

# Terminal Crossbreeding: A Missed Opportunity for the Beef Industry

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# Main Take-Home Message

- If the genetic potential for growth is the same in commercial cows as it is in the bulls they are bred to, some profit potential is probably left on the table.

# Overview

- Terminal crossbreeding systems
- Practicality of raising replacement heifers in one-bull herds
- Need for producers to specialize in producing young bred cows with maternal genetics
  - How to make such a system sustainable and profitable
  - Genetic characteristics of such a population
- Obstacles to implementation
- Advantages to the entire beef industry
- Breeding Maternal Cattle

# Terminal Crossbreeding Systems

- Breeding cows strong in maternal traits to bulls that are strong for terminal traits
- Was used extensively in the 1970s when exotic continental European breed bulls were commonly bred to British breed cows
  - Calving difficulty can be a challenge
  - Producing a sufficient number of replacements can be a challenge

# The Traditional Replacement Rate Challenge

- Almost all cows in system are maternal
- About half of cows in the system need to be bred to maternal bulls to produce enough replacements to maintain a population of maternal cows
- This means only about half of steers and 2/3 of fed cattle are sired by terminal bulls
  - The remainder are straight maternal steers of substantially less value

# Terminal Sire Breeding Goals

- Early growth rate
- Calving ease as trait of the calf
- Feed efficiency
- Meat quality
- Carcass composition
- Disease resistance
- Calf survival and vigor
- Male fertility

# Maternal Breeding Goals

- Female fertility
- Maternal calving ease
- Low maintenance requirements (small size)
- Longevity
- Milk production (but is more better?)
- Disease resistance
- Temperament
- Maternal instinct
- Adapted to the production environment

# Fundamental Principles of Animal Breeding

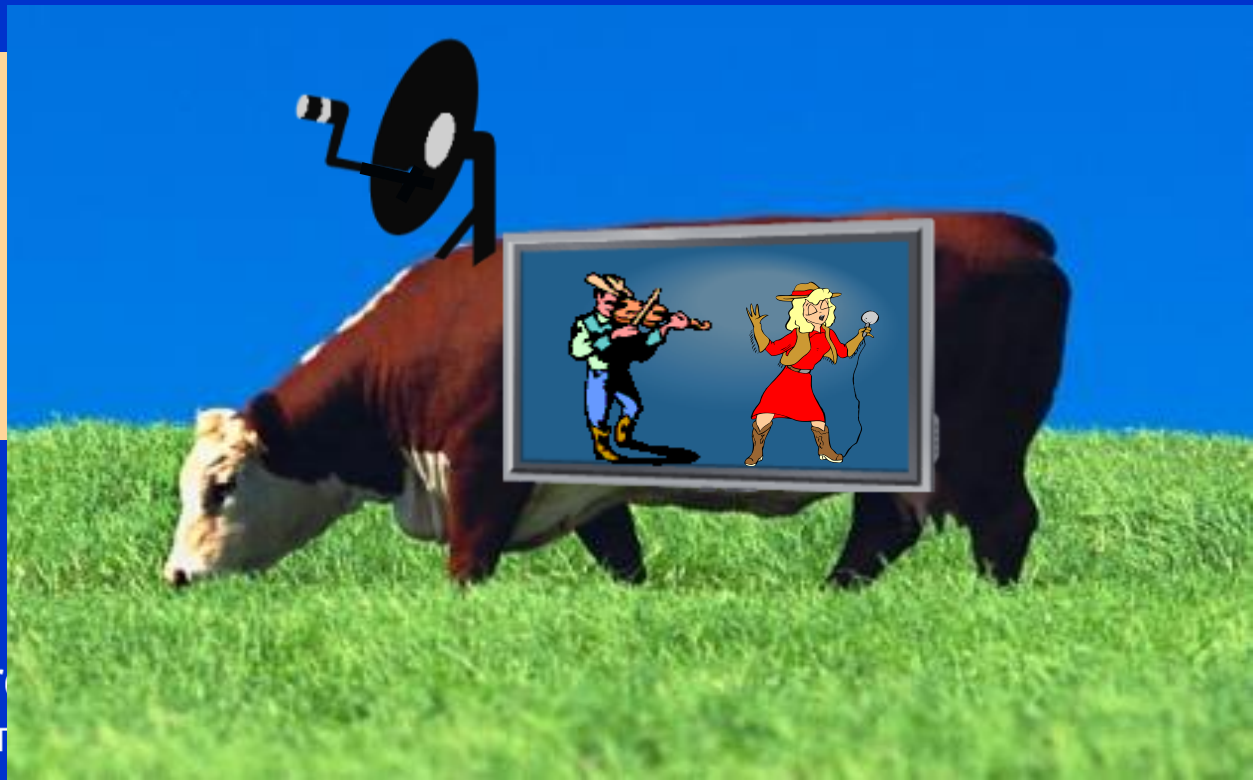
- Focus on fewer traits allows faster progress per generation
- Modern breeders are not leaving this opportunity and on the table.
- Terminal crossbreeding is much easier with higher female fecundity



