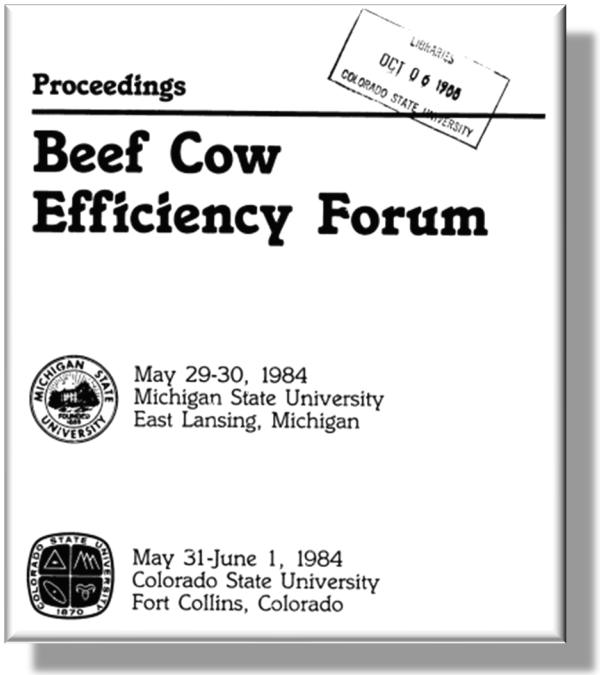
GENETIC CONSIDERATIONS FOR THE COWHERD

Matt Spangler
mspangler2@unl.edu
University of Nebraska-Lincoln

Breeding Objectives

- Identifies economically relevant traits
- Helps ranch become more efficient
- A detailed description of operation goals, including:
  - How replacements will be procured
  - How, and when, animals will be sold
  - Management and environmental constraints
  - Time horizon to consider profit



"Anytime the matter of cow efficiency becomes overwhelmingly complex, we should revert to basics...

Profit = Wean. Wt. x % calf crop x $/lb X # of cows – annual cost of cow-calf operation"

--Dr. Robert Totusek, Oklahoma State University

Improving Efficiency

- [Dam Weight*Lean Value of Dam + **No. Progeny***Progeny Weight*Lean Value of Progeny] - [Dam Feed*Value of Feed for Dam + **No. Progeny***Progeny Feed*Value of Feed for Progeny].

- By simply increasing number of progeny per dam through either selection, heterosis from crossing, or better management, we will increase efficiency of production.

Heterosis

- Hybrid Vigor
- Superiority of a crossbred animal as compared to the average of its straightbred parents
- More divergent parental lines = more heterosis
- NOT available from within breed matings

Inversely Related

Trait	Heritability	Heterosis
Reproduction (fertility)	Low	High
Production (growth)	Moderate	Moderate
Product (carcass)	High	Low

What is Heritability?

- Fraction of (adjusted) phenotypic variation due to variation in additive genetics
  - Higher heritability means faster genetic change all else equal
  - Low heritability does not necessarily mean limited genetic variation

Basic Model

$$P = G + E + e$$

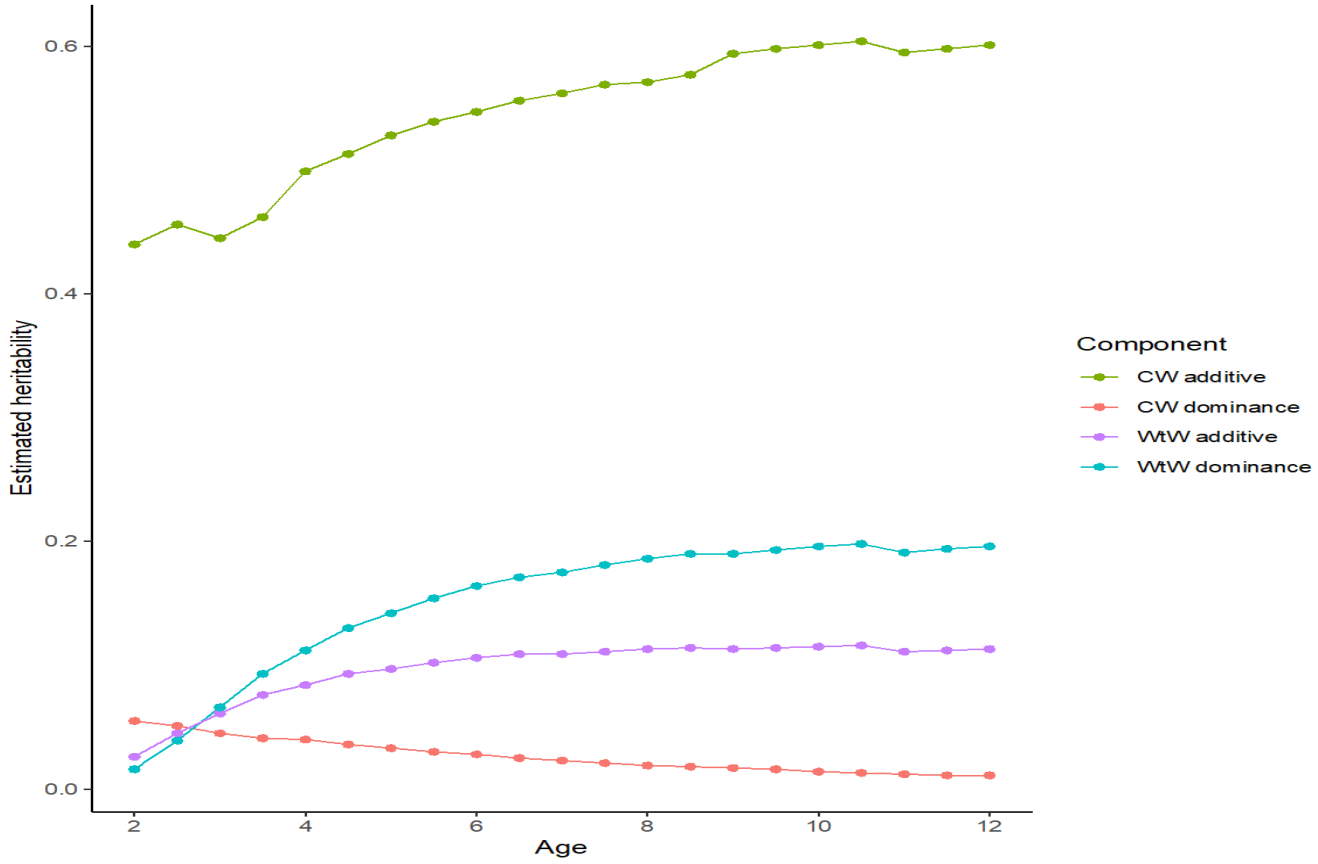
- Most heritability estimates reported have adjusted the “P” for known sources of “E”.
- This means that the heritability is the fraction of variation in what is leftover that is due to additive genetic variation.
- In other words, if h^2 is 10%, this does not mean that “E” explains the other 90%!

Advantages of the Crossbred Cow

Trait	Observed Improvement	% Heterosis
Longevity	1.36	16.2
Cow Lifetime Production:		
No. Calves	0.97	17.0
Cumulative Wean. Wt., lb.	600	25.3

Adapted from Cundiff and Gregory, 1999.

