Trends in Beef Cattle Performance Record Collection and Genetic Evaluation Systems in the United States

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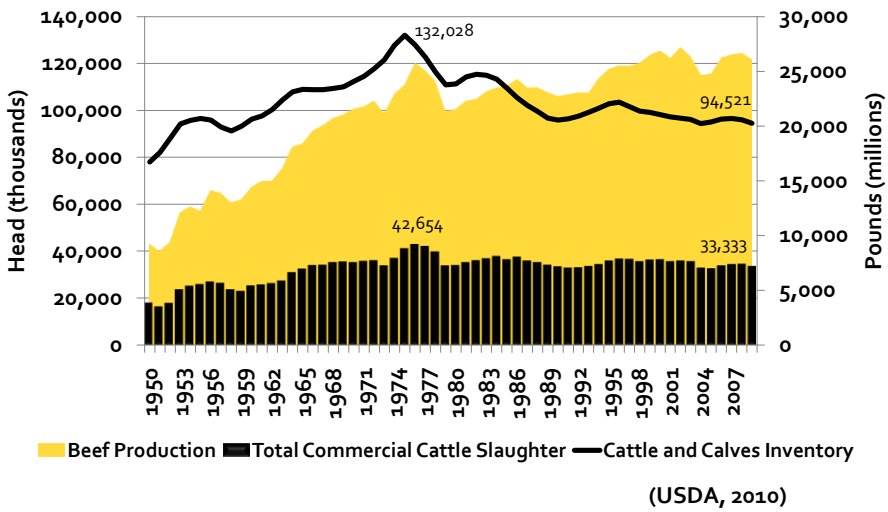
Overview

- US Beef Industry
  - Inventories
  - Production
  - Structure
- Trends
  - Genetic
  - Performance Recording
  - Breed Registrations
  - New trait development
  - New Technologies

US Beef Industry Overview

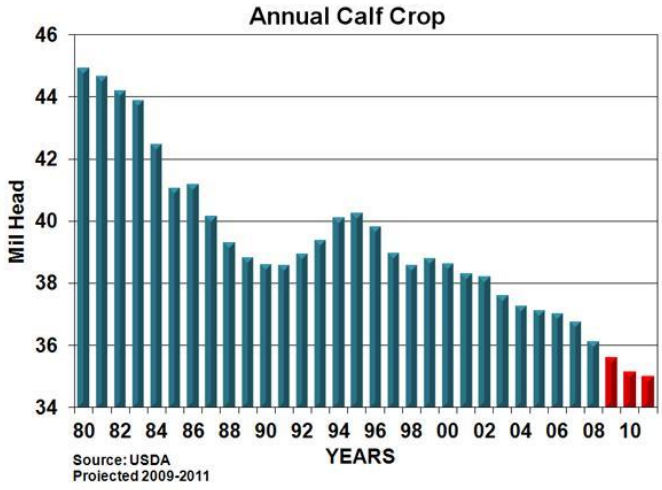
- US beef production is a big business
  - Largest segment in Ag sector of US economy
  - $61 billion in 2007 (USDA, 2007)
  - 32.8 million beef cows (USDA, 2007)
  - 765,000 beef farms/ranches (USDA, 2009a)

US Beef Cattle Inventories and Production

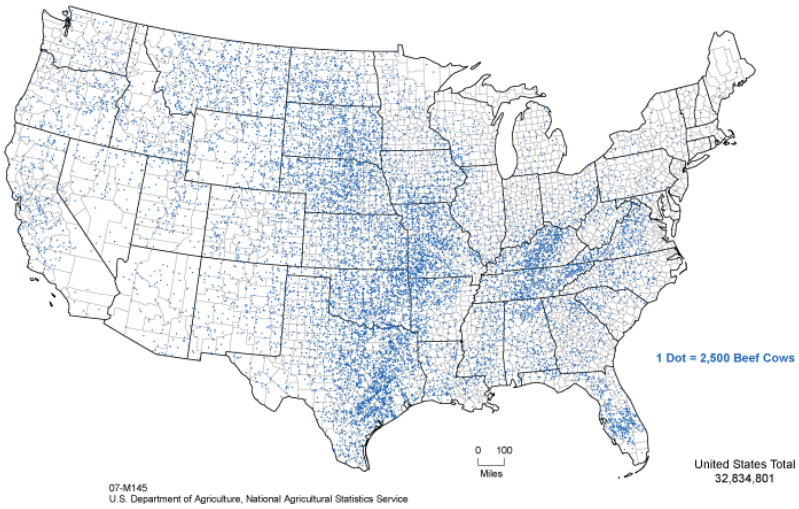


(USDA, 2010)

