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Understanding and Applying Economically Relevant Traits (ERT) and Indices for the Commercial Cattle Rancher

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INTRODUCTION

The amount of information upon which to base selection decisions has continued to increase over time as has the effort to develop tools to best use this information. From a beef industry historical perspective, initially information for selection was primarily based on pedigree, then improvements came with performance recording and the original efforts of the Beef Improvement Federation to set guidelines to standardize that performance information. Later on, with advancements in computing, combined with the historical databases of performance information genetic evaluation systems were developed to calculate expected progeny differences (EPD). Now with advancements in DNA technologies, genomic breeding value information is available. While the additional information gleaned by large-scale genetic evaluation, the resulting EPD and now DNA marker information, may better characterize animals genetically, the amount of information is often overwhelming when trying to make the best selection and purchase decisions. What is needed is a good method to wade through voluminous amounts of information to focus on improving beef production profitability.

Two approaches to wading through the wealth of information have been developed and will be outlined in this paper: Economically relevant traits (ERT) and Selection Indices.

ECONOMICALLY RELEVANT TRAITS

The best tool for selection of genetically superior seedstock is EPD. Time and again these have proven to be successful in producing genetic change in livestock populations. That said, as with performance information, the number of EPD has grown from those for birth, weaning, and yearling weight; and milk production to more than 15 EPD in some cases over the last 30 years. The increase in number of EPD was based on the presumption that EPD for more traits helped better characterize the genetic capability of potential replacement animals (Bourdon, 1988). In many instances, EPD were produced because data were cheaply and easily collected and therefore EPD **could** be calculated; yet little consideration was given to the value of those EPD. In several instances, the EPD produced often reflected the same ultimate trait of interest. For instance, birth weight and calving ease EPD are both related to or reflect the ability of an animal's progeny to be born unassisted. Having two EPD for the same trait of interest makes for a less accurate decision when both are used simultaneously

for selection. The multitude of EPD and a plethora of data on individuals with actual performance and pedigree information provided in sale catalogs results in a difficult challenge for the producer trying to make a good selection decision.

Recognizing this problem Golden et al. (2000) developed the concept of the economically relevant trait (ERT) in an effort to educate and aid producers in starting to wade through the wealth of data representing animals' genetic merit. At the base level, an ERT is a trait that is directly associated with a cost of or income from production. From a genetic improvement perspective, another way to illustrate an ERT is to consider making a genetic change in performance for a specific trait. If we can change performance in that trait one unit and that change results in a change in either income or expense, then the trait is an ERT. On the flip side, if we change a trait one unit and costs or income may or may not change, then the trait is likely an indicator trait. Dystocia, or calving difficulty provides an excellent example of the difference between an ERT and an indicator trait. The two EPD related to dystocia are birth weight and calving ease. Using both can result in a less accurate selection decision than using the one that represents the ERT. What the commercial producer wants is to reduce dystocias or incidences of calving difficulty. At lower levels of dystocia, calf survival and heifer rebreeding rates increase resulting in greater income. Therefore, calving ease is the ERT. Conversely birth weight is only an *indicator* of calving difficulty. Reflecting a bit on calving out heifers, often there are heifers that need assistance delivering an 80 pound calf, yet in other heifers delivering an 80 pound calf is no problem. Producers often consider this comparison and immediately respond that there are a whole host of other factors involved in determining whether a heifer calves unassisted or not. Potential influences beyond birth weight include pelvic size, calf shape, and heifer "try"—some heifers just seem to give up. The point is that calf birth weight does not explain all of the differences in why a heifer requires or does not require assistance at calving. Birth weight is only an indicator of calving ease and therefore should not be the focus of selection decisions designed to reduce dystocias. Calving ease is the ERT and therefore calving ease EPD reflect the ERT--calving ease—and should be used for selection decisions. As a bit of an aside, calving ease EPD are calculated with both birth weight and calving ease data, so the EPD actually account for all information on dystocias and successful deliveries.

