ACROSS-BREED EPD TABLES FOR THE YEAR 2013 ADJUSTED TO BREED DIFFERENCES FOR BIRTH YEAR OF 2011

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Summary

Factors to adjust the expected progeny differences (EPD) of each of 18 breeds to the base of Angus EPD are reported in the column labeled 6 of Tables 1-7 for birth weight, weaning weight, yearling weight, maternal milk, marbling score, ribeye area, and fat thickness, respectively. An EPD is adjusted to the Angus base by adding the corresponding across-breed adjustment factor in column 6 to the EPD. It is critical that this adjustment be applied only to Spring 2013 EPD. Older or newer EPD may be computed on different bases and, therefore, could produce misleading results. When the base of a breed changes from year to year, its adjustment factor (Column 6) changes in the opposite direction and by about the same amount.

Breed differences are changing over time as breeds put emphasis on different traits and their genetic trends differ accordingly. Therefore, it is necessary to qualify the point in time at which breed differences are represented. Column 5 of Tables 1-7 contains estimates of the differences between the averages of calves of each breed born in year 2011. Any differences (relative to their breed means) in the samples of sires representing those breeds at the U.S. Meat Animal Research Center (USMARC) are adjusted out of these breed difference estimates and the across-breed adjustment factors. The breed difference estimates are reported as progeny differences, e.g., they represent the expected difference in progeny performance of calves sired by average bulls (born in 2011) of two different breeds and out of dams of a third, unrelated breed. In other words, they represent half the differences that would be expected between purebreds of the two breeds.

Introduction

This report is the year 2013 update of estimates of sire breed means from data of the Germplasm Evaluation (GPE) project at USMARC adjusted to a year 2011 basis using EPD from the most recent national cattle evaluations. The 2011 basis year is chosen because yearling records for weight and carcass traits should have been accounted for in EPDs for progeny born in 2011 in the Spring 2013 EPD national genetic evaluations. Factors to adjust Spring 2013 EPD of 18 breeds to a common base were calculated and are reported in Tables 1-3 for birth weight (BWT), weaning weight (WWT), and yearling weight (YWT) and in Table 4 for the maternal milk (MILK) component of maternal weaning weight (MWWT). Tables 5-7 summarize the factors for marbling score (MAR), ribeye area (REA), and fat thickness (FAT).

The across-breed table adjustments apply **only** to EPD for most recent (spring, 2013) national cattle evaluations. Serious errors can occur if the table adjustments are used with earlier

or later EPD which may have been calculated with a different within-breed base.

The following describes the changes that have occurred since the update released in 2012 (Kuehn and Thallman, 2012):

New samplings of sires in the USMARC GPE program continued to increase progeny records for all of the breeds. Numbers of progeny added ranged from 23 in Salers to 93 in Angus. The GPE program has entered a new phase in which more progeny are produced from breeds with higher numbers of registrations. However, all of the breeds will continue to produce progeny in the project and sires continue to be sampled on a continuous basis for each of the 18 breeds in the across-breed EPD program.. These additional progeny improve the accuracy of breed differences estimated at USMARC (column 3 in Tables 1-7) particularly for breeds with less data in previous GPE cycles (e.g., South Devon, Tarentaise, Santa Gertrudis, Chiangus). Progeny born in 2012 from South Devon and Tarentaise have begun to impact birth weight and weaning weight results. For the first time, there are enough daughters of Chiangus and Santa Gertrudis sires to estimate maternal milk (Table 4) breed of sire differences and factors.

Other significant changes were largely due to changes in national cattle evaluations for individual breeds. The primary change occurred as a result of the multi-breed analysis conducted by Simmental causing base shifts (columns 1 and 2, Tables 1-7) for Simmental, Red Angus, and Gelbvieh. In general base shifts only affect the adjustment factors (column 6, Tables 1-7). Part of the goal of this new multi-breed cooperation among the three breeds was to place their EPDs on the same base and scale across all three breeds. This should have the effect of making their adjustment factors (to an Angus base) similar for all traits. For weight traits, Gelbvieh and Red Angus did consistently have similar adjustment factors. For carcass traits (Tables 5-7), Gelbvieh and Simmental had similar adjustment factors. Refinement in both the multi-breed evaluation and the USMARC database should bring adjustment factors close for all three breeds in the future.

Materials and Methods

All calculations were as outlined in the 2010 BIF Guidelines. The basic steps were given by Notter and Cundiff (1991) with refinements by Núñez-Dominguez et al. (1993), Cundiff (1993, 1994), Barkhouse et al. (1994, 1995), Van Vleck and Cundiff (1997–2006), Kuehn et al. (2007-2011), and Kuehn and Thallman (2012). Estimates of variance components, regression coefficients, and breed effects were obtained using the MTDFREML package (Boldman et al., 1995). All breed solutions are reported as differences from Angus. The table values of adjustment factors to add to within-breed EPD are relative to Angus.

Models for Analysis of USMARC Records

An animal model with breed effects represented as genetic groups was fitted to the GPE data set (Arnold et al., 1992; Westell et al., 1988). In the analysis, all AI sires (sires used via

artificial insemination) were assigned a genetic group according to their breed of origin. Due to lack of pedigree, dams mated to the AI sires and natural service bulls mated to F_1 females were also assigned to separate genetic groups (i.e., Hereford dams were assigned to different genetic groups than Hereford AI sires). Cows from Hereford selection lines (Koch et al., 1994) were used in Cycle IV of GPE and assigned into their own genetic groups. Through Cycle VIII, most dams were from Hereford, Angus, or MARCIII (1/4 Angus, 1/4 Hereford, 1/4 Pinzgauer, 1/4 Red Poll) composite lines. In order to be considered in the analysis, sires had to have an EPD for the trait of interest. All AI sires were considered unrelated for the analysis in order to adjust resulting genetic group effects by the average EPD of the sires.

Fixed effects in the models for BWT, WWT (205-d), and YWT (365-d) included breed (fit as genetic groups) and maternal breed (WWT only), year and season of birth by GPE cycle by age of dam (2, 3, 4, 5-9, >10 yr) combination (241), sex (heifer, bull, steer; steers were combined with bulls for BWT), a covariate for heterosis, and a covariate for day of year at birth of calf. Models for WWT also included a fixed covariate for maternal heterosis. Random effects included animal and residual error except for the analysis of WWT which also included a random maternal genetic effect and a random permanent environmental effect.

For the carcass traits (MAR, REA, and FAT), breed (fit as genetic groups), sex (heifer, steer) and slaughter date (245) were included in the model as fixed effects. Fixed covariates included slaughter age and heterosis. Random effects were animal and residual error. To be included, breeds had to report carcass EPD on a carcass basis using age-adjusted endpoints, as suggested in the 2010 BIF Guidelines.

The covariates for heterosis were calculated as the expected breed heterozygosity for each animal based on the percentage of each breed of that animal's parents. In other words, it is the probability that, at any location in the genome, the animal's two alleles originated from two different breeds. Heterosis is assumed to be proportional to breed heterozygosity. For the purpose of heterosis calculation, AI and dam breeds were assumed to be the same breed and Red Angus was assumed the same breed as Angus. For purposes of heterosis calculation, composite breeds were considered according to nominal breed composition. For example, Brangus (3/8 Brahman, 5/8 Angus) × Angus is expected to have 3/8 as much heterosis as Brangus × Hereford.

Variance components were estimated with a derivative-free REML algorithm with genetic group solutions obtained at convergence. Differences between resulting genetic group solutions for AI sire breeds were divided by two to represent the USMARC breed of sire effects in Tables 1-7. Resulting breed differences were adjusted to current breed EPD levels by accounting for the average EPD of the AI sires of progeny/grandprogeny, etc. with records. Average AI sire EPD were calculated as a weighted average AI sire EPD from the most recent within breed genetic evaluation. The weighting factor was the sum of relationship coefficients between an individual sire and all progeny with performance data for the trait of interest relative to all other sires in that breed.

For all traits, regression coefficients of progeny performance on EPD of sire for each trait were calculated using an animal model with EPD sires excluded from the pedigree. Genetic groups were assigned in place of sires in their progeny pedigree records. Each sire EPD was 'dropped' down the pedigree and reduced by ½ depending on the number of generations each calf was removed from an EPD sire. In addition to regression coefficients for the EPDs of AI sires, models included the same fixed effects described previously. Pooled regression coefficients, and regression coefficients by sire breed were obtained. These regression coefficients are monitored as accuracy checks and for possible genetic by environment interactions. The pooled regression coefficients were used as described in the next section to adjust for differences in management at USMARC as compared to seedstock production (e.g., YWT of males at USMARC are primarily on a slaughter steer basis, while in seedstock field data they are primarily on a breeding bull basis). For carcass traits, MAR, REA, and FAT, regressions were considered too variable and too far removed from 1.00. Therefore, the regressions were assumed to be 1.00 until more data is added to reduce the impact of sampling errors on prediction of these regressions. However, the resulting regressions are still summarized.

Records from the USMARC GPE Project are not used in calculation of within-breed EPD by the breed associations. This is critical to maintain the integrity of the regression coefficient. If USMARC records were included in the EPD calculations, the regressions would be biased upward.

