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NORTH CENTRAL ARIZONA NEWSLETTER

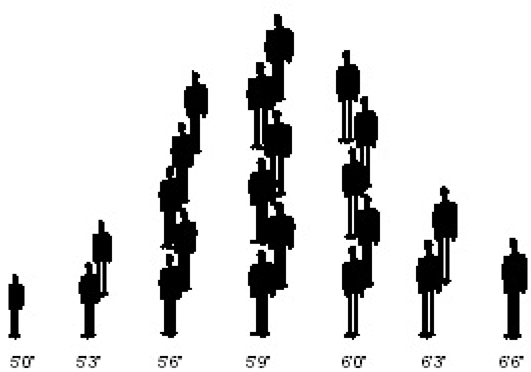
APRIL - MAY - JUNE, 1999

Statistics Review

by Jim Sprinkle, Area Extension Agent, Animal Science

In the last newsletter, we presented a statistics primer in order to make principles of genetic selection more understandable. Selecting individuals within populations (cow herds) is best applied using repeated cow records and statistics. Since Part II of the article "Genetic Selection on the OX Ranch" will utilize statistics to predict genetic change in the OX Ranch cowherd, a review of the statistics article presented in the last newsletter is in order.

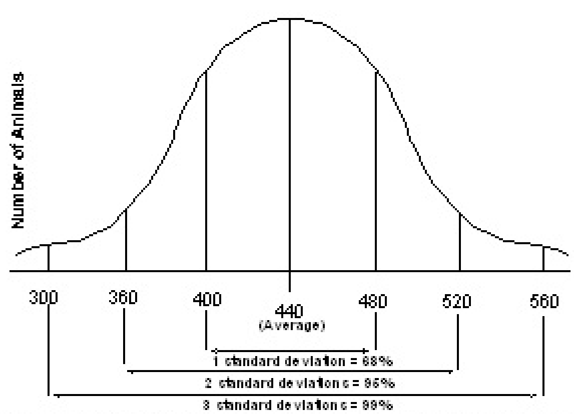
Figure 1. Height of Soldiers in Two Squads



In Figure 1, we described a sample from a genetic population which was distributed "normally" in a bell curve. In any given "normal" population, most individuals tend to be average. In the above example, most (73%) of the soldiers were from 5' 6" to 6' 0" tall. Height classifications for this sample differed by a standard deviation of 3 inches. As explained in the last newsletter, the standard deviation is calculated by a mathematical formula and allows us to rank the sampling population by categories or classification. An individual in a normal population considered to be "different" from average would be two standard deviations (6 inches) greater or less than the sampling distribution average (5'9"). The individuals in Figure 1 that could be considered statistically different from the average height would be greater than 6'3" or less than 5'3" tall. Only a small percentage (usually around 5%) of a normal population will be different from the average or mean of the population. The size of the standard deviation depends upon the inherent variability of the sample and adequate sample size.

In Figure 2, a bell curve is presented for weaning weights in a cow herd. The sample mean or average cowherd weaning weight is 440 lbs. and the standard deviation is 40 lbs. In a normal population such as in Figure 2, 68% of the herd will be within 1 standard deviation (greater or less than) of the average. For Figure 2, 68% of calves would weigh from 400 to 480 lbs and 95% of calves would weigh between 360 and 520 lbs. at weaning. Calves considered to be different from the herd average would be less than or greater than 2 standard deviations from the average, or would weigh either less than 360 lbs. or more than 520 lbs. If you wished to select

Figure 2. Weaning Weight Bell Curve



Adapted from: Scientific Farm Animal Production, 3rd Ed., Taylor and Bogart, 1988, Macmillan Pub. C

a future herd bull exceeding the herd average by 90 lbs., you would have about 2 chances in 100 to select such an individual.

Genetic Selection on the OX Ranch (Part II)

by Jim Sprinkle, John Murphy (owner OX Ranch), and Dick Rice (U of A Livestock Specialist)

Expected Genetic Progress for Selection

Progress made will depend upon the number of selected individuals chosen each generation, the heritability of the given traits, and the genetic differences between selected individuals and the population you're trying to change. Sometimes, one trait will be negatively correlated to another trait you are selecting for. Genetic progress for opposing traits will be slower than for two traits that are positively correlated with each other. More information on phenotypic (what you see) and genetic correlations for various traits will be discussed later.

