Usage and Interpretation of Genetic Information

What is an EPD?

"EPD" is an acronym for the term "Expected Progeny Difference". It is a prediction of the difference between the average performance of future progeny of an animal and the average performance of a theoretical reference animal (an animal with an EPD of zero). To make this comparison fair, one must assume that mates are genetically similar and that all animals are raised in similar environments.

For example, a particular sire might have an EPD of +4.0 for birth weight. This means that he is expected to produce calves that are 4.0 pounds heavier, on average, than the theoretical reference bull who has an EPD of zero for birth weight.

However, it is more meaningful to use EPDs to compare the genetic merit of two different bulls within the same breed. For example, assume that Sire A has a weaning weight EPD of +40 and Sire B has a weaning weight EPD of +20. Based on this information, Sire A would be expected to produce calves that are 20 pounds heavier (40-20=20), on average, than the calves of Sire B.

EPDs are simply designed to compare the genetic merit of animals for a particular trait, nothing more.

What advantages do EPDs have over actual data of the individual or within herd ratios?

EPD's include performance information (weights) on the individual, ancestors (sire and dam, grandsire, great grandsire, maternal grandsire, etc.), relatives or siblings, and progeny (for those who are old enough to have produced offspring). Data is adjusted to account for environmental differences. There is simply more information from which a genetic estimate can be determined.

Ratios are measures of individual performance compared to the within-herd average. They contain no pedigree or progeny information and are only appropriate for comparing animals within the same herd or contemporary group. EPDs, however, are calculated using all sources of information: pedigree, individual performance, and progeny performance. EPDs are comparable across herds within a given breed.

How can we compare EPDs on animals in different herds if their calves were raised in different environments?

Genetic relationships exist between animals of different herds, and statistical procedures account for performance differences that exist between genetically similar animals due to environmental differences.

How much do EPDs depend on pedigree vs. own performance vs. progeny information?

The relative importance of these sources of information depends on the amount of information available from each source. The EPDs of young animals (low accuracy) will be based entirely on pedigree and individual performance information. EPDs for animals with large numbers of progeny (high accuracy) will be based primarily on progeny information.

Do EPDs reflect absolute changes in the offspring?

No. EPDs are not additive, they are used to compare differences between two animals. If over the course of 4 years you use a different bull each year (with birth weight EPDs of +2, +3, +5, and +5), you have NOT added 15 lbs of actual birth weight to your calf crop. By difference, you have added only 5 lbs of birth weight to your calves, and that assumes you were using a bull with a low birth weight EPD of zero before purchasing the new bulls.

Isn't zero considered to be the average value for an EPD?

Although zero represents the theoretical average value for an EPD, it rarely represents the breed average. The reason for this is that zero represents the average or base value of foundation animals or animals within the year (base year) that EPDs were initially established for the breed. The base does not change over time despite genetic change within the breed. Thus, as breeders make genetic progress, the breed average value for EPDs will move away from zero. However, because the base remains constant, a given EPD will always have the same biological interpretation.

For example, a bull born in 1980 with an EPD of +10 for weaning weight has the same genetic ability for preweaning growth as a bull born in 2000 with an EPD of +10 for weaning weight. However, in 1980, a bull with a +10 EPD for

weaning weight may have been above the breed average; today, the bull with a +10 EPD for weaning weight may be far below the breed average.

Can EPDs be compared across breeds?

For all practical purposes, no. Different breeds have different bases (zero points). This makes it difficult to compare EPDs, but conversion tables are available that allow comparisons of EPDs across breeds. Without these conversion tables, which may be open to some error, we cannot compare EPDs across breeds.

Is the breed average important?

Most sire summaries will publish the average EPD and a range of EPDs for each of their traits. Although EPDs are used to compare the genetic merit of different animals, knowing the breed average and percentile rankings of bulls within the summary will allow producers to more accurately assess both the genetic and economic worth of a sire compared to all sires within the breed.

What is a "significant" difference in EPDs?

A mistake that breeders often make that is often perpetuated through livestock judging contests is to interpret small differences in EPDs as being meaningful. A sire with a yearling weight EPD of +45 might be genetically faster growing than a sire with a +40 yearling weight EPD, but a 5-pound difference will be undetectable in most herds. However, a 5-pound difference in a birth weight EPD (+7 vs. +2) will be very significant.

