Using DNA to determine the performance and economics of commercial herd bulls in multisire natural service breeding groups

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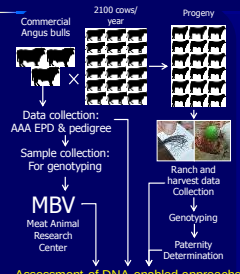
Outline

- Overview of CA commercial ranch project
- Prolificacy of commercial sires
- Feeder calf and retained ownership value of calves
- EPDs, prolificacy and total income
- Effect of calving distribution on income
- Practical implications and take homes

California Commercial Ranch Project



Three ranches:

- Cowley (900 cows)
- Kuck (500 cows)
- Mole-Richardson (700 cows)

Approximately 150 Angus bulls, and 6000 calves on project

USDA NIFA
United States Department of Agriculture
National Institute of Food and Agriculture

Work flow and collaborators

- DNA on all bulls goes for whole genome scan – collaboration with Jerry Taylor (MO) and John Pollak (MARC)
- Molecular breeding value (MBV) prediction of genetic merit based on MARC training data set – collaboration with Dorian Garrick (IA), Taylor (MO), and U.S. Meat Animal Research Center (NE)
- Ranch data including sire groupings, birth dates and weaning weights on all calves, all EIDed, and "DNAed" for parentage determination – collaboration with Dan Drake and producers
- Steer feedlot in weights, treatments, and carcass traits, weight, grading information and meat sample collected in the processing plant – collaboration with Harris Ranch (CA)
- Compile data and compare three sources of genetic estimates: breed EPDs (bEPDs), commercial ranch EPDs (rEPDs), and MBVs

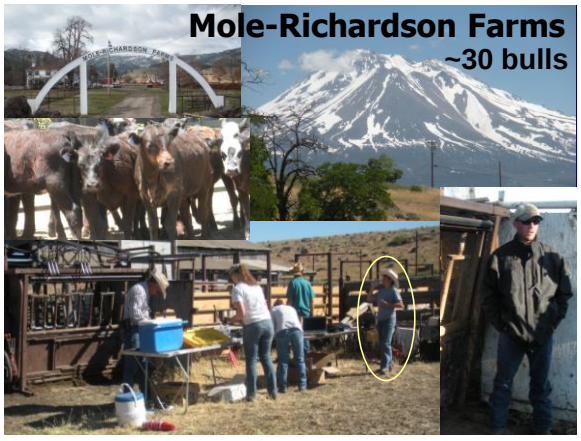
Kristina Weber, PhD student with occasional guidance from PI

Sample and phenotype collection

Calving Date	No. of Ranches	WW	Feedlot In-Weight	Carcass
Spring 2009	2	Fall 2009: ~600 head	Fall 2009/ Winter 2010: ~500 head	Spring/Summer 2010: ~450 head
Fall 2009	3	Winter/Spring 2010: ~1500 head	Late Summer/ Fall 2010: ~900 head	Winter 2011: ~850 head
Spring 2010	2	Fall 2010	Fall 2010/ Winter 2011	Spring/Summer 2011
Fall 2010	3	Winter/Spring 2011	Late Summer/ Fall 2011	Winter 2012
Spring 2011	2	Fall 2011	Fall 2011/ Winter 2012	Spring/Summer 2012
Fall 2011	3	Winter/Spring 2012	Late Summer/ Fall 2012	Winter 2013
Total records		**6000 records** >20 collection trips	**4000 records** Sent electronically	**4000 records** >35 collection trips


Cowley Ranch
~20 bulls/season
COWLEY RANCH


Kuck Ranch
~10 bulls/season


Mole-Richardson Farms
~30 bulls


HARRIS
RANCH
Honest to Goodness Beef
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Cooperating ranchers were key to success of this project
• Need to test new technologies to see how they work under practical conditions
• Inadequate research on field application of new technologies
• Cooperating ranches make a substantial contribution of time, labor and expenses
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Technology Tools Learnings

EIDs, electronic scales, computers, handhelds, DNA sampling, genotyping

- Technology problems were constant but declined as we obtained experience
- Each additional piece of equipment exponentially increased problems
- Background knowledge and expertise in computing level for troubleshooting was very high
- Electronics were remarkably durable
- Record keeping was an important attribute to make this project work

Average bull age at the beginning of the breeding season, and number of calves produced per bull that sired at least one calf on 3 commercial ranches in Northern California in 2009 and 2010.

