DNA-based progeny testing and development of commercial ranch EPDs

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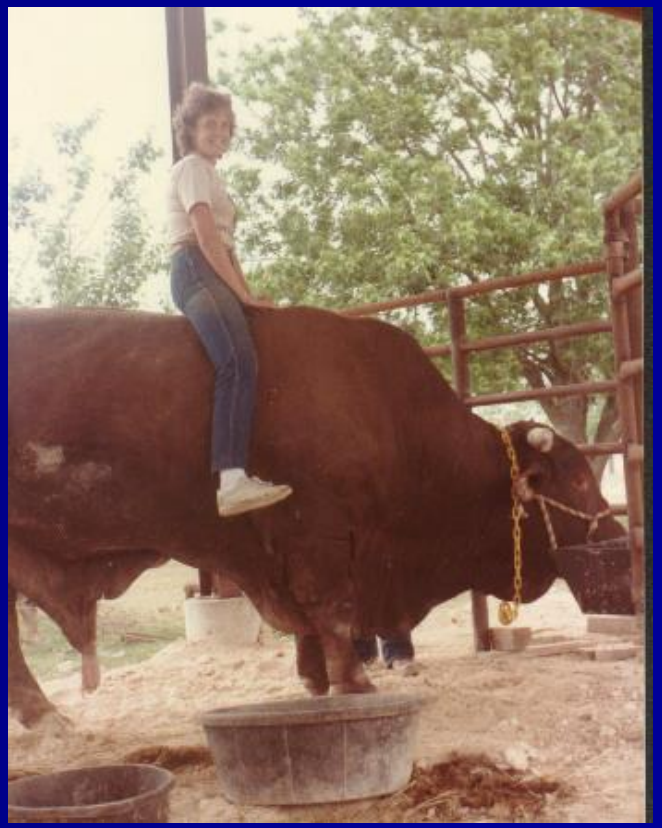


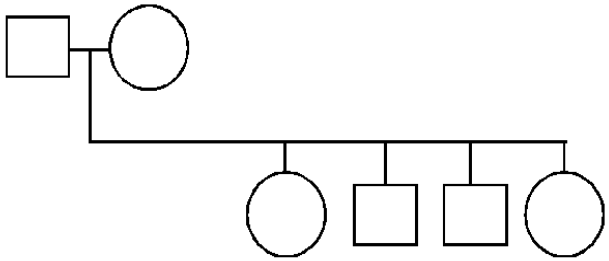
Why is parentage important ?

- Identify bulls producing problem calves
- Identify extremes in phenotypes
- ID of cleanup bulls after AI
- Determine bull dominance – 50% of the bulls sire 80% of the calves
- Paternity testing offers a way to develop on-ranch EPDs (rEPD) through ranch progeny tests for any measured trait

Probability of exclusion (P_E)

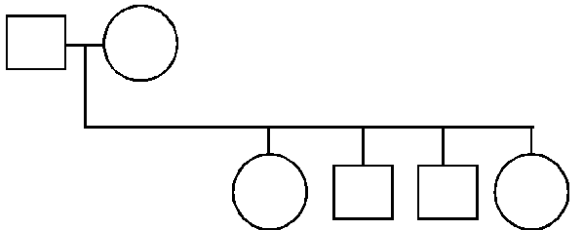
- P_E = the probability that a random individual other than a true parent from a population in Hardy-Weinberg equilibrium is excluded as the parent of another randomly chosen individual.
- For unrelated sires, the probability of unambiguous parentage assignment is equal to P_E raised to the power of the number of non-parent candidate bulls

