Livestock Nutrition DNR-SWCP

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Stolen mostly from

Justin Sexten, Craig Roberts, K C Olson, Rich Crawford

University of Missouri

Introduction

- This is not a comprehensive course in livestock nutrition.
  The nutritional topics discussed relate to grazing animals on pasture. It is important for grassland management specialists to understand these principles and be able to discuss them with clients.
- Benefits of a Basic Understanding of Nutrition
  - Provides the basis by which animal performance can be predicted
    - Livestock grow, milk, and produce wool in proportion to the quality and quantity of nutrients they consume.

Topics of Discussion

- Forage Nutrient Profiles
  - Effects of Plant Maturity
  - Effects of Plant Diversity
- Animal Nutrient Requirements
  - Energy Partitioning
  - Effect of Body Size
  - Effect of Physiological State
- Management Considerations
  - Animal Selectivity
  - Season of Use
  - Supplemental Feeding

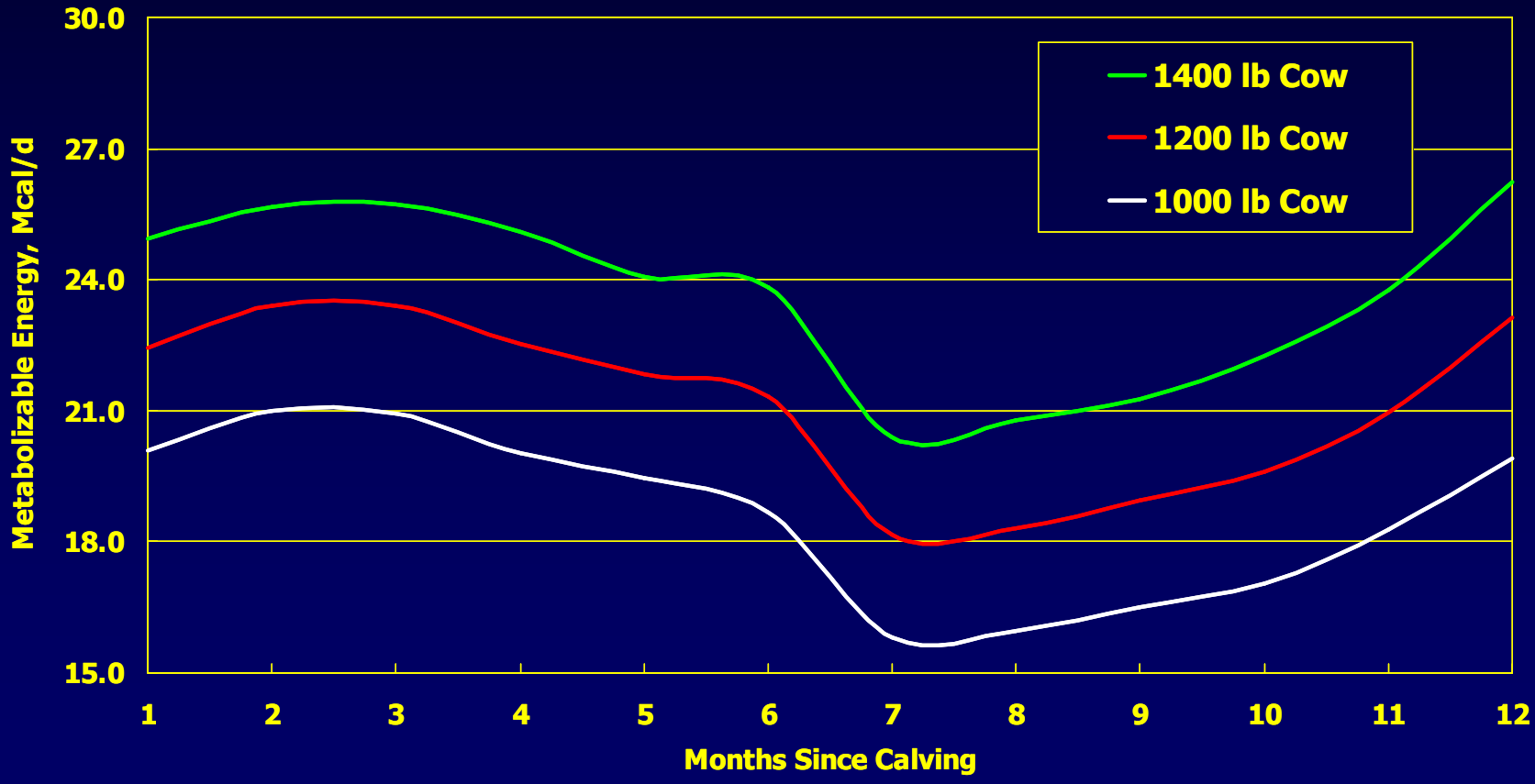
Hierarchy of Nutrient Use

1. Parasites (they get theirs 1st)
2. Maintenance (stayin' alive)
3. ***Fetus Development*** (next generation)
4. Milk Production (provide for baby)
5. Growth (attain mature genetic potential)
6. ***Breeding*** (perpetuate species)
7. Condition (BCS of 5-6 prior to calving)

– John Merrill, TCU Ranch Management Program

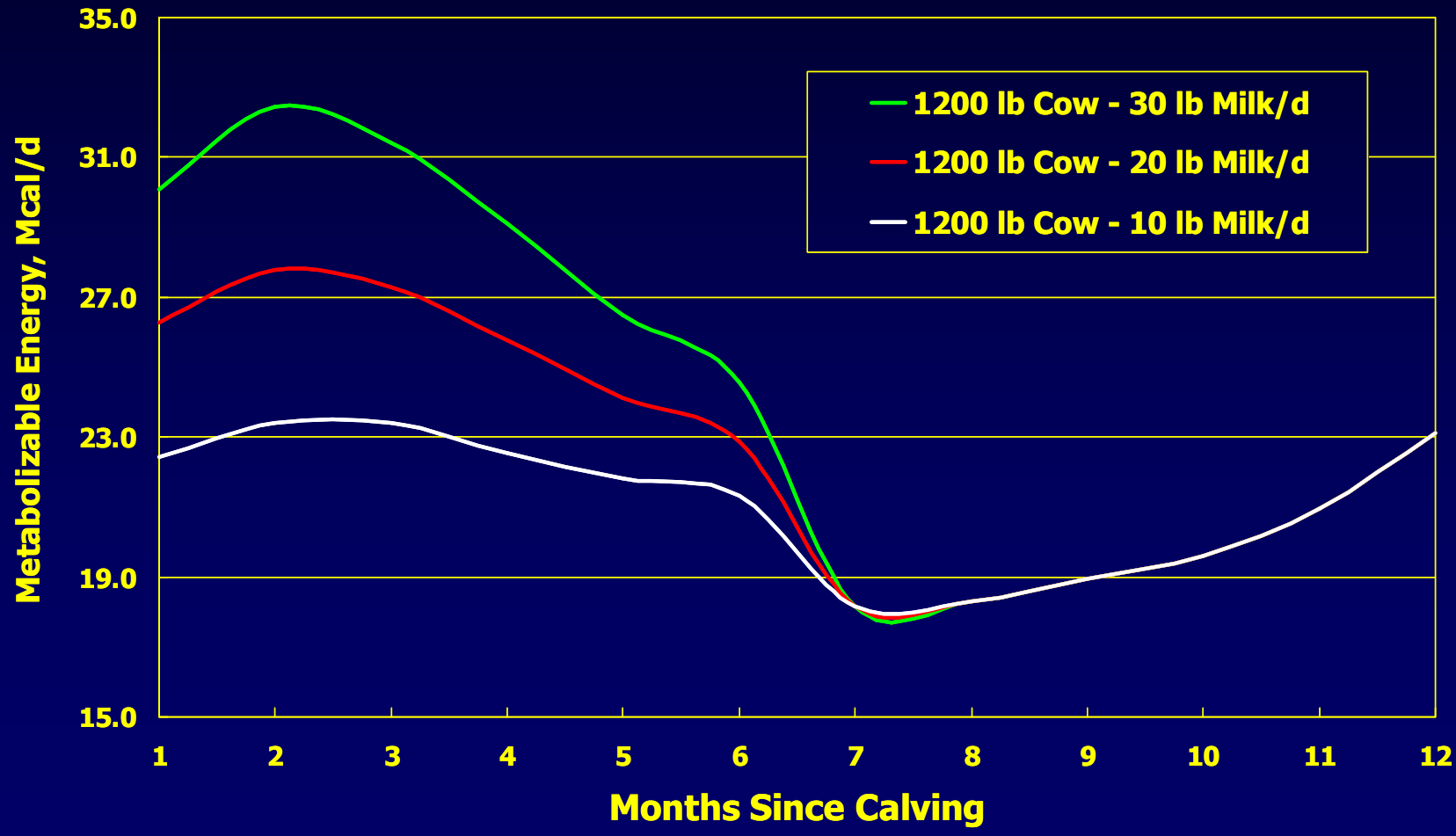
Animal Nutrient Requirements

- Effect of Cow Body Size



Animal Nutrient Requirements

- Effect of Milk Production Level and Pregnancy
  - Do high-milking cows have higher nutrient requirements when they're not lactating?



