Beef Cow Nutrition and Reproduction: A Systems Approach

Rachel Endecott, PhD
MSU Extension Beef Cattle Specialist
April 10, 2013
We gotta hurry! The dog and pony show starts at 5!

Photo courtesy Janna Kincheloe
Topics for Today

- Factors affecting nutrition and reproduction throughout production cycle
  - Late gestation
  - Calving season
  - Breeding season
  - Heifer development
Reproductive Traits

1. Puberty/Resume cycling
2. Fertile ovulation
3. Conception (cow and bull)
4. Maintenance of pregnancy
5. Give birth to live calf

- These interdependent traits culminate in a qualitative response, measured one time every year!

A. Roberts, USDA-ARS
Energy and Protein Requirements by Physiological Stage

<table>
<thead>
<tr>
<th>Stage</th>
<th>TDN</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-Gestation</td>
<td>12.4</td>
<td>1.69</td>
</tr>
<tr>
<td>Late Gestation</td>
<td>14.4</td>
<td>2.15</td>
</tr>
<tr>
<td>Early Lactation</td>
<td>17.6</td>
<td>3.00</td>
</tr>
</tbody>
</table>
Fig. 1. Partitioning of nutrients in beef cows fed diets differing in quality.

Adams and Short, 1988
Nutrient Analyses of Feedstuffs

• Highly (very, very highly) recommended
• Feedstuffs and water should be sampled and tested!
• Can’t manage if you don’t measure
• Evaluate nutrient analyses vs cow requirements
• Balance appropriate ration
Late Gestation
What’s Happening in Late Gestation

• 75% of fetal growth attained
• Conceptus requires 100 to 150 pounds of weight gain
  • Fetus plus membranes and fluids
• Young cows still growing
Rapid Fetal Growth During Third Trimester

- Sometimes cow unable to meet fetal nutrient demands from diet
- Maternal reserves of energy and protein will be used
- Cow will lose body condition
Rapid Fetal Growth During Third Trimester

- Fetus gaining weight
- Loss in cow condition may not result in change in scale weight
Cow Body Condition and Calf Serum Immunoglobulin M

P = 0.05
Adapted from Odde, 1997

Calf serum IgM, mg/dL

Cow Body Condition Score

3 4 5 6
Cow Body Condition and Calf Serum Immunoglobulin G

Calf serum IgG, mg/dL

Cow Body Condition Score

P = 0.23
Adapted from Odde, 1997
Passive Immunity and Pre-Weaning Health

- Compared to calves with adequate passive immunity, calves with failure of passive immunity were
  - ~2 times more likely to be ill pre-weaning
  - ~5 times more likely to die pre-weaning

Dewell et al., JAVMA 2006
Cow Nutrient Restriction and Calf Passive Immunity

- Idaho study
  - First-calf heifers fed at one of six protein concentrations for 100 days pre-calving
  - Calves fed colostrum from dairy cows
  - Evaluated calf’s ability to absorb immunoglobulins

Blecha et al., JAS 1981
Calves From Dams Fed Low Protein Diets Less Able to Absorb IgG

Calf serum IgG, mg/dL

Diet percent protein

SE = 119
Blecha et al., JAS 1981
Mountains & Minds
Prepartum Dietary Energy Can Impact Reproduction

Days or Percent

- Postpartum Interval, d
- Percent Cycling at Breeding
- October Pregnancy Rate, %

Low Prepartum Energy High Prepartum Energy

- Postpartum Interval: 80 days, 69 days
- Percent Cycling at Breeding: 55%, 68%
- October Pregnancy Rate: 67%, 79%

P < 0.05

Bellows et al., 1982
Inputs Required to Get Thin Cows to Gain Weight
Inputs Required to Get Thin Cows to Gain Weight

• BRaNDS ration balancing program
• Post-weaning
• Third trimester
Feedstuffs for Examples

- Alfalfa-grass hay
  - 60% TDN, 14% CP

- Corn
  - 90% TDN, 9% CP
Scenario: 1400-lb Cow, Maintain BCS 6, 3rd Trimester

Mature cow gains 0.37 lb/d
Scenario: Same Cow, BCS 3, Gaining $\frac{3}{4}$ BCS/Month, 3rd Trimester

Mature cow gains 0.91 lb/d

Mature cow gains 2.31 lb/d
Scenario: Same Cow, BCS 3, Gaining \(\frac{3}{4}\) BCS/Month, 2nd Trimester

