"Have they got DNA testing working yet?"

Alison Van Eenennaam, UC Davis

Cooperative Extension Specialist

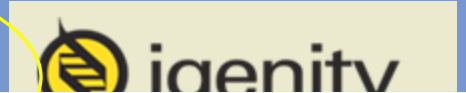Animal Biotechnology and Genomics

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OVERVIEW

- What is "DNA" getting used for?
- Markers for marbling
- Markers for tenderness
- Paternity testing in multiple sire bull pastures
- What else is coming along?

Commercial companies are now offering DNA markers for use in Marker-Assisted Selection (MAS) for given traits
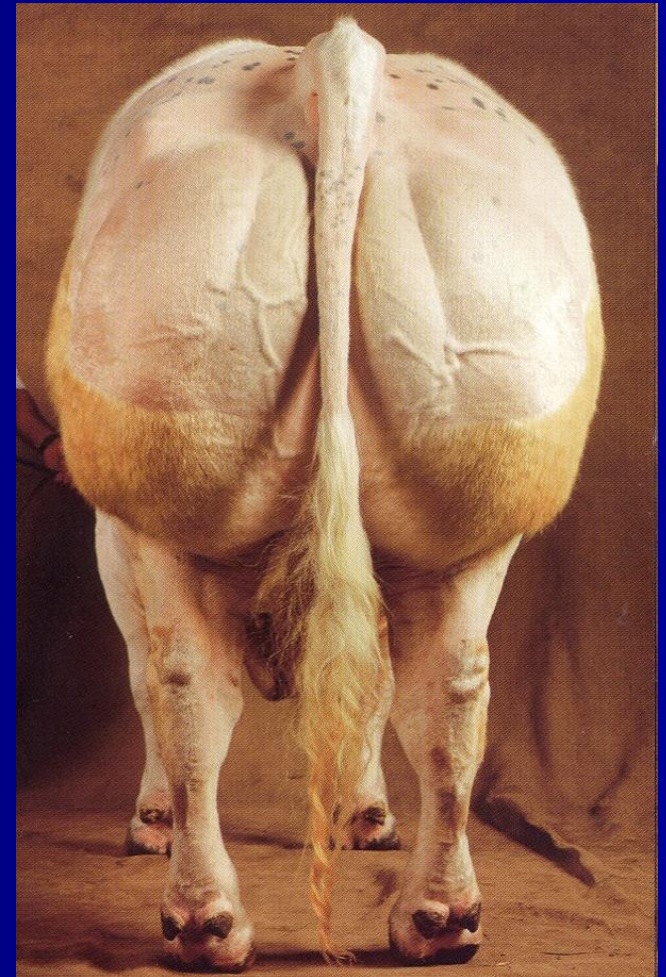
Marker-assisted selection is the process of using the results of DNA testing to assist in the selection of individuals to become parents in the next generation.

What is a Genetic Marker ?

A DNA sequence variation that has been associated with a given trait in one or more populations

Current applications: Marker-assisted selection

- Testing for genetic defects e.g. BLAD

- Testing for single gene traits e.g. coat color

- Marker-assisted selection for multigenic or quantitative traits e.g. tenderness

Traits that are most likely to benefit from MAS (descending order)

- Simply inherited genetic defects,
- **carcass quality and palatability attributes**,
- fertility and reproductive efficiency,
- maintenance requirements
- carcass quantity and yield,
- milk production and maternal ability, and
- growth performance.

Quantitative traits with markers currently commercialized or under development

- Meat Tenderness
- Quality Grade (Marbling)
- Beef Cattle Feed Efficiency
- Meat Yield
- Disease Resistance
- Dairy Form
- Milk and Milk Component Yield

Validation

Prior to moving genetic markers from discovery populations to commercialization, it is important to validate their purported effects on the trait of interest in different breeds and environments, and assess them for correlated responses in associated traits

http://www.nbcec.org/nbcec/

Validated tests currently on the US market for qualitative beef traits

Name	Trait	Desired Genotype
• GeneSTAR®	Quality Grade	****
• GeneSTAR®	Tenderness	******
• Igenity™ *Tender* GENE	Tenderness	"10"

Selection for Marbling

Progeny from Angus bulls with high (>.4) and low (< -0.16) EPDs for marbling were compared. 74% of high offspring graded choice versus 47% of low EPD offspring.

