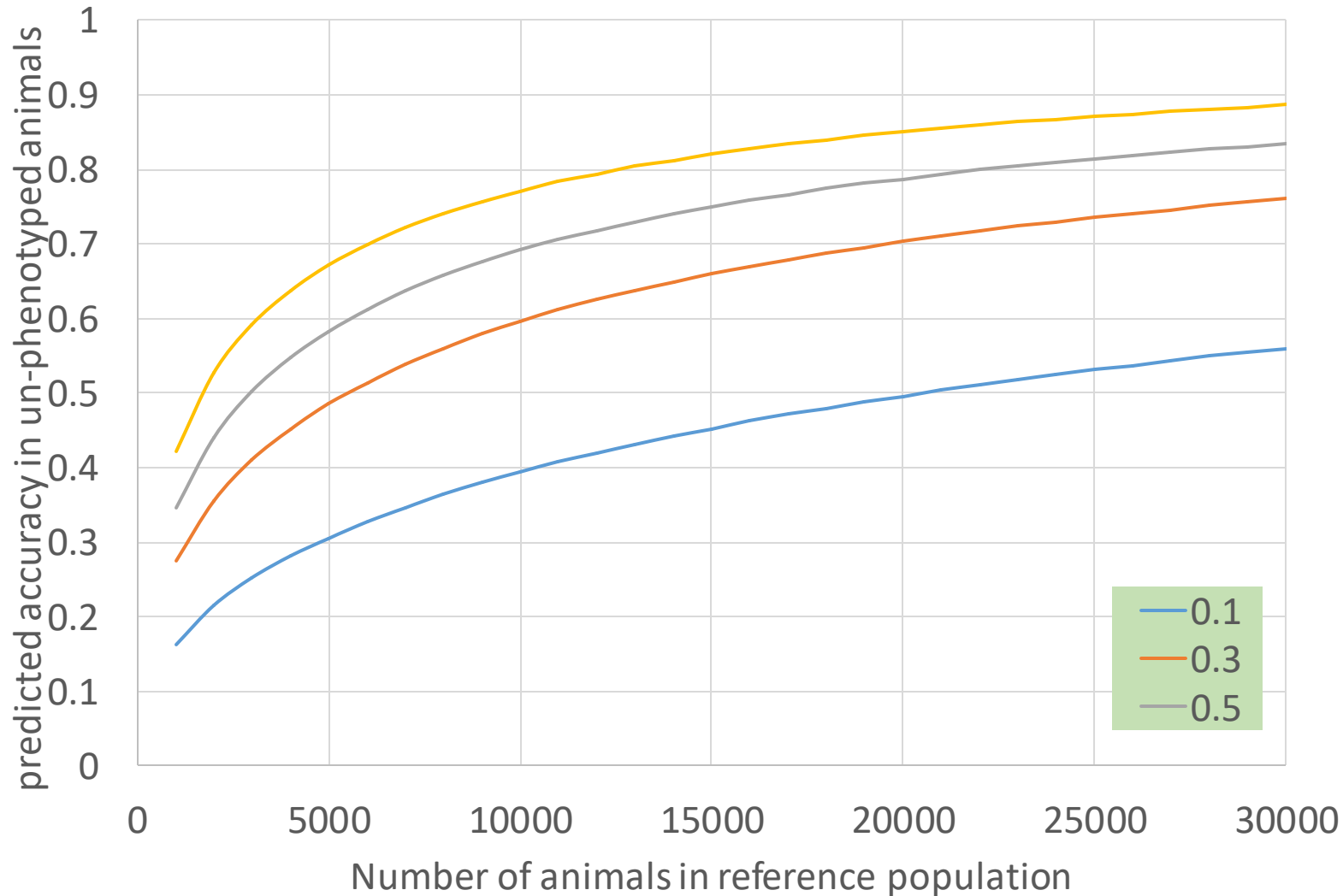


Bigger reference more accuracy from single-step

D. Johnston et al. AAABG 2023



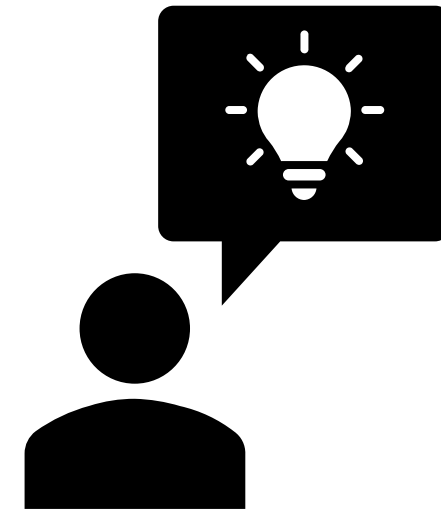