Mature cow gains 1.99 lb/d

Mature cow gains 2.35 lb/d

<table>
<thead>
<tr>
<th>Feedstuff</th>
<th>Pounds Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa-Grass Hay</td>
<td>30</td>
</tr>
<tr>
<td>Alfalfa-Grass Hay</td>
<td>28</td>
</tr>
<tr>
<td>Corn</td>
<td>3</td>
</tr>
</tbody>
</table>
Calving Season
Calving Distribution

- Follows how cows are calving within the calving season
- Split into 21-day periods
- Starting date
  - Breeding date/bull turnout plus 283 days
  - When 3rd mature cow calves
# Calving Distribution Table

<table>
<thead>
<tr>
<th>Cow Age</th>
<th>No. of Cows</th>
<th>% of Cows Calving</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>d 1-21</td>
</tr>
<tr>
<td>2</td>
<td>79</td>
<td>55</td>
</tr>
<tr>
<td>3</td>
<td>62</td>
<td>29</td>
</tr>
<tr>
<td>4</td>
<td>44</td>
<td>43</td>
</tr>
<tr>
<td>5+</td>
<td>70</td>
<td>60</td>
</tr>
<tr>
<td>Total</td>
<td>225</td>
<td>48</td>
</tr>
</tbody>
</table>
Calving Distribution Graph

<table>
<thead>
<tr>
<th>Calving Period</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5+</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st 21 days</td>
<td>55</td>
<td>43</td>
<td>60</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>2nd 21 days</td>
<td>29</td>
<td>43</td>
<td>36</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>3rd 21 days</td>
<td>27</td>
<td>21</td>
<td>20</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>All</td>
<td>16</td>
<td>20</td>
<td>19</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

Percent of Calves Born

Calving Period

BIF Guidelines
Heifers Differ From Cows in Postpartum Reproductive Performance

<table>
<thead>
<tr>
<th>Reproductive Measure</th>
<th>Days or Percent</th>
<th>Reproductive Measure</th>
<th>Days or Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postpartum Interval, d</td>
<td>89 a</td>
<td>Percent Cycling at Breeding</td>
<td>91 b</td>
</tr>
<tr>
<td></td>
<td>59 b</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>October Pregnancy Rate, %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>64 a</td>
<td></td>
<td>82 b</td>
</tr>
</tbody>
</table>

Bellows et al., 1982

a,b P ≤ 0.05
## Calving Difficulty Impacts Subsequent Reproductive Performance

Laster et al., 1973

<table>
<thead>
<tr>
<th>Cow Age</th>
<th>Calving Difficulty</th>
<th>% in Estrus During AI</th>
<th>AI Conception</th>
<th>Overall Conception</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>No dystocia</td>
<td>68</td>
<td>66</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Dystocia</td>
<td>59</td>
<td>51</td>
<td>71</td>
</tr>
<tr>
<td>3</td>
<td>No dystocia</td>
<td>72</td>
<td>64</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>Dystocia</td>
<td>55</td>
<td>46</td>
<td>73</td>
</tr>
<tr>
<td>4 &amp; 5</td>
<td>No dystocia</td>
<td>86</td>
<td>78</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Dystocia</td>
<td>77</td>
<td>64</td>
<td>64</td>
</tr>
</tbody>
</table>
Calving Difficulty Impacts Subsequent Reproductive Performance

- Heifers experiencing dystocia as 2-year-olds weaned 14% fewer calves per cow exposed as 3-year-olds.
- Calves from 3-year-olds who experienced dystocia as 2-year-olds were born 13 days later and 46 pounds lighter at weaning.

Laster et al., 1973
Duration of Labor Impacts Postpartum Reproductive Performance

Reproductive Measure

- Postpartum Interval, d
- Percent Cycling at Breeding
- October Pregnancy Rate, %

Doornbos et al., 1984

a,b P ≤ 0.10

Montana State University Extension

Mountains & Minds
Strategies for Improved Young Cow Reproductive Performance

• Proper heifer development and pre- and post-calving nutrition
• Start yearling breeding season early
• Shorten yearling breeding season
Strategies for Improved Young Cow Reproductive Performance

- Keep young cows separate from older cows
  - Before, after calving
  - Consider after breeding
- Early weaning?
Breeding Season
Percent of Operations That Test Bulls (Semen Evaluation)

West: 31%
Central: 34%
South Central: 15%
East: 10%

Region

NAHMS Beef, 2007-08
Bull Testing: Operations With 200+ Cows

Percent of Operations

<table>
<thead>
<tr>
<th>Type of Bull</th>
<th>Current Bulls</th>
<th>New Bulls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>61</td>
<td>96</td>
</tr>
</tbody>
</table>

