

# MULTIBREED ANIMAL EVALUATION AND ITS APPLICATION TO THE THAI ENVIRONMENT

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- Multibreed Populations
- Genetic and Environmental Effects
- Modeling Strategies
- Multibreed Model
- Covariance Estimation Procedure
- Results From Experimental Herds
- Implications for National Sire Evaluations

## Multibreed Population

Population composed of purebred  
and crossbred animals that  
interbreed

Complete

Incomplete



## Numbers of Sires



BGD	BGS					
	A	.75A	.50A	.25A	B	Br
A	16	7	9	10	15	16
.75A	13	9	9	9	17	13
.50A	16	11	9	11	18	15
.25A	11	6	7	7	12	10
B	13	11	9	11	20	16
Br	10	7	8	10	12	16



## Numbers of Dams



BGD	BGS					
	A	.75A	.50A	.25A	B	Br
A	69	24	22	28	40	40
.75A	13	20	23	22	24	29
.50A	50	36	38	47	54	50
.25A	21	16	23	16	25	24
B	45	40	36	43	107	44
Br	21	15	19	23	23	66



## Numbers of Calves



BGD	BGS					
	A	.75A	.50A	.25A	B	Br
A	117	25	22	28	40	40
.75A	29	21	25	24	27	32
.50A	62	41	46	57	65	66
.25A	24	20	24	19	32	28
B	53	44	39	49	195	50
Br	23	16	19	26	25	106



## Number of Sires



BGD	BGS		
	Sanmar	1/2S1/2B	Brahman
Sanmar	88	0	14
1/2S1/2B	14	10	18
3/4S1/4B	14	0	0
Brahman	41	1	22



## Number of Dams



BGD	BGS		
	Sanmar	1/2S1/2B	Brahman
Sanmar	410	0	80
1/2S1/2B	39	68	75
3/4S1/4B	29	0	0
Brahman	75	1	110

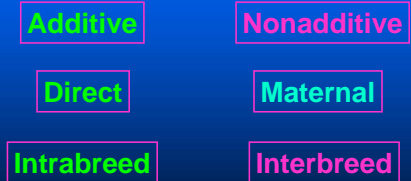


## Number of Calves

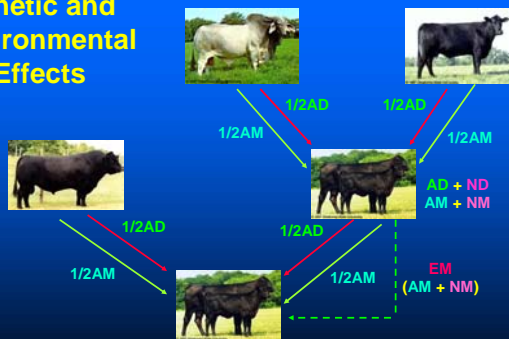


BGD	BGS		
	Sanmar	1/2S1/2B	Brahman
Sanmar	1309	0	147
1/2S1/2B	92	242	242
3/4S1/4B	88	0	0
Brahman	264	1	371

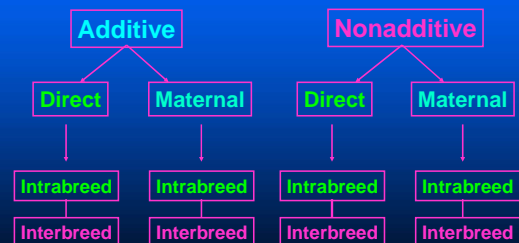
## Genetic and Environmental Effects



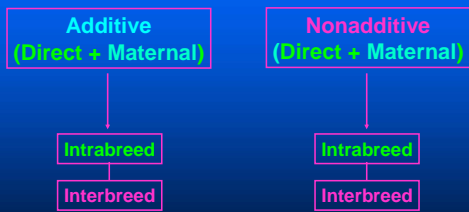
## Genetic and Environmental Effects



## Chart of Genetic Effects



## Chart of Environmental Effects



## Modeling Strategies Considered

All Subclass Effects

All Regression Effects

A Combination of Subclass and Regression Effects

## Actual Modeling Strategy

Effects	Prediction	Covariance Components
Additive	Subclass	Regression
Nonadditive	Regression	Regression
Environmental	Subclass	Regression

## Additive Regression Effects

Intra and interbreed allelic effects from all parental breeds

2 Breeds

Intrabreed (A)  
Intrabreed (B)  
Interbreed ( $m_A-m_B$ )