Vieselmeyer, B. A., R. J. Rasby, B. L. Gwartney, C. R. Calkins, R. A. Stock, and J. A. Gosey. 1996. Use of expected progeny differences for marbling in beef: I. Production traits. J Anim Sci. **74**:1009-1013.

Selection for Tenderness

$

Summary to date

- Markers are not a replacement of EPDs – they only explain some of the variation in the trait
- Good genetics will never overcome poor management (environment)
- MAS is likely to accelerate genetic progress in some traits better than others
- Ensure you weigh the cost and benefits of using MAS in your production system just as you would with any other input

11 Marker Panel ($65)

MetaMorphix, Inc.

Work in Your Best Genes

TRU-TENDERNESS™

FEATURES

- Contains 11 DNA markers where each marker is highly associated with expression of tenderness in meat products

- Measures the cumulative effects of all 11 markers associated with meat tenderness

- Results are expressed as the Molecular Genetic Value (MGV) which can be utilized to rank animals by their genetic potential

- Animals can be tested at any age

- Validated in Angus (validation in other breeds is underway)

BENEFITS

- The most powerful and comprehensive DNA selection tool currently available for tenderness

One in a series of break-through products that will advance breeding practices in the cattle industry, *Tru-Tenderness™* is a powerful and comprehensive DNA selection tool that can determine the genetic potential of animals to produce tender meat. In a collaborative research program between Cargill and MMI Genomics, an innovative scientific approach was used on over 4000 feedlot animals to identify the majority of regions throughout the bovine genome that have an effect on this valuable consumer trait.

Tru-Tenderness™ is a DNA-based genetic test that contains a panel of 11 unique DNA markers, each one highly associated with expression for tender meat. By measuring the cumulative effects for each of these 11 markers, *Tru-Tenderness™* accounts for a substantial proportion of the total genetic variation for this complex metabolic trait.

Since tenderness can only be measured in harvested cattle it is difficult, time consuming and expensive to make genetic progress for this trait using traditional genetic improvement tools. *Tru-Tenderness™* changes this paradigm by allowing producers to accurately assess the genetic

128 Marker Panel ($145)

MetaMorphix, Inc.

Work in Your Best Genes

TRU-MARBLING™

FEATURES

- Contains 128 DNA markers where each marker is highly associated with expression of marbling score

- Measures the cumulative effects of all 128 markers associated with marbling

- Results are expressed as the Molecular Genetic Value (MGV) which can be utilized to rank animals by their genetic potential

- Animals can be tested at any age

- Validated in Angus (validation in other breeds is underway)

BENEFITS

- The most powerful and comprehensive DNA selection tool currently available for marbling

One in a series of break-through products that will advance breeding practices in the cattle industry, *Tru-Marbling*™ is a powerful and comprehensive DNA selection tool that can determine the genetic potential of animals to express marbling. In a collaborative research program between Cargill and MMI Genomics, an innovative scientific approach was used on over 4000 feedlot animals to identify the majority of regions throughout the bovine genome that have an effect on this economically important trait.

Tru-Marbling™ is a DNA-based genetic test that contains a panel of 128 unique DNA markers, each one highly associated with the expression for marbling score and quality grade. By measuring the cumulative effects for each of these 128 markers, *Tru-Marbling*™ accounts for a significant proportion of the total genetic variation for this complex metabolic trait—the first DNA-based product to do so!

Tru-Marbling™ is an advanced and revolutionary tool that will allow cattle producers to make early breeding decisions that **increase the accuracy** of selection and **decrease the age** at which animals can be selected.

The results? Rapid improvement of marbling within herds and the ability to determine the "Tru" genetic potential of animals.

BREED-TRU
DNA VERIFIED

1756 Picasso Avenue
Davis, California   95618
1.800.311.8808
www.breedtru.com

MOLECULAR GENETIC VALUE (MGV)   REPORT

NAME	Legends of the West - Angus Farm		REPORT DATE	08/23/2006
ADDRESS	13457 Trujillo Creek Road		ORIGINAL REPORT	08/23/2006
	Aguilar, CO		CASE ID	MT-0059302S
	81020		CUSTOMER	LWAF - Legends of the West Angus Farm
CONTACT	Wes Johnson, Foreman			

