

Size, Efficiency, and Complementarity

Beef Improvement Federation
April 19, 2012

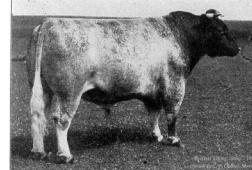
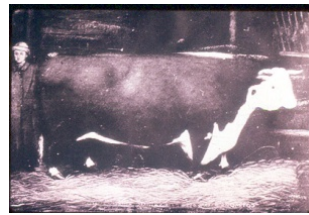
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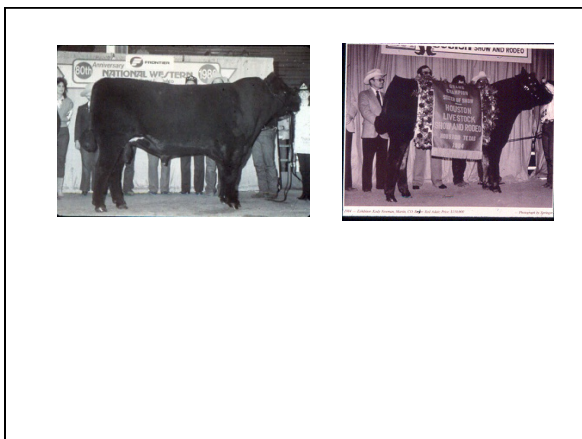
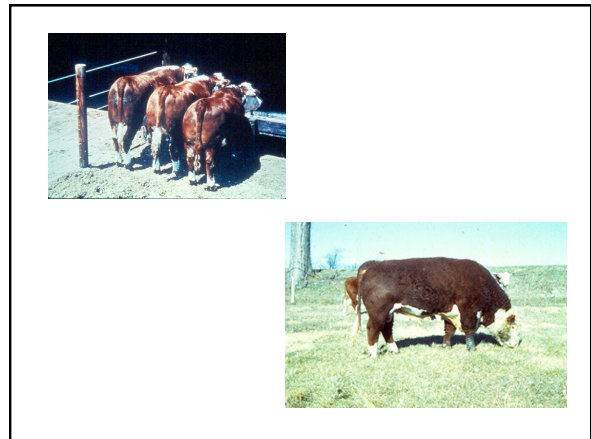
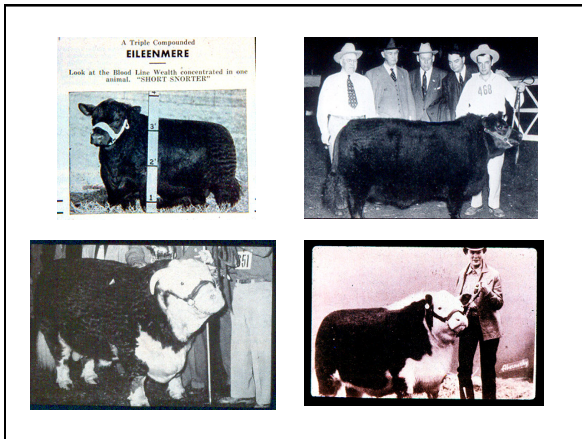
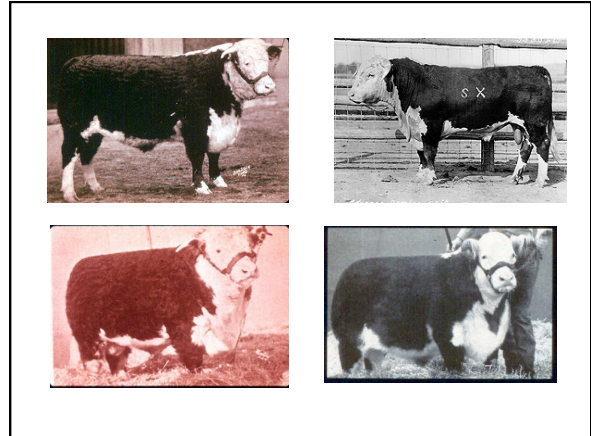
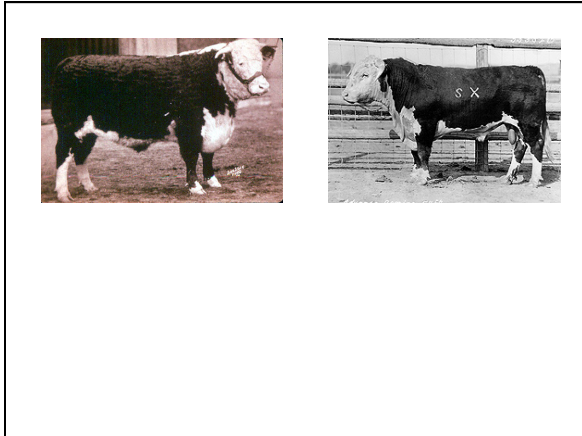
Emeritus

