

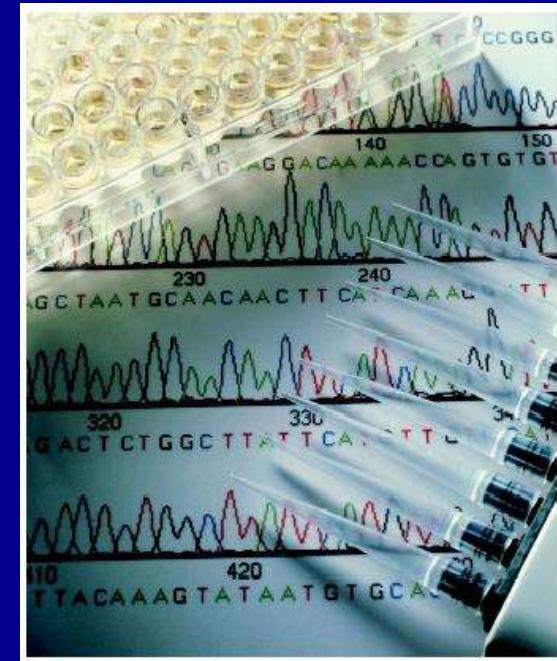


# "What has DNA done for me lately?"

Alison Van Eenennaam, Ph.D.

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Animal Biotechnology and Genomics  
UC Davis

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



# Curly Calf: What is Arthrogryposis Multiplex (AM) ??

- Curly calf syndrome
- Since September 8, 2008, researchers at the University of Illinois have been investigating the genetic condition called Arthrogryposis Multiplex (AM), commonly referred to as "Curly Calf Syndrome (CCS)" in Angus cattle.



# Arthrogryposis Multiplex (curly calf)

Calves are born dead or die shortly after birth. The spine and legs appear crooked or twisted and the joints of the legs are often fixed in positions. Front legs are contracted and rear limbs may be contracted or extended. Calves are small and appear thin due to limited muscle development. There may be a cleft affecting the nose or palate.

## Appearance of a calf with Arthrogryposis Multiplex.

Photo used with permission from  
<http://www.angus.org>.





# DNA test has been developed for Arthrogryposis Multiplex (curly calf)

- AM (Curly Calf Syndrome) is caused by a recessive genetic defect, tentatively traced to a maternal grandsire “Rito 9J9 of B156 7T26, Registration No. 9682589”, of GAR Precision 1680 (USA1680).
- The “impacted genetics” therefore currently refers to all animals with **Rito 9J9 of B156 7T26** in their pedigrees.
- A list of AM Free (AMF) and carrier (AMC) bulls and cows can be found at the Angus association website  
[http://www.angus.org/ccs\\_info.html](http://www.angus.org/ccs_info.html)



# Other genetic abnormalities to be on the look out for:



**Lethal Congenital Hydrocephalus**: Born near term, 25-35 lb birth weights, head is volleyball to basketball sized

**Fawn Calf Syndrome**: calves at birth assume an abnormal crouched posture, resembling an elk or deer fawn



# Companies offering AM (curly calf) test

DNA testing company	Website	Cost of test	Preferred tissue type
Agri-genomics	<a href="http://www.agrigenomicsinc.com">www.agrigenomicsinc.com</a>	\$25	<ul style="list-style-type: none"><li>• Whole blood</li><li>• Semen</li></ul>
Igenity	<a href="http://www.igenity.com">www.igenity.com</a>	\$26	<ul style="list-style-type: none"><li>• Whole blood</li><li>• Semen</li><li>• Hair</li><li>• Tissue</li></ul>
MMI genomics	<a href="http://www.metamorphixinc.com">www.metamorphixinc.com</a>	\$24 (1-19 samples) \$22 (20-99 samples) \$20 (100 + samples)	<ul style="list-style-type: none"><li>• Semen</li><li>• Blood on FTA cards</li></ul>
Pfizer Animal Genetics	<a href="http://www.pfizeranimalgenetics.com">www.pfizeranimalgenetics.com</a>	\$29* (*each test earns \$10 credit towards GeneSTAR testing through 6/1/09)	<ul style="list-style-type: none"><li>• Whole blood</li><li>• Semen</li><li>• Blood on FTA cards</li><li>• Hair sample (&gt; 25 hairs)</li></ul>



# The following groups also collaborate with GeneSeek, Inc., to collect and provide samples for AM testing (~\$25/sample)

## **Stockman's Resource Center LLC**

**2371 330th Street**

Eddyville, Iowa 52553

[stockmansresource@hotmail.com](mailto:stockmansresource@hotmail.com)

[www.stockmansresource.com](http://www.stockmansresource.com)

Office phone: 641-969-4111

Mobile: 641-660-0771

## **Genex Cooperative, Inc.**

Headquarters:

100 MBC Drive

Shawano, WI 54166

Phone: 888-333-1783

Fax: 715-526-3219

[info@crinet.com](mailto:info@crinet.com)

## **SEK Genetics**

Don Coover

9525 70th Rd.

Galesburg, KS 66740

[don@sekgenetics.com](mailto:don@sekgenetics.com)

Phone: 800-443-6389



## From September 8–November 3, 2008 identified genetic problem, developed test prototype, and released carrier status of 736 AI bulls!

- From a scientific standpoint, the AM test is based on the presence of a specific change or mutation in the DNA sequence. For AM, this change is the complete deletion of a segment of DNA that encompasses two different genes (a gene is a sequence in the DNA that encodes a protein).
- One of these genes is expressed at a crucial time in the development of nerve and muscle tissue. The mutation results in no protein being produced from this gene and therefore it is unable to carry out its normal function, referred to as a loss-of-function mutation.

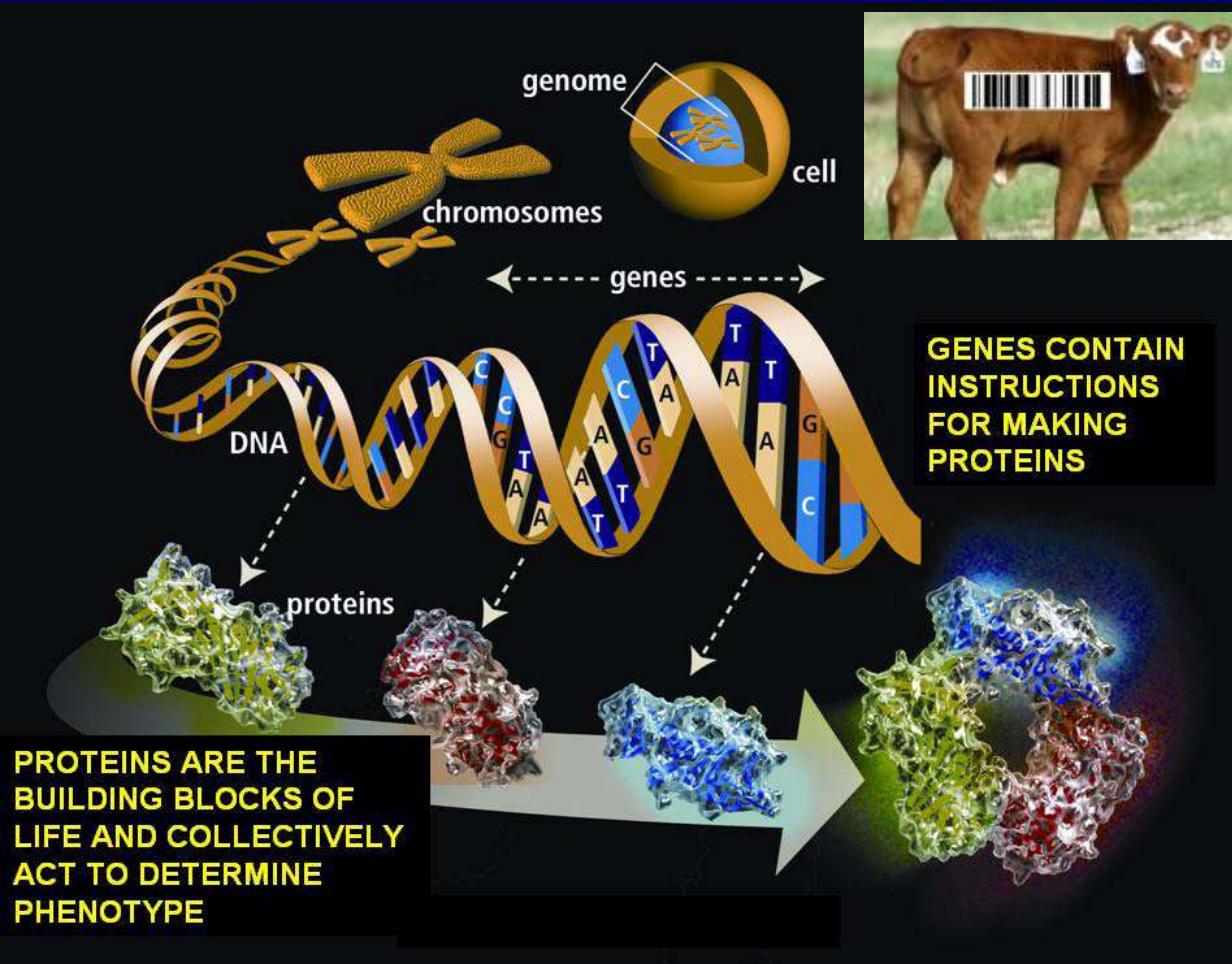


# Why are these genetic defects appearing now?

Naturally-occurring recessive genetic defects are common in all species, and only become evident when certain lines of cattle are used very heavily, such that both cows and bulls have common ancestors in their pedigree, (double bred descendants) thereby allowing a rare genetic defect to become homozygous in their offspring