TRU-MARBLING and TRU-TENDERNESS   REPORT

BREED	NAME	REG #	TAG/ TATTOO	SEX	BORN	SAMPLE ID	MARBLING MGV	TENDERNESS MGV
Angus	AF Paul Bunyan	19352178	AZ-105	M	06/14/2004	0539812G	-28.61	0.92
Angus	AF Casey Jones	19352211	AZ-112	M	05/29/2004	0539813G	-19.41	-3.98
Angus	AF Alamo Rising	19352385	AZ-146	M	06/19/2005	0539814G	42.79	-0.75
Angus	AF Geronimo	19352448	AZ-175	M	12/20/2004	0539815G	70.15	-4.40

All four animals represented in the above test result have *Tru-Marbling*™ and Tru-Tenderness™ MGVs. All MGVs within a trait have the same accuracy because every animal has the same number of markers in the prediction of genetic potential.

Paul Bunyan and Casey Jones are predicted to grade in the low Select and No Roll USDA grades because of their large negative marbling MGVs. Alamo Rising and Geronimo are predicted to grade in the USDA grades of high Choice and Prime because of their high MGVs for marbling. MGVs near 0 are expected to grade in the high Select USDA grading category.

Paul Bunyan is predicted to produce tough meat with the larger MGV for *Tru-Tenderness*™. Casey Jones and Geronimo are predicted to produce very tender meat. Alamo Rising is predicted to produce acceptable tenderness, bordering on slightly tough.

These results can be used to rank bulls for their genetic potential for marbling and tenderness.

Should I use DNA-based marker-assisted selection in my breeding program?

The increased economic returns from greater genetic gain as a result of using the markers must outweigh the cost of genotyping

Translation

"will marker assisted selection make you money ?"

Marker-Assisted Selection (MAS)

<u>Assisted</u> - To give help or support to, especially as a subordinate or supplement; aid

<u>Driven</u> - Powered, operated, or controlled; to exert inescapable or coercive pressure on

Marker-Driven Selection (MAD)

Animal Biotechnology and Genomics Education

Marker-Driven Selection (MAD)

Marker-Assisted Selection (MAS)

PATERNITY ANALYSIS IN A LARGE COMMERCIAL CATTLE RANCH SETTING

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Daniel J. Drake
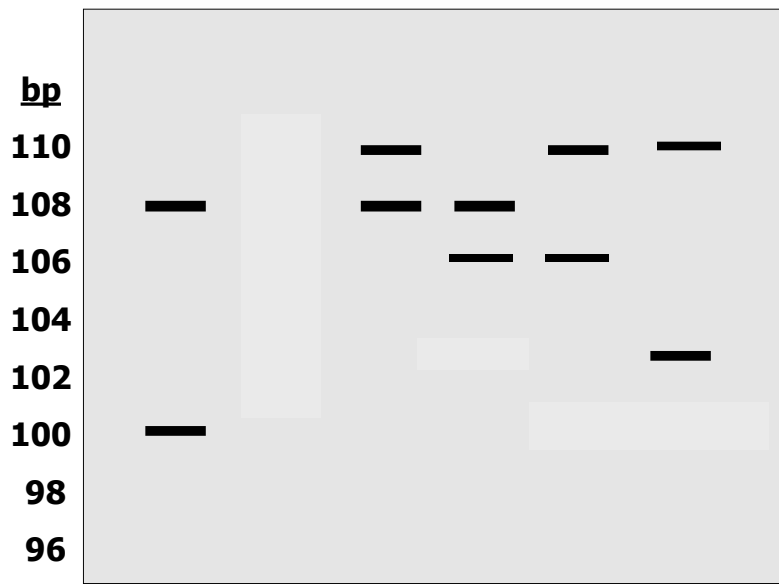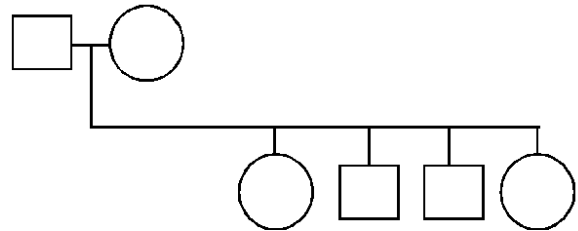## M. Cecilia T. Penedo
University of California, Davis

http://animalscience.ucdavis.edu/animalbiotech/

SNP loci have two alleles – so only homozygotes are informative; ⬇$

Microsatellite loci can have upwards of 10 alleles – better able to exclude; ⬆$
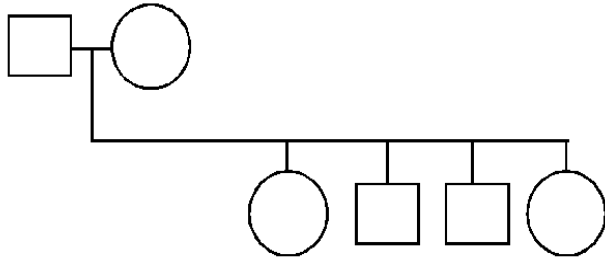
Prather Ranch – Macdoel Northern California