Capture Both Additive and Dominance



Snelling et al., 2022

Life cycle energy intake/kg edible product

- **Efficiency of growth in cows is NOT the target**
- **Maintenance requirement and efficiency are the target**

0 1000 2000

Dickerson, 1978

Economic Efficiency

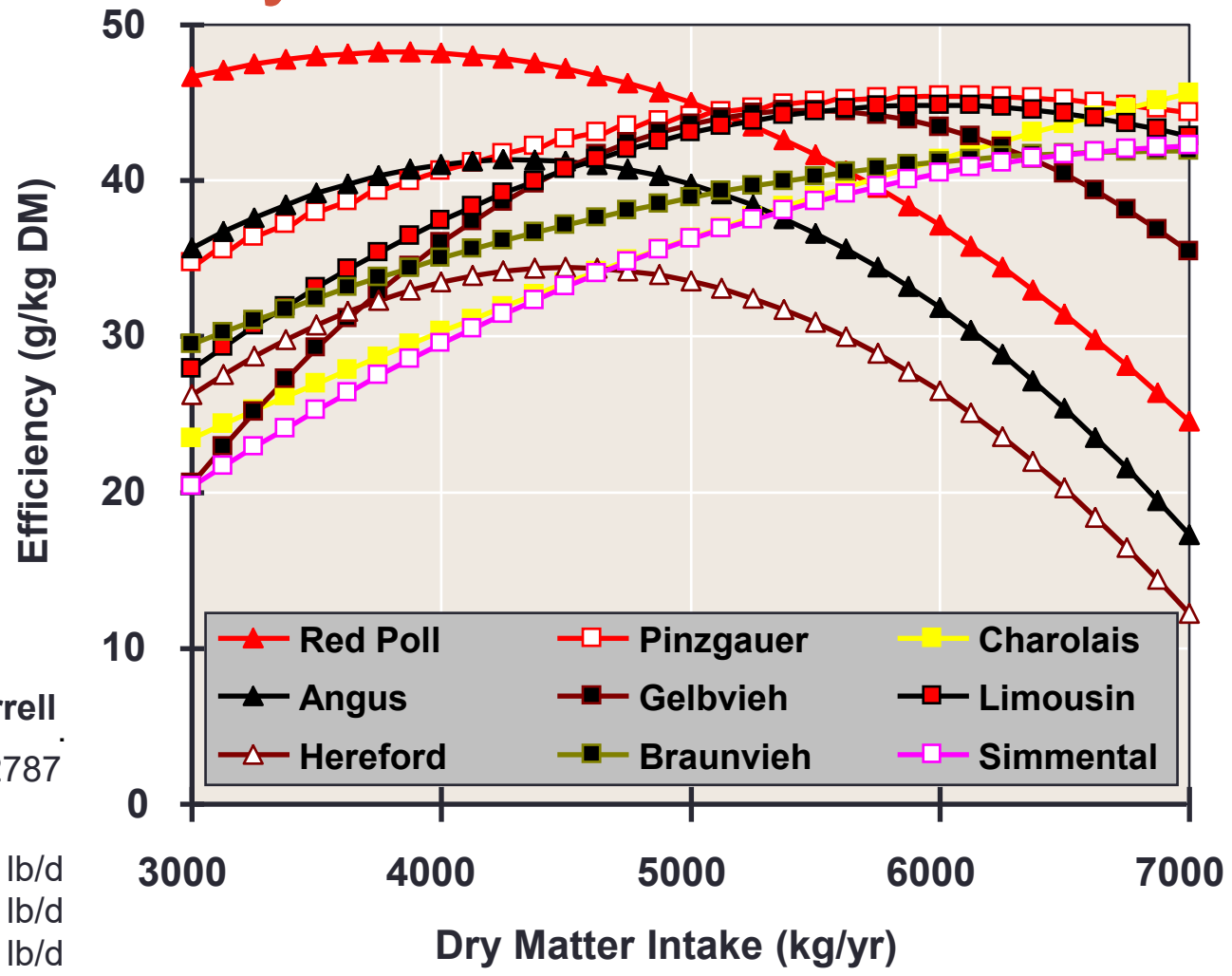
van Oijen et al. (1993)

	Low	Med.	High
Income			
Weaning	496.40	493.60	501.10
Slaughter	810.1	808.40	789.40
Expense			
Weaning	549.80	553.40	568.80
Slaughter	814.20	837.50	828.30
Econ. Eff.			
Weaning	90.3	89.2	88.1
Slaughter	99.5	96.5	95.3