The equation we use for predicting genetic change per generation is:

genetic change/generation = heritability of trait x selection differential

The selection differential is the difference between selected individuals for a specific trait (e.g., weaning weight) and the average for all animals by sex in the herd. For example, the selection differential would be 60 lbs. if heifers at weaning averaged 400 lbs. and selected heifers weighed 460 lbs.

Only a portion of differences in animals which you can see or measure (e.g., weaning weight) is due to genetics. Part of the difference is also due to environment (cow age, sickness, rainfall, etc.). Heritability is an estimate of the amount of the difference you expect to be passed on to offspring through the parent's genes. Table 1 lists heritability estimates for different traits.

Table 1. Heritability Estimates for Different Traits	
Birth Weight	.35 to.50
Weaning Weight	.25 to .30
Yearling Weight	.40
Feedlot Post Weaning Gain	.41
Feed Efficiency	.35 to.45
Fat Thickness	.32 to .53
Yield Grade	.76
Quality Grade	.21
Marbling	.32 to .40
Tenderness	.20
Rib Eye Area	.38 to .50

Heritability of 0 to .2 is considered low, .3 to .5 is considered moderate, and .6 to 1.0 is high.

If calculations with the above formula are made for only one sex, the result must be divided by 2 since one parent only contributes ½ of the genes for the next generation. To obtain genetic change per year, results using the above equation are divided by the generation interval. The generation interval is obtained by determining the average age of parents in the herd. For commercial beef cow operations, the generation interval is around 5 or 6 years of age. For Arizona, a generation interval of 6 years is usually the one to use.

Let's calculate expected genetic change per year for post weaning average daily gain (**PWG**) using your carcass data. The standard deviation for PWG for all heifers, selected and non-selected, was .48 lbs and the average PWG was 2.54 lbs. per day. For heifers, this means that about 34% of the heifers had PWG between 2.06 and 2.54 lbs. and another 34% of the heifers had PWG between 2.54 and 3.02 lbs./day. Suppose that the heifers in Table 2 had been retained as replacements. The average standard deviation for PWG for these heifers was +.85 for an improvement of .408 lbs. PWG /day {.85 std. dev. x (.48 lbs/standard deviation) = .408 lbs./day}.

Let's assume that selected bulls you chose to use had an average standard deviation of 1.5 for PWG. The average standard deviation of both sets of parents would then be 1.18 {(.85 + 1.5)/2 = 1.18}. If you multiply the average standard deviation of selected individuals x the overall herd PWG standard deviation of .48, it will give you a figure equal to the selection differential (1.18 X .48 = .57 lbs). Multiplying this times the PWG heritability of .41, gives the following result.

$$\text{lbs. PWG/generation} = 1.18 \text{ std. dev.} \times \frac{.48 \text{ lbs.}}{\text{std. dev.}} \times .41 \text{ heritability}$$

lbs. PWG/generation = .232 lbs. or by dividing by generation interval of 6

change/year = .04 lbs. PWG/year

If you were selecting for this single trait only, in ten years you could expect to increase PWG by .4 lbs. However, you may want to also select marbling as a secondary trait. Finally, I would suggest also considering rib eye area (**REA**) as a threshold trait. In explanation, if a dam's or sire's progeny do not have REA close to the mean then don't use the parents for generating replacements unless PWG and marbling are truly outstanding. Some individuals I listed in Table 2 had REA standard deviations of -.61 to -.67, but were good in one or both of the other traits of PWG and marbling. I used the carcass yield grade REA scale below to assist in threshold determinations.

