DECISION SUPPORT USING CUSTOMIZABLE INDICES ACROSS BREEDS

M.L. Spangler, B.L. Golden, L.A. Kuehn, W.M. Snelling, R.M. Thallman, and R.L. Weaber

DONE WITH CHANGES?

- Releasing a single-step evaluation should allow the opportunity to turn organizational focus to other areas of genetic evaluation
  - Obviously additional improvement to be made overtime relative to ss
- Economic indices clearly misunderstood
- Effort now needs to be focused on
  - Phenotypes
  - Enabling (accurate/informed) selection decisions

PARTIAL (UNDERUTILIZED) SOLUTIONS

- EPD have been available to the U.S. beef industry for over 40 years
  - Survey data suggest that only 30% of beef cattle producers utilize them in making selection decisions (Weaber et al., 2014).
- Part of this lack of technology adoption is likely due to the confusion surrounding how best to use them and the fact that some breed associations publish in excess of 20 EPD per animal.
- Decisions are left up to a clientele that does not have either the needed tools, skills, or time to optimally make use of massive amounts of genetic, environmental and economic information.

Increasing list of EPD

Requires turning tools into impactful decisions

METHODS OF MULTIPLE TRAIT SELECTION

- Tandem Selection
- Independent Culling Levels
- Selection Indices

INDICES ARE NOT NEW

- Economic selection indices were originally proposed by Hazel and Lush (1942) and further developed by Hazel (1943).
  - First released on a breed wide basis in 2004.
- There have been a number of efforts in the scientific community to use quantitative bioeconomic models to explicitly inform this tradeoff decision (e.g., MacNeil et al., 1994; Wilton and Goddard, 1996; Van Groningen et al., 2006; Aby et al., 2012).

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)

General Purpose

- $W, $EN (Angus)—Sub-indices
- API (Simmental)
- BMI$, BII$, CEZ$ (Hereford)
- HerdBuilder (Red Angus)
- $Cow (Gelbvieh)
- $M (Beefmaster)

SELECTION INDEX IN A NUTSHELL

- Tool to enable informed multiple-trait selection
- Based on:
  - Breeding objectives
  - Economic parameters
  - Relationships among traits
  - Population (herd) means
- Designed to improve commercial level profitability
- Not to be confused with breed (organization) specified trait goals
- New (~ 10 years) to the beef industry but "old hat" to other industries

SHORTCOMINGS

- Although these tools are extremely useful and the preferred method of selection by the scientific community, they do have short-comings.
  - Not directly comparable across-breeds.
  - Assume constant environmental conditions and marketing strategies for all producers
  - Decision quantification is in an additive context only
  - Not engaging—black box

DECISIONS SHOULD CONTEMPLATE MULTIPLE POPULATIONS (BREEDS)

- Beef cattle EPD of different breeds can be reported on different bases, and are therefore not directly comparable.
- In response to industry requests, the USMARC has computed and reported Across-breed EPD adjustment factors annually since 1993
- Conceptually simple to use, but can be cumbersome in practice
- Currently released on an annual basis (summer), making them out of date by the following spring when the majority of bull purchases take place, particularly if major changes are made to any national cattle evaluations by individual breeds.
- Limited to a narrow suite of traits and do not account for differences in heterosis generated by different breeds of bulls when used to breed cows of a specific breed composition.

CONUNDRUM

- Promoting the use of crossbreeding and a focus on ERT yet not delivering tools that enable this goal in a user-friendly fashion.
- Across-breed EPD adjustment factors and estimates of breed differences for traits that are not routinely evaluated must be expanded to include additional ERT and be released in a dynamic format that provides updated adjustments more frequently.

NEW EPD FOR ERT

- Recent changes to project design (including increased progeny per sire) will make it feasible to compute multibreed EPD of sires sampled in GPE for novel traits
- We aim to develop and release EPD for ERT that are not routinely collected and thus not readily available across U.S. beef breed associations through our web-based decision support platform.
- This will enable commercial cattle producers to make selection decisions using a more complete, and thus accurate, selection index.
  - Indirectly encourage an industry to ramp up the collection and utilization of phenotypic records for ERT that are currently missing from the available list of EPD.