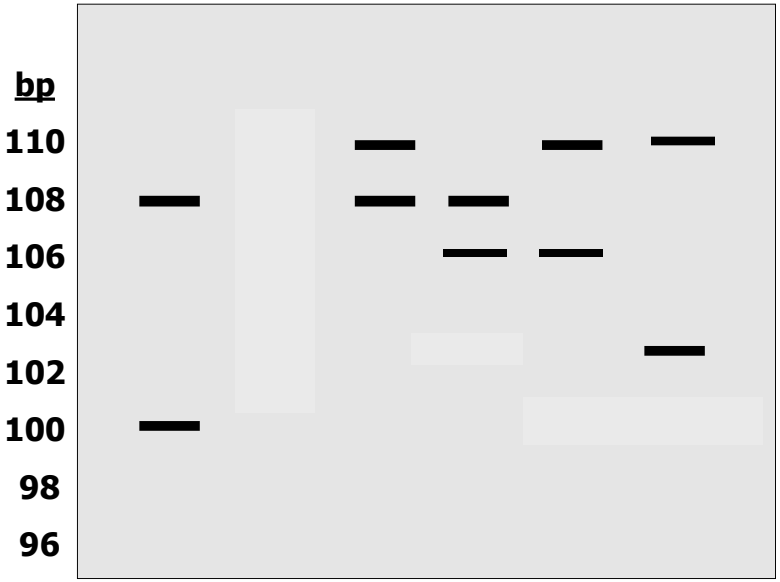
SNP locus has two alleles – so only homozygotes are informative



TT	AA	AT	TA	TT
AT	AA	AT	TA	TT
AA	AA	AT	TA	TT

Microsatellite locus can have as many as 10 alleles – better able to exclude





Implications

- Currently there are three competing SNP genotyping technologies – Affymetrix, Sequenom, and Illumina – prices are now less than 1 cent per SNP
- Although they are less powerful per locus, it is likely that SNP markers will replace alternatives (i.e. microsatellites) over the next 5 years

PATERNITY ANALYSIS IN LARGE COMMERCIAL CATTLE RANCH SETTING USING SNPs - UC DAVIS EXPERIENCE

- Blood collected on FTA cards from **27** herd sires and **624** calves derived from a multiple-sire pasture

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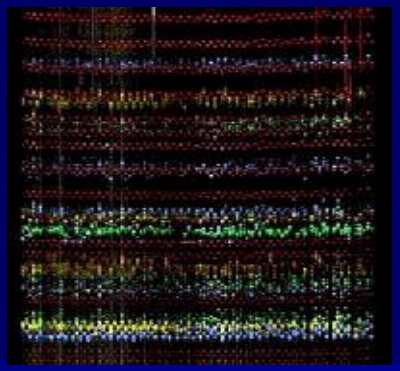
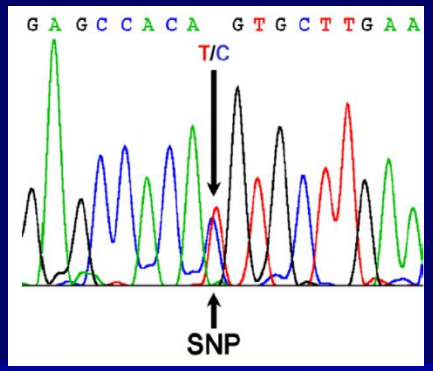
Genotyping