Cow Efficiency of Breeds Fed at Differing Levels of Dry Matter

Red Poll
Angus
Pinzgauer

Braunvieh
Limousin
Hereford
Charolais
Gelbvieh
Simmental



Charolais
Pinzgauer
Limousin
Simmental
Braunvieh
Gelbvieh

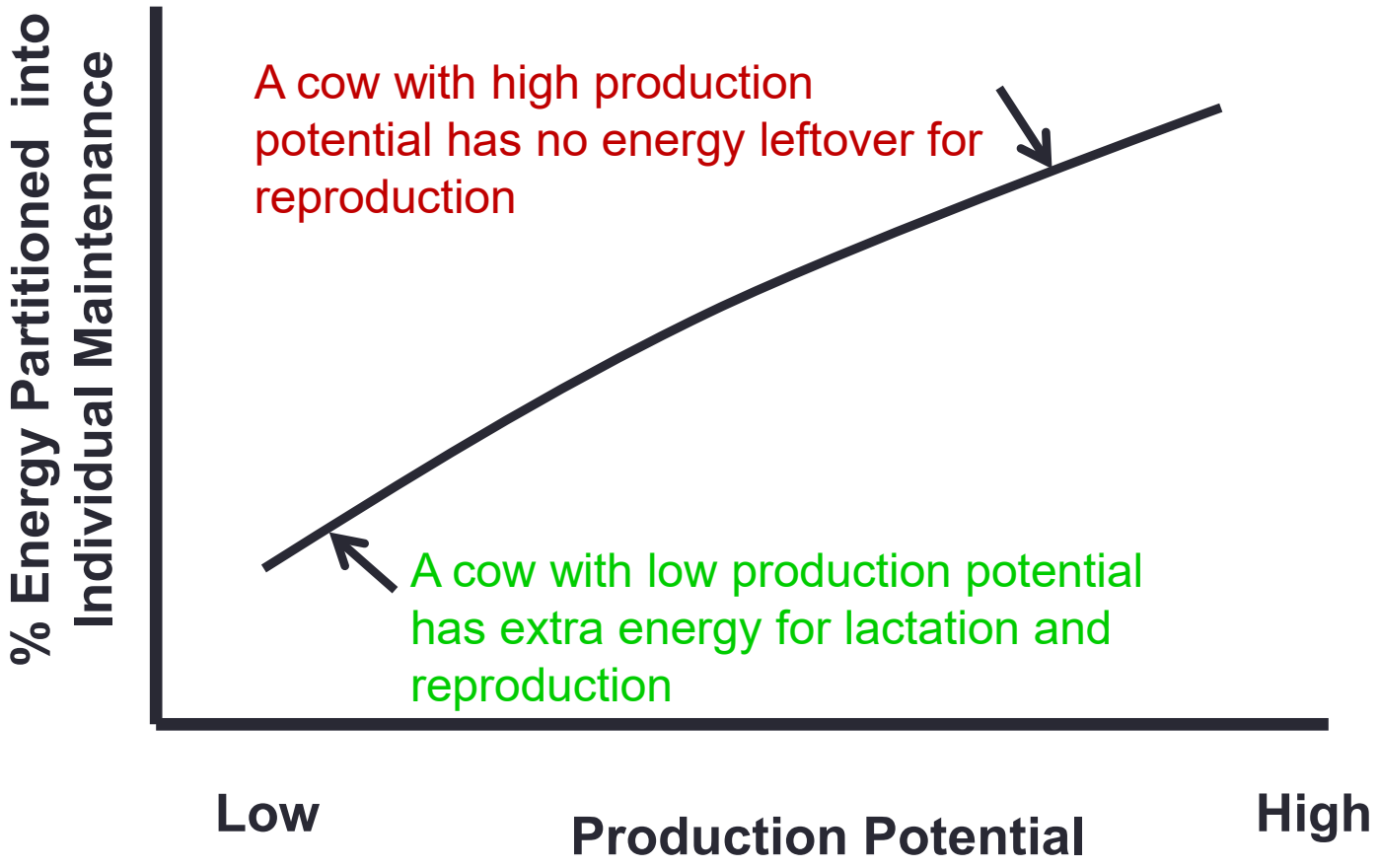
Red Poll
Angus
Hereford

Jenkins and Ferrell
1994. JAS 72:2787

3,000 kg/yr ~ 18 lb/d
5,000 kg/yr ~ 30 lb/d
7,000 kg/yr ~ 42 lb/d

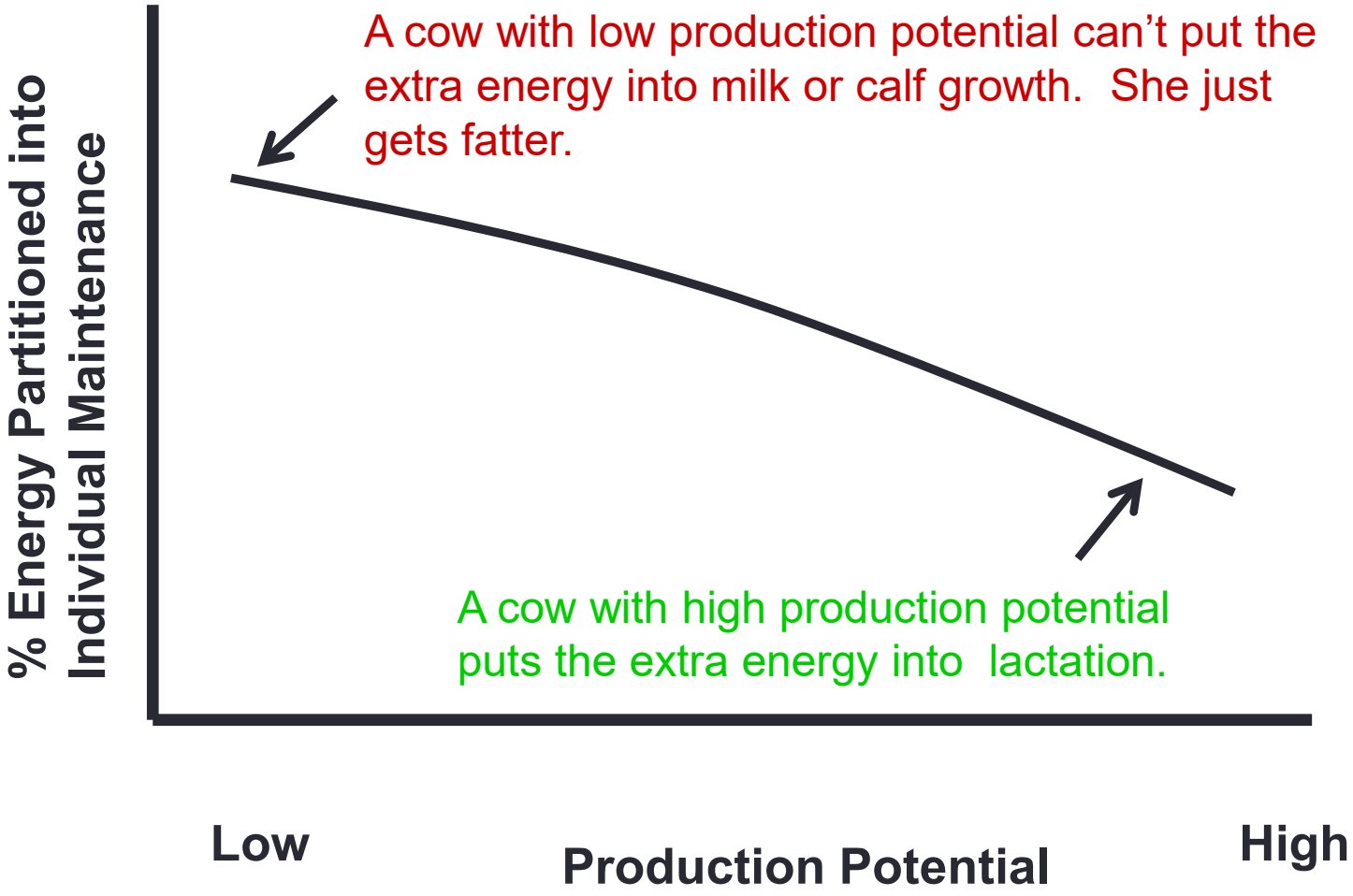
Low Feed Environment

Dunn et al., 2010



High Feed Environment

Dunn et al., 2010



Growth—Related to Mature Size

	BW	WW	YW
MW	0.57	0.62	0.45

Northcutt and Wilson, 1993

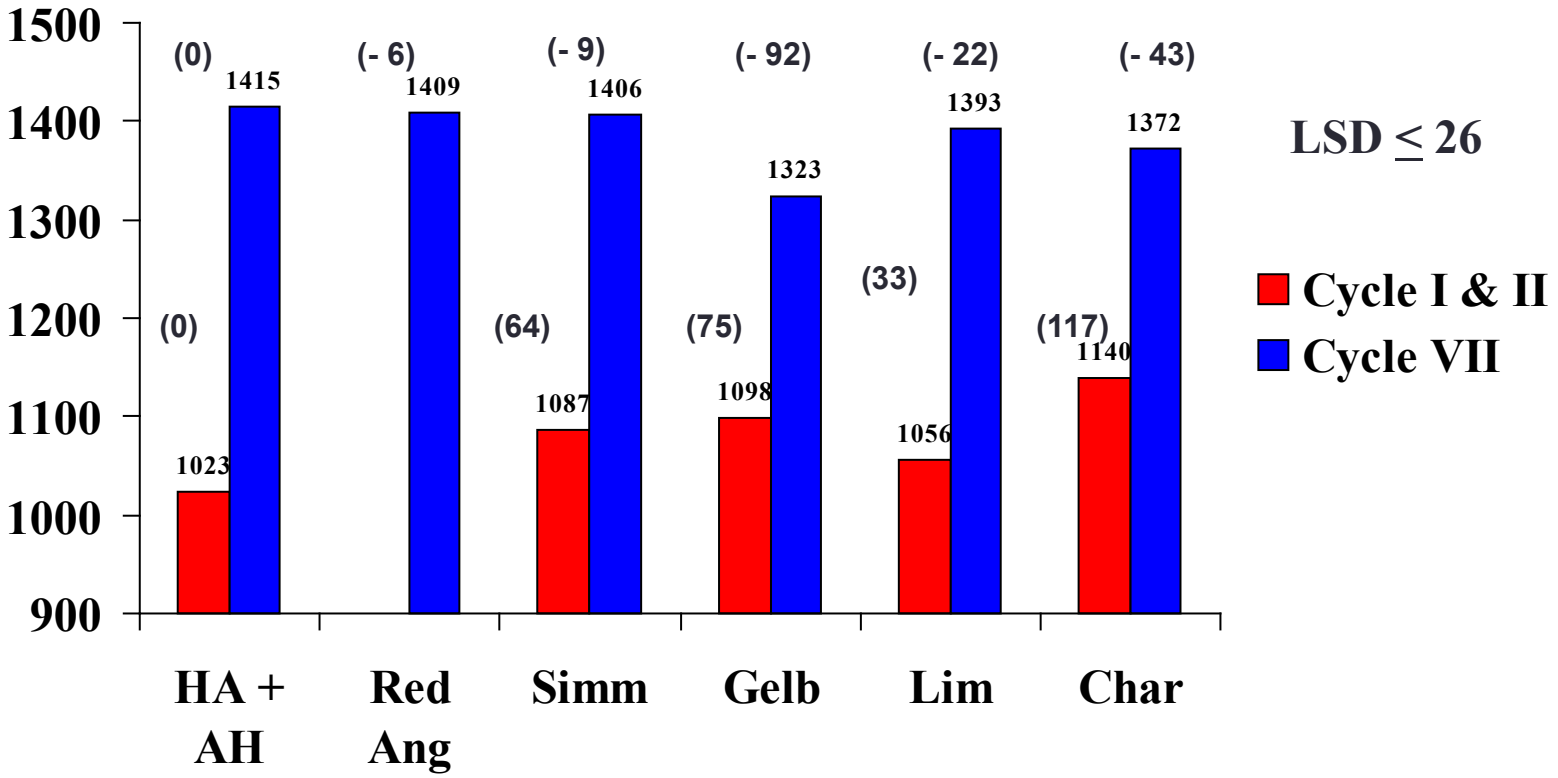
Breed Comparison

TABLE 2: BREED OF SIRE MEANS FOR 2021 BORN ANIMALS UNDER CONDITIONS SIMILAR TO USMARC

Breed	Birth Wt. (lb)	Weaning Wt. (lb)	Yearling Wt. (lb)	Maternal Milk (lb)	Marbling Score[a]	Ribeye Area (in^2)	Fat (in)	Carcass Wt.(lb)
Angus	84.7	540.9	981.3	520.5	6.25	13.72	0.662	921.7
Hereford	87.1	517.9	917.5	509.8	5.34	13.47	0.600	871.7
Red Angus	83.8	520.1	940.6	521.4	5.87	13.44	0.633	884.9
Shorthorn	89.1	499.7	900.7	517.0	5.42	13.67	0.531	864.8
South Devon	87.9	503.5	899.0	521.3	5.42	13.69	0.511	853.9
Beefmaster	86.9	527.8	916.4	510.3				
Brahman	94.3	554.2	918.7	515.3	4.88	13.44	0.507	853.7
Brangus	86.8	527.0	933.3	519.8				
Santa Gertrudis	88.4	528.7	919.3	514.4	5.12	13.27	0.579	870.6
Braunvieh	87.8	508.8	897.3	532.1	5.47	14.36	0.493	846.3
Charolais	89.6	541.0	949.7	515.7	5.32	14.51	0.472	899.5
Chiangus	87.7	506.4	906.0	515.9	5.43	13.99	0.523	874.0
Gelbvieh	86.4	536.9	954.3	522.6	5.29	14.32	0.525	884.6
Limousin	86.1	535.6	938.2	512.8	5.41	14.53	0.534	891.7
Maine-Anjou	86.2	494.9	874.0	506.5	5.18	14.29	0.458	849.5
Salers	85.3	519.9	924.0	521.9	5.32	14.19	0.510	866.2
Simmental	86.8	542.6	961.2	517.4	5.52	14.40	0.511	896.3
Tarentaise	86.3	520.1	888.4	509.2				

[a]Marbling score units: 4.00 = Sl^{00}; 5.00 = Sm^{00}

BREED GROUP MEANS FOR MATURE WEIGHT OF F1 CROSS COWS IN CYCLES I AND II (BIRTH YEARS: 1970-74) COMPARED TO CYCLE VII (BIRTH YEARS 1999-2000)



Breed Differences in Mature Cow Weight

Breed	Corrected Breed Effect Contrasted to Angus, lb.
Hereford	-30.4
Red Angus	-47.7
Charolais	14.3
Gelbvieh	-71.1
Limousin	-76.1
Simmental	-16.9
Brahman	20.9
Brangus	-44.9
Beefmaster	-75.9