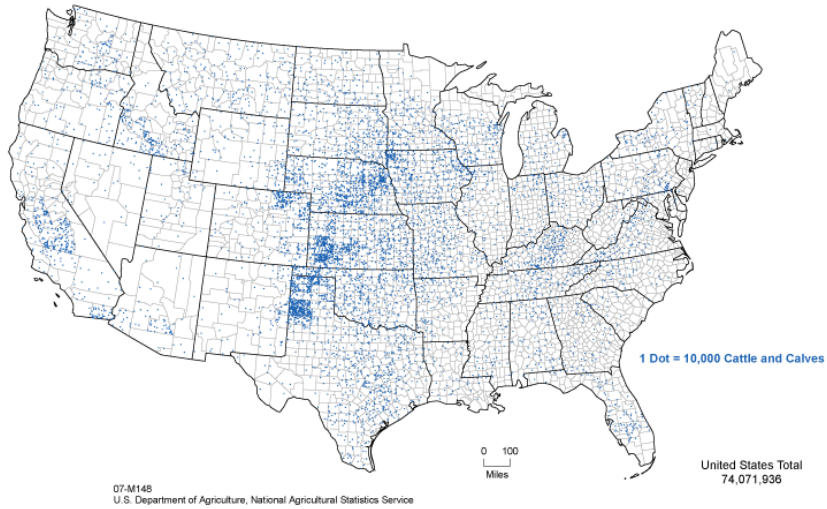
US Annual Calf Crop



US Beef Cow Inventory Dispersion

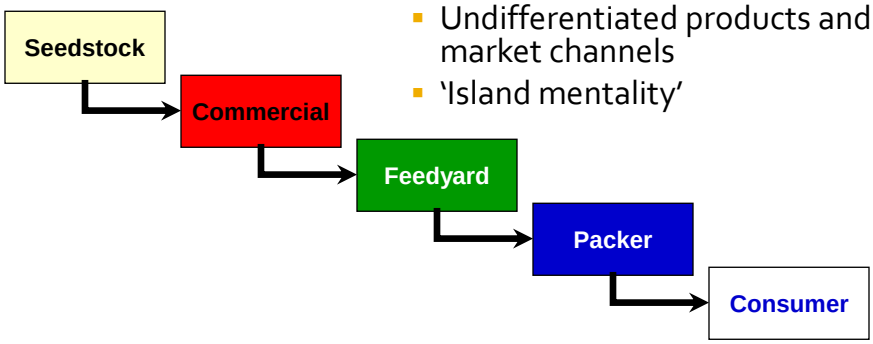


US Cattle and Calves Sold

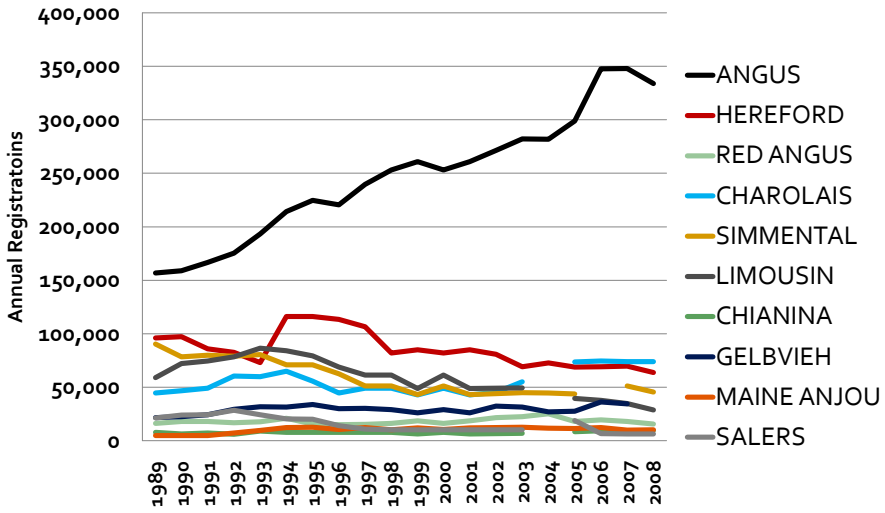


US Beef Industry Structure

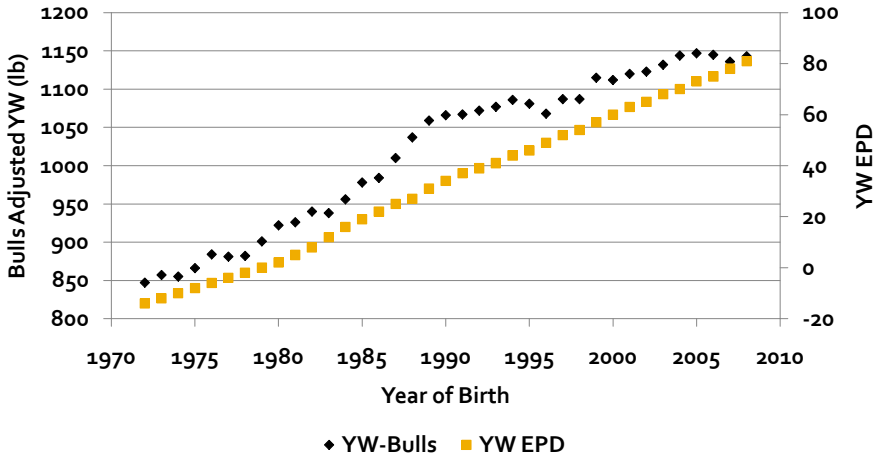
- Segmented business
  - Uncoordinated
    - Marketing
    - Breeding decisions/objectives
  - Undifferentiated products and market channels
