What are herd bulls accomplishing in multiple sire breeding pastures?

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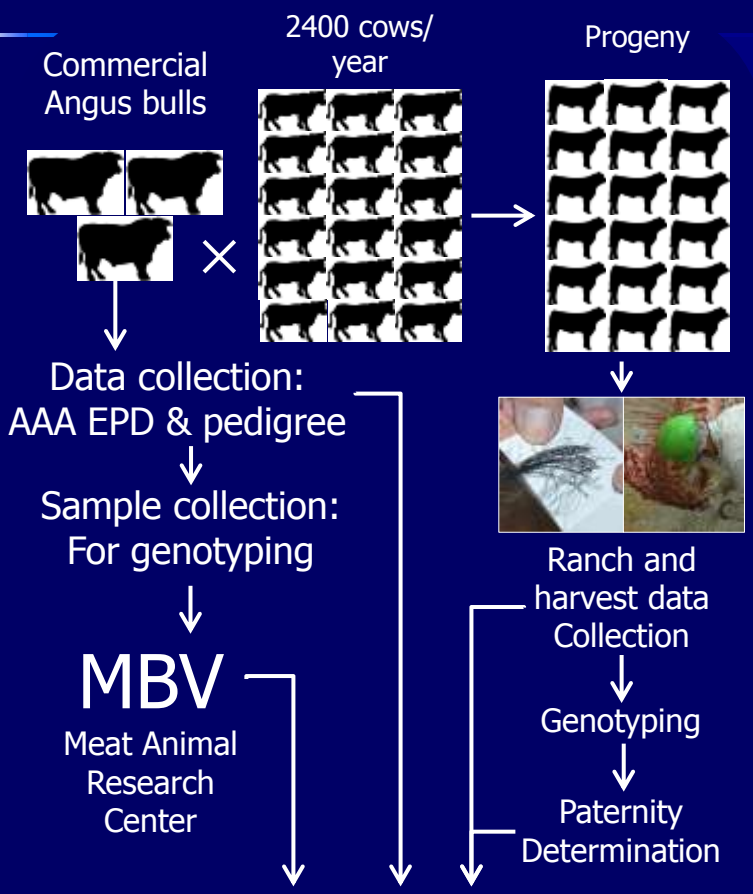
Outline

- Overview of CA Commercial Ranch Project
- Herd bull performance and calf output
- Modeling the value of this information

California Commercial Ranch Project



Assessment of DNA-enabled approaches for predicting the genetic merit of herd sires on commercial beef ranches

Four ranches:

- Cowley (900 cows)
- Kuck (500 cows)
- Mole-Richardson (700 cows)
- UC Davis (300 cows)

Approximately 100 Angus bulls, and 2,400 cows per year on project

United States Department of Agriculture
National Institute of Food and Agriculture

What does a California Commercial Ranch collaborator look like?

Photo taken in 1949 at Red Bluff Bull Sale, CA Generously provided by Cathy Maas from Crowe Hereford Ranch, Millville, CA.

Cowley Ranch

~20 bulls/season

Kuck Ranch

Mole-Richardson Farms

~30 bulls

You choose the bull for the following ranch environment

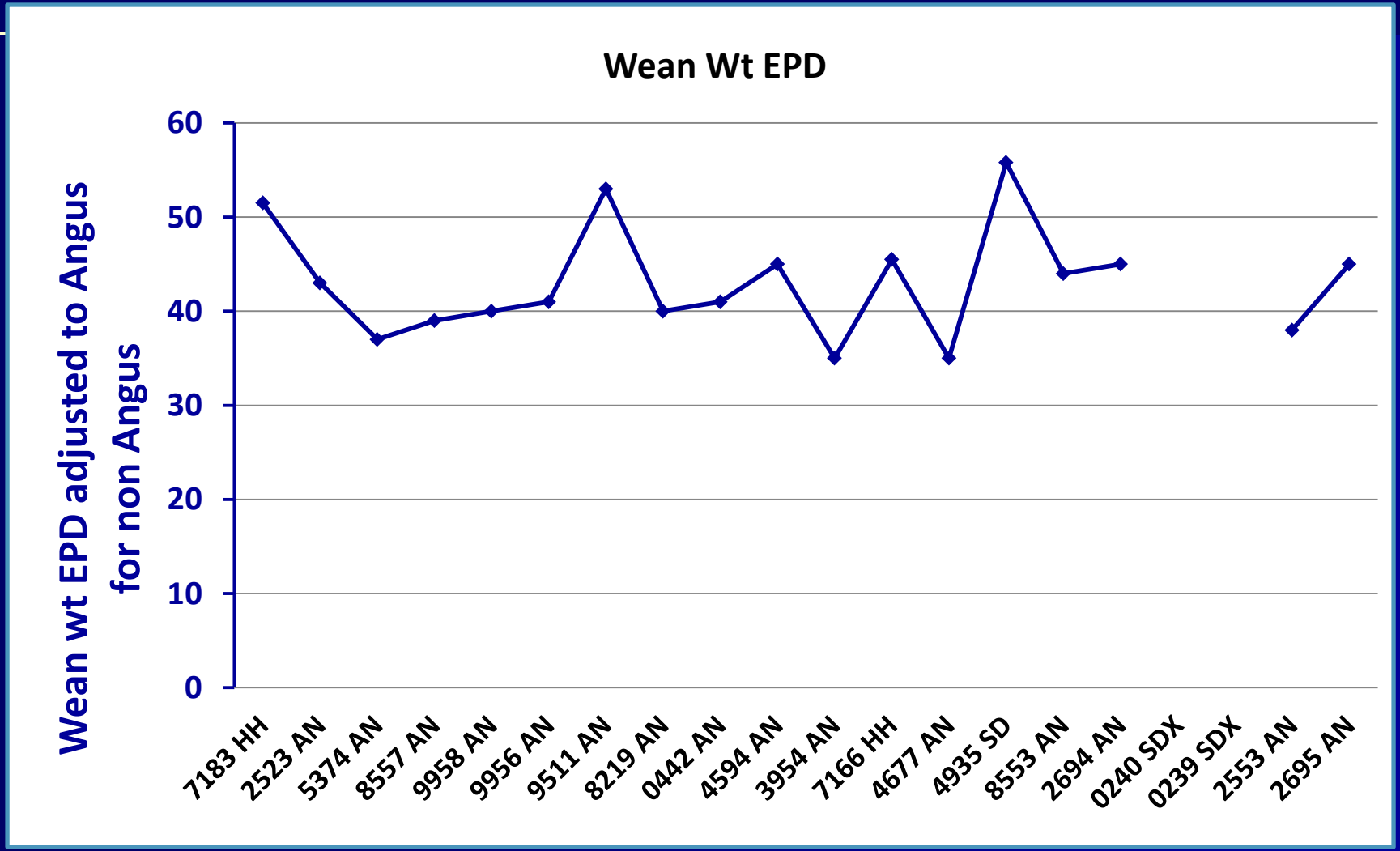
- Predominantly Angus cows
- Multi-bull breeding pasture
- All bulls appeared sound and passed BSE
- All bulls had acceptable semen quality
- Approximately 25:1 cow to bull ratio
- Fenced relatively flat breeding pastures
- Calves sold shortly after weaning