# The bovine genome is similar in size to the genomes of humans, with an estimated size of 3 billion base pairs.

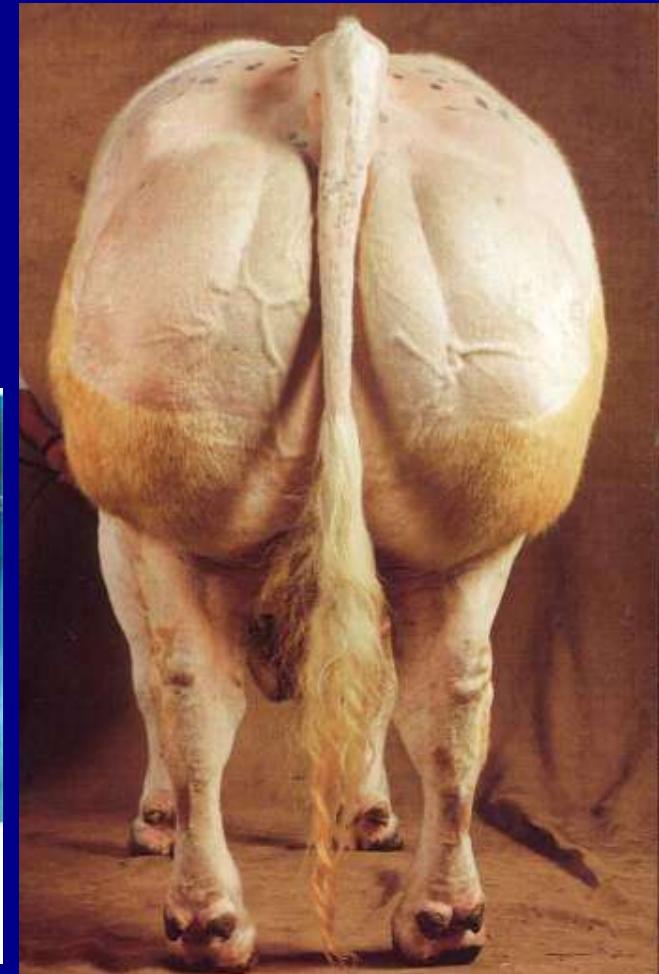


Human & cattle genomes are 83% identical



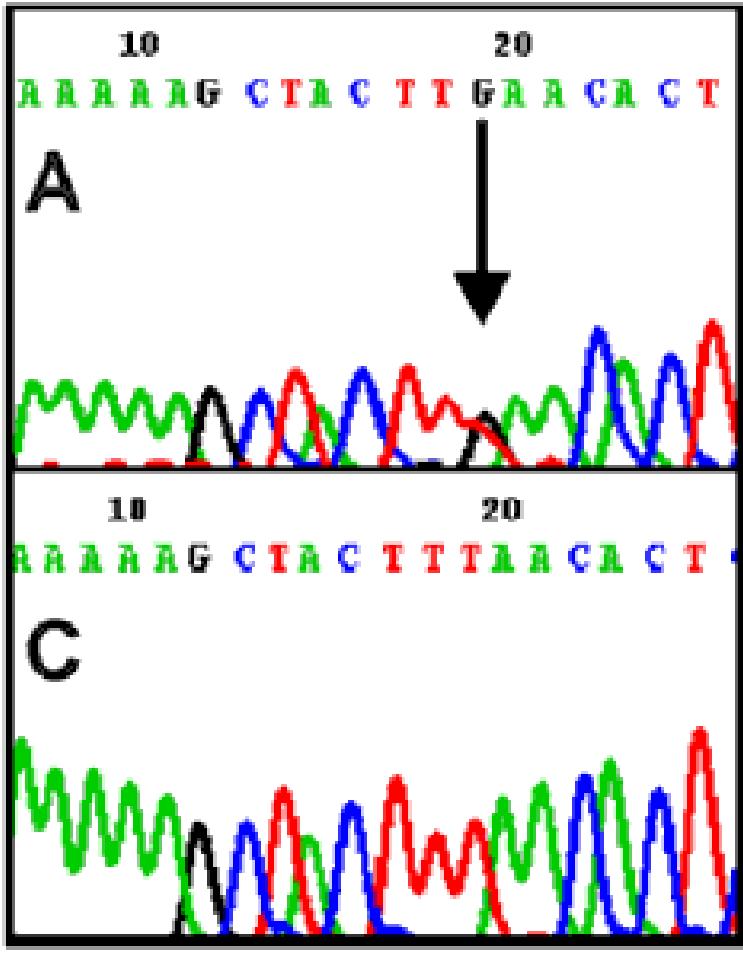


# Loss of Myostatin gene causes double muscling





# Genotyping



Carrier bull -  
AMC





# Breeding two carriers will give 25% chance of affected calf

- **AMC x AMC =  $\frac{1}{4}$  affected (AMA):  $\frac{1}{2}$  normal-appearing carrier (AMC):  $\frac{1}{4}$  AM free (AMF)**

If only one parent is a carrier, then all of the offspring will be normal appearing, but half of them will be carriers (AMC)

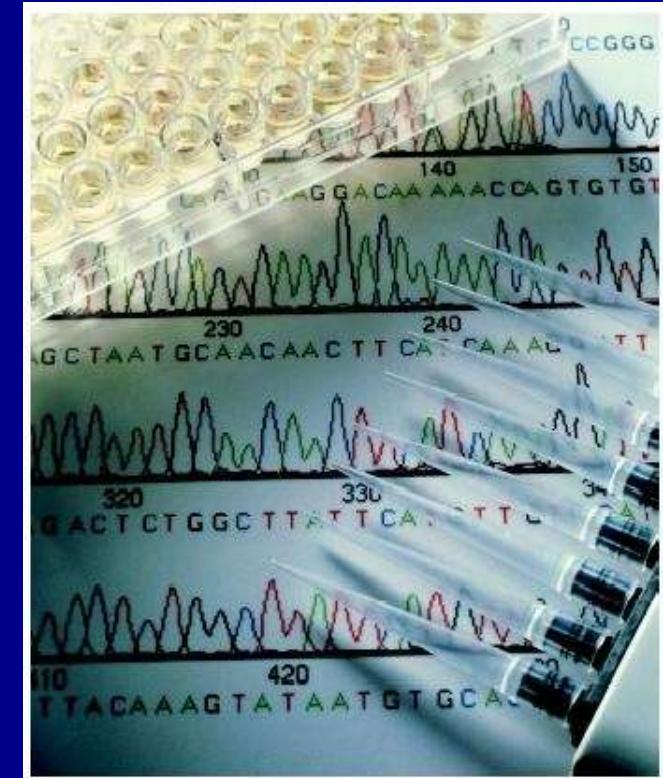
- **AMC x AMF =  $\frac{1}{2}$  normal-appearing carrier (AMC):  $\frac{1}{2}$  AM free calf (AMF)**



# There will be a Quiz! DNA-test Opinion Survey

Alison Van Eenennaam, UC Davis

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University of California, Davis  
[alvaneenennaam@ucdavis.edu](mailto:alvaneenennaam@ucdavis.edu)

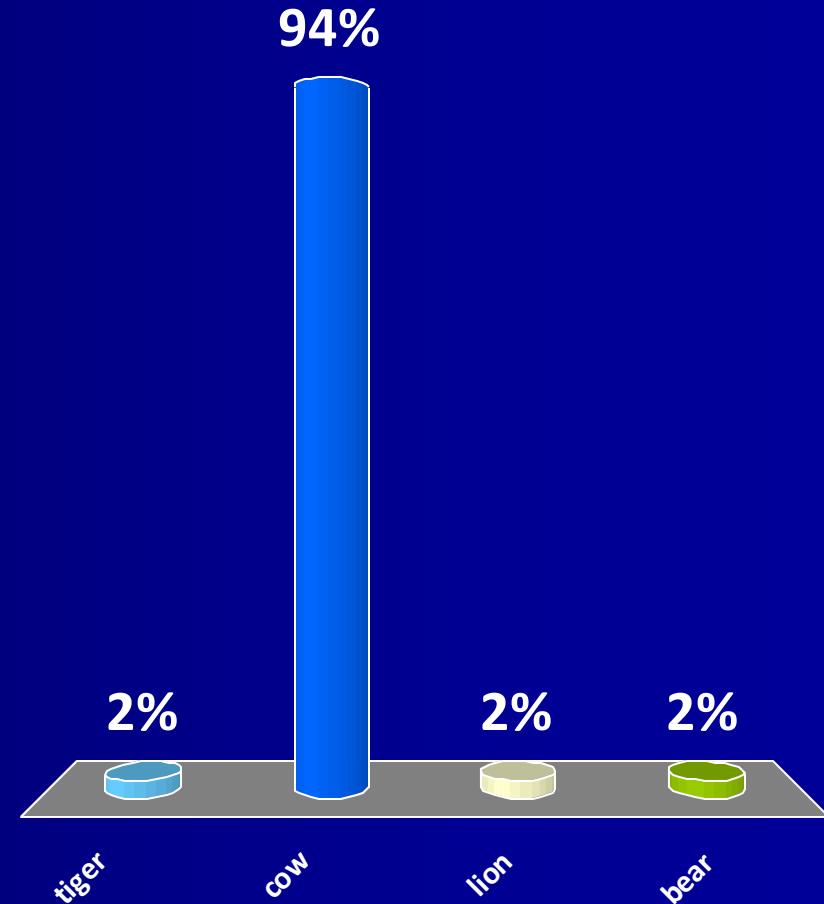




**Kitten**  
**calf**

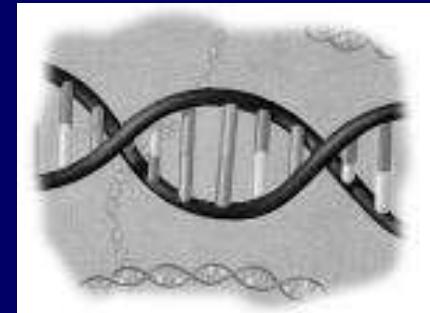
is to **cat**  
is to \_\_\_\_\_.