Adjustment of USMARC Solutions

The calculations of across-breed adjustment factors rely on breed solutions from analysis of records at USMARC and on averages of within-breed EPD from the breed associations. The basic calculations for all traits are as follows:

USMARC breed of sire solution (1/2 breed solution) for breed i (USMARC (i)) converted to an industry scale (divided by b) and adjusted for genetic trend (as if breed average bulls born in the base year had been used rather than the bulls actually sampled):

$$M_i = USMARC\ (i)/b + [EPD(i)_{YY} - EPD(i)_{USMARC}].$$

Breed Table Factor (A_i) to add to the EPD for a bull of breed i:

$$A_i = (M_i - M_x) - (EPD(i)_{YY} - EPD(x)_{YY}).$$

where,

USMARC(i) is solution for effect of sire breed i from analysis of USMARC data,

$EPD(i)_{YY}$ is the average within-breed 2013 EPD for breed i for animals born in the base year (YY, which is two years before the update; e.g., YY = 2011 for the 2013 update),

EPD(i)$_{USMARC}$ is the weighted (by total relationship of descendants with records at USMARC) average of 2013 EPD of bulls of breed i having descendants with records at USMARC,

b is the pooled coefficient of regression of progeny performance at USMARC on EPD of sire (for 2013: 1.17, 0.84, 1.01, and 1.14 BWT, WWT, YWT, and MILK, respectively; 1.00 was applied to MAR, REA, and FAT data),

i denotes sire breed i, and

x denotes the base breed, which is Angus in this report.

Results

Heterosis

Heterosis was included in the statistical model as a covariate for all traits. Maternal heterosis was also fit as a covariate in the analysis of weaning weight. Resulting estimates were 1.41 lb, 13.09 lb, 19.04 lb, -0.007 marbling score units (i.e. $4.00 = Sl^{00}$, $5.00 = Sm^{00}$), 0.26 in^2, and 0.038 in for BWT, WWT, YWT, MAR, REA, and FAT respectively. These estimates are interpreted as the amount by which the performance of an F_1 is expected to exceed that of its parental breeds. The estimate of maternal heterosis for WWT was 11.12 lb.

Across-breed adjustment factors

Tables 1, 2, and 3 (for BWT, WWT, and YWT) summarize the data from, and results of, USMARC analyses to estimate breed of sire differences on a 2011 birth year basis. The column labeled 6 of each table corresponds to the Across-breed EPD Adjustment Factor for that trait. Table 4 summarizes the analysis of MILK. Tables 5, 6, and 7 summarize data from the carcass analyses (MAR, REA, FAT). Because of the accuracy of sire carcass EPDs and the greatest percentage of data being added to carcass traits, sire effects and adjustment factors are more likely to change for carcass traits in the future.

Column 5 of each table represents the best estimates of sire breed differences for calves born in 2011 on an industry scale. These breed difference estimates are reported as progeny differences, e.g., they represent the expected difference in progeny performance of calves sired by average bulls (born in 2011) of two different breeds and out of dams of a third, unrelated breed. Thus, they represent half the difference expected between purebreds of the respective breeds.

In each table, breed of sire differences were added to the raw mean of Angus-sired progeny born 2008 through 2012 at USMARC (Column 4) to make these differences more interpretable to producers on scales they are accustomed to.

Figures 1-4 illustrate the relative genetic trends of most of the breeds involved (if they

submitted trends) adjusted to a constant base using the adjustment factors in column 6 of Tables 1-7. These figures demonstrate the effect of selection over time on breed differences; breeders within each breed apply variable levels of selection toward each trait resulting in reranking of breeds for each traits over time. These figures and Column 5 of Tables 1-7 can be used to identify breeds with potential for complementarity in mating programs.

Across-breed EPD Adjustment Factor Example

Adjustment factors can be applied to compare the genetic potential of sires from different breeds. Suppose the EPD for yearling weight for a Hereford bull is +90.0 (which is above the year 2011 average of 86 for Hereford) and for a Limousin bull is +98.0 (which is above the year 2011 average of 84.2 for Limousin). The across-breed adjustment factors in the last column of Table 3 are -23.6 for Hereford and -35.9 for Limousin. Then the adjusted EPD for the Hereford bull is 90.0 + (-23.6) = 67.4 and for the Limousin bull is 98.0 + (-35.9) = 62.1. The expected yearling weight difference when both are mated to another breed of cow, e.g., Angus, would be 67.4 − 62.1 = 5.3 lb. The differences in true breeding value between two bulls with similar within-breed EPDs are primarily due to differences in the genetic base from which those within-breed EPDs are computed.

Birth Weight

The range in estimated breed of sire differences for BWT (Table 1, column 5) ranged from 0.8 lb for Red Angus to 7.5 lb for Charolais and 11.1 lb for Brahman. Angus continued to have the lowest estimated sire effect for birth weight (Table 1, column 5). The relatively heavy birth weights of Brahman-sired progeny would be expected to be offset by favorable maternal effects reducing birth weight if progeny were from Brahman or Brahman cross dams which would be an important consideration in crossbreeding programs involving Brahman cross females. Changes in breed of sire effects were generally small, less than 1.5 lb for all breeds relative to last year's update (Kuehn and Thallman, 2012).

Weaning Weight

With the exception of South Devon, all of the 17 breed differences (Table 2, column 5) were within 5 lb of the values reported by Kuehn and Thallman. (2012). The number of South Devon progeny with weaning weight increased by approximately 30%. South Devon and Tarentaise are the most likely to shift due to increasing data in future evaluations. Changes in breed effects for other breeds seem to be stabilizing since continuous sampling started in 2007.

Yearling Weight

Breed of sire effects for yearling weight were also similar to Kuehn and Thallman (2012) in general. All but two of the estimates were within 8 lb of last year's estimates. The estimated Santa Gertrudis breed difference increased by 12.7 lb and the Chiangus difference decreased by

10.7 lb likely due to increased sampling and progeny. Angus continued to have the greatest rate of genetic change for yearling weight, causing most breed of sire differences relative to Angus to decrease at least slightly.

Maternal Milk

Changes to the maternal milk breed of sire differences (Table 4, column 5) were generally small. All changes were less than 4 lb difference from those reported in 2012. However, the breed solution estimates (Table 4, column 3) are expected to change the most in future updates as GPE heifers from each of the 18 breeds being continuously sampled are developed and bred. Chiangus and Santa Gertrudis estimates and factors for maternal milk are presented here for the first time.

Marbling

Marbling score was again highest in Angus and South Devon. Most changes relative to last year's update were minor with the exception of Chiangus (USMARC breed solution; due to increased numbers of progeny sampled) and Gelbvieh (likely due to new genetic evaluation). Continental breeds continue in general to be lower for marbling score relative to Angus (most more than 0.5 score units lower).

Ribeye Area

Continental breeds had higher ribeye area estimates relative to the British breeds (Table 6, column 5) as would be expected. Continued selection for ribeye area in Angus led to a higher mean EPD (0.06 sq in larger) in 2011 for Angus and resulted in decreases for most breeds relative to Angus (Column 5) compared to last year's update.

Fat Thickness

Progeny of Continental breeds again had 0.1 to 0.2 in less fat at slaughter than British breeds (Table 7, Column 5) and other breeds were leaner than Angus. Charolais, Salers, Maine Anjou, and Simmental were predicted to be the leanest breeds among the 13 breeds analyzed for carcass traits. Limousin was not included in the FAT analysis because they do not report an EPD for FAT. Changes in breed of sire effects relative to Angus were all minor compared to the previous year (Kuehn and Thallman, 2012).

Accuracies and Variance Components

Table 8 summarizes the average Beef Improvement Federation (BIF) accuracy for bulls with progeny at USMARC weighted appropriately by average relationship to animals with phenotypic records. The sires sampled recently in the GPE program have generally been higher accuracy sires, so the average accuracies should continue to increase over the next several years.

Table 9 reports the estimates of variance components from the animal models that were used to obtain breed of sire and breed of MGS solutions. Heritability estimates for BWT, WWT, YWT, and MILK were 0.58, 0.17, 0.45, and 0.15, respectively. Heritability estimates for MAR, REA, and FAT were 0.49, 0.48, and 0.40, respectively.

Regression Coefficients

Table 10 updates the coefficients of regression of records of USMARC progeny on sire EPD for BWT, WWT, and YWT which have theoretical expected values of 1.00. The standard errors of the specific breed regression coefficients are large relative to the regression coefficients. Large differences from the theoretical regressions, however, may indicate problems with genetic evaluations, identification, or sampling. The pooled (overall) regression coefficients of 1.17 for BWT, 0.84 for WWT, and 1.01 for YWT were used to adjust breed of sire solutions to the base year of 2011. These regression coefficients are reasonably close to expected values of 1.0. Deviations from 1.00 are believed to be due to scaling differences between performance of progeny in the USMARC herd and of progeny in herds contributing to the national genetic evaluations of the 18 breeds. Breed differences calculated from the USMARC data are divided by these regression coefficients to put them on an industry scale. A regression greater than one suggests that variation at USMARC is greater than the industry average, while a regression less than one suggests that variation at USMARC is less than the industry average. Reasons for differences in scale can be rationalized. For instance, cattle at USMARC, especially steers and market heifers, are fed at higher energy rations than some seedstock animals in the industry. Also, in several recent years, calves have been weaned earlier than 205 d at USMARC, likely reducing the variation in weaning weight of USMARC calves relative to the industry.