## Nonadditive Regression Effects

Intra and interbreed interaction effects between alleles of all parental breeds

2 Breeds

Intrabreed A/A  
Intrabreed B/B  
Interbreed A/B, B/A

## Multibreed Model

Record

Multibreed Contemporary Group  
Age Dam-Sex Calf-Dam Group

Sire Group and Mgs Group  
(A, N, D, M)

Sire and Mgs  
(A, N, D, M)

Residual

# Multibreed Contemporary Groups



= Sex  
≈ Age  
≈ Environment

# Multibreed Group 1



# Multibreed Group 2



# Multibreed Group 3



# Multibreed Group 4






# Multibreed Group 5



## Multibreed Group 6



## Connectedness

Contemp Group			
1	X		
2	X		X
3	X	X	X
4		X	X
5	X	X	X
6	X		X
7	X		

## Age of Dam

Age of Dam x Sex of Calf x Breed  
Group of Dam Subclass

Regression of Age of Dam (within Sex of Calf) on their fraction of Breed A

## Additive Genetic Groups

Group of Sire  
(Direct, Maternal)

Intrabreed A  
Intrabreed B  
Interbreed ( $m_A - m_B$ )

Subclass Groups (Accumulated)  
Regression Groups (Deviated from B)

## Nonadditive Genetic Groups

Group of Sire x Group of Dam  
(Direct, Maternal)

Interbreed A/B, B/A

Regression Groups  
(Deviated from A/A and B/B)

## Additive Genetic Deviations

Sire  
(Direct, Maternal)

Intrabreed A  
Intrabreed B  
Interbreed ( $m_A - m_B$ )

Multibreed Additive Genetic  
Covariances

## Nonadditive Genetic Deviations

Sire x Breed Group of Dam  
(Direct, Maternal)

Interbreed A/B, B/A

Interbreed Nonadditive Genetic  
Covariances

## Multibreed Genetic Predictions

MEPD	Direct (D)	Maternal (M)
Additive (A)	AD	AM
Nonadditive (N)	ND	NM
Total (T=A+N)	TD	TM

## Covariance Estimation Procedure

Multibreed REML GEM Algorithm  
(MREMLEM)

Sire-Mgs Model

Cholesky Elements of  
Base Cov Matrices

Base Cov Matrices

Multibreed Cov Matrices

Variance Ratios & Correlations

## Multibreed Herds

Angus-Brahman - U. Florida (1998)

Growth Traits (Preweaning)

Carcass Traits

Romosinuano-Brahman - Turipaná (1998)

Growth Traits (Pre & Postweaning)

Sanmartinero-Brahman - La Libertad (1999)

Growth Traits (Pre & Postweaning)

BON-Brahman - El Nus (2000)

Growth Traits (Pre & Postweaning)

## Traits

Birth Weight

Carcass Weight  
Longiss. Muscle Area

Weaning Weight

Fat over LMA  
KPH Fat

Postweaning Gain

Marbling  
W-B Shear Force

## Objectives

Estimation of Genetic Parameters

Prediction of Genetic Values

## Model

Record

Contemporary Group and Age of Dam

Sire Group and Mgs Group  
(A, N, D, M)

Sire and Mgs  
(A, N, D, M)

Residual

## Base Covariances (2 Breeds & 2 Traits)

Additive Genetic  
10 Intra Breed Angus {D,M}  
10 Intra Breed Brahman {D,M}  
10 Inter Breed AB {D,M}

Nonadditive Genetic  
10 Inter Breed AB {D,M}

Environmental  
3 Intra Breed Angus {D&M}  
3 Intra Breed Brahman {D&M}  
3 Inter Breed AB {D&M}

## Genetic Ratios

heritability  
=  
Additive Var/Phenotypic Var

interactibility  
=  
Nonadditive Var/Phenotypic Var

## Estimates of Genetic Ratios Growth Traits

	Heritab A	Heritab B	Interact A/B
BWD	.22	.23	.15
WWD	.25	.29	.18
BWM	.17	.18	.16
WWM	.18	.21	.20

## Estimates of Genetic Ratios Carcass Traits

	Heritab A	Heritab B	Interact A/B
CW	.46	.39	.27
LMA	.42	.53	.28
FAT	.14	.24	.02
KPH	.03	.14	.05
MB	.16	.16	.12
WBS	.58	.17	.07

