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The unintended consequences
(What we really learned)

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Sometimes we learn more by accidence or coincidence than what we planned. Sometimes examining details will confirm or disavow ideas that we have come to accept. Spending three years of detailed work on commercial ranches has happily given us the opportunity to learn even more than originally planned.

Bulls and breeding

The typical reproductive life span of a bull is only about 5 years of age. On average bulls sired 20 calves per season but some bulls averaged 40 calves per season for several seasons. Older bulls (past 5 years of age) were capable of breeding 20 plus cows. Typically every breeding season saw a range of 0 to 40 plus calves per bull; this is when bulls were given equal opportunity with a ratio of about 25 cows per bull. Bulls siring no progeny are not making a genetic contribution. Generally bulls that were prolific tended to stay prolific. Bulls that were of low prolificacy occasionally improved (more so than the highly prolific bulls declined). So we say that prolificacy is moderately repeatable. Analysis also says it is low to moderately heritable. There is no good test for prolificacy except actual use. Unfortunately, by then the financial investment may be difficult to recuperate with any sort of culling program or management decision based on actual prolificacy. The data did suggest that scrotal circumference EPDs offered some selection potential for improved prolificacy (Figure 1). This was low but considering the lack of alternative selection tools for prolificacy and its importance, SC EPD should be given some emphasis in selection decisions. SC is also related to earlier maturing in replacement heifers and larger circumferences are beneficial in breeding soundness exams for bulls.

Young two year old bulls if mixed with older bulls will typically sire no or very few calves. Yet they will perform well if together. If prolificacies are known it would seem to make sense to distribute the high prolificacy bulls across breeding units. Lower prolificacy bulls would fill-in the remaining required number of bulls in each unit. Since prolificacy is usually not known attempting to create as uniform a group of bulls as possible is best. Factors to consider would be breed, horns, size, and age. Bulls are social animals so putting bulls that are known fighters with each other should be avoided.

Current Ranch Bull EPDs versus Breed Average EPDs for bulls

Ranchers attempting to improve the genetic potential of their bulls are often unsure of the EPD values they should be looking at. They are usually concerned about calving ease and weaning

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weight so look at birthweight EPD (or calving ease direct EPD) and weaning weight EPD. But, what value is most appropriate is another question. Frequently they consider "breed average" and breed averages are often published in sale catalogs. Breed averages are of little value for a specific ranch. Their best source of information is the EPD values of the bulls they have been using. The performance of the progeny from these bulls reflects how a certain "EPD" will actually perform under their conditions. We have compiled the EPDs for the bulls used in the project along with the performance of their calves. This is not to say that the EPDs used by these ranches will work for all ranches. But they are much closer to actual performance than a national EPD average. It is important to recognize that these bulls have been selected for not only calving and weight traits but also carcass traits since they are part of a vertically integrated marketing plan. The EPD values and actual progeny values are shown (Tables 1 and 2) for current Angus sires, each ranch and the ranch average. The difference between fall and spring born calves is also shown.

Number of calves versus superior growth of calves

The bulls making the largest contribution to sale weight and thus gross income for the ranch were not those with the highest weaning or yearling weights (Figure 2). Rather the bulls siring the most calves are providing the most income. This agrees with research that reproduction is far more important to ranch profit than growth, which is more important than carcass traits. Most reproductive traits are lowly heritable so crossbreeding gives the largest improvement in reproduction. If crossbreeding or the use of composite breeds is bypassed then selection within a breed offers some opportunities. But very few producers select bulls on reproductive traits, concentrating instead on avoidance of dystocia and emphasis on growth (even if seeking only moderate frame size). Unfortunately, few reproductive traits have had EPDs to use in a genetic selection program. More recently EPDs for heifer pregnancy (HP), stayability (STAY), calving ease maternal (CEM), and scrotal circumference (SC) are more available and are worthwhile selection criteria. Preliminary data from this project suggests SC EPD has a small but significant relationship with prolificacy (Figure 1). These opportunities differ between breeds but provide tools for commercial producers striving to improve reproductive performance of their herds. The American Angus Association supplemental sire records for sires born on or after 2009 (and with at least 10 progeny with weaning weights recorded) shows nearly 1/3 had SC and CEM EPDs but only about 3 percent had HP EPDs. The number of bulls with this type of data will increase. But even as reproductive EPDs increase, effective practical tools for the commercial cattleman to use additional EPDs in objectively evaluating multiple trait EPDs is very limited. This will slow adoption of multi-trait EPD evaluations.

