Genetic Trend for American Tarentaise

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Introduction

The Colorado State University Center for Genetic Evaluation of Livestock recently calculated updated expected progeny differences (EPD) based on the animal pedigree and performance database of the American Tarentaise Association. The resulting EPD provide an important selection tool for breeders and also allow breeders to evaluate the historical genetic improvement of the breed through evaluation of the genetic trends. Genetic trends represent the overall or average genetic change resulting from the combined efforts of breeders to improve animal performance over many generations. These trends may also identify traits needing further selection pressure. For instance, many breeds have focused on increasing growth rate over the last 32 years, if those breeds neglect changes in birth weight associated with changes in early growth, this would be apparent from the genetic trends in the breed.

Latest Analysis

The most recent EPD analysis was completed in April 2016. The next previous analysis was performed in April 2014. Comparing the analyses, 1,442 animals were added to the dataset, which corresponded to an additional 1,125 birth weights, 949 weaning weights, 64 yearling weights and 67 calving ease observations. Expected progeny differences were calculated for a total of 120,242 individual animals which corresponded to 3,188 individual sires and 47,478 individual dams. A total of 85,691 birth weight observations, 73,067 weaning weight observations, 9,087 yearling weight observations and 14,652 calving ease observations were used in the evaluation. These data are summarized in Table 1.

Table 1. Summary statistics detailing the number, average, minimum and maximum observations used in the 2016 American Tarentaise Association's National Cattle Evaluation.

	Birth Weight	Weaning Weight	Yearling Weight	Calving Ease[1]
Number	85,691	73,067	9,457	14,652
Average	78.4	515.12	860.31	0.69
Minimum	31	161	410	0
Maximum	160	962	1445	1

[1]Calving ease is heifer or 2-year-old calving ease, and observations are analyzed as 0 (some assistance required) versus 1 (no assistance was required).

Given the additional birth, weaning, yearling and calving ease observations, changes in an individual animal's EPD are expected. It is also reasonable to expect changes in accuracy of those EPD. For instance, in 2014 analysis of a bull may have had only 5 progeny (let's assume that all of the performance data was submitted on these progeny) and as a result he received a low accuracy EPD. In the most recent analysis, that same bull may now have 30 or more progeny with performance data. The additional information results in more knowledge about the genetic ability of that bull. As a result, the new EPD for that bull will likely have changed (potentially in either direction) and the corresponding accuracy values for these new EPD will have increased.

The EPD for each animal were used to calculate genetic trends for all traits. Remember that the process of EPD calculation results in updated EPD for every animal in the database regardless of the animal's birth date. In the case of the American Tarentaise Association, EPD are constantly updated for animals born dating back to the 1960's. These updated and more accurate EPD (more accurate because there is more information in the database) are then used to calculate the genetic trends for each trait. Genetic trends are based on the average EPD of all animals born in a given year. The genetic trends for animals registered with the American Tarentaise Association from 1960 onwards are shown in Figures 1 and 2.