  - 'Island mentality'



US Beef Breed Registrations

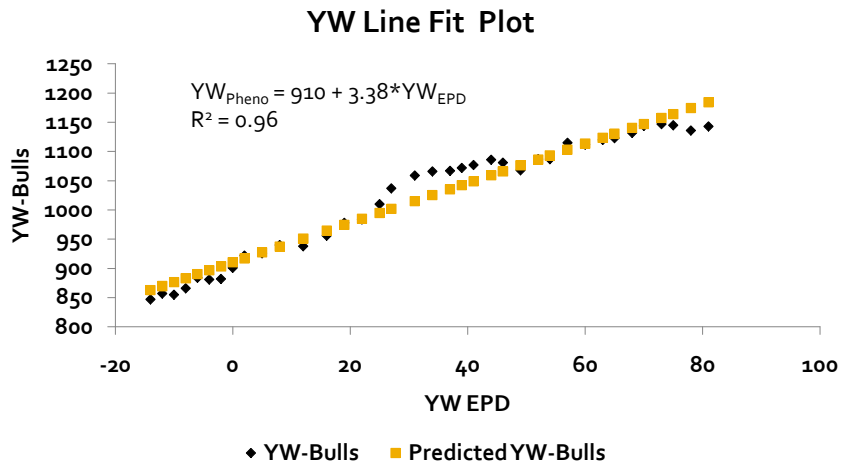


Yearling Weight Phenotypic and Genetic Trend



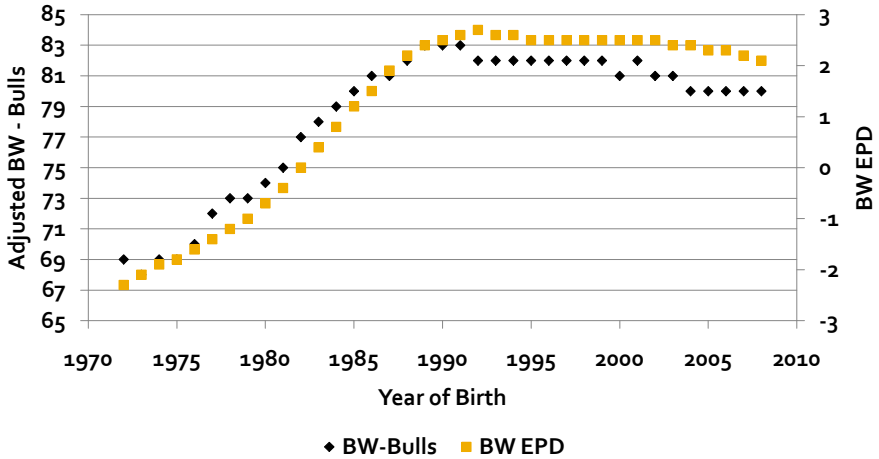
Data Source: 2009 Am. Angus Sire Evaluation Report; Phenotypic and Genetic Trends

EPDs Work—Selection for increased growth



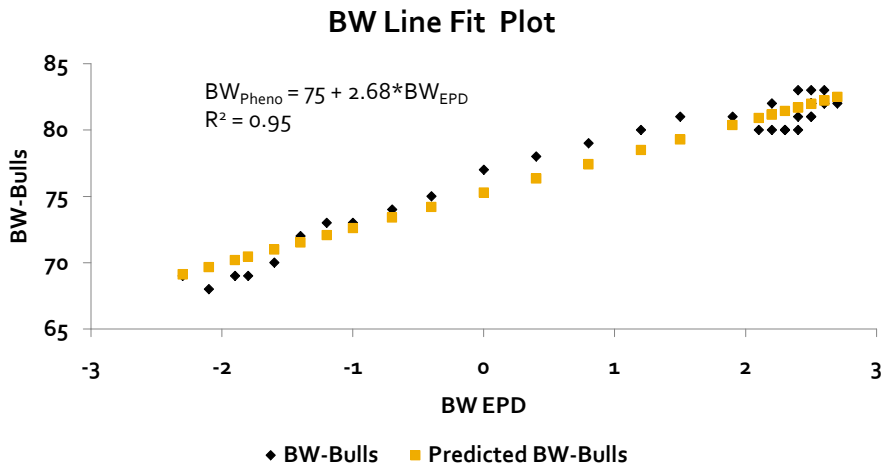
Data Source: 2009 Am. Angus Sire Evaluation Report; Phenotypic and Genetic Trends