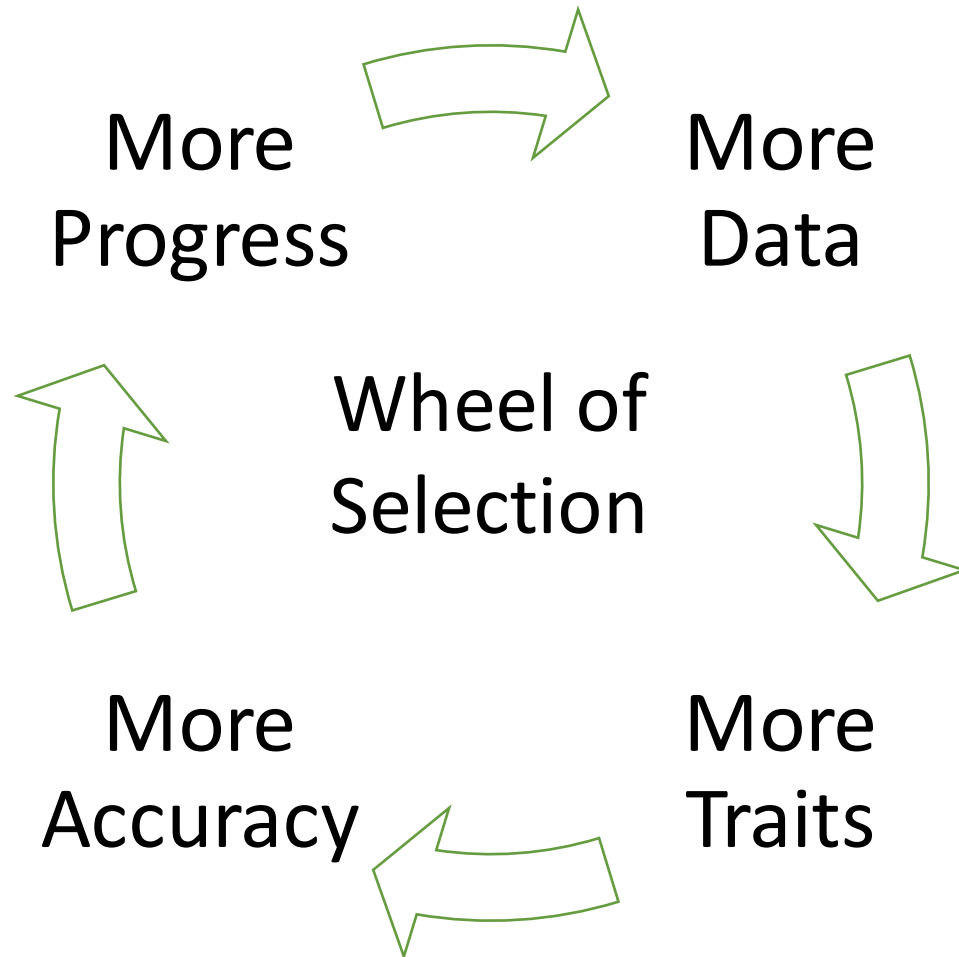
More is More



Genomic selection accuracy continues to increase with more data

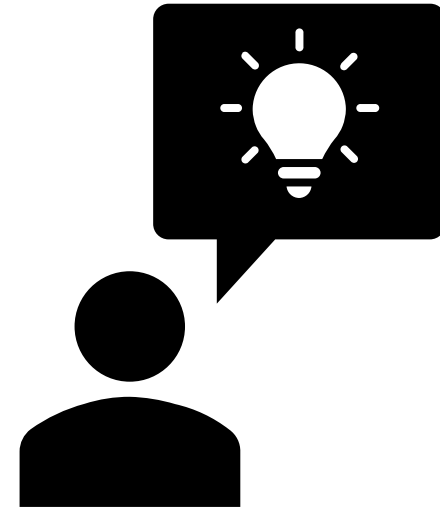
Universal Truth in Beef cattle selection