The coefficients of regression for MILK are also shown in Table 10. Several sire (MGS) breeds have regression coefficients considerably different from the theoretical expected value of 1.00 for MILK. Standard errors, however, for the regression coefficients by breed are large except for Angus and Hereford. The pooled regression coefficient of 1.14 for MILK is reasonably close to the expected regression coefficient of 1.00.

Regression coefficients derived from regression of USMARC steer progeny records on sire EPD for MAR, REA, and FAT are shown in Table 11. Each of these coefficients has a theoretical expected value of 1.00. Compared to growth trait regression coefficients, the standard errors even on the pooled estimates are higher, though they have decreased from the previous year. While REA and FAT are both close to the theoretical estimate of 1.00, we continued to use the theoretical estimate of 1.00 to derive breed of sire differences and EPD adjustment factors. Pooled regression estimates for these two traits may be used in future updates.

Prediction Error Variance of Across-Breed EPD

Prediction error variances were not included in the report due to a larger number of tables included with the addition of carcass traits. These tables were last reported in Kuehn et al. (2007;

available online at http://www.beefimprovement.org/proceedings.html). An updated set of tables is available on request (Larry.Kuehn@ars.usda.gov).

Implications

Bulls of different breeds can be compared on a common EPD scale by adding the appropriate across-breed adjustment factor to EPD produced in the most recent genetic evaluations for each of the 18 breeds. The across-breed EPD are most useful to commercial producers purchasing bulls of two or more breeds to use in systematic crossbreeding programs. Uniformity in across-breed EPD should be emphasized for rotational crossing. Divergence in across-breed EPD for direct weaning weight and yearling weight should be emphasized in selection of bulls for terminal crossing. Divergence favoring lighter birth weight may be helpful in selection of bulls for use on first calf heifers. Accuracy of across-breed EPD depends primarily upon the accuracy of the within-breed EPD of individual bulls being compared.

Table 1. Breed of sire solutions from USMARC, mean breed and USMARC EPD used to adjust for genetic trend to the year 2011 base and factors to adjust within breed EPD to an Angus equivalent – BIRTH WEIGHT (lb)

Breed	Number		Ave. Base EPD		Breed Soln at USMARC	BY 2011 Sire Breed	BY 2011 Sire Breed	Factor to adjust EPD
	AI Sires	Direct Progeny	Breed 2011	USMARC Bulls	(vs Ang)	Average	Difference[a]	To Angus
			(1)	(2)	(3)	(4)	(5)	(6)
Angus	131	1822	1.7	1.8	0.0	87.3	0.0	0.0
Hereford	140	2246	3.5	2.2	3.7	91.7	4.5	2.7
Red Angus	43	615	-0.9	-1.9	-0.3	88.1	0.8	3.4
Shorthorn	52	461	2.4	1.4	6.4	93.7	6.5	5.8
South Devon	25	195	2.6	2.1	4.1	91.4	4.1	3.2
Beefmaster	44	395	0.2	1.0	6.5	92.1	4.8	6.3
Brahman	56	672	1.8	0.6	11.5	98.3	11.1	11.0
Brangus	47	397	0.8	1.0	4.3	90.8	3.5	4.5
Santa Gertrudis	21	249	0.5	0.9	6.8	92.6	5.4	6.6
Braunvieh	30	430	2.4	4.1	5.0	89.9	2.6	1.9
Charolais	100	1070	0.6	0.2	8.2	94.7	7.5	8.6
Chiangus	24	247	3.1	3.2	4.3	90.9	3.6	2.2
Gelbvieh	73	980	1.4	2.7	4.2	89.6	2.4	2.7
Limousin	62	1053	1.5	0.9	3.4	90.8	3.6	3.8
Maine Anjou	38	435	2.0	3.3	6.7	91.8	4.5	4.2
Salers	50	428	1.7	2.5	2.9	89.0	1.8	1.8
Simmental	71	1011	2.3	3.2	6.0	91.5	4.3	3.7
Tarentaise	17	245	1.9	2.1	2.3	89.1	1.9	1.7

Calculations:
(4) = (3) / b + [(1) − (2)] + (Recent Raw Angus Mean: 87.3 lb) with b = 1.17
(5) = (4) − (4, Angus)
(6) = (5) − (5, Angus) − [(1) − (1, Angus)]
[a]The breed difference estimates represent half the differences that would be expected between purebreds of the two breeds.

Table 2. Breed of sire solutions from USMARC, mean breed and USMARC EPD used to adjust for genetic trend to the year 2011 base and factors to adjust within breed EPD to an Angus equivalent − WEANING WEIGHT (lb)

Breed	Number		Ave. Base EPD		Breed Soln at USMARC (vs Ang)	BY 2011 Sire Breed Average	BY 2011 Sire Breed Difference[a]	Factor to adjust EPD To Angus
	AI Sires	Direct Progeny	Breed 2011	USMARC Bulls				
			(1)	(2)	(3)	(4)	(5)	(6)
Angus	131	1682	47.0	26.2	0.0	577.0	0.0	0.0
Hereford	138	2082	45.0	27.3	-2.1	571.5	-5.5	-3.5
Red Angus	43	595	54.8	48.4	-0.9	561.5	-15.4	-23.2
Shorthorn	52	438	15.3	14.5	-0.4	556.5	-20.4	11.3
South Devon	25	176	40.9	26.1	-4.2	566.0	-10.9	-4.8
Beefmaster	44	382	10.0	13.3	19.1	575.6	-1.3	35.7
Brahman	56	584	15.0	7.8	20.5	587.7	10.8	42.8
Brangus	47	383	23.7	21.8	8.5	568.2	-8.7	14.6
Santa Gertrudis	21	241	4.3	8.5	15.5	570.5	-6.5	36.2
Braunvieh	30	403	41.1	45.0	-2.4	549.4	-27.5	-21.6
Charolais	99	972	24.4	14.0	21.7	592.4	15.5	38.1
Chiangus	24	228	36.8	40.3	-5.4	546.2	-30.7	-20.5
Gelbvieh	73	919	63.7	56.1	9.8	575.4	-1.5	-18.2
Limousin	62	971	46.5	30.4	2.0	574.7	-2.3	-1.8
Maine Anjou	38	404	39.4	39.4	-1.8	554.1	-22.9	-15.3
Salers	50	405	41.3	33.0	1.7	566.4	-10.5	-4.8
Simmental	70	923	62.1	57.0	20.9	586.1	9.2	-5.9
Tarentaise	17	237	16.0	-2.6	1.2	576.2	-0.7	30.3

Calculations:

(4) = (3) / b + [(1) − (2)] + (Raw Angus Mean: 556.2 lb) with b = 0.84

(5) = (4) − (4, Angus)

(6) = (5) − (5, Angus) − [(1) − (1, Angus)]

[a]The breed difference estimates represent half the differences that would be expected between purebreds of the two breeds.

Table 3. Breed of sire solutions from USMARC, mean breed and USMARC EPD used to adjust for genetic trend to the year 2011 base and factors to adjust within breed EPD to an Angus equivalent – YEARLING WEIGHT (lb)

	Number		Ave. Base EPD		Breed Soln	BY 2011	BY 2011	Factor to
			Breed	USMARC	at USMARC	Sire Breed	Sire Breed	adjust EPD
	AI	Direct	2011	Bulls	(vs Ang)	Average	Difference[a]	To Angus
Breed	Sires	Progeny	(1)	(2)	(3)	(4)	(5)	(6)
Angus	128	1512	86.0	49.0	0.0	1045.3	0.0	0.0
Hereford	133	1926	74.0	45.7	-27.2	1009.7	-35.6	-23.6
Red Angus	42	543	81.6	67.1	-9.9	1013.0	-32.3	-27.9
Shorthorn	45	382	24.8	22.8	12.7	1022.9	-22.4	38.8
South Devon	15	134	77.2	50.4	-5.2	1030.0	-15.4	-6.6
Beefmaster	38	275	14.0	19.7	0.3	1002.9	-42.5	29.5
Brahman	55	517	24.1	12.9	-30.4	989.3	-56.0	5.9
Brangus	40	262	43.1	40.1	-2.8	1008.4	-36.9	6.0
Santa Gertrudis	21	210	6.3	11.0	10.4	1013.9	-31.4	48.3
Braunvieh	30	376	64.8	70.9	-20.6	981.8	-63.5	-42.3
Charolais	94	884	43.1	26.8	23.4	1047.7	2.4	45.3
Chiangus	24	201	67.9	70.5	-18.8	987.0	-58.3	-40.2
Gelbvieh	71	875	93.5	74.9	0.3	1027.1	-18.2	-25.6
Limousin	62	904	84.2	59.2	-25.8	1007.7	-37.7	-35.9
Maine Anjou	37	375	78.2	81.1	-4.6	1000.8	-44.5	-36.7
Salers	50	380	79.6	64.0	-4.5	1019.5	-25.9	-19.5
Simmental	65	829	90.3	83.1	23.5	1038.8	-6.5	-10.9
Tarentaise	7	189	28.6	-3.6	-32.6	1008.2	-37.1	20.3

Calculations:

(4) = (3) / b + [(1) – (2)] + (Raw Angus Mean: 1008.3 lb) with b = 1.01

(5) = (4) – (4, Angus)

(6) = (5) – (5, Angus) – [(1) – (1, Angus)]

[a]The breed difference estimates represent half the differences that would be expected between purebreds of the two breeds.