Hot Carcass Weight, lbs.	Req. REA for no Discount in Preliminary Yield Grade, sq. in.
600	11.0
625	11.3
650	11.6
675	11.9
700	12.2
800	13.4

Table 2. Selected Heifers from the OX Little Horse Ranch										
Cow #	Begwt	Endwt	Avg. daily gain	Marbling	Quality grade	Rib eye area	Yield grade	STD. DEV. Avg. daily gain	STD. DEV. Marbling	STD. DEV. Rib eye area
6070	668	1,224	2.79	360	Select+	15.8	2.03	**0.51**	**-0.71**	**2.33**
6198	542	1,237	3.49	370	Select+	10.8	3.57	**1.97**	**-0.60**	**-0.61**
6121	651	1,185	2.69	390	Select+	12.2	2.86	**0.30**	**-0.38**	**0.21**
5194	629	1,210	2.92	400	Choice-	14.0	3.33	**0.78**	**-0.27**	**1.27**
6019	586	1,111	2.64	410	Choice-	12.7	3.84	**0.20**	**-0.16**	**0.50**
6058	664	1,304	3.22	410	Choice-	13.7	3.21	**1.41**	**-0.16**	**1.09**
6130	614	1,195	2.92	420	Choice-	12.6	3.43	**0.78**	**-0.05**	**0.44**
6076	643	1,237	2.98	420	Choice-	11.8	4.10	**0.91**	**-0.05**	**-0.03**
6065	610	1,161	2.77	430	Choice-	12.7	3.08	**0.47**	**0.06**	**0.50**
248	658	1,237	2.90	430	Choice-	11.8	4.28	**0.74**	**0.06**	**-0.03**
5181	505	1,052	2.75	440	Choice-	12.8	2.61	**0.43**	**0.17**	**0.56**
6141	540	1,087	2.75	470	Choice-	11.6	3.03	**0.43**	**0.50**	**-0.14**
6167	577	1,105	2.66	480	Choice-	13.2	3.25	**0.24**	**0.61**	**0.80**
6048	637	1,181	2.73	540	Choice	14.3	2.77	**0.39**	**1.27**	**1.44**
6027	586	1,226	3.22	550	Choice	10.7	4.15	**1.41**	**1.38**	**-0.67**
6091	768	1,452	3.44	590	Choice	14.4	4.38	**1.87**	**1.82**	**1.50**
6078	619	1,208	2.96	610	Choice+	13.2	3.26	**0.87**	**2.04**	**0.80**
6018	522	1,179	3.30	630	Choice+	14.0	3.52	**1.57**	**2.26**	**1.27**
AVERAGE	612	1200	2.95	464	Choice-	12.91	3.37	0.85	0.43	0.62

Begwt is weight when entering feedlot; Endwt is ending feedlot weight; marbling is using 1995 Beef Quality Audit scale: practically devoid = 100 (Standard-), traces = 200 (Standard), slight = 300 (Select), small = 400 (Choice-), modest = 500 (Choice), moderate = 600 (Choice+), slightly abundant = 700 (Prime-), moderately abundant = 800 (Prime), and abundant = 900 (Prime+); rib eye area is expressed as sq. in.; yield grade scale is (1 to 5, 5 = fattest); STD. DEV. is standard deviation for either average daily gain, marbling, or rib eye area.

You do not appear to be that far off of breed average for heifer REA and for steers you appear to be slightly above average. I believe you can accommodate a slight decrease in REA to achieve more marbling and still be within industry averages. One factor to consider with REA selection is that it is negatively correlated with quality grade or marbling. The phenotypic correlation varies, but a median value is -.1.

When you select for a trait, it may be positively or negatively correlated with another trait. I have listed some phenotypic and genetic correlations between some traits in Table 3.

Correlation

Correlation is the degree of association between two traits. Generally speaking, it ranges between +1 and -1, but does not indicate which is the cause and which is the effect. Correlation is bracketed in three categories (+ or -): low 0 to .2; moderate .3 to .5, and high .6 to 1.0.

Table 3. Genetic and Phenotypic Correlation Between Traits (Average of several trials) **(Data from various sources, but primarily from a literature review by Bruce Shanks, Montana State University grad student)**		
Traits	Genetic Correlation	Phenotypic Correlation
Rib eye area & Post weaning gain	.55	.37
Marbling & Post weaning gain	.20	.13
Fat thickness & Post weaning gain	-.03	.23
Traits	Genetic Correlation	Phenotypic Correlation

Table 3. Genetic and Phenotypic Correlation Between Traits (Average of several trials)
(Data from various sources, but primarily from a literature review by Bruce Shanks, Montana State University grad student)