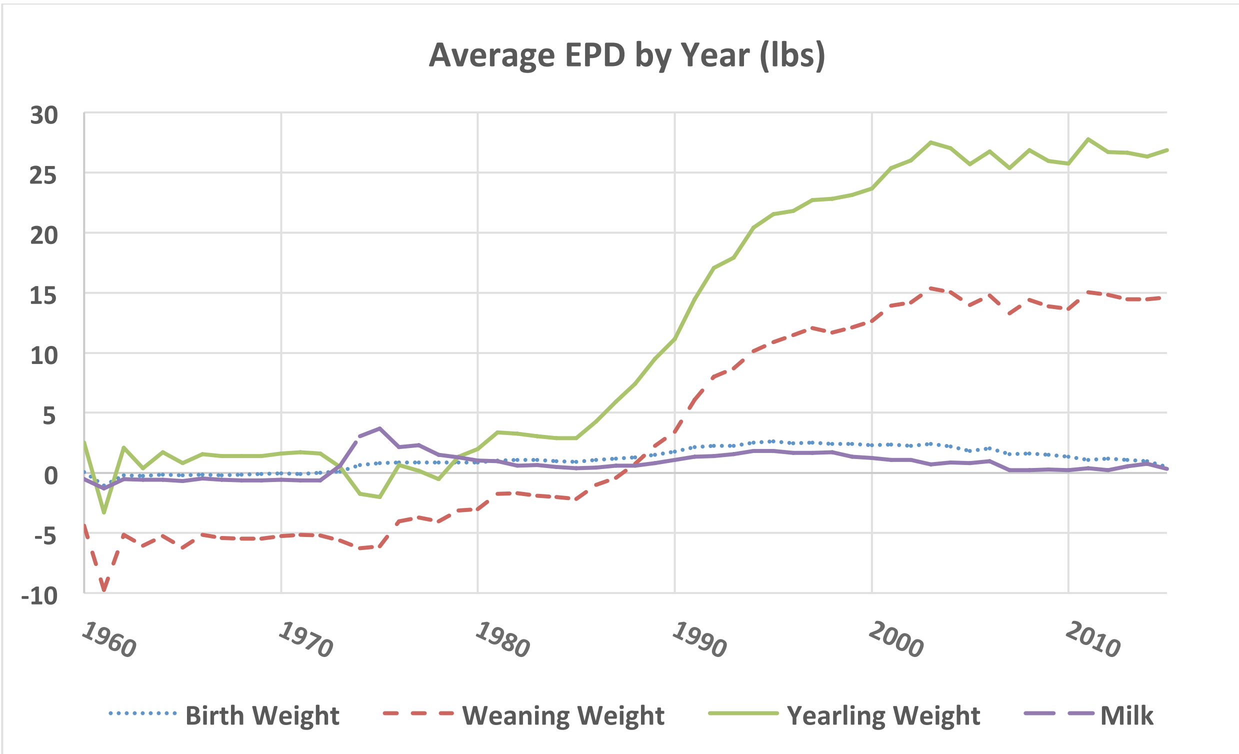
The Growth Trait Trends

Since 1984 there has been considerable genetic change in both weaning and yearling weight with the greatest change in yearling weight. Over the last 56 years, the average annual change in yearling weight has been 0.6 lbs., whereas weaning weight has increased an average of 0.5 lbs./year over the same time frame. However, in the last 20 years, weaning weight has averaged a 0.2 lbs. increase per year.

From Figure 1, we see the trend for birth weight has remained at a consistently, steady level. Moderating birth weight while increasing weaning and post weaning growth is ideal. Birth weight is genetically correlated to other growth traits like weaning weight and yearling weight, meaning that as the genetic merit of weaning and yearling weights is increased, birth weight should also increase. Increases in birth weight are also associated with increases in dystocia, the larger the calf the more likely there will be calving difficulty. It is possible to select for both increased weaning and yearling growth while selecting against increases in birth weight, and these growth trends show exactly that.

Likewise in Figure 1, there has been little change in milk over the last 56 years. Milk is nothing more than a maternal component of weaning weight, and is reported in pounds of calf weaned. Milk is the difference in maternal production of an individual animal's daughters expressed by the weaning weight of their calves. Here, milk production is not actually measured, but we can partition calf-weaning weight into his / her own genetics for growth (WW EPD) and into the environment provided by his / her dam (Milk EPD).

Figure 1. Genetic trends for growth traits in the American Tarentaise Association.