## Straightbred and Crossbred Heritabilities

	BWD	BWM	WWD	WWM
A x A	.22	.17	.25	.05
B x B	.23	.18	.29	.09
A x B	.19	.15	.22	.07
.5A.5B x A	.16	.32	.18	.44

## Straightbred and Crossbred Heritabilities

	CW	RA	FR	KP	MB	SF
A x A	.46	.42	.14	.03	.16	.58
B x B	.39	.53	.24	.14	.16	.17
A x B	.30	.34	.18	.07	.13	.25
.5A.5B x A	.37	.33	.03	.02	.19	.43

## Correlation Estimates

$r_s(\text{BWD, WWD})$  .24 A and .22 B

$r_s(\text{WWD, WWM})$  -.28 A and -.22 B

$r_n(\text{BWD, WWD})$  .18 A/B

$r_n(\text{BWM, WWM})$  .12 A/B

$r_A(\text{CWD, LMAD})$  .45 A and .40 B

## Multibreed Predictions

Comparison of sires of any fraction of parental breeds

Graphs assumed sires to be mated to  $\frac{1}{2}$ A  $\frac{1}{2}$ B cows

## Multibreed Genetic Bases

Additive Genetic Base

=

Mean of Brahman Alleles from Purebred and Crossbred Animals

Nonadditive Genetic Base

=

Mean of A/A and B/B Intralocus Interactions from Purebred and Crossbred Animals

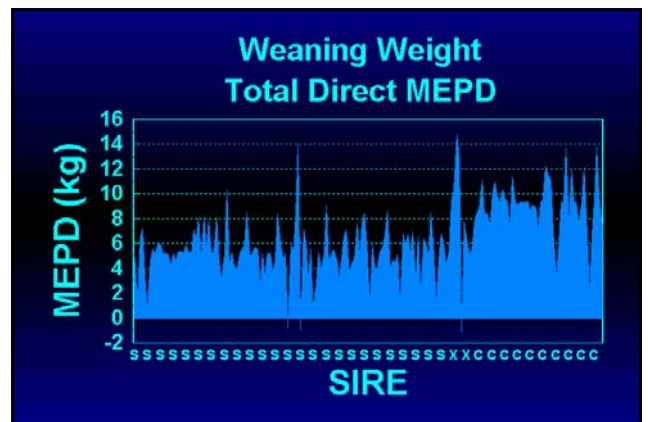
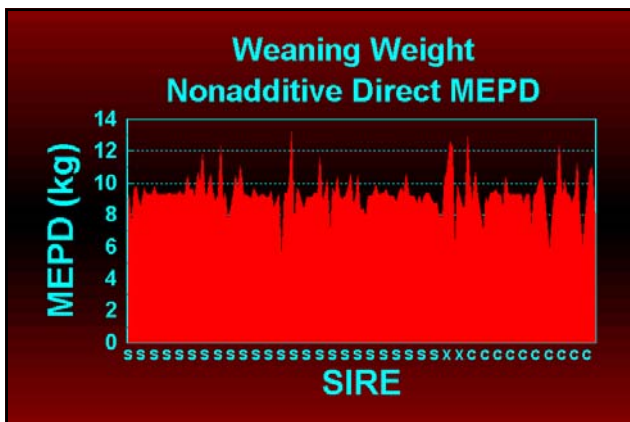
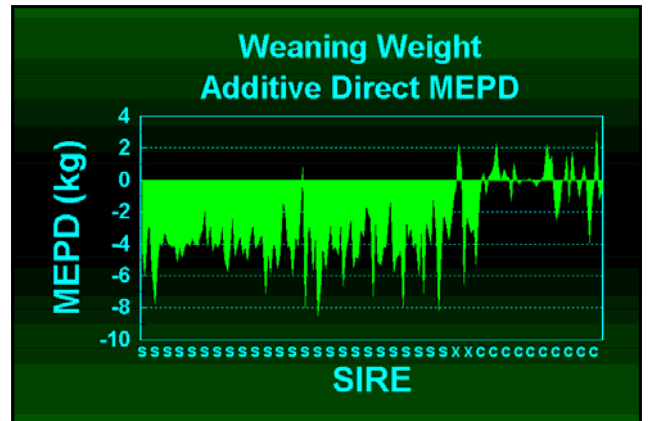
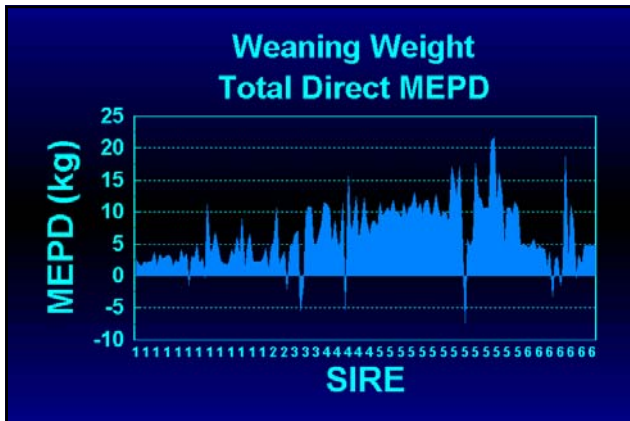
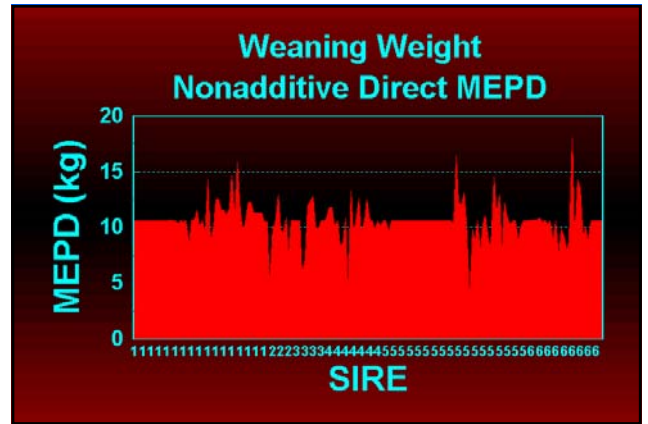
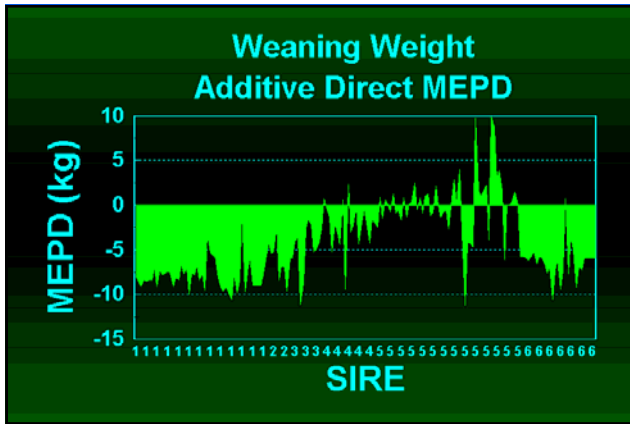
## MEPD Graphs - Growth Traits