Ranch	Year	Season	# of sires	Mean bull age	Total # of calves	Number of calves per bull		Aver # of calves per bull/season
						Min	Max	
A	2009	Spring	13	2.5 ± 0.6	246	6	40	**18.9** ± 12.5
A	2009	Fall	19	2.9 ± 0.9	345	1	47	**18.2** ± 13.9
A	2010	Spring	19	3.4 ± 0.9	366	5	36	**19.3** ± 10.7
B	2009	Spring	8	3.5 ± 2.7	139	1	44	**17.4** ± 16.6
B	2009	Fall	9	4.4 ± 2.2	196	10	48	**21.8** ± 11.4
B	2010	Spring	8	2.9 ± 1.2	129	3	28	**16.1** ± 9.1
C	2009	Fall	30	3.3 ± 10	639	2	54	**21.3** ± 13.8
C	2010	Fall	27	3.7 ± 1.3	568	1	52	**21.0** ± 13.1
MEAN				**3.3**	**2628**			**19** ± 2

Additionally, 7.3% sires failed completely (i.e. no calves sired) in any given breeding season.

Feeder calf and retained ownership value of calves.

- We compared the projected income that would have been derived per bull from 1) selling calves as feeders (cash load) or 2) using a retained ownership marketing system (going to the grid) was calculated using the production data from the California commercial ranch project (Scott Brown, MO)
- A total of 2,241 calves from 3 commercial northern California cow/calf ranches were evaluated.
- Feeder calf prices were calculated using feedlot in weights and market prices based on a single day (Green City, MO 11/23/10), and may not be representative of general trends.
- Feedlot in weights averaged 706 pounds, and the average feeding period was 152 days. Average carcass traits were: carcass weight: 743 lb; Choice: 84.5%; Prime: 1.3%; YG: 3.2; fat thickness: 0.62 inches; and ribeye area: 12.8 sq. inches.

Figure 1. Feeder calf value ($/head; blue bars; left axis) and feed costs at the feedlot ($/head; green triangles, left axis), and gross carcass grid value ($/head; red squares, right axis). Both feeder and gross carcass value ($/head) were significantly different between sires.

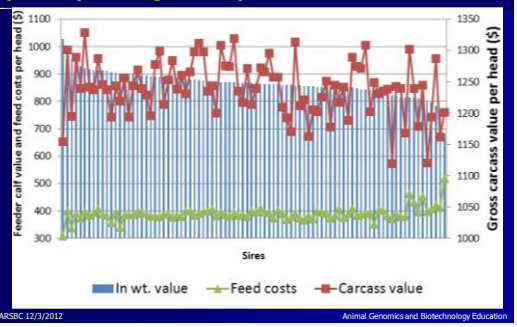


Figure 2. The average "retained value" (red squares; determined by subtracting feedlot costs from the carcass grid) and feeder value (blue bars; in wt.value) of calves sired by commercial ranch bulls.

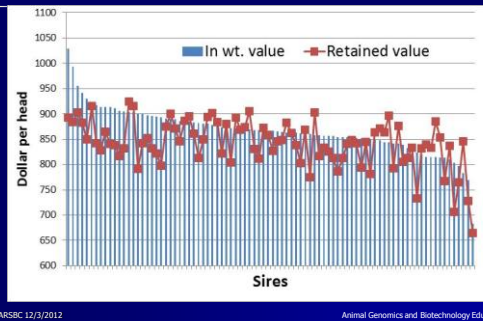


Figure 3. Average profit ($/head) resulting from retained ownership (i.e. subtracting the feeder calf value from the retained calf value) of each calf sired by commercial ranch bulls.