Marbling & Rib eye area	-.10	-.01
Marbling & Fat thickness	.33	.22
Birth weight & Post weaning gain	.23	
Weaning Wt. & Post weaning gain	.41	.15
Yearling Wt. & Post weaning gain	.87	.75
Feed Efficiency & Post weaning gain*	-.4 to -.7	-.5 to -.8
Yield Grade & Quality Grade	-.10 to -.20	

**A negative correlation is not always undesirable as in the case of a negative correlation between feed efficiency and PWG. What this really means is that if a animal has more genetic potential for growth then it will take less lbs. of feed for him to gain weight than for a slower gaining steer.*

By selecting for PWG, you will also increase yearling weight. This can have a negative effect for conception rate if cow size increases. To get around this, I suggest you apply a selection threshold to selected females for frame size. To meet industry goals, a good size cow should not be above a frame score 6 (See Table 4). Otherwise, final finishing weight of offspring usually exceeds that desired by the current market. Steers which finish out at weights exceeding 1400 lbs. are beginning to get too big to furnish the size steaks consumers desire. Heavy weight carcasses (950 lbs. carcass weight; 1450 lbs. live weight) are more difficult to handle and market by packing plants and incur a price penalty (may be as much as $.15 per lb.). The Beef Improvement Federation (**BIF**) guidelines uses age as part of the equation to calculate

Table 4. Weights at Different Body Condition Scores (BCS) for Different Frame Sizes of Mature Cattle, lbs. *

				Body Condition								
Frame Size**	Height, cm	Height, inches	Lbs. / BCS	1	2	3	4	5	6	7	8	9
1	112	44.1	69	643	701	759	817	882	955	1035	1114	1193
2	117	46.1	74	696	758	821	884	955	1034	1120	1206	1291
3	122	48.0	80	750	818	886	953	1030	1115	1208	1300	1393
4	127	50.0	86	803	876	948	1021	1102	1194	1293	1392	1491
5	132	52.0	92	856	934	1011	1088	1175	1273	1379	1484	1590
6	137	53.9	98	911	993	1075	1157	1250	1354	1467	1579	1691
7	142	55.9	103	964	1051	1138	1225	1323	1433	1552	1671	1789
8	147	57.9	109	1017	1109	1200	1292	1396	1512	1637	1763	1888
9	152	59.8	115	1072	1168	1265	1362	1471	1593	1725	1857	1989

*From Fox et. al, 1988. Journal of Animal Science 66:1475.

** For Mature Cows; 1=smallest; height measured at hip over hook bones.

frame size for immature cattle (See Table 5). You could impose a hip height maximum for replacement heifers of 45 inches at weaning or 49 inches as an early yearling (11 to 13 months). This should adequately fit frame size to age for most selected heifers. Alternately, you could estimate birth date from weight at branding. If you have the dam's mature frame size (Table 4), you could estimate the calf age with Table 6. For example, if a calf"s dam was a frame score 6 and her calves ordinarily weigh around 550 lbs. at weaning at 7 months (peak milk production of 18 lbs.) then calves weighing less than 160 lbs. at branding would be less than 30 days old. Less than 240 lbs. at branding, would be less than 60 days old and less than 300 lbs. would be less than 90 days old.

Table 5. Heifer Hip Height, Inches*									
	Frame Score of Heifers								
Age in Months	1	2	3	4	5	6	7	8	9
5	33.1	35.1	37.2	39.3	41.3	43.4	45.5	47.5	49.6
6	34.1	36.2	38.2	40.3	42.3	44.4	46.5	48.5	50.6
7	35.1	37.1	39.2	41.2	43.3	45.3	47.4	49.4	51.5
8	36.0	38.0	40.1	42.1	44.1	46.2	48.2	50.2	52.3
9	36.8	38.9	40.9	42.9	44.9	47.0	49.0	51.0	53.0
10	37.6	39.6	41.6	43.7	45.7	47.7	49.7	51.7	53.8
11	38.3	40.3	42.3	44.3	46.4	48.4	50.4	52.4	54.4
12	39.0	41.0	43.0	45.0	47.0	49.0	51.0	53.0	55.0
13	39.6	41.6	43.6	45.5	47.5	49.5	51.5	53.5	55.5
14	40.1	42.1	44.1	46.1	48.0	50.0	52.0	54.0	56.0
15	40.6	42.6	44.5	46.5	48.5	50.5	52.4	54.4	56.4

* Measured over hip at hook bones. From Beef Improvement Federation, BIF Guidelines for Uniform Beef Improvement Programs. 6th Ed. University of GA, Athens.