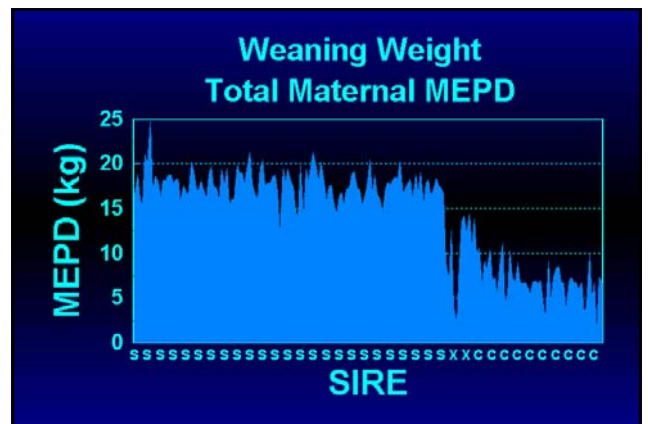
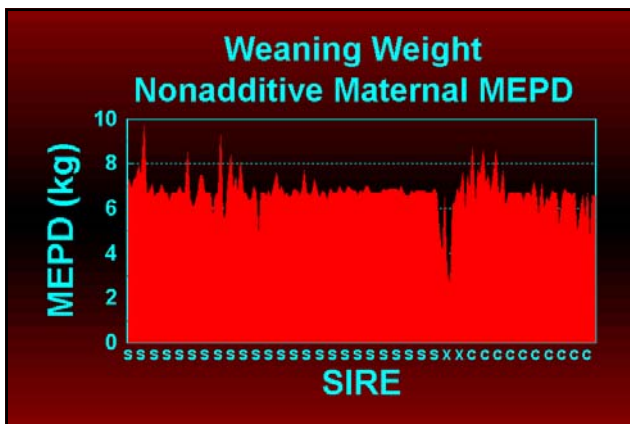
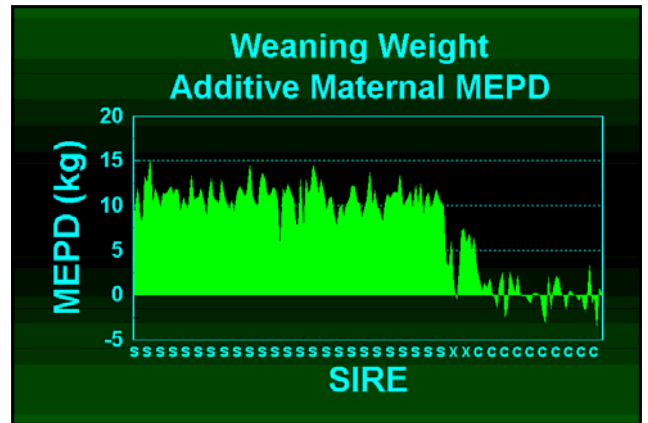
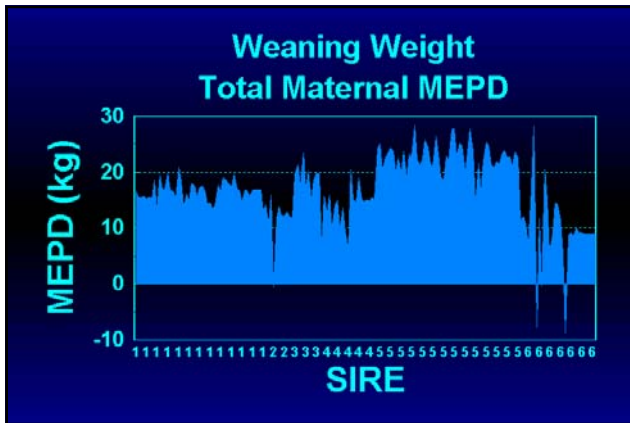
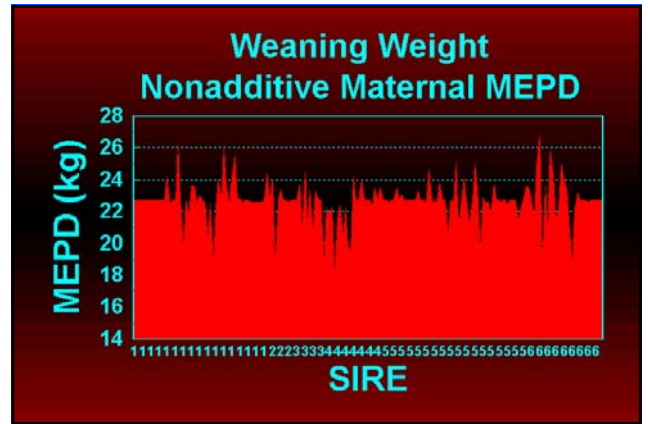
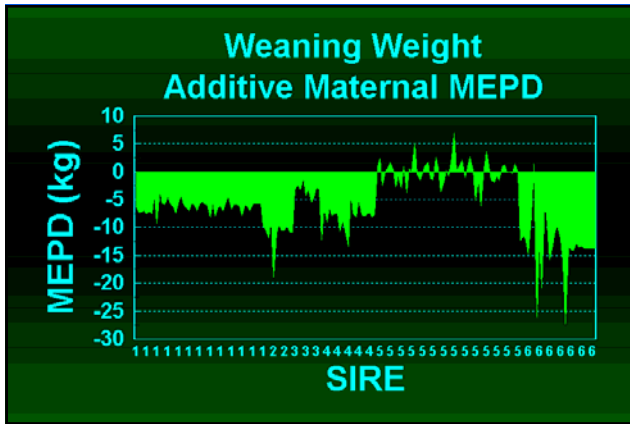


