MOOTOPIA: AN ANIMAL BREEDERS WISH LIST FOR THE BEEF INDUSTRY

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THE THINGS YOU DO THAT DRIVE ME BSC ON A SCAFFOLD OF EDUCATIONAL MATERIAL

A guy you might love to hate (or hate to love?)

Overall Thesis

- The beef industry is ill positioned to take advantage of emerging genetic selection tools. This poor strategic position is due to cumulative mistakes and missed opportunities over the past ~70 years. My hypothesis is that this situation will not be corrected unless, almost by chance, corrections are dictated by outside forces.

- Nonetheless I feel an obligation to opine.

Crossbreeding . . . Again

- There is no logic in providing additional examples of the benefits of exploiting non-additive genetic effects.
- However, the lack of industry-wide structured crossbreeding systems creates tremendous inefficiency.
- I am unaware of any breed association that truly promotes crossbreeding.
  - Only promoted in the context of using their own germplasm.
  - Most recognized crossbreeding as a means of finding a niche as one breed garnered the majority of market share.

Feeder Calves Should be Crosses

- Some are not and a meaningful fraction of those that are were not constructed with intelligent design.
- Given feeder calf production is largely a product of land ownership, I see no immediate solution to this issue.
  - Lots of small herds
  - These produce a large fraction of the total feeder calves
  - Household income not dependent on cattle production
- Impactful consolidation in the cow/calf sector is unlikely, but extreme revenue discounts could help the issue.
  - Need to correctly, and objectively, value feeder cattle
  - This has the potential to engage all sectors in NCE

Raising Replacements
Small Herds

- A small number of replacements makes managing heifers as a separate group challenging
- Night calving—Is it worth it to spend hours looking over a few heifers?

Producing Maternal Replacements

- "Maternal" is more than "I didn't select for carcass"
- Culling open cows is not selecting for fertility
  - Improvement comes primarily from bull selection
- Presumably larger ranches
- Preferably composite cows
- Produce bred cows (2nd or later parity).
  - F1 cows bred to terminal bulls

Raising Replacement Heifers Small Herds

- Fact is these herds produce a large fraction of all calves in the U.S.
- It seems logical that these herds could increase profit if they purchased replacement females
  - Females bred for 2nd (or later) calf
- Bulls selected for terminal traits and cows selected for maternal traits
  - True complementarity

Parsing Maternal v. Terminal

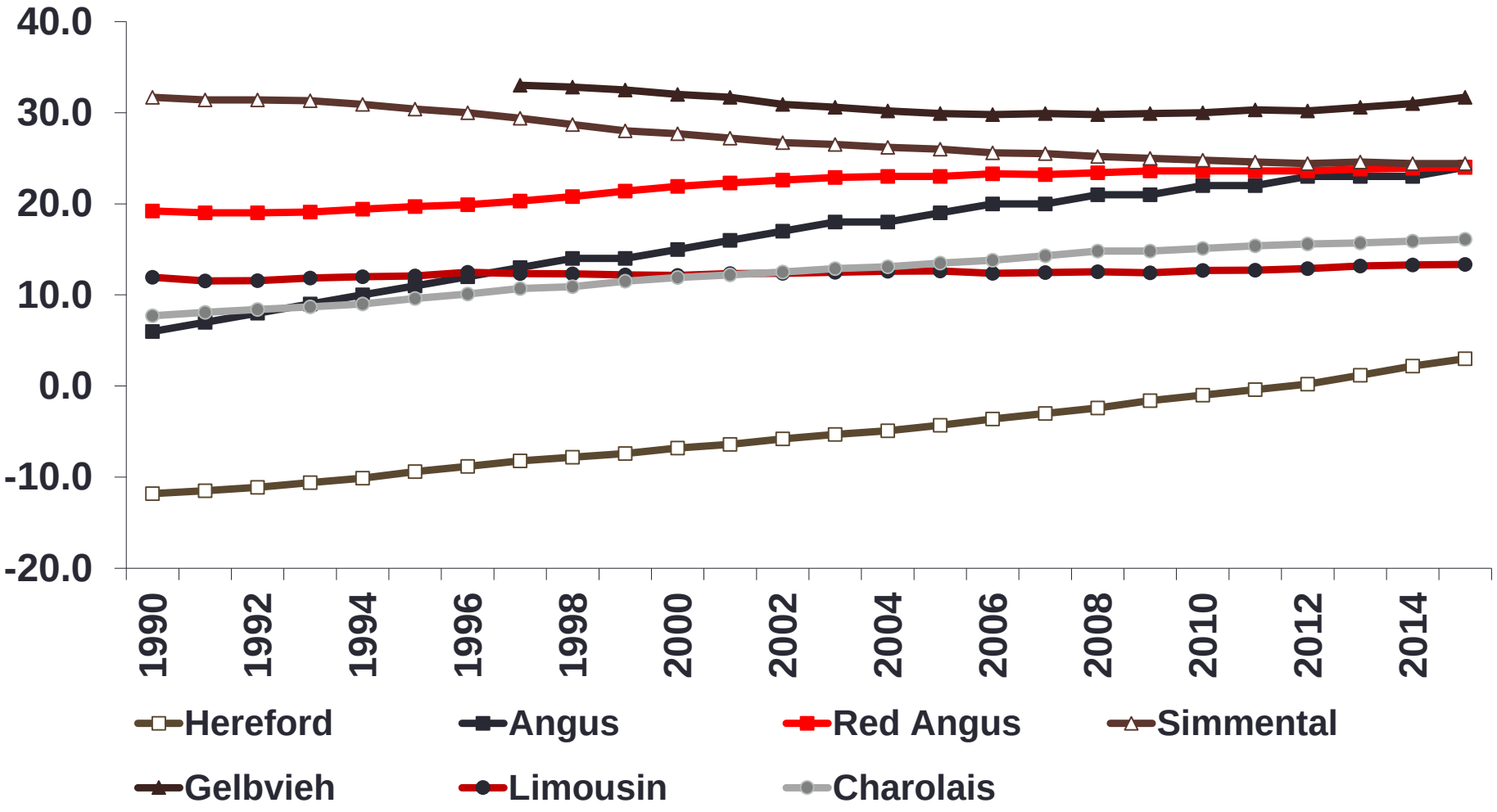
- Heavier calves and more product from smaller cows
  - Reduce industry-wide feed intake by smaller cows
- Less calving difficulty industry-wide
  - Maternal producers are the only ones calving heifers
- Increased uniformity industry-wide
  - Common objectives
- Focus objectives
  - Only trying to do one thing