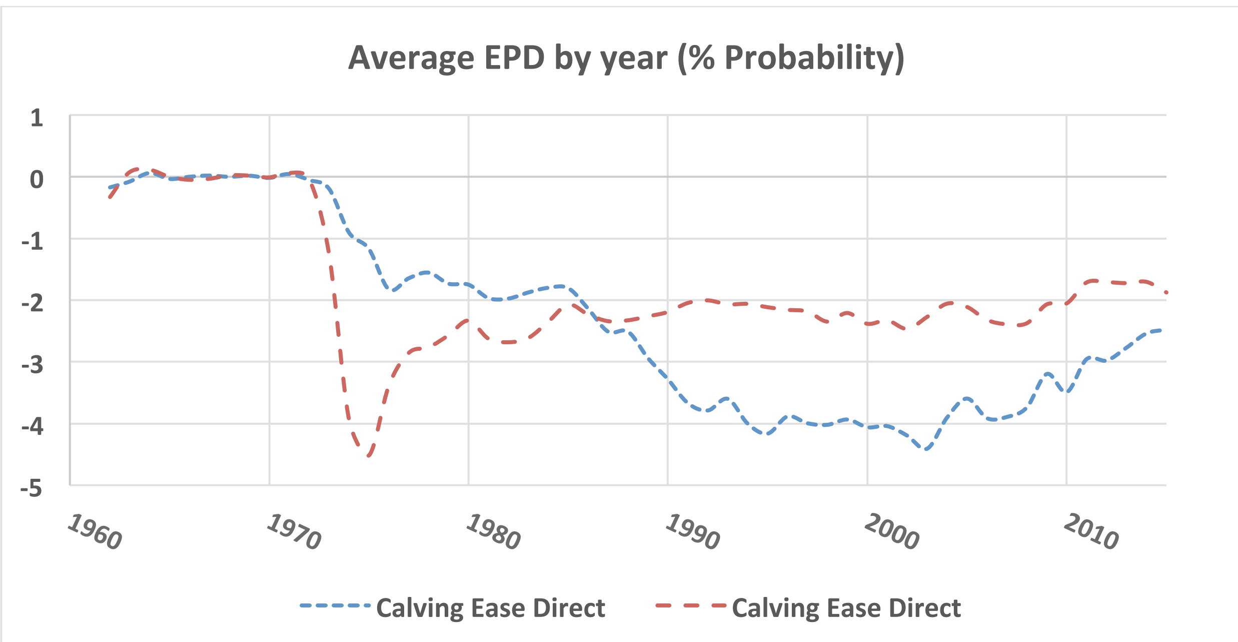
The Calving Ease Trait Trends

Direct. In the American Tarentaise analysis, calving ease scores **and** birth weight observations are used to calculate calving ease direct and calving ease total maternal EPD. The calving ease direct EPD represents differences in probability of an unassisted calving of 2-year-old heifers, where a higher EPD means a greater portion of calves are born unassisted. Calving ease direct EPD represents only the genes a parent passes on to its offspring, which in turn determines whether that offspring is born unassisted. When calving ease is analyzed, it is treated as a binary trait no assistance (score of 0), versus some sort of assistance (score of 1). In order to properly statistically evaluate these observations, an underlying normal distribution of genetic values is assumed. It is this distribution that is analyzed. What comes out of the evaluation is a set of EPD probabilities of calving ease that are converted to a % value and centered around zero (for both positive and negative EPD). Calving direct EPD is interpreted in the following manner. Assuming sire A has a calving ease direct EPD of -1 and sire B has a calving ease direct EPD of +9, sire B's progeny, on average, should have 10% fewer assisted calvings than offspring of sire A **in first calf heifers**.

Maternal. The second calving ease EPD, calving ease total maternal, predicts the probability of a given animal's daughters calving unassisted at two years of age. There are two factors that contribute to the calving ease of a sire's daughters: (i) The genes the sire passes on to his grand-progeny through his daughters that determines how easy that calf is born (These genes contribute to biological factors such as calf shape and weight), and (ii) The direct physical characteristics of the heifer herself, which influence whether a 2-year-old heifer calves unassisted (such as pelvic area and “desire” to give birth - discounting those heifers that “give up” during calving). The sire passes genes on to his daughters that control these characteristics. Calving ease total maternal EPD can be interpreted as follows. If sire A has a calving ease total maternal EPD of -5% and sire B has a calving ease total maternal EPD of +5%, on average we would expect the daughters of sire B to have 10% fewer difficult births than daughters produced by sire A. Again, a larger calving ease total maternal EPD is better.

Trends. The historical genetic trend for calving ease direct has been downward and unfavorable, however in the past 10 years the trend in calving ease direct has been upward at a rate of 0.15% per year – a favorable change. Over the last 10 years, the trend in calving ease total maternal has been upward at a rate of .07% per year—also a favorable trend.

Figure 2. Genetic trends for calving ease EPD in the American Tarentaise Association.



Perspective on Genetic Trend

The two figures shown previously, illustrate the overall average genetic trend for American Tarentaise since 1960, based on all animals produced and registered during this time span. Not all breeders will have the same amount and/or direction of change. Some may have produced more through increased intensive selection, some less. The important concept to remember is that each breeder needs to produce animals that are appropriate to their production environment. Milk production, is a good example to illustrate this difference. Breeders in environments where feed is plentiful and of good quality, can likely increase milk production; whereas producers in more nutritionally restrictive environments may not want to increase milk EPD for their herd. In a nutritionally restrictive environment, increases in milk may increase calf weight but more cows may fall out of the herd due to reduced reproductive ability. Fallout due to reproductive efficiency would result in a need to retain more weaned heifers as potential replacements and reduce the overall number of calves marketed.