Technology tools

This commercial ranch genomics project used about 7,000 calves and those calves generated a minimum of 1 million unique values for record keeping. This does not include any of the DNA marker data nor breed association or on-ranch EPDs. It does include values such as ID, birthdates, weaning weights, and carcass traits, for example. Clearly electronic data capture and transfer were necessary. All cooperating partners were accommodating (and in some cases enthusiastic) but technological problems were constant, if ever declining. Each additional piece of equipment was exponential in potential interactions and problems. Just supplying power under field conditions can be problematic. Electronics were actually remarkably durable considering the dust, wind, rain, snow, heat and abuse they were subject to. But all those factors

had to be dealt with during field operations. And, the background knowledge and expertise required for the equipment in this project was beyond what should be expected of the average commercial producer. While the recordkeeping requirements for a research project are beyond those of commercial production, all of the equipment was commercially available products for producers. Considering the age of most producers and the limited time for continuing education the likelihood of successful adoption of these technological tools is limited.
While it is antithetic to the rugged, independent individual cowboy, methods to consolidate or integrate to take advantage of new technology should be considered. Many new agricultural products such as sophisticated tractors, implements and highly selective herbicides require specialists for their use or repair. Similar conscription of specialists and/or integration of producers in information technology may be needed for advancing livestock production requirements. This is especially true as many important attributes are from records and not from easily measured factors.

DNA technology
Predictions about genetic merit by "DNA" (markers) are being incorporated into EPDs by some breed associations. Producers don't need to know the specific methodology just that it is being done. One of the first consequences is the accuracy of young bull's EPDs is improving. EPDs for young bulls are based on pedigree since there is no other data. Information directly from the individual e.g. weaning weight adds accuracy. Obtaining birth weights, weaning weights and ultrasound tells us something additional about the genetic merit. DNA is one more type of information, providing more information at an early age. Thus, the accuracy of the EPD will improve further. We have made progress in the past because on the average EPDs are correct. We will see more separation in young bulls' EPDs and genetic progress can be faster with increased EPD accuracy. So, in case you haven't figured it out yet, understand EPDs they are not going away.

Research indicates DNA information is more helpful to the feedlot and processor but does benefit everyone in the production chain. However, it should be determined at the cow calf level to take first advantage. The problem is spreading the cost or capturing the added value. Those mechanisms do not yet exist. Someone will need to develop a method to capture the added value. Perhaps a password protected database linked to animal ID. This could provide the age/source verification data as well as genomic values. Ownership brings password access to the information available real time through the web. Creative individuals will develop methods to capture those added values.

Cooperating ranches, business entities and future research and education
Any successes attributed to Cooperative Extension rest with people, and especially the producers and processors. Becoming a cooperating ranch requires a huge leap of faith: faith that something good will come out of the extra time and costs. Usually it does, even if it is negative or contrary information to what was expected. Opportunities for Extension work at government facilities are increasingly limited, and different from producer circumstances. That does not bode well for testing nor producers.

During the course of this project questions or comments from producers made it abundantly clear that not all marketing of DNA tests was appropriate, caveat emptor. This is not a unique

phenomenon to DNA tests. Is it conspiracy or incompetence selling a product that is efficacious under one set of conditions but knowingly being used under different conditions?
Cattle producers have made many changes to remain in business, sometimes changing the business to remain in the black: agritourism, new crops, purebreds to commercial cattle, cattle to crops to name a few. Sacrifice to stay on the land. A local rancher said cattlemen have learned to cope with the cyclic nature of droughts, prices and disease but regulations just keep coming, there is no end. Small-scale producers may benefit from specialized markets at higher prices, lower costs and/or increased flexibility, with larger producers benefitting from economy of scale, technological applications, and supply chain opportunities. What about the mid-scale producers? Perhaps some sort of organization or collection to effectively function as a large entity while retaining more limited acceptable individualism.

Figure 1. A small but significant relationship was found between bull's SC EPD and their number of progeny.