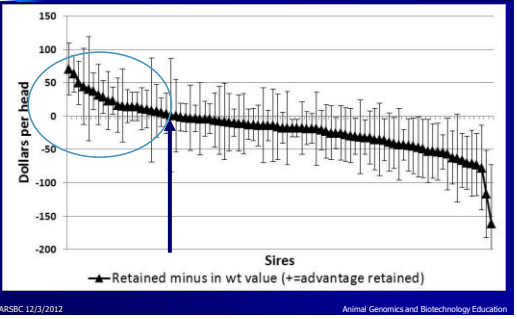
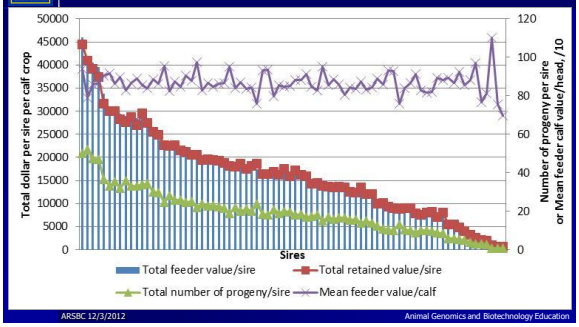


Figure 4. Total income as feeder calves per sire or total retained ownership varied by sire (Total dollar per sire per calf crop, left axis), and the number of progeny per sire (right axis) and the mean individual feeder value/calf (right axis, $/10)



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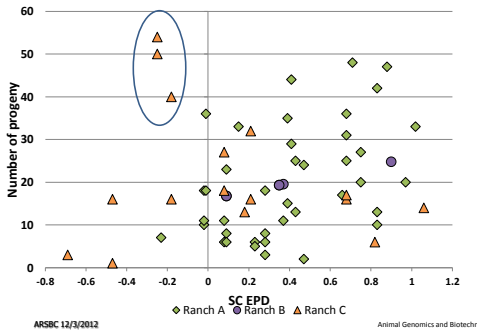
Can we select for bull prolificacy?

Current 50th percentile Angus sires have a SC EPD of 0.50, compared to about 1.0 for the 20th percentile.



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Small significant trend for increased prolificacy with larger SC EPD

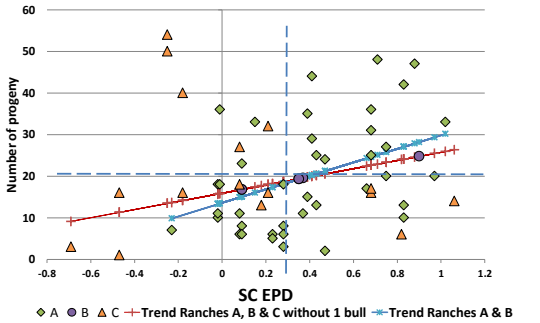

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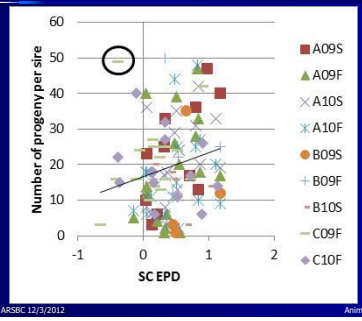
Figure 5A. The number of progeny was related to SC EPD.

Legend refers to Ranch (A, B or C), Year (2009 or 2010), and Season (Spring or Fall) of calving.



Based on this relationship each unit increase (1 cm) in SC EPD would be associated with **8.2** (±3.0) more progeny per bull per season

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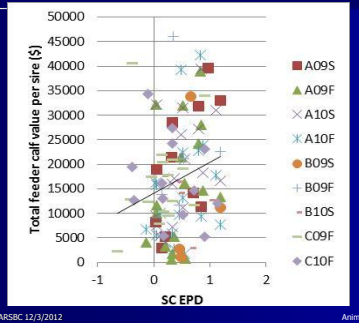
Figure 5B. The total feeder calf value was related to SC EPD.

Legend refers to Ranch (A, B or C), Year (2009 or 2010), and Season (Spring or Fall) of calving.



Based on this relationship each unit increase (1 cm) in SC EPD would be associated with **$7,615** (± 2615) more total feeder calf value per sire.