Birth Weight Phenotypic and Genetic Trend



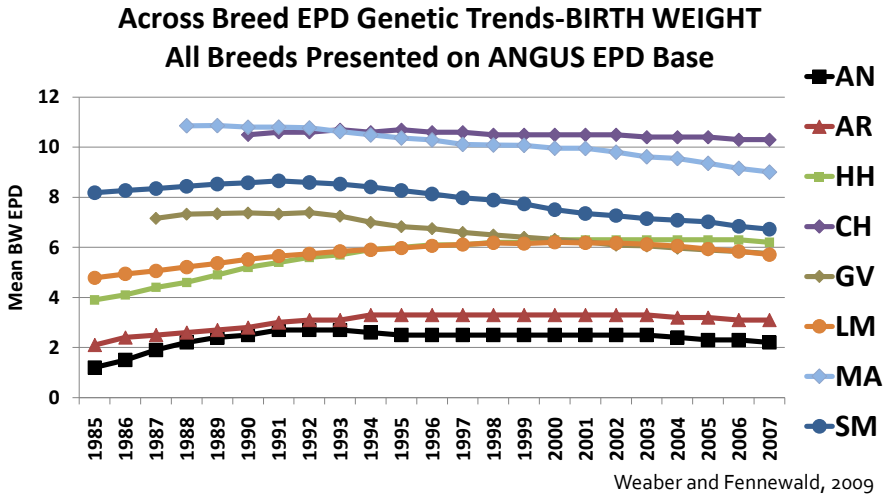
Data Source: 2009 Am. Angus Sire Evaluation Report; Phenotypic and Genetic Trends

EPDs Work—Selection for Birth Weight



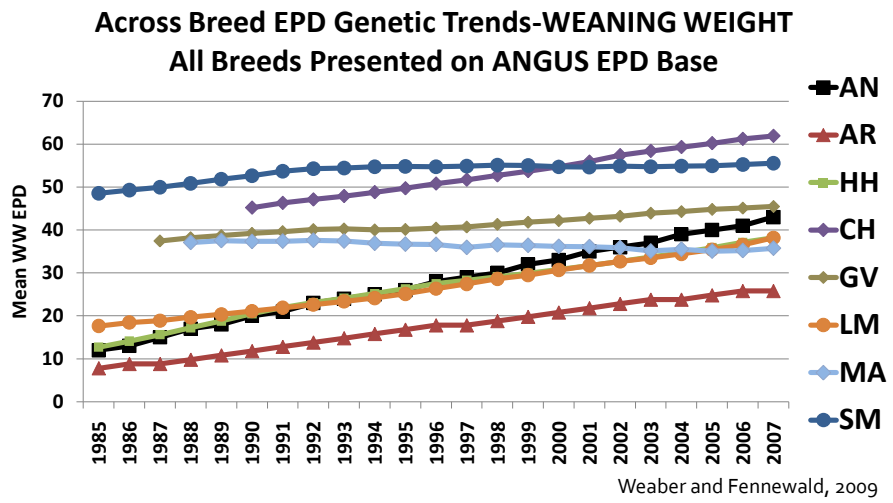
Data Source: 2009 Am. Angus Sire Evaluation Report; Phenotypic and Genetic Trends