Another consequence of selecting for PWG and also marbling is that fat thickness may increase (phenotypic correlation of fat thickness to both traits is weakly positive). This is a disadvantage in respect to yield grade but may be an advantage for brood cow fleshing ability and conception rate.

Positive benefits for the correlated trait of improved feed efficiency will be realized by selecting for PWG. The phenotypic correlation between PWG and feed efficiency was -.6 for a small data set of Brahman crosses which I analyzed. When I evaluated the data by regression analysis, I found that each .1 lb. increase in PWG resulted in a .21 lb. feed per lb. of gain improvement in feed efficiency. For a larger data set which included Brahman crosses, each .1 lb. increase in PWG improved feed efficiency by .16 lb. feed per lb. gain.

Selecting for more than one trait will reduce progress made in a particular trait. The percentage progress in one trait that can be expected while selecting for multiple traits is given by the equation 1 ÷ square root of the number of traits selected. By selecting for two traits, you should make around 70% progress in the trait of interest. Selection for three traits would result in 58% progress and four traits 50% progress.

$1 \div \sqrt{2} = .70$; $1 \div \sqrt{3} = .58$; $1 \div \sqrt{4} = .50$

If you select for both PWG and marbling with the bulls and heifers used in the previous example on page 2, you should still be able to increase PWG by .028 lbs./year (.04 X .7 = .028) or by .28 lbs. in ten years time. Using the example in the PWG, Feed Efficiency, and Profitability section in the last issue of this newsletter, this could potentially increase profitability in the feedlot by $25 per head.

Selection Strategy

My suggestion is that you place primary selection upon PWG and secondary selection on marbling and use REA as a threshold trait for selection. From the data you have collected thus far, you could use a spreadsheet program or scientific calculator to determine standard deviations for PWG, marbling, and REA for heifers and steers as I have done. Next, cows could be ranked by the standard deviations of offspring for the selected traits. You could then make a preliminary seed stock assignment for sires and dams of these selected offspring for consideration as a nucleus herd to generate

Table 6 .Estimating Calf Age from Weaning Weights, Milk Production, and Frame Size*										
				Calf Weight at corresponding day of lactation, lbs.						
Frame Size**	Height, cm	Height, inches	Peak Milk Yield, lbs.	30 d	60 d	90 d	120 d	150 d	180 d	210 d
1	112	44.1	6	119	167	213	257	299	348	398
			12	130	187	242	290	339	389	444
			18	139	205	262	317	367	420	477
2	117	46.1	6	121	172	220	266	312	361	416
			12	134	194	249	301	350	403	460
			18	143	209	271	328	378	429	493
3	122	48.0	6	123	178	229	275	323	376	431
			12	139	200	257	310	361	416	475
			18	147	216	279	337	392	449	510
			24	156	233	299	352	418	480	546
			30	163	246	319	372	444	506	574
4	127	50.0	6	132	185	235	284	337	389	449
			12	143	207	266	321	372	429	491
			18	152	222	286	348	403	462	526
			24	161	238	308	367	431	493	561
			30	167	253	328	389	458	521	590
5	132	52.0	6	136	191	244	295	350	405	464
			12	147	213	273	330	385	442	506
			18	156	229	295	356	416	477	541
			24	165	244	317	383	444	508	576
			30	172	257	337	407	471	537	607
6	137	53.9	6	139	196	251	304	359	416	477
			12	152	218	282	339	396	455	521
			18	161	235	304	367	427	491	557
			24	169	251	326	394	455	521	590
			30	176	264	345	416	484	550	623
7	142	55.9	6	143	202	257	312	367	427	491
			12	156	224	288	350	407	469	537
			18	165	242	310	378	440	506	572
			24	174	257	332	403	466	535	605
			30	180	271	352	427	495	565	638
8	147	57.9	6	147	207	266	321	376	438	504
			12	161	213	297	359	418	480	550
			18	169	246	319	389	453	521	587
			24	178	264	341	414	480	550	620
			30	185	277	361	438	506	579	656
9	152	59.8	6	152	213	273	330	385	449	517
			12	165	235	304	367	429	493	565
			18	174	253	328	400	466	537	601
			24	183	268	350	422	491	583	634
			30	189	284	370	447	519	592	671
*From Fox et. al, 1988. Journal of Animal Science 66:1475.										
**For Mature Cows; 1=smallest; height measured at hip over hook bones.										

