SDSU Extension

BEEF

Chapter 40

Understanding EPDs and How to Use Them

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Introduction

An expected progeny difference (EPD) is the predicted performance of an individual's future progeny. Progeny performance is determined by many factors, including genetics, management, nutrition, and other environmental effects. However, the only factor directly transmitted from an individual to his or her progeny is the individual's genetics. Nutrition, management, and disease prevention decisions are made by the producer without concern for the passage of generations. Thus, EPDs predict the genetic value of an individual as a parent. An EPD can be predicted for any trait with performance records that are routinely collected by breeders. As we shall learn later, EPDs can also be predicted by direct investigation of an individual's DNA; we call these predictions genomic EPDs. We can use performance records from individuals together with those from any relatives (i.e., parents, grandparents, half-sibs, full-sibs, progeny, and more distant relatives) to calculate the individual's EPD.

Why should we use EPDs?

Although performance data and ratios can be used directly for genetic selection, EPDs will be a more accurate prediction of genetic merit than the performance data. The main reason is because EPDs can remove the effects of nutrition, management, and other environmental effects, leaving only genetic effects that can be transmitted to an individual's offspring. An animal's performance for a trait is a combination of genetic and environmental effects. For example, we may wish to compare genetic merit for three bulls: A, B, and C. Herd 1 uses semen from bulls A and B while herd 2 uses semen from bulls B and C (Figure 1). In Figure 1, the mean weaning weights of the progeny from each bull in each herd are reported.

If we select based on only performance data, we would likely select Bull A. His progeny weighed on average 660 lbs at weaning, which is considerably better than the progeny sired by Bull B (average performance of 590 lbs) and Bull C (600 lbs). However, clearly Herd 1 is producing calves that weigh heavier at weaning than

Herd 1	Herd 2
Bull A = 660 lbs.	Bull B = 550 lbs.
Bull B = 630 lbs.	Bull C = 600 lbs.

Figure 1: Demonstration of why EPDs should be used for genetic selection when EPDs are available. If we used only performance data, we would conclude bull A produces progeny that weigh heavier at weaning than bulls B and C. However, clearly herd 1 produces heavier calves at weaning than herd 2 (see performance of bull B in both herds). After adjusting for herd effects, bull C is clearly the genetically superior bull for weaning weight.

Herd 2. You can see this herd effect most clearly by comparing calves produced by Bull B in both herds. Calves sired by Bull B in Herd 1 weighed on average 630 lbs while calves sired by Bull B in Herd 2 weighed on average only 550 lbs, an 80 lbs difference between the herds. For a more fair comparison among bulls, we can adjust performance values for Herd 2 by 80 lbs. Thus, the adjusted performance for Bull B in Herd 2 is 630 lbs (same as Herd 1) and the adjusted performance for Bull C is 680 lbs. After adjusting for the herd effect, you would probably select Bull C instead of Bull A!

When breed associations calculate EPDs, they simultaneously adjust for not only herd effects, but also the effects of the genetic merit of mates, age, season of birth, year of birth, nonrandom mating, and other non-genetic effects on performance data. By accounting for these effects, the accuracy of selection when using EPDs can result in a substantial improvement over using performance data for basing selection decisions. Although EPDs are not always available, EPDs should be used exclusively when making selection decisions when available. Using performance data when EPDs are available will result in decreased accuracy of selection and thus slower rates of genetic improvement.

Accuracy of EPDs

Accuracies of EPDs are important and should be accounted for when selecting animals when the risk of an incorrect selection decision has economic consequences. Semen from a proven bull with many progeny records and genetically superior EPDs will cost more than semen from a yearling bull that also has genetically superior EPDs. The reason is because we are more confident that the EPDs on the proven bull reflect his true genetic merit. EPD accuracy measures the selection risk that a producer assumes when selecting the animal to produce offspring. If accuracy is low, the producer assumes more risk that the animal's EPD is not a very accurate prediction of genetic merit. If accuracy is high, the animal's EPD is a more accurate prediction of genetic merit and the producer assumes less risk when selecting that animal. Accuracies range from 0 to 1, where 1 is the highest accuracy possible.