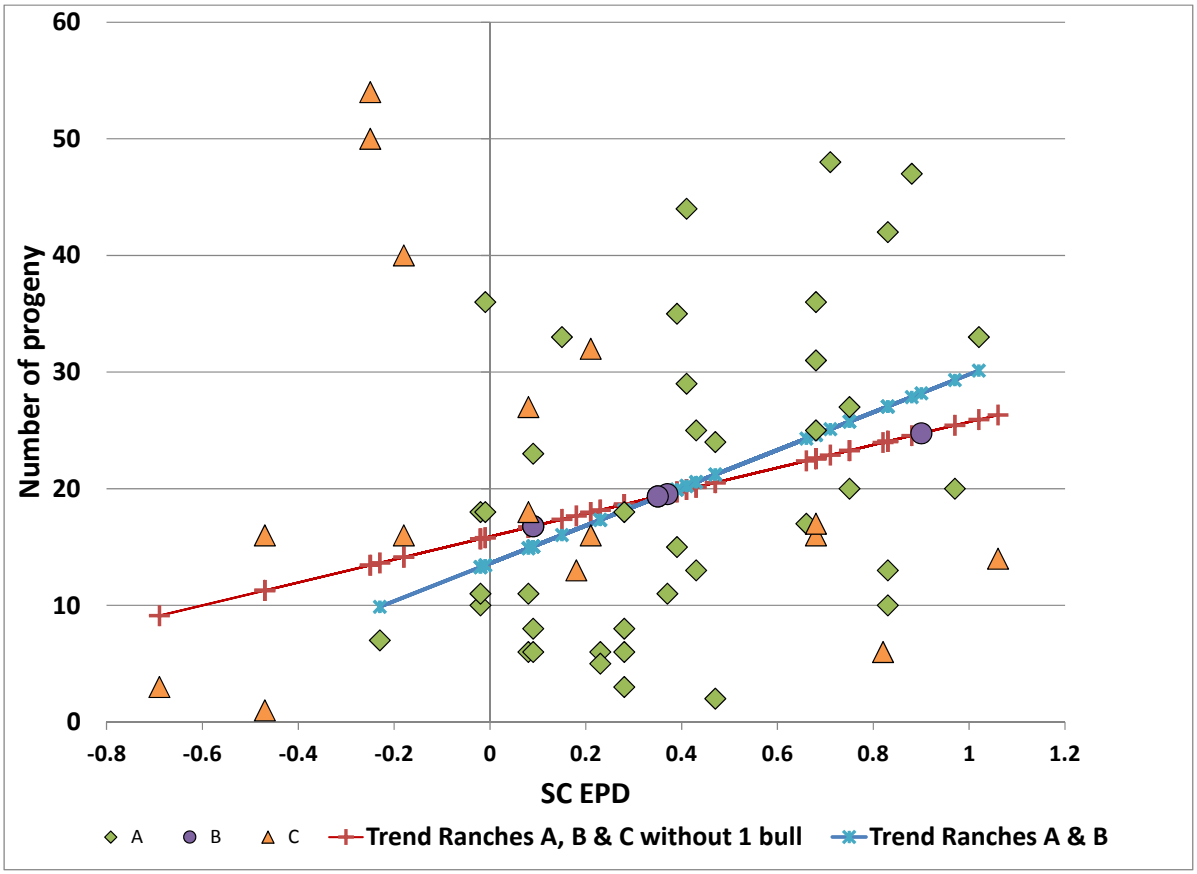
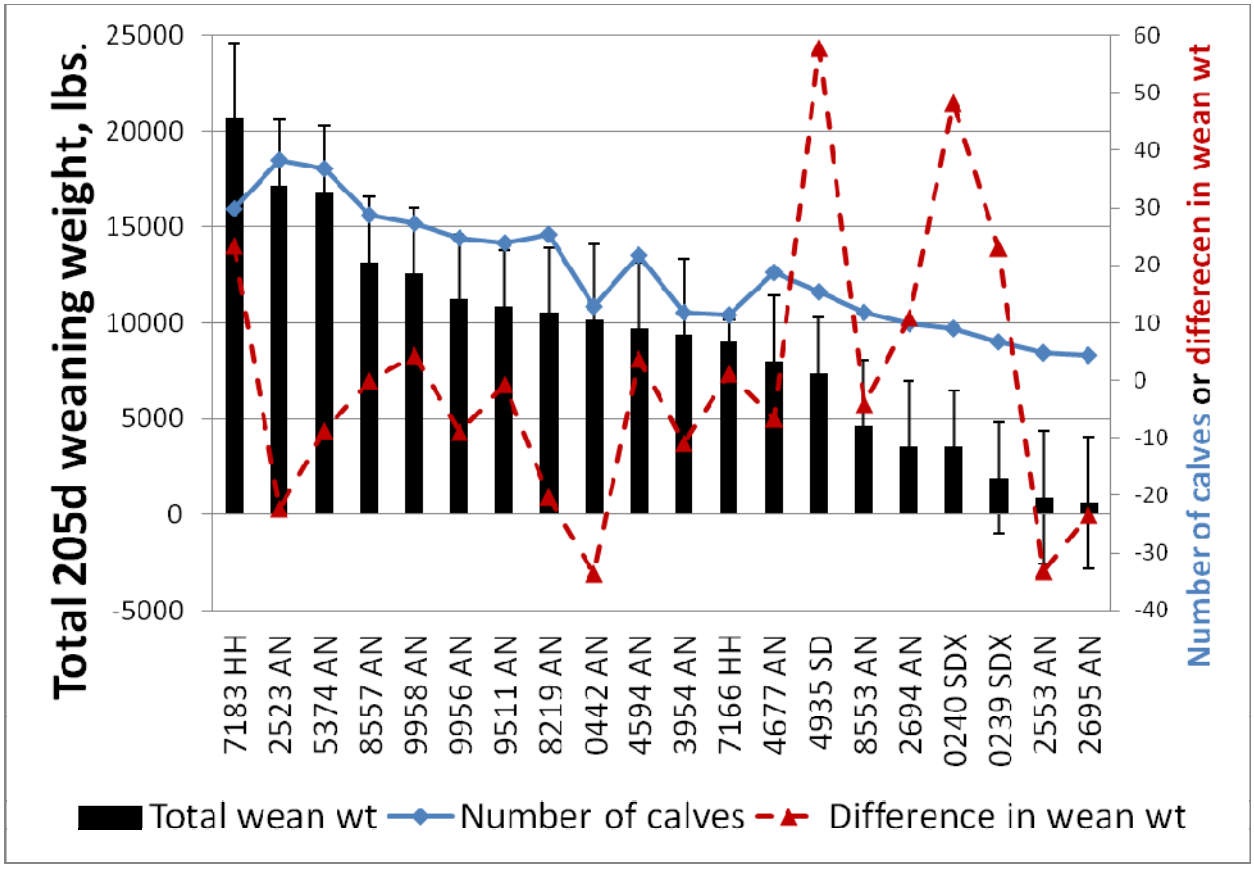