Table 4. Breed of maternal grandsire solutions from USMARC, mean breed and USMARC EPD used to adjust for genetic trend to the year 2011 base and factors to adjust within breed EPD to an Angus equivalent – MILK (lb)

Breed	AI Sires	Number Direct Gpr	Direct Progeny	Ave. Base EPD Breed 2011 (1)	Ave. Base EPD USMARC Bulls (2)	Breed Soln at USMARC (vs Ang) (3)	BY 2011 Sire Breed Average (4)	BY 2011 Sire Breed Difference[a] (5)	Factor to adjust EPD To Angus (6)
Angus	123	2816	636	23.0	13.9	0.0	565.3	0.0	0.0
Hereford	123	3502	809	18.0	9.6	-24.4	543.2	-22.1	-17.1
Red Angus	35	767	216	19.9	16.6	-1.4	558.3	-7.0	-3.9
Shorthorn	38	369	145	2.3	4.2	12.0	564.8	-0.5	20.2
South Devon	14	347	69	22.9	19.1	5.6	564.9	-0.4	-0.3
Beefmaster	30	292	74	2.0	-0.9	-5.6	554.2	-11.1	9.9
Brahman	49	764	228	6.4	5.3	16.6	571.9	6.6	23.2
Brangus	26	280	59	11.3	4.9	-3.7	559.3	-6.0	5.8
Santa Gertrudis	19	114	74	0.7	-1.6	-3.5	555.4	-9.9	12.4
Braunvieh	24	589	147	34.0	33.6	22.6	576.4	11.1	0.1
Charolais	87	1460	358	6.9	5.3	-2.0	556.1	-9.2	6.9
Chiangus	19	107	72	10.9	5.5	-4.2	557.9	-7.4	4.7
Gelbvieh	65	1430	336	25.5	28.2	20.5	571.4	6.1	3.6
Limousin	57	1611	377	22.1	18.6	-4.6	555.7	-9.6	-8.7
Maine Aniou	35	559	136	19.7	22.1	1.5	555.2	-10.1	-6.8
Salers	43	449	150	19.5	20.9	10.5	564.0	-1.3	2.2
Simmental	63	1552	353	22.9	26.2	13.0	564.4	-0.9	-0.8
Tarentaise	6	341	78	0.6	5.3	17.7	567.0	1.7	24.1

Calculations:
(4) = (3) / b + [(1) – (2)] + (Raw Angus Mean: 556.2lb) with b = 1.14
(5) = (4) – (4, Angus)
(6) = (5) – (5, Angus) – [(1) – (1, Angus)]
[a]The breed difference estimates represent half the differences that would be expected between purebreds of the two breeds.

Table 5. Breed of sire solutions from USMARC, mean breed and USMARC EPD used to adjust for genetic trend to the year 2011 base and factors to adjust within breed EPD to an Angus equivalent – MARBLING (marbling score units[a])

| | Number | | Ave. Base EPD | | Breed Soln at USMARC | BY 2011 Sire Breed | BY 2011 Sire Breed | Factor to adjust EPD |
| | | | Breed 2011 | USMARC Bulls | (vs Ang) | Average | Difference[b] | To Angus |
Breed	AI Sires	Direct Progeny	(1)	(2)	(3)	(4)	(5)	(6)
Angus	111	663	0.46	0.18	0.00	6.09	0.00	0.00
Hereford	128	877	0.05	-0.02	-0.52	5.36	-0.73	-0.32
Red Angus	40	176	0.38	0.44	-0.04	5.71	-0.38	-0.30
Shorthorn	43	201	-0.02	0.02	-0.32	5.45	-0.64	-0.16
South Devon	13	49	0.40	-0.10	-0.20	6.11	0.02	0.08
Santa Gertrudis	21	100	0.00	0.00	-0.84	4.96	-1.12	-0.66
Braunvieh	30	184	0.50	0.41	-0.43	5.46	-0.63	-0.67
Charolais	42	207	0.03	-0.04	-0.65	5.22	-0.87	-0.44
Chiangus	23	95	0.19	0.22	-0.41	5.37	-0.72	-0.45
Gelbvieh	68	373	0.04	-0.17	-0.76	5.26	-0.83	-0.41
Limousin	59	345	-0.02	-0.07	-0.96	4.90	-1.19	-0.71
Maine Anjou	37	191	0.21	0.20	-0.82	4.99	-1.09	-0.84
Salers	46	182	0.20	-0.39	-0.67	5.73	-0.36	-0.10
Simmental	64	365	0.08	-0.02	-0.62	5.29	-0.80	-0.42

Calculations:
(4) = (3) / b + [(1) − (2)] + (Raw Angus Mean: 5.81) with b = 1.00
(5) = (4) − (4, Angus)
(6) = (5) − (5, Angus) − [(1) − (1, Angus)]
[a]$4.00 = Sl^{00}$, $5.00 = Sm^{00}$
[b]The breed difference estimates represent half the differences that would be expected between purebreds of the two breeds.

Table 6. Breed of sire solutions from USMARC, mean breed and USMARC EPD used to adjust for genetic trend to the year 2011 base and factors to adjust within breed EPD to an Angus equivalent – RIBEYE AREA (in^2)

Breed	AI Sires	Number Direct Progeny	Ave. Base EPD Breed 2011 (1)	Ave. Base EPD USMARC Bulls (2)	Breed Soln at USMARC (vs Ang) (3)	BY 2011 Sire Breed Average (4)	BY 2011 Sire Breed Difference[a] (5)	Factor to adjust EPD To Angus (6)
Angus	111	664	0.42	0.06	0.00	13.12	0.00	0.00
Hereford	128	877	0.26	-0.05	-0.21	12.87	-0.25	-0.09
Red Angus	40	176	0.15	-0.10	-0.23	12.77	-0.35	-0.08
Shorthorn	43	201	0.07	0.01	0.16	12.98	-0.14	0.21
South Devon	13	49	0.21	0.21	0.32	13.07	-0.05	0.16
Santa Gertrudis	21	101	0.01	-0.02	-0.13	12.66	-0.46	-0.05
Braunvieh	30	184	0.71	0.83	0.98	13.63	0.51	0.22
Charolais	42	208	0.20	0.07	1.03	13.92	0.80	1.02
Chiangus	23	96	0.09	0.00	0.39	13.24	0.12	0.45
Gelbvieh	68	375	0.30	0.20	0.92	13.78	0.66	0.78
Limousin	59	346	0.54	0.30	1.33	14.33	1.21	1.09
Maine Anjou	37	191	0.15	0.12	1.01	13.80	0.68	0.95
Salers	46	183	0.03	0.03	0.76	13.52	0.40	0.79
Simmental	64	366	0.59	0.42	0.89	13.82	0.70	0.53

Calculations:

(4) = (3) / b + [(1) − (2)] + (Raw Angus Mean: 12.76 in^2) with b = 1.00

(5) = (4) − (4, Angus)

(6) = (5) − (5, Angus) − [(1) − (1, Angus)]

[a]The breed difference estimates represent half the differences that would be expected between purebreds of the two breeds.

Table 7. Breed of sire solutions from USMARC, mean breed and USMARC EPD used to adjust for genetic trend to the year 2011 base and factors to adjust within breed EPD to an Angus equivalent – FAT THICKNESS (in)

Breed	Number AI Sires	Number Direct Progeny	Ave. Base EPD Breed 2011 (1)	Ave. Base EPD USMARC Bulls (2)	Breed Soln at USMARC (vs Ang) (3)	BY 2011 Sire Breed Average (4)	BY 2011 Sire Breed Difference[a] (5)	Factor to adjust EPD To Angus (6)
Angus	111	664	0.010	0.001	0.000	0.611	0.000	0.000
Hereford	128	877	0.002	-0.005	-0.056	0.552	-0.058	-0.050
Red Angus	40	176	-0.002	-0.008	-0.037	0.570	-0.041	-0.029
Shorthorn	43	201	-0.010	-0.005	-0.149	0.448	-0.162	-0.142
South Devon	13	49	0.010	0.010	-0.102	0.500	-0.111	-0.111
Santa Gertrudis	21	101	0.002	0.010	-0.106	0.487	-0.124	-0.116
Braunvieh	30	184	-0.067	-0.104	-0.206	0.432	-0.179	-0.102
Charolais	42	208	0.000	0.001	-0.219	0.381	-0.230	-0.220
Chiangus	23	96	0.005	0.029	-0.129	0.449	-0.162	-0.157
Gelbvieh	68	375	-0.042	-0.075	-0.213	0.422	-0.189	-0.136
Maine Anjou	37	191	0.000	0.000	-0.230	0.372	-0.239	-0.229
Salers	46	183	0.000	-0.006	-0.214	0.394	-0.217	-0.207
Simmental	64	366	-0.058	-0.058	-0.199	0.402	-0.209	-0.141

Calculations:

(4) = (3) / b + [(1) − (2)] + (Raw Angus Mean: 0. 601 in) with b = 1.00

(5) = (4) − (4, Angus)

(6) = (5) − (5, Angus) − [(1) − (1, Angus)]

[a]The breed difference estimates represent half the differences that would be expected between purebreds of the two breeds.