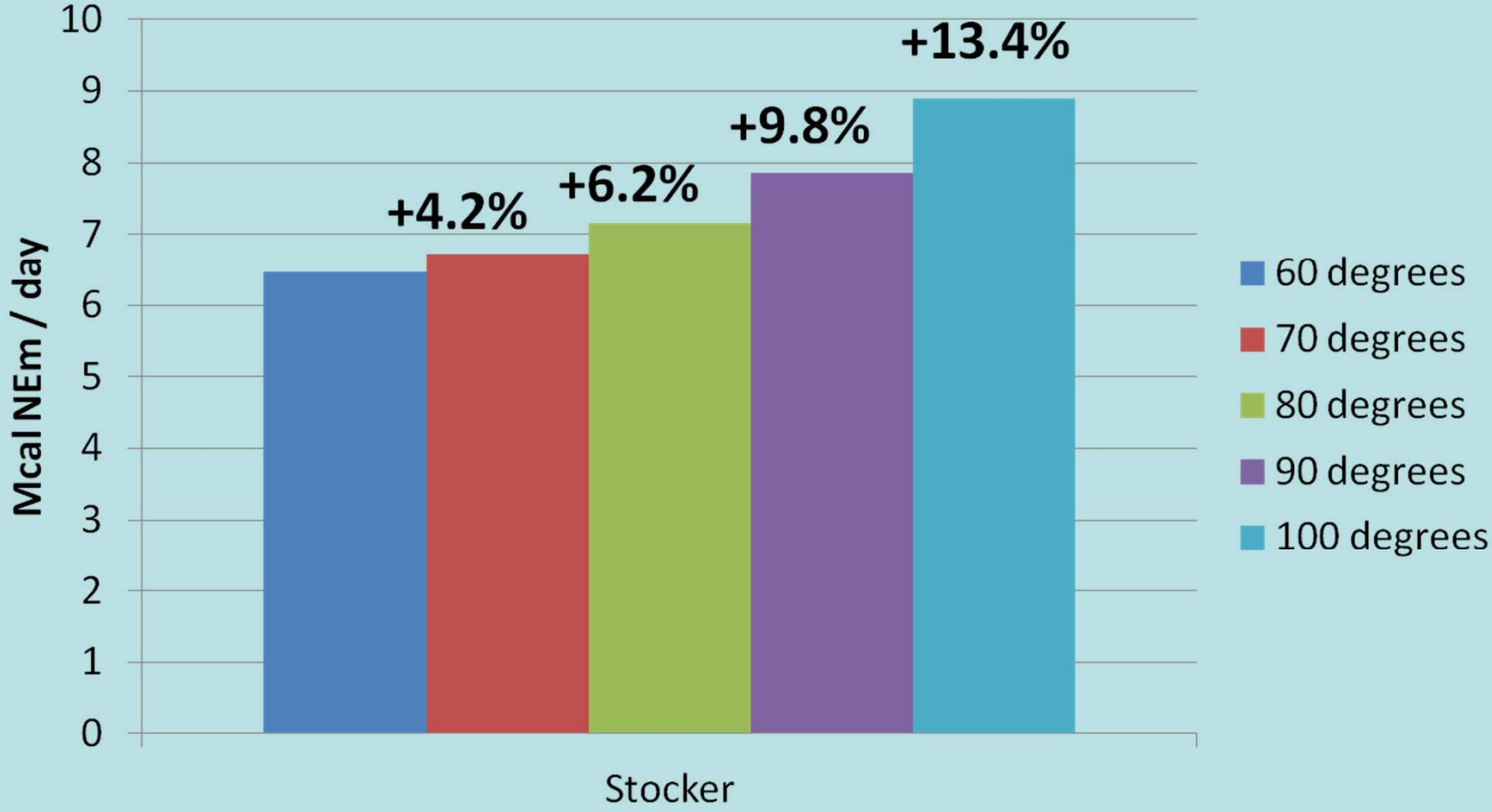
Genetic role in maintenance

Type / Breed	Maintenance Multiplier
English / Angus, Hereford	1
Dairy / Holstein, Jersey	1.2
Continental	
Limousin, Charolais,	1.0
Chianina	1.1
Gelbvieh	1.2
Simmental, Braunvieh	
Bos indicus	
Brangus	0.95
Brahman	0.90

NRC, 2000

Heat stress and maintenance

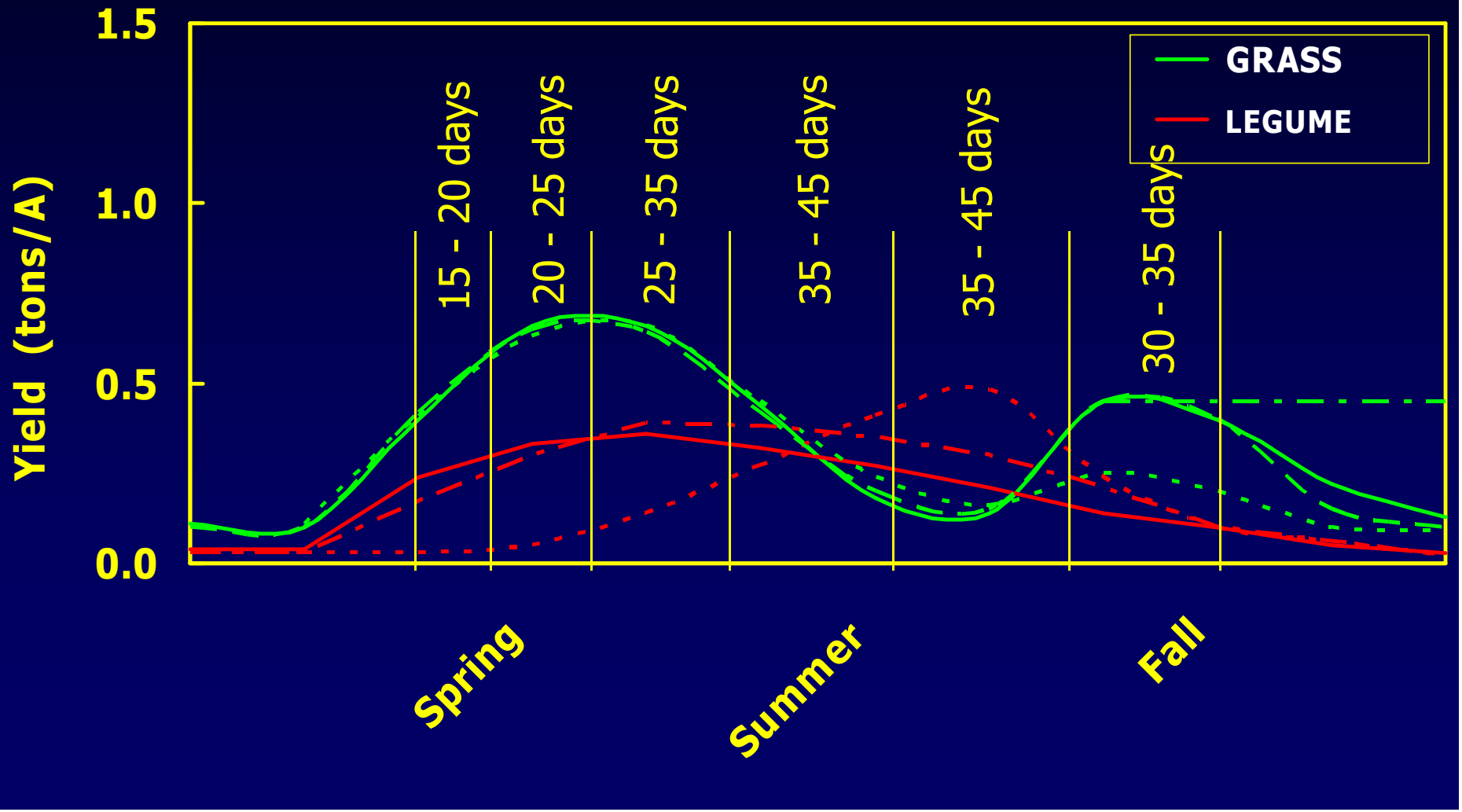
Remember hierarchy—increased maintenance requirement = reduced conception