## MEPD Graphs - Carcass Traits

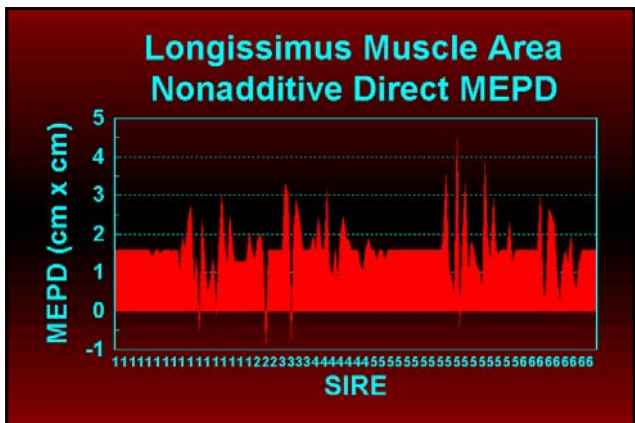
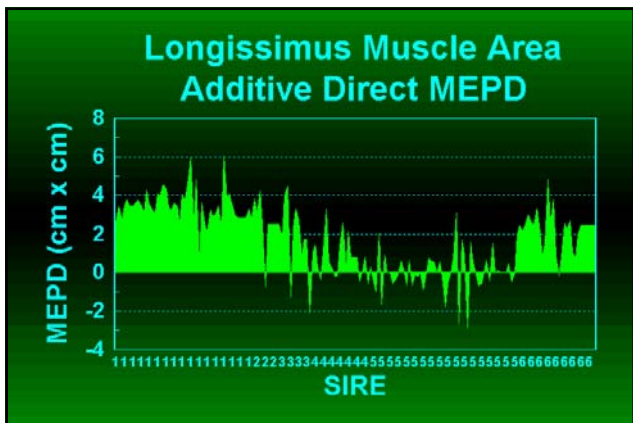
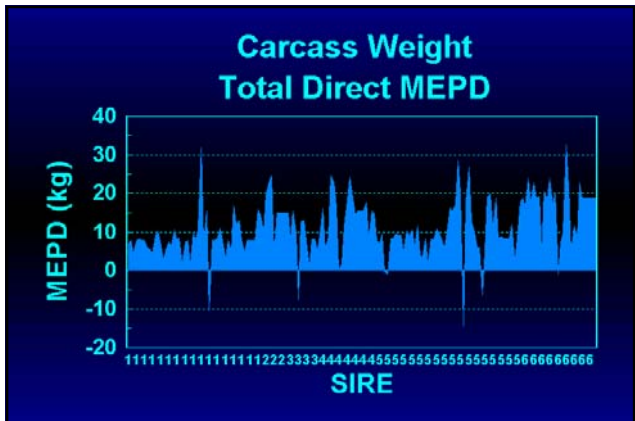
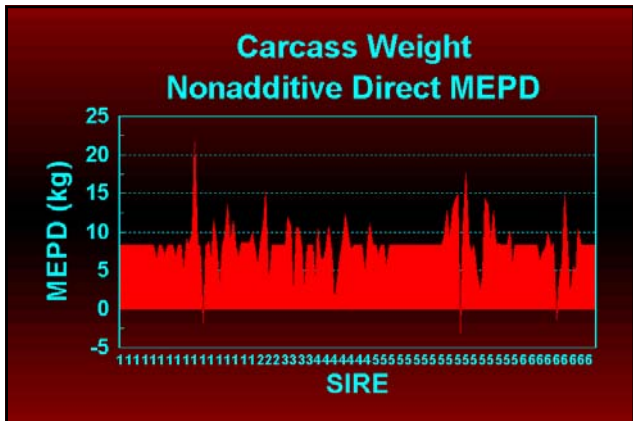
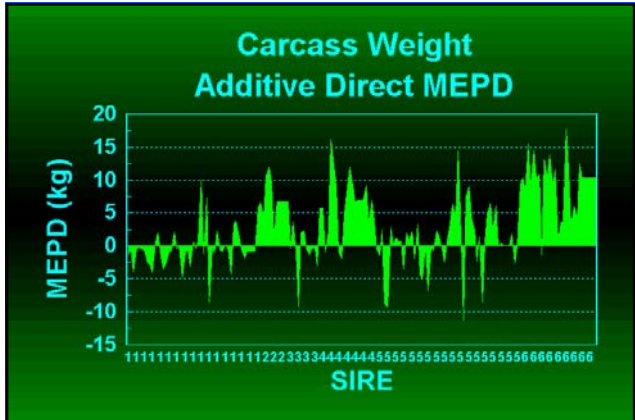