# Practicality of Raising Replacement Heifers in One-Bull Herds

- Generally not enough replacements in one year to be practical to manage as a separate group.
- Not a very efficient use of time to be night calving 3-5 heifers.

“Cow as an Entertainment Center”



# Practicality of Raising Replacement Heifers in One-Bull Herds

- Nonetheless, these herds produce a substantial fraction of the calves in the beef industry and that seems unlikely to change.
- These herds would be more productive, profitable, and enjoyable for their owners if they purchased replacement females that were bred for their 2<sup>nd</sup> or later calf and sold their entire calf crops to be fed for harvest.
- Ideally, the bulls would be selected for terminal traits and the cows for maternal traits.

# Practicality of Raising Replacement Heifers in One-Bull Herds

- The advantages of changing to this structure are not limited to one-bull herds.
- The educational, cultural, and marketing challenges to getting this approach adopted should not be underestimated.
- Furthermore, the current lack of a substantial supply of maternal-oriented young bred cows in the marketplace would make it very challenging to try to convince conventional all-purpose producers to specialize in terminal calf production.



# Producers of Young Bred Cows with Maternal Genetics

- There is a need for specialized producers of these
- Would probably tend to be larger than average producers, but not necessarily.
- Large ranches could have both maternal and terminal herds in the same operation.
- The ideal product would be young maternal cows bred to terminal bulls to have their 2<sup>nd</sup> calf.
  - A more realistic product is maternal cows bred to terminal bulls to have their 3<sup>rd</sup> or 4<sup>th</sup> calf.

# Producing Young Bred Cows: Turnover and Age at Sale

- On average, each cow needs to produce a heifer to replace her in order to maintain herd size.
  - Sex ratio, pregnancy, and culling rates determine age at sale.
  - If growing the herd, cows will need to be sold at an even older age.
  - Beyond bred heifers, the younger the cows can be sold, the more productive (and probably more profitable) the enterprise will be.
  - In general, about 2-3 calves would be required to replace a cow, so they could be sold bred for their 3<sup>rd</sup> or 4<sup>th</sup> calves as coming five-year-olds.

# Producing Young Bred Cows: Turnover and Age at Sale

- For her last breeding in the maternal producer's herd, the cow should ideally be bred to a terminal sire to better match the calves in the herd she would be sold into.
  - It could be challenging to determine how many will be sold each year depending on number of incoming replacements, weather, forage availability and forage conditions
- Altering the sex ratio could be very helpful in reducing age at sale of females and enhancing the average value of calves produced in this type of program.

# Lessons from the Dairy Industry

- It was only a few decades ago that the dairy industry faced a replacement rate crisis
- It was solved by:
  - Genetic evaluation of fertility
  - Use of sexed semen
- Sexed semen is fundamentally responsible for the beef-on-dairy phenomenon

# Sexed Semen

- Sexed semen is rapidly becoming a feasible technology that should be a game-changer for consideration of terminal crossbreeding



# Uses of Sexed Semen in Terminal Crossbreeding

- Perhaps use sexed (female) semen during the first estrus cycle of the breeding season and then switch to natural service or unsexed semen.
- Another strategy could be to use sexed semen more heavily in heifers (in which it is probably more effective) and less heavily in breeding for the 2<sup>nd</sup> calf.
- This could likely reduce the predominant age at sale to bred for 3<sup>rd</sup> calves as coming four-year-olds.

# Producing Young Bred Cows: Sex Ratio

- Altering sex ratio would also:
  - Reduce the incidence of calving difficulty (by reducing the number of heavier bull calves), especially at the start of the calving season when calves are coming at the fastest pace.
  - Reduce the number of maternal line steers that need to be marketed, likely at a discount and lower weight.