You can improve EPD accuracy by accurate recording of performance records, collection of performance records on not only the individual of interest but also his or her relatives, and DNA testing. Generally, it is relatively more difficult to increase accuracy of EPDs on females than males because males can produce many more progeny throughout their lifetimes. Given the same number of collected performance records, accuracies of EPDs may still vary among traits. All other things being equal, highly heritable traits (e.g., carcass merit) will reach higher accuracies with fewer records than lowly heritable traits (e.g., fertility). However, because carcass traits are not as widely reported as weight traits, accuracies of carcass merit EPDs will usually be lower than weight trait EPDs.

Producers do not necessarily need to use only sires with highly accurate EPDs. Yearling bulls, almost by definition, cannot have EPD with high accuracy because achieving high accuracy requires progeny or a highly accurate DNA test. Good reasons exist for using sires with lowly accurate EPDs, including cost of the bull or semen from the bull. When using bulls with lowly accurate EPDs, producers should mitigate selection risk by 1) using a larger number of sires with lowly accurate EPDs and 2) setting higher selection thresholds when selecting young bulls. For example, you might choose to purchase semen from three proven bulls in the top 25% of current sires for weaning weight EPD. However, if you choose to purchase semen from young bulls, you might purchase semen from seven bulls and set a more stringent threshold of the top 10% of available young bulls. Although each individual bull has a lowly accurate EPD, the accuracy of the average EPD of all seven bulls is much higher than the accuracy of any one of these bull's EPDs. This approach ensures that if one young bull's true genetic merit is substantially worse than the bull's EPD, that young bull will sire a smaller fraction of calves.

Accuracies can be converted to confidence ranges, which some producers find easier to interpret than accuracies. A confidence range represents the accuracy of the EPD in units of the trait. For example, if the 68% confidence range for an individual's weaning weight EPD is +20 and +40 lbs.\, then we are 68% confident that the individual's true weaning weight EPD is between +20 and +40 lbs. Accuracy of an EPD is inversely proportional to the size of the confidence interval. For example, a highly accurate EPD will have a narrow 68% confidence range while a lowly accurate EPD will have a broader 68% confidence range.

Producers who wish to use 68% or 95% confidence range will need to calculate confidence ranges themselves using possible change tables published by breed associations (Table 4). Each breed association publishes its own possible change table and it's not appropriate to use a possible change table published by one breed association for other breeds. First, you find the accuracy of the EPD of interest in the first column of the table. The accuracies are listed in 0.05 increments; if the accuracy of your EPD is not listed, round to the closest listed accuracy value. Then go across the row closest to the accuracy of your EPD to find the possible change value for the EPD of interest. If you wish to calculate a 68% confidence range, you can use this possible change value directly. If you wish to calculate a 95% confidence range, you need to multiply the listed possible change value by 2. Finally, subtract the possible change value to the animal's EPD to obtain the lower boundary of the confidence range, and add the possible change value to the animal's EPD to obtain the upper boundary of the confidence range.

For example, we may wish to calculate a 68% confidence range for an American Angus bull with a weaning weight EPD = +30 lbs and an accuracy of this EPD = 0.50. According to Table 4, the possible change value for this accuracy for a weaning weight EPD = 5.8. This bull's 68% confidence range for his weaning weight EPD is therefore between 24.2 lbs and 35.8 lbs. We would be 68% confident that this bull's true progeny difference for weaning weight is between 24.2 lbs and 35.8 lbs. If we wanted to calculate a 95% confidence range, we would repeat the above steps except we would multiply the possible change value by two.

What information is used to calculate EPDs?

An EPD can be calculated based on performance records of an individual and his or her relatives. The accuracy of the EPD depends on the source of performance records (e.g., individual's own record(s), half-sibs, progeny), number of records, the trait heritability, and whether performance records are collected on the economically relevant or indicator trait.

1. Source of performance records. Performance records of an individual and his or her relatives can be used to calculate EPDs. Closer relatives provide more information than more distant relatives; for example, performance records of an individual's parents will provide more information than records of an individual's grandparents. Performance information on relatives can be valuable for genetic prediction. Given heritability of 0.05, a single performance record on an individual results in an equivalent accuracy of genetic prediction as 20 records on the individual's half-sibs. In fact, 20 progeny performance records for a trait with heritability of 0.05 results in accuracy of genetic prediction that is about twice the accuracy of a single performance record on the individual itself! For this reason, AI studs progeny test bulls to more accurately estimate their genetic merit.