Genetic Trends Trick Us

- Genetics trends across the “Big 7” suggest we are doing a ”good job”.

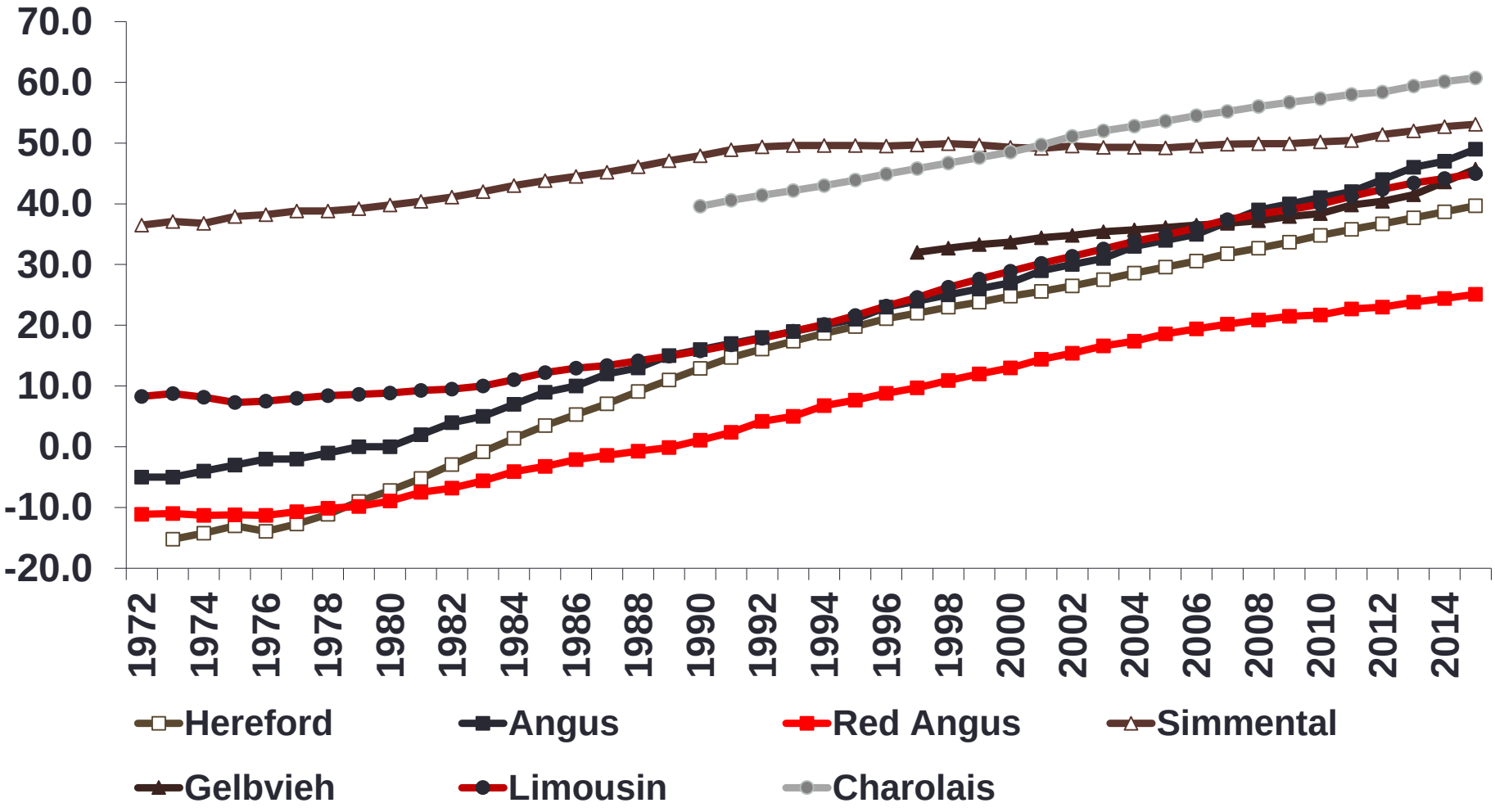
- What is our job?