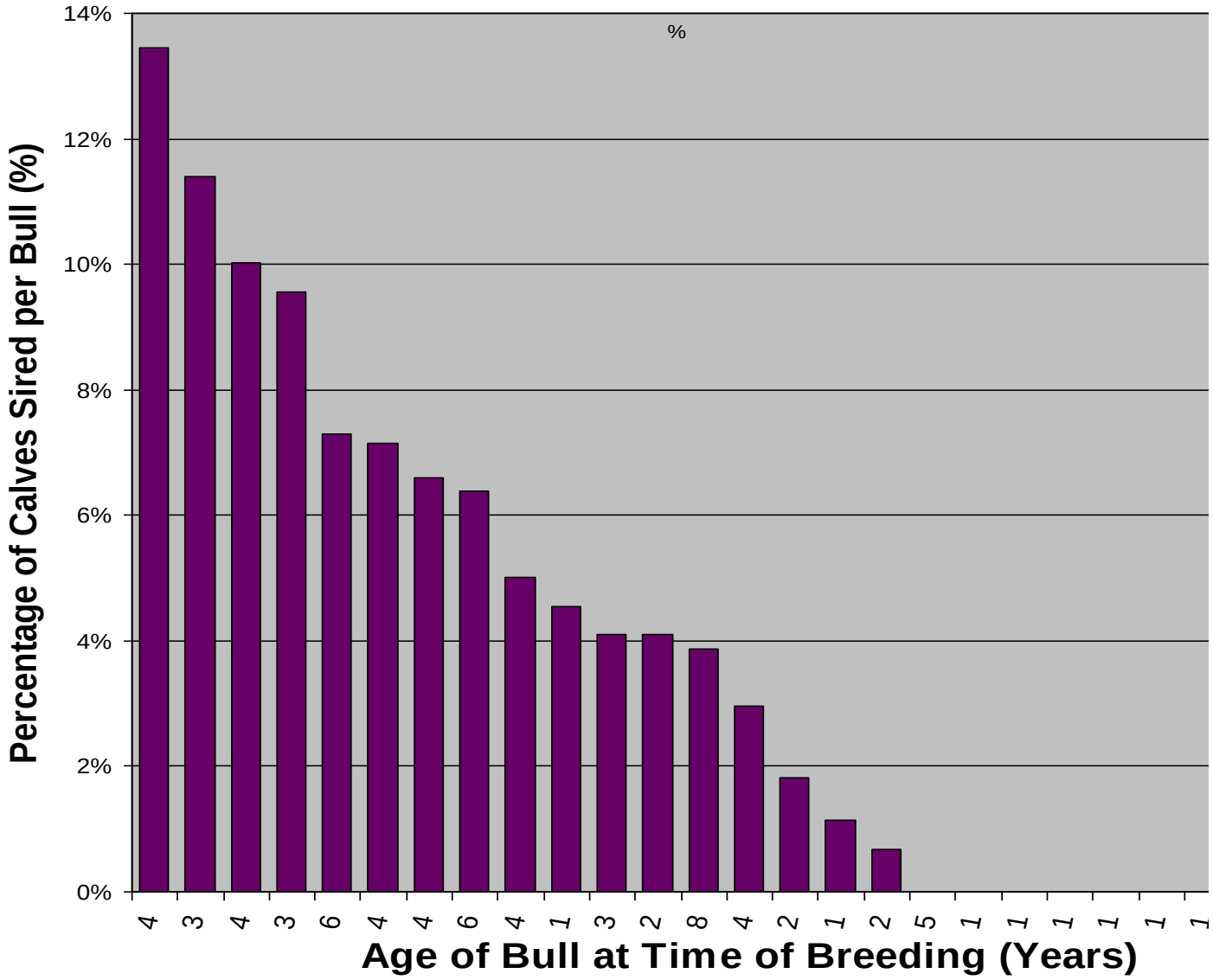




- STRs using a panel of 23 cattle markers (P_E=99.9%)
- SNPs using a panel of 28 loci (P_E=95.5%)