If I use a bull with a negative EPD for a particular trait, will that trait decrease in my herd?

Let's use the EPD for carcass weight as an example. A negative EPD does not automatically imply that you will decrease carcass weights of your cattle; it depends on the genetic merit of your current sires compared to the proposed sire. Remember, all EPD values must be compared between animals to determine if an increase or decrease in the trait is expected, regardless of whether the EPD value is positive or negative.

What EPDs are best?

It depends! It depends on the genetics of your current cow herd. It depends on the goals of your operation. It depends on your environment. Even if you wish to enhance growth, the highest growth EPDs may not be best for your herd, long-term. Many traits are interrelated. For example, when growth is increased, often birth weights and associated dystocia problems can be increased as well. When we enhance milk production, maintenance costs of the cow herd will increase and reproductive performance will decrease if our feed resources are limited. One of the most enduring challenges in beef cattle breeding is to determine the best balance of trait levels (and associated EPDs) for a given environment and clientele.

What is meant by accuracy?

The accuracy value reflects the amount and relevance of information used to calculate an individual EPD. Accuracy values range from zero (very poor) to one (extremely accurate). Accuracy measures the reliability of an EPD. EPDs with accuracy values greater than 0.8 are highly reliable; there is little risk that performance of progeny will differ from what the EPDs indicate. On the other hand, the average progeny performance of an individual with low accuracy values (< .40) may be quite different from what his EPDs suggest. Young sires whose EPDs are based primarily on pedigree and individual performance information have low accuracy values. As progeny information becomes available, the EPDs will be adjusted to reflect the true genetic merit of that animal and accuracy values will increase.

Selected Beef Cattle EPD definitions:

1) **Birth Weight**: predicts differences in birth weights of calves, larger values may be indicative of potential dystocia problems when used on heifers, measured in pounds of calf.

2) **Weaning Weight**: predicts differences in weaning weights of calves due to the direct growth genetics of the calf, measured in pounds of calf.

3) **Maternal Milk**: predicts differences in weaning weights of calves due to differences in milk production of the dam, measured in pounds of calf. Example: If Sire A = +10 and Sire B = -5, then you would expect calves from the daughters of Sire A to average 15 pounds heavier at weaning than the calves from the daughters of Sire B due to differences in milk production, on average.

4) **Total Maternal**: weaning weights are the result of both direct growth genetics of the calf plus maternal milking ability of the dam. Thus the total maternal EPD combines these two values (weaning weight EPD and the maternal milk EPD) into a single value. It is calculated as the (maternal milk EPD + ½ of the weaning weight EPD). This EPD value is given different names dependent upon the breed association – maternal weaning weight, total maternal, combined maternal, milk and growth, etc.

5) **Yearling Weight**: predicts differences in yearling weights of cattle, it is a measurement of direct growth post-weaning and is often used to reflect potential performance of market-bound progeny in the feedlot, measured in pounds of calf.

6) **Scrotal Circumference**: some breeds publish scrotal circumference EPDs that predict differences in scrotal circumference of male progeny; expressed in cm. Higher values are indicative of greater testicular development and fertility at 12 months of age. Daughters of sires with greater scrotal circumference values also tend to reach puberty at younger ages.

7) **Stayability**: This EPD is the probability that a sire's daughters will remain in the herd for at least 6 years. Example: If Sire A = +15 and Sire B = +5, then the daughters of Sire A have a 10% greater probability of remaining in production for at least 6 years compared to the daughters of Sire B. Since most females are culled for reproductive reasons, this EPD value provides an indication of fertility.

8) **Gestation Length**: measured in days, smaller or negative values represent shorter gestation periods. More importantly, cows with shorter gestation periods have more days for recovery post-calving. Theoretically, it should be easier for them to rebreed in a timely fashion.

9) **Heifer Pregnancy**: expressed as a probability or percentage. Higher values indicate that a sire's daughters are more likely to become pregnant and successfully enter the cowherd compared to the daughters of bulls with a lower heifer pregnancy EPD value. Example: If Sire A = +10 and Sire B = 0, then the daughters of Sire A are 10% more likely to become pregnant and successfully enter the cowherd.

10) **Mature Size EPDs**: These include the yearling hip height (measured in inches), mature hip height of daughters (measured in inches), and mature weight of daughters (measured in pounds). These types of EPDs are designed to provide information regarding mature size of the potential offspring. Desired values for an individual operation depend on their goals, feed availability, and current average cow size of their herd. Larger mature size is often associated with greater maintenance

requirements.