1. tiger
2. cow
3. lion
4. bear

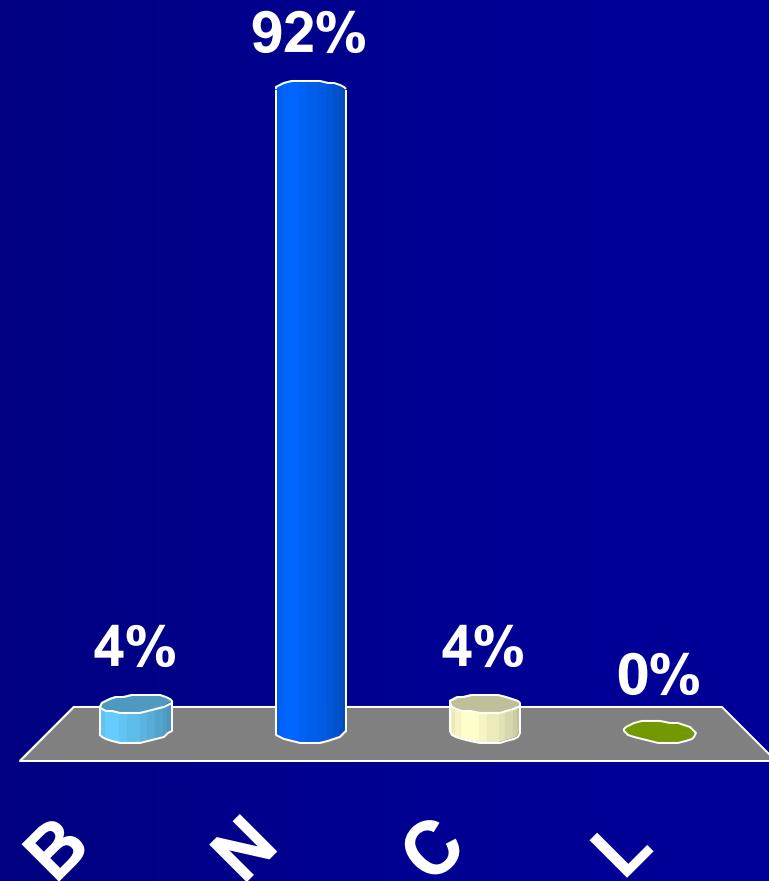




# This is a picture of D\_A.



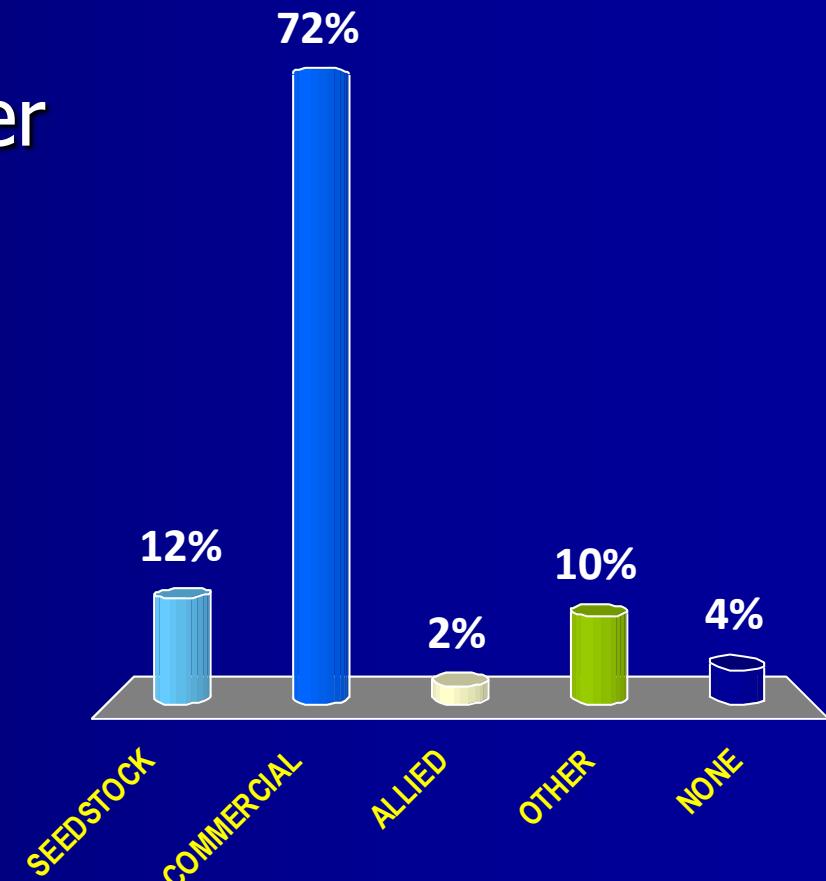
1. B
2. N
3. C
4. L





# Who are you?

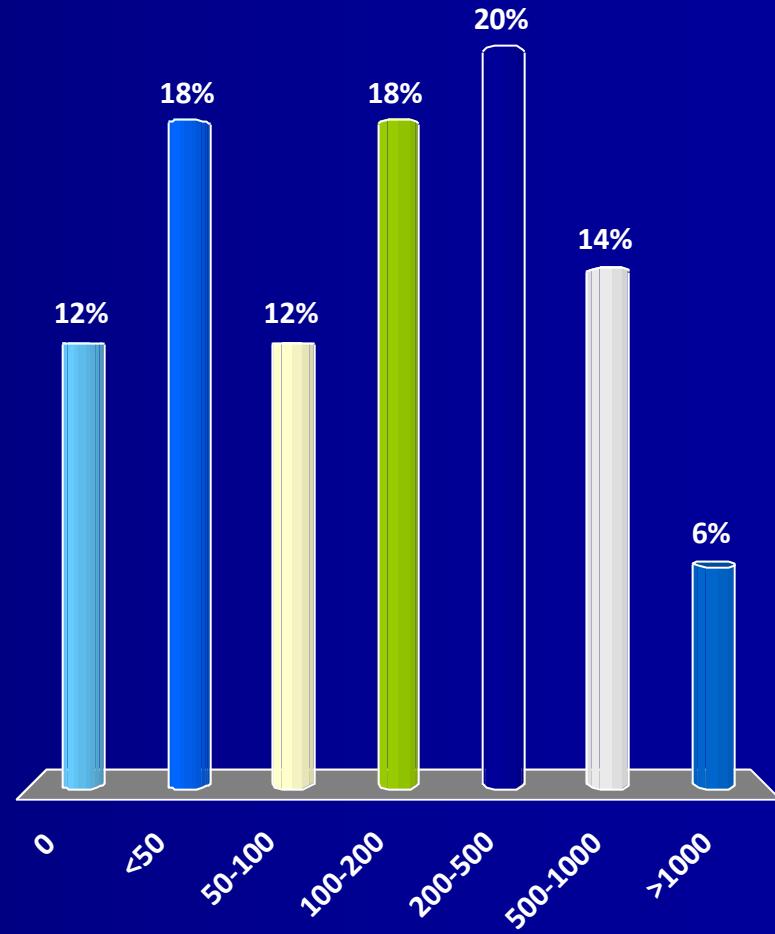
1. Seedstock producer
2. Commercial producer
3. Allied industry
4. Other
5. None





# How many cows do you run?

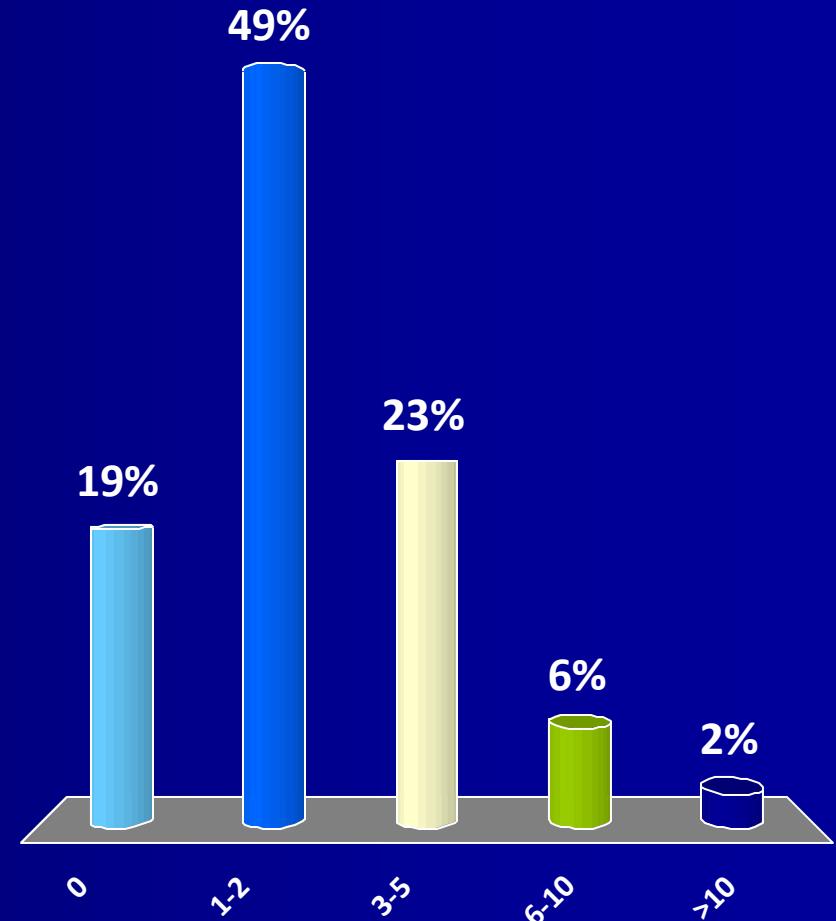
1. 0
2. <50
3. 50-100
4. 100-200
5. 200-500
6. 500-1000
7. >1000





# How many bulls do you plan to purchase this year?

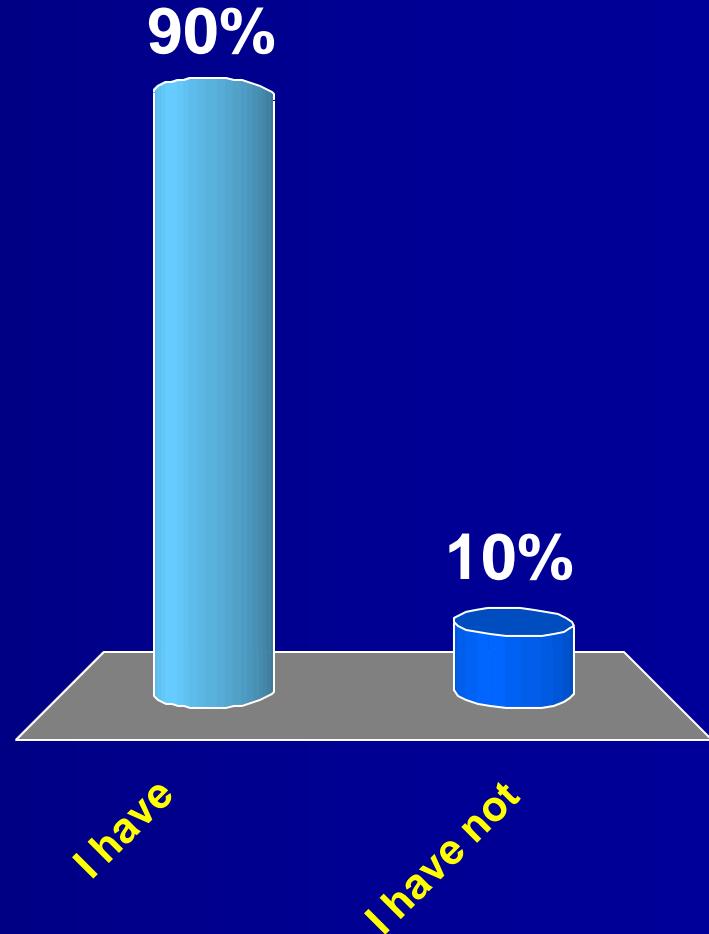
1. 0
2. 1-2
3. 3-5
4. 6-10
5. >10





# Who has heard about DNA testing for beef cattle?

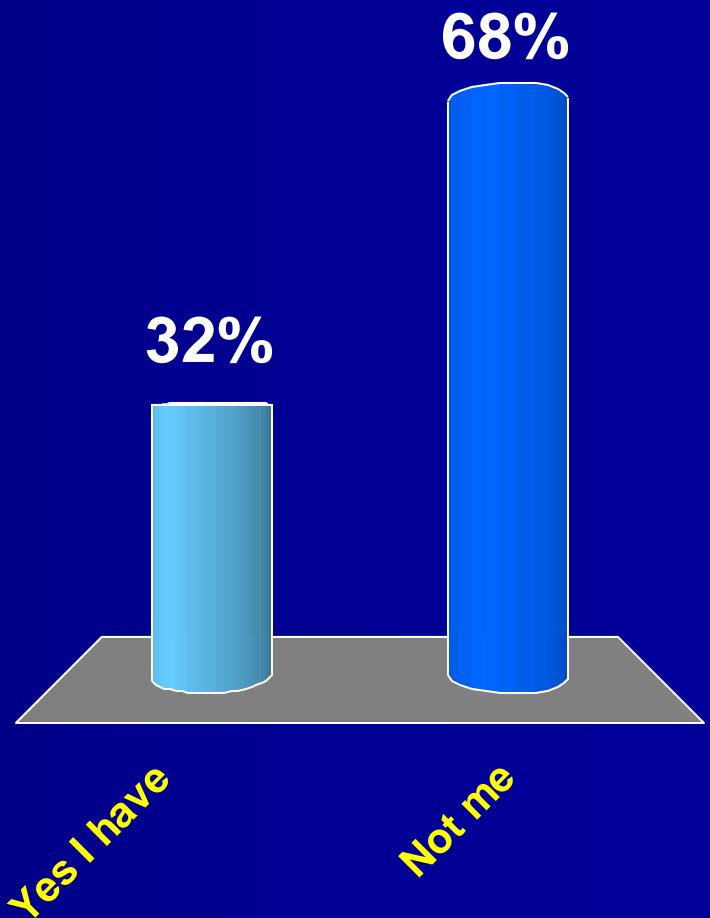
1. I have
2. I have not





# Who has collected samples from their cattle for DNA testing?

1. Yes I have
2. Not me





# Current applications: Tests for simple traits

- Testing for genetic defects e.g. curly calf
- Testing for single gene traits
- Testing for Coat color
- Testing for horned/polled



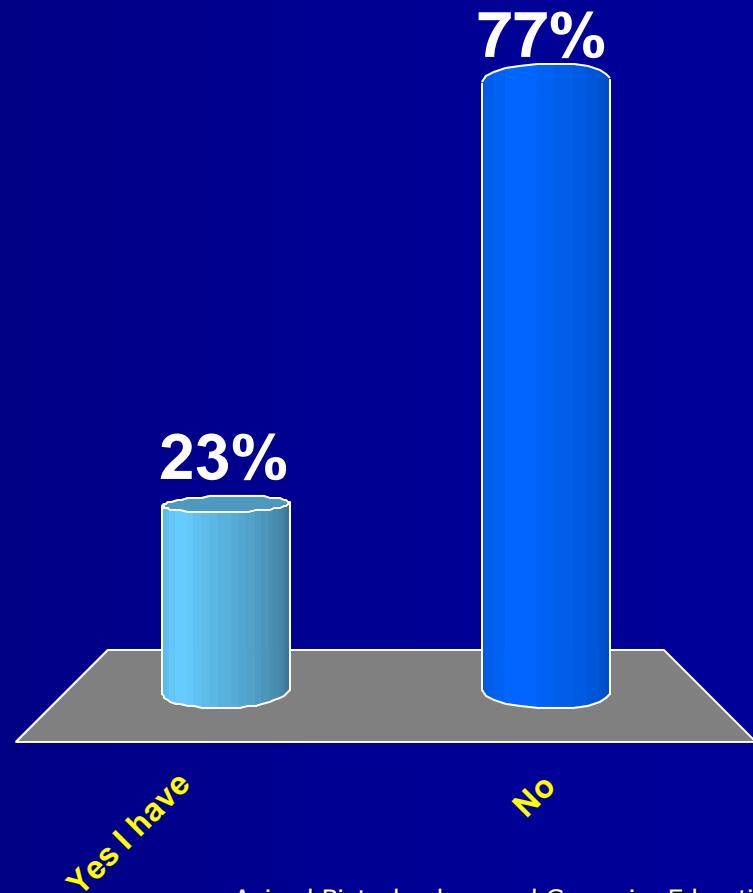
# Who has tested their cattle for simple traits?