Data = Accuracy = Progress

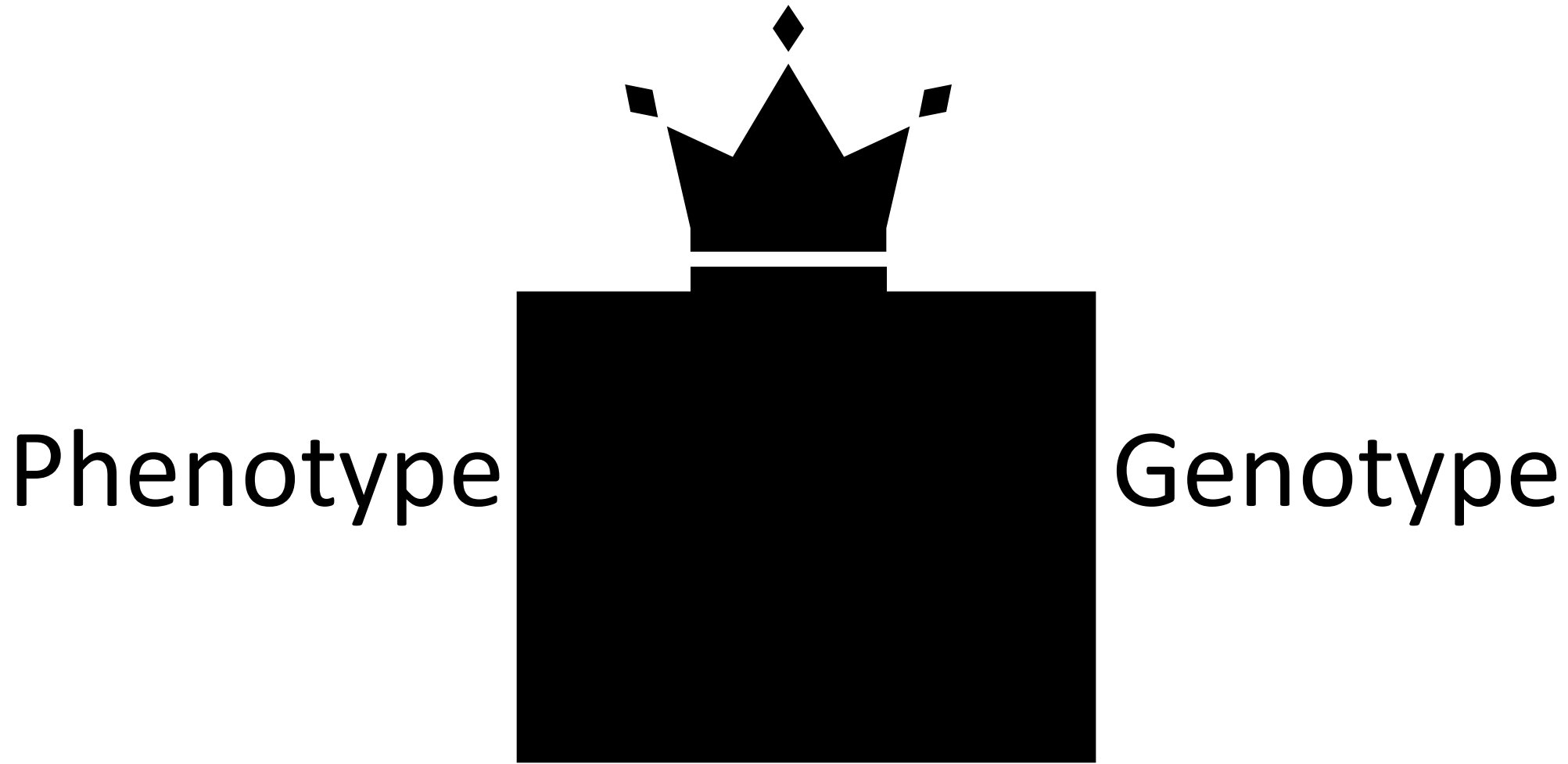


Universal Truth in Beef cattle selection

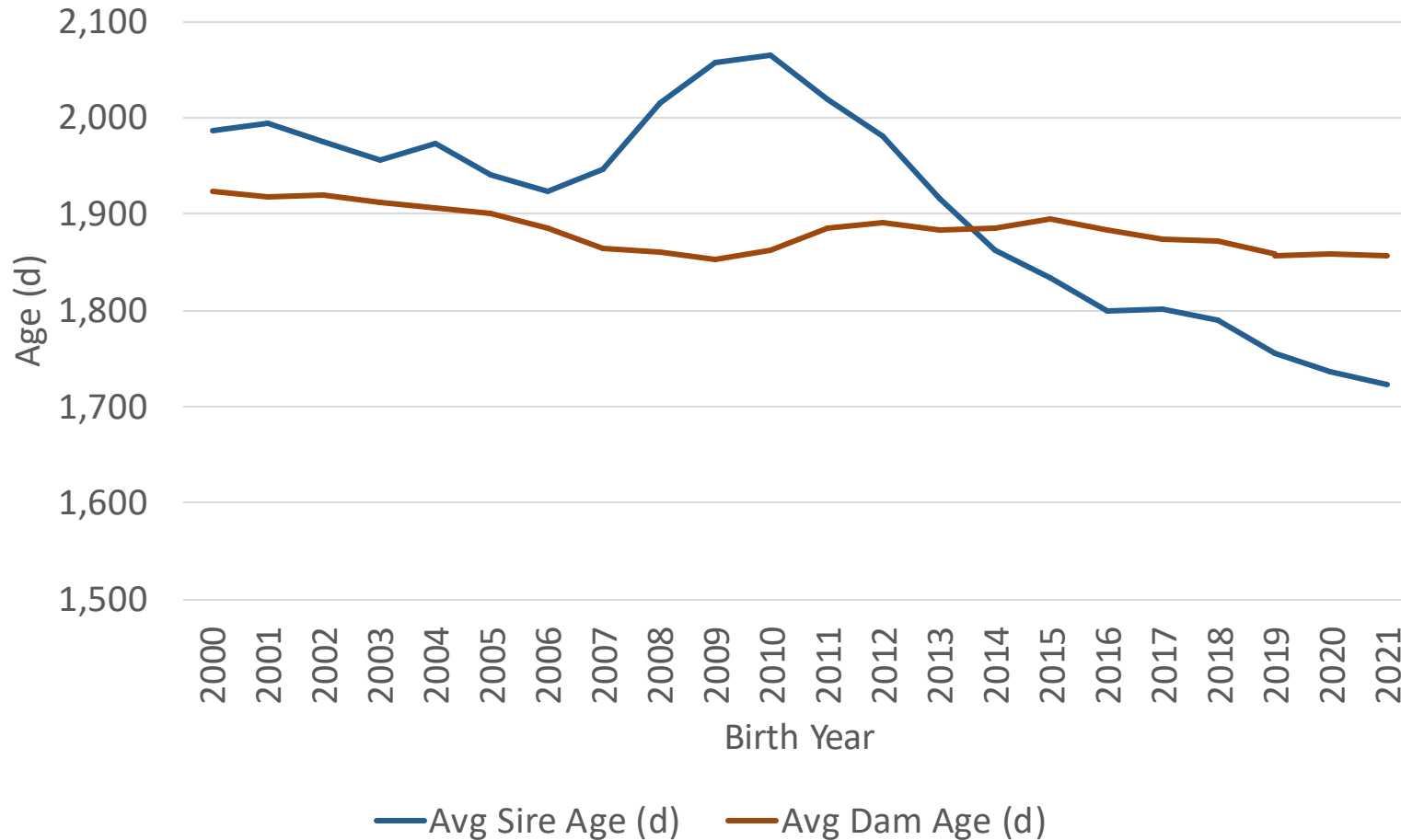
“Without data, we can do nothing.”