Santa Gertrudis	-33.0

Ribeiro et al., 2022

MATERNAL ECONOMIC VALUES

Traits	Economic value ($/trait unit)	Genetic SD	Relative economic value
Maternal Objective			
CDd, %	-1.28	1.64	-2.11
CDm, %	-1.39	1.10	-1.53
WWd, kg	1.63	11.35	18.49
WWm, kg	1.14	9.89	11.28
MW, kg	-0.96	34.94	-33.46
HP, %	2.68	0.45	1.19

Stayability would be a driver if it had been considered

Ochsner et al., 2017

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
  - Composite females (or F_1)
- Bulls selected for terminal traits and cows selected for maternal traits
  - True complementarity
  - Stayability, moderate weight, moderate milk, total maternal calving ease, and convenience traits (e.g., docility, udder/teat)

Advantages

- Heavier calves and more product from smaller cows
  - Benefit of terminal producer
  - 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

Calving Ease

- Total maternal calving ease
  - No assistance needed at calving

Calving Ease Score	Decrease in Conception*
2	3%
3	11%

* 90 days post-partum

Spangler et al., 2006

Terminal or General Purpose?

Terminal

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

General Purpose

- $M, $C (Angus)
- API (Simmental)
- BMI$, BII$ (Hereford)
- HerdBuilder, ProS (Red Angus)
- $Cow (Gelbvieh)
- $M (Beefmaster)
- $CEZ, $BMI (Shorthorn)

Example

- Profitability per exposure
- All-Purpose Index (API; Simmental)
- Bull A 170
- Bull B 146

- 30 cows/yr. over 4 yrs. = 120 exposures
- 120 exposures X (170-146) =
- $2,880 profit difference
- If you follow the assumptions of the index!

Sire Selection

- The most effective means of generating response in all traits, even those that are sex-limited.
- Happens, at most, once per year.
- “Value” is largely determined ad hoc, and purchase price is sometimes (often?) a function of available cash flow (not necessarily from the cattle enterprise)
- Selection criteria contemplate breed, breeder (provider), and individual bulls.

Optimization game

- Objective needs of the cowherd
- Desires of the decision maker
- Financial resources
- Allocation of time to sire selection activity/chore

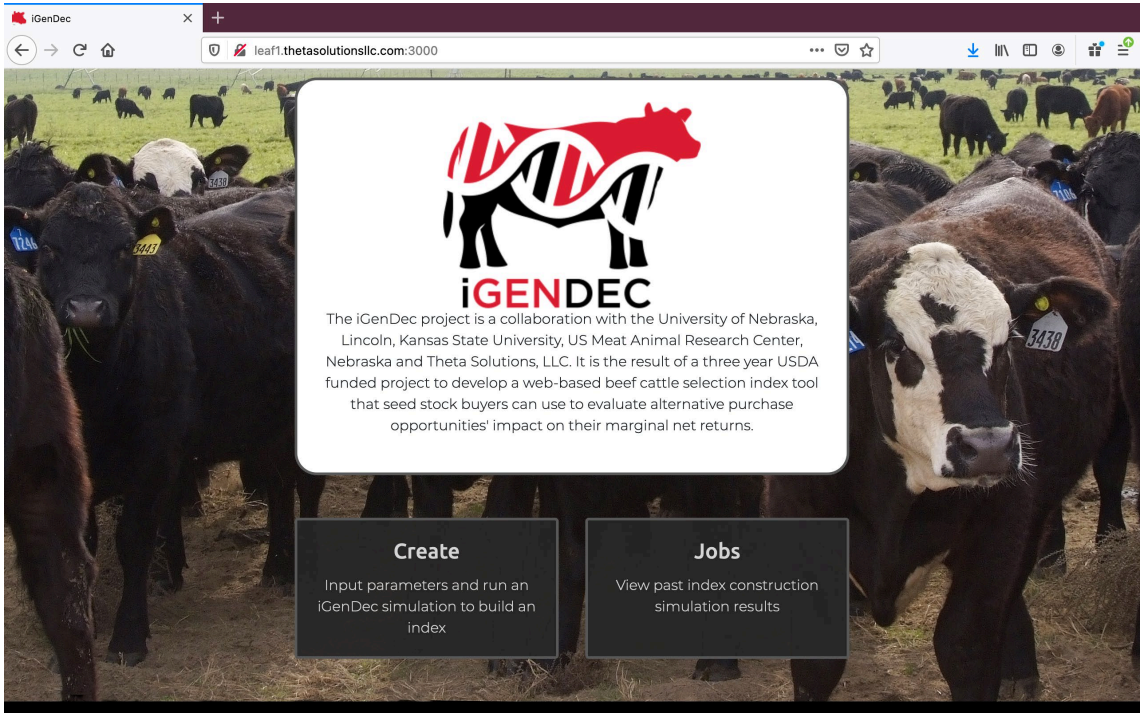
Investment Thought process

- Producers face the problem of obtaining the best bulls for their operation in that given setting.