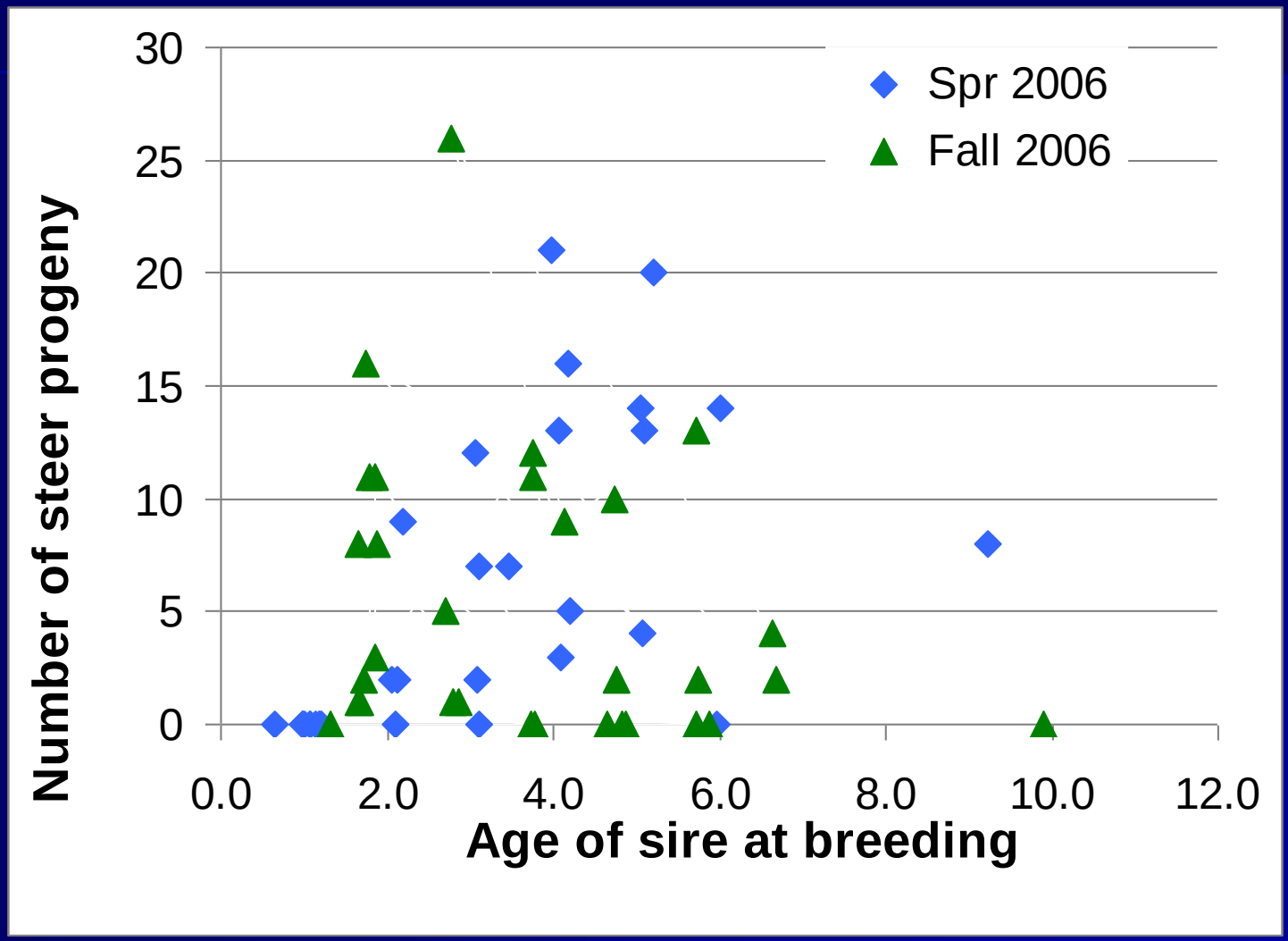
A. L. Van Eenennaam, R. L. Weaber, D. J. Drake, M. C. T. Penedo, R. L. Quaas , D. J. Garrick, E. J. Pollak. 2007. DNA-based paternity analysis and genetic evaluation in a large commercial cattle ranch setting. Journal of Animal Science. 85:3159–3169