A BLUPers view on the Monarchy



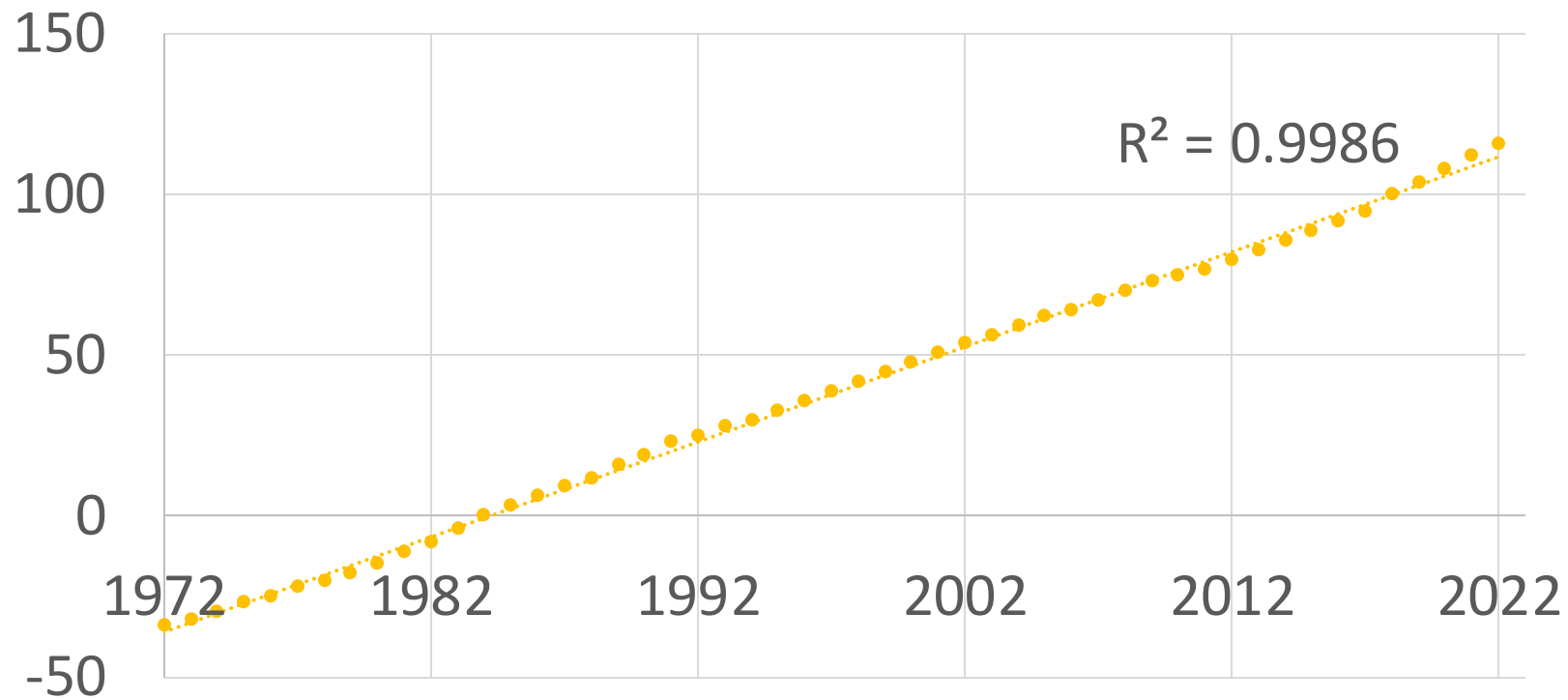
Average age of parents declining is a symptom of earlier selection with genomics



Declining age most dramatic in sires.