replacements. When I did my first selection for steer and heifer's mothers based upon PWG, marbling, and REA standard deviations, I only came up with 45 animals or 27% of the sampled population. To generate adequate replacements, you will probably need to designate 40% of the cows as the nucleus herd. Since only a small number of bulls are required to be selected each year, you can establish more rigid selection criteria for them (standard deviation for primary trait of interest of + 2.0). In order to adequately supply the required 40% seedstock producers for cows, you will need to accept a standard deviation of about + 1.0 for the primary selection trait. Table 7 provides guidance on the standard deviations you can expect for selection criteria to generate an adequate number of replacement heifers and bulls.

Table 7. Standard Deviations and Required Number of Replacements to Maintain Herd
(Adapted from Breeding & Improvement of Farm Animals, 8th Ed., Legates and Warwick, 1990, McGraw Hill.)

			Selection Criteria	**Selection Criteria**
Cull at 6 years	% Males Needed*	% Females Needed*	Standard deviation, males	Standard deviation, females
60% calf crop raised	6.7	67	1.94	.54
80% calf crop raised	5.0	50	2.06	.80
100% calf crop raised	4.0	40	2.15	.97
Cull at 7 years				
60% calf crop raised	6.7	57	1.94	.69
80% calf crop raised	5.0	43	2.06	.92
100% calf crop raised	4.0	34	2.15	1.08
Cull at 8 years				
60% calf crop raised	6.7	48	1.94	.83
80% calf crop raised	5.0	36	2.06	1.05
100% calf crop raised	4.0	29	2.15	1.18

* Percentage of cow herd required to generate adequate replacements; assumes 50% of calves born are females. For example, for cows culled at 8 years with an average 80% weaning rate, it would require 3 bulls (.50 bulls x 5 = 2.5 bulls) and 18 heifers (.50 heifers x 36 = 18 heifers) be selected each year for each 100 cows.

If cows are culled at 8 years of age, and you weaned an 80% calf crop for the entire cow herd exposed to bulls, then you would need to retain 36% of weanling heifers as replacements. This level of replacements is allowing for an 87% conception rate for replacement heifers.

Since you will not be able to evaluate replacement heifers for post weaning gain at the time of weaning, some type of preliminary heifer selection from the nucleus cowherd may be needed. If the calf age can be estimated at branding time from Table 6, the first attempt at heifer selection could be made from weaning weight ratios (adjusted for age of dam within sex according to BIF guidelines; Table 8). Since mature cows typically wean heavier calves than young growing cows, adjusted weaning weights are used to evaluate calves from younger cows fairly. To obtain weaning weight ratios, the adjusted weaning weight for each heifer calf is divided by the average weaning weight for all heifers in the herd and multiplied by 100. For example, if the heifer average weaning weight is 400 lbs. and a selected heifer's adjusted weaning weight was 450 lbs., her weaning weight ratio would be 113. Prospective replacements could also be evaluated for threshold frame score being less than or equal to 6 as was discussed earlier.

Table 8. Beef Improvement Federation Weaning Weight Adjustments for Age of Dam, Lbs.*						
Cow Age						
Sex of Calf	2	3	4	5	6-10	more than 11
Male	60	40	20	0	0	20
Female	54	36	18	0	0	18

* From Beef Improvement Federation, BIF Guidelines for Uniform Beef Improvement Programs. 6th Ed. University of GA, Athens. Breed specific values for weaning weight adjustments are available from BIF. Example calculation: a heifer calf from a two-year-old cow which had an actual weaning weight of 410 lbs. would have an adjusted weaning weight of 464 lbs. and a heifer calf from a five-year-old cow with an actual weaning weight of 430 lbs. would have an adjusted weaning weight of 430 lbs.

After the initial selection, selected females could be evaluated for PWG as they are developed on a low energy diet or on pasture. Final selections at breeding time could be made according to standard deviations for PWG. The number of initial replacements should then be divided by .9 to allow for culling based upon breeding, etc.

