Across Breed EPD and multi-breed genetic evaluation developments

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Across breed EPD program

- Program has been in place since 1993
  - Birth, weaning, yearling weight; milk
  - Carcass traits added in 2008
  - Carcass weight added in 2015
- Develop factors that allow producers to compare genetic merit of bulls across breeds
- Data from USMARC Germplasm Evaluation Program

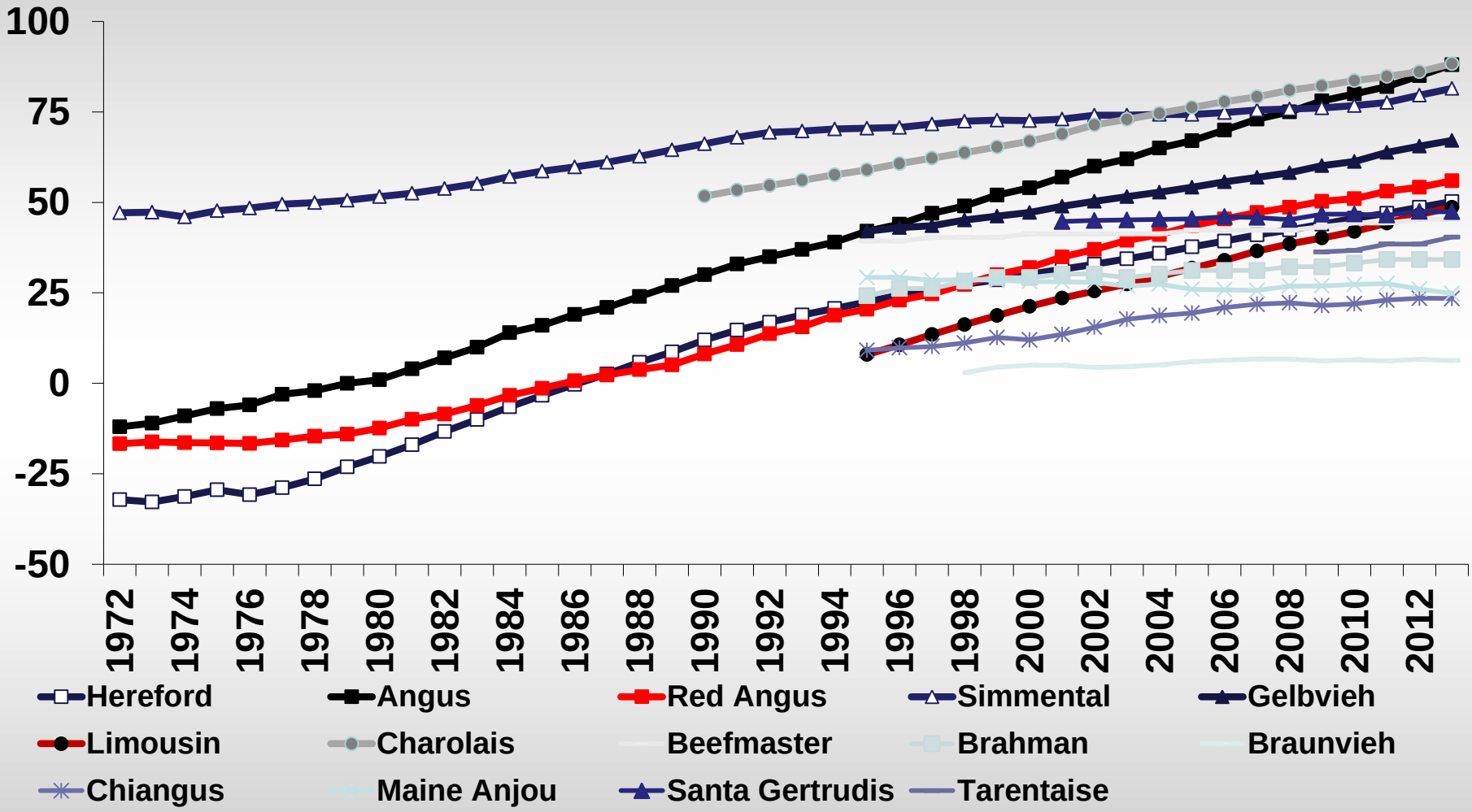
2015 ABEPD factors

TABLE 1: ADJUSTMENT FACTORS TO ADD TO EPDs OF EIGHTEEN DIFFERENT BREEDS TO ESTIMATE ACROSS BREED EPDs

Breed	Birth Wt. (lb)	Weaning Wt. (lb)	Yearling Wt. (lb)	Maternal Milk (lb)	Marbling Score[a]	Ribeye Area (in^2)	Fat Thickness (in)	Carcass Wt.(lb)
Angus	0.0	0.0	0.0	0.0	0.00	0.00	0.000	0.0
Hereford	2.7	-4.4	-26.6	-17.8	-0.32	-0.10	-0.053	
Red Angus	3.4	-25.7	-30.9	2.4	-0.32	0.03	-0.023	-6.2
Shorthorn	5.1	-30.7	-12.3	4.6	-0.24	0.31	-0.107	-11.6
South Devon	3.6	-8.0	-25.9	2.4	-0.09	0.21	-0.129	-22.3
Beefmaster	5.7	36.1	32.3	11.9				
Brahman	10.9	47.5	9.2	23.6	-0.83	-0.11	-0.146	-28.5
Brangus	3.9	13.9	5.1	4.6				-12.5
Santa Gertrudis	6.9	41.4	42.2	14.2	-0.62	-0.06	-0.097	-5.4
Braunvieh	2.5	-22.1	-49.3	-0.4				-44.9
Charolais	8.6	39.6	40.8	7.3	-0.39	0.98	-0.207	5.4
Chiangus	3.5	-26.9	-38.8	0.2	-0.40	0.34	-0.114	-20.9
Gelbvieh	2.7	-21.5	-30.4	1.6	-0.33	0.65	-0.117	-22.6
Limousin	3.0	-17.0	-42.0	-8.8	-0.60	0.98		-13.4
Maine-Anjou	5.0	-24.5	-35.0	-3.6	-0.60	0.78	-0.192	-23.6
Salers	2.2	-4.1	-26.3	4.9	-0.14	0.85	-0.203	-29.7
Simmental	3.6	-4.8	-9.5	3.6	-0.38	0.43	-0.137	3.8
Tarentaise	3.1	28.3	9.6	23.4				

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

Genetic Trends for Yearling Weight, lb



Adapted from Spring 2015 Genetic Trends from Breed Associations and 2015 AB-EPD factors

Limitations of ABEPD program

- Factors do not account for difference in heterosis in commercial cross
  - Angus vs. Simmental bull with Angus females
- Additive factors not adequate to accommodate many traits
  - Calving ease, heifer pregnancy, etc.
- Yearly updates not sufficient for continuously updated national cattle evaluations

Possible solutions

- Web-based decision support
  - Current focus of a collaboration/grant
    - KSU, UNL, CSU, USMARC, Bruce Golden
  - Could combine with bioeconomic simulation