PRATHER RANCH

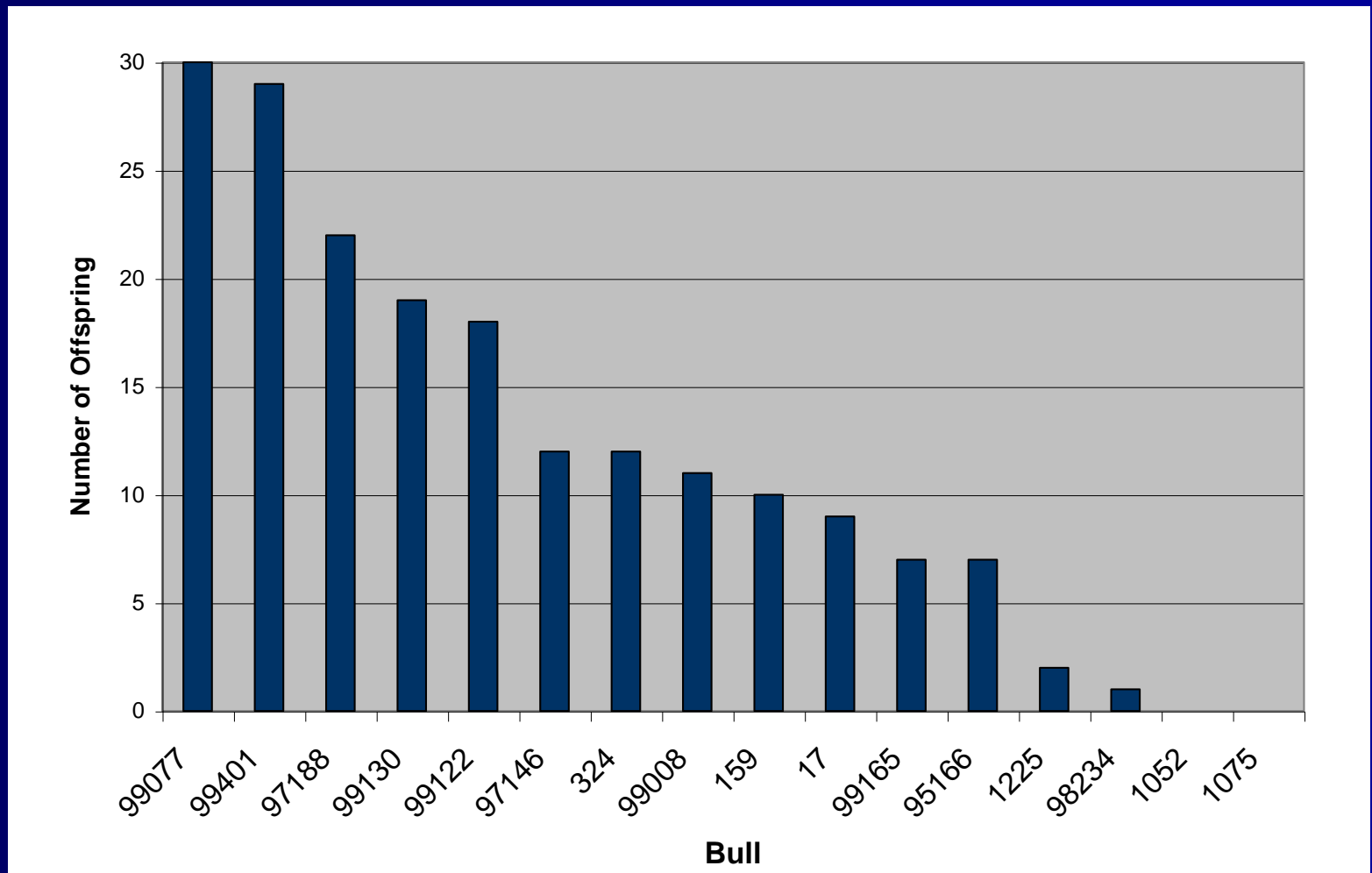# 2004 Trial Conducted 4/30-5/1/2004

■ Blood collected on FTA cards

293 calves
Total of 16 bulls

Number of offspring sired by 16 mature herd bulls (2004)

2005 Trial Conducted 4/20-5/21/2005
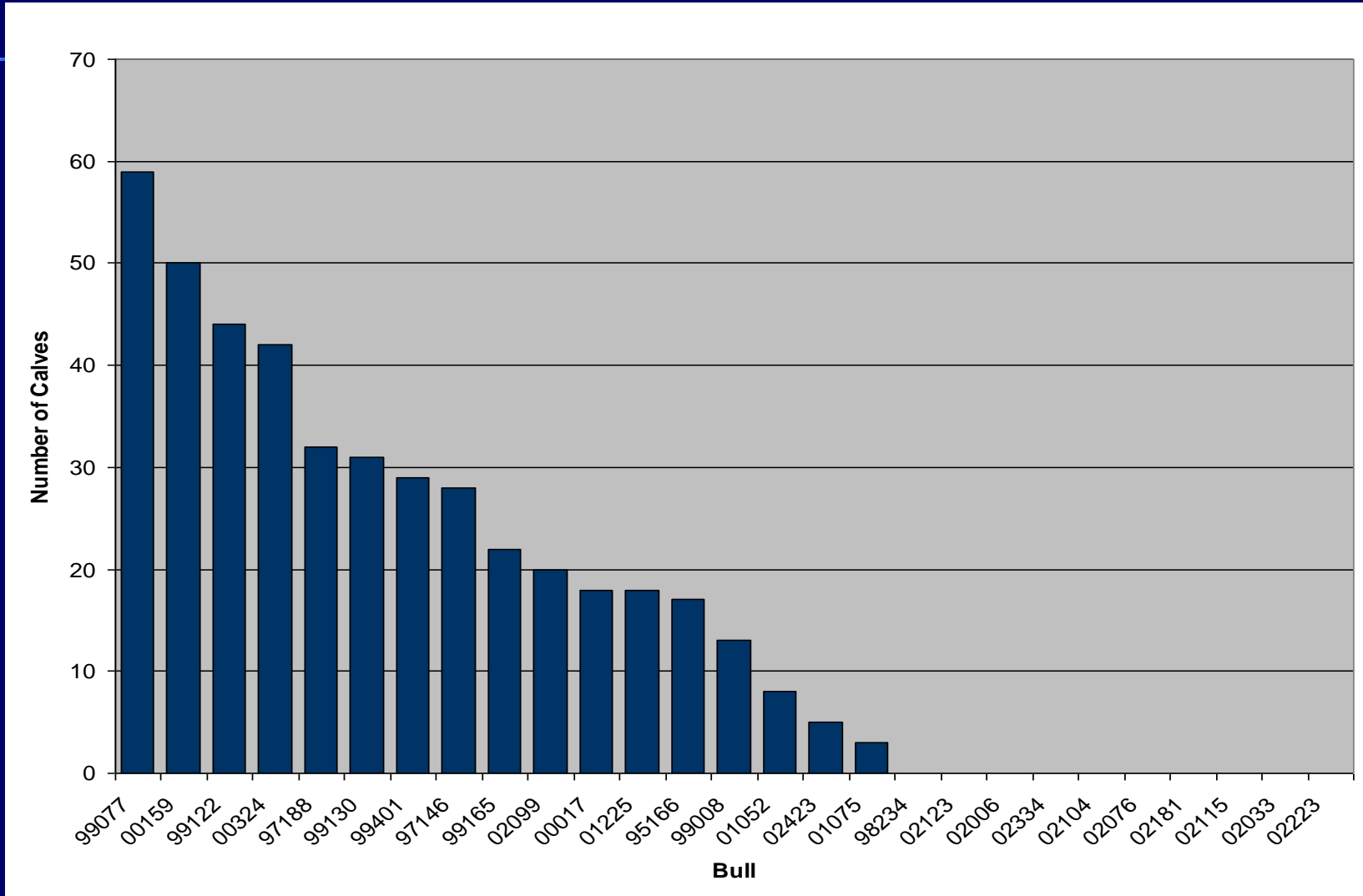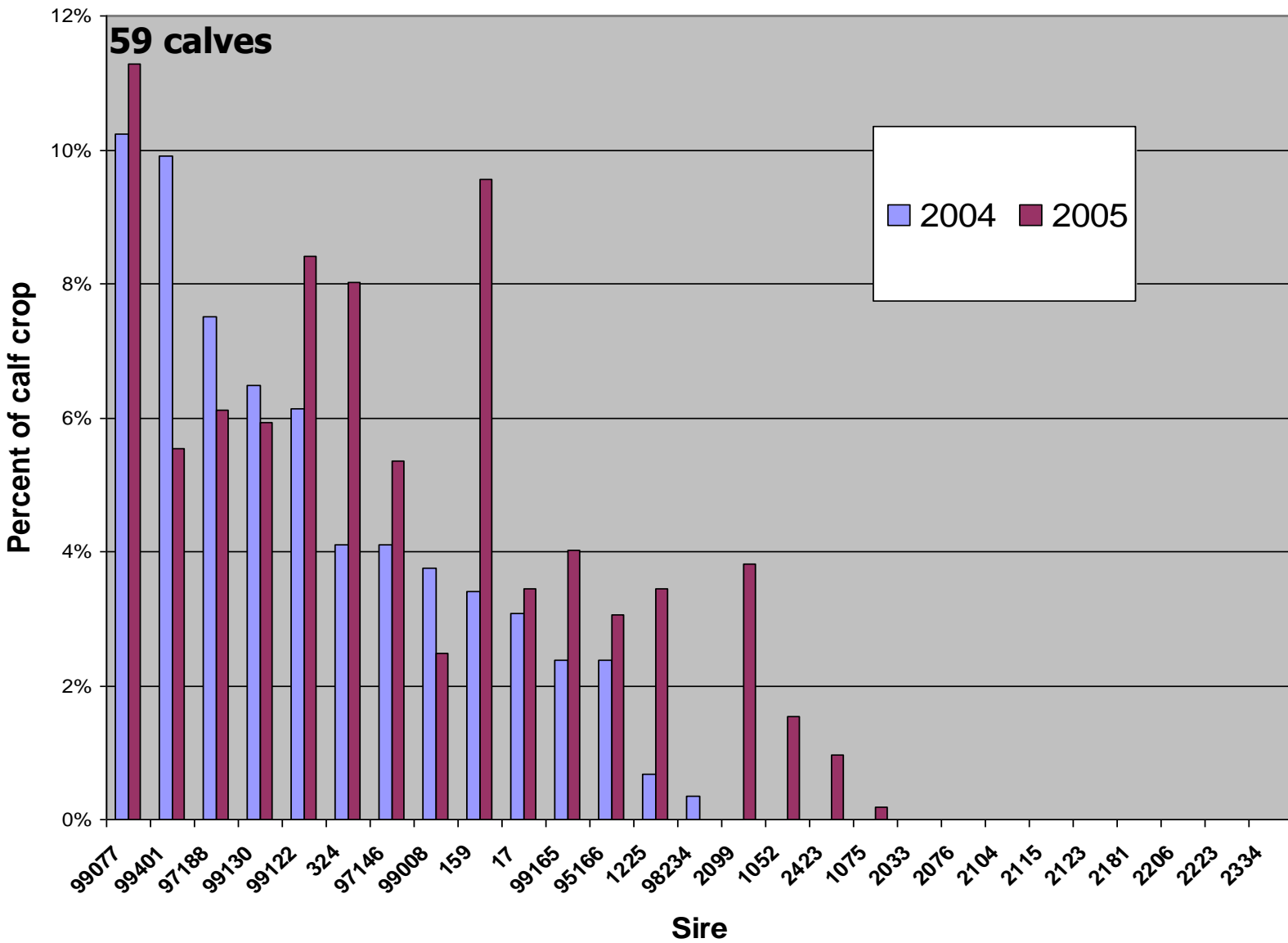
- **Blood collected on FTA cards**

624 calves

Total of 27 bulls

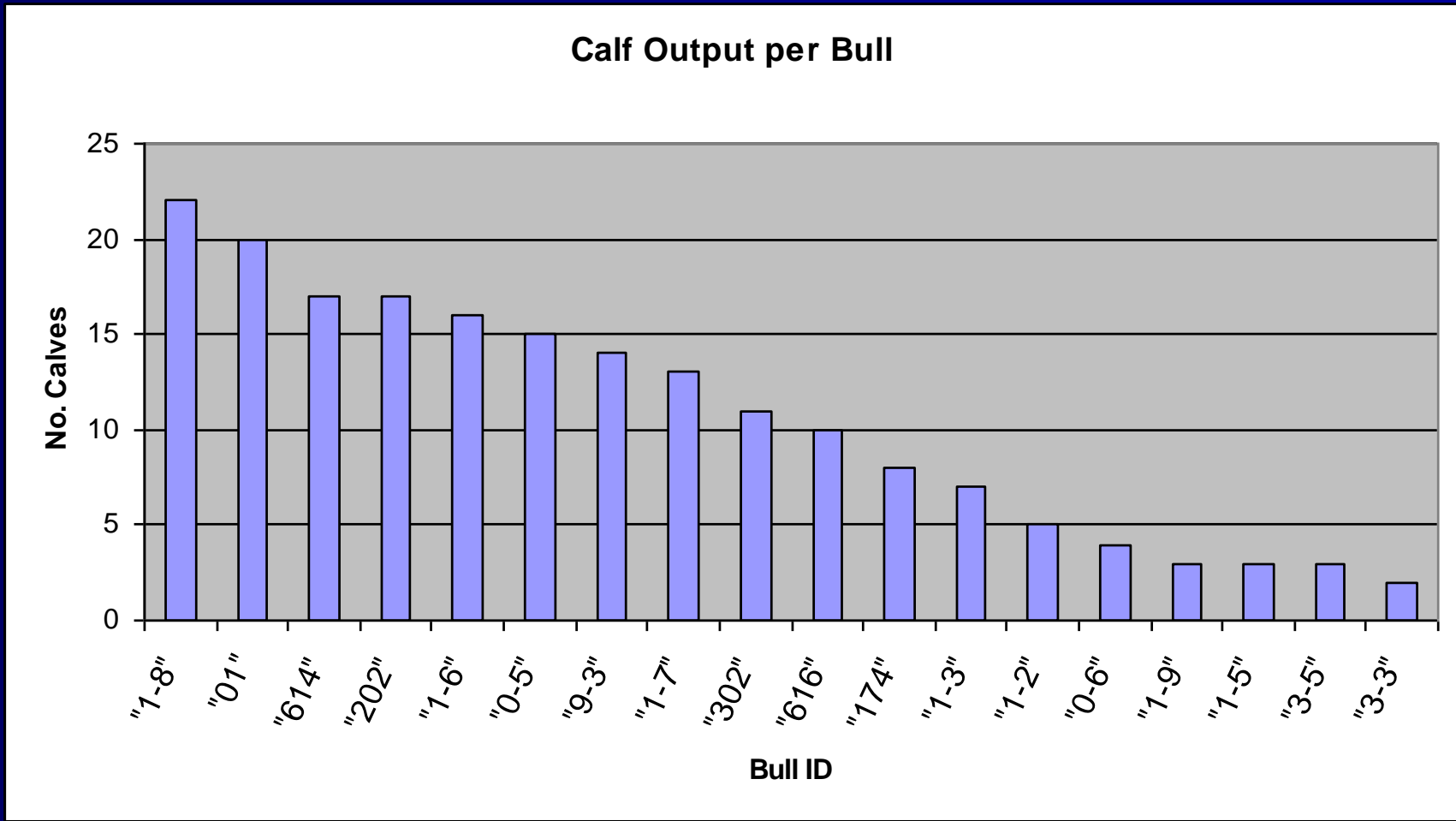# Number of offspring sired by 27 herd bulls (2005)

MANX

Bull output varies a lot !

Calf Output per Bull

RESULTS OF THE EPD ANALYSIS

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RESULTS OF WW EPD ANALYSIS

HERD BULLS	AdjWW EPD	AdjWW Acc	Equiv prog
1-8	13.5	0.32	19.0
4-1	5.6	0.36	25.0
8-1	4.6	0.28	15.3
6-1	2.5	0.34	22.0
4-2	1.3	0.33	21.0
1-1	0.9	0.11	4.0
2-1	0.4	0.30	17.0
4-3	-1.6	0.39	29.0
3-1	-3.2	0.46	46.0
4-5	-3.7	0.49	57.0
2-2	-4.5	0.09	3.0
6-2	-5.6	0.41	33.0
4-4	-7.1	0.43	38.0
3-2	-7.6	0.30	17.0
4-6	-8.1	0.24	12.0
3-3	-14.3	0.45	42.7
2-3	-22.1	0.19	8.0

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

1. Run young bulls in different pasture to mature bulls

2. Ideally run DNA tests on all bulls before breeding and sort them into breeding groups on the basis of test results (i.e. maximize genotype diversity among bulls); minimally separate 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 assigned to a single sire
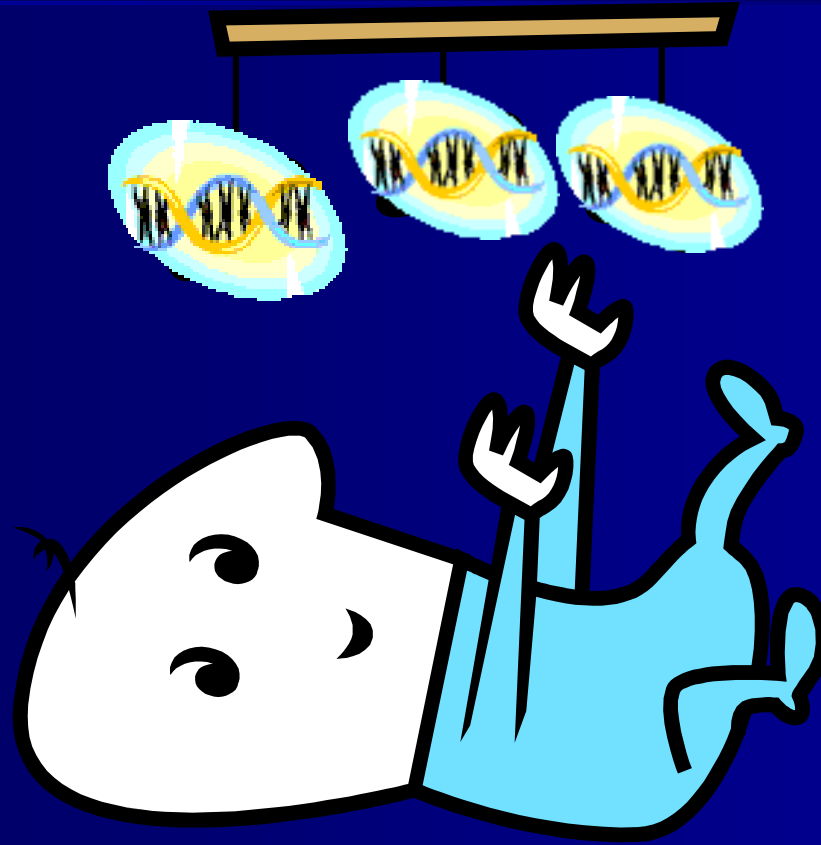
This year we are bleeding the bulls at BSE - BEFORE they go out with the cows !

This is a young industry....

An animal is born and tagged...

a SNP panel run on the DNA....

DNA from uniquely IDed calf will be run through a 100 SNP panel of DNA- markers

- **unique permanent genetic fingerprint,**
- **genetic tests for 100 markers linked to economically relevant traits, and to**
- **confirm parentage.** Genotype data then stored for future traceback of products derived from that animal, and incorporated into herd and breed EPD calculations.
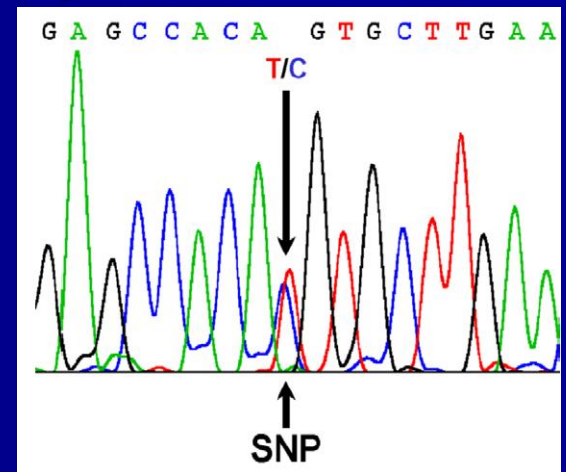
...and animal is then managed according to genetic potential.

Results are used to make decisions regarding

- Markets

- Feeding strategies

- Health product requirements

- Breeding decisions – guide selection and replacement choices . Which bulls are producing good calves, no calves ? Which bull should be used with each heifer calf to maximize her offspring's performance

Questions ?