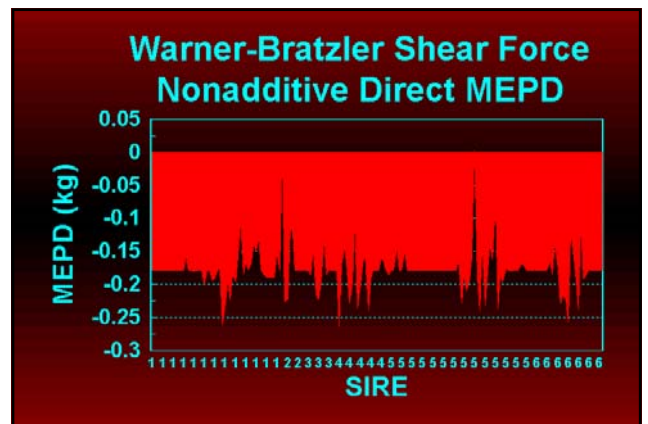
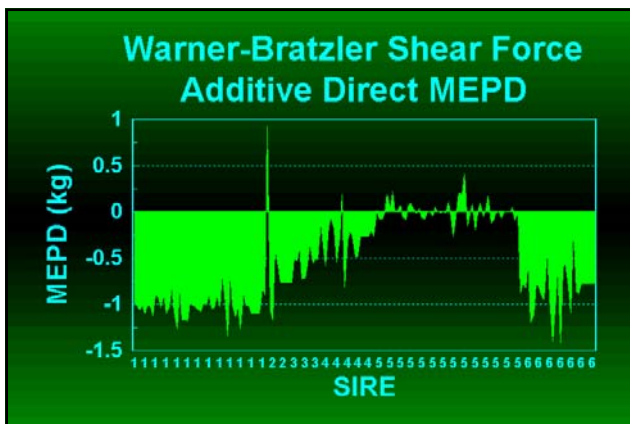
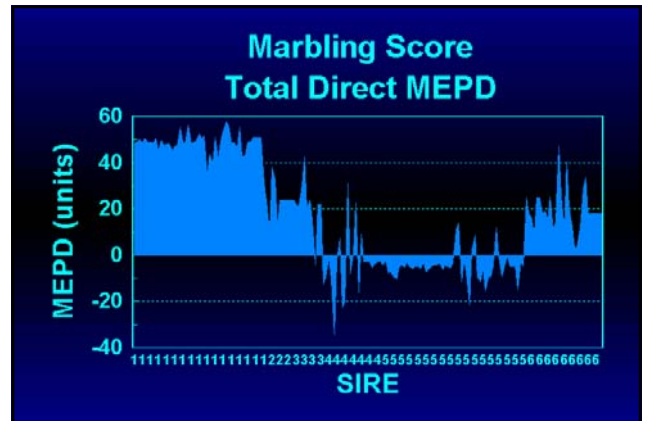
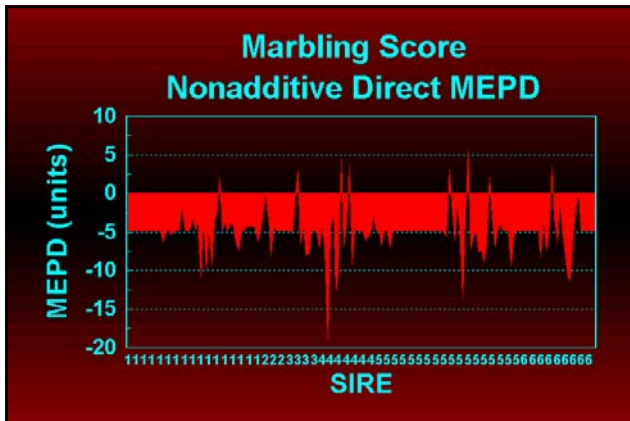
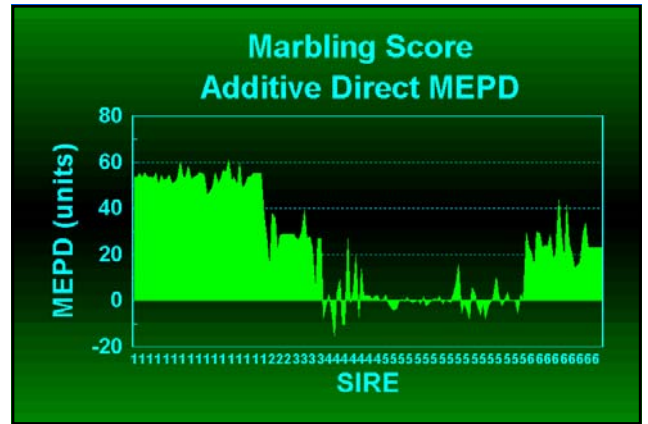
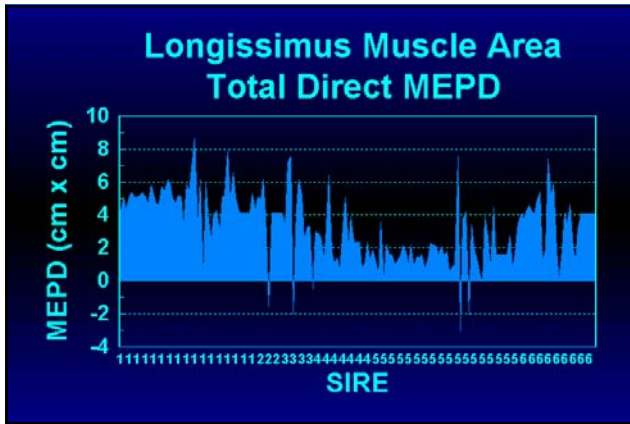