Age, sex and status

- Maintenance not influenced by age (once maturity is achieved)
- Intact males have 15% greater maintenance energy requirement
- Lactating animals have a 20% increase in maintenance requirements

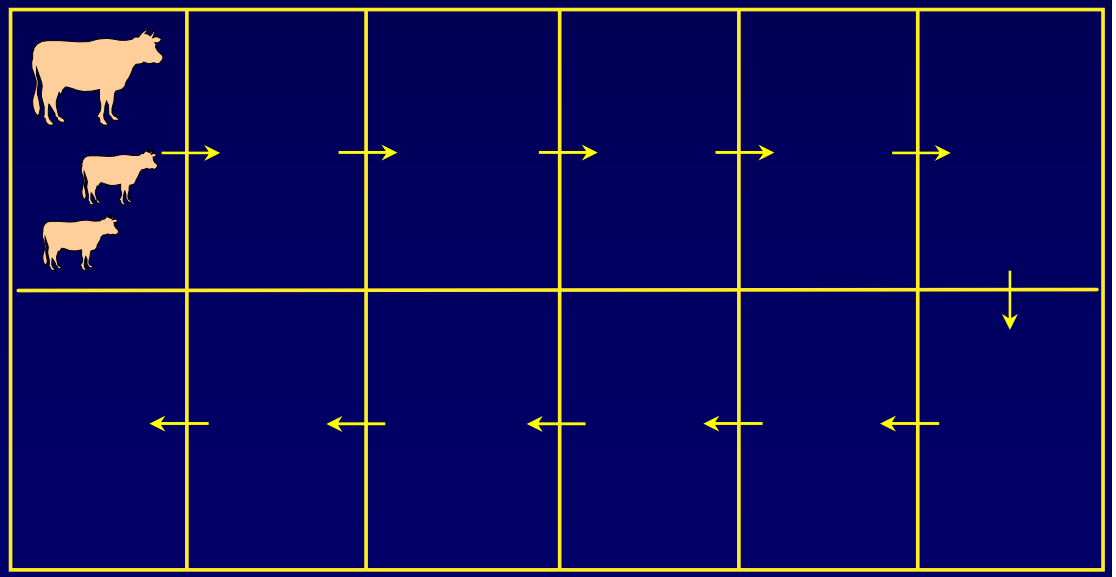
Yield Distribution: grazing season



Sward Dynamics

Example: 12 paddock system

- 3 day grazing period…only an "average" grazing period
- 36-day grazing cycle (also an average length)
- 33-day rest period (an average rest period).



Management Considerations

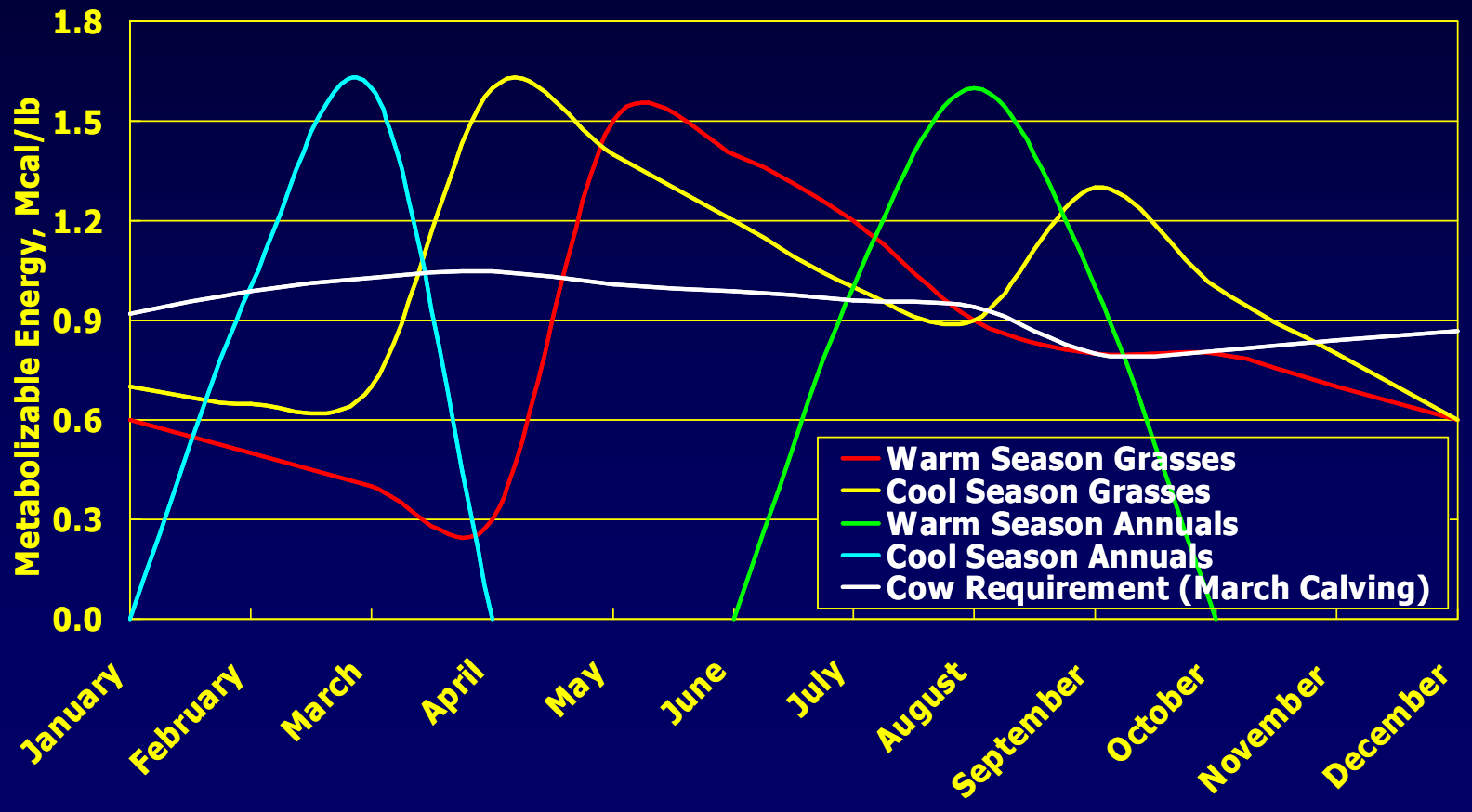
- Diet Selection by Grazing Ruminants
  - Grazing animals have the ability to select a diet of higher nutritional quality than the average nutritional quality of pasture forage
  - This is the result of the animal selecting specific plant species and plant parts to eat
  - Selection is driven by:
    - Palatability
    - Differential access due to plant growth form
    - Habit and experience (including what their mothers taught them, what their peers are eating, and post-ingestive feedback)
    - Characteristics that affect ingestion, e.g. texture, hairiness, thorns, height, and so on
  - As a result, it is difficult to predict performance or make effective use of forage testing
    - We must rely on experimental data and computer models to estimate intake and predict performance of grazing animals