1. Yes I have
2. No



## Examples

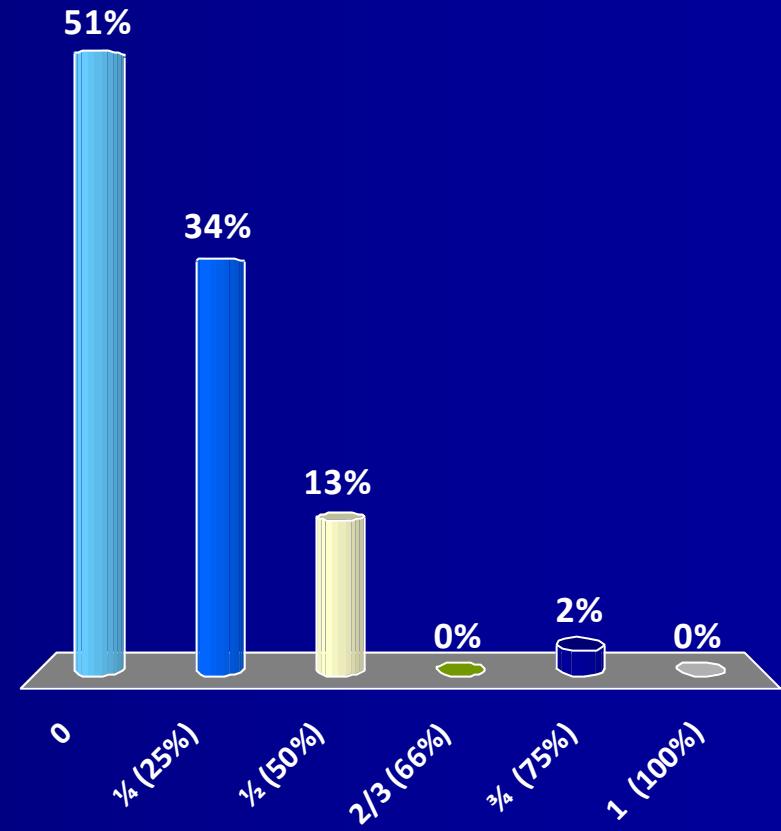
- Horned/Polled
- Coat color
- Genetic defects





**If you breed a curly calf carrier cow (AMC) to an curly calf free bull (AMF), what is the chance that the offspring will be stillborn as a result of being curly calf?**

1. 0
2.  $\frac{1}{4}$  (25%)
3.  $\frac{1}{2}$  (50%)
4.  $\frac{2}{3}$  (66%)
5.  $\frac{3}{4}$  (75%)
6. 1 (100%)





# Current applications: Paternity testing

- 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
- Enable on-ranch EPD calculations for commercial sires in a herd

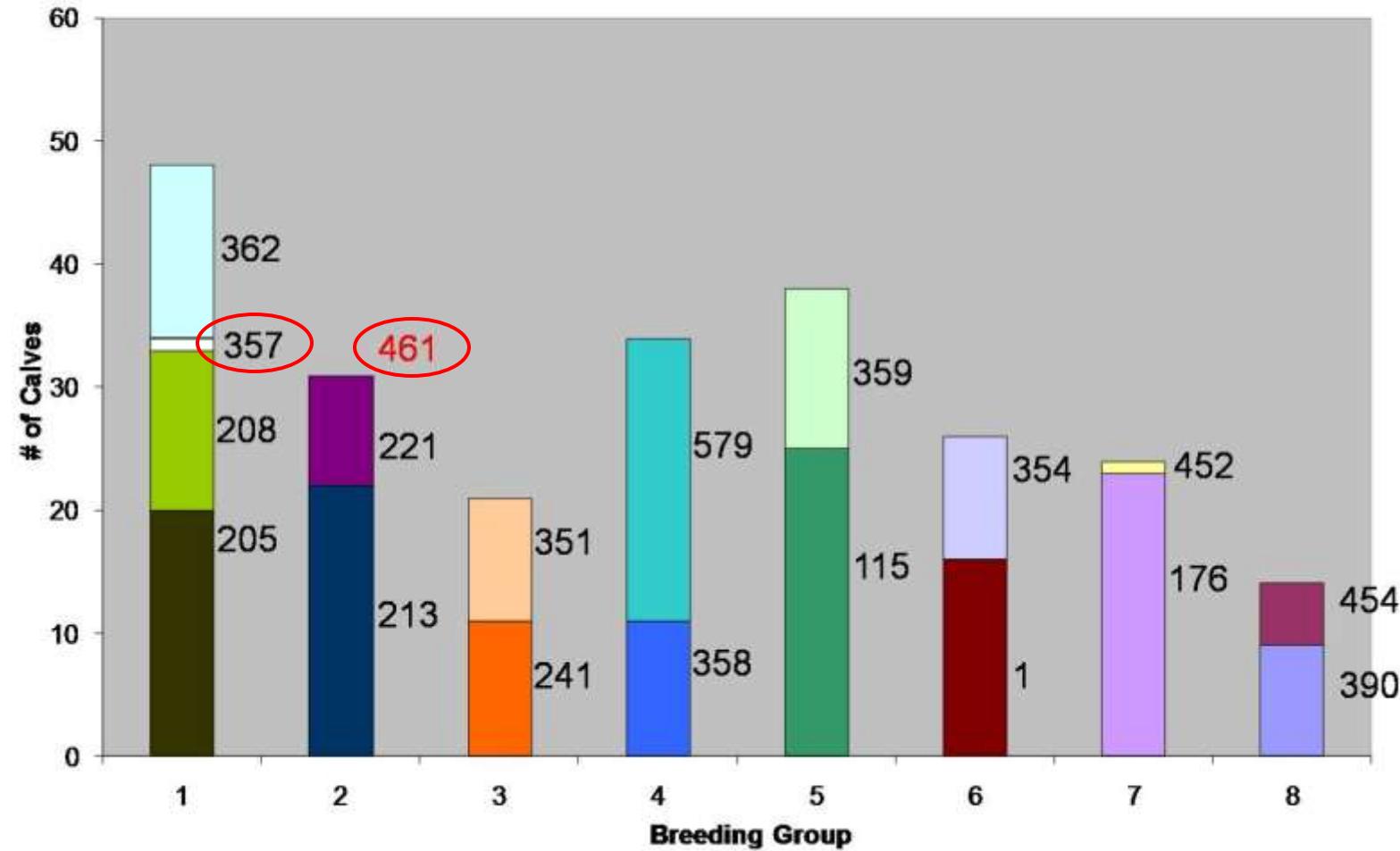


# UC Davis herd 2006



## 2006 Sire Prolificacy by Breeding Group

(19 bulls; progeny range 0-25 calves per bull)

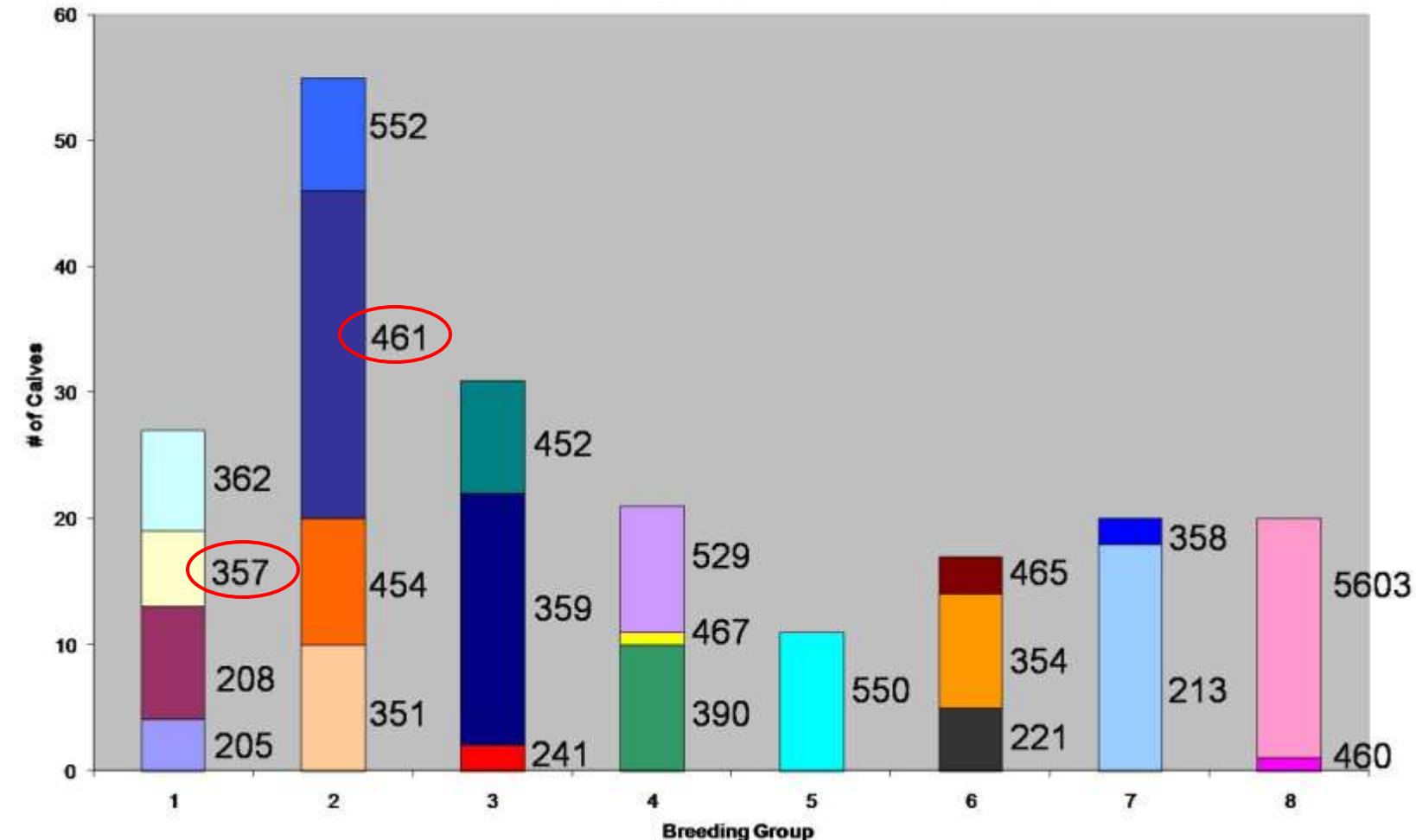




# UC Davis herd 2007

## 2007 Sire Prolificacy by Breeding Group

(22 bulls; progeny range 1-26 calves per bull)