BW EPD Genetic Trends



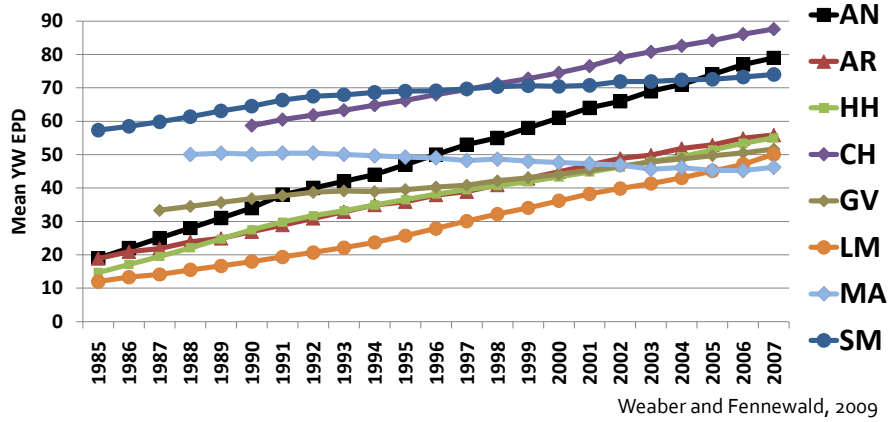
Weaber and Fennewald, 2009

WW EPD Genetic Trends



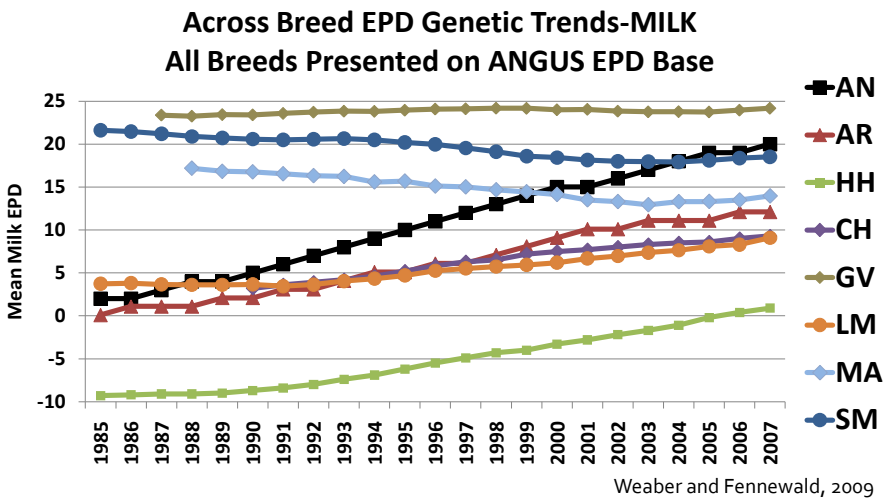
Weaber and Fennewald, 2009

YW EPD Genetic Trends



Weaber and Fennewald, 2009

MILK EPD Genetic Trends



Weaber and Fennewald, 2009

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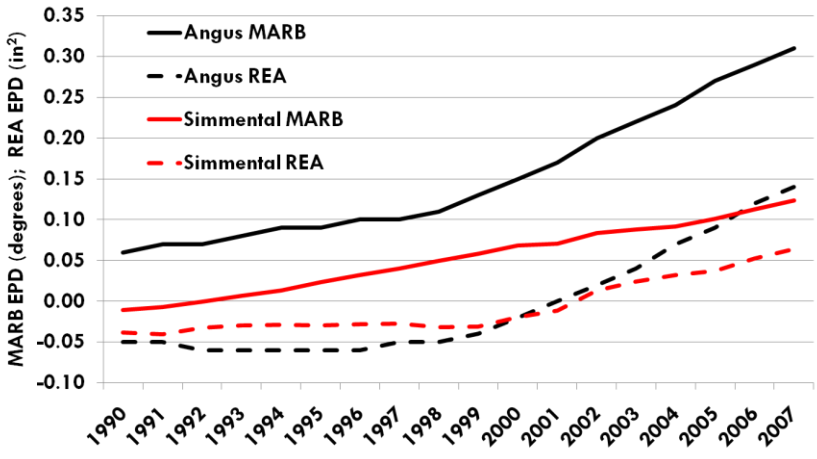
Genetic Trends for Marbling and Ribeye Area



(Am. Angus Association, 2009; Am. Simmental Association, 2009)

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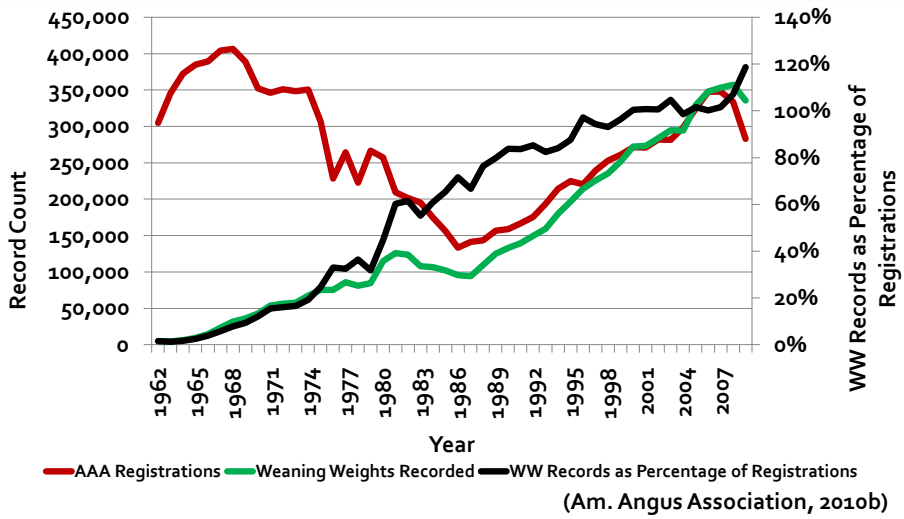
US Genetic Evaluations