NAHMS Beef, 2007-08
Bull Breeding Soundness Exam

- Conduct 30-60 days prior to breeding season
- Physical examination
- Measure scrotal circumference
- Evaluation of semen sample
Bull Physical Exam

• Visual appraisal and rectal palpation
  • Good condition, structurally sound
• Good time to review previous management, disease, stress
  • Fat bulls or bulls on hot rations
  • Infection, fever
  • Frostbite
Bull Scrotal Circumference

- Primarily related to sperm production and semen volume
- Related to age of puberty in heifers

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>≤ 15</th>
<th>&gt; 15-18</th>
<th>&gt; 18-21</th>
<th>&gt; 21-24</th>
<th>&gt;24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrotal circumference (cm)</td>
<td>30</td>
<td>31</td>
<td>32</td>
<td>33</td>
<td>34</td>
</tr>
</tbody>
</table>
Bull Semen Evaluation

- **Motility**
  - ≥ 30% individual motility, “fair” gross motility

- **Morphology**
  - ≥ 70% normal sperm
Bull Semen Evaluation: Sperm Abnormalities
Conditioning for Breeding Season

• 30-90 days adjustment time for new purchases ideal
• Consult your veterinarian about an appropriate health program
Conditioning for Breeding Season

• Yearling bulls should continue to gain 1.5-2 lb/day
  • 11-12% CP, 70% TDN
  • Bulls consume 10-15% more than comparable weight steer
Turnout Body Condition Score of 6

• Visible bone structure
  • No distinct structure
  • Transverse processes felt with firm pressure

• Muscling
  • Hindquarters plump and full

• Fat cover
  • Spongy foreribs and tail head
  • Brisket has some fat
Breeding Season Management

- Plane of nutrition during breeding will be same as cows
- Ensure bulls enter breeding season in good condition
  - Will lose 100-300 pounds
- Monitor frequently for injury, etc.
Recovery After Breeding Season

- Recommend bulls reach 75% of mature body weight at 2 years of age
- Example: expect 2000 lb mature weight
  - 1250 lb at turnout, needs to be 1500 lb at 2
  - Loses 200 lb during breeding = 1050 lb
  - Needs to gain 450 lb in 9 months
  - Average daily gain of 2 lb/day
Recovery After Breeding Season

- Mature bulls in good shape after breeding season can get by on all-roughage diet
- Young bulls may need supplemental energy, depending on forage quality
Establish Breeding Season

START

BREEDING SEASON

END
Breeding Season Length by Percent of Operations

<table>
<thead>
<tr>
<th>Breeding Season Length</th>
<th>Percent of Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 64 d</td>
<td>26</td>
</tr>
<tr>
<td>64-84 d</td>
<td>13</td>
</tr>
<tr>
<td>85-105 d</td>
<td>22</td>
</tr>
<tr>
<td>106-149 d</td>
<td>17</td>
</tr>
<tr>
<td>150+ d</td>
<td>22</td>
</tr>
</tbody>
</table>

NAHMS Beef, 2007-08
Some Reasons to Consider A Controlled Breeding Season

- Nutrition adjusted to physiological state
- Cattle observed for calving difficulty
- Calf crop more uniform in age & weight
- Facilitation of management
- Identification of reproductively unsound cattle
Heifer Development
Heifer Reproduction: Most Limiting Factor is Puberty

- Definition: First ovulation and show estrus
- Hormone sensitivity of receptors in the brain and ovaries
Age at Puberty is Important

- Goal: Calve as 2-year-olds (23-25 mo.)
- Then must conceive at 14-16 months
Breed Affects Age at Puberty

- Breeds selected for increased milk production
  - Younger at puberty
- Breeds selected for greater growth and mature size
  - Older at puberty
Heterosis Affects Age at Puberty

- Percent of heifers reaching puberty at a given age is greater for crossbreds than straightbreds
  - Heterosis effects decrease with increasing age
Increased Percentages of Crossbred Heifers Cycling vs Straightbreds

Days of Age

Increased Percent of Heifers
Sire Scrotal Circumference and Age at Puberty

- Selection for larger scrotal circumference in herd sires is an indirect method of selecting for younger age at puberty in heifers.
Angus Genetic Trend for Scrotal Circumference
Timing of First Calf and Lifetime Productivity

- Heifers that calved early in their first calving season continued to calve early and wean heavier calves throughout their lifetime
  - Lesmeister et al., 1973
Puberty is Correlated with Weight