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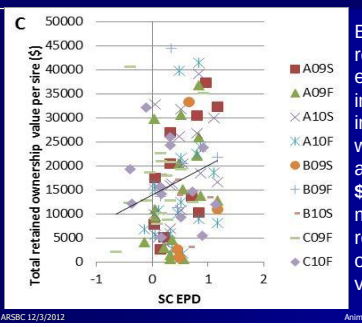
Figure 5C. The total retained ownership value per sire was related to SC EPD.

Legend refers to Ranch (A, B or C), Year (2009 or 2010), and Season (Spring or Fall) of calving.



Based on this relationship each unit increase (1 cm) in SC EPD would be associated with **$7,369** (± 2562) more total retained ownership value per sire.

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EPDs, prolificacy and total income.

- Scrotal circumference (SC) and cow energy value index ($EN) EPDs were positively correlated to total feeder calf income per sire, total retained ownership value per sire and sire prolificacy.
- Generally at least 5% of the total variation (as measured by R^2) in each trait was explained by SC EPD. Cow Energy Value Index ($EN) EPD also tended to be positively related to those traits but typically explained only about 3% of the variation.
- Four EPDs were linearly related to percent grading Choice plus or better: $G, MARB, $QG, and $B

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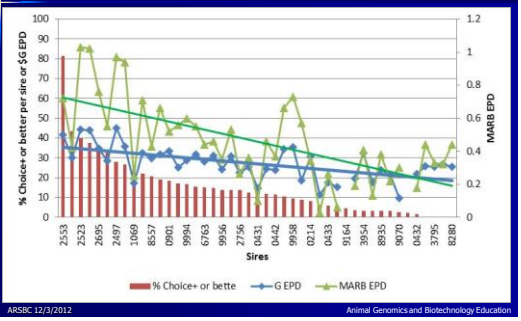
Figure 8. The percentage of progeny grading USDA Choice plus or prime (red columns) ranged from 0 to 81% with significant differences between sires. $G (left axis; blue line) and MARB EPDs (right axis; green line) were linearly related to this value.



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Effect of calving distribution

- Calving distribution was categorized into 4 periods based on day of calving: 1) days 1-21; 2) days 22-42; 3) days 43-64; 4) days past 64 with the first calf born in a calf crop being day 1.
- If the genetic potential of sires differs by day of calving, then the impact of days of calving will be confounded by sire effects.
- DNA paternity testing has the added advantage in that it allows sire effects to be teased apart from day of calving effects in multisire herds.

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Figure 7. Conceptions per week were greater (P<.02) during each week of the breeding season for the first 10 weeks of the breeding seasons for the two most prolific bulls (from each calf crop) compared to the two least prolific bulls.

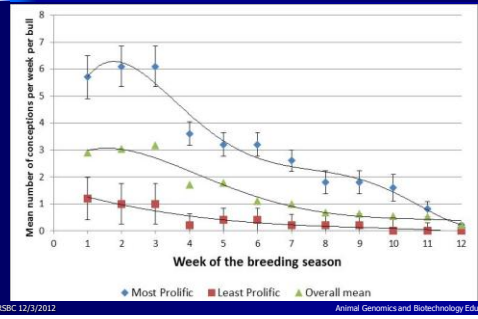

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Table 2. Calving distribution categorized as 21-d periods impact on feeder calf and retained ownership value. Periods were evaluated without removing sire effects (left), and with sire effects removed (right).

TRAIT	Calving Period	Without Sire Effects Removed Mean		With Sire Effects Removed Mean	
Feeder calf value, $/hd	1	878.93	a	877.60	a
	2	870.91	b	865.25	b
	3	850.06	c	846.60	c
	4	829.22	d	821.60	d
Calf age into feedlot,d	1	353.6	a	356.6	a
	2	336.8	b	340.0	b
	3	316.5	c	319.9	c
	4	280.3	d	283.4	d
Carcass grid value,$/hd	1	1244.89	a	1250.39	a
	2	1244.62	a	1247.52	a
	3	1213.31	b	1219.61	b
	4	1200.06	b	1200.34	b
Retained value, $/hd (Carcass grid value minus feed cost)	1	859.00	a	852.80	a
	2	855.59	a	846.72	a
	3	826.98	b	822.30	b
	4	806.91	c	796.21	c

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Figure 9. Cumulative percent of total feeder calf value. Approximately 40% of the total income from feeder calves generated by the end of the first 21 days of the calving season. About 72% of the total feeder calf income was generated by calves born in periods 1 and 2 (first 42 days).