# Marketing Young Bred Cows: Sex Ratio

- It might be profitable to breed cows designated for sale with male-sexed terminal semen, but would need to capture added value from improved sex ratio
  - Best if early ultrasound pregnancy detection could be used to identify AI-sired calves and/or determine sex of calves
  - A lower cost strategy could be to sell based on a guaranteed sex ratio and pay a rebate if not realized.

# Selection for Maternal Traits

- Genetic improvement for maternal traits should primarily come from bull selection
- It would benefit greatly from better maternal trait EPDs based on data from all parities.

# Selection for Maternal Traits

- Culling should be minimal and based almost solely on immediate effect on profitability.
- Don't cull commercial cows in the hope of improving genetics of the herd (applies to seedstock herds as well).
  - Attempting to use culling to achieve genetic progress would make the system unsustainable.
  - But, keeping daughters of the best cows for use in nucleus herds would be beneficial.

# Length of Breeding Season

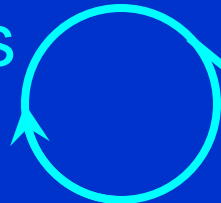
- Short breeding seasons:
- Reduce pregnancy rate
- Increase replacement rate
- Are reasonable if justified by immediate profitability
- Are not justified by the idea that they will improve breeding value for fertility

# Mating Systems for Terminal Crossbreeding

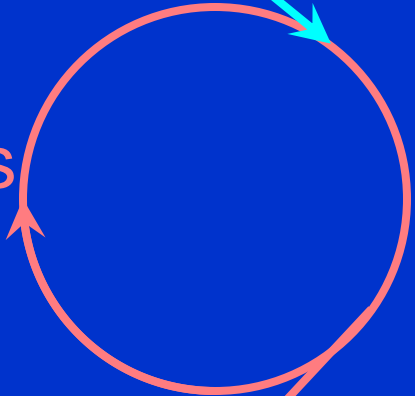
- Probably simplest for maternal females to be a composite, but other crossbreeding systems would also work.
- But we should not miss the opportunity to take advantage of heterosis in the primary cow herds that produce commercial calves for the beef industry

# Maternal Composite Cows

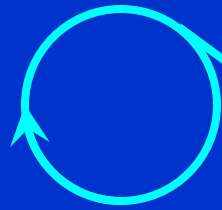
Small Maternal Sires



Young Maternal Composite Females



Large Terminal Sires



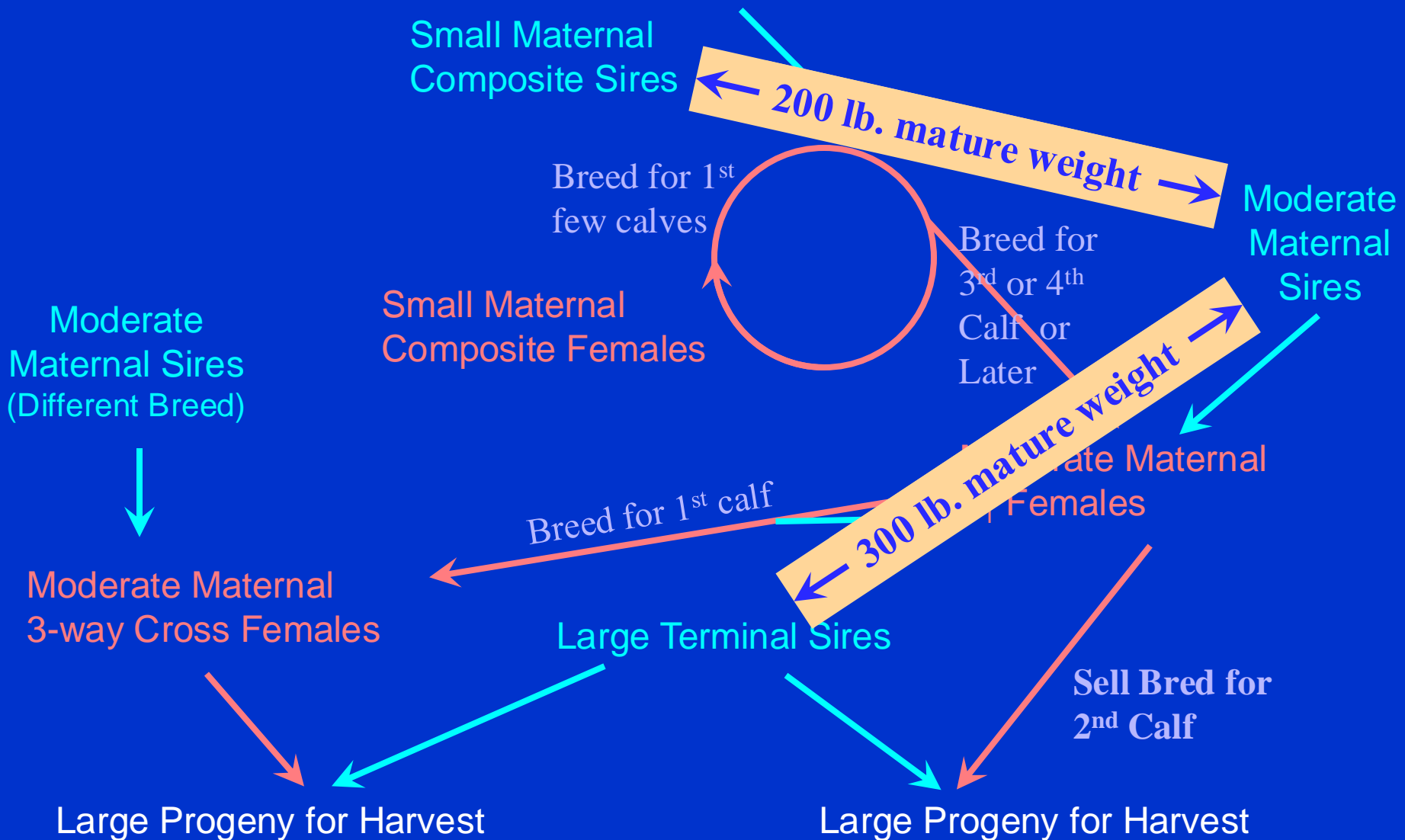
Sell Bred for  
3<sup>rd</sup> or 4<sup>th</sup> Calf