Management Considerations

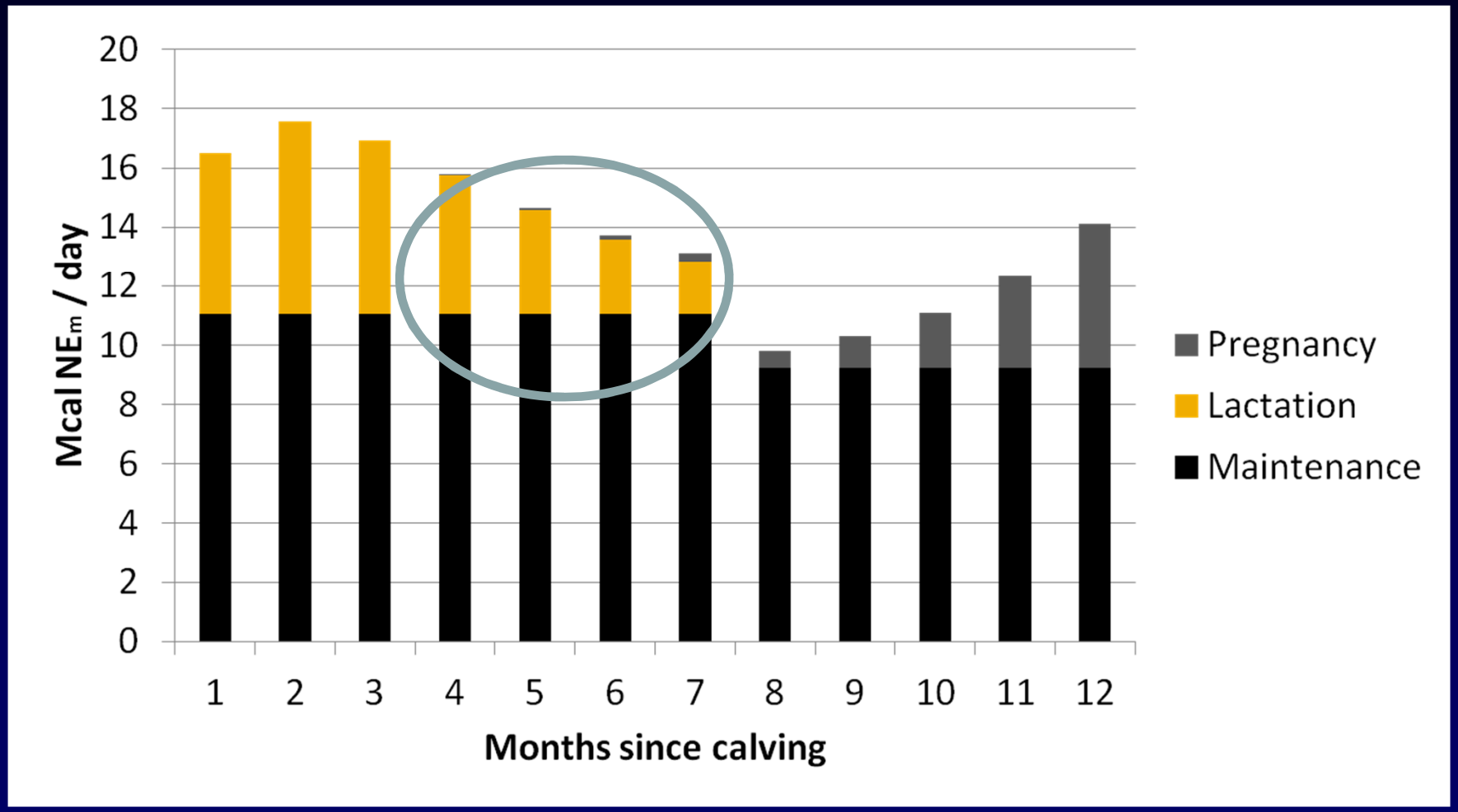
- Managing Season of Use
  - Involves manipulating the production cycle to synchronize periods of peak nutrient demand by livestock with peak forage quality OR to synchronize periods of low livestock nutrient demand with low foraged quality and growth (Note the difference!)
    - Maximizes the length of time that pasture forage will meet animal requirements
    - Implications for extending the grazing season
    - Minimizes the need for certain types of supplemental feeding