2. Number of records. Increasing number of records will generally result in higher selection accuracy. However, when selection accuracy approaches one, adding additional performance records results in little improvement in EPD accuracy.

3. Trait heritability. Additive genetic variation explains a larger percentage of performance differences for highly heritable traits than for lowly heritable traits. Thus, an individual performance record for a highly heritable trait

provides more information than an individual performance record for a lowly heritable trait. For example, achieving a selection accuracy of 0.80 will require more performance records for a lowly heritable trait relative to a trait with a higher heritability.

4. Are performance records collected on the economically relevant trait or an indicator trait? Many beef producers select bulls with low birth weight EPDs to reduce dystocia, especially among first-calf heifers. The economically relevant trait, however, is not birth weight. Birth weight is an indicator trait for calving ease, which is the economically relevant trait. Birth weight is genetically correlated with calving ease; heavier birth weight genetics is correlated with increased genetic risk of dystocia. Beef producers select for lower birth weight EPDs because they want to reduce dystocia, not because birth weight itself is economically relevant. (Producers receive no income and incur no expenses for the a calf's birth weight!)

Selection accuracy of an EPD will be higher when performance records on the economically relevant trait are used instead of the indicator trait, all else being equal. However, good reasons sometimes exist for using indicator traits instead of the economically relevant trait. In the example above, many breed associations do not require reporting of calving ease data, but almost all breed associations require reporting of birth weights. As a consequence, most breed associations do not calculate calving ease EPDs. Individual breeders would be justified in selecting on birth weight EPDs when calving ease EPDs are unavailable.

How to use and interpret EPDs

An EPD is only useful when comparing two or more individuals or an individual to the breed as a whole. For example, if a bull has a weaning weight EPD = +30 lbs, this number is not meaningful by itself. Certainly, we hope a bull will not sire calves that weigh 30 lbs at weaning! We don't know the breed of the bull and we are not comparing this herd bull to other individuals. In contrast, if we know weaning weight EPDs for two bulls of the same breed, then we can predict the relative weight of the progeny of each bull at weaning. For example, bull A has a weaning weight EPD = + 40 lbs and bull B has a weaning weight EPD = + 30 lbs. Both bulls are the same breed, so we can directly compare the EPDs of both bulls. On average, bull A's progeny are expected to weigh 10 lbs more at weaning than the progeny from bull B (40-30 = 10 lbs).

You can also compare an individual animal to recorded animals of the same breed as a whole. Each breed association publishes breed average EPD (Table 1) and percentile ranking tables (Table 2). For example, black Angus bull A has a weaning weight EPD = +35 lbs. Table 1 lists the breed average EPDs for various categories of sires and dams in the American Angus breed. Assume bull A is a current sire, which is defined as a sire with at least one calf in the herd book within the last two years (Table 1). Because +35 lbs is 12 lbs below the average weaning weight EPD for current sires, we conclude that bull A is expected to produce progeny that weigh on average 12 lbs. less at weaning than an average American Angus current sire. We can obtain a more detailed comparison of how this bull ranks to the American Angus breed using percentile rankings (Table 2). Notice from Table 2 that a weaning weight EPD = + 35 lbs is equivalent to the top 85-90% of current sires in the American Angus breed, which is near the bottom of current sires.

To compare animals from different breeds, use a breed adjustment factor. Each year, the United States Department of Agriculture's Meat Animal Research Center publishes a table of breed adjustment factors used for comparing beef animals across breeds (Table 3). To compare EPDs across breeds, you add or subtract the EPDs for each breed you are comparing by the appropriate adjustment factor in this table. For example, we want to compare weaning weight EPDs for Hereford bull A (+45 lbs) and Charolais bull B (+25 lbs). The appropriate adjustment factor for Herefords is -3.5 and for Charolais is 38.1. We therefore subtract 3.5 from the EPD of the Hereford bull (45 – 3.5 = 41.5 lbs). Similarly, we add 38.1 to the EPD of the Charolais bull (25 + 38.1 = 63.1 lbs). We can then directly compare the EPDs between the two bulls. Thus, the Charolais bull B is expected to produce progeny that weigh on average 21.6 lbs heavier than Hereford bull A at weaning.