Here are your choices

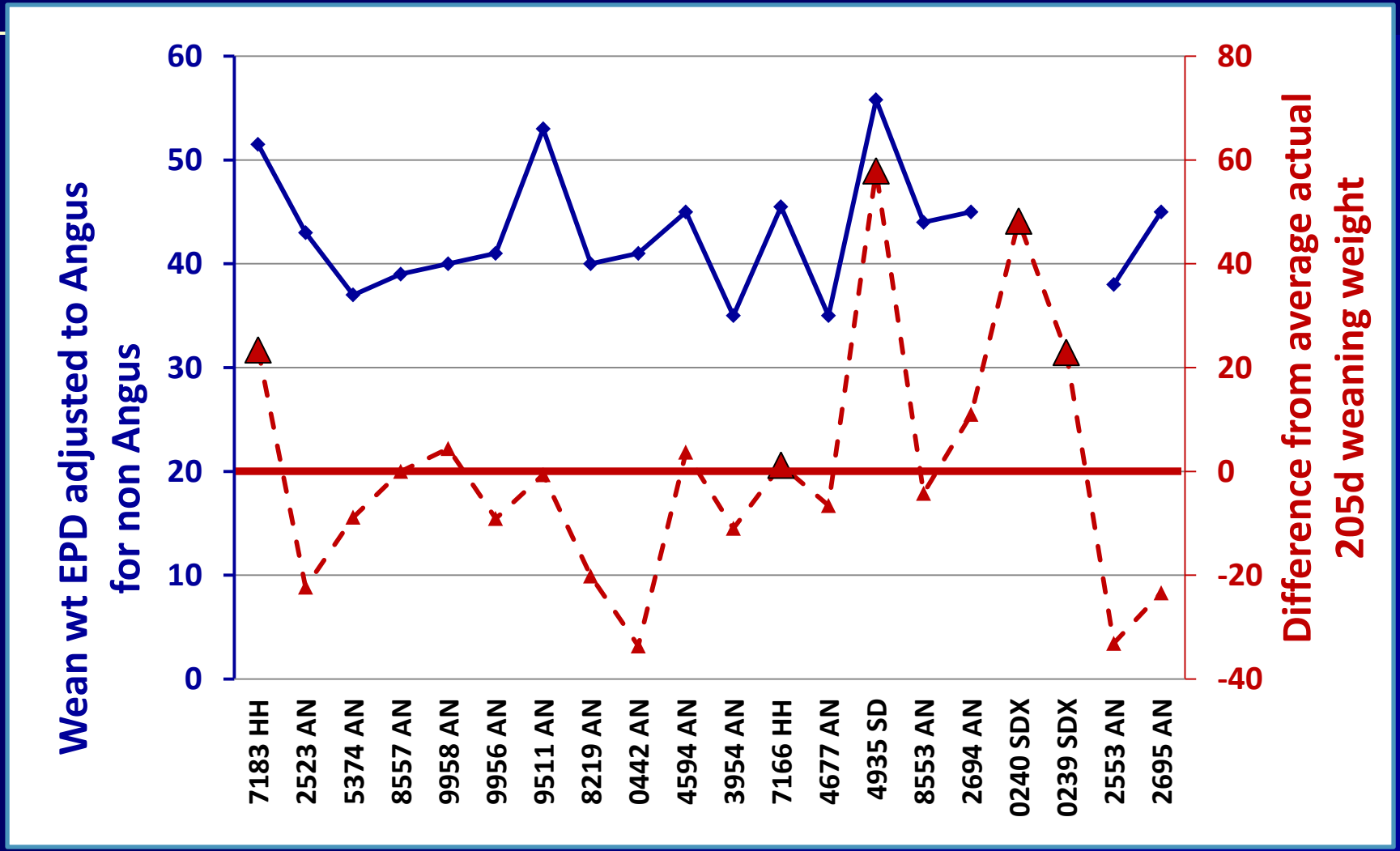
No.	Bull Id & Breed	Age	CED EPD	CED ACC	WN WT EPD	WN WT ACC	Sire
1	7183 HH	3.4	0.9	0.12	51.5	0.29	Go Excel
2	2523 AN	4.4	11	0.3	43.0	0.27	New Frontier
3	5374 AN	4.3	8	0.05	37.0	0.05	Integrity
4	8557 AN	4.3	1	0.29	39.0	0.26	Bushwacker
5	9958 AN	2.4	12	0.31	40.0	0.26	Premium Beef
6	9956 AN	2.4	12	0.31	41.0	0.27	Premium Beef
7	9511 AN	3.4	6	0.29	53.0	0.26	Mytty In Focus
8	8219 AN	2.8	5	0.3	40.0	0.27	Premium Beef
9	0442 AN	1.9	6	0.29	41.0	0.27	New Design
10	4594 AN	2.4	7	0.29	45.0	0.28	Mytty In Focus
11	3954 AN	3.3	9	0.24	35.0	0.26	Broadcast
12	7166 HH	3.4	-1.5	0.11	45.5	0.32	Go Excel
13	4677 AN	2.4	8	0.29	35.0	0.27	Total
14	4935 SD	4.3			55.8	0.51	Rider's Dream
15	8553 AN	4.3	0	0.3	44.0	0.27	Bushwacker
16	2694 AN	4.3	6	0.05	45.0	0.05	Destination
17	0240 SDX	4.3					
18	0239 SDX	4.3					
19	2553 AN	4.4	11	0.3	38.0	0.27	New Frontier
20	2695 AN	4.3	6	0.05	45.0	0.05	Destination