  - Heterosis, trait scaling, continuous updates all possible
- Multibreed evaluation
  - Current implementation by American Simmental Association/International Genetic Solutions (ASA/IGS)

Obstacles to full Multibreed

- Merger of multiple breed databases
  - Structures are often very different
  - IDs duplicated in several breeds (but not known as duplicates)
    - Difficult to resolve
    - Standardized ID system would help
- Cooperation between database curators
  - Breed associations
  - Genetic prediction ‘centers’
  - Individual producers/commercial entities

Multibreed obstacles

- Estimating population parameters
  - Direct and maternal heterosis
  - Direct and maternal additive breed effects
  - Field data usually not suitable
    - Contemporary groups structure
      - Will discuss further
    - Confounding between heterosis and breed
    - Amount of crossbred data relative to purebred (depends on classification of ‘purebred’)
- Research data useful here

Contemporary groups

- In order to estimate breed differences from field data, we need contemporary groups that include purebreds of both breeds
  - Rarely occurs; often breeds are in different groups
  - Even when crossbreds and purebreds are in the same group, direct comparisons are not possible without adjusting for heterosis (requires good estimates of heterosis)

Estimation of heterosis

- In order to estimate heterosis from field data, we need groups with crossbreds and purebreds of both parental breeds
  - Rarely occurs; usually crossbreds are in a different groups
  - Even when crossbreds and purebreds are in the same group, typically purebreds of only one of the breeds are present

Estimating breed differences

- Contemporary group

Sire 1: Limousin WW Avg: 650 lb	Sire 2: Angus WW Avg: 675 lb	Sire 3: Lim-Flex WW Avg: 670 lb

  - All mated to mature purebred Limousin cows
  - What was the cause of the different averages?
    - Heterosis
    - Sire
    - Breed differences

YES
(and no)

Estimating breed differences

- Problem can be improved with more sires in group still other considerations that are difficult to address
  - Reciprocal matings
  - Biased sampling of sires from other breeds
  - Heterosis still difficult to separate from breed
  - Were calves really treated the same?