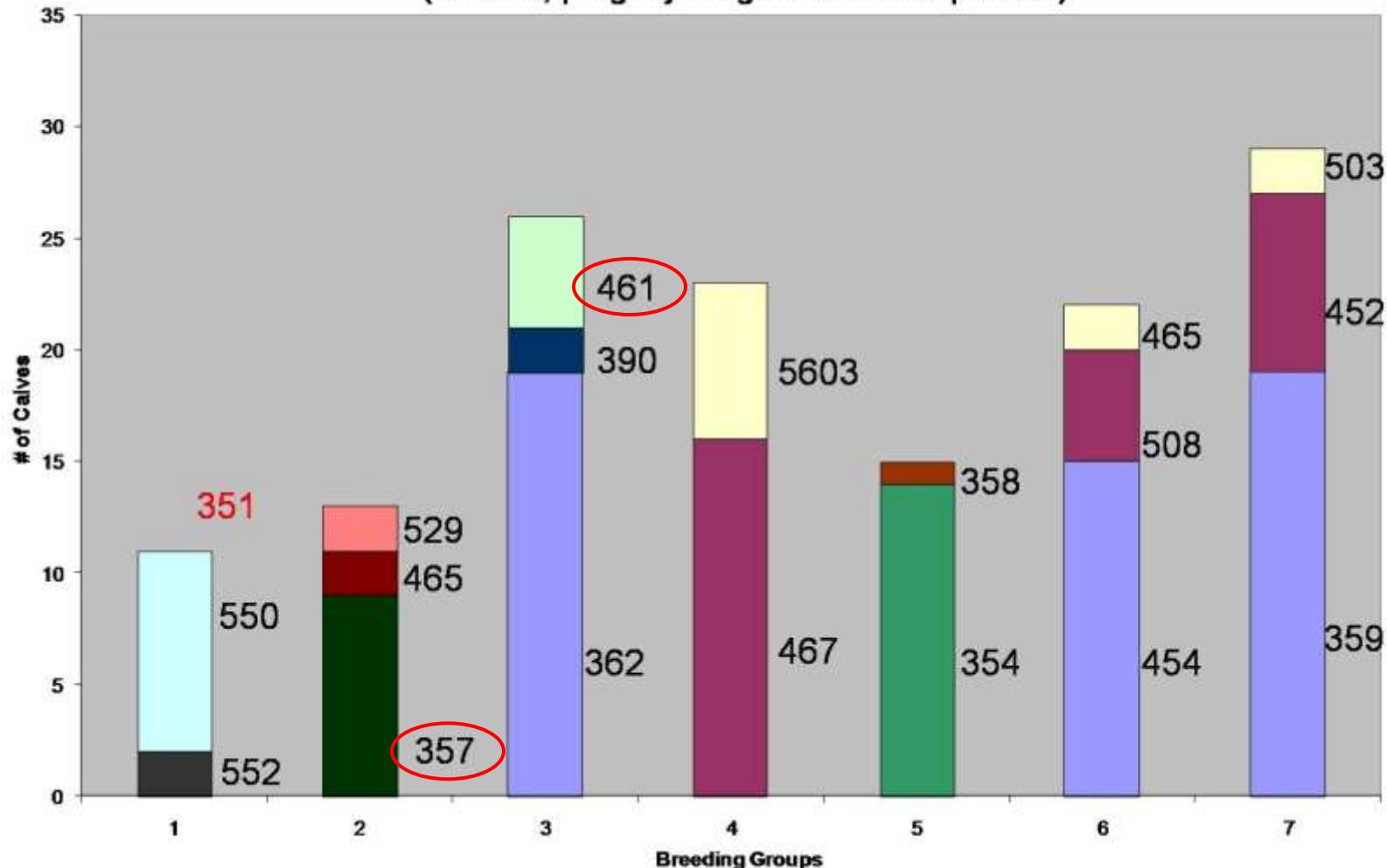




# UC Davis herd 2008

## 2008 Sire Prolificacy by Breeding Group

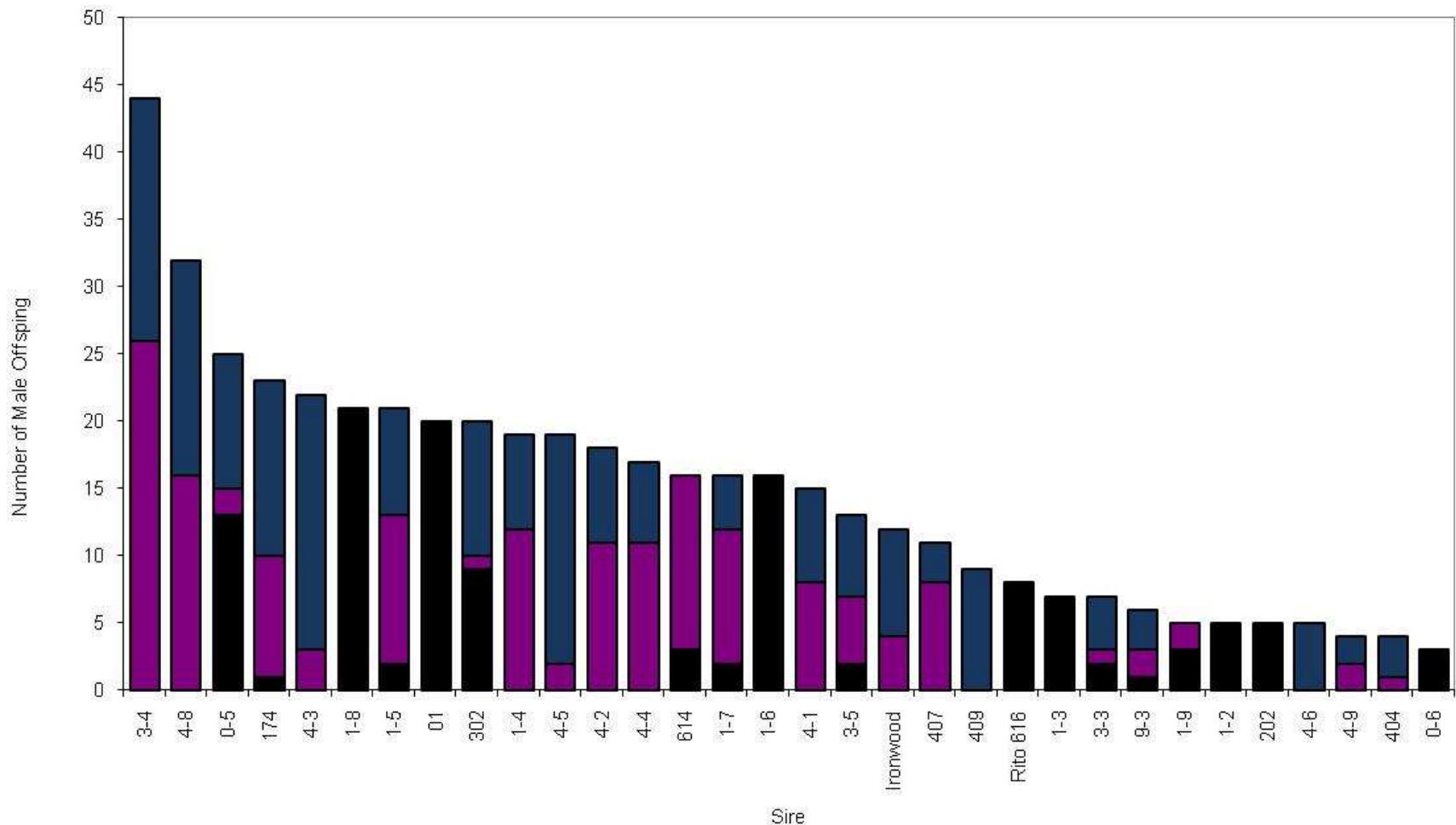
(19 bulls, progeny range 0-19 calves per bull)





### Bull Prolificacy - Number of Calves per Bull per Cohort Group

■ SPRING 2006 (N=18)   ■ FALL 2006 (N=22)   ■ SPRING 2007 (N=22)





# Tests for complex traits – currently 10-100 SNPs

- Meat Tenderness
- Quality Grade (Marbling)
- Beef Cattle Feed Efficiency
- Yield Grade
- Fat thickness
- Ribeye area
- Average Daily Gain
- (Heifer pregnancy rate, stayability, calving ease, docility)



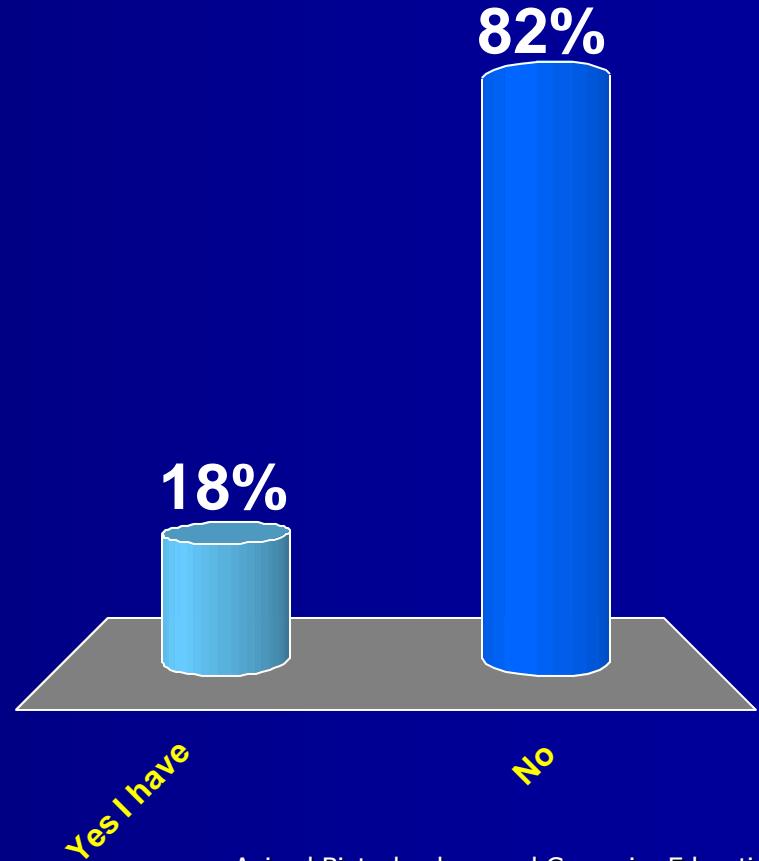
# Current applications: Test for complex traits

	Pfizer	Igenity	MMI
Quality Grade	Results reported as # of stars/MVP	Results reported on scale 1-10	Results reported as "MGV"
Tenderness	GeneSTAR Quality Grade	Igenity Profile – Quality Grade	Tru-Marbling
Other	GeneSTAR Tenderness	Igenity Profile - Tenderness	Tru-Tenderness
	Feed Efficiency	Igenity Profile – Marbling, Yield Grade, Fat thickness, Ribeye area, Average Daily Gain, Heifer pregnancy rate, stayability, calving ease, docility	