Percentile and Possible Change Tables

Percentile and possible change tables are presented in Tables 3 and 4. Table 3 provides breeders with a means to compare the genetic level of their animals (EPD) to others within the breed. For instance, an animal with an EPD of -3.3 for birth weight (BW) would be in the top 1% of the Tarentaise breed for that trait. Similarly, an animal with an EPD of 14.4 for weaning weight (WW) would be in the top 25% of the breed.

The possible change table is provided to give breeders a means of determining how much confidence to put in an EPD as a representation of an animal's true progeny difference. Consider a particular bull that has a WW EPD of 25 with an accuracy of 0.40. Breeders can use this and the possible change table to determine a confidence interval for that EPD. Using this bull as an example, we expect that this animal's true progeny difference to be between 15.1 and 29.1 pounds—a fairly wide range. We are 68% confident that this bull's true value for WW is within this range. Notice that as accuracy increases, possible change values decrease. With more information at higher accuracies, there is more faith in the EPD and an expectation that with more data those EPDs will change little.

As stated previously, comparisons can only be made within the Tarentaise breed. There is no way to directly compare these values to other breeds. Many studies have been conducted outlining how changes in EPD correlate to changes in phenotype. While it is not a 1 to 1 ratio (1 unit change in EPD corresponding to a 1 unit change in phenotype), the relationship is fairly close. Across breed EPD adjustment factors can be used to compare your results to other breeds. These are published by the USDA's Meat Animal Research Center and an article in Beef Magazine outlines how to use it.

http://beefmagazine.com/cattle-genetics/marc-updates-across-breed-epds-2015

Conclusion

Overall the genetic trends show that animals registered with the ATA have changed considerably on a genetic level since the 1960's. The ATA has made good progress improving early growth and calving ease. As the association looks to the future, the most important concept to remember is to focus selection on those traits that directly influence your (and your customer's) profitability for their production environment.

Figure 3. Percentile Table for Tarentaise Sires

Top	BW	WW	YW	Milk	CED	CETM
1%	-3.5	39.5	59.3	8.1	8.9	7.0
2%	-2.8	35.3	52.0	7.2	7.5	6.0
3%	-2.4	32.5	48.2	6.6	6.7	5.5
4%	-2.1	30.7	46.2	6.1	6.0	5.0
5%	-1.8	28.8	44.3	5.8	5.4	4.6
10%	-0.9	23.2	37.8	4.7	4.0	3.5
15%	-0.4	19.7	32.8	4.0	3.2	2.8
20%	0.0	16.9	29.1	3.3	3.1	2.4
25%	0.0	14.3	25.8	2.8	3.1	2.4
30%	0.3	12.1	22.6	2.3	2.5	2.4
35%	0.5	9.8	19.5	1.9	1.9	2.0
40%	0.8	7.7	16.9	1.5	1.4	1.6
45%	1.1	5.7	14.1	1.1	0.9	1.2
50%	1.4	3.9	11.8	0.7	0.4	0.8
55%	1.7	2.2	9.6	0.3	-0.1	0.3
60%	2.0	0.7	7.3	-0.1	-0.6	-0.1
65%	2.3	-1.0	5.1	-0.5	-1.1	-0.5
70%	2.7	-2.6	3.0	-0.5	-1.7	-1.0
75%	3.1	-4.2	1.7	-0.5	-2.2	-1.4
80%	3.5	-5.1	1.4	-0.9	-2.9	-2.0
85%	4.0	-5.8	-1.2	-1.5	-3.6	-2.6
90%	4.7	-8.4	-4.5	-2.2	-4.6	-3.4
95%	5.7	-12.6	-10.0	-3.4	-6.3	-4.5
100%	11.2	-50.6	-41.4	-14.0	-12.3	-10.9

Figure 4. Possible Change.

Accuracy	BW	WW	YW	MILK	CED	CETM
0	2.96	16.51	17.43	5.24	0.22	0.22
0.1	2.67	14.86	15.69	4.72	0.20	0.20
0.2	2.37	13.21	13.94	4.20	0.17	0.18
0.3	2.07	11.56	12.20	3.67	0.15	0.16
0.4	1.78	9.91	10.46	3.15	0.13	0.13
0.5	1.48	8.26	8.71	2.62	0.11	0.11
0.6	1.18	6.60	6.97	2.10	0.09	0.09
0.7	0.89	4.95	5.23	1.57	0.07	0.07
0.8	0.59	3.30	3.49	1.05	0.04	0.04
0.9	0.30	1.65	1.74	0.52	0.02	0.02
1	0.00	0.00	0.00	0.00	0.00	0.00