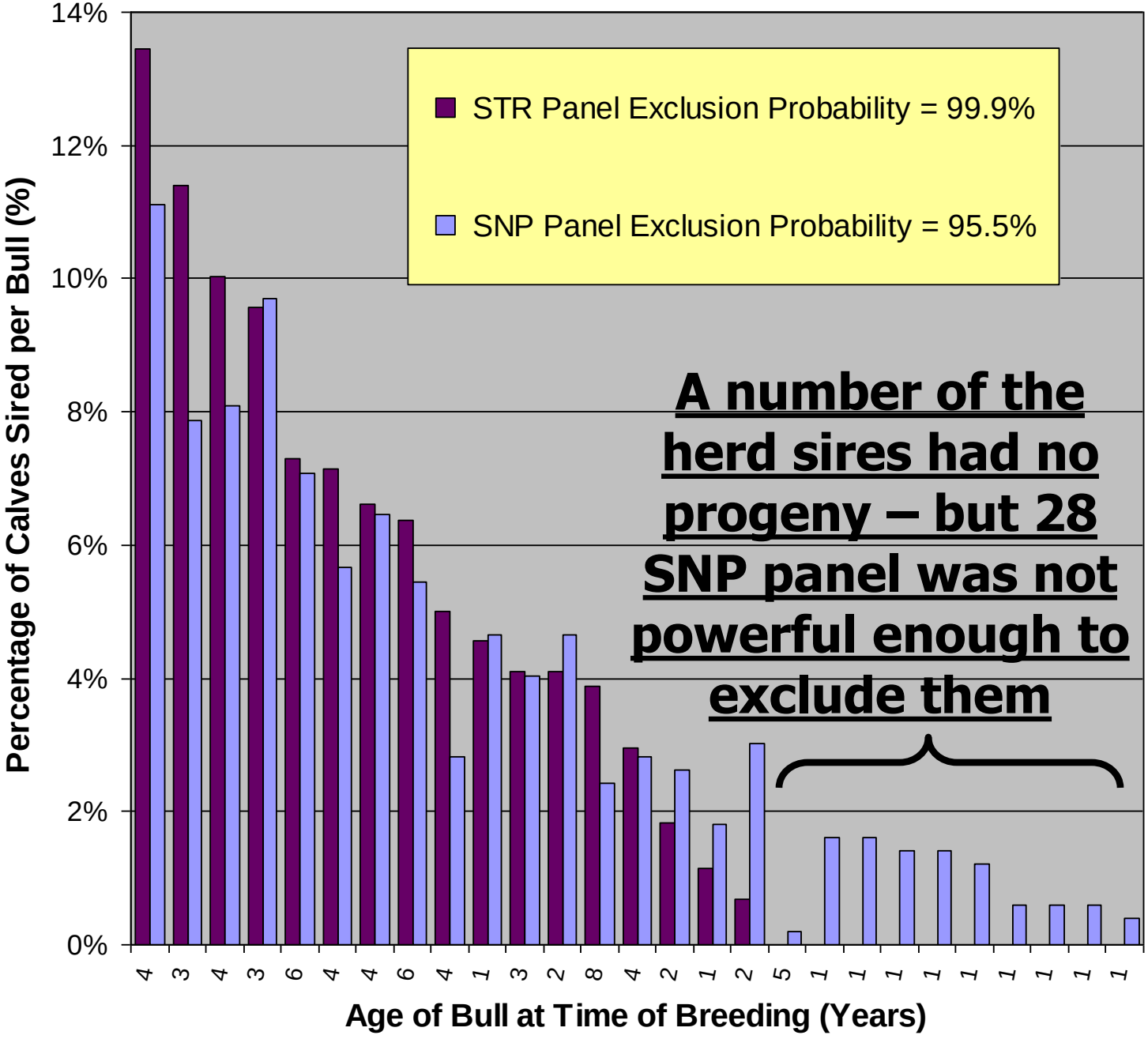
Number of offspring sired by 27 herd bulls (2005)