Table 8. Mean weighted[a] accuracies for birth weight (BWT), weaning weight (WWT), yearling weight (YWT), maternal weaning weight (MWWT), milk (MILK), marbling (MAR), ribeye area (REA), and fat thickness (FAT) for bulls used at USMARC

Breed	BWT	WWT	YWT	MILK	MAR	REA	FAT
Angus	0.79	0.77	0.71	0.72	0.52	0.51	0.49
Hereford	0.65	0.62	0.61	0.58	0.26	0.39	0.30
Red Angus	0.92	0.91	0.91	0.88	0.65	0.64	0.66
Shorthorn	0.81	0.80	0.74	0.79	0.62	0.60	0.54
South Devon	0.41	0.45	0.37	0.44	0.02	0.05	0.05
Beefmaster	0.87	0.89	0.86	0.73			
Brahman	0.67	0.67	0.61	0.60			
Brangus	0.87	0.81	0.79	0.69			
Santa Gertrudis	0.85	0.82	0.74	0.77	0.33	0.52	0.44
Braunvieh	0.55	0.48	0.38	0.41	0.11	0.15	0.09
Charolais	0.80	0.74	0.65	0.68	0.48	0.51	0.45
Chiangus	0.82	0.79	0.79	0.75	0.25	0.23	0.34
Gelbvieh	0.84	0.83	0.82	0.80	0.55	0.54	0.55
Limousin	0.93	0.89	0.83	0.83	0.75	0.75	
Maine Anjou	0.78	0.77	0.77	0.77	0.31	0.28	0.32
Salers	0.83	0.82	0.76	0.81	0.25	0.29	0.33
Simmental	0.94	0.94	0.94	0.92	0.72	0.72	0.72
Tarentaise	0.94	0.93	0.95	0.94			

[a]Weighted by relationship to phenotyped animals at USMARC for BWT, WWT, YWT, MAR, REA, and FAT and by relationship to daughters with phenotyped progeny MILK.

Table 9. Estimates of variance components (lb^2) for birth weight (BWT), weaning weight (WWT), yearling weight (YWT), and maternal weaning weight (MWWT) and for marbling (MAR; marbling score units^2), ribeye area (REA; in^4), and fat thickness (FAT; in^2) from mixed model analyses

Analysis	Direct		
	BWT	WWT[a]	YWT
Direct			
Animal within breed (19 breeds)	71.69	479.57	3596.10
Maternal genetic within breed (19 breeds)		425.79	
Maternal permanent environment		723.31	
Residual	51.39	1227.99	4411.95
Carcass Direct	MAR	REA	FAT
Animal within breed (13-14 breeds)	0.278	0.671	0.0099
Residual	0.286	0.729	0.0148

[a]Direct maternal covariance for weaning weight was -61.43 lb^2

Table 10. Pooled and within-breed regression coefficients (lb/lb) for weights at birth (BWT), 205 days (WWT), and 365 days (YWT) of F_1 progeny and for calf weights (205 d) of F_1 dams (MILK) on sire expected progeny difference and by sire breed

	BWT	WWT	YWT	MILK
Pooled	1.17 ± 0.04	0.84 ± 0.03	1.01 ± 0.04	1.14 ± 0.07
Sire breed				
Angus	1.05 ± 0.10	0.87 ± 0.07	1.18 ± 0.08	1.04 ± 0.15
Hereford	1.17 ± 0.07	0.76 ± 0.05	0.97 ± 0.06	1.03 ± 0.15
Red Angus	1.10 ± 0.15	0.81 ± 0.15	0.61 ± 0.17	1.42 ± 0.28
Shorthorn	0.62 ± 0.22	0.56 ± 0.20	0.64 ± 0.26	1.25 ± 0.73
South Devon	-0.29 ± 0.52	0.69 ± 0.32	0.02 ± 0.48	0.17 ± 1.57
Beefmaster	1.98 ± 0.36	0.86 ± 0.25	0.73 ± 0.40	3.79 ± 0.72
Brahman	2.03 ± 0.21	1.00 ± 0.19	1.28 ± 0.23	0.07 ± 0.45
Brangus	1.57 ± 0.26	0.85 ± 0.23	1.16 ± 0.33	0.31 ± 0.65
Santa Gertrudis	4.08 ± 0.84	1.41 ± 0.31	1.11 ± 0.35	0.63 ± 1.05
Braunvieh	0.70 ± 0.27	0.58 ± 0.25	0.71 ± 0.38	0.44 ± 0.58
Charolais	1.16 ± 0.12	0.93 ± 0.11	0.80 ± 0.13	1.15 ± 0.25
Chiangus	1.68 ± 0.30	0.27 ± 0.26	0.72 ± 0.32	0.22 ± 0.55
Gelbvieh	1.14 ± 0.14	0.82 ± 0.12	1.03 ± 0.13	1.02 ± 0.26
Limousin	0.99 ± 0.12	1.01 ± 0.10	1.13 ± 0.12	1.77 ± 0.26
Maine Anjou	1.47 ± 0.19	0.86 ± 0.20	0.54 ± 0.27	1.91 ± 0.46
Salers	1.30 ± 0.24	0.77 ± 0.27	0.42 ± 0.26	1.69 ± 0.44
Simmental	1.08 ± 0.16	1.51 ± 0.14	1.27 ± 0.13	0.99 ± 0.34
Tarentaise	0.78 ± 0.59	1.03 ± 0.24	1.49 ± 0.84	1.12 ± 0.93

Table 11. Pooled and within-breed regression coefficients marbling (MAR; score/score), ribeye area (REA; in^2/in^2), and fat thickness (FAT; in/in) of F_1 progeny on sire expected progeny difference and by sire breed

	MAR	REA	FAT
Pooled	0.57 ± 0.05	0.86 ± 0.06	1.01 ± 0.09
Sire breed			
Angus	0.97 ± 0.10	0.86 ± 0.14	1.29 ± 0.17
Hereford	0.50 ± 0.14	0.54 ± 0.14	0.98 ± 0.17
Red Angus	0.62 ± 0.19	1.10 ± 0.23	0.74 ± 0.47
Shorthorn	1.54 ± 0.32	1.31 ± 0.59	1.81 ± 0.51
South Devon	-0.28 ± 0.61	2.01 ± 3.21	9.34 ± 2.58
Santa Gertrudis	0.60 ± 0.82	0.95 ± 0.45	0.75 ± 0.50
Braunvieh	0.74 ± 0.52	0.23 ± 0.27	0.35 ± 0.43
Charolais	1.21 ± 0.26	1.22 ± 0.31	1.56 ± 0.49
Chiangus	0.66 ± 0.23	0.71 ± 0.49	0.79 ± 0.47
Gelbvieh	1.37 ± 0.21	1.32 ± 0.17	1.83 ± 0.31
Limousin	1.11 ± 0.39	1.22 ± 0.18	
Maine Anjou	-0.05 ± 0.26	-1.23 ± 0.50	0.95 ± 0.56
Salers	0.05 ± 0.08	1.74 ± 0.65	1.35 ± 0.63
Simmental	0.87 ± 0.20	0.68 ± 0.18	0.58 ± 0.36