Genetic Trends for Maternal Milk, lb



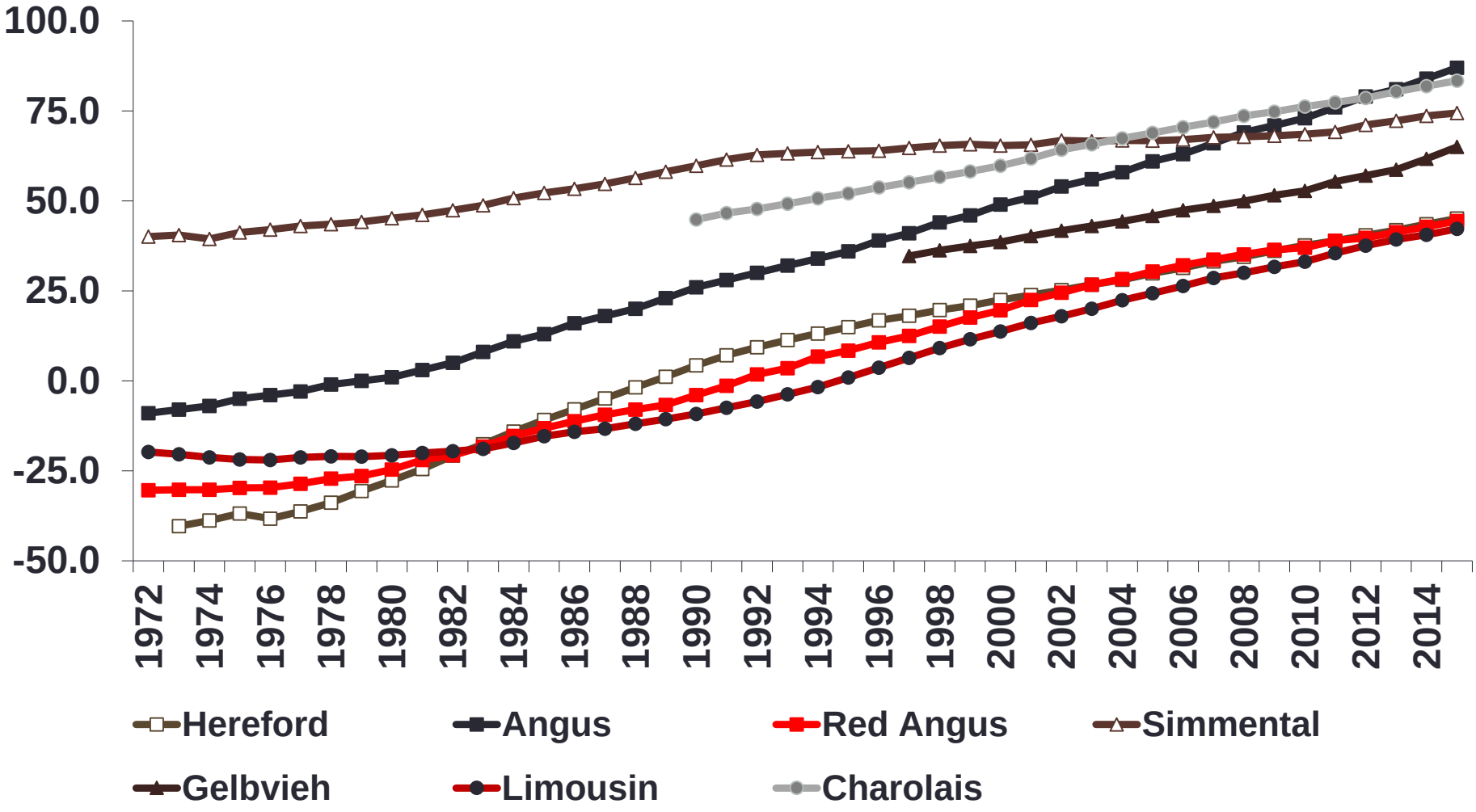
Adapted from Spring 2016 Genetic Trends from Breed Associations and 2016 AB-EPD factors