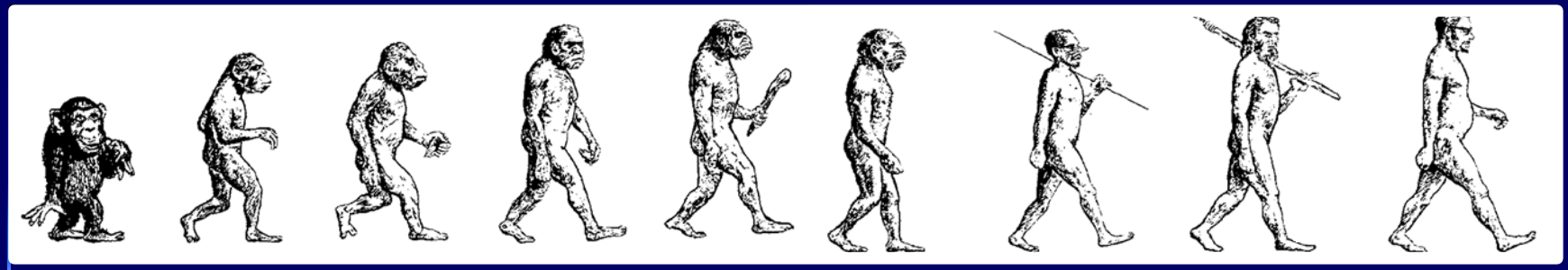


Test young bulls: number of progeny influences EPD accuracy

Manage for more progeny from young bulls for higher accuracy on-ranch EPDs



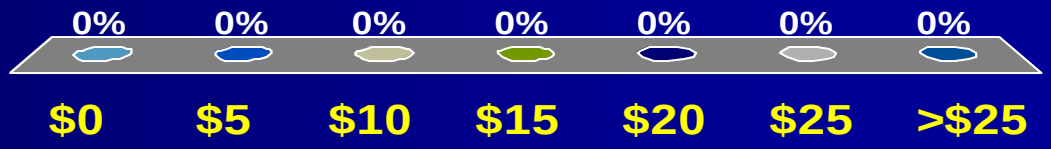

14%
12%
10%
8%
6%
4%
2%
0%
Percentage of Calves Sired per Bull (%)
STR Panel Exclusion Probability = 99.9%
SNP Panel Exclusion Probability = 95.5%
A number of the herd sires had no progeny – but 28 SNP panel was not powerful enough to exclude them
4 3 4 3 6 4 4 6 4 1 3 2 8 4 2 1 2 5 1 1 1 1 1 1 1 1 1
Age of Bull at Time of Breeding (Years)



	28 SNP Panel – 27 sires 2005 (PE=95.5%)		62 SNP Panel – 23 sires 2006 (PE=99.975%)		99 SNP Panel – 28 sires 2007 (PE=99.999%)	
One sire assigned	175	23.3%	260	86.7%	294	97.0%
More than one sire	420	67.3%	16	5.3%	1	0.33%
All excluded	29	4.6%	24	8.0%	8	2.6%
TOTAL	624		300		303	

How much (per calf) would you be willing to pay to obtain paternity of calves produced in a multisire pasture?

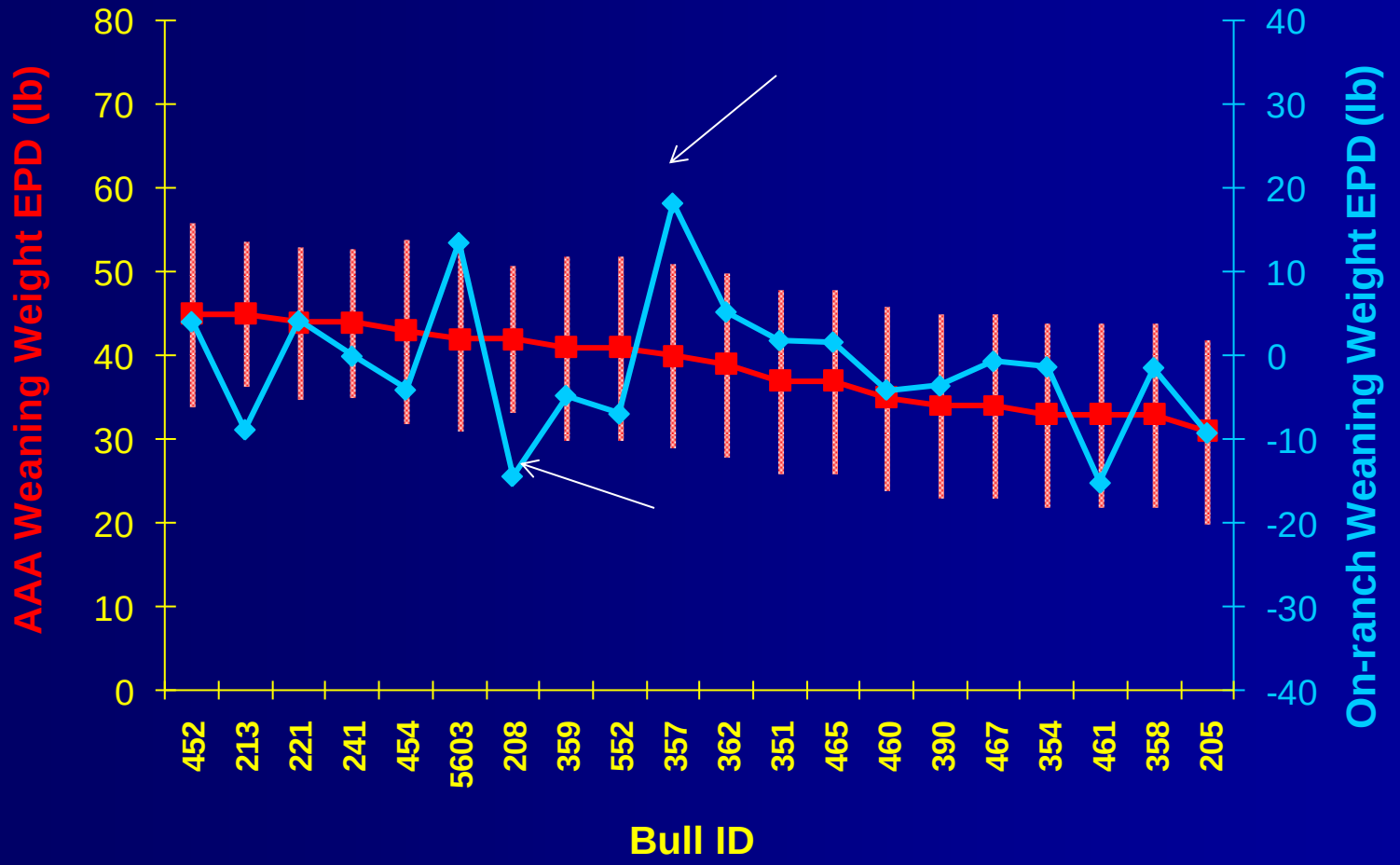
1. $0
2. $5
3. $10
4. $15
5. $20
6. $25
7. >$25