- ‘Best’ is a relative concept.

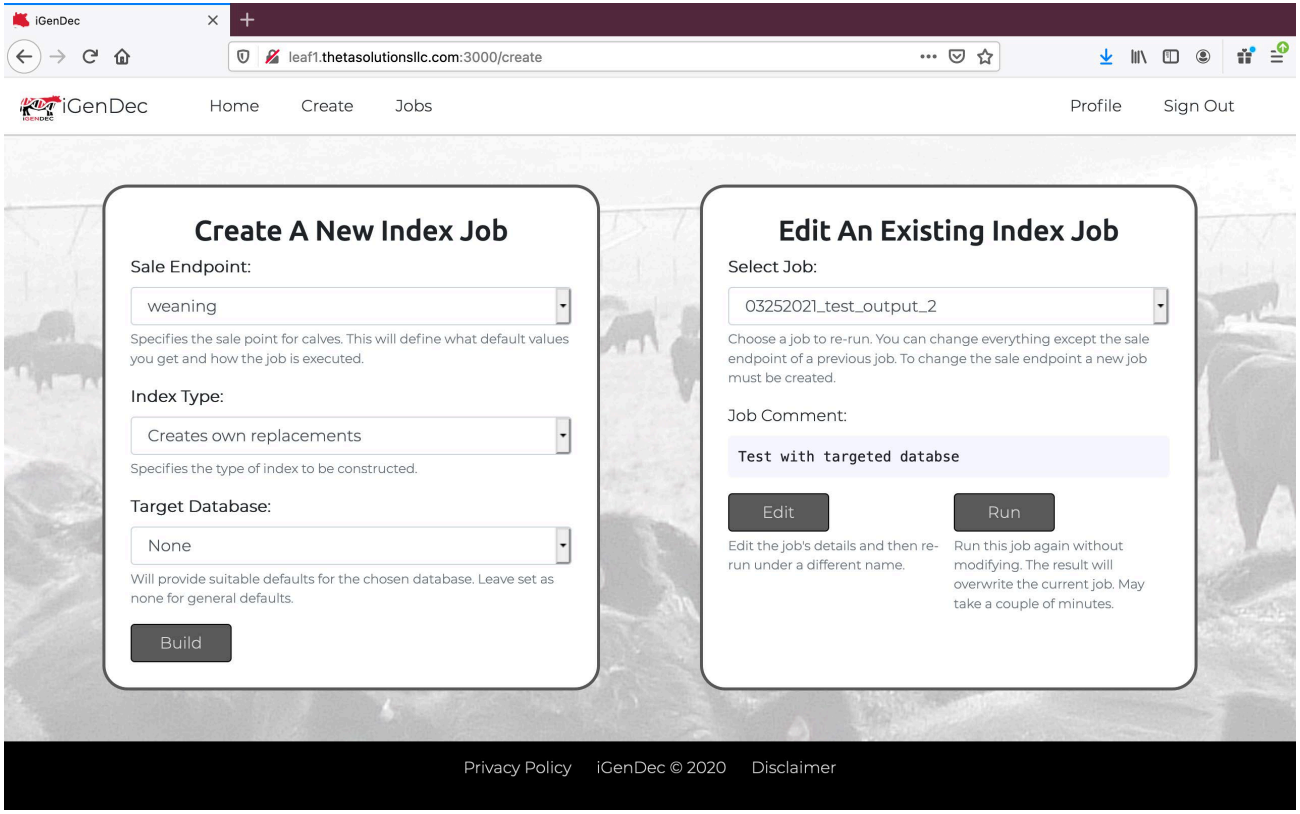
- A ‘less desirable’ bull may become the preferred choice over a ‘more desirable’ bull if his sale price discount is larger than the differential in value between the two bulls.