Forage Nutrient Profiles

- Forage Metabolizable Energy, compared to needs of a March calving cow

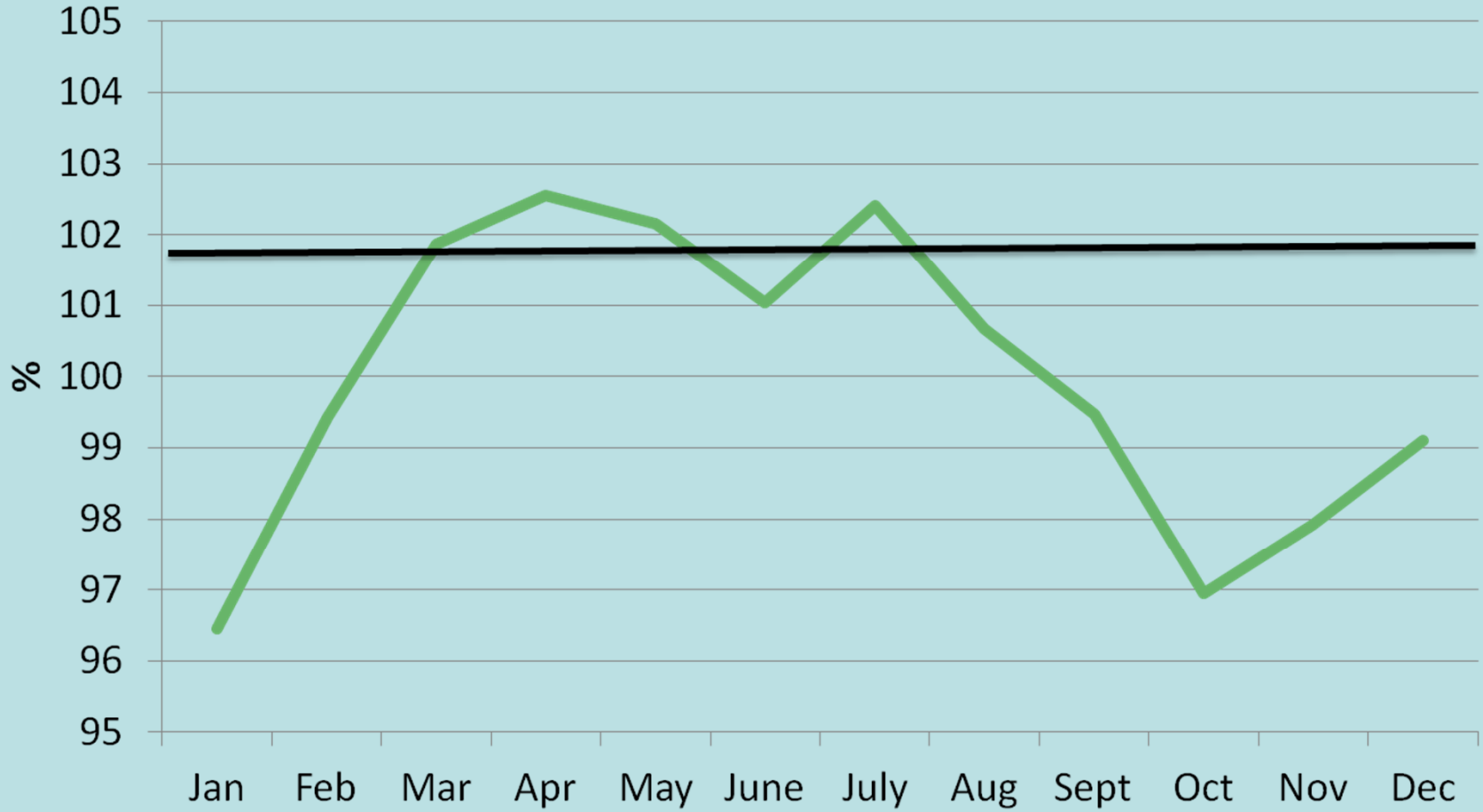


1300 pound cow
Energy requirements



Selecting a calving season

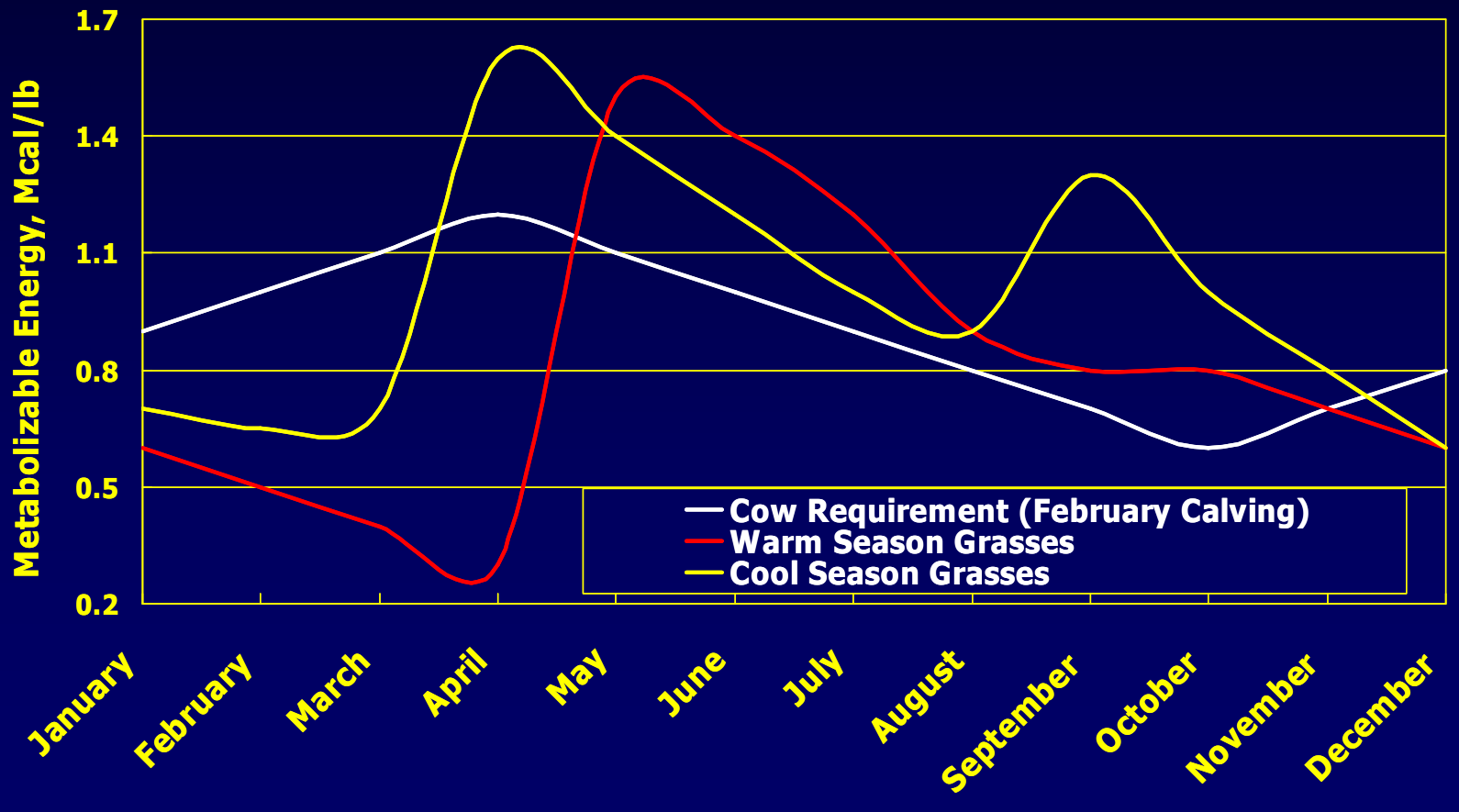
Weaned calf 10 year seasonality index



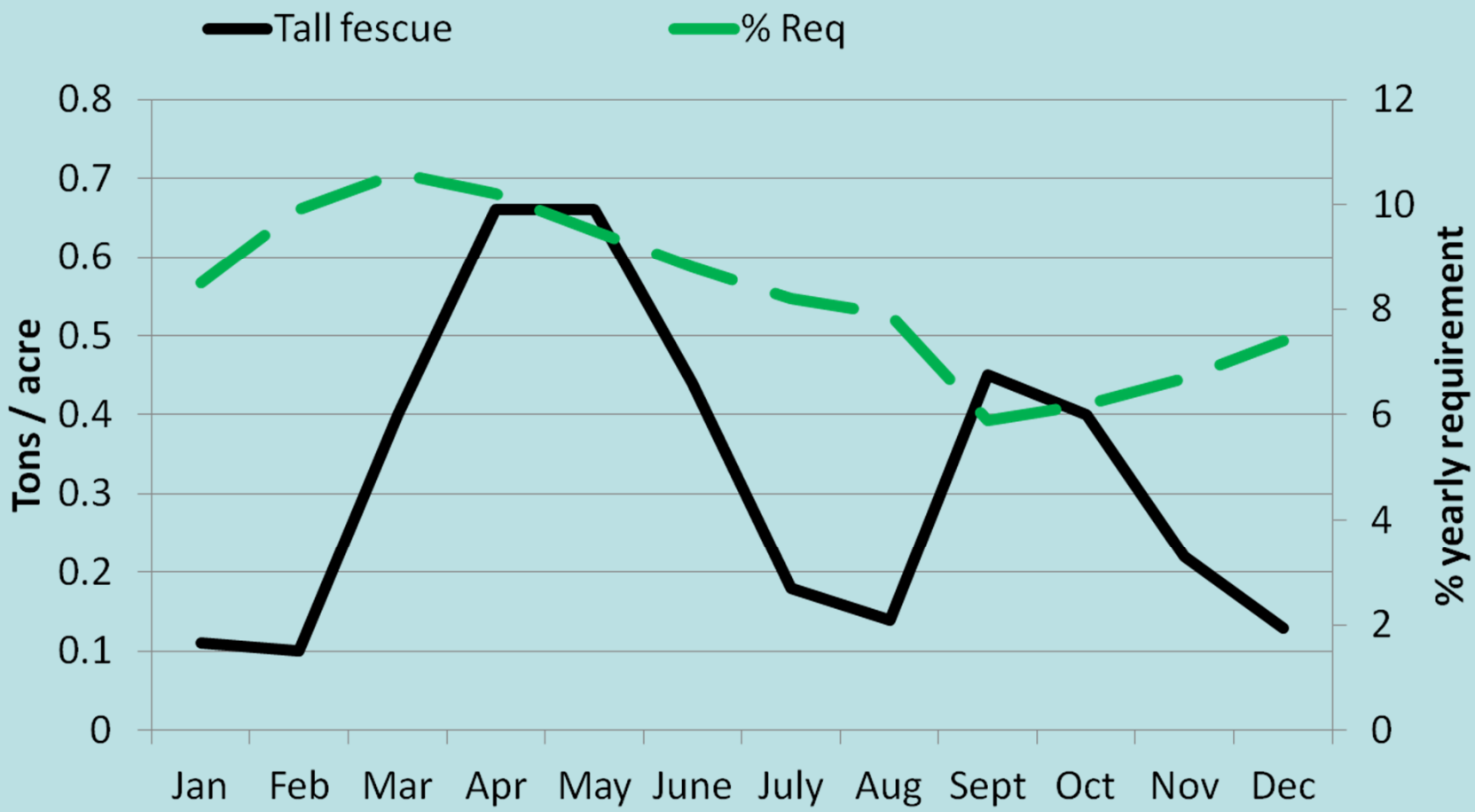
IA State, John Lawrence

Management Considerations

- Managing Season of Use: February Calving