*** EPDs adjusted to Angus for non-Angus bulls**

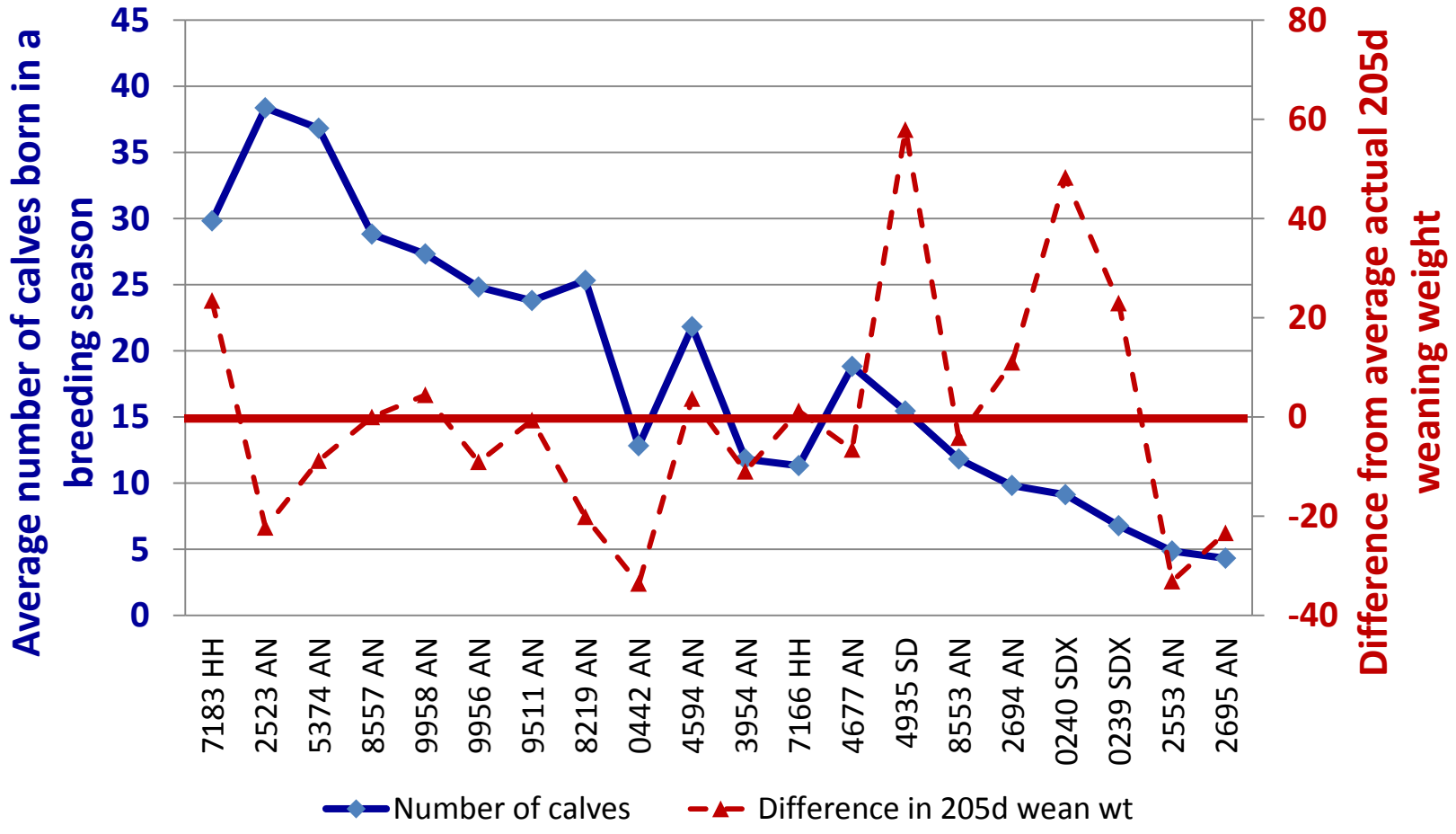
Weaning weight EPDs (---)