Table 1: Spring 2014 average EPDs published by the American Angus Association for current sires.[1,2]

CED	BW	WW	YW	RADG	YH	SC	Doc	HP	CEM	Milk	MW	MH	CW	Marb	RE	Fat
+5	+1.7	+47	+84	+0.16	+0.5	+0.73	+10	+8.6	+8	+23	+29	+0.3	+26	+0.43	+0.36	+0.01

[1] Published by the American Angus Association on their website, http://www.angus.org/nce/breedaverageepds.aspx, retrieved on 05/30/2014.
[2] Current sires is defined by the American Angus Association as a sire with at least one calf present in the herd book within the last two years.
CED = calving ease direct; BW = birth weight; WW = weaning weight; YW = yearling weight; RADG = residual average daily gain; YH = yearling height; SC = scrotal circumference; Doc = docility; HP = heifer pregnancy rate; CEM = calving ease maternal; MW = mature weight; MH = mature height; CW = carcass weight; Marb = marbling; RE = ribeye area

Table 2: Spring 2014 percentile breakdown of EPDs for current sires of the American Angus Association.[1,2]

Top Pct	CED	BW	WW	YW	RADG	YH	SC	Doc	HP	CEM	Milk	MW	MH	CW	Marb	RE	Fat
1%	+16	-2.9	+73	+125	+0.31	+1.3	+2.11	+32	+15.6	+15	+38	+100	+1.3	+57	+1.20	+1.09	-0.054
2%	+14	-2.2	+70	+120	+0.29	+1.2	+1.93	+29	+14.7	+14	+36	+91	+1.1	+54	+1.08	+0.99	-0.046
3%	+14	-1.9	+68	+117	+0.28	+1.1	+1.82	+28	+14.2	+14	+35	+86	+1.0	+51	+1.01	+0.93	-0.041
4%	+13	-1.6	+66	+114	+0.27	+1.1	+1.73	+27	+13.8	+13	+34	+82	+1.0	+49	+0.95	+0.89	-0.037
5%	+13	-1.4	+65	+112	+0.26	+1.0	+1.66	+26	+13.5	+13	+34	+77	+0.9	+48	+0.91	+0.86	-0.033
10%	+11	-0.6	+61	+106	+0.23	+0.9	+1.44	+22	+12.3	+12	+31	+65	+0.8	+42	+0.78	+0.74	-0.024
15%	+10	-0.1	+58	+102	+0.22	+0.8	+1.30	+20	+11.5	+11	+30	+58	+0.7	+39	+0.70	+0.67	-0.017
20%	+10	+0.2	+56	+99	+0.21	+0.8	+1.19	+18	+10.9	+11	+29	+52	+0.6	+36	+0.64	+0.61	-0.012
25%	+9	+0.6	+55	+96	+0.20	+0.7	+1.09	+17	+10.4	+10	+28	+48	+0.6	+34	+0.59	+0.56	-0.008
30%	+8	+0.8	+53	+94	+0.19	+0.7	+1.00	+15	+9.9	+10	+27	+43	+0.5	+32	+0.55	+0.51	-0.004
35%	+8	+1.1	+52	+91	+0.18	+0.6	+0.93	+14	+9.5	+10	+26	+39	+0.5	+30	+0.51	+0.47	+0
40%	+7	+1.3	+50	+89	+0.17	+0.6	+0.86	+13	+9.1	+9	+25	+36	+0.4	+29	+0.48	+0.43	+.003
45%	+6	+1.5	+49	+87	+0.16	+0.6	+0.79	+12	+8.8	+9	+25	+33	+0.4	+27	+0.44	+0.39	+.006
50%	+6	+1.8	+48	+85	+0.16	+0.5	+0.72	+11	+8.5	+8	+24	+30	+0.3	+26	+0.41	+0.35	+.010
55%	+5	+2.0	+46	+83	+0.15	+0.5	+0.65	+10	+8.2	+8	+23	+26	+0.3	+24	+0.38	+0.32	+.013
60%	+5	+2.2	+45	+81	+0.14	+0.4	+0.58	+9	+7.9	+7	+22	+23	+0.2	+23	+0.34	+0.28	+.016
65%	+4	+2.5	+44	+78	+0.13	+0.4	+0.51	+7	+7.6	+7	+22	+19	+0.2	+21	+0.31	+0.25	+.020
70%	+3	+2.7	+42	+76	+0.13	+0.3	+0.43	+6	+7.3	+6	+21	+15	+0.1	+19	+0.28	+0.20	+.024
75%	+3	+3.0	+40	+73	+0.12	+0.3	+0.35	+5	+6.8	+6	+20	+10	+0.1	+17	+0.25	+0.16	+.027
80%	+2	+3.2	+39	+70	+0.11	+0.2	+0.26	+3	+6.4	+5	+18	+6	+0	+15	+0.21	+0.11	+.032
85%	+1	+3.6	+36	+66	+0.10	+0.2	+0.16	+1	+5.8	+5	+17	+0	+0	+13	+0.17	+0.06	+.037
90%	-1	+4.0	+33	+61	+0.08	+0	+0.03	-2	+5.0	+3	+15	-7	-0.1	+10	+0.11	-0.01	+.044
95%	-3	+4.7	+27	+51	+0.06	-0.2	-0.17	-6	+3.8	+2	+12	-21	-0.3	+4	+0.04	-0.11	+.055