February calving



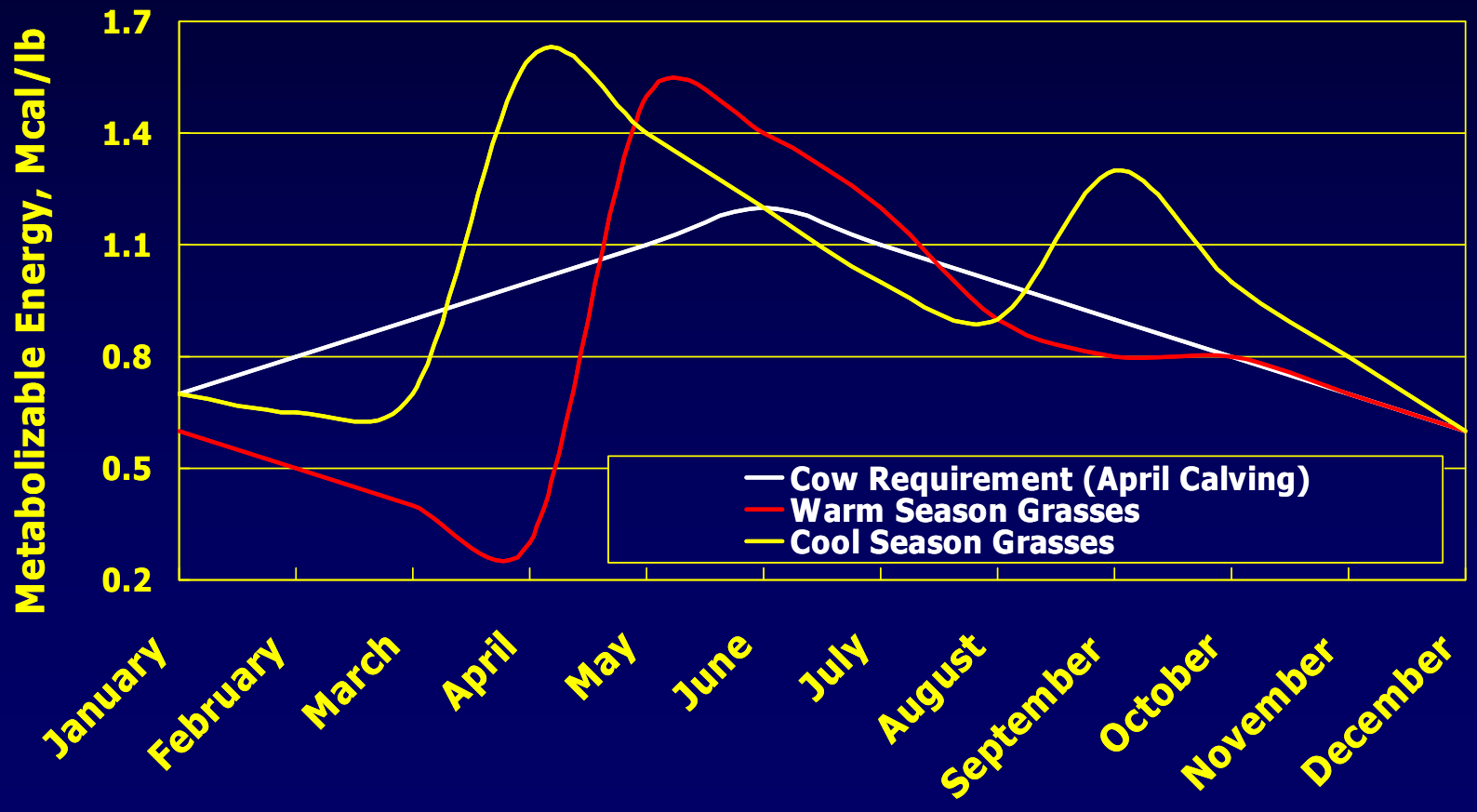
February calving considerations

- Advantages
  - Calve prior to crop field work
  - Cooler breeding season
  - Maximize milk on grass

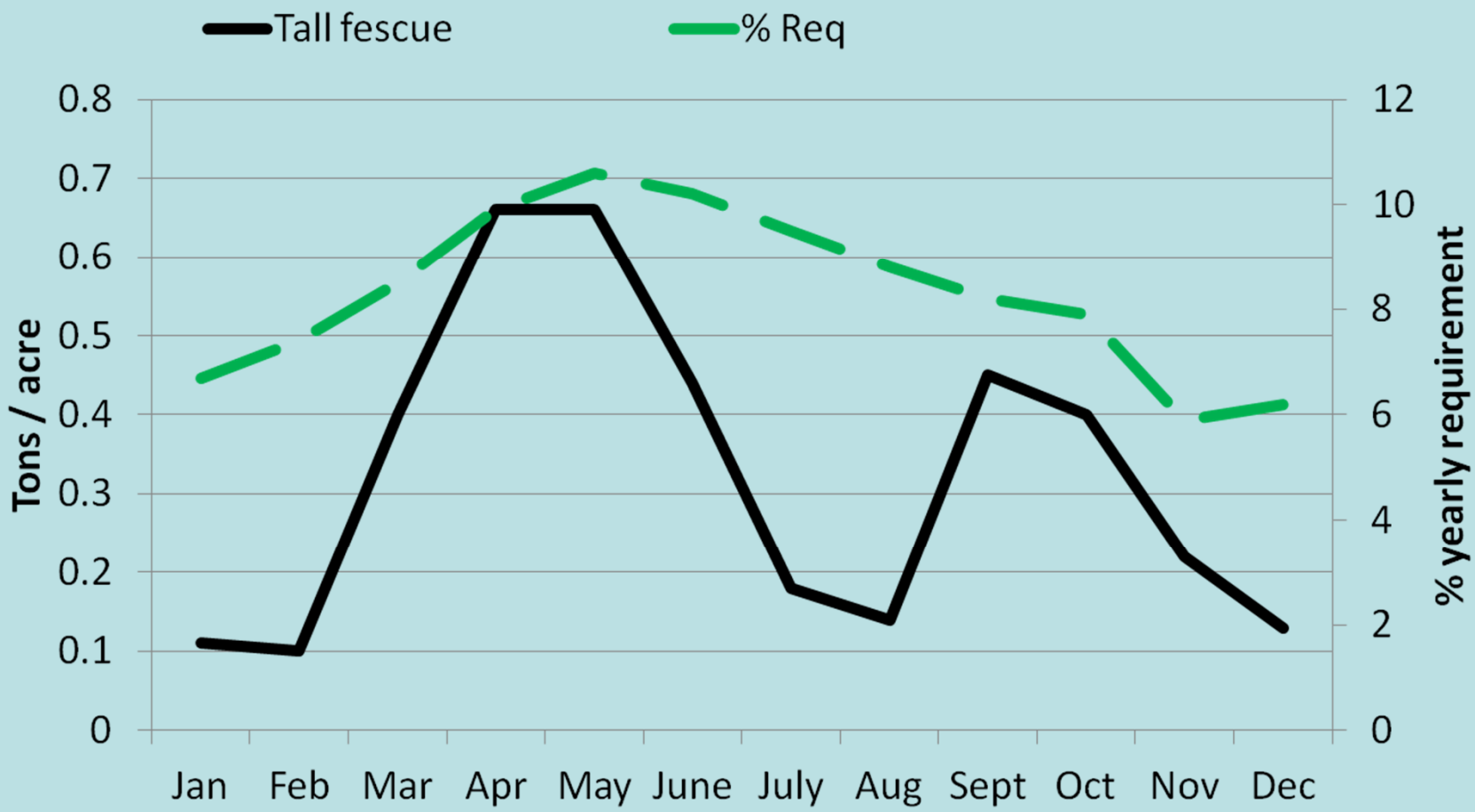
- Disadvantages
  - Cold weather, mud
  - Supplement early pasture growth
  - Greatest nutrient requirements occur during most expensive feeding period
  - Weaned calf market at low point