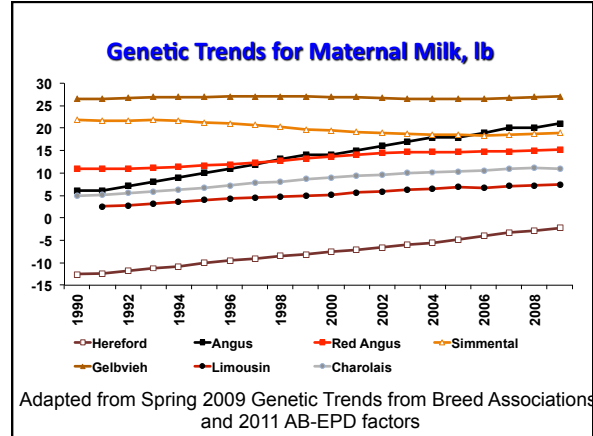
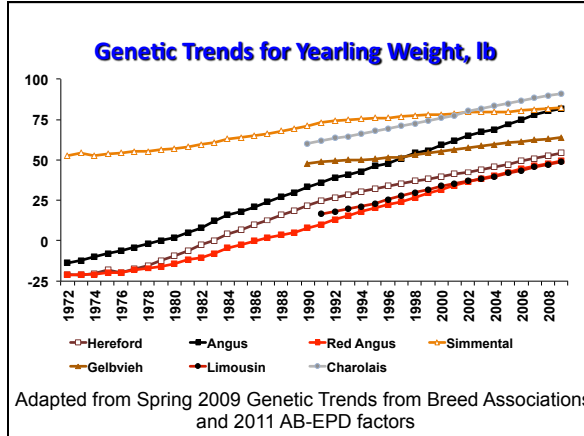
- One who retains a title, but is retired from long, active service on account of age or infirmity.
- Webster's Unabridged, 2nd Ed.

Size

- Visual
- **Body Measurements**
- Live Body Weight
- **Live Body Weight at defined composition**
- Empty Body Weight
- **Carcass Weight**
- Carcass Weight at defined composition







Angus Weight and Frame

	1972	1990s	2010
Yearling Weight	847	1066-1115	1142
Frame Score			

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	1972	1990s	2010
Yearling Weight	847	1066-1115	1142
Frame Score	2.5	5.8	5.5

- Symposia on Size and Efficiency**
- “Crossbreeding for Beef ” - May, 1970 JAS
 - “Beef Cattle Type for Maximum Efficiency” - May, 1972 JAS
 - “Size as a Component of Efficiency” - April, 1979 JAS
 - Beef Cow Efficiency Forum” - May, 1984 Michigan St. Univ and Colorado St. Univ.
 - “The Optimum Beef Cow” - 1995 BIF
 - “Measuring Beef Cattle Efficiency” - 2002 BIF

- “We cannot recommend selection based on preweaning and postweaning gain for all herds and all breeds without constraints. Surely, the beef cattle industry will not benefit by having all breeds tending toward the same size.”

- T. C. Cartwright, 1970 JAS

- “The genetic trends over the last 14 years for yearling weight in Angus and Hereford breeds may need to be slowed.”

-R. L. Willham, 1982 BIF

- “Long-term selection of breeds for a common criteria is not likely to make all breeds the same, at least not for a long period of time.”

- Larry Cundiff, 1983 BIF

Biological Efficiency, Growing

- Feed : Gain (feed conversion) or Gain : Feed
- Feed Consumed Adjusted for Gain
- Kleiber Ratio ($ADG / Wt^{3/4}$)
- Gain / 100 lb TDN
- Maintenance Efficiency
- Partial Efficiency of Growth
- Residual Feed Intake or Residual ADG

(NOTE: None consider cost of inputs or outputs)

- 1933 Minn. Tech Bul. “showed rather high correlation between ADG and efficiency of gain”. Proposed evaluation of efficiency based on ADG to one year of age.