11) **Mature Cow Maintenance**: Higher values indicate that mature cows generated from this sire will be more likely to maintain adequate body condition, which is critical for maintaining reproductive performance.

12) **Carcass Weight**: measured in pounds of hot carcass weight. Example: If Sire A = +15 and Sire B = +5, then the offspring of Sire A should produce carcasses that average 10 lbs more than those of Sire B at an age constant endpoint. This EPD will become more important if the window of acceptable carcass weights narrow in the market place.

13) **Ribeye Area**: expressed in units of square inches. Larger values indicate greater ribeye areas and muscle mass, but offspring must be compared on an age-constant basis. Also, bigger is not necessarily better; it depends upon your marketing criteria.

14) **Fat Thickness**: expressed in inches of backfat. Smaller values would indicate less fat and potentially greater cutability; again, cattle must be compared on an age-constant basis. Caution – if you select cattle that are too lean, it could lead to problems with quality (feedlot cattle) and fleshing ability (breeding cattle).

15) **Percent Retail Product**: expressed as a percentage. Combines carcass traits (hot carcass weight, fat thickness, ribeye area, and % kidney, pelvic, and heart fat) into a composite EPD to detect differences in cutability. It is heavily influenced by fat thickness, which accounts for a majority of the variation between animals.

16) **Yield Grade:** expressed in units of Yield Grade. It combines carcass traits (hot carcass weight, fat thickness, ribeye area, and % kidney, pelvic, and heart fat) into a composite EPD to detect differences in cutability. To enhance cutability or yield grades, negative values are desired since Yield Grades range from 1 to 5 where 1 represents high cutability and 5 represents a low cutability.

17) **Marbling Score**: expressed in units of a marbling score. Example: If Sire A = +.25 and Sire B = -.25, then the offspring of Sire A should produce carcasses that average a half marbling score greater than the carcasses produced from the offspring of Sire B. In realistic terms, if the progeny of Sire B produce carcasses with an average marbling score of Slight^{70} (High Select), then you could expect the progeny of Sire A to produce carcasses with an average marbling score of Small^{20} (Low Choice). Depending on the market, this could be worth $20/cwt of carcass weight! This assumes that bulls are bred to the same group of cows and the feedlot cattle are fed and handled under the same environmental conditions.

18) **% IMF**: expressed as a percentage of intramuscular fat. This EPD provides an indication of differences in intramuscular fat (marbling) based upon ultrasound measurements that is genetic and will be passed onto a sire's offspring.

19) **$Weaned Calf:** expressed in $/head. This index predicts combines birth weight, weaning weight, maternal milk, and mature cow size to predict the value differences in pre-weaning performance of their progeny. Example: Sire A = +25, Sire B = +15; the progeny of Sire A should have a $10/head advantage in pre-weaning value compared to the progeny of Sire B, on average.

20) **Cow Energy Value ($EN):** expressed as annual dollar savings per cow. This index is used to assess differences in cow energy requirements. Factors used to calculate this value include

differences energy requirements for lactation (milk production) and mature body size. Larger values are desired; more dollars "saved" on feed energy expenses.

21) **$Feedlot:** expressed in $/head. This index predicts the value differences associated with the post-weaning performance of future progeny. Example: Sire A = +30, Sire B = +10; the progeny of Sire A should generate $20 more value than the progeny of Sire B through the feedlot phase, on average. This increase in economic value will likely be associated with increased gains and efficiency of gain. The index assumes that bulls would be bred to the same cows and the feedlot cattle would be fed under identical environmental conditions.

22) **$Grid:** expressed in $/head. This index predicts the value differences of cattle when sold on a carcass grid merit using Certified Angus Beef standards. The index assumes that bulls are bred to genetically similar cows and cattle are fed under identical environmental conditions.

23) **$Beef:** expressed in $/head. This index effectively combines the $Feedlot and $Grid values because it predicts expected value differences in future progeny performance for post-weaning and carcass value, combined. The index assumes that bulls are bred to genetically similar cows and cattle are fed under identical environmental conditions.

24) **Terminal Sire Profitability Index:** expressed in dollars of profitability/head. This index is used with the Charolais breed, and it assumes that all offpsring will be fed out and marketed on a carcass merit system.