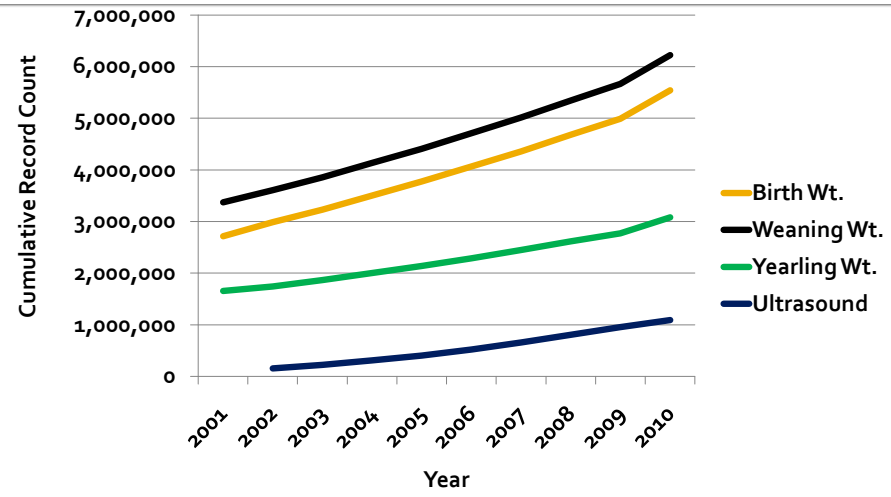
	Growth								Reproduction					Carcass							Ultrasound				Other		
Breed	Birth Weight	Weaning Weight	Milk	Yearling Weight	Total Maternal	Yearling Height	Mature Height	Mature Weight	Scrotal Circumference	Gestation Length	Calving Ease Direct	Calving Ease Maternal	Heifer Pregnancy	Carcass Weight	Ribeye Area	Fat Thickness	Marbling	Retail Product	Yield Grade	Tenderness	Percent Intramuscular Fat	Ribeye Area	Fat Thickness	Retail Product	Stayability	Maintenance Energy	Docility
Angus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X			X
Charolais	X	X	X	X	X				X		X	X		X	X	X	X										
Gelbvieh	X	X	X	X	X				X	X	X	X		X	X		X								X		
Hereford	X	X	X	X	X				X		X										X	X	X				
Limousin	X	X	X	X					X		X														X		X
Maine Anjou	X	X	X	X	X									X	X	X	X	X									
Red Angus	X	X	X	X	X						X	X	X		X	X	X								X	X	
Simmental	X	X	X	X	X		X	X			X	X	X	X	X	X	X		X	X					X		

Registration and Weaning Wt. Record Counts – Am. Angus Assn.



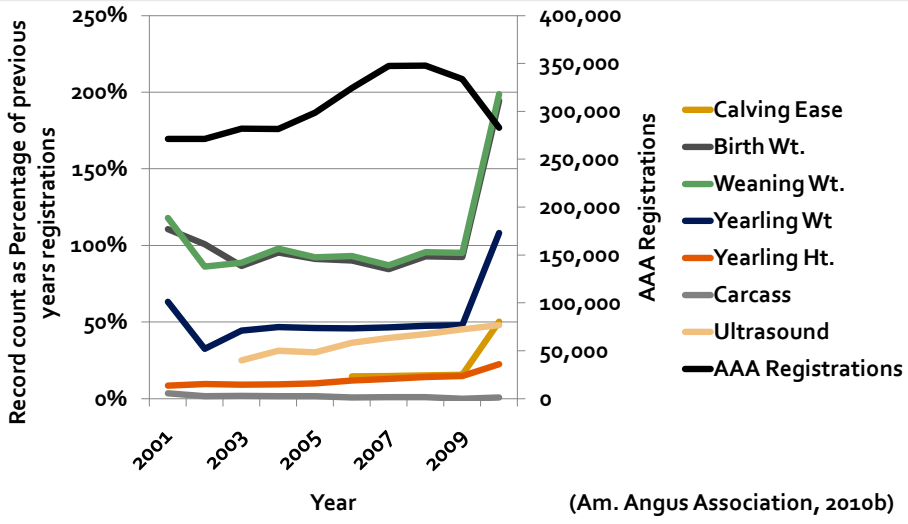
(Am. Angus Association, 2010b)

Trends in Performance Records – Am. Angus Assn.