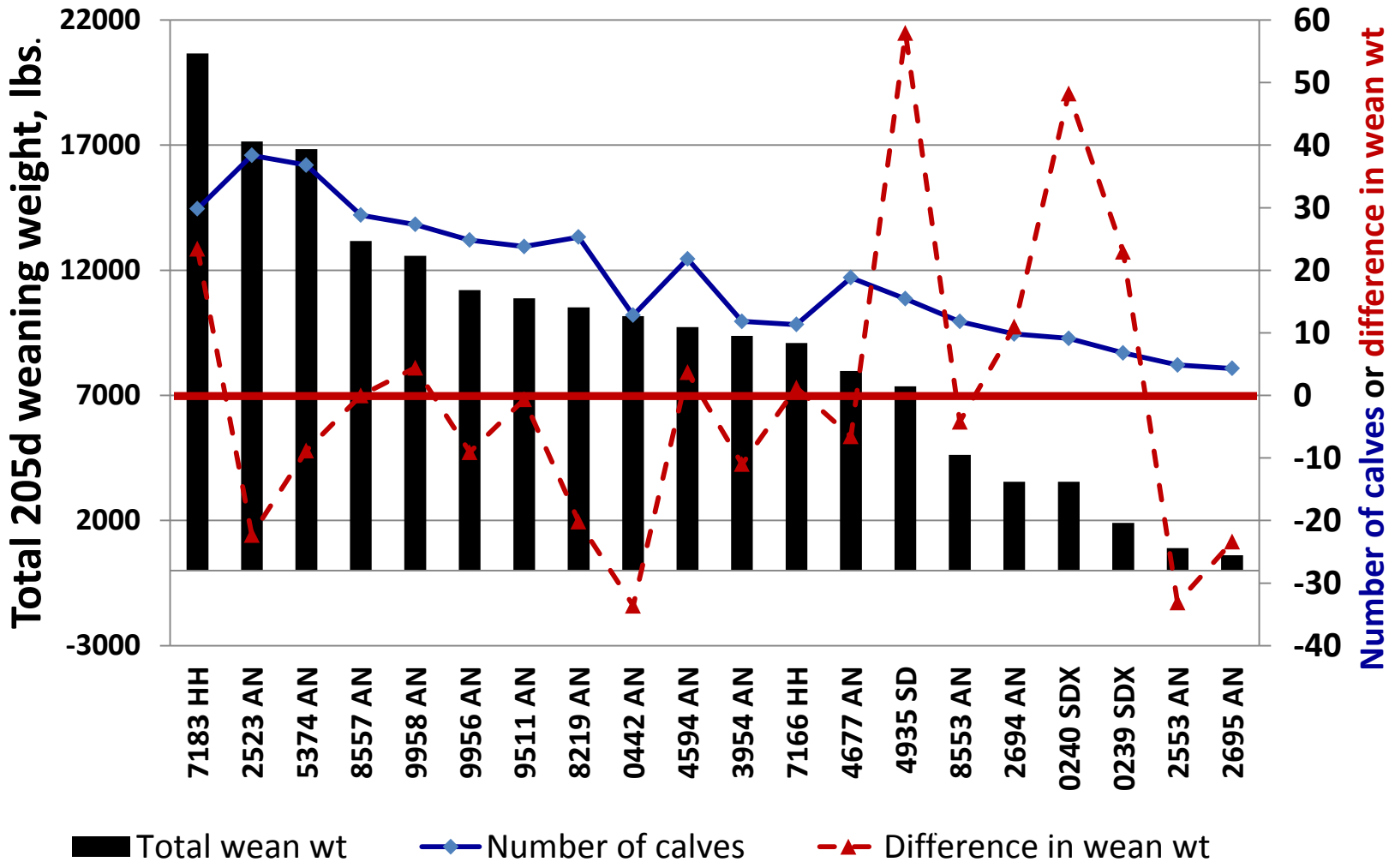
Actual 205 day weight performance of calves (---)



Average number of calves born per breeding season



Total 205d weaning weight, no. of calves, and difference from 205d weaning weight mean (Figure 2)



Total 205d weaning weight, number of calves, and difference from 205d weaning weight mean (Figure 3)