- Puberty will occur at a genetically predetermined size among individual animals.
- High pregnancy rates can be obtained only when heifers reach that target weight.
Target Weight Concept

• The “sure-thing” approach
• Heifer should reach 60-65% of her mature body weight by breeding
• Idea is that 90% plus will exhibit estrus by the start of the breeding season
Winter Weight Gains and Age at Puberty

Short and Bellows, 1971
Winter Weight Gain & Timing of Puberty

Percent of Heifers

Before Breeding | During Breeding | After Breeding

Winter Weight Gain

Short and Bellows, 1971
Winter Weight Gain and Pregnancy Rates

Short and Bellows, 1971
Summer Weight Gain of Three Winter Weight Gain Groups

Average Daily Gain, lb

0.0  0.2  0.4  0.6  0.8  1.0  1.2  1.4

0.6 lb/ d  1.0 lb/ d  1.5 lb/ d

1.3  1.2  0.9

Winter Weight Gain

Short and Bellows, 1971
Overfeeding Not a Good Strategy

- Costly
- Weak estrous symptoms
- Reduced conception rate
- High embryonic mortality
- Decreased mammary development
Do “Modern-Day” Heifers Need to Grow to 60-65% of Mature Body Weight?

Light heifers allowed additional 15 days of breeding season. Similar preg rates in both groups.

Martin et al., 2007
Some Non-Pregnant Heifers Didn’t Reach Puberty Before Breeding

- 79% of heifers were pre-pubertal at 51% MBW.
- 45% of heifers were pre-pubertal at 57% MBW.

Source: Martin et al., 2007
More on the Nebraska Data…

- Used lower quality diet to develop lighter group
- Lighter group allowed extra 15 days of breeding – similar preg rates
- Even with longer breeding season, was still more cost effective
  - Around $24/pregnant heifer
Fort Keogh Heifer Development Study Shows Similar Results to Nebraska

<table>
<thead>
<tr>
<th>Feeding Program</th>
<th>Percent Heifers Pregnant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restricted</td>
<td>87</td>
</tr>
<tr>
<td>Control</td>
<td>91</td>
</tr>
</tbody>
</table>

Roberts et al., 2009
Fort Keogh: Retention to 5\textsuperscript{th} Breeding Season

<table>
<thead>
<tr>
<th>Dam Treatment</th>
<th>Restricted Dams</th>
<th>Control Dams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restricted Heifers</td>
<td>66</td>
<td>39</td>
</tr>
<tr>
<td>Control Heifers</td>
<td>51</td>
<td>50</td>
</tr>
</tbody>
</table>

Roberts et al., 2009
More on the Fort Keogh Data…

- Used lower quantity of same feed to develop lighter group
- Decreased harvested feed inputs 22%
- Increased efficiency of gain
- Restricted group more cost effective
  - $22 per pregnant heifer
Similarities Between Nebraska and Fort Keogh Data

- Composite cattle used – heterosis a factor?
  - Half Red Angus, half Continental breeds
- 10% decrease in pubertal heifers at breeding time in lighter groups
- Increased cost effectiveness for lighter groups
  - $22-$24 per pregnant heifer
Extensively-Developed Heifers Exhibit Compensatory Summer Gain

<table>
<thead>
<tr>
<th>Study</th>
<th>Development Method</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Funston &amp; Larson, 2011</th>
<th>Mulliniks et al., 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olson, et al. 1992</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 1</td>
<td>Drylot</td>
<td>0.56^a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extensive</td>
<td>0.66^b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 2</td>
<td>Drylot</td>
<td>0.37^a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extensive</td>
<td>0.80^b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funston &amp; Larson, 2011</td>
<td>Drylot</td>
<td>0.47^a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extensive</td>
<td>0.67^b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mulliniks et al., 2012</td>
<td>Drylot</td>
<td>0.61^a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extensive</td>
<td>0.83^b</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^a^, ^b^  P < 0.10
What Happens if Nutrition Following Start of Breeding is Inadequate?