The concept of ERT can help identify where selection pressure should be applied and what data has little value in the selection process, in turn reducing the amount of information needed to make a good selection decision. To use the concept in this manner, the producer first needs to consider their production and marketing system—what are the sources of income? What EPD represent those traits? Then consider what traits directly influence that producer's costs of production. That complete list of traits (and their EPD) are the ERT and should be the basis for making selection decisions. The other traits are likely indicators and should not be used when making selection decisions—they won't change profitability. As an example application, let's use a cow/calf producer selling calves at weaning through an auction. The value of those calves is predominantly determined by weight of the calf. In that case, the weaning weight EPD therefore reflects an ERT and should contribute to selection decisions. The yearling weight EPD does not contribute nor does the birth weight EPD—they are indicators. No consider a neighboring ranch that retains and feeds its own calves, selling directly to the packer on a grid basis. In this scenario, income is based on carcass

weight, quality and yield grades. For this WW EPD is no longer economically relevant but rather carcass weight, quality and yield grades are. Appropriate ERT are operation dependent and the concept helps narrow information for selection.

The concept of ERT can help the producer to focus selection pressure on what will directly influence profitability. Discarding, information that in the end, will not have a consistent influence on operation profitability. Yet there is another tool that takes ease of selection one step further—the selection index.

SELECTION INDEX

The selection index is a relatively old technology (Hazel, 1943) yet the methodology combined with today's EPD for ERT make an extremely attractive option for making profitable replacement selection and purchase decisions. Selection indexes combine EPD and the economic value of each ERT into a single value that represents an animal's total genetic worth, or aggregate breeding value, for those traits. That value is then used like an EPD—the difference in index value predicts differences in progeny performance. When the value of the index is in dollars the difference reflects differences in progeny value or profitability. But like EPD, there are often a variety of indexes available. The key to successful use lies in identifying the index that best suits your operation while also remembering that with selection indexes the goal is to improve multiple traits simultaneously.

Most currently available indexes are “generalized” meaning they are designed to be used by multiple breeders for specific marketing endpoints. These typically use industry economic averages to determine economic weights with most of the data historical in nature. Yet there is considerable evidence showing index selection is very successful (MacNeil, 2003; Enns and Nicoll, 2008).

The challenge for commercial producers is to choose the index that best fits their production and marketing system and then to use that appropriately, realizing that different traits will be emphasized in different indexes. To select the best index, the breeder must have identified the primary marketing endpoint for their animals (e.g. sale at weaning, after backgrounding, fats sold on a live weight basis, or marketing on a grid). For instance, a cow/calf producer selling weaned calves through an auction should select an index that emphasizes weaning weight while someone marketing calves on a quality grid after retained ownership should select an index emphasizing quality grade and carcass weight. Once those marketing conditions are identified, then compare that knowledge with the traits in each available index. The index with the most agreement with your production system is the appropriate index. The process is outlined in the numbered steps below as taken from the National Beef Cattle Evaluation Consortium's Sire Selection Manual (www.nbcec.org):

1. Identify your production and marketing system
 - a. When will the animals be marketed (at what age)?
 - b. How will the animals be marketed (private treaty, public auction, etc)?
 - c. What is the current performance and genetic level of your herd?

2. Identify an index appropriate to the production system outlined in #1
 - a. Questions to be addressed
 - i. What traits are included in the index?
 - ii. What are the relative economic values used to weight the traits (or at least what data is used to estimate cost of production and value of income sources)
3. Decide on the appropriate index for evaluation based on the most similarity between points 1 and 2.
4. Evaluate index based on past performance and economic data (very difficult, so is listed as “optional”)

For those skeptical of index selection, item number 4 provides a measure of confidence in a particular index, answering the question “Does this index produce results consistent with my production system?”

Realize that with generalized indexes, even for one suited to your marketing system, some traits may be emphasized that you do not need to change. For instance, weaning indexes often value calving ease. If your production system has no problem with calving difficulty, further change in that trait is not be required. Conversely, generalized indexes often do not emphasize all traits that you deem important. In those cases it is necessary to use EPD for those additional traits in addition to the index value to emphasize those traits not included. Even with the need to emphasize those traits separately, an index will combine information on multiple traits simultaneously to ease the process of selection and help the commercial producer limit the amount of information considered to make good selection decisions.

CONCLUSION

Both the concept of economically relevant traits and the selection index can help producers reduce the amount of information needed to make good selection decisions. By reducing the number of traits considered, the producer can make faster progress than otherwise possible. The use of selection indexes further reduces the amount of information needed to make profitable selection decisions.

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