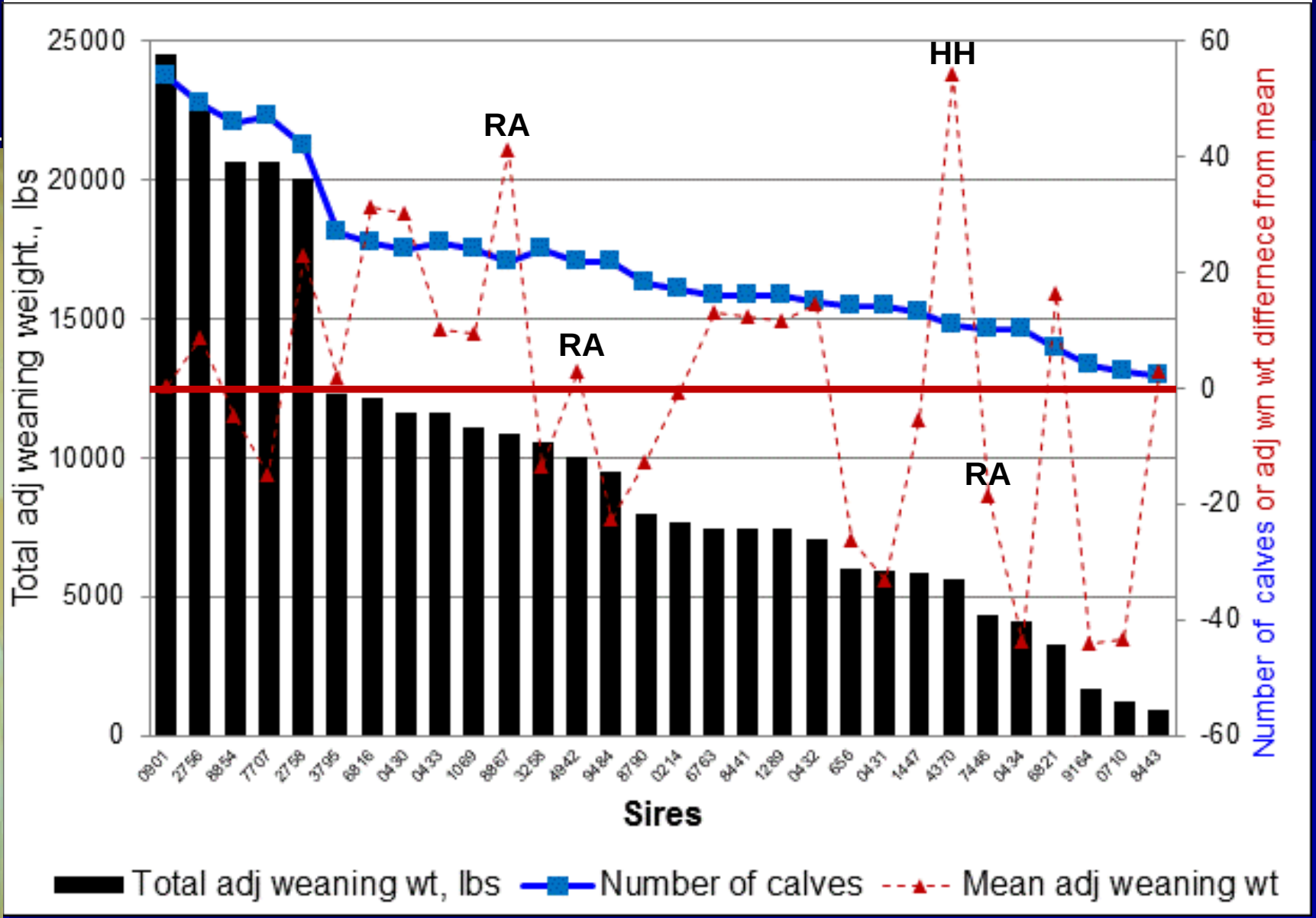


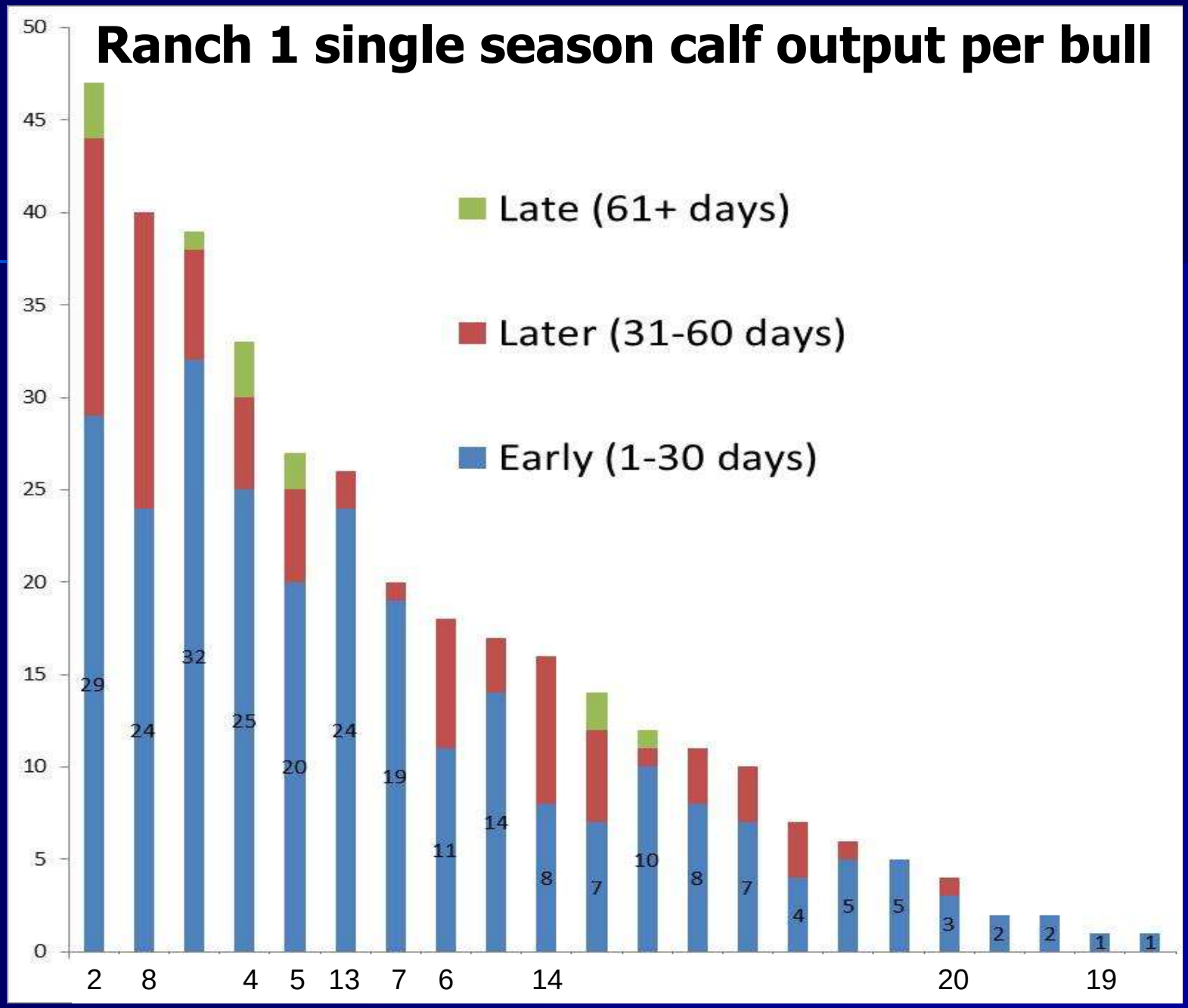
Table 1. Average bull age at the beginning of the breeding season, and number of calves produced per bull that sired at least one calf on 3 commercial ranches in Northern California in 2009 and 2010.