Genetic Trends for Weaning Weight, lb



Adapted from Spring 2016 Genetic Trends from Breed Associations and 2016 AB-EPD factors

Genetic Trends for Yearling Weight, lb



Adapted from Spring 2016 Genetic Trends from Breed Associations and 2016 AB-EPD factors

What Trends Are Important?

- Producer level profitability attributable to genetics
  - More specifically attributable to genetic gain in the nucleus.
  - For now, that is API and TI if you are a Simmental breeder.
  - Avoid desired gains indices.

Why Do We Need Selection Indexes?

"There is no easily accessible, objective way for breeders, particularly breeders in the beef and sheep industries where ownership is diverse and production environments vary a great deal, to use these predictions intelligently."

-- R. M. Bourdon, 1998

Simulation Framework

- Stochastic Model
  - Allows for random variation in multiple traits
  - Variation based on fluctuation in historical data
- Simulated base herd
  - Multiple iterations

$$b = P^{-1}Gv$$

Economic values
from simulation

Terminal or Maternal?

Terminal

- $B, $F, $G (Angus)
- TI (Simmental)
- CHB$ (Hereford)
- MTI (Limousin)
- EPI and FPI (Gelbvieh)
- Charolais
- GridMaster (Red Angus)

Maternal

- $W, $EN (Angus)
- API (Simmental)
- BMI$, BII$, CEZ$ (Hereford)
- HerdBuilder (Red Angus)
- $Cow (Gelbvieh)

Improving Indices

- Improvement in current indices can be made by increasing the number of ERT that have EPD
  - Input traits
  - Fertility

Maternal Traits of Importance

- Female fertility
- Maternal calving ease
- Maintenance requirements*
- Longevity
- Maternal weaning weight (Milk)*
- Disease susceptibility
- Adaptation
- Temperament

Problem…

We do a very poor job of measuring (and valuing) input

Seedstock Selection Focused on Downstream Value

- Do we currently measure all traits that are economically relevant to the commercial industry?

- We need dense recording of additional phenotypes considering commercial phenotypes as the ERT (seedstock records are indicators).
  - Fertility
  - Carcass
  - Disease
  - Packing plant value

Commercial Data is Important

- Improvement in current indices can be made by increasing the number of ERT that have EPD
  - Input traits
  - Fertility
- Genomic selection in beef cattle will only be fully realized when we collect traits for which genomics could be most helpful.

Trait	Country[2]
Scrotal circumference	AU, NZ, SA, NA, AR, UK, IR, BR, FR, US, CA, ME
Days to calving	AU, NZ, SA, NA
Heifer pregnancy	US, VE, BR
Heifer calving success	FR
Age at 1st calving	IR, UK, BR
Calving interval	IR, DE, UK
Stayability/productive life	US, CA, VE, UK, FR, BR

Adapted from Johnston (2014).

People Just Don’t Understand

- Poor technology adoption is related to the sum of many underlying issues:
  - Genetic prediction seems opaque
  - Consultancy is often from sources other than what might be preferred
  - Commercial producers do not have the needed time to excel in all areas, and focus on day-to-day animal and financial management
  - Combining all partial solutions is a very cumbersome task
    - Breeding objective
    - Breeding system
    - Breed choice
    - Trait emphasis
    - Sire selection
    - And all need to contemplate that which is economical and possible given environmental constraints

Goal

- To develop a web-based decision support tool that combines all partial solutions towards providing sire selection recommendations based on relative economic value to a firm (producer).
- Furthermore, this tool would provide guidance in an economic framework relative to the value of added information.
  - Commercial phenotypes
  - Genomics