Figure 1. Relative genetic trends for birth weight (lb) of the seven most highly used beef breeds (1a) and all breeds that submitted 2013 trends (1b) adjusted for birth year 2011 using the 2013 across-breed EPD adjustment factors.
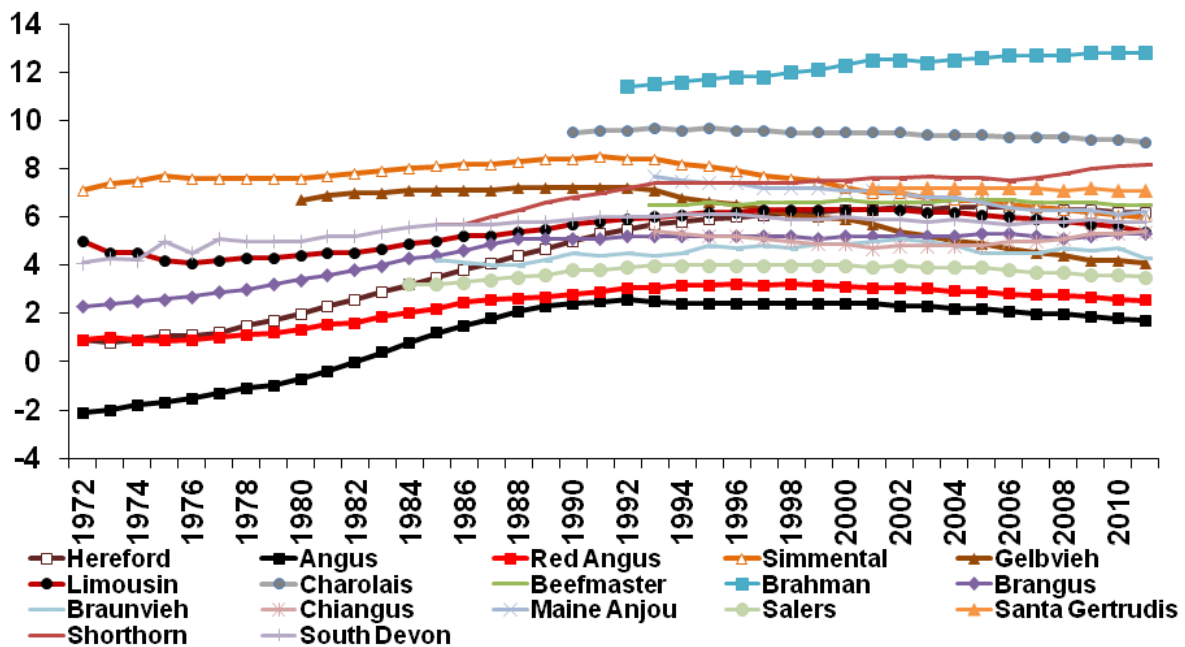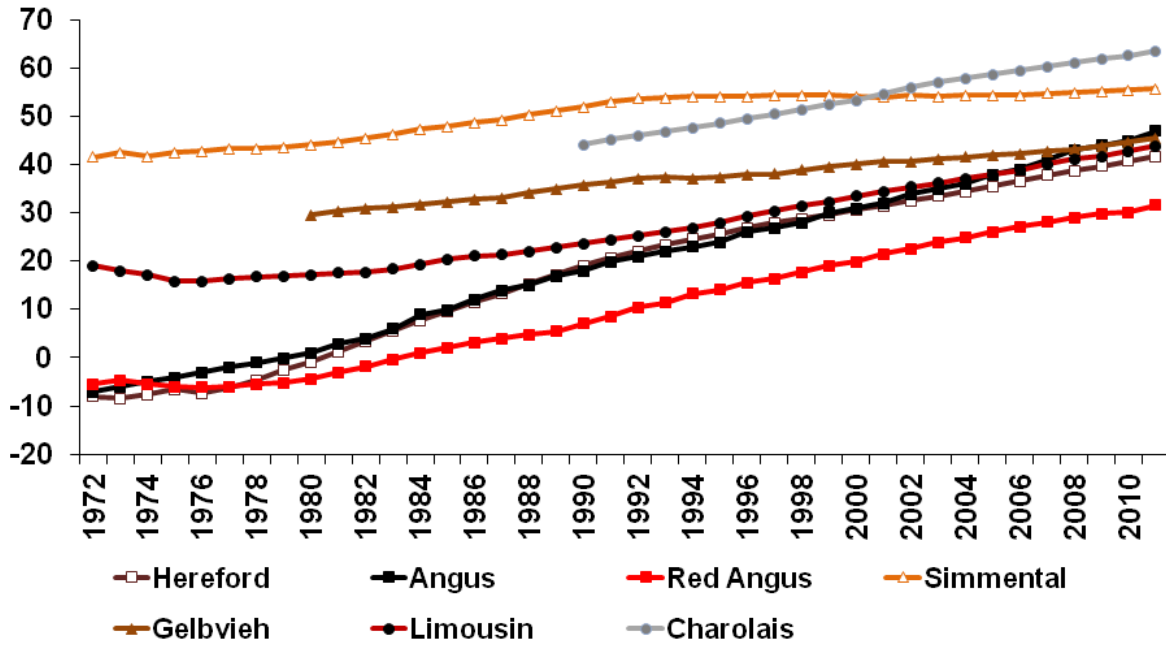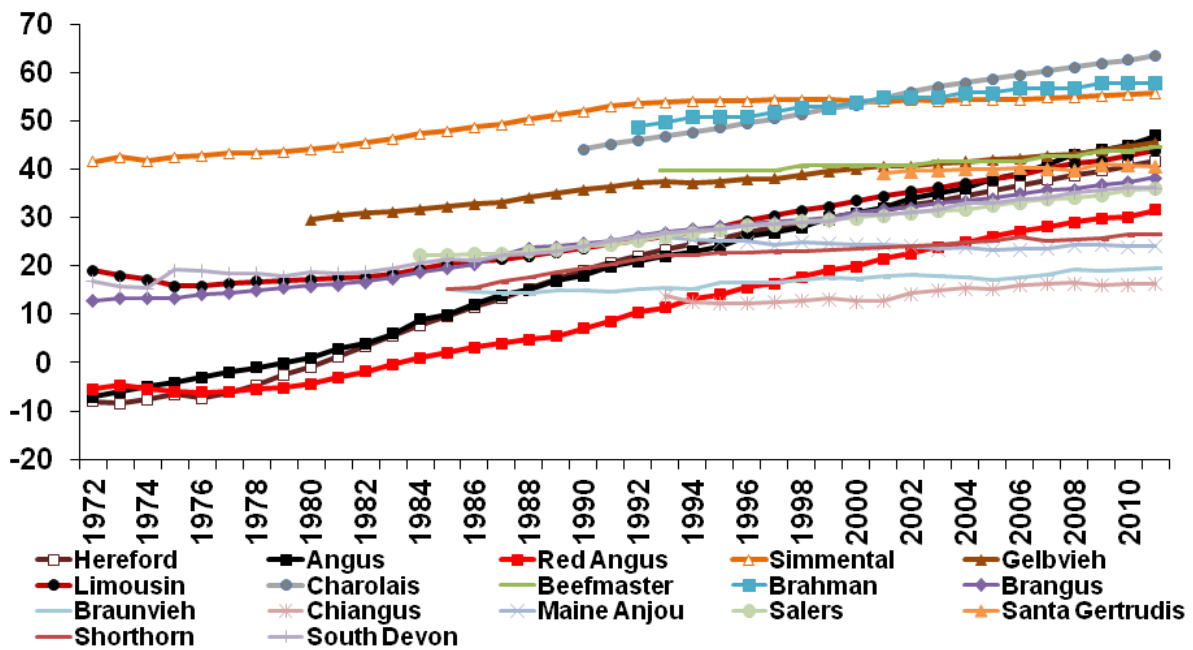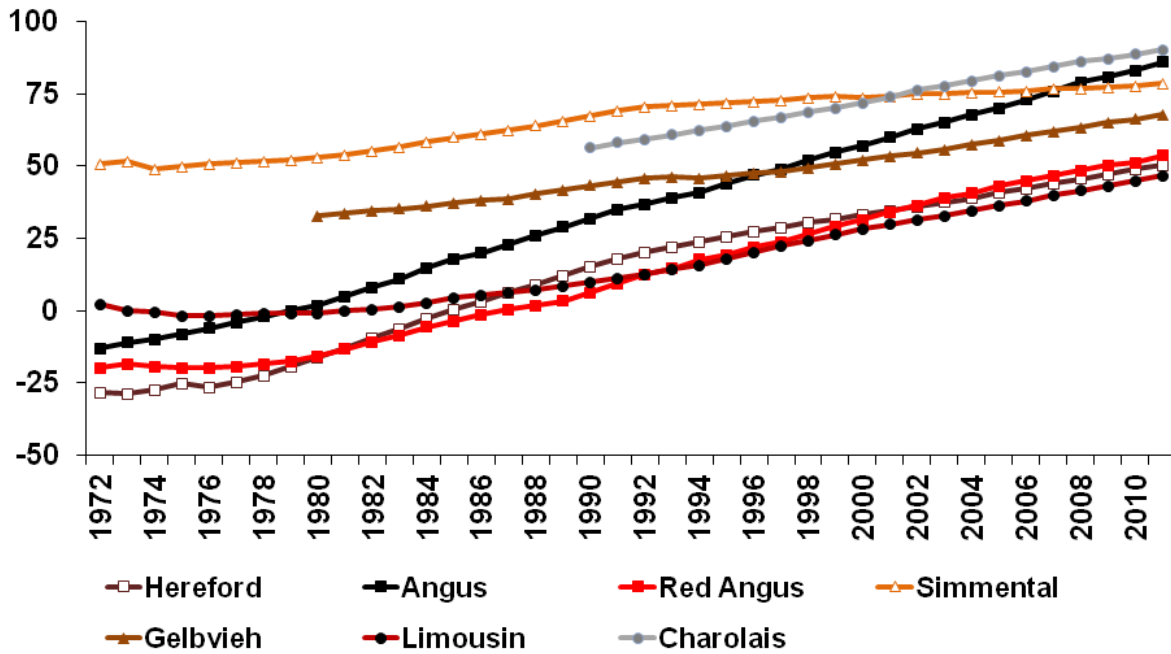
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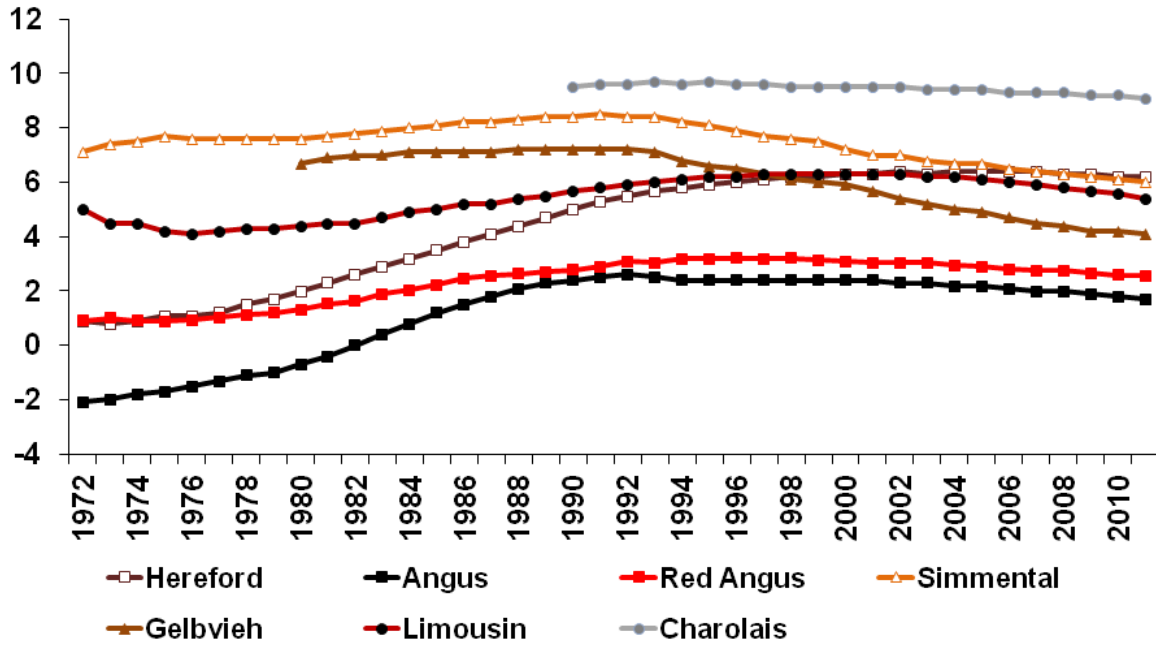
1b.