Progeny for Harvest





# System with F<sub>1</sub> Cows for Near-Optimum Complementarity



# Size Disparity Between Cows and Bulls

- This is the essence of complementarity as Tom Cartwright use the term.
- It is the greatest opportunity to improve efficiency of cow-calf production
- The primary constant is dystocia
- It can be mitigated by breeding to maternal sires (female semen) in early parities and to terminal sites (male semen) in later parities

# Obstacles to Implementation

- Tradition
- Difficult to establish a market for maternal females until a group of dedicated terminal producers develops
  - Would take years to breed cattle best suited for this purpose
  - Difficult to convince all-purpose producers to terminal production until a reliable supply of maternal line cows develops
- Need to balance growth with calving ease

# Advantages to the Beef Industry

- Natural efficiency of heavier calves and carcasses from smaller cows (terminal producers)
- Less calving difficulty in heifers (maternal producers)
- More uniform stream of calves with better carcass characteristics going into feedlots
- Smaller producers can focus on doing one thing well

# Effect of Cow Size on Efficiency and Profitability

- Smaller cows may or may not be inherently more efficient, but they are almost certainly more profitable if they can be bred to bulls of greater genetic potential for growth
- Maternal breeds should generally be selected for lower mature size and maternal calving ease
- Terminal breeds should generally be selected for greater early growth and greater calving ease

# What Size Cows are Most Efficient?

- I don't think we really have a good answer
- Perhaps larger cows where nutrients are abundant and smaller where they are sparse.
- It's really hard to measure.
- There are numerical artifacts that can mislead people into thinking small cows are more efficient than they really are.
- We would need to know how much cows of various sizes eat to answer it adequately

# Beef Breeds Have Become Far Too Similar

- Breeds that used to have some of the smallest cows now have the biggest cows
- Selection objectives vary only minimally among beef breeds
- Almost all beef breeds have general purpose breeding objectives
- This presents a challenge for the industry moving to a more efficient mating system.



# Conclusions

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- Maternal breeds should generally be selected for lower mature size and maternal calving ease
- Terminal breeds should generally be selected for greater growth and greater calving ease

# Conclusions

- Most breeds need to decide whether they are a maternal or terminal breed.
- The notion that beef breeds should be all-purpose is pervasive, but counterproductive
- Beef breeds have become far too similar in mature size and most other characteristics
- Heterosis is important and underutilized, but it is not a “free lunch”
  - Greater production comes at the partial expense of higher inputs

# Conclusions

- Complementarity and terminal crossbreeding systems are underutilized
- A change in industry structure with regard to replacement females could benefit the entire industry
  - Specialized production of young replacement females with maternal genetics
- An economically feasible sexed semen technology could make terminal crossbreeding much more practical

# For More Information:

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