[1] Published by the American Angus Association on their website, http://www.angus.org/nce/percentbreakdown.aspx, retrieved on 05/30/2014.
[2] Current sires is defined by the American Angus Association as a sire with at least one calf present in the herd book within the last two years.
CED = calving ease direct; BW = birth weight; WW = weaning weight; YW = yearling weight; RADG = residual average daily gain; YH = yearling height; SC = scrotal circumference; Doc = docility; HP = heifer pregnancy rate; CEM = calving ease maternal; MW = mature weight; MH = mature height; CW = carcass weight; Marb = marbling; RE = ribeye area

Table 3: Across breed adjustment factors for comparing EPDs across breeds.[1]

Breed	BW	WW	YW	Milk	Marbling Score	REA	Fat Thickness
Angus	0.0	0.0	0.0	0.0	0.00	0.00	0.000
Hereford	2.7	-3.5	-23.6	-17.1	-0.32	-0.09	-0.050
Red Angus	3.4	-23.2	-27.9	-3.9	-0.30	-0.08	-0.029
Shorthorn	5.8	11.3	38.8	20.2	-0.16	0.21	-0.142
South Devon	3.2	-4.8	-6.6	-0.3	0.08	0.16	-0.111
Beefmaster	6.3	35.7	29.5	9.9	---	---	---
Brahman	11.0	42.8	5.9	23.2	---	---	---
Brangus	4.5	14.6	6.0	5.8	---	---	---
Santa Gertrudis	6.6	36.2	48.3	12.4	-0.66	-0.05	-0.116
Braunvieh	1.9	-21.6	-42.3	0.1	-0.67	0.22	-0.102
Charloais	8.6	38.1	45.3	6.9	-0.44	1.02	-0.220
Chiangus	2.2	-20.5	-40.2	4.7	-0.45	0.45	-0.157
Gelbvieh	2.7	-18.2	-25.6	3.6	-0.41	0.78	-0.136
Limousin	3.8	-1.8	-35.9	-8.7	-0.71	1.09	---
Maine-Anjou	4.2	-15.3	-36.7	-6.8	-0.84	0.95	-0.229
Salers	1.8	-4.8	-19.5	2.2	-0.10	0.79	-0.207
Simmental	3.7	-5.9	-10.9	-0.8	-0.42	0.53	-0.141
Tarentaise	1.7	30.3	20.3	24.1	---	---	---

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

[1] Adjustment factors were calculated by Dr. Larry Kuehn and Dr. Mark Thallman at the USDA-Meat Animal Research Center, Clay Center, NE and are freely available.