			# of sires	Bull Age		Mean bull age	Total # of calves	Number of calves per bull		Aver # of calves per bull/season
Ranch	Year	Season		Min	Max			Min	Max	
1	2009	Spring	13	1.5	3.1	2.5 ± 0.6	246	6	40	**18.9** ± 12.5
1	2009	Fall	19	1.6	3.8	2.9 ± 0.9	345	1	47	**18.2** ± 13.9
1	2010	Spring	19	2.1	5.2	3.4 ± 0.9	366	5	36	**19.3** ± 10.7
2	2009	Spring	8	0.7	9.2	3.5 ± 2.7	139	1	44	**17.4** ± 16.6
2	2009	Fall	9	1.4	8.8	4.4 ± 2.2	196	10	48	**21.8** ± 11.4
2	2010	Spring	8	1.7	5.3	2.9 ± 1.2	129	3	28	**16.1** ± 9.1
3	2009	Fall	30	1.6	5.6	3.3 ± 10	639	2	54	**21.3** ± 13.8
3	2010	Fall	27	1.6	5.2	3.7 ± 1.3	568	1	52	**21.0** ± 13.1
						3.3	**2628**			**19 ± 2**

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

No obvious phenotype associated with the bulls that sired no offspring

Ranch 1 single season calf output per bull



Calf output was moderately repeatable, and correlated with Scrotal Circumference EPD

Using the 20 bulls that were in use for 2 or 3 breeding seasons (Figure 2), on Ranch 1 and 2 calculated the repeatability of 5 traits between their 1st and 2nd breeding season.

Repeatability

- total adjusted weaning weight r=0.50
- number of calves r=0.50
- mean adjusted weaning weight=0.675

Also analyzed calf output repeatability between the same bulls from the single Fall calving group on Ranch 3 in years 1 and 2 (Figure 3).

Repeatability

- number of calves r=0.33

Sire output as total adjusted weaning weight and number of calves were not well correlated to Angus Association growth EPDs but had moderate correlation to scrotal circumference EPDs (r=0.42 & 0.38; n=5), respectively.

BUT DOES IT PAY?

Modeled the savings from using DNA information to cull non-prolific bulls

Assumptions

- Bulls used for 4 years (bought at 18 months of age, used until culled for age at 5 ½ years old)
- Average prolificacy of bulls which do produce calves: 20 ± 2 calves/bull (i.e. average prolificacy across the battery is 18.6 calves/bull)
- Percent of bulls which produced no calves: 7%
- 1 breeding season per year
- Bull premature death rate: 1%
- Bull injury rate: 3%
- Average age at injury: 4 years
- Annual vet costs: $75/year, $25 if bull died prematurely mid-year
- Salvage value
  - Non-injured $2000
  - Injured $1000
- Cost of trucking bull to sale: $50
- Selling commission: $20

What was modeled?

- Paternity test
  - Performed once on the entire bull battery (all bulls and calves tested)
  - Paternity test price (/head): $10, $15, or $20
  - Bulls are not replaced if they are culled for poor prolificacy
- Bull Purchase price: $3500, $4500, or $5500
- Annual feed costs per bull: $425, $525, or $625
- Bulls sired an average of 20 calves per year

Bull costs

In a herd with 7% of bulls consistently producing no calves and the rest of the bulls producing 20 calves/calf crop on average:

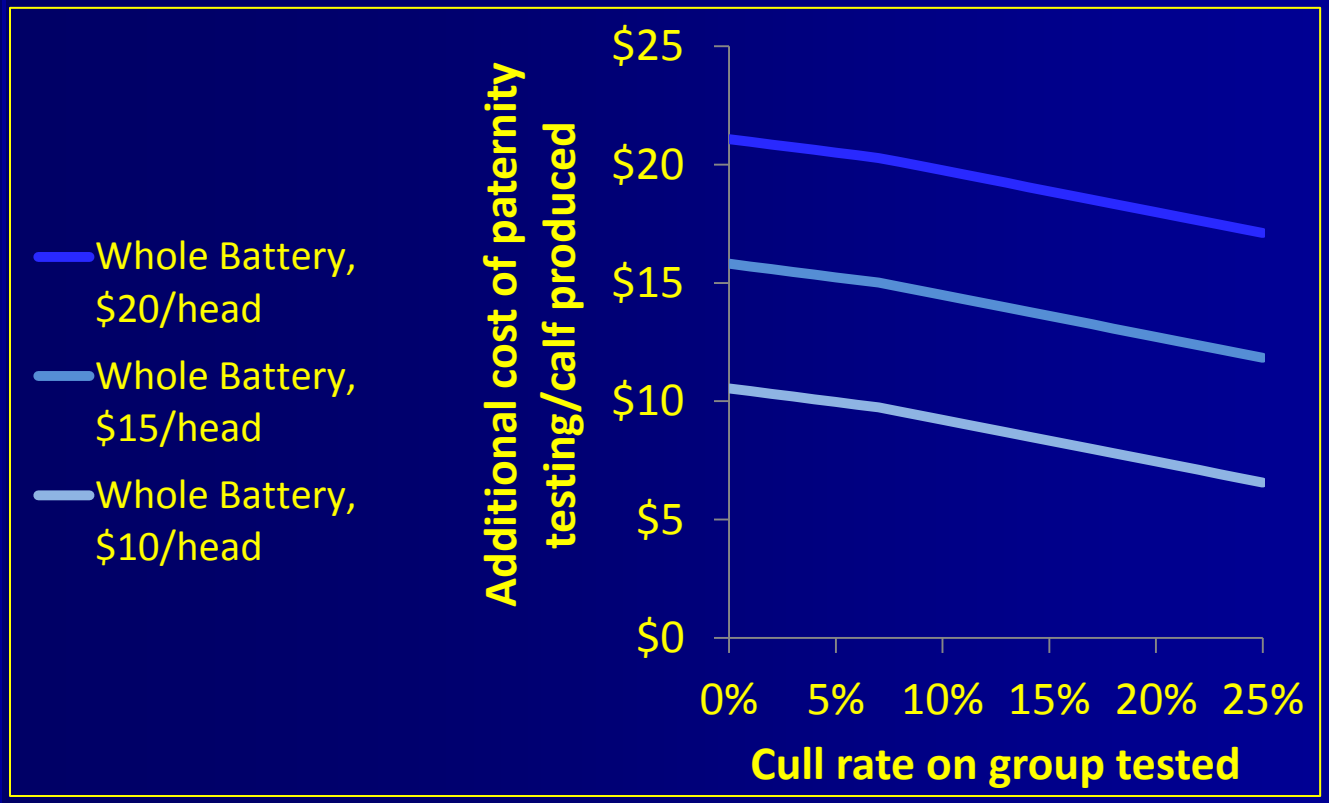
The average bull will be used 3.94 years (3 years, 11 months) and produce a total of 73 calves over his productive life.

Bull Purchase Price	Annual Feed Costs/ Bull	Average Lifetime Bull Costs (Total)	Average Lifetime Bull Costs/ Calf Produced
$3500	$425	$3,583.18	$48.96
$3500	$525	$3,976.71	$54.33
$3500	$625	$4,370.25	$59.71
$4500	$425	$4,583.18	$62.62
$4500	$525	$4,976.71	$68.00
$4500	$625	$5,370.25	$73.37
$5500	$425	$5,583.18	$76.28
$5500	$525	$5,976.71	$81.66
$5500	$625	$6,370.25	$87.04

Additional cost of paternity testing

In a herd with

- **7% of bulls consistently producing no calves**
- **The rest of the bulls producing 20 calves/calf crop on average**
- **Purchase price $3500 - Average annual feed costs $425**



For cull rates up to 25% (1 in 4 bulls tested) and paternity tests costing $10-$20/head, the cost of testing is always greater than the $ saved by culling low prolificacy bulls

What does it take to make paternity testing pay?

Assumptions:

- 7% of zero prolificacy bulls
- Other bulls producing 20 calves/calf crop on average
- Purchase price $4500
- Paternity test price $15/head
- Testing the whole battery and all calves once

Annual Feed Costs/Bull	Cull rate to reach break-even
$425	87.5%
$525	77.0%
$625	68.8%
$825	55.6%

What paternity test price would it take to reach break-even at 7% and 25% cull rates?