Once you have designated the nucleus herd, you may want to consider estrus synchronization and artificial insemination to increase the genetic influence of superior sires. Commercial studs are available which can collect semen from your top sires and freeze it for later use. If carcass EPD data was available for Brangus sires this would represent an outstanding chance for genetic improvement. Unfortunately, I could not find Brangus EPD carcass data. Therefore, you may need to continue to rely on your own data to evaluate bulls.

All selected females could continue to be evaluated with additional carcass information as progeny are evaluated for marbling and REA. This information would be combined with PWG to keep selection on track. I would suggest that carcass data be collected for at least two years to increase repeatability and confidence in the selection process. Multiple records from each cow increases the confidence of genetic predictions. After collecting two years data, then you may want to collect carcass data when market conditions warrant feeding out cattle. The frequency of this data collection will depend upon on how often you wish to evaluate progress being made for marbling and to a lesser extent REA. Rib eye area could be considered as a proxy indicator of yield grade and total retail product. The phenotypic correlation between yield grade and REA in one study was -.47. (In other words, a larger rib eye is indicative of a lower yield grade or a leaner carcass.)

Other Comments

Concerning your question on your cover letter regarding testing for tenderness, this could be done but would be expensive. The Warner-Bratzler shear test involves cooking a core sample of a steak and then testing it in a press for the kilograms of pressure required to shear the sample. Marbling is more heritable than the Warner-Bratzler shear test (.40 vs .26) and much less expensive to evaluate. Also, the genetic correlation between marbling and the Warner-Bratzler shear test is high and negative. For animals to a similar age or for the same amount of time in the feedlot, the average correlation over five studies was -.96. This means that for more marbling in the steak, less force was required to shear the steak sample, implying greater tenderness. Therefore, you should make more progress for tenderness by selecting for marbling and at much less cost than by utilizing the Warner-Bratzler shear test.

The easiest way to evaluate quality grade and yield grade is with a commonly accepted carcass grid. I have included one in Table 9.

You are correct in stating that there seems to be little correlation between end weight and quality grade with *your data set.* In fact, when I ran a correlation analysis on the data, the correlation between end weight and marbling was only .26 for heifers and .21 for steers. However, I consider your steers to be under finished (average back fat of .15; industry target of .3 to .4) and your heifers to be over finished (average back fat of .56). Still, phenotypic correlations between these two traits reported in the literature average around .17 when animals are fed to an age- or time-in-feedlot constant basis. This degree of correlation is considered low.

Closing Comments

You may want to see if Dr. Rice wants to get a geneticist on campus involved to calculate genetic variance and covariance for your herd carcass data. They could then calculate heritability for your herd for the carcass and growth

Table 9. Example Carcass Grid					
Base Value of Choice # 3 is set at $1.00 /lb. (Current price $1.035/lb. on 4-14-99 at Omaha)					
	Yield Grade				
Quality Grade	1	2	3	4	5
Prime	$ 1.07	$ 1.05	$ 1.03	$ 0.90	$ 0.85
Choice	$ 1.04	$ 1.02	**$ 1.00**	$ 0.85	$ 0.80
Select	$ 0.98	$ 0.96	$ 0.94	$ 0.79	$ 0.74
Standard	$ 0.80	$ 0.80	$ 0.80	$ 0.74	$ 0.69
To convert to a live weight price, multiply carcass price by the average dressing % of .60 to .62.					
Out Cattle Penalities, Price Reductions/lb.					
950 lb. or greater carcass	$ -0.15				
dark cutter	$ -0.30				
stag	$ -0.30				
hard bone	$ -0.30				
less than 550 lb. carcass	$ -0.15				

traits of interest. They could also evaluate whether or not they think a selection index using post weaning gain, marbling, and rib eye area (or alternately, other traits of interest to you and them) could be developed. A selection index is oftentimes more effective than selecting for two or more traits as I have outlined above. A selection index is a formula which attaches economic weights for the traits in question.