Multibreed model

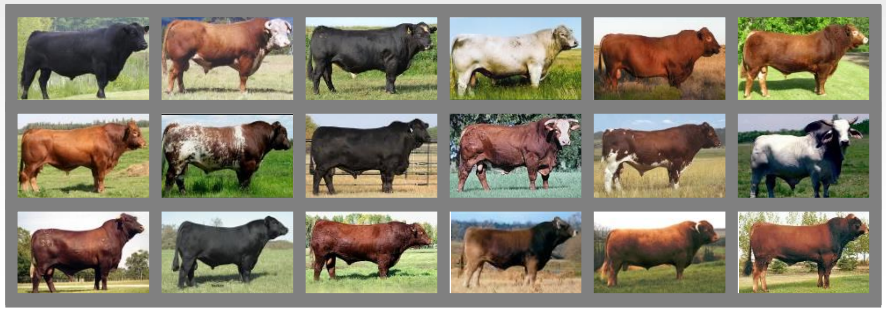
- Prior estimates of breed effects and heterosis essentially required
- Source of information most likely from research data
  - GPE program is designed to estimate breed differences from current industry samples

Proposal

- Use breed differences from GPE to parameterize multibreed model currently in use by American Simmental Association
  - Provide both breed effects and heterosis
  - Can basically pre-adjust data for breed composition
  - Need to consider where the programs are different and how to accommodate differences

GPE Target Population Structure

AI Sires:
AN, HH, SM, CH, AR, LM, GV, SH, BN,
BM, MA, BR, CI, SG, SA, BV, SD, TA



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PB & F_1 Steers

PB & F_1 Bulls

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PB & F_1 Heifers

Natural Service PB, F_1, & F_1^2 Steers & Heifers

Across breed differences

TABLE 2: BREED OF SIRE MEANS FOR 2013 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 Thickness (in)	Carcass Wt.(lb)
Angus	86.6	570.2	1041.9	558.2	6.14	13.24	0.668	904.9
Hereford	90.9	562.8	1004.2	536.4	5.36	12.93	0.606	
Red Angus	87.2	550.5	1009.9	557.6	5.72	12.86	0.632	886.6
Shorthorn	92.3	537.5	994.3	559.5	5.41	12.98	0.519	861.4
South Devon	91.0	555.4	1008.7	562.1	5.92	13.16	0.537	877.9
Beefmaster	90.9	566.3	1000.2	549.1				
Brahman	97.7	583.7	988.5	564.4	4.79	12.63	0.509	845.5
Brangus	89.9	558.7	1005.1	549.3				883.9
Santa Gertrudis	92.1	565.2	1001.2	549.7	4.97	12.66	0.561	870.8
Braunvieh	90.4	542.5	973.8	569.1				848.3
Charolais	94.0	585.9	1042.2	551.0	5.25	13.99	0.452	894.2
Chiangus	90.9	536.6	977.2	552.2	5.36	13.26	0.502	862.4
Gelbvieh	88.6	566.2	1020.9	565.1	5.34	13.83	0.490	879.1
Limousin	89.9	567.5	1002.5	551.8	4.94	14.21		885.4
Maine-Anjou	91.2	541.0	978.6	548.7	5.04	13.70	0.414	856.3
Salers	88.7	558.1	1007.6	559.1	5.46	13.62	0.453	865.2
Simmental	90.6	578.3	1035.3	560.7	5.35	13.93	0.469	903.4
Tarentaise	89.3	565.9	994.3	559.3				

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

Potential problems

- Currently, priors for ASA/IGS model are for breed by year effects
  - GPE analysis based on sampling from industry sires and adjusting solutions to the EPDs of the sampled bulls
    - In essence using breed genetic trends to adjust solutions from GPE data
    - Only Hereford and Angus bulls sampled throughout GPE
    - Interpolation likely necessary

Potential problems

- New trait development
  - Currently summarize whole GPE database for weight traits and carcass traits as part of the ABEPD process
  - Still missing CED, CEM, stayability and heifer pregnancy that are reported for several breeds
    - Multinomial distributions of these traits will require some form of scaling from GPE to multibreed

Potential problems

- Heterosis
  - While heterosis is reported as part of GPE, prior to current continuous sampling protocol, most estimates were based on Angus x Hereford crosses
  - One goal of current program is to estimate breed-specific heterosis
    - Important for multibreed
    - Still far from complete

Possible solutions

- Breed x year solutions
  - Need to examine what we can do to fill in the years
  - Current ASA method places a high correlation among yearly estimates
  - Possibly can reference old solutions and newer solutions and interpolate
    - Adjust within years by within group EPD differences
    - Would exclude genetic trend (circular logic)

Possible solutions

- New trait development
  - Have already prototyped CED with UNL collaboration
    - For ABEPD system, need to put all breeds on the same scale then transform to breed of interest
    - Scaled EPD by additive SD of EPD
    - Similar methodology could be applied to heifer pregnancy and stayability
      - Records may be limited on some breeds in GPE, but will grow over time