Figure 2. Total contribution of sale weight (shown as Total 205d weaning weight) varies significantly among bulls. Bulls with more progeny made a much larger contribution than bulls with higher individual calf weaning weights.



Expected Progeny Differences -- EPDs

Table 1.	**CED**	BW	WW	YW	RADG	YH	SC	DOC	**HP**	CEM	MILK	MW	MH	$EN
current Angus sires	**5.0**	1.8	46.0	83.0	0.13	0.4	0.51	9.0	**7.9**	8.0	22.0	30.0	0.4	-0.6
Cowley	**6.0**	1.5	40.0	76.7	0.14	0.3	0.42	8.6	**9.0**	8.7	21.9			2.5
Kuck	**4.0**	1.9	41.0	78.2	0.12	0.4	0.46	8.3	**7.2**	7.4	20.5			3.7
MR	**4.1**	1.9	43.2	77.1	0.10	0.3	0.26	7.7	**8.7**	7.6	19.7			4.1
Ranch average	**4.7**	1.7	41.4	77.3	0.12	0.3	0.38	8.2	**8.3**	7.9	20.7			3.4

Actual Measurements

Cowley		523	703
Kuck		515	768
MR		489	661
Ranch average		509	710.67
Fall vs Spr season		17	49

Expected Progeny Differences -- EPDs

Table 2.	**CW**	**MARB**	RE*100	Fat	$W	$F	**$G**	**$QG**	$YG	**$B**	**In weight**	**calf adg**	**Post Wean ADG**
current Angus sires	**23.0**	**0.39**	28	0.01	26.4	25.6	**24.1**			**54.0**			
Cowley	**19.4**	**0.518**	23	0.02	25.1	20.9	**28.4**	**25.5**	2.90	**55.4**			
Kuck	**19.9**	**0.358**	16	0.01	24.6	22.1	**22.5**	**20.4**	2.16	**50.5**			
MR	**15.2**	**0.289**	20	0.01	25.9	19.8	**21.7**	**17.7**	4.02	**45.0**			
Ranch average	**18.2**	**0.388**	20	0.01	25.2	20.9	**24.2**	**21.2**	3.03	**50.3**			

Actual Measurements

Cowley	7.28	5.97	12.7	0.66		313	2.13	1.43
Kuck	7.51	5.75	12.9	0.67		356	2.03	1.86
MR	7.61	5.70	13.0	0.67		375	1.97	1.12
Ranch average	7.47	5.81	12.9	0.67		348	2.04	1.47
	*100							
Fall vs Spr season	-15	0.08	0.13	0.03		21	-0.3	0.2