– cited by Black and Knapp, 1938 JASAP

- “A total feeding period of 140 days or more would be required to determine efficiency of the animals on test.”

- Knapp et al, 1942 JAS

BIF Guidelines

- “Yearling weight at 365 days or long yearling weight at 452 or 550 days is an important trait because it has a high heritability and substantial genetic association with efficiency of gain and yield of trimmed, boneless retail beef.”
- 112 days for central tests; less for input to breed association genetic evaluations.
- Evaluated on age-constant basis.

- Rate of gain as an index of utilization of feed efficiency in steers is accurate only if:
 - 1) the size of the animals is equal and
 - 2) the gain in weight is representative of the gain in energy of body substance.

- Using rate of gain as a measure of efficiency would tend to bias upward the efficiency of larger animals.

- Kleiber, 1936 JASAP

- “Gross efficiency over constant-maturity (i. e., constant-composition) intervals is associated with intrinsic efficiency and is not expected to be related to differences in size.”

- Taylor and Young, 1966 J. Agr. Sci. cited by Smith et al, 1976 JAS

Importance of End Point

- Fed for the same length of time or to same weight, larger types tend to gain faster, more efficiently, and are leaner.
- When cattle of differing size are fed to the same compositional end point, differences tend to diminish in rate of gain and leanness and often disappear in feed efficiency.

- “Traits affecting efficiency in growing animals, particularly in the feedlot, differ considerably from those desired in the cow herd.”

- Notter, D. R., 2002 BIF

- “An understanding of biological relationships between growing animals and mature animals pertaining to feed efficiency has yet to be established”.

- Kent Gray, BIF 2010

Biological Efficiency, Cow/Calf

- Weaning Wt
- Weaning Wt / Cow Wt (or Cow Wt ^{3/4})
- Weaning Wt / Cow Exposed to Breeding
- Weaning Wt / Cow Exposed / Cow Wt
- Weaning Wt / energy intake (cow + calf)
- Residual Feed Intake

NOTE: None consider cost of inputs or outputs

- It would seem that if there were a size that is most efficient, we would have arrived at it by trial and error by this time. But we still do not know how big beef cattle should be.”

- “I believe there will be a place and a need for cattle which vary in size and rate of maturity and that no one size will have all advantages under all conditions.”

- E. W. Klosterman, 1972 JAS

- A casual inventory of the kinds and types of feed and other resources available for beef production can only lead to the conclusion that different performance levels for many economic traits may be indicated to most effectively utilize the resources available in different geographical areas and production situations.”

- K. E. Gregory, JAS 1972

- “A wide of range of size classes was potentially optimal depending on the prevailing economic conditions.”

- D. R. Notter, et al., 1979 JAS

- “Optimal values for both size and milk production may vary as production costs and relative prices of cattle change. There appears to be opportunity, largely untapped, for increasing efficiency by more closely matching cattle to production conditions.”

- T. C. Cartwright, 1979 JAS

- “At lower feed availability, breeds moderate in growth and milk were more efficient because of higher conception rate. At higher feed availability, breeds higher in growth and milk were most efficient because feed was enough for genetic potentials to be expressed.
- An efficient cow for one producer may be ineffective under different management.”

- Jenkins and Ferrell, 2002 BIF

The Efficient Cow

- “Efficient cows are those that produce calves regularly and easily.
- Most of the other biological characteristics of the cow herd are negotiable, depending on markets and production environments.”

- D. R. Notter, BIF, 2002

Matching Genetics to Conditions

Forage Availability	Environmental Stress	Milking Ability	Mature Size	Ability to Store Energy	Stress Tolerance	Calving Ease	Lean to Fat ratio
High	Low	M to H	M to H	L to M	M	M to H	H
	High	M	L to H	L to H	H	H	M to H
Med	Low	M to H	M	M to H	M	M to H	M to H
	High	L to M	M	H	H	H	M
Low	Low	L to M	L to M	H	M	M to H	M
	High	L	L	H	H	H	L to M
Maternal		M to H	L to H	M to H	M to H	H	L to M
Paternal		L to M	H	L	M to H	M	H

- “The efficiency of production of individual slaughter cattle measured as an output / input function of the individual may rank quite differently measured as an output / input function of the herd.”