Possible solutions

- Breed specific heterosis
  - UNL collaboration also developed to begin exploring breed and breed-type specific heterosis (Schiermiester et al., 2015)
    - Fitting main effect of heterosis (or breed-type) and random breed specific heterosis effects
    - Resolution not great yet, but evidence of breed-type specific heterosis for weight traits
    - Working on increasing crosses between 7 largest breeds and of those breeds with all others

Future plans

- Continue trait development and examination of breed effect model implications
  - Important training in NCE for graduate student development

Conclusion

- We think the GPE program and the multibreed model are a natural fit
- Will improve the base adjustment among current members of IGS
- Can help to transition to mating and selection decision support programs

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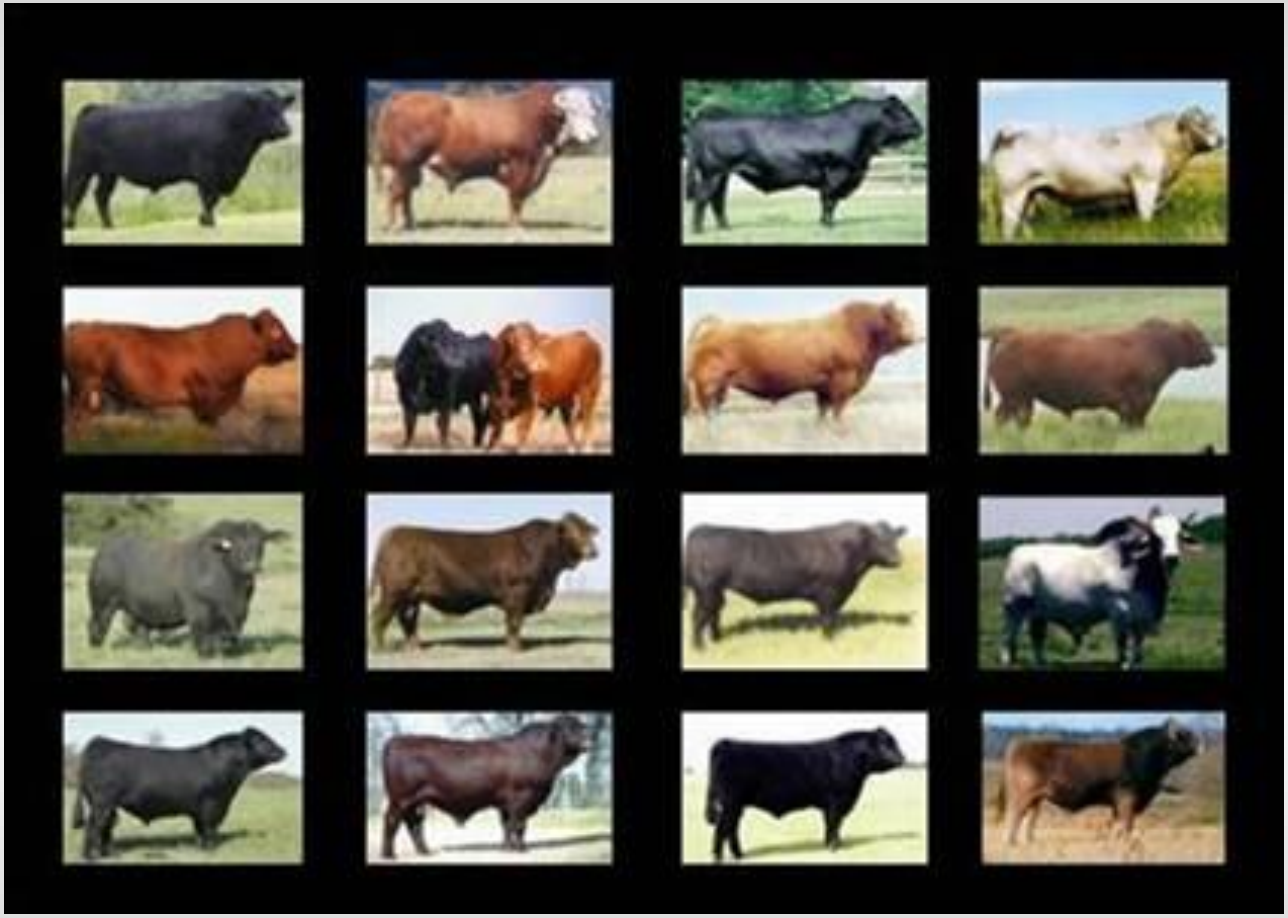
Discussion and questions?



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