Overview

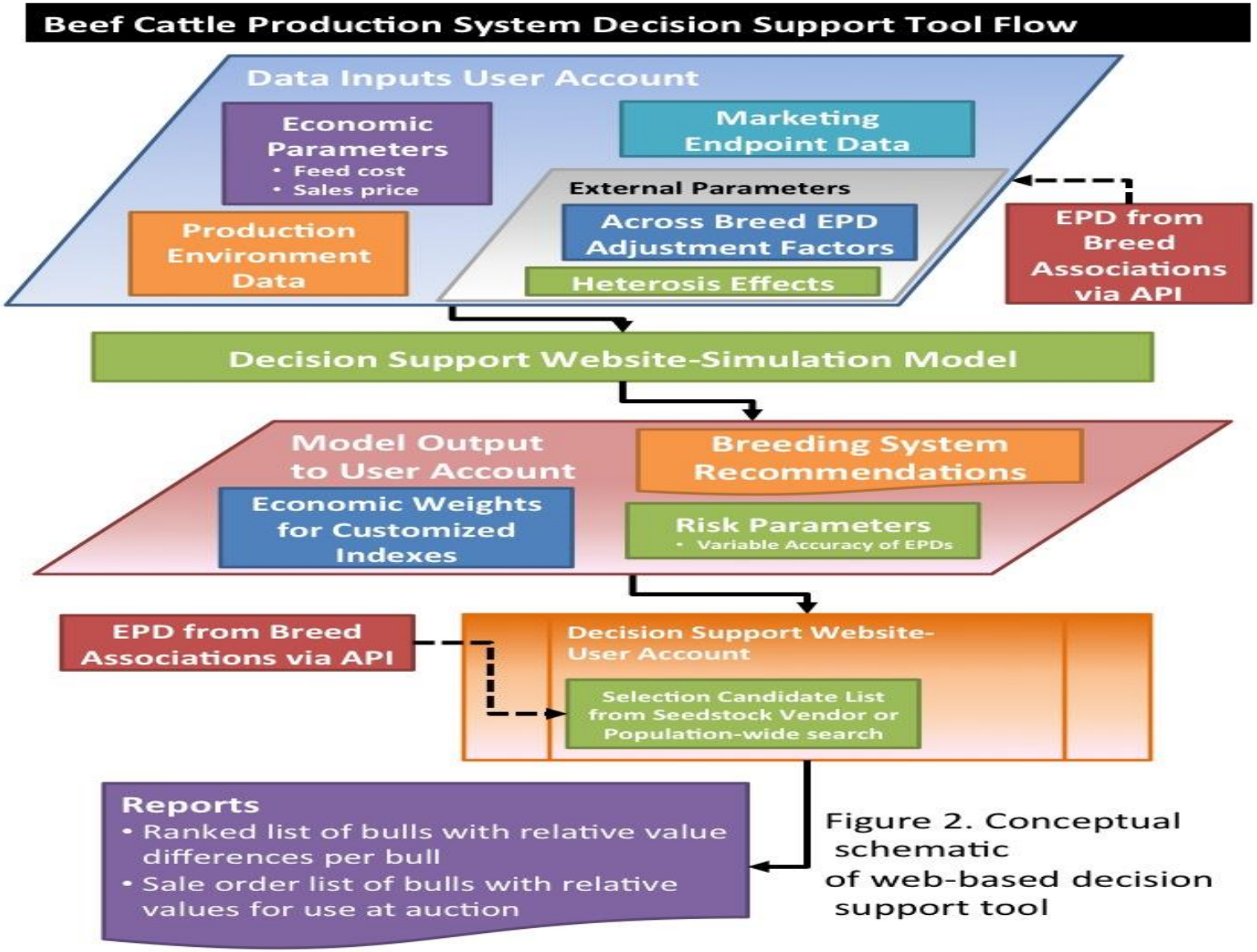


Figure 2. Conceptual schematic of web-based decision support tool

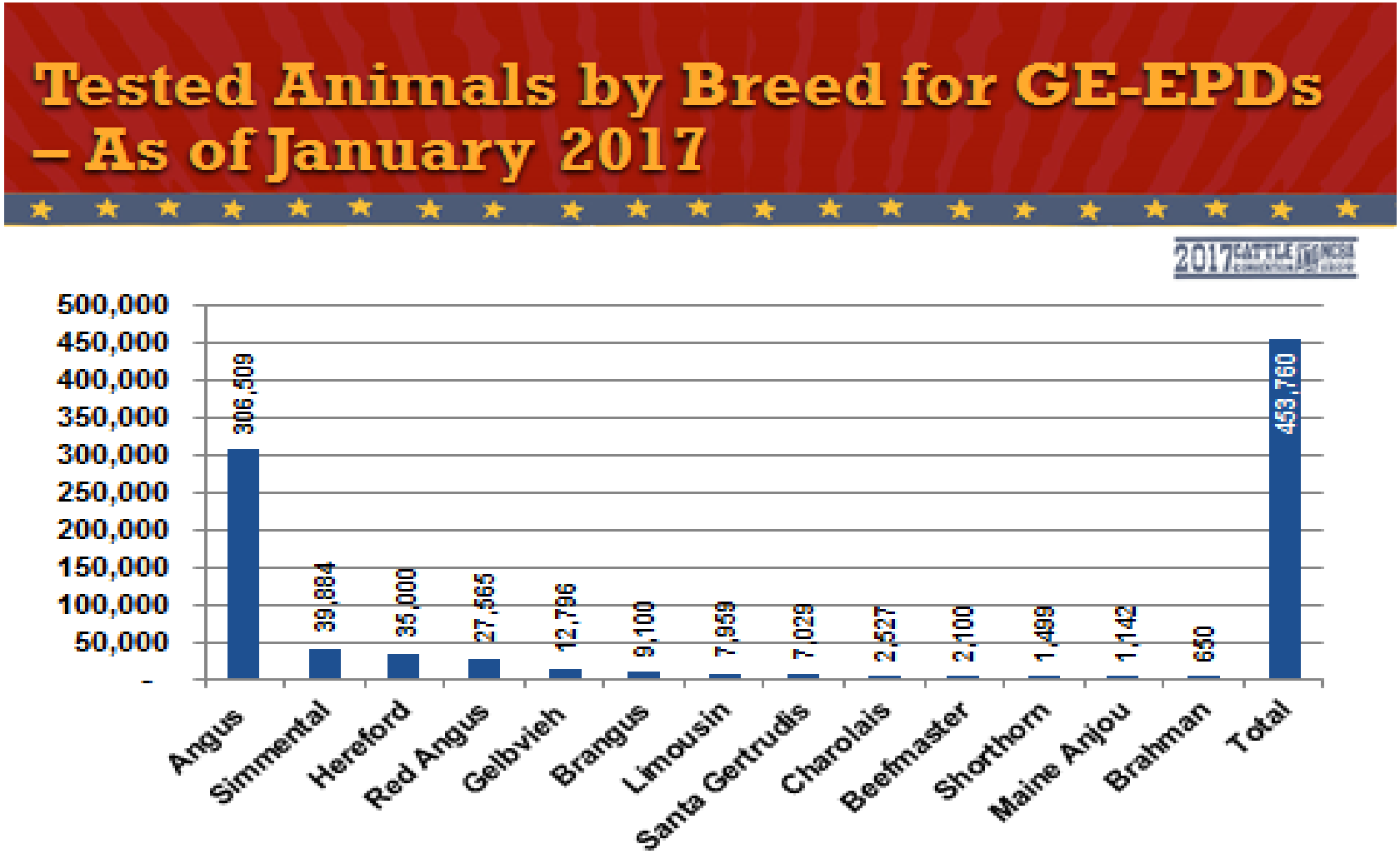
Tradeoffs

- Genotyping can increase the accuracy of EPD, but represents an additional cost above phenotyping.
- The accuracy of the decision (bull purchase) changes with additional information.
- The sparse phenotypes mentioned will be needed to fully exploit genomic investment.
- Quantifying this provides a feedback loop and pull through demand between commercial and seedstock assuming the price point is correct.

Benefits of Multi-breed NCE

- 1) Comparison of bulls from differing breeds
  - Commercial producers may wish to use more than one breed of sire
- 2) More complete (accurate) evaluation of the genetic merit of “composite” animals
  - Composite sires present an often easier to implement crossbreeding system for commercial producers
  - Ideally CG animals of differing breeds together

Current Genotyping Status



Slide provided by Kent Andersen

How are Genomic EPD Being Used?

- For selection?
  - If so, then you genotype every calf born
- For marketing?
  - Genotyping selected animals
  - Creates bias in two-step procedures
  - Reduces the amount of data such that GE-EPD may not be possible (or impactful) for maternal traits.