Management Considerations

- Managing Season of Use: April Calving



April calving

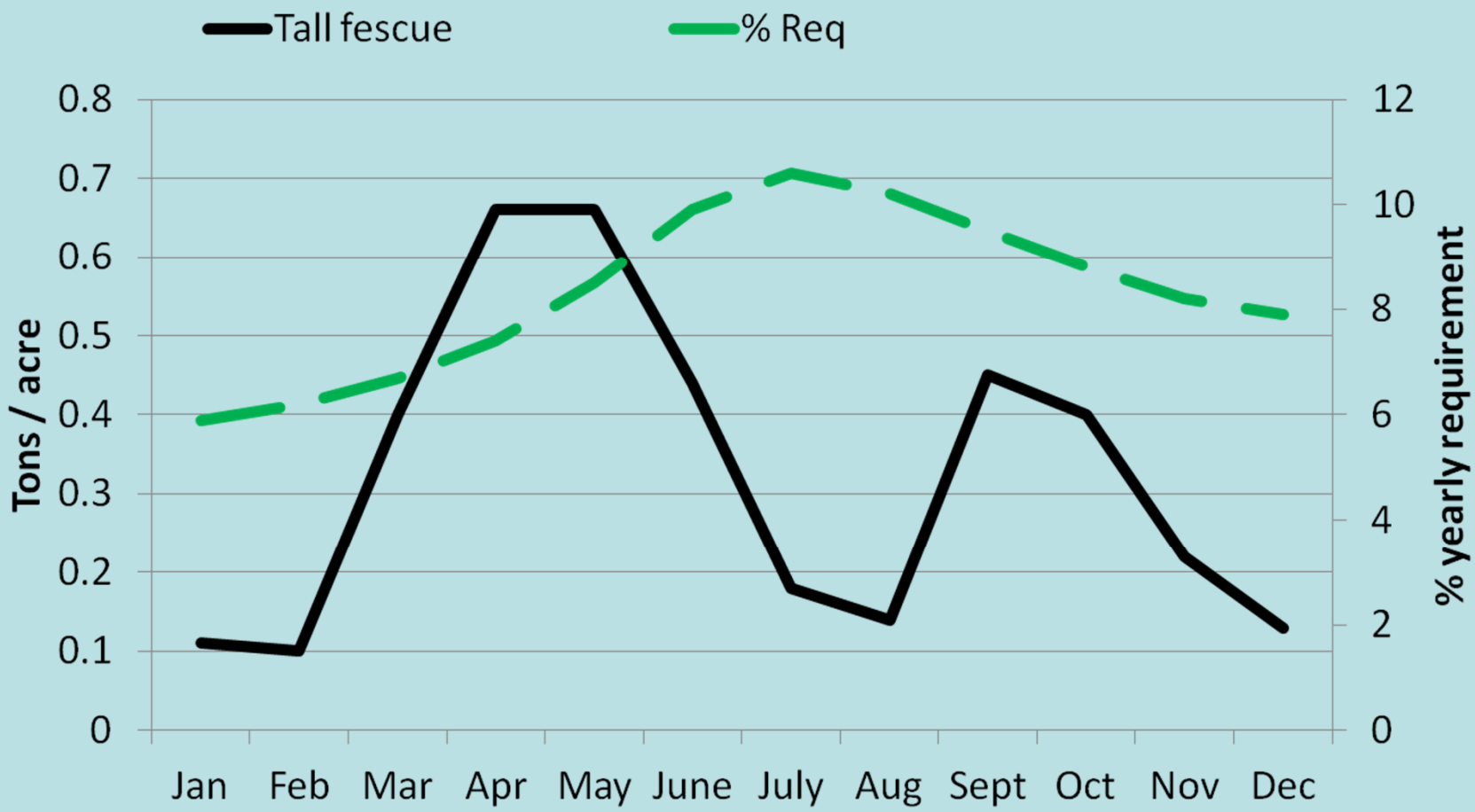


April calving considerations

- Advantages
  - Nutrient requirements align closer with forage production

- Disadvantages
  - Calve during planting season
  - Hotter breeding season
    - July 4th turn in
  - Market weaned calves at low point of price cycle

June calving

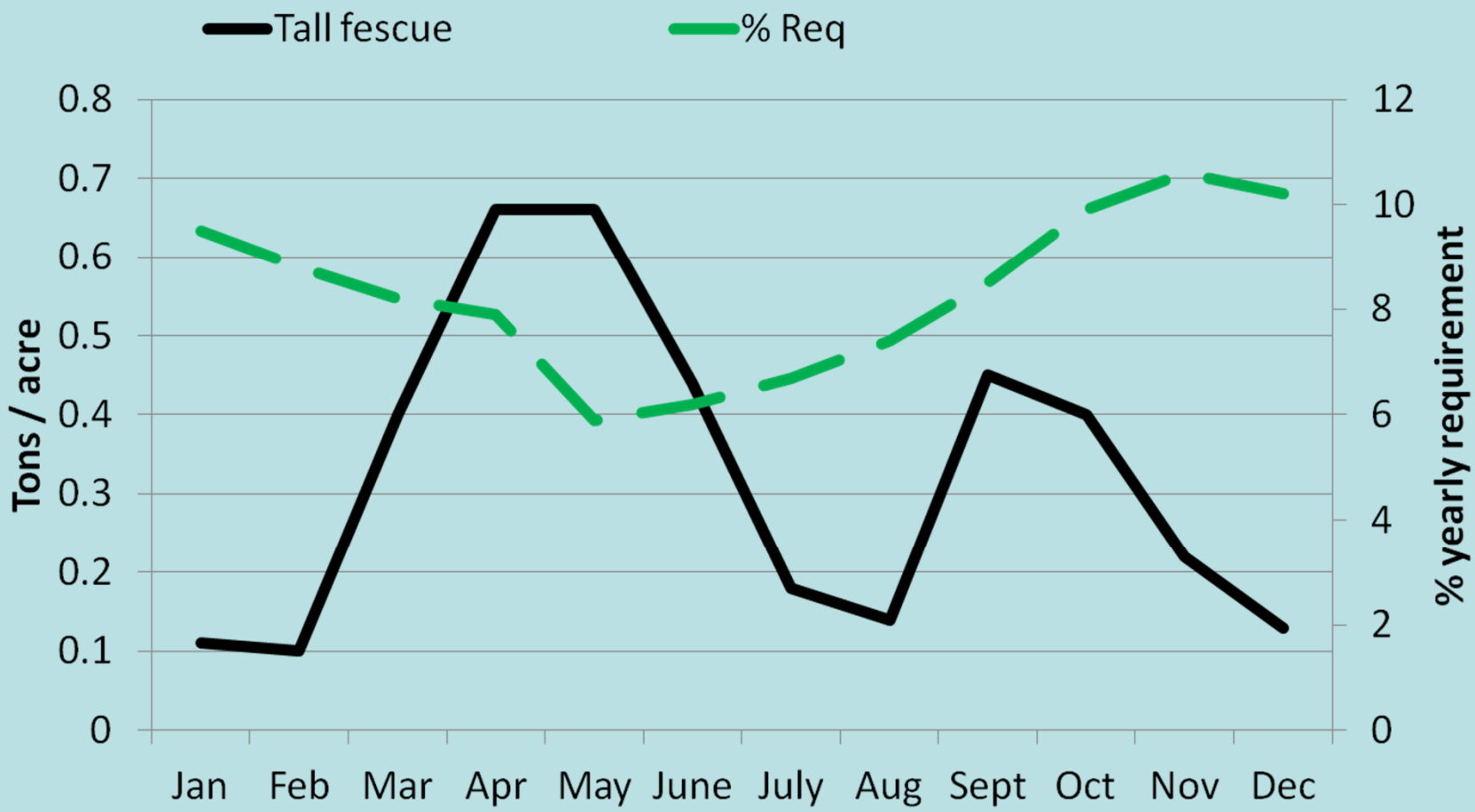


June calving considerations

- Advantages
  - Cows accumulate condition prior to calving
  - Early fall breeding season
  - Good calving conditions