Table 4: Possible change table published by the American Angus Association for calculating EPD confidence ranges. Each breed association publishes their own possible change table; thus, this particular possible change table only applies to registered American Angus cattle.[1]

Accuracy	CED	BW	WW	YW	RADG	YH	SC	Doc	HP	CEM	Milk	MW	MH	CW	Marb	RE	Fat
0.05	7.8	2.49	11.0	16.2	0.082	0.41	0.70	14.7	6.0	9.3	9.2	38	0.62	18	0.28	0.31	0.041
0.10	7.2	2.36	10.4	15.3	0.078	0.39	0.66	13.9	5.7	8.8	8.7	36	0.58	17	0.26	0.29	0.039
0.15	6.7	2.23	9.9	14.5	0.074	0.37	0.62	13.2	5.4	8.3	8.2	34	0.55	16	0.25	0.27	0.037
0.20	6.2	2.10	9.3	13.6	0.069	0.35	0.59	12.4	5.0	7.8	7.8	32	0.52	15	0.24	0.26	0.035
0.25	5.8	1.97	8.7	12.8	0.065	0.32	0.55	11.7	4.7	7.3	7.3	30	0.49	14	0.22	0.24	0.033
0.30	5.4	1.84	8.1	11.9	0.061	0.30	0.51	10.9	4.4	6.8	6.8	28	0.45	13	0.21	0.23	0.030
0.35	5.1	1.71	7.5	11.1	0.056	0.28	0.48	10.2	4.1	6.3	6.3	26	0.42	12	0.19	0.21	0.028
0.40	4.7	1.58	7.0	10.2	0.052	0.26	0.44	9.4	3.7	5.8	5.8	24	0.39	12	0.18	0.19	0.026
0.45	4.3	1.44	6.4	9.4	0.048	0.24	0.40	8.6	3.4	5.4	5.3	22	0.36	11	0.16	0.18	0.024
0.50	3.9	1.31	5.8	8.5	0.043	0.22	0.37	7.9	3.1	4.9	4.9	20	0.32	10	0.15	0.16	0.022
0.55	3.5	1.18	5.2	7.7	0.039	0.19	0.33	7.1	2.8	4.4	4.4	18	0.29	9	0.13	0.15	0.020
0.60	3.2	1.05	4.6	6.8	0.035	0.17	0.29	6.4	2.5	3.9	3.9	16	0.26	8	0.12	0.13	0.017
0.65	2.7	0.92	4.1	6.0	0.030	0.15	0.26	5.6	2.2	3.4	3.4	14	0.23	7	0.10	0.11	0.015
0.70	2.4	0.79	3.5	5.1	0.026	0.13	0.22	4.8	1.9	2.9	2.9	12	0.19	6	0.09	0.10	0.013
0.75	2.0	0.66	2.9	4.3	0.022	0.11	0.18	4.1	1.6	2.4	2.4	10	0.16	5	0.07	0.08	0.011
0.80	1.6	0.53	2.3	3.4	0.017	0.09	0.15	3.3	1.3	2.0	1.9	8	0.13	4	0.06	0.06	0.009
0.85	1.2	0.39	1.7	2.6	0.013	0.06	0.11	2.6	1.0	1.5	1.5	6	0.10	3	0.04	0.05	0.007
0.90	0.8	0.26	1.2	1.7	0.009	0.04	0.07	1.8	0.7	1.0	1.0	4	0.06	2	0.03	0.03	0.004
0.95	0.4	0.13	0.6	0.9	0.004	0.02	0.04	1.1	0.4	0.5	0.5	2	0.03	1	0.01	0.02	0.002

[1] Published by the American Angus Association on their website, http://www.angus.org/Nce/Accuracy.aspx, retrieved on 05/30/2014.

CED = calving ease direct; BW = birth weight; WW = weaning weight; YW = yearling weight; RADG = residual average daily gain; YH = yearling height; SC = scrotal circumference; Doc = docility; HP = heifer pregnancy rate; CEM = calving ease maternal; MW = mature weight; MH = mature height; CW = carcass weight; Marb = marbling; RE = ribeye area

Because EPDs change, the breed average, percentile ranking, and across-breed adjustment tables will also change over time. Thus, you should always refer to the most recently published breed average, percentile ranking, and breed adjustment tables. Do not be concerned with the absolute numbers of the EPDs. Although it may seem strange to state that an animal's weaning weight EPD is 30 lbs, remember that EPDs are only used for comparing two animals and for comparing an animal to the breed registry as a whole. The absolute value of the EPD is meaningless.