Proposed Solution

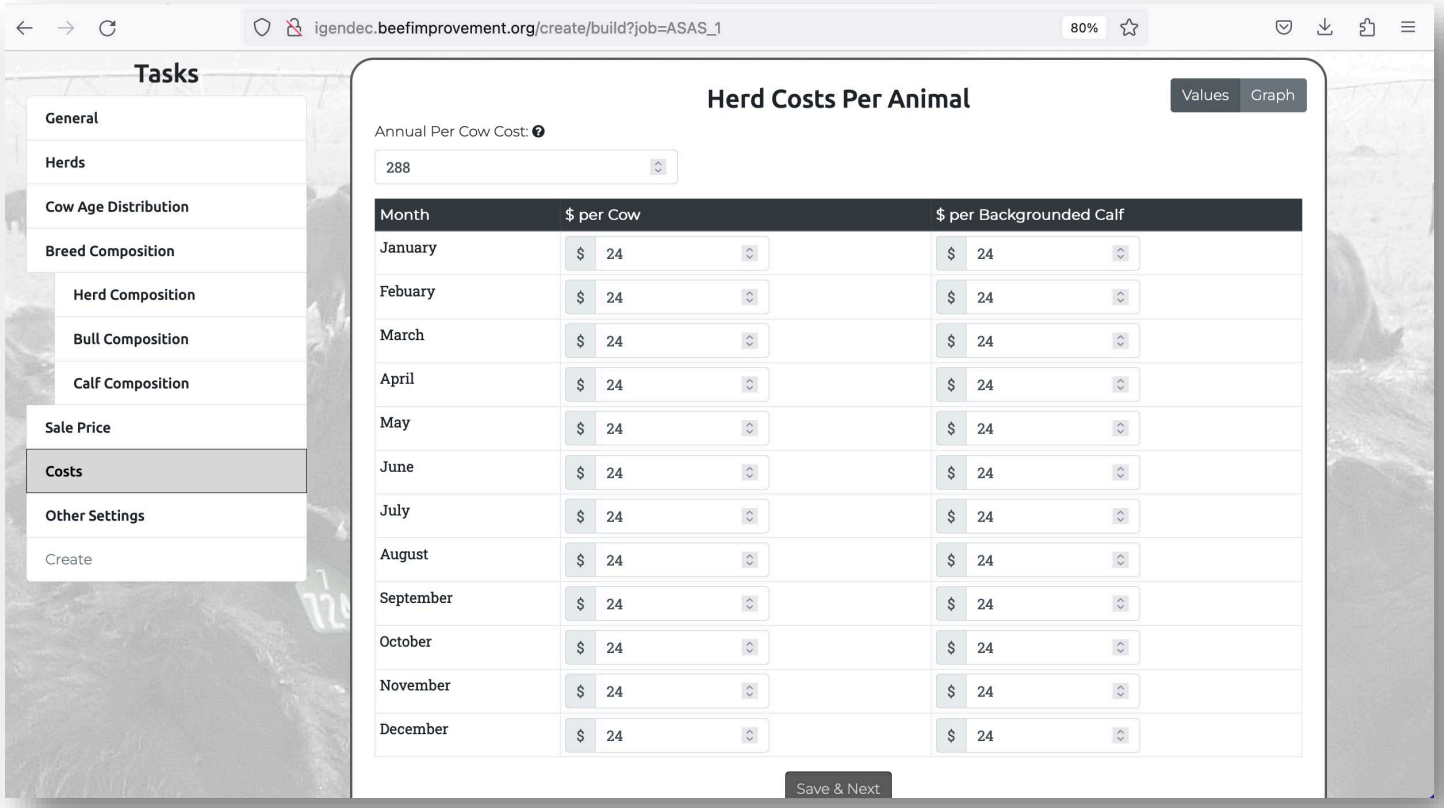


https://beefimprovement.org/resource-center/igendec/

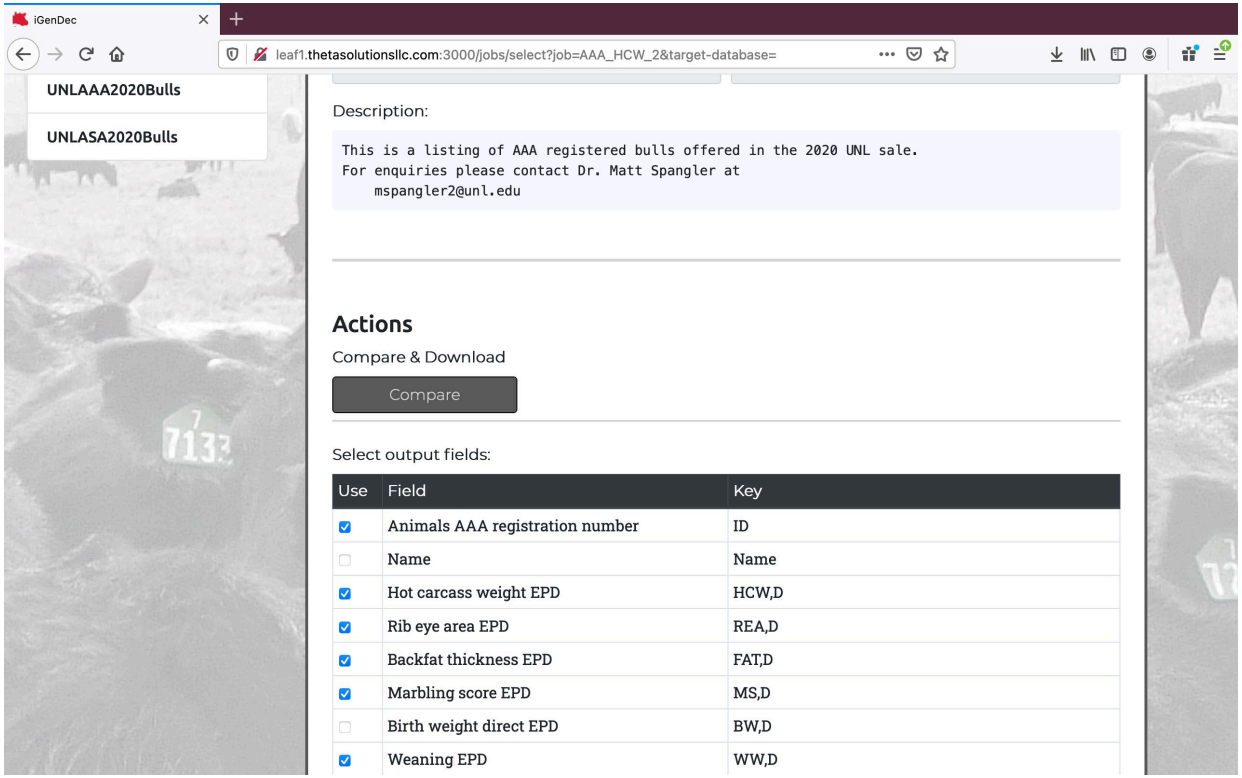
Breeding objective

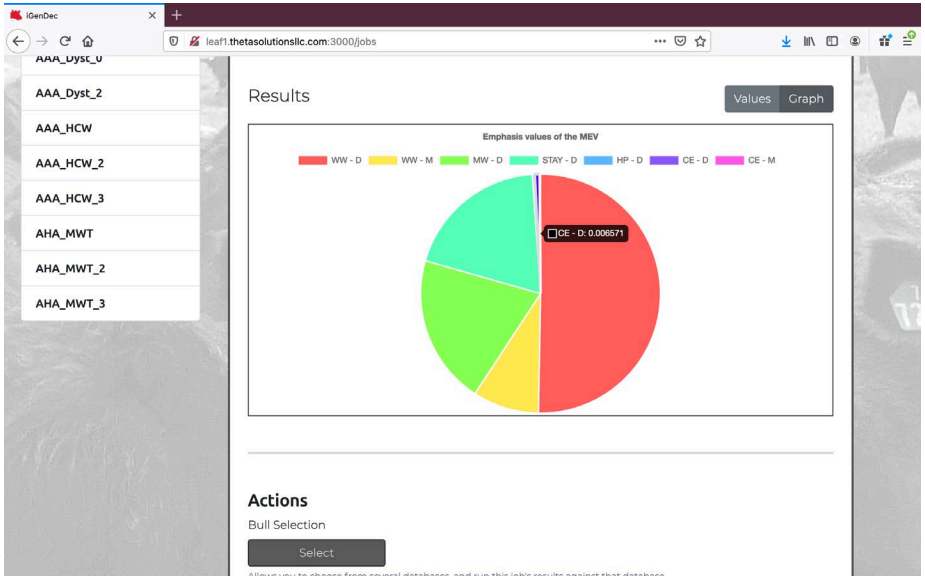


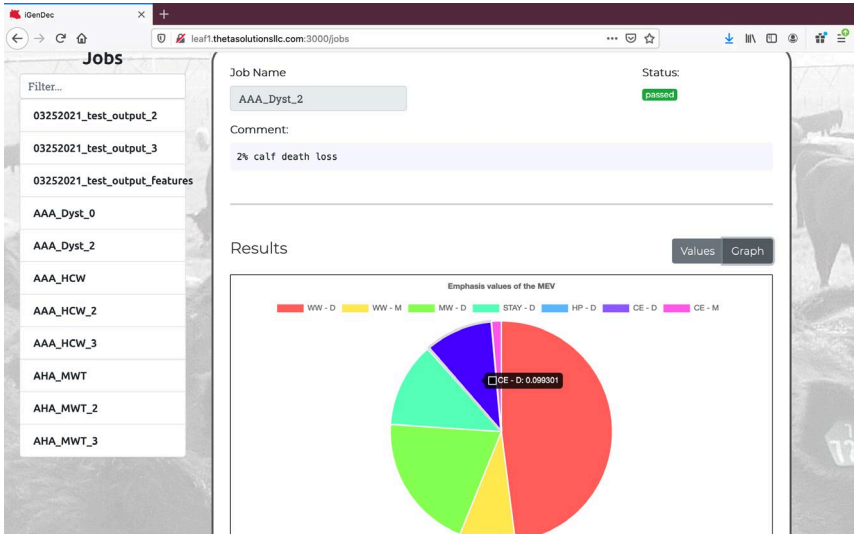