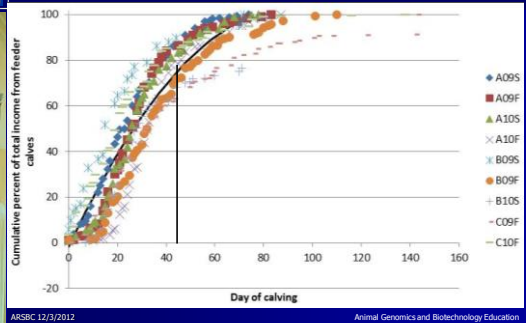

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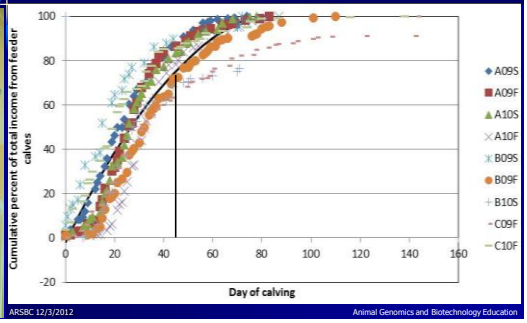
Figure 10. Cumulative percent of total retained ownership value About 40% of the total income from feeder calves generated by the end of the first 21 days of the calving season. About 72% of retained ownership calf income was generated by calves born in periods 1 and 2 (first 42 days).



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Summary and practical implications

- The number of calves born per sire per calf crop varied from 0 to 54.
- The number of progeny per sire explained most (98.4%) of the variation in the sires' total income, whereas the individual calf value explained only another 0.88% of the variation. **This clearly supports the old adage that any calf is better than no calf.**
- Scrotal circumference (SC) and cow energy value ($EN) EPDs were positively correlated with herd sire prolificacy (number of calves), and both total feeder calf and retained ownership value per sire.
- Four EPDs were linearly related to percent grading Choice plus or prime: $G, MARB, $QG, and $B
- Calves from the first 21d of the calving season returned about 40% of ranch income, and those from the first 42d of the accounted for 72%
- These data suggest inclusion of SC and $EN EPDs might be useful as selection criteria in commercial herd sire selection, & emphasize the importance of management approaches to increase the proportion of calves born in the first 21 or at most 42 days of the calving season

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Costs of natural service sire averaged $92 per live calf born

- Costs for natural service breeding continue to rise. The major factors involved are original purchase price, annual costs of feeding and maintaining bulls, often high injury and death rates, along with potential facility repairs associated with bulls.
- A range of potential cost per calf can be estimated for either a 10 or 20% bull death loss rate, purchase price ranging from $3,000 to $6,000 and annual feed and maintenance costs of $500 to $900 per bull gives a range of $48-$136/calf born. e.g. An average bull costing $4,500 with annual costs of $700 and 15% death loss siring 20 calves per year results in a cost per live calf born of $92.

D.J. Drake. 2012., **Artificial insemination for beef cattle — Costs and Benefits.** Presented at Yreka, Feb 23, Willows, Feb 24, Cottonwood, Feb 24 and Eureka, CA Feb 25, 2012.

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Results of spring calving timed single insemination and natural service on predominantly black cows.

Table 2. Results of spring calving timed single insemination and natural service on predominantly black cows.

	No. of calves	Age at wean	Actual wean wt	Adj. 205d wt	WDA	Value at $1.25	Breeding cost/calf	Income – Breed $
AI Polled Hereford sired calves	26	189	556	606	2.95	$695	97	$598
Angus sired calves	135	179	496	576	2.78	$620	79	$541
Advantage for AI		10	60	30	0.17	$75	-$18	$57
P value		0.001	<.001	0.009	0.003	<.001		<.0001

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Questions?

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