But my bull with high genetic merit for weaning weight produces some calves with light weaning weights! Why?

A common complaint of producers is that a bull with good EPDs for traits of interest can still sire calves that perform poorly. Below are the main reasons why bulls with desirable EPDs for traits of interest can still produce progeny that perform poorly for these traits. These same reasons explain why bulls with undesirable EPDs can produce progeny that perform well for traits of interest.

1. Environment can influence performance. Nutrition, stress levels, disease exposure, climate, and other management decisions can change calf performance. Sometimes these environmental effects are easily identified. For example, calf scours may result in slower growth which could impact weaning weights. Other environmental effects cannot be easily identified. Even calves within the same herd or contemporary group may be subject to different, unknown environmental effects that can alter performance.

2. Genetic merit of mates. If a bull with genetically superior EPDs is mated to a cow with poor EPDs, the progeny will probably not perform at the highest level. Half of a calf's genetics are transmitted from each parent. Although sires produce more progeny than dams, we should not discount genetic merit of the cowherd.

3. "Randomness" of genetic inheritance. In cattle, two alleles are present at each gene sequence. Only one of these alleles will be transmitted from a parent to his or her progeny. The allele that is transmitted to progeny is determined randomly. Sometimes in an individual animal, one allele will be genetically superior for an economically relevant trait than the other allele. Thus, by random chance, a calf may receive a large proportion of alleles that confer decreased merit for traits of interest.

4. Accuracy of EPDs could be low. When we only have pedigree or pedigree and a single own performance record on an animal, the accuracy of the animal's EPD will be lower than an animal with extensive numbers of progeny records. To improve accuracies, we need to collect more performance records on progeny of the individual or perhaps use DNA testing. A bull with a lowly accurate, yet genetically superior EPD may sire calves with lower genetic merit because his true genetic merit was less than the EPD. As more data is collected on the bull and his relatives and progeny, the EPD will move closer to the bull's true genetic merit for the trait. Keep in mind that even when accuracies are low, the EPD will be a better predictor of genetic merit than performance records.

Genomic-enhanced EPDs

As mentioned at the beginning of the chapter, we can use DNA test information to calculate a genomically-enhanced EPD. Although a genomic EPD can be calculated using only DNA test information, most genomically-enhanced EPDs also incorporate performance records into their calculations. Genomically-enhanced EPDs are the preferred method for using DNA test information to select animals. In a genomically-enhanced EPD, the DNA test information is weighted by the increase in accuracy from using the DNA test on that animal. Without genomically-enhanced EPDs, producers would need to decide how much emphasis to place on traditional EPDs vs. standalone DNA tests. The genomic-enhanced EPD takes that guesswork away from the evaluation of candidates for selection; the DNA test information is appropriately weighted based on its value and the amount and type of collected performance records on the individual.

Genomically-enhanced EPDs can increase selection accuracy at an early age; in theory, DNA testing can be accomplished in utero, although in practice DNA tests are completed sometime before weaning. The genomic-enhanced EPDs therefore allow us to select individuals more accurately at a younger age. The DNA tests have little utility for progeny tested bulls for routinely measured weight traits. Progeny testing already results in a highly accurate EPD for these traits; DNA testing adds very little to the accuracy of EPDs for proven bulls. Even for proven bulls, DNA testing may still increase selection accuracy for traits that are difficult to measure (e.g, disease susceptibility), lowly heritable traits (e.g., fertility), and traits measured late in life (e.g., stayability, carcass merit).

Summary

The whole point of calculating EPDs is to make more accurate selection decisions for economically relevant traits. Not appropriately using EPDs results in the accuracy of selection decisions being reduced which in turn will result in slower rates of genetic gain. It's important to understand that a highly favorable EPD is not a guarantee that this individual will always produce superior progeny for that trait. The merit of beef calves is subject to other factors in addition to the merit of one parent, including the genetic merit of the other parent, environmental effects (e.g., nutrition, management), and the randomness of genetic inheritance. However, as a measure of genetic merit, EPDs are superior to performance data, ratios, and visual evaluation for traits where EPDs are available. Genomic information can further increase the accuracy of EPDs at a younger age and for traits that are not routinely measured.