Web interface: Cow Cost



Comparing Bulls

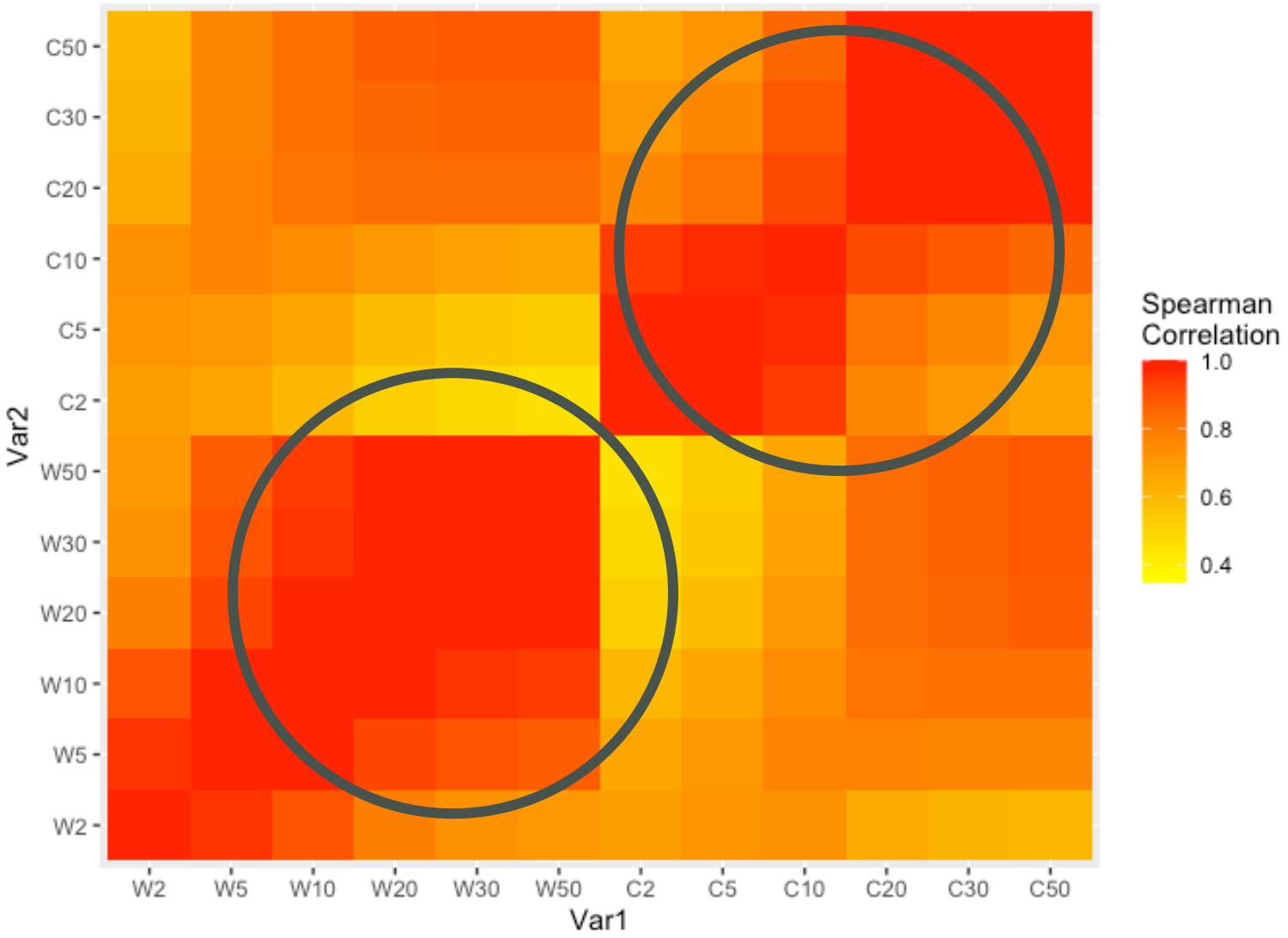




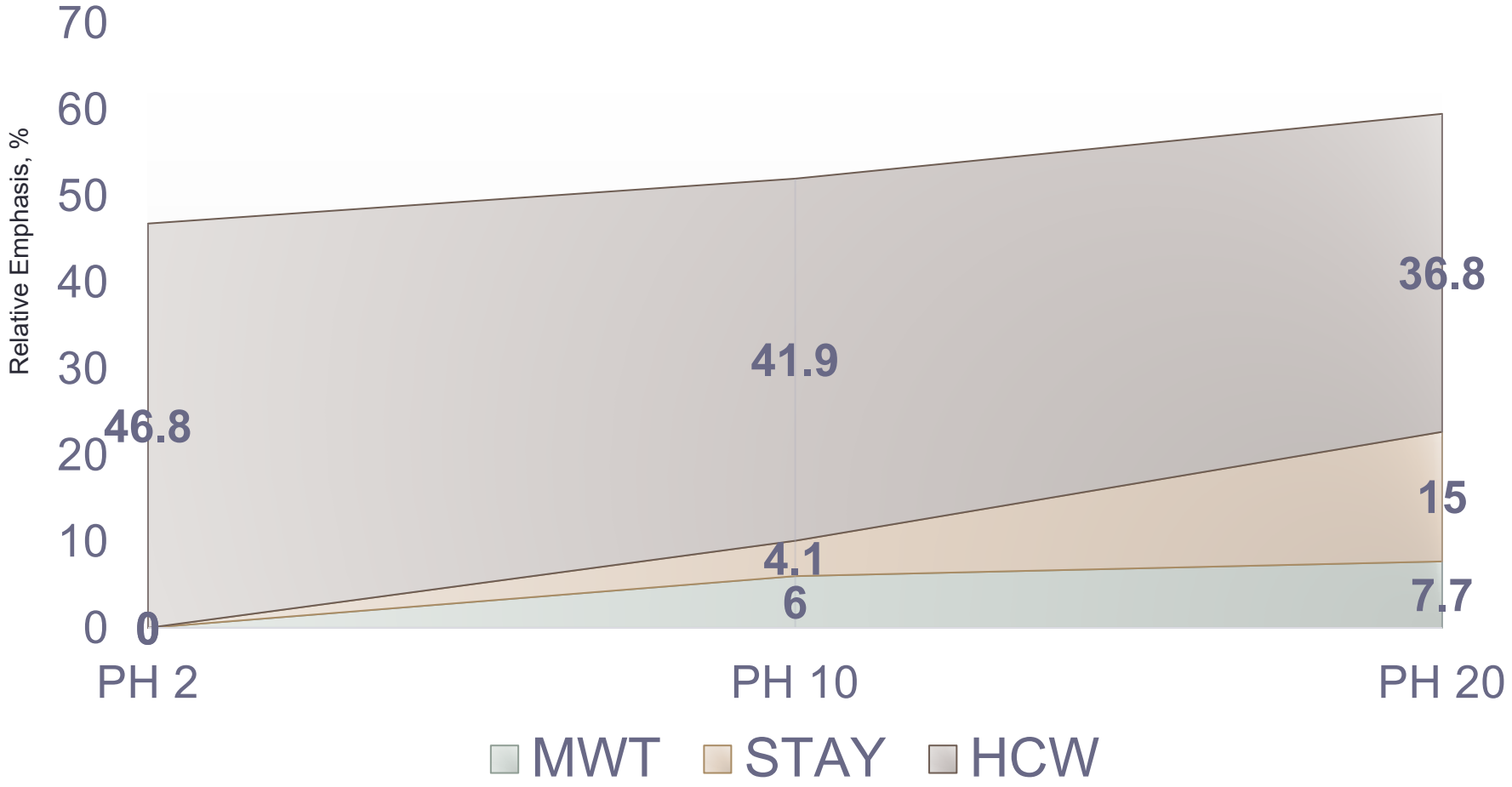


Change from ~0% to ~10% relative emphasis on CED going from 0% to 2% calf death loss due to dystocia