My initial assumption is that it will probably not be effective to integrate an overall carcass value (grid carcass price) into a selection index. Perhaps I am wrong in my assumption. My thinking is that at this time, the benefits being paid for added carcass value are so small and so many animals are considered average, that more rapid genetic progress may be made by selection for post weaning gain, marbling, and rib eye area . If carcass traits are rewarded better in the future, perhaps one could then develop a selection index incorporating carcass value along with feedlot performance.

Sincerely,

Jim Sprinkle

Update from John Murphy

May 10, 1999

Dear Jim:

Currently utilized carcass grids do not appear to realistically reward favorable quality and yield grades and do appear to severely penalize carcasses with unfavorable quality and yield grades. As a result, a sale to a packer based upon a grid is not as attractive to a producer as it should be. Unless we are willing to gamble on the possibility that these grids will be reformed within a reasonable time, the true value of favorable quality and yield grades should be heavily discounted if not ignored when formulating a carcass value equation.

Currently, the factors which economically benefit a producer who is retaining ownership until sale to the packer seem to be limited to post weaning average daily gain. The value of increased PWG can be easily calculated and eliminates the frequent carcass analysis required in order to make breeding selections based upon other factors. Because of the favorable genetic and phenotypic correlation between PWG and marbling, tenderness, rib eye area, weaning weight and feed efficiency, any improvement in PWG is also likely to improve quality in these other areas which we can hope will someday be recognized in the market place. Accordingly, I have scrapped all of my calculations designed to determine the true value of these various traits and decided to concentrate on PWG and frame size as you have suggested.

As you point out, selection based only upon PWG may eventually result in excessive cow size and the resulting lower conception rates and higher market discounts.

Unfortunately, it is difficult to accurately determine the birth dates of calves born on the open range which has a low carrying capacity such as the OX Ranch. Without accurate age data, it is difficult to accurately judge frame size for immature animals. On the other hand, I note from the information you have assembled that the difference between the hip height of a five month old heifer and a seven month old heifer is approximately 2 inches whereas the difference between the hip height of a heifer with a frame score of 1 and the hip height of a heifer with a frame score of 2 is approximately the same. Thus, even if our age estimate is two months off, the indicated frame score will only be off by one point.

In light of the foregoing, I propose that we do the following.

1. Continue with the DNA testing so that we can continue to determine the parentage of each offspring;

2. Continue to obtain PWG for each offspring.

3. Modify our culling practices in order to cull the following:
    a. Bulls and cows producing animals with low PWG;
    b. Bulls that have demonstrated poor performance;
    c. Bulls and cows that produce offspring that exceed the targeted frame scores;
    d. Cows that do not demonstrate high fertility; and
    e. Bulls and cows that do not produce offspring with acceptable conformation; and

4. Periodically analyze the carcasses in order to measure our progress in improving marbling and rib eye area. At the same time, evaluate feed efficiency in the feedlot.

Very truly yours,

John A. Murphy, Jr.

Summary of Key Points Related to Genetic Selection

1. Genetic Change per year can be predicted for traits using the genetic change equation and heritability estimates in the preceding article.
2. Rankings for bulls and cows within the herd can be made using standard deviations for the traits of interest. To generate adequate replacements, about 40% of the herd will need to be designated as a nucleus herd. For females, the minimum acceptable standard deviation for the selected trait would probably around + 1.00. Since fewer bulls need to be selected (around 5% of the total calves produced), more rigorous selection with a standard deviation of + 2.00 can be used. If selecting for more than one trait, you will need to lower the minimum standard deviation for secondary traits in order to generate an adequate number of replacements.
3. Progress gained by selecting for multiple traits will be slower than that made by selecting for just one trait.
4. Some desirable traits of selection may be positively correlated (associated) with other traits you may not wish to select for. For example, selecting for increased post weaning gain may also increase mature cow size. This can be a disadvantage in a limited range environment. To circumvent the effect of undesirable correlated traits, threshold trait selection can be applied to the herd. As an example, selecting for increased post weaning gain can be balanced by not retaining any females with a frame score greater than 6.
5. You can obtain standard deviations for the cow herd through the use of a scientific calculator or any spreadsheet program. Standard deviations can also be obtained by hand using the equation in the last newsletter.
6. Genetic selection through the use of standard deviations also needs to be accompanied by visual inspection for conformation and selection for management goals (fertility, disposition, etc.) as Mr. Murphy suggests.