- Disadvantages
  - Peak nutrient requirements during
    - Slowest (?) forage growth
    - Heat stress
  - Feeder calves marketed during low market point

October calving



October calving considerations

- Advantages
  - Cool calving and breeding season
  - Few calving problems
  - Cows can acquire BCS during spring and summer
  - Weaned and un-weaned calves ready to utilize spring flush
  - Market calves on high spring market
- Disadvantages
  - High nutrient requirements during winter period
  - Small calves (tail end of calving season) can fail to thrive (stunted) during harsh winter (North part of MO)

Management Considerations

- Principles of Supplemental Feeding
  - Supplemental Nutrients
  - Ruminal Bacteria
  - Supplement Function
    - Type
    - Amount
    - Pricing
    - Delivery

Ruminal Bacteria

- Fiber Digesters (adversely affected when starch-based supplement exceeds 0.6% BW)
  - Most important to forage-fed ruminants
  - Relatively slow growing
  - Narrow pH tolerance
- Starch Digesters
  - Important to grain-fed ruminants
  - Highly competitive for ruminal resources
  - Rapid growth and reproduction when substrate is available - comes at the expense of fiber digesters
  - Tolerance for low ruminal pH

Feeding Guidelines

- Issues to Consider
  - Unit feed cost:
    - Dry matter
    - Energy (NE_m or NE_g)
    - Protein
  - Protein Content
  - Labor cost and time requirement*
  - Equipment/infrastructure cost*
  - Size constraints
  - Animal performance - average
  - Animal performance – uniformity

* Often overlooked

Feeding Guidelines

- Salient Points
  - There is a perceived requirement for additional labor with hand-fed supplement delivery
    - Daily hand feeding is unnecessary
    - Weekly feed intake can be prorated over 2, 3, or 4 days per week depending on supplement type - performance is equivalent to daily feeding
      - The timing of nutrient intake does not appear to be critical over 2 to 4 day time intervals
    - Labor requirement becomes comparable to self-fed supplement delivery

Which forage should be used first?
Or "How did I get here?"
Or "How do avoid this dilemma?"

Conventional Nutrition

Ration Balancing

- Forage(s)
- Grain(s)
- Oilseed Meal(s)
- Byproduct(s)
- Mineral(s)
- Vitamin(s)

Animal Needs

- Protein
- Energy
- Lipids (fats)
- Minerals
- Vitamins

Pasture Nutrition

Ration Balancing

Pasture → Animal Needs

- Protein
- Energy
- Lipids (fats)
- Minerals
- Vitamins

Pasture Nutrition

Animal performance is related to:

- Intake
- Quality (digestibility)

Pasture Nutrition

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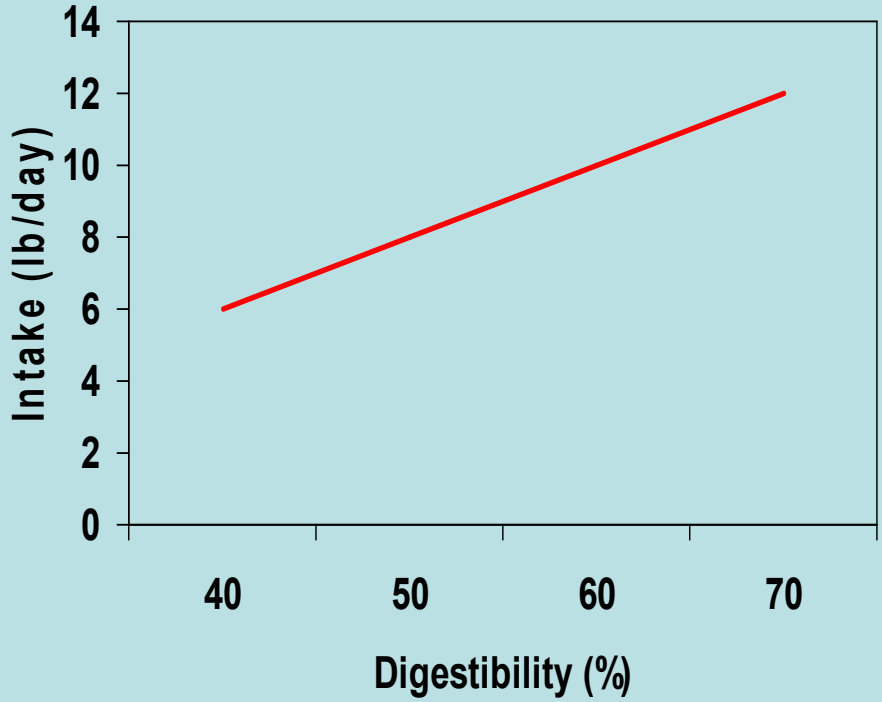

Pasture Nutrition

INTAKE

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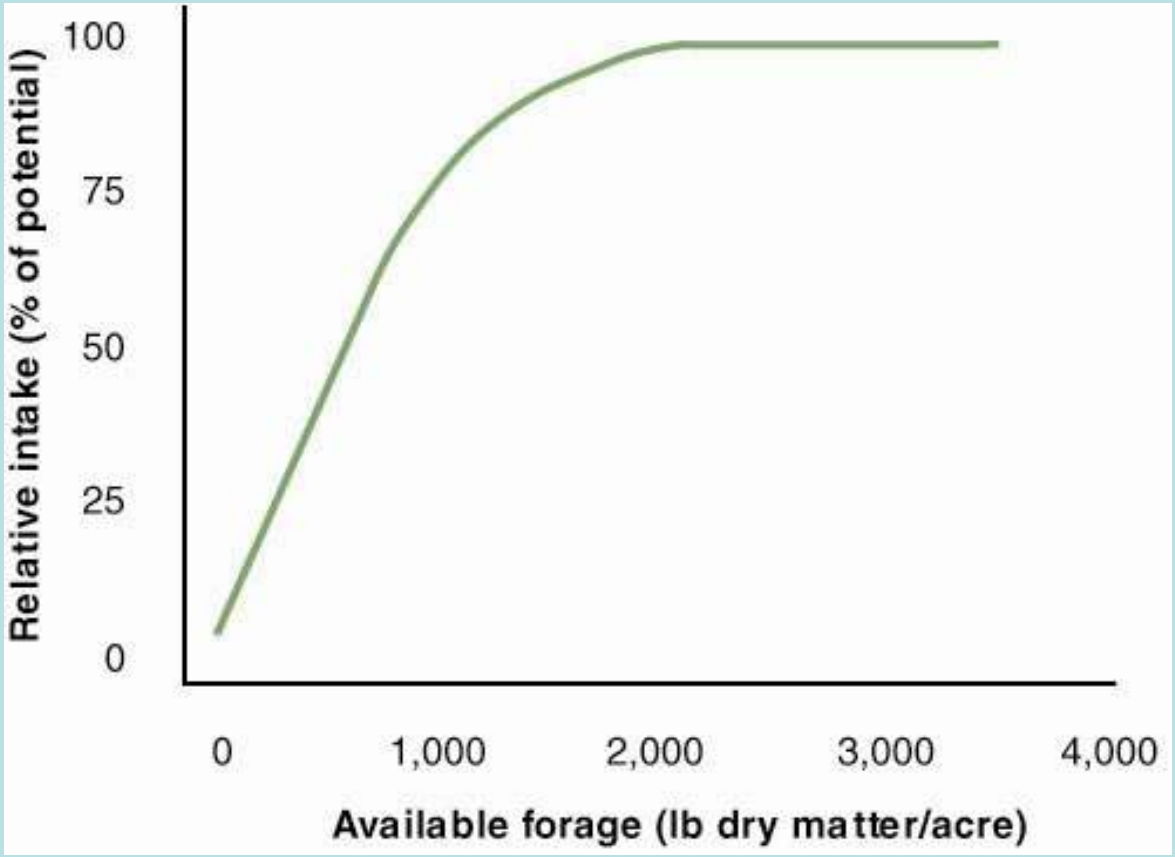
Effect of Forage Availability on Relative Forage Intake



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