- T. C. Cartwright, 1969 JAS

- “We must now place less selection emphasis on individuality per se and more on herd output / input.”

- T. C. Cartwright, 1970 JAS

- “The primary goal of beef improvement should be increased profitability. This goal is obtainable by increasing productivity and reducing costs at the herd level, rather than individual level.

- H. A. Fitzhugh, 1985 BIF

Cow Efficiency

- Individual cow or entire system?
- Cow-calf producers operate on a fixed resource.
- Larger (and heavier-milking) cows can potentially wean heavier calves.
- Fewer large (and/or heavy-milking) cows can be maintained on the same resource.
- Cow-calf producers should think of performance and efficiency not per cow but per operation.

Complementarity

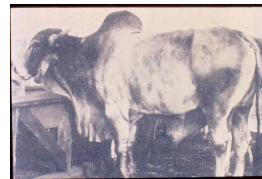
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BIF Guidelines, 9th Ed., 2010

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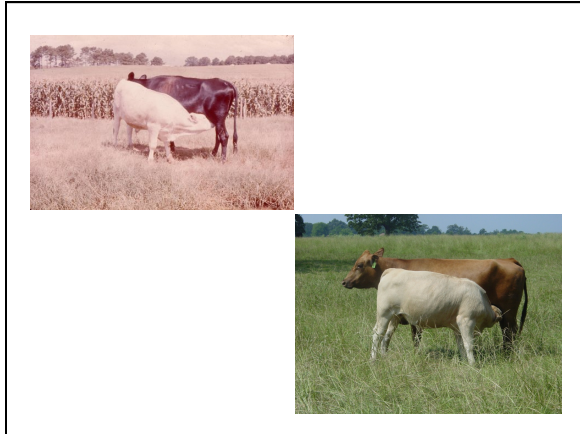
Complementarity

- “The advantage resulting from the **manner** in which two characters combine or complement each other.”

- 1969 Texas A&M Beef Cattle Short Course

- “The degree to which two or more breeds match so that the strengths of one breed **cover** the weaknesses of the other.”

- T. C. Cartwright, 1970 JAS



Complementarity of Size

- Breeding relatively small dams to relatively large sires can increase efficiency, even without crossbreeding.
- If heifers are retained, “cow-size creep” occurs and advantage is gradually lost.
- Maximum benefit from complementarity requires a terminal breeding system.

- Specialized dam and sire lines and/or breeds will be developed. Emphasis will shift from general purpose to special purpose cattle.”

- T. C. Cartwright, 1970 JAS

- “The development of separate and distinct cow and sire lines would require some form of integration within the industry”.

- E. W. Klosterman, 1972 JAS

Thallman Overview

- Beef breeds have become far too similar.
- Breed convergence dilutes the impact of breed complementarity.
- Most breeds need to decide whether they are a maternal or terminal breed.
- Need for some producers to specialize in producing young cows with maternal genetics.

- M. Thallman, 2012 NCBA

Thallman Overview

- Difficult to establish a market for maternal females until a group of dedicated terminal producers develops.
- Difficult to convince all-purpose producers to terminal cross until a reliable supply of maternal line cows develops.
- An economically feasible sexed semen technology could make terminal crossbreeding much more practical.

Summary

- There is no inherent advantage in efficiency from increasing size of cattle.
- All breeds of cattle are becoming larger and more similar in size.
- Maximum complementarity requires a terminal breeding system.

Summary

- Since cattle are more similar today and maximum exploitation of complementarity requires a terminal breeding system, complementarity due to size will probably not be implemented at high levels.
- However, opportunity remains high for complementarity from differences in type.



Final Thoughts

- The cow-calf segment requires about 2/3 of the total nutrients from conception to product.
- Economics dictates these nutrients must come mostly from relatively low-cost forages.
- The U. S. beef industry will not be sustainable at current levels if this is ignored.
- Market preferences are important.
- But size of cattle will ultimately depend on what is feasible in the nation's cow herds.