# MEPD Graphs - Carcass Traits





## Warner-Bratzler Shear Force Total Direct MEPD



## Correlation between MEPD Growth Traits

	(A, N)	(A, T)	(N, T)
<b>BWD</b>	.25	.98	.42
<b>WWD</b>	.20	.94	.53
<b>BWM</b>	.40	.96	.65
<b>WWM</b>	.32	.98	.52

## Correlation between MEPD Carcass Traits

	(A, N)	(A, T)	(N, T)
<b>CW</b>	.41	.93	.72
<b>RA</b>	.29	.94	.59
<b>FR</b>	.04	1.00	.06
<b>KP</b>	.16	1.00	.24
<b>MB</b>	.22	.99	.33
<b>SF</b>	.33	1.00	.39

## Implications - Variability

Additive and Nonadditive Genetic Effects were important sources of variation for growth related traits

Feasible to Select for Additive and Nonadditive MEPD in Bos Taurus-Brahman Multibreed Populations

## Implications - Predictions

No straightbred or crossbred sire group was completely superior to another group (Ranges Overlapped)

Conservative Selection Rule  
First select Sires for Additive MEPD, and then for Total MEPD

## Cattle Breed Groups in Thailand

### Beef

Charolais  
Simmental  
Limousin  
Brangus  
American Brahman  
Thai Brahman  
Thai Native  
Red Sindhi

### Dairy

Holstein  
Thai Brahman  
Thai Native  
Red Sindhi  
Friesian x Sahiwal F1  
(Austr, New Zealand)  
Indian Friswal  
Jamaica Hope

## Mating Strategies

Primarily Crossbreeding

Upgrading (e.g., to Holstein)  
Intermediate Crossbred Groups

Straightbred and Crossbred Sires

Straightbred and Crossbred Dams



## Dairy Matings



BGD	Breed Group Sire				
	H	.75H	.50H	.25H	T
H	x				
.75H	x	x			
.50H	x	x	x		
.25H	x	x	x	x	
T	x	x	x	x	x



## Beef Matings



BGD	Breed Group Sire				
	C	.75C	.50C	.25C	T
C	x				
.75C	x	x	x	x	x
.50C	x	x	x	x	x
.25C	x	x	x	x	x
T	x	x	x	x	x

## Multibreed Populations

A Single Multibreed Population  
All breeds and Crossbred Groups

Several Overlapping Multibreed Populations  
Charolais-Brahman  
Bos taurus-Bos indicus

Several Extended Breeds  
(Brahman Sires; Brahman and Brahman x  
Thai Native Dams)

## Multibreed Genetic Bases

Single Multibreed Population  
Single Base (Add, Nonadd)

Overlapping Multibreed Populations  
Single Reference Base (Add, Nonadd)  
Connected Reference Bases (Add, Nonadd)

Extended Breeds  
Weak Connections (Mgs, Mgd ?)

## Multibreed Genetic Evaluations

Single Multibreed Population  
Additive, Nonadditive, Total

Overlapping Multibreed Populations  
Additive, Nonadditive, Total

Extended Breeds  
Additive, Nonadditive, Total (Within Ex Br)

## Publication of MEPD

Paper Multibreed Sire Summaries  
Additive (Feasible)  
Nonadditive, Total (Unfeasible)

Electronic Multibreed Sire Summaries  
Additive, Nonadditive, Total

Better Alternative  
Mating Program Service

## Final Remarks

Definition of Multibreed Populations

Methodological Research and  
Development (Dairy, Beef)

Publication of Genetic Predictions

Additional Services

