

Using GPE and the across-breed EPD program to help parameterize multibreed evaluation

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

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

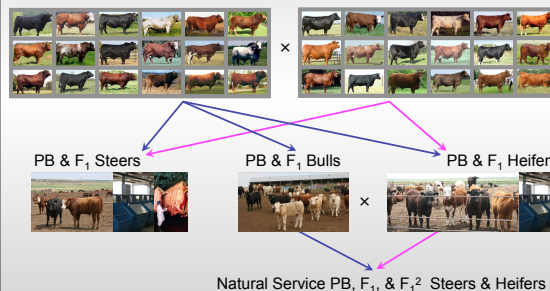
- Primarily descended from Arnold et al. (1992) animal model
 - Elzo et al., 1983, 1990 sire model
- $$y = Xb + ZQg + Za + WSd + WT\delta + e$$
- Includes
 - Additive breed effects and heterosis
 - Additive animal effects
 - Animal x breed interaction (dominance)
 - Likely difficult to fit in most data sets

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

GPE Target Population Structure

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



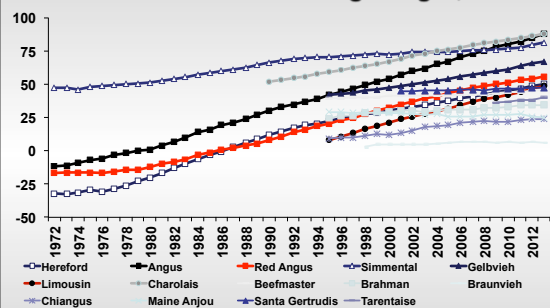
Review of ABEPD program

- Across-breed EPD program
 - Estimate breed differences from GPE using a sire and dam model (F₁ progeny records)
 - Adjust records for bull EPD

$$B_i = USMARC_i / b + (EPD_{i,YY} - EPD_{i,USMARC})$$

- EPD_{i,YY} is the breed average EPD (current)
- EPD_{i,USMARC} weighted average USMARC sire EPD where weight is the sum of numerator relationships between sires and progeny with phenotypes
- *b* is a scaling factor to convert USMARC solution to an industry scale

Genetic Trends for Yearling Weight, lb



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

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

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
 - Carcass weight added in 2015
 - 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 (Schiermister 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
 - Collaborations between UNL and USMARC likely because of previous interest and success
 - Important training in NCE for graduate student development

Future plans

- Ties in well with direction of ABEPD program and GPE reporting
 - Would like to develop web-based reporting and query system
 - Efficient updating of ABEPD and faster reporting of novel trait results
 - Current focus of an AFRI grant proposal for decision support tools (Spangler presentation)

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

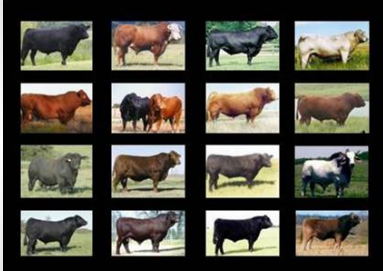
Conclusion

- Please let us know if you are interested in any of these development opportunities
- We are looking for good collaborations to move this program ahead as quickly as possible
- Will eventually transition to genomics

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Discussion and questions?



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