We can make them bigger

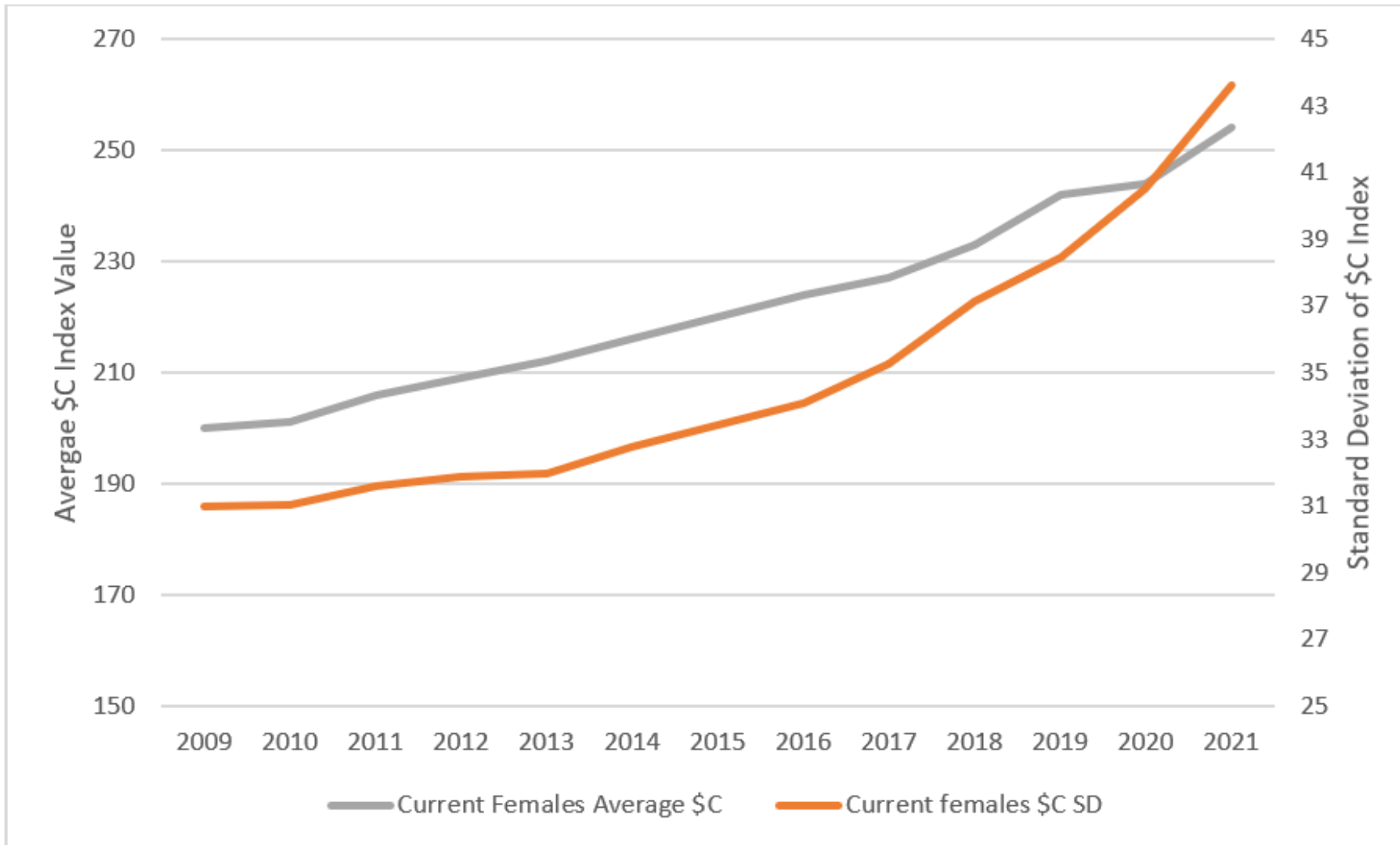
YW



- No matter what the technology Angus EPD increase by about 3lb/year
- 2050 YW AVE EPD = 200