# Who has tested their cattle for complex (multigenic) traits?

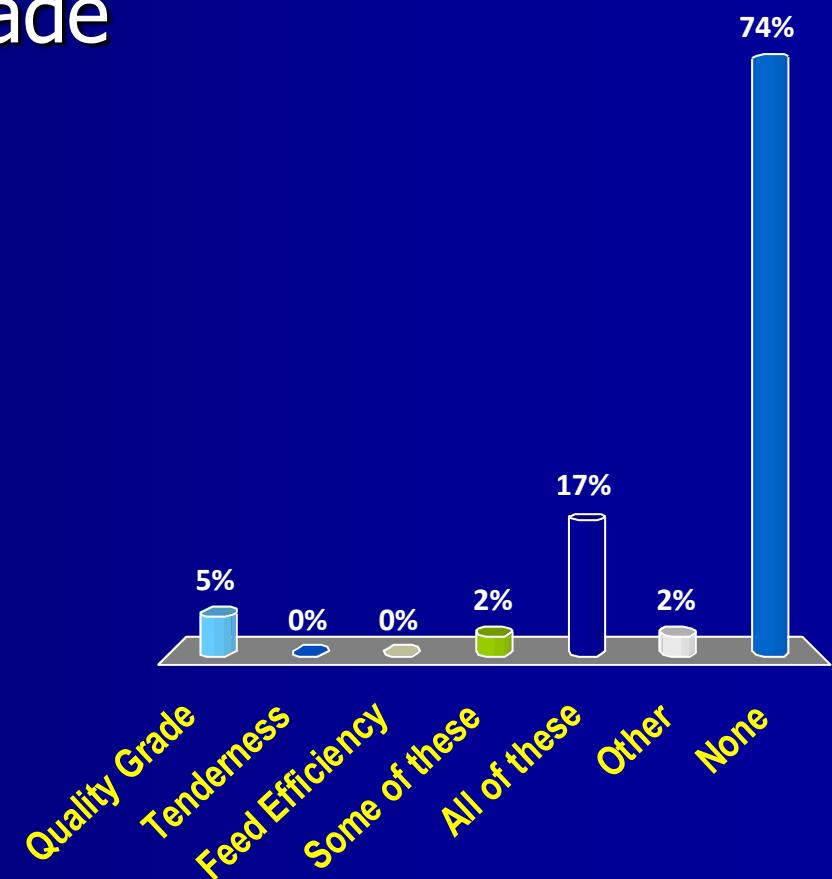
1. Yes I have
2. No





# Which quantitative tests have you done?

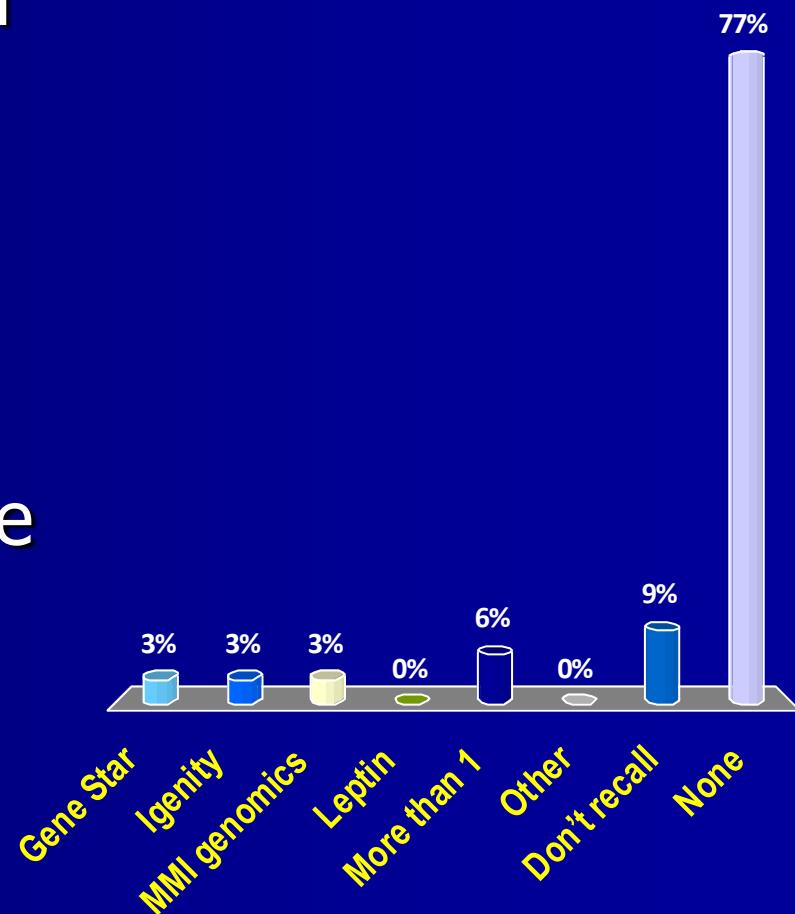
1. Marbling/Quality grade
2. Tenderness
3. Feed Efficiency
4. Some of the above
5. All of the above
6. Other
7. None





# What test did you use?

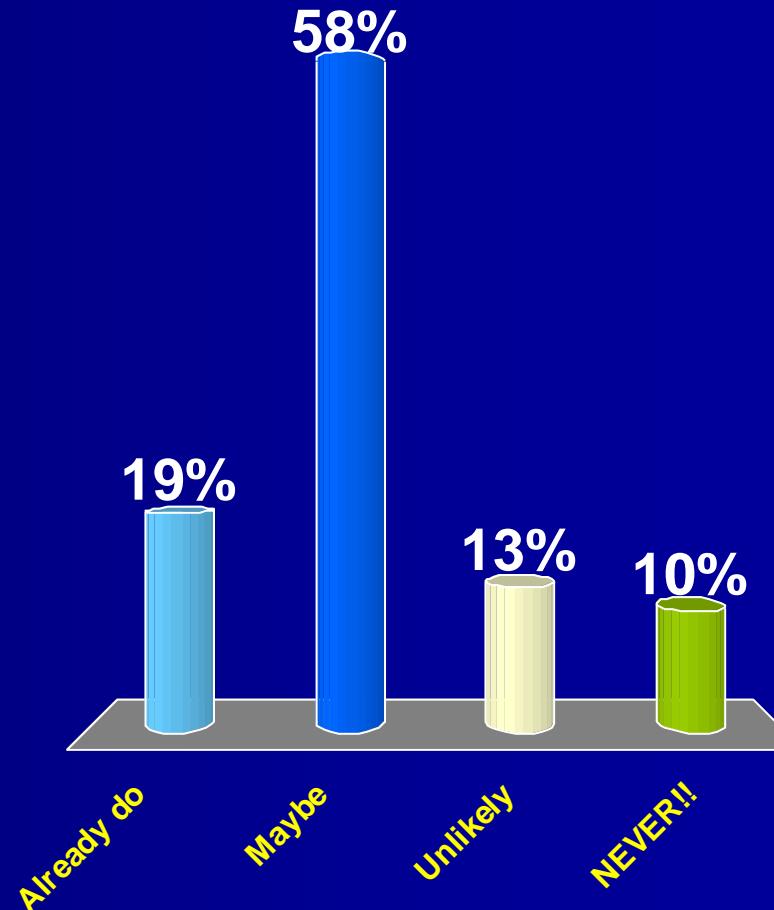
1. Gene Star/Bovigen/Pfizer
2. Igenity Profile/Merial
3. MMI genomics  
(TruTenderness/TruMarbling)
4. Leptin
5. More than 1 of the above
6. Other
7. Don't recall which test
8. None





# Who thinks they might use DNA testing for complex traits one day?

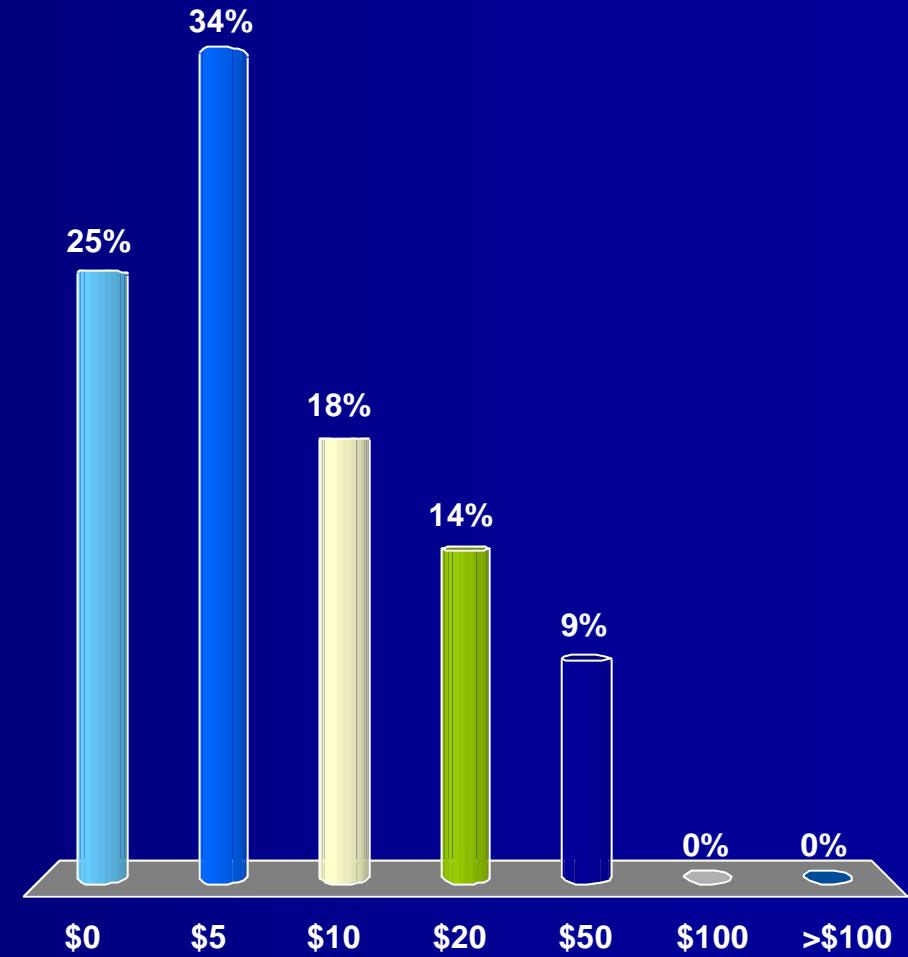
1. Already do
2. Maybe
3. Unlikely
4. NEVER!!





# How much would you be willing to pay for a marbling test...

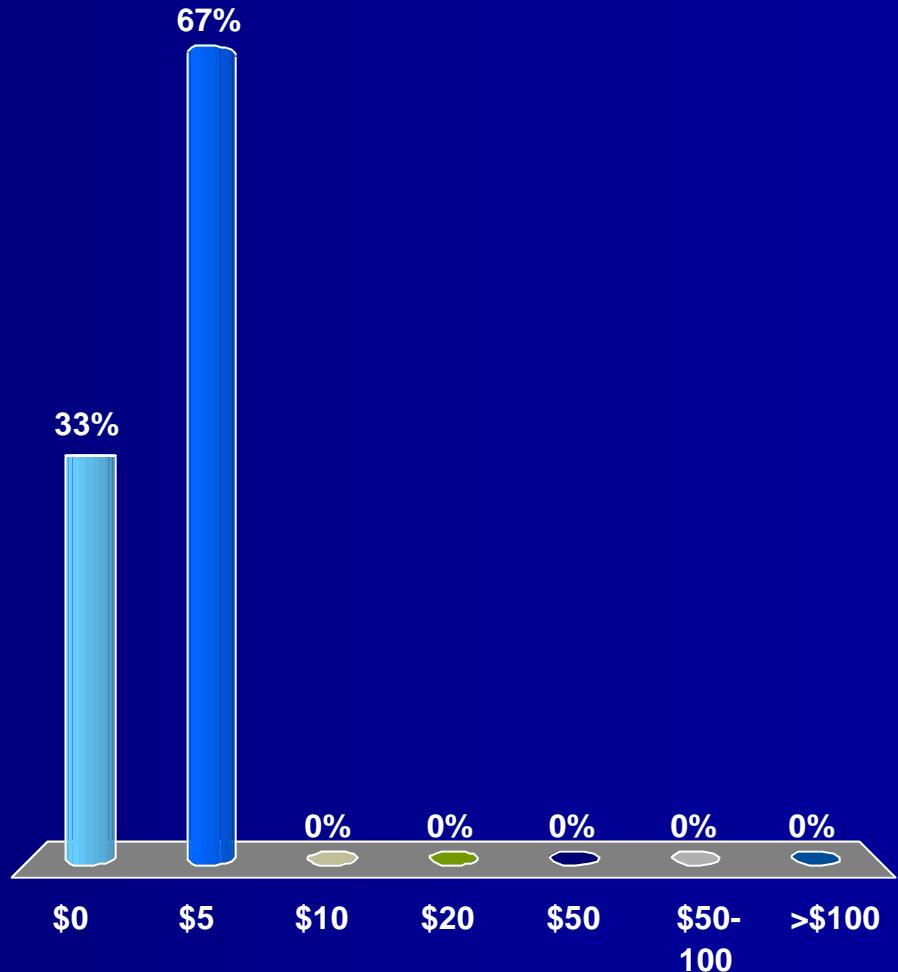
1. \$0
2. \$5
3. \$10
4. \$20
5. \$50
6. \$100
7. >\$100





# How much would you be willing to pay for a tenderness test?

1. \$0
2. \$5
3. \$10
4. \$20
5. \$50
6. \$50-100
7. >\$100



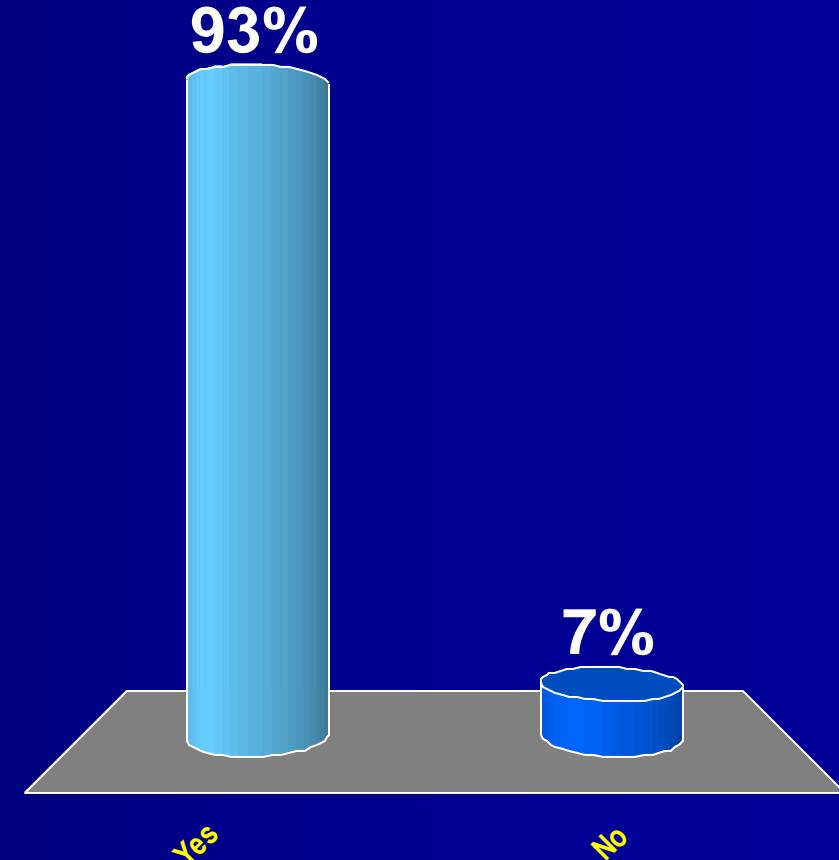


# Is there a value to increasing the accuracy of EPDs?

1. Yes
2. No

Production					
CED Acc	BW Acc	WW Acc	YW Acc	YH Acc	SC Acc
I +6 .05	I +3.3 .05	I +45 .05	I +83 .05	I +.1 .05	I +.19 .05