Month-Yr	Spr 2010	Spr 2011	Spr 2012	Spr 2013	Spr 2014
Mar-2009	**Breed**				
Jan-2010	Calve				
Mar-2010		**Breed**			
Aug-2010	Wean				
Jan-2011		Calve			
Mar-2011			**Breed**		
Apr-2011	Harvest				
Aug-2011		Wean			
Jan-2012			Calve		
Mar-2012				**Breed**	
Apr-2012		Harvest			
Aug-2012			Wean		
Jan-2013				Calve	
Mar-2013					**Breed**
Apr-2013			Harvest		
Aug-2013				Wean	
Jan-2014					Calve
Mar-2014					
Apr-2014				Harvest	
Bull Age at breeding	1.5	2.5	3.5	4.5	5.5
Age at genetic evaluation	**3.0**				

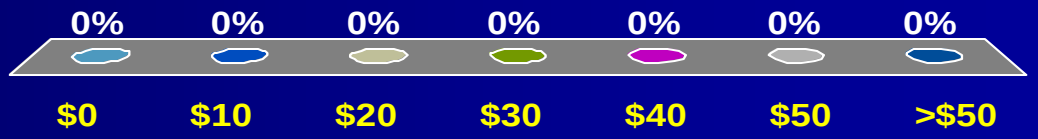
← **First WW rEPD**

AAA Weaning Weight (lb) EPD (red) ± 67% Confidence Interval (pink) overlaid with rEPDs (blue)



How much (per herd bull) would you be willing to pay to obtain herd bull within-herd rEPDs for traits you measure on your ranch?

1. $0
2. $10
3. $20
4. $30
5. $40
6. $50
7. >$50



What can you do to optimize your success with paternity identification ?

1. Run young bulls in different pasture to mature bulls
2. Ideally separate closely related bulls into different pastures.
3. Make sure all potential sires are tested – keep in and out dates if you add/remove bulls or if you see a bull where he should not be; to the extent possible exclude bulls that had no possibility of siring any calves.
4. Keep the number of bulls per breeding group/pasture as small as is feasible – as that raises the percentage of calves that will be unambiguously assigned to a single sire

Questions?