• YW • Linear (YW) Genetic Trends from AAA.org

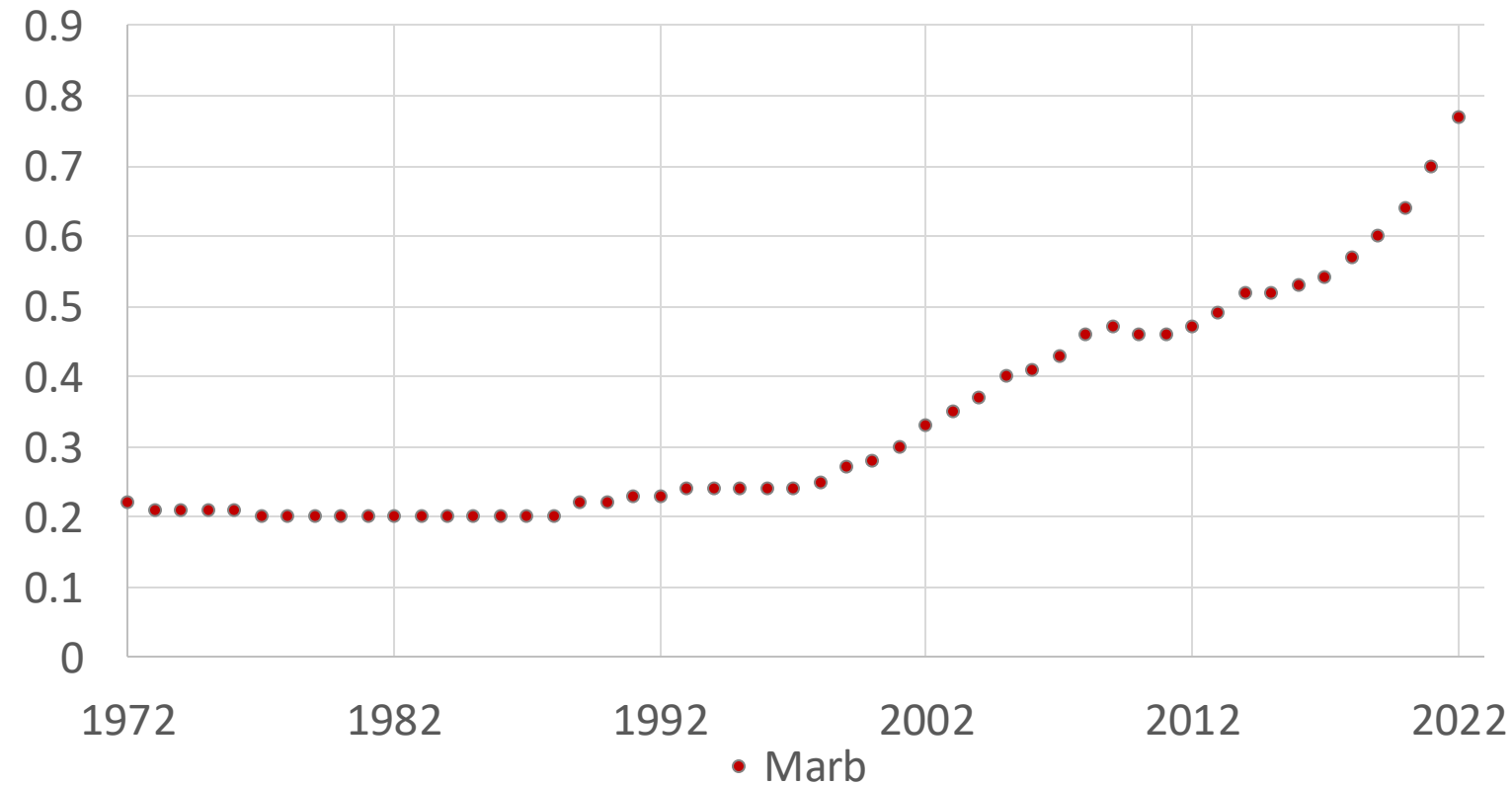
Cows are increasing in merit with greater differential identified