Carcass					
Cwt Acc	Mrb Acc	RE Acc	Fat Acc	C Grp C Prog	U Grp U Prog
I +15 .05	I +.45 .05	I +.44 .05	I +.015 .05		





# What is the value of accuracy?

## Twin Valley Precision E161



Reg. No.: 12346200  
Calved: 5/16/1995  
Semen: \$250  
Certificates: \$35



Production						Maternal					
CED Acc	BW Acc	WW Acc	YW Acc	YH Acc	SC Acc	CEM Acc	Milk Acc	MkH MkD	MW Acc	MH Acc	\$EN
+6 .92	+3.1 .97	+42 96	+92 .95	+.3 .94	+.07 .94	+9 .90	+18 94	1378 4501	+84 89	+.8 89	-.71

Carcass						\$Values					
Cwt Acc	Mrb Acc	RE Acc	Fat Acc	C Grp C Prog	U Grp U Prog	Wean Value	Feedlot Value	Grid Value	QG Value	YG Value	Beef Value
+22 .63	+.22 .67	+.48 .67	+.006 62	16 35	3465 8164	14.59	34.28	21.71	14.59	7.12	50.7

Fall 2008 EPD

Tehama Bando 155

G A R Precision 1680  
#11520398

9J9 G A R 856

Band 234 of Ideal 3163

Tehama Blackcap G373

Rito 9J9 of B156 7T26

Blackbird G A R 833

S S Traveler 6T6

W C C Blackcap C9  
+11911768 R

Q A S Traveler 23-4

S S Miss Power Play 4A4

Brusco

Premier Blackcap 6276A

Premier Lady Blackcap 2861U

## Prime Maker Plus



Reg. No.: 15729763  
Calved: 12/31/2006  
Semen: \$20  
Certificates: \$35



Quality Grade				Tender				Feed Effic.			
QG1	QG2	QG3	QG4	T1	T2	T3	FE1	FE2	FE3	FE4	FE5
				2	1	1	2	1	1	1	1

Click photo to enlarge

Prime Maker Plus is the culmination of years of conscientious breeding at Donnell Cattle Co. This 6.5 frame bull has strong, balanced EPDs, and super carcass values which combine to put him in the top 1% for \$Beef Value for the breed. Prime Maker Plus is a thick, long bodied bull with excellent structure and phenotype, and a GeneStar rating of 4 star tenderness and 5 star feed efficiency. BW 87 lb., WW 812 lb., ratio 114, YW 1,409 lb., ratio 115, IMF 9.99, ratio 152, RE 17.7, ratio 126, Fat .35, ratio 100. Don't overlook this unique package of pedigree and performance.

= Top 10% or better

Production						Maternal					
CED Acc	BW Acc	WW Acc	YW Acc	YH Acc	SC Acc	CEM Acc	Milk Acc	MkH MkD	MW Acc	MH Acc	\$EN
+3 .27	+3.4 .33	+52 .24	+96 .22		+.20 .30	+4 .13	+27 .15				-7.35

Carcass						\$Values					
Cwt Acc	Mrb Acc	RE Acc	Fat Acc	C Grp C Prog	U Grp U Prog	Wean Value	Feedlot Value	Grid Value	QG Value	YG Value	Beef Value
+19 .12	+1.07 17	+48 21	+.010 .14			24.56	34.41	42.27	35.04	7.23	69.25

Spring 2009 EPD

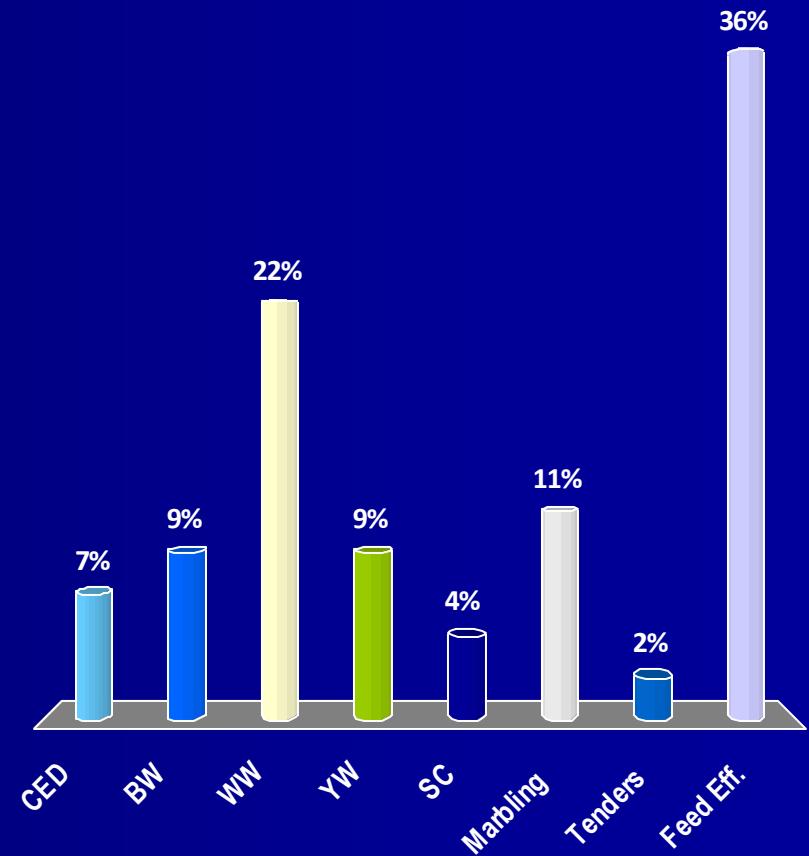
C A Future Direction 5321  
D C C Rito Direct 3C3  
D C C Ideal 370 of Ext 6100  
G A R Precision 1680  
C A Miss Power Fix 308  
N Bar Emulation EXT  
Eldorado 6100 Ideal 5108 156

G A R Integrity  
D C C Integrity 5111  
D C C Rita 3J7 of 112 180  
Bon View New Design 1407  
G A R Precision 1019  
Rito 1I2 of 2536 Rito 6I6  
D C C Ideal 180 of 692 8375



# For which trait would an increase in accuracy have the greatest value?

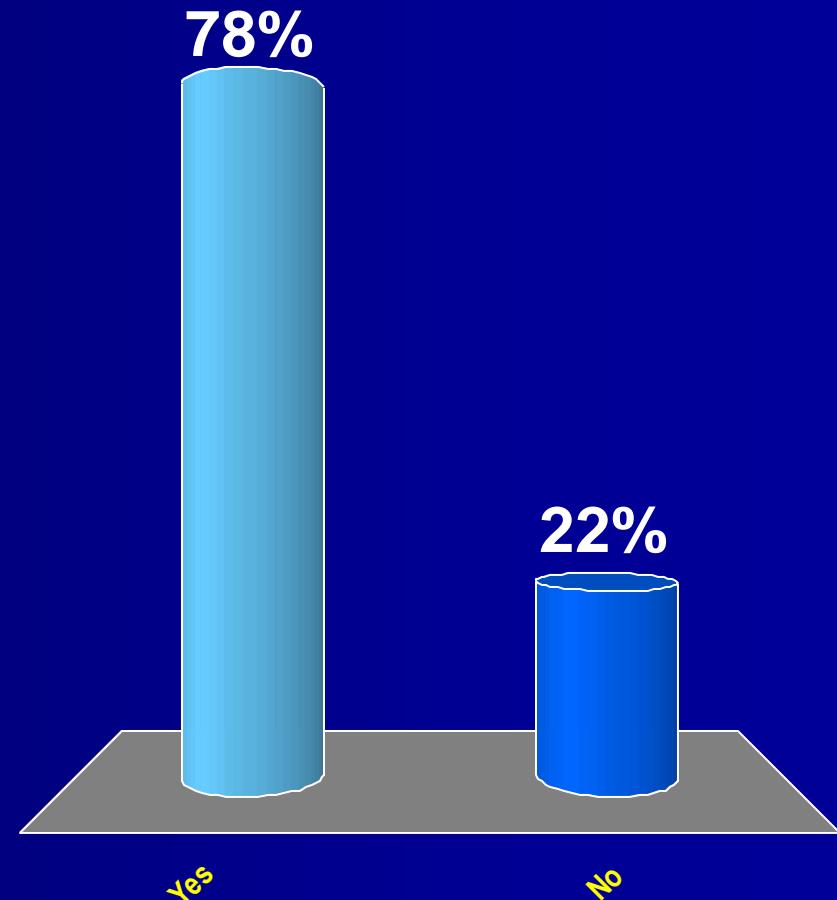
1. CED
2. BW
3. WW
4. YW
5. SC
6. Marbling
7. Tenderness
8. Feed Efficiency





# If there was a DNA test for weaning weight –would you use it?

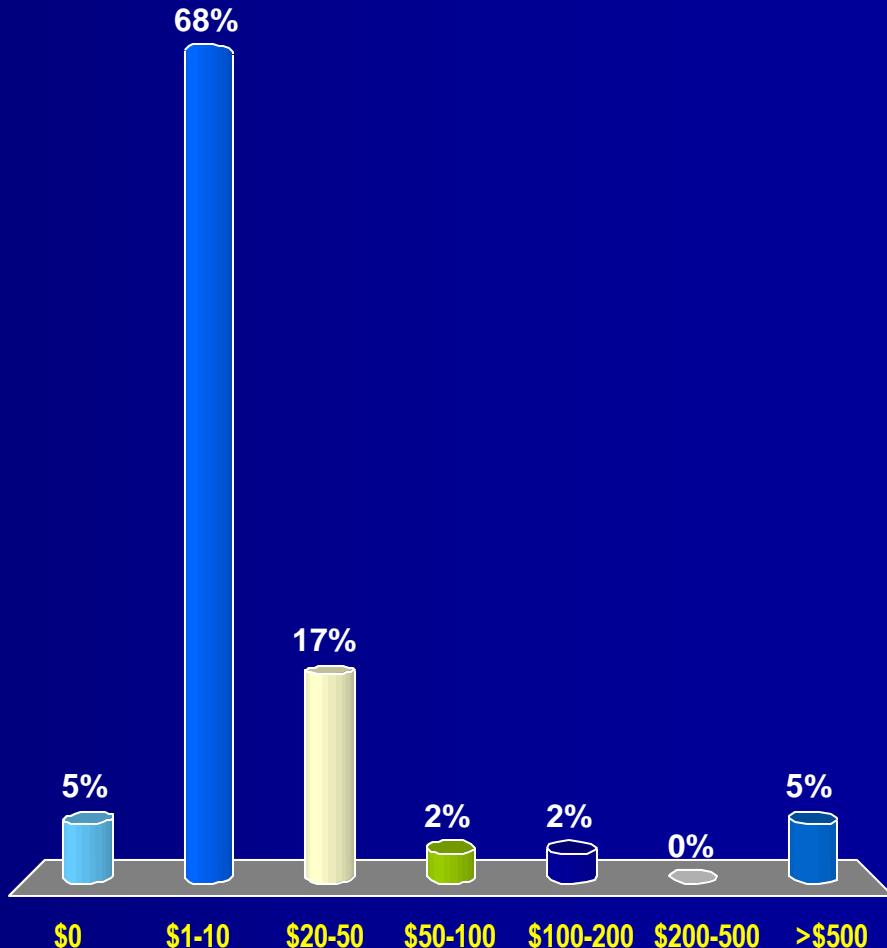
1. Yes
2. No





# How much would you pay for a DNA test that increases the accuracy of a yearling bull WW EPD from 0.05 (i.e. parent average) to 0.4?