(Am. Angus Association, 2010b)

Performance Record Counts as Percentage of Previous Years Registrations – Am. Angus Assn.



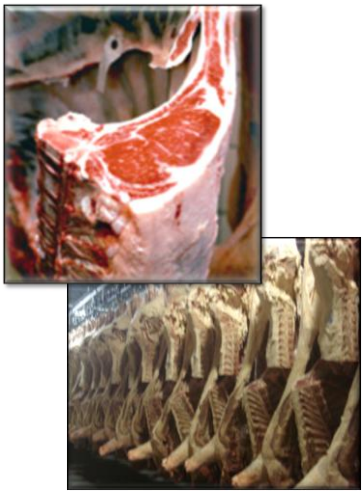
(Am. Angus Association, 2010b)

Evolution of Performance Record Systems

- Traditional – registration and performance systems separate ($ for each) – Pay as you go
- Cow or herd based systems
  - One fee for performance record processing, registration and transfer
  - Cow based system, per cow charge on entire inventory (AR, SM, GV)
  - Hybrid systems (decoupling of registration and performance record charges)
- Objectives – more performance record density and fertility/longevity data

Phenotype and Evaluation Development

- Calving Ease (Direct and Maternal)
  - DONE!
- Growth (BW, WW, YW, CW)
  - DONE!
- Carcass (Marbling, Yield, Fat Thickness, REA)
  - DONE!



Phenotype and Evaluation Development

- Maternal/Reproduction
  - Heifer Pregnancy
  - Stayability/LPL
    - SP(5|1)
    - S(5| 1,2,3,4)
- Temperament/Docility
  - Chute Scores
- Feed Intake/Efficiency
  - FCR, FE, RFI, FI

Why is multiple trait selection..

- Difficult?
  - Lots of EPDs
  - Some for Economically Relevant Trait (ERT) some for Indicator Traits
- Important?
  - More than one trait is important for enterprise, operation or industry profitability

The Role of Economically Relevant Traits

- A trait that has a direct cost or return associated with it is an Economically Relevant Trait (ERT).
- Traits that are correlated to ERTs are indicator traits.
- Example: Is Birth Weight or Calving East the ERT? Why??
- Weaning Weight or Yearling Weight?

Relative Economic Weights for Integrated Beef Firm

Reproduction:Growth:End Product

2:1:1

(Melton, 1995)

Angus Selection Indexes

- $W = Weaning Value ($ per head)
  - BW, WW, Milk, Mature Wt.
- $F = Feedlot Value ($ per head)
  - WW, YW and correlations
- $ QG = Quality Grade ($ per head)
- $ YG = Yield Grade ($ per head)
- $G = Grid Value ($ per head)
  - Grade and yield components
- $B = Beef Value ($ per head)
  - $F and $G adjusted for weight and costs
- $EN = Cow Energy (savings/cow/year)
  - Milk and Mature Wt. as they relate to maintenance energy requirements

New tools…rapidly changing

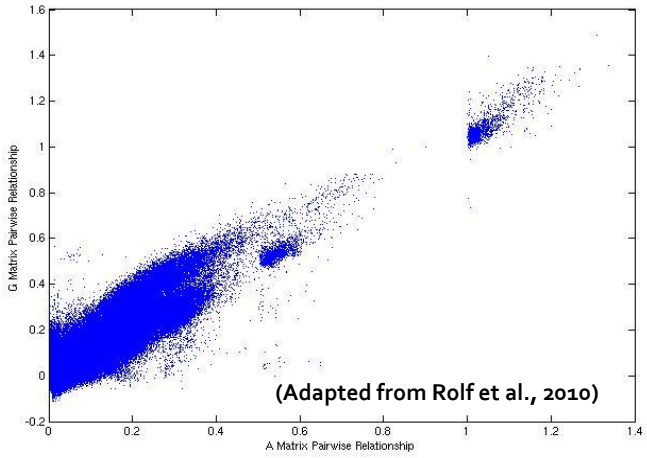
- New tools
  - Sequencing
  - SNP detection and characterization
  - High throughput genotyping platforms
    - 3K, 20K, 50K, 800K SNP per chips
- Bovine Genome Sequence
  - SNP identification
  - Additional SNP discovery to build BovineSNP50 chip