Tools are identifying Elite females to target for advanced breeding technologies such as ET

Marbling Trend is kicking up

Marb

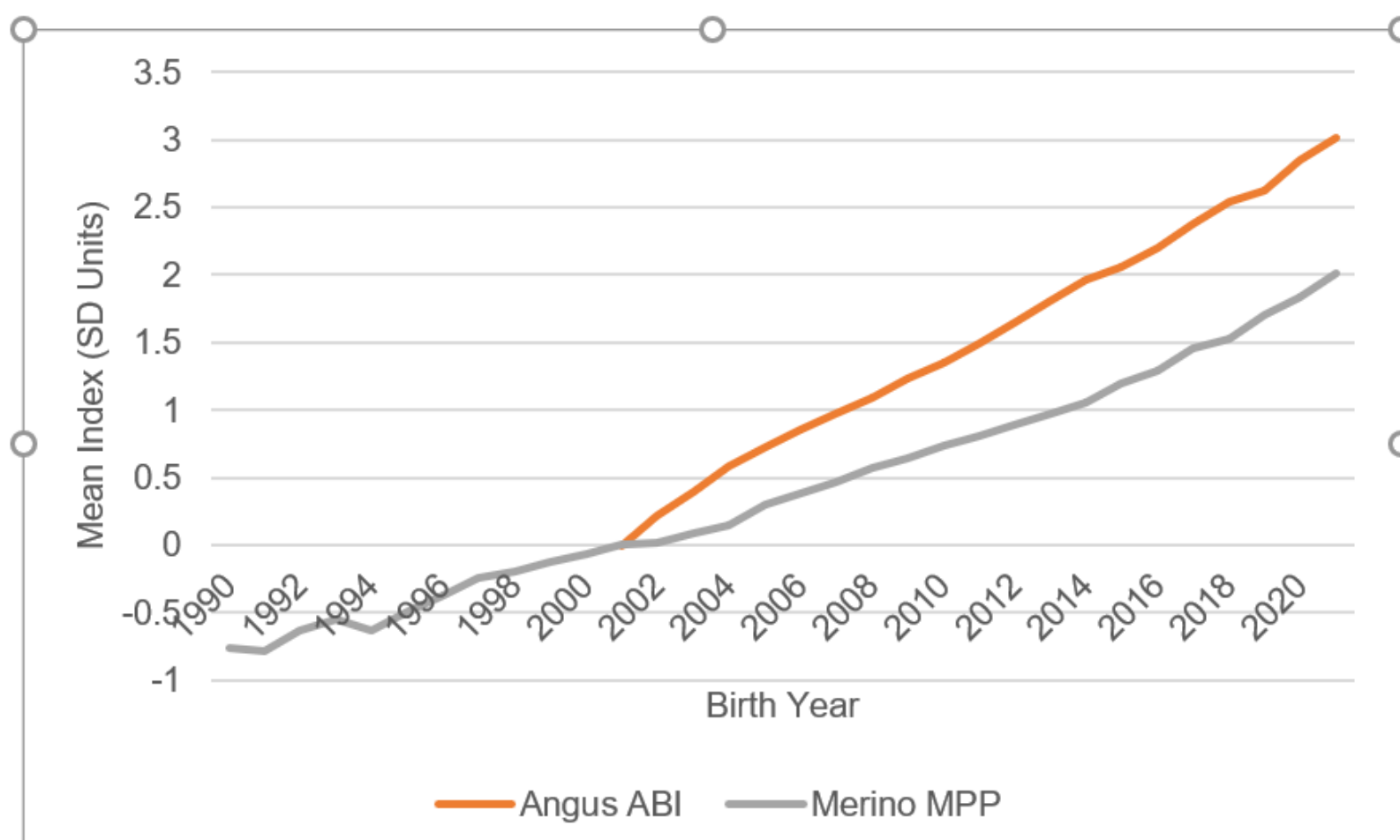


2018 to 2022 trend is double the previous 5 years

Angus.org



Increasing Trends post Genomics

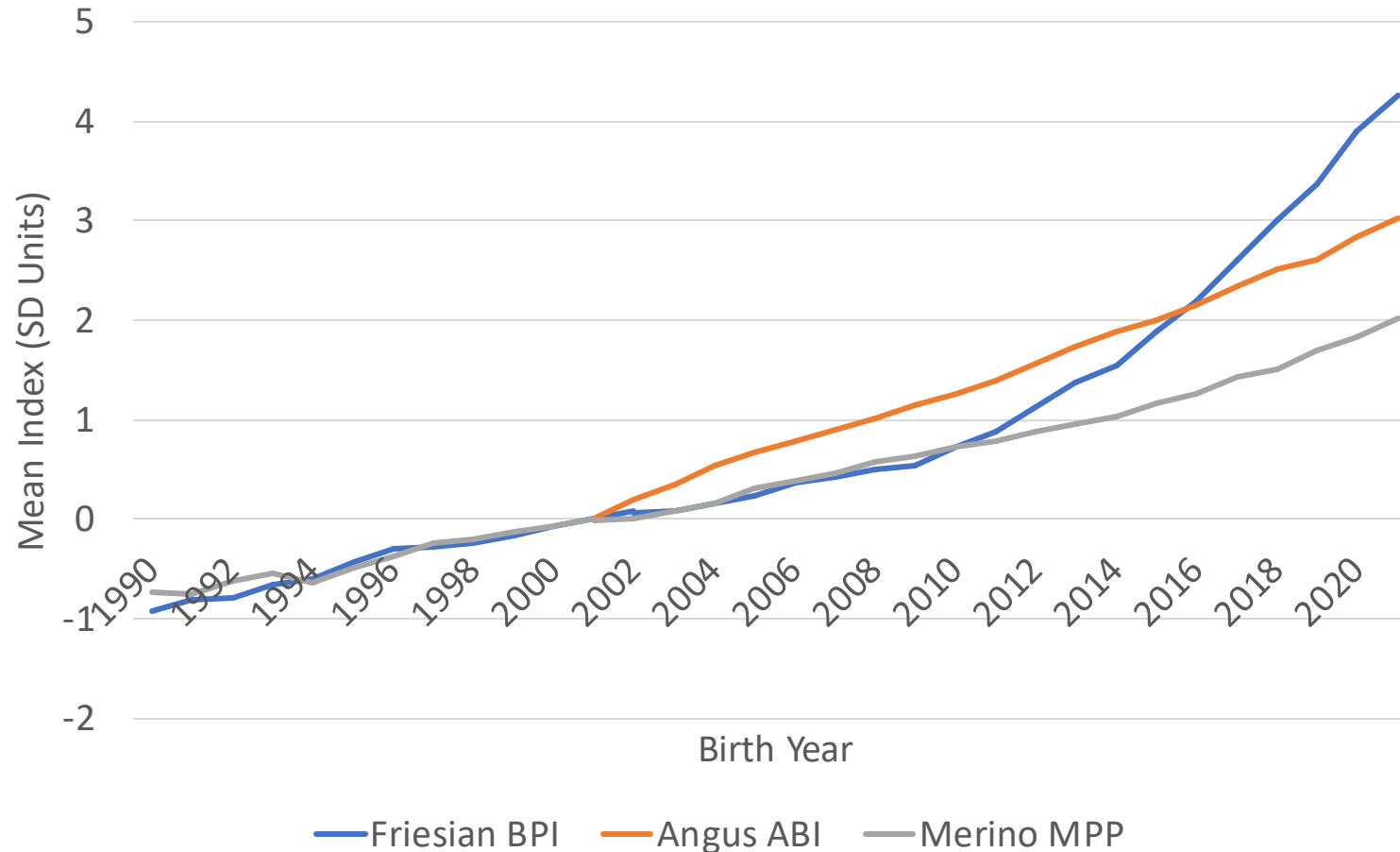


~50% increase in Merino
~20% increase in Angus

Source: Datagene, Angus Australia and Sheep Genetics (2023)



Increasing Trends post Genomics



- ~50% increase in Merino
- ~20% increase in Angus
- 4 fold increase in Friesians

Source: Datagene, Angus Australia and Sheep Genetics (2023)

Miller AAABG 2023



Final Thoughts

- The 'big change' has happened and it is genomic selection
- The black box reigns is powerful
- Limiting factor is data – it is a scramble for data to get ahead
- The recipe is clear – more data, more accuracy, more progress – just about any trait