Cull Rate	Annual Feed Costs/Bull	Paternity Test Cost/head
7%	$425	$0.76
	$525	$0.89
	$625	$1.01
	$825	$1.28
25%	$425	$4.05
	$525	$4.62
	$625	$5.18
	$825	$6.32

There are other advantages of DNA-based paternity testing

The use of multi-sire breeding pasture is desirable because:

- Higher fertility
- Elimination of sire failure
- Tighter calving season

- Reduces the need for different breeding pastures
  - Allows for better pasture management
  - Less sorting and working of animals into different groups

DNA testing enables

- Can use it determine which bull is causing calving problems
- Enables the development of commercial-ranch genetic evaluations

Summary and some learnings along the way

1. Bulls produced average of 19 calves (large variation)
   - Calf output was moderately repeatable (~0.33-0.5)
   - Prolific bulls tended to remain prolific, low tended to stay low
2. 7% of bulls had no calves – 1 in 14
3. Do not use yearling bulls in with older bulls - older bulls will be dominant and chance of injury goes up
4. Heifer bulls (low CED) often ended up as mature cow bulls despite having been selected on CED!!
5. There are few EPDs for selection on reproduction
6. Crossbreeding still works! And would be expected to improve reproduction traits also
7. Paternity testing on commercial ranches for sire failure needs to be inexpensive to be cost-effective

USDA Integrated Grant Collaborators "Integrating DNA information into Beef Cattle Production Systems"

Producer Collaborators:

- Jack Cowley, Cowley Rancher, Siskiyou County, CA
- Dale, Greg, and Richard Kuck, Kuck Ranch, Siskiyou County, CA
- Matt Parker, Mole-Richardson Ranch, Siskiyou County, CA

Processor Collaborators:

- Harris Ranch Beef Company, Coalinga, CA
- Los Banos Abattoir, Los Banos, CA

Graduate Students

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- Dr. Mike Goddard, University of Melbourne and Victorian DPI, Australia
- Dr. Darrh Bullock, Extension Professor, University of Kentucky, KY
- Dr. Leslie "Bees" Butler, Extension Marketing Specialist, UC Davis, CA
- Dr. Daniel Drake, University of California Cooperative Extension Livestock Advisor, CA
- Dr. Dorian Garrick, Professor, Iowa State University, IA
- Dr. John Pollak, US Meat Animal Research Center, Clay Center, NE
- Dr. Mark Thallman, US Meat Animal Research Center, Clay Center, NE

Software Collaborators:

- Jim Lowe, Cow Sense Herd Management Software, NE

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

"This project is supported by National Research Initiative Grant no. 2009-55205-05057 to AVE from the USDA National Institute of Food and Agriculture."

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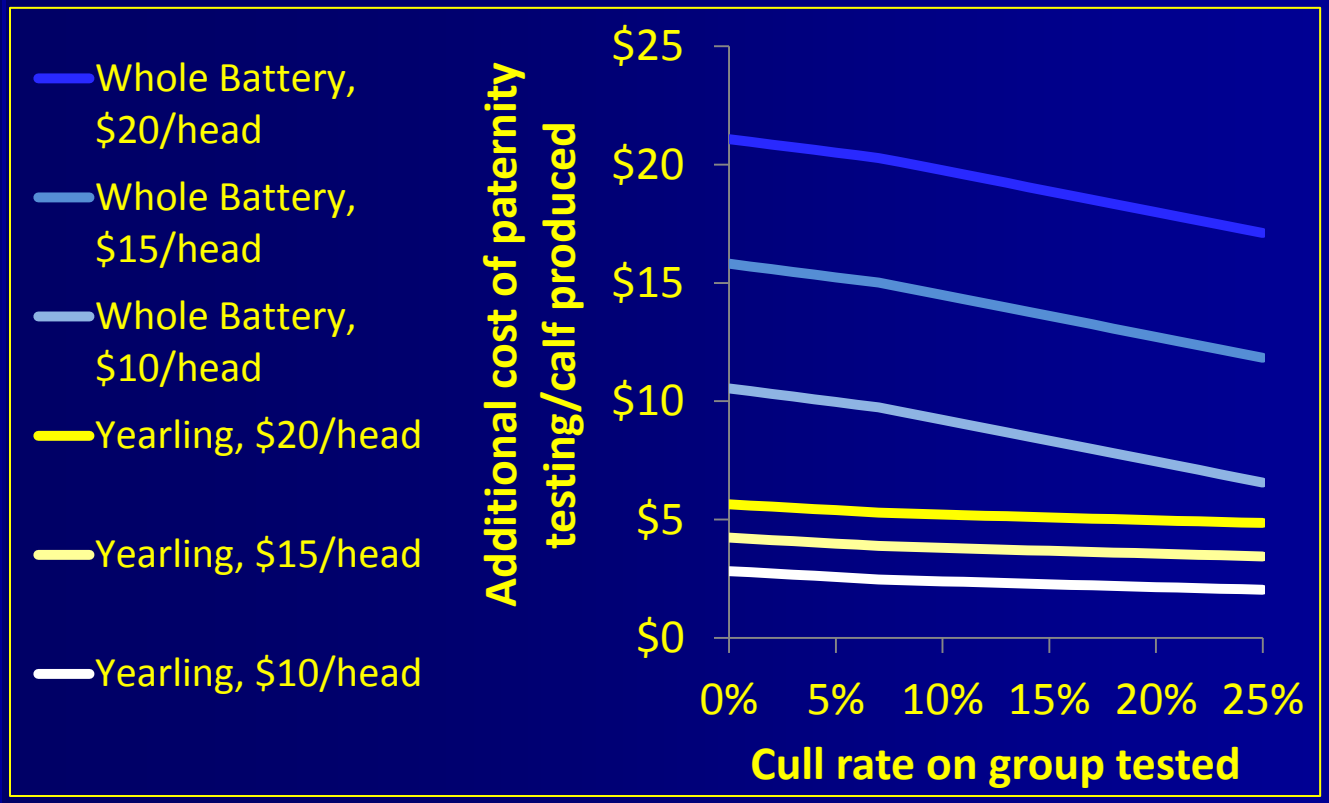

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