VALUE DISCOVERY OF ADDED INFORMATION

- Many ERTs are not currently evaluated nor collected routinely in the seedstock sector
- However, they drive value downstream
  - Reproduction phenotypes (longevity)
  - Disease (pulls, treatments, mortality)
  - “Routine” carcass data
  - Plant value—primal yield, dark cutters, blood splash, etc.

GENERAL FORM FOR EPD (OR BREEDING VALUE)

- $b=G^{11}G_{12}v$
- $b=v$

CHANGE TO ACCURACY

$$r_{HI} = \frac{\boldsymbol{b'G_{12}v}}{\sqrt{(\boldsymbol{b'G_{11}b})(\boldsymbol{v'Cv})}}$$

- Upper bound of accuracy (assumes EPD accuracy of 1)
- Replacing G_{11} with P gives the lower bound of accuracy (phenotypic selection)
- As component trait accuracy increases, so does r_{HI}

MAKING (TAKING) DECISIONS

- Bull purchasing decisions are unique to each herd as producer-specific production goals and inputs vary considerably.
- CED emphasis for mating to heifers, low labor, or high levels of dystocia.
- Low-input environments where forage availability is low, selection for decreased mature size and lower milk production levels are advantageous
- Targeted market endpoint also dictates traits and production levels that are economically relevant

PAST EFFORTS

- Decision support tools that address these various scenarios have been proposed before
  - Decision Evaluator for the Cattle Industry; **DECI**; Williams and Jenkins, 1998;
  - Colorado Beef Cow Production Model; **CBCPM**; Shafer et al., 2005
- Not widely adopted due to the level of complexity and detail relative to firm-level inputs required to parameterize the underlying model.
- To achieve wide-spread use, a tiered level of input information, with default values which are customizable, from each specific user is required.

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 WORK

- In April of 2018, awarded a USDA AFRI CARE grant. Grant funding lasts for 3 years.
- 1) Develop web-based decision support tools to aid beef producers and beef breed associations in making critical selection and mating decisions including within- and across-breed selection and crossing systems.
- 2) Train key technology adopters (seedstock producers) and consultants (extension personnel, beef breed association personnel, academics) to use the decision support tools in a "train the trainer" approach to extension.
- 3) Fill existing knowledge gaps by estimating breed and heterosis effects for economically relevant traits and their indicators and estimating genetic correlations among those traits.
-

OVERALL OBJECTIVE

- The fundamental objective is to develop and provide software that enables beef producers to make more profitable genetic selection decisions, integrating additive and non-additive genetic effects, available resources, and firm-level economics.
- We will develop a web-based application to compute AB-EPD
- A producer could upload a set of EPD or select individual animals from any collaborating breed association or breeding organization and receive direct comparisons of EPD across these breeds.
- We further plan to expand the suite of traits that would be included beyond the growth and carcass merit traits that are currently available.

PROPOSED USE CASES

- Currently we have framed three possible use cases:
- Commercial buyers (genetic purchasing decisions based on firm-specific breeding objectives)
- Seedstock sellers (matching sale offering to individual customers)
- Seedstock buyers (matching genetic purchasing decisions to specified goals)

INTERFACE

- For any of these cases, the user would:
  - Identify a set of candidates for selection.
  - Enter information about their operation and cow herd in order to determine the appropriate selection index.
  - Tiered systems to accommodate different levels of knowledge
  - Increased production/economic level knowledge increases accuracy

CONCLUSION

- The impetus for this project is **not** the belief that currently available selection indices are so inherently flawed that they are of little value.
- Encouraging beef cattle producers to utilize proven tools and we believe that allowing beef cattle producers to take part in the creation of their own selection index has the potential to increase the rate of technology adoption.
- The other primary improvement is in the ability to combine multiple partial solutions (e.g., additive and non-additive genetic effects) to enable sire selection across breeds in an economic framework.

FINAL THOUGHTS

- Contemplate bull buying decisions as the capital investment that they are.
- Our goal is to enable these decisions and help alleviate the cumbersome, near impossible, task to combine all partial solutions into an optimized decision.

SURVEY

- Survey responses will be anonymous and summarized to help develop new selection tools and training programs. The survey is accessible until December 31, 2018
- https://kstate.qualtrics.com/jfe/form/SV_aXJA9F3EyMfmSpf

THANK YOU

- Beef cattle production system decision support tools to enable improved genetic, environmental, and economic resource management
- USDA NIFA award number 2018-68008-2788