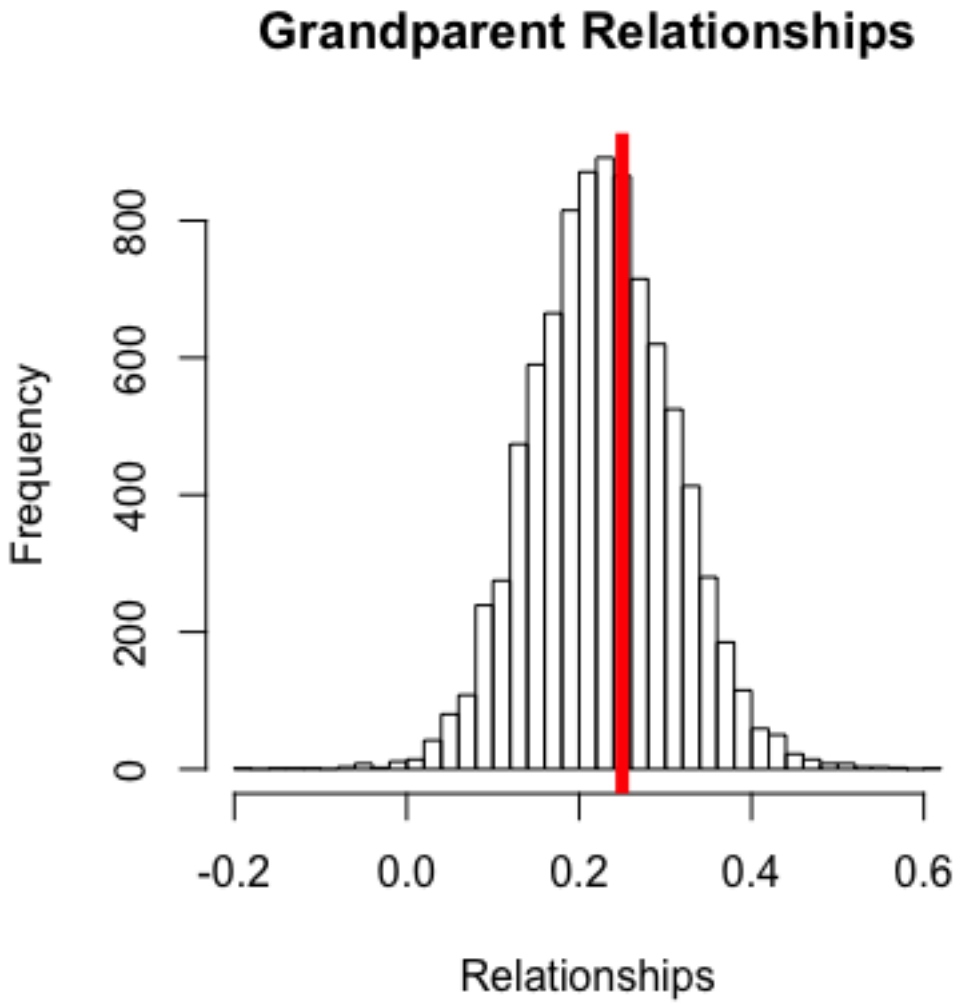
Do You Understand Accuracy?

- PEV is the deviation of the genetic variance and the variance in predicted breeding values.
- The SEP is the square root of PEV
  - Think possible change
- As PEV increases, the variation in EPD decreases.
- As PEV increases, accuracy (of any form) decreases.
- BIF accuracy is a function of the “true” accuracy
  - Much more conservative
  - Interpretation is very hard
  - Way not publish something simpler to comprehend?
    - Confidence Intervals?

“Phenotypes” for Training

- Two real choices
- EPD or degressed EPD
  - Allows more power since EPD contains more information than just the animal’s own phenotype
  - Limited to the traits that have published EPD for that breed
  - Must account for variable accuracy of EPD
  - Training must mimic the way the EPD was derived

- Phenotypes
  - Not limited to published EPD
  - Connectedness to larger population may be problematic
  - Less information content