Figure 2. Relative genetic trends for weaning weight (lb) of the seven most highly used beef breeds (2a) and all breeds that submitted 2013 trends (2b) adjusted for birth year 2011 using the 2013 across-breed EPD adjustment factors.

2a.

2b.

Figure 3. Relative genetic trends for yearling weight (lb) of the seven most highly used beef breeds (3a) and all breeds that submitted 2013 trends (3b) adjusted for birth year 2011 using the 2013 across-breed EPD adjustment factors.
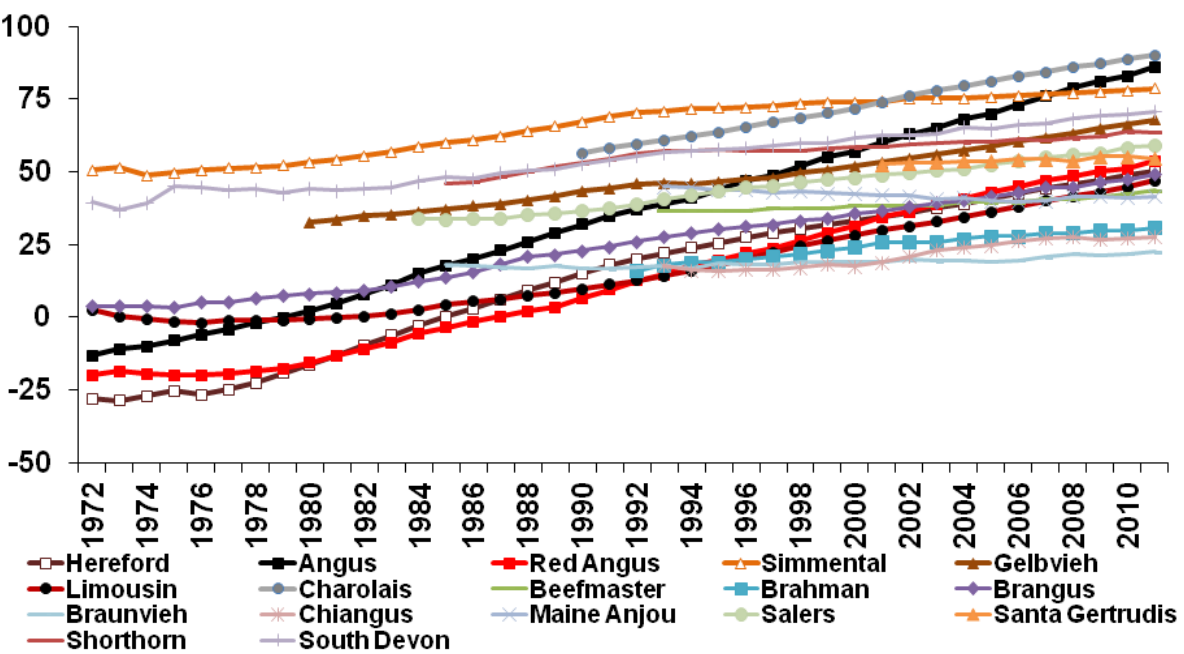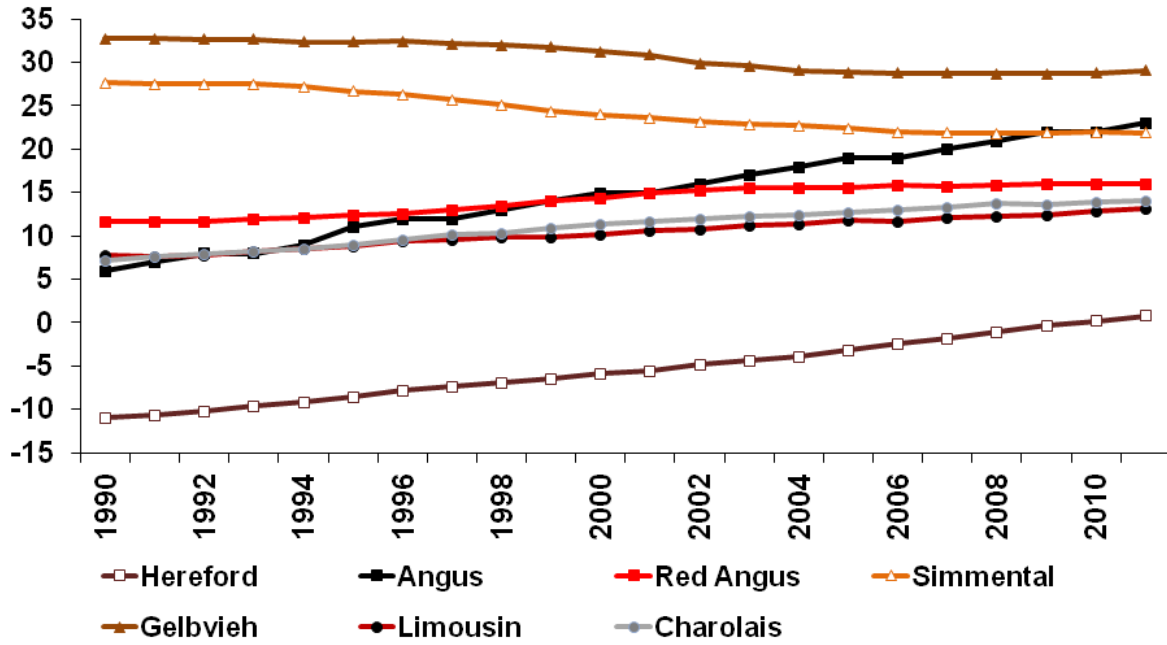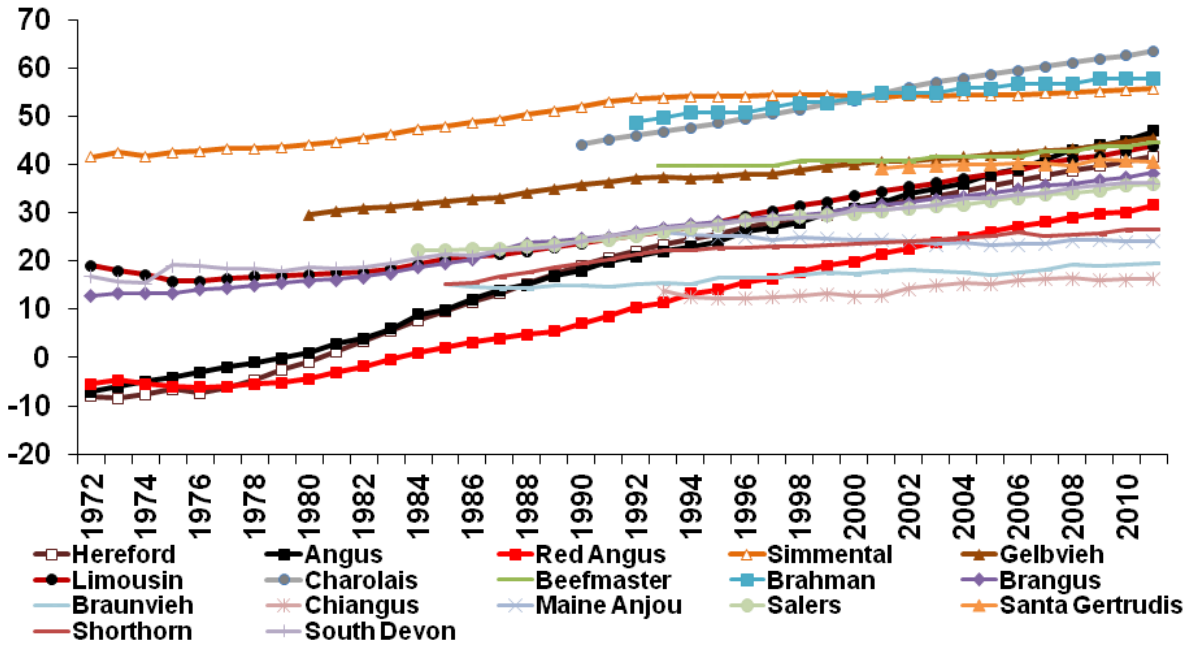
3a.