- Acute nutrient restriction (40% of maintenance) prevented ovulation in 70% of heifers with no change in condition
  - White et al., 2001
- Decreased pregnancy success for heifers moved from feedlot to grass post-AI
  - Perry et al., 2009
Nutrition Through Subsequent Calvings

- Nebraska and New Mexico data – all treatment groups treated fairly similarly after heifer development.
- Montana data – Ad libitum and restricted animals continue on their treatments for any supplemental feed throughout lifetime.
Pregnancy Rates Through 4\textsuperscript{th} Calf for Low vs High Gain Heifer Development

<table>
<thead>
<tr>
<th>Pregnant with</th>
<th>Development Method</th>
<th>Low Gain</th>
<th>High Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1\textsuperscript{st} calf</td>
<td>92%</td>
<td>88%</td>
<td></td>
</tr>
<tr>
<td>2\textsuperscript{nd} calf</td>
<td>91%</td>
<td>91%</td>
<td></td>
</tr>
<tr>
<td>3\textsuperscript{rd} calf</td>
<td>94%</td>
<td>92%</td>
<td></td>
</tr>
<tr>
<td>4\textsuperscript{th} calf</td>
<td>96%</td>
<td>96%</td>
<td></td>
</tr>
</tbody>
</table>

Funston and Deutscher, 2004
New Mexico: Increased Retention Rate in RUP-Supplemented Range Heifers

Retention Rate, %

Cow Age

*P<0.10; **P<0.01

Mulliniks, et al., 2012
Fort Keogh CGC Retention Rate

Retention Rate, %

Cow Age

<table>
<thead>
<tr>
<th>1197</th>
<th>1138</th>
<th>994</th>
<th>867</th>
<th>749</th>
<th>631</th>
<th>504</th>
<th>384</th>
</tr>
</thead>
</table>

*R MargDam
*R AdeqDam
*C MargDam
*C AdeqDam

*P = 0.07
**P ≤ 0.02

*P = 0.07
**P ≤ 0.02

Mountains & Minds
What About Calving Difficulty?

- Adequate growth and development to ensure little calving difficulty important to longevity
### Similar Calving Difficulty Between Development Methods

<table>
<thead>
<tr>
<th>Study</th>
<th>Development Method</th>
<th>Development Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funston &amp; Deutscher, 2004</td>
<td>Low Gain</td>
<td>High Gain</td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; calf</td>
<td>1.25</td>
<td>1.22</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; calf</td>
<td>1.07*</td>
<td>1.17*</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; calf</td>
<td>1.07</td>
<td>1.04</td>
</tr>
<tr>
<td>Funston &amp; Larson, 2011</td>
<td>Cornstalks/Range</td>
<td>Drylot</td>
</tr>
<tr>
<td></td>
<td>1.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Larson et al., 2011</td>
<td>Range</td>
<td>Cornstalks</td>
</tr>
<tr>
<td>Exp. 1</td>
<td>1.2</td>
<td>1.4</td>
</tr>
<tr>
<td>Exp. 2</td>
<td>1.4</td>
<td>1.7</td>
</tr>
</tbody>
</table>

*P < 0.05
Summary: Heifer Development

- There is no “one size fits all” answer
- Each operation is different
- Choose development program that fits your resources, environment, and goals
Monitoring Nutrient Status

- Body weight and body condition score
  - At weaning
  - Start of third trimester
  - At calving
## Was Goldilocks Right About “Just Right”?

<table>
<thead>
<tr>
<th>Nutrient Consumption</th>
<th>Reproductive Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive energy intake</td>
<td>Low conception, abortion, dystocia, retained placenta, reduced libido</td>
</tr>
<tr>
<td>Inadequate energy intake</td>
<td>Delayed puberty, suppressed estrus and ovulation, suppressed libido and spermatozoa production</td>
</tr>
<tr>
<td>Excessive protein intake</td>
<td>Low conception rate</td>
</tr>
<tr>
<td>Inadequate protein intake</td>
<td>Suppressed estrus, low conception, fetal reabsorption, premature parturition, weak offspring</td>
</tr>
</tbody>
</table>
More Goldilocks Theory…

<table>
<thead>
<tr>
<th>Nutrient Consumption</th>
<th>Reproductive Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A deficiency</td>
<td>Impaired spermatogenesis, anestrus, low conception, abortion, weak offspring, retained placenta</td>
</tr>
<tr>
<td>Phosphorus deficiency</td>
<td>Anestrus, irregular estrus</td>
</tr>
<tr>
<td>Selenium deficiency</td>
<td>Retained placenta</td>
</tr>
<tr>
<td>Copper deficiency</td>
<td>Depressed reproduction, impaired immune system, impaired ovarian function</td>
</tr>
<tr>
<td>Zinc deficiency</td>
<td>Reduced spermatogenesis</td>
</tr>
</tbody>
</table>
Topics for Today

• Factors affecting nutrition and reproduction throughout production cycle
  • Late gestation
  • Calving season
  • Breeding season
  • Heifer development
The End
Contact Information

Rachel Endecott

(406) 994-3747 – office
(406) 853-3956 – cell
rachel.endecott@montana.edu

www.msuextension.org/beefcattle