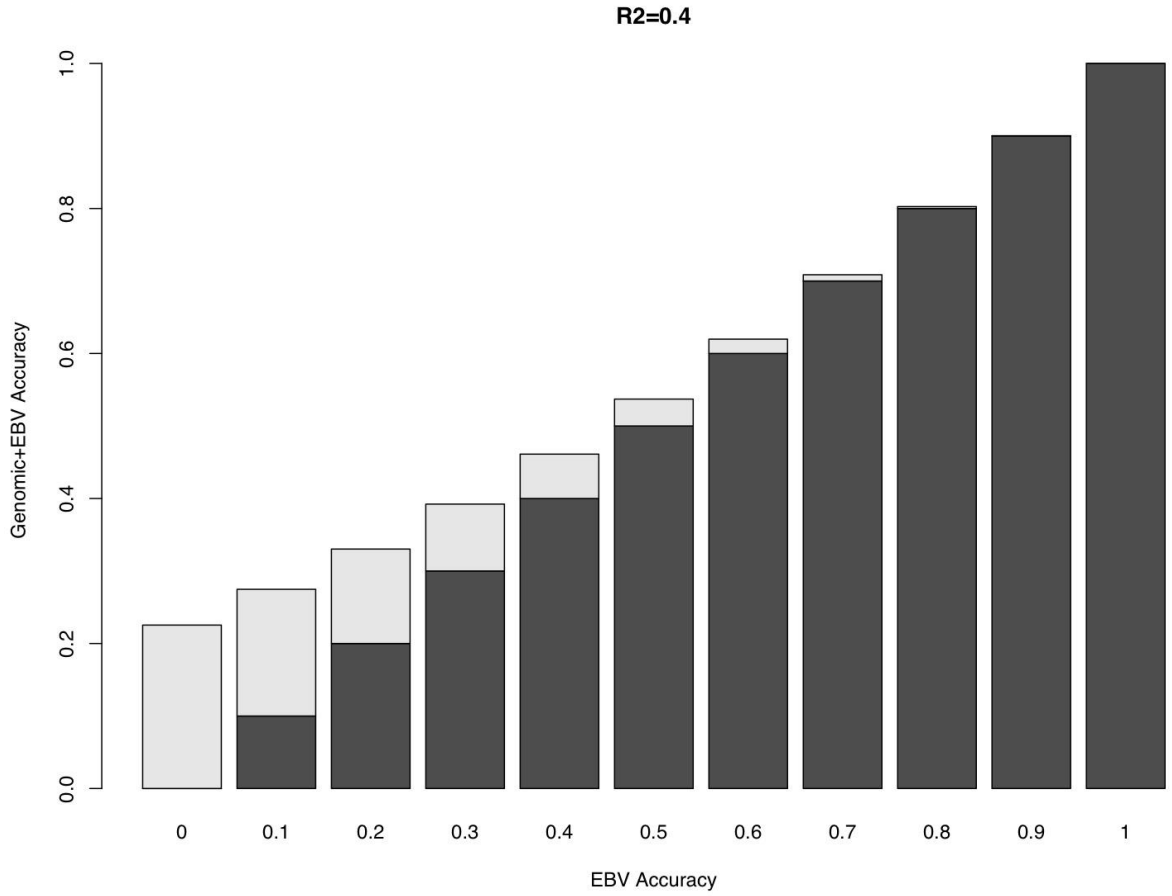

Grandparent Relationships
Frequency
0
200
400
600
800
-0.2
0.0
0.2
0.4
0.6
Relationships

Accuracy, h^2 and Progeny Counts

Approximate number of progeny needed to reach accuracy levels (true (r) and the BIF standard) for three heritabilities (h^2)

Accuracy		Heritability Levels		
r	BIF	h^2 (0.1)	h^2 (0.3)	h^2 (0.5)
0.1	0.01	1	1	1
0.2	0.02	2	1	1
0.3	0.05	4	2	1
0.4	0.08	8	3	2
0.5	0.13	13	5	3
0.6	0.2	22	7	4
0.7	0.29	38	12	7
0.8	0.4	70	22	13
0.9	0.56	167	53	30
0.999	0.99	3800	1225	700

Impact on Accuracy--%GV=40%



Increased Accuracy-Benefits

- Mitigation of risk
- Faster genetic progress

$$\Delta_{BV} / t = \frac{r_{BV,EBV}\, i \sigma_{BV}}{L}$$

- Increased accuracy does not mean higher or lower EPD!
  - Increased information can make EPDs go up or down

Sequencing Is Just Beginning

- New GGPF250 assay
- Best chance we have at
  - Predicting across populations
    - Birth weight MBV based on 293 variants-- r_g ranged between 0.25-0.44
    - Single variant (birth weight)—r_g ranged between 0.17 and 0.34
  - Developing MAM products
    - An objective, but the highest hanging fruit
    - GxExM

Understanding of Genomic Selection

- The single thing that has stood out to me the most in the genomic selection era is that the majority of beef seedstock producers never understood EPD and accuracy to begin with. At some point this will manifest itself and I fear we run the risk of messing up the end game.

Correlated Response . . .

- The lack of judicious technology adoption will create a “brain drain” in the beef industry.
- Jeremy
- Industry will need to help train its own replacements
  - Increasingly female
  - Non-ag backgrounds

Organizational Focus

- IF beef is considered as the end product, then organizations should focus on tools that aid producers in producing beef that is accepted (and demanded) by consumers.
  - This is a dramatic culture shift.
  - Breed Associations currently consider potential parents (yearling seedstock) as the end product.
  - This means an exclusive focus on genetic selection tools and the marketing of said tools that must accompany them.
  - All other activities are then secondary and should likely be parsed to a separate entity.

Helpful Resources

- http://beef.unl.edu
- www.nbcec.org
- www.eBEEF.org