3b.

Figure 4. Relative genetic trends for maternal milk (lb) of the seven most highly used beef breeds (4a) and all breeds that submitted 2013 trends (4b) adjusted for birth year 2011 using the 2013 across-breed EPD adjustment factors.

4a.

4b.

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MEAN EPDs REPORTED BY DIFFERENT BREEDS

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Expected progeny differences (EPDs) have been the primary tool for genetic improvement of beef cattle for over 40 years beginning with evaluations of growth traits. Since that time EPDs have been added for several other production traits such as calving ease, stayability, carcass merit and conformation. Most recently, several breed associations have derived economic indices from their EPDs to increase profit under different management and breeding systems.

It is useful for producers to compare the EPDs of potential breeding animals with their breed average. The current EPDs from the most recent genetic evaluations of 24 breeds are presented in this report. Mean EPDs for growth traits are shown in Table 1 (24 breeds), for other production traits in Table 2 (18 breeds), and for carcass and composition traits in Table 3 (20 breeds). Several breeds also have EPDs and indices that are unique to their breed; these EPDs are presented in Table 4.

Average EPDs should only be used to determine the genetic merit of an animal relative to its breed average. To compare animals of different breeds, across breed adjustment factors should be added to animals' EPDs for their respective breeds (see Across-breed EPD Tables reported by Kuehn and Thallman in these proceedings).

This list is likely incomplete; evaluations for some breeds are not widely reported. If you see a breed missing and would like to report the average EPDs for that breed, please contact Larry (Larry.Kuehn@ars.usda.gov) or Mark (Mark.Thallman@ars.usda.gov).

Table 1. Birth year 2011 average EPDs from 2013 evaluations for growth traits

Breed	Birth	Weaning	Yearling	Maternal	Total
Angus	1.7	47	86	23	
Hereford	3.5	45	74	18	41
Murray Grey	3.5	21	33	4	14
Red Angus	-0.9	55	82	20	47
Red Poll	1.7	15	24	6	
Shorthorn	2.4	15.3	24.8	2.3	10.0
South Devon	2.6	40.9	77.2	22.9	43.4
Beefmaster	0.2	10	14	2	
Braford	1.1	9	14	2	7
Brahman	1.8	15	24.1	6.4	
Brangus	0.8	23.7	43.1	11.3	23.1
Red Brangus	1.6	13.2	20.6	5.2	11.8
Santa Gertrudis	0.5	4.3	6.3	0.7	
Senepol	0.9	9.0	9.9	2.5	6.9
Simbrah	4.0	62.3	85.5	21.8	52.8
Braunvieh	2.4	41.1	64.8	34.0	54.5
Charolais	0.6	24.4	43.1	6.9	19.1
Chianina	3.1	36.8	67.9	10.9	29.3
Gelbvieh	1.4	63.7	93.5	25.5	57.3
Limousin	1.5	46.5	84.2	22.1	
Maine-Anjou	2.0	39.4	78.2	19.7	
Salers	1.7	41.3	79.6	19.5	40.2
Simmental	2.3	62.1	90.3	22.9	53.8
Tarentaise	1.9	16	28.6	0.6	

Table 2. Birth year 2011 average EPDs from 2013 evaluations for other production traits

Breed	Calving Ease Direct (%)	Calving Ease Maternal (%)	Scrotal Circ (cm)	Docility Score	Mature Weight (lb)	Heifer Pregnancy (%)	Stayability (%)
Angus	5	7	0.60	11	37	8.4	
Hereford	0.6	1	0.7		85		
Murray Grey	-0.6	-0.2	0.2		50		
Red Angus	4	4				10	10
Shorthorn	-1.7	-1.7					
South Devon			0.1				
Beefmaster			0.2				
Brangus	5.1	7.1	0.62				
Simbrah	3.9	4.7		7.4			
Braunvieh	6.1	5.6					
Charolais	2.8	3.7	0.61				
Chianina	5.6	-1.2					
Gelbvieh	8.6	5.9[a]					5.5
Limousin	8.8	5.0	0.4	20.3			
Maine Anjou	7.7	3.7					
Salers	0.3	0.3	0.3	8.4			23.3
Simmental	9.0	8.1		9.3			18.9
Tarentaise	-1.2	0.6					

[a]Maternal calving ease listed as Calving Ease Daughters (CED) in Gelbvieh sire summary.

Table 3. Birth year 2011 average EPDs from 2013 evaluations for carcass and composition traits

Breed	Carcass Wt (lb)	Retail Product (%)	Yield Grade	Carcass Marbling Score	Ribeye Area (in^2)	Fat Thickness (in)	Rump fat (in)	WBSF (lb)
Angus	25			0.46	0.42	0.01		
Hereford				0.05	0.26	0.002		
Murray Grey	29	0.4		0.0[a]	0.10[a]	0.00[a]	0.00[a]	
Red Angus	17		-0.01	0.38	0.15	0.00		
Shorthorn	4.9			-0.02	0.07	-0.01		
South Devon	27.5	0.8		0.4	0.21	0.01		
Beefmaster				0.00[a]	0.04[a]	0.00[a]	0.01[a]	
Braford	6			0.01	0.05	0.012		
Brahman	6.6	0.01		0.00	0.06	-0.001		-0.01
Brangus	14.8			0.01[b]	0.30[b]	-0.001[b]		
Santa Gertrudis	0.8			0.00	0.01	0.002		
Simbrah	25.9		-0.21	-0.06	0.35	-0.070		-0.02
Braunvieh	34.6			0.50	0.71	-0.067		
Charolais	14.5			0.03	0.20	0.000		
Chianina	6.0	-0.02		0.19	0.09	0.005		
Gelbvieh	27.0		-0.12	0.04	0.30	-0.042		
Limousin	24.5		-0.05	-0.02	0.54			
Maine-Anjou	0.26	0.27		0.21	0.15	0.00		
Salers	21.5	0.0		0.2	0.03	0.00		
Simmental	26.5		-0.25	0.08	0.59	-0.058		-0.29

[a]Derived using ultrasound measures and reported on an ultrasound scale (IMF% instead of marbling score)

[b]Reported on an ultrasound scale (IMF% instead of marbling score) but calculated using ultrasound and carcass data in a multi-trait model

Table 4. Birth year 2011 average EPDs from 2013 evaluations for other traits unique to individual breeds

Angus	Residual Average Daily Gain (lb)	Mature Height (in)	Yearling Height (in)	Cow Energy Value ($)	Weaned Calf Value ($)	Feedlot Value ($)	Grid Value ($)	Beef Value ($)
	0.16	0.4	0.4	-3.74	26.33	27.73	27.88	63.17

Hereford	Baldy Maternal Index	Brahman Influence Index ($)	Certified Hereford Beef Index ($)	Calving Ease Index ($)
	17	15	21	15

Red Angus	Mature Cow Maintenance (Mcal/mo)
	2

Gelbvieh	Feedlot Merit ($)	Carcass Value ($)
	32.32	19.88

Limousin	Mainstream Terminal Index ($)
	44.4

Simmental	All Purpose Index ($)	Terminal Index ($)	Simbrah	All Purpose Index ($)	Terminal Index ($)
	106.0	62.9		65.62	51.25

Murray Grey	600-d wt (lb)	Gestational length (d)	Days to calving (d)
	48	-0.1	-0.7