DNA Marker Testing

- Increased utility
  - Markers will describe a larger portion of additive genetic merit
    - Inclusion of many more marked QTL
  - Panels will be generated for a larger number of ERT and qualitative traits
  - Enhance selection response and elimination of deleterious genes
  - Incorporation of genomic data into genetic evaluation systems
- Rapid proliferation over next 12-18 months

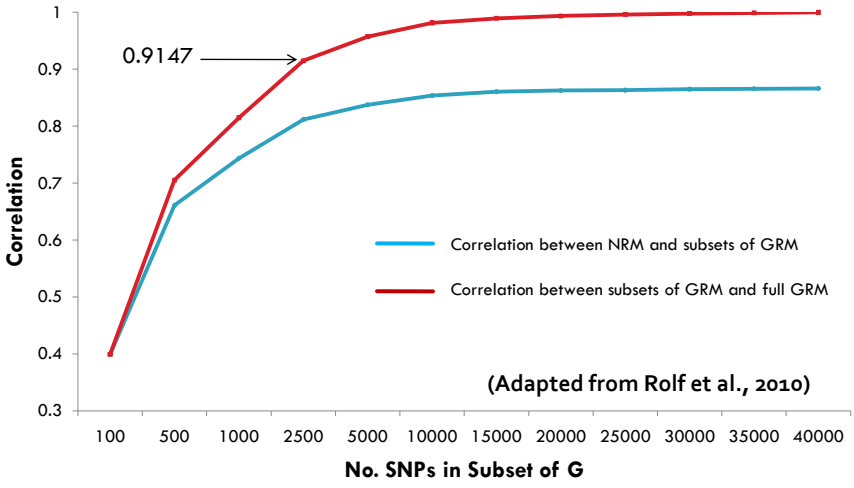
Traditional vs. Genomic Relationships

- n=1,707 animals



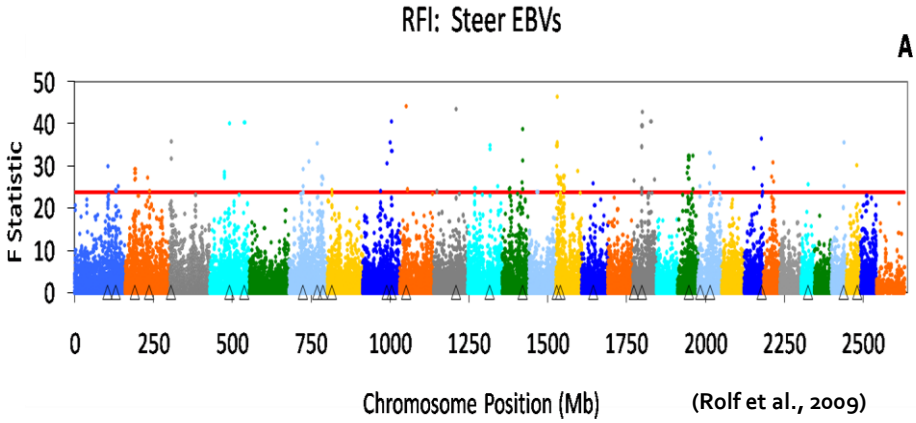
(Adapted from Rolf et al., 2010)

Bootstrap Correlations



SNP50 Whole Genome Scan for RFI QTL Discovery

$$h^2 = 0.20; \%\sigma_A^2 = 50; \%\sigma_P^2 = 10$$



Convergence

- Large marker panels or whole genome selection system
- Incorporate marker data into EPD calculation
  - Am. Simmental used WBSF markers in computation of EPD
  - Am. Angus Association debut of Genome Assisted Carcass EPDs
- Improves accuracy for young animals/selection candidates
- Reduces need to collect expensive phenotypes
- Eliminates discrepancies in MBV and EPD

MBV as additional correlated trait-MARB-IMF-MBV

	MARB	IMF	MBV
MARB	~0.45	~ 0.60	??
IMF		~0.35	??
MBV			~ 1.0

Heritability on diagonal, genetic correlations off diagonal

Beef Improvement Federation Commission on DNA Markers

"The BIF Commission believes that information from DNA test only has value in selection when incorporated with all other available forms of performance information for economically important traits in NCE, and when communicated in the form of an EPD with a corresponding BIF accuracy."

--Tess 2008

Challenges/Opportunities

- Development of ERTs
  - Phenotypic record collection is difficult and expensive
- Expansion of herd/cow based recording systems to capture fertility/longevity data
- Expansion of participation in performance system by seed stock and commercial producers
- Implementation of genomic selection tools
  - ERT/defect focused
  - Adequately sized resource populations for training/QTL discovery
  - Evaluation and delivery platforms to handle genotype/MBV data
  - Cost vs. response to selection

Thank You!

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