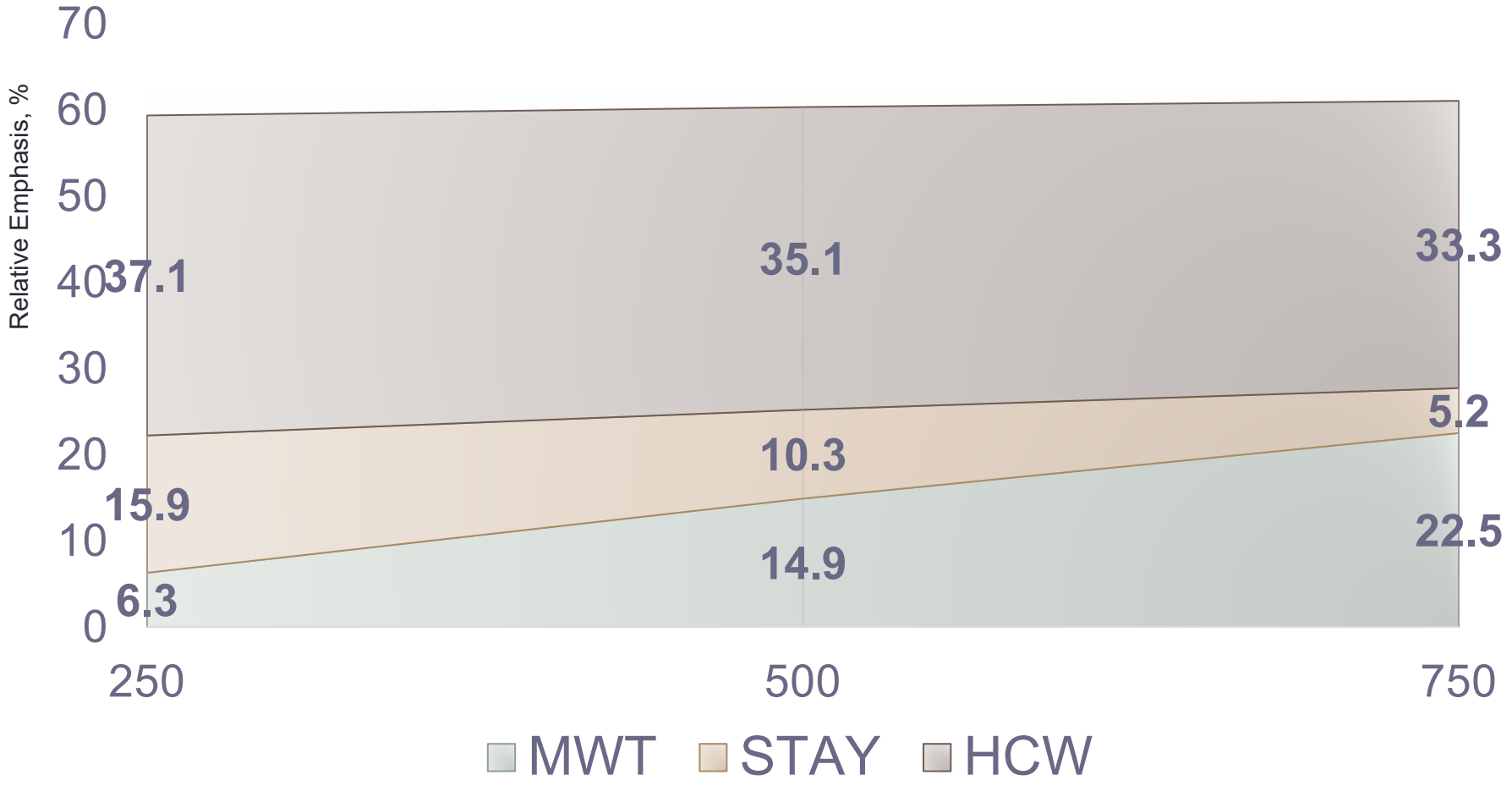
Comparing Ranks of Bulls

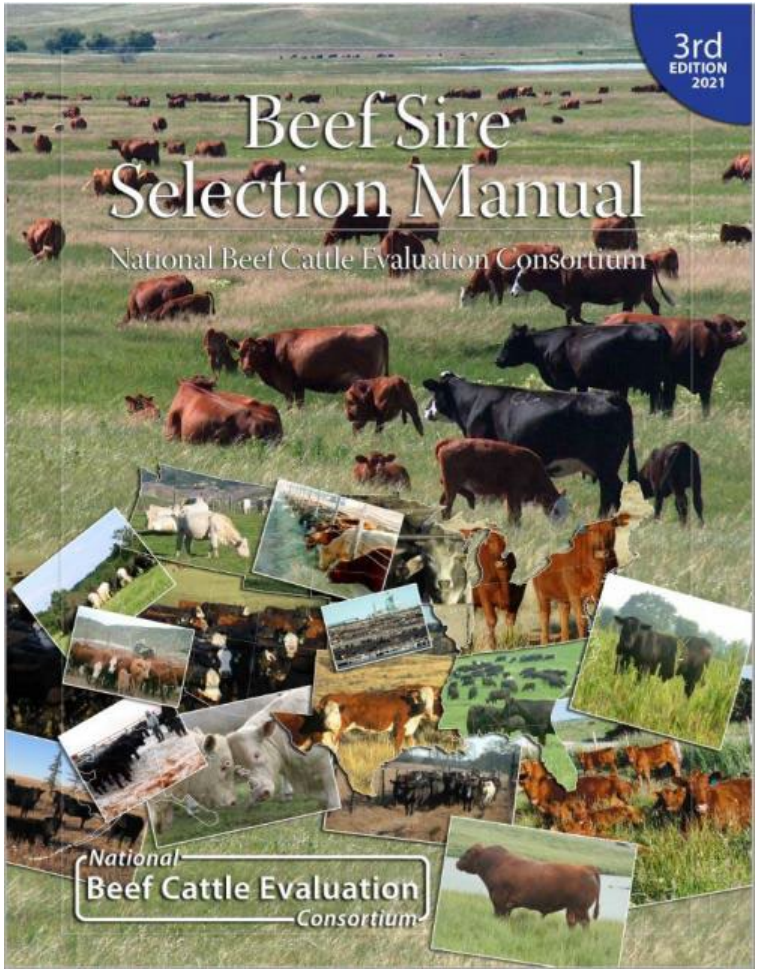


Changes in Relative Emphasis by Planning Horizon (PH) Length for Mature Cow Weight (MWT), Stayability (Stay) and Hot Carcass Weight (HCW)



Changes in Relative Emphasis by Annual Variable Cow Costs (US $) for Mature Cow Weight (MWT), Stayability (Stay) and Hot Carcass Weight (HCW)





iGENDEC

- https://ebeef.ucdavis.edu/2021-nbcec-beef-cattle-sire-selection-manual

Genomics for Commercial Ranches

- Increases the accuracy of EPD
  - Buy bulls that have been tested
- Can enable parent verification/determination
  - Choice of replacement females in some circumstances
  - Choices relative to culling bulls
- Can detect carriers of undesirable traits (e.g., horns, coat color, genetic defects)
  - Should be resolved at seedstock level
- Could improve management decisions IF:
  - Testing has a ROI—both accuracy and cost
  - Accuracy can be variable across breeds and in unrelated populations
  - Buyers are willing to pay for increased knowledge

Summary

- Know your costs
  - Select on PROFIT not just revenue
- Concentrate on Economically Relevant Traits (ERTs)
- Understand the differences between sources of information
- Know that EPDs and Economic Index values are more valuable than actual records or ratios
  - EPD 7-9 times more effective in generating response to selection than actual measurements

Thank You

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

UNIVERSITY OF Nebraska Lincoln