1. \$0
2. \$1-10
3. \$20-50
4. \$50-100
5. \$ 100-200
6. \$200-500
7. >\$500





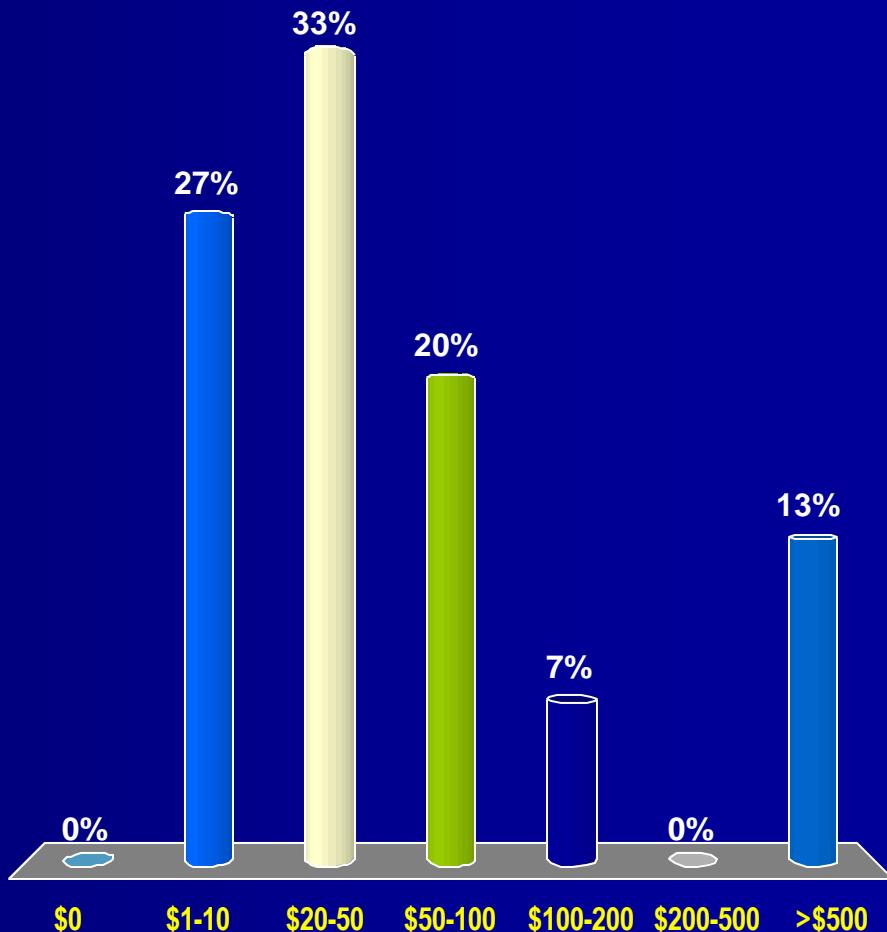
# That is equivalent to having 22 progeny records at birth

BIF accuracy	<u>Number of progeny records required</u>	
	Low heritability (0.1)	Moderate heritability (0.3)
.01	1	1
.02	2	1
.05	4	2
.08	8	3
.13	13	5
.20	22	7
.29	38	12
.40	70	22
.56	167	53
.93	1921	608
.99	3800	1225



# How much would you pay for a DNA test that increases the accuracy of a yearling bull WW EPD from 0.05 (i.e. parent average) to 0.4?

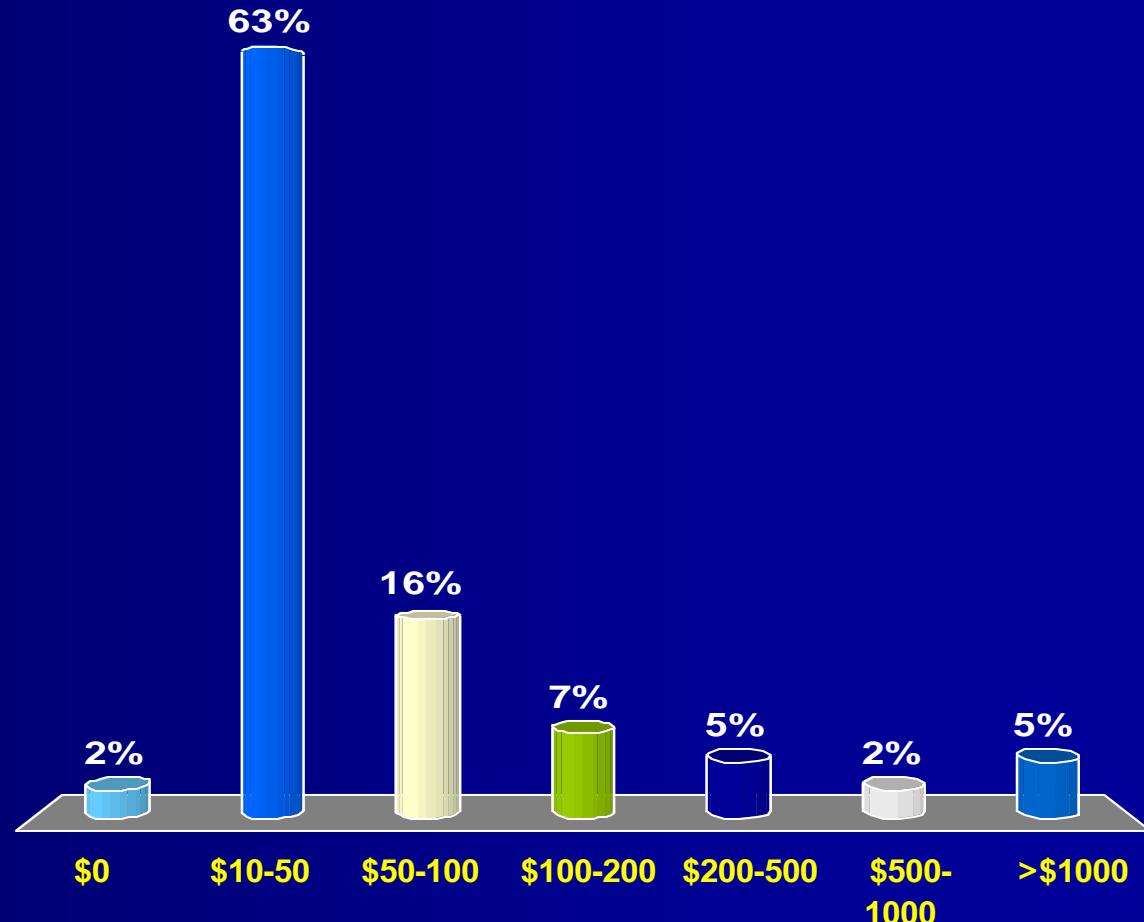
1. \$0
2. \$1-10
3. \$20-50
4. \$50-100
5. \$ 100-200
6. \$200-500
7. >\$500





# How much would you pay for a DNA test that increases the accuracy of a yearling bull WW EPD from 0.05 (i.e. parent average) to 0.9?

1. \$0
2. \$10-50
3. \$50-100
4. \$100-200
5. \$ 200-500
6. \$500-1000
7. >\$1000





# California to host BIF 2009!

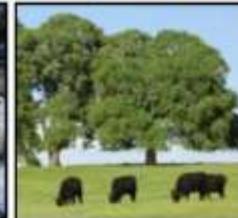
## Mark your calendars!

<http://www.calcattlemen.org/bif2009.html>

2009 Beef Improvement Federation Annual Research Symposium and Annual Meeting



Sacramento, California  
April 30 – May 3, 2009

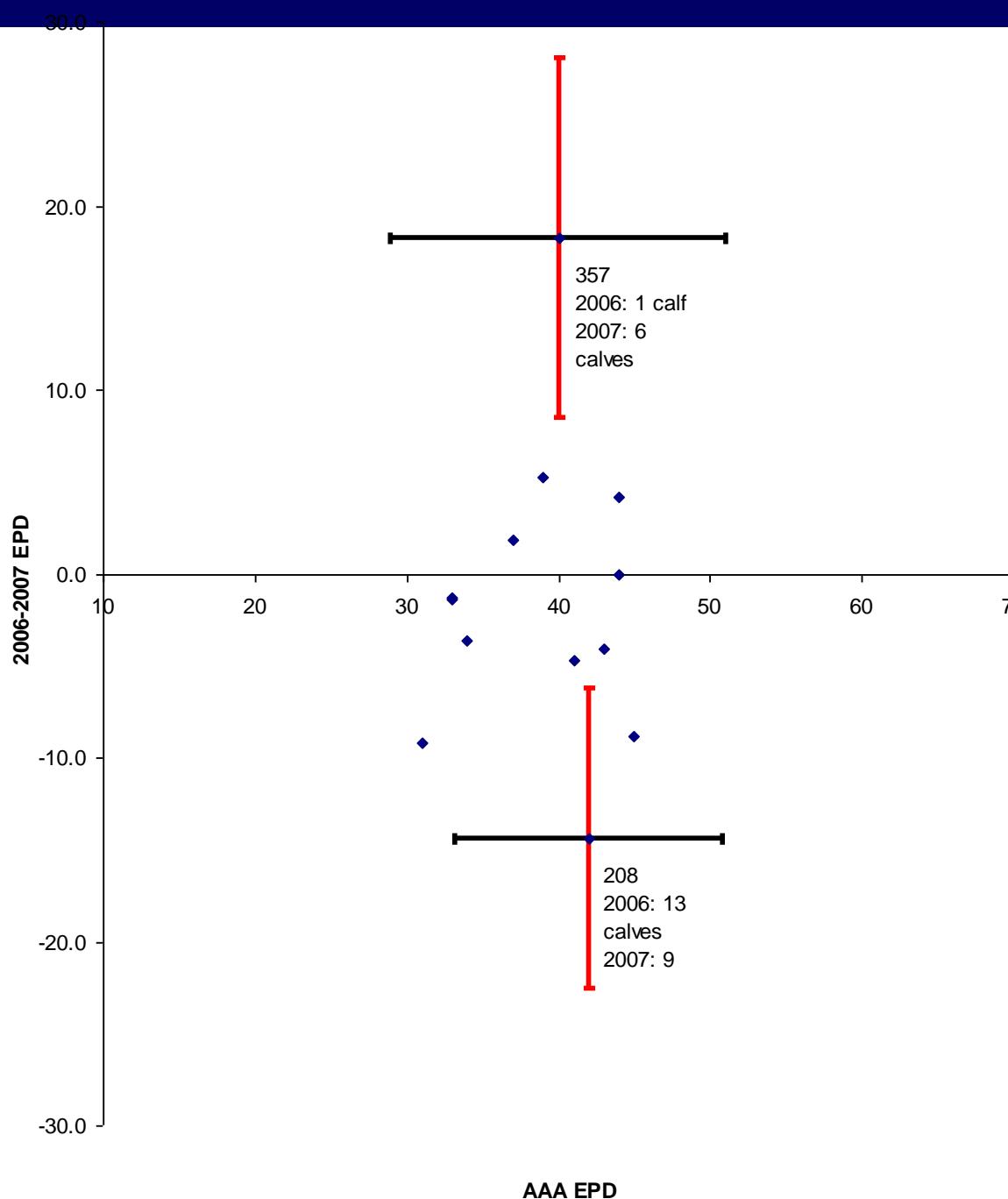


CALIFORNIA  
BEEF RUSH '09

Wednesday April 29<sup>th</sup>  
Thursday April 30<sup>th</sup>

Friday May 1<sup>st</sup>  
Saturday May 2<sup>nd</sup>  
Sunday May 3<sup>rd</sup>

Early Registration  
Registration and Evening Reception  
Eastern Tour "Foothill Bovines, Equines and Fine Wines"  
Convention, Family/Spouse Tour, Evening Dinner  
Convention and Evening on your Own in Sacramento  
Western Tour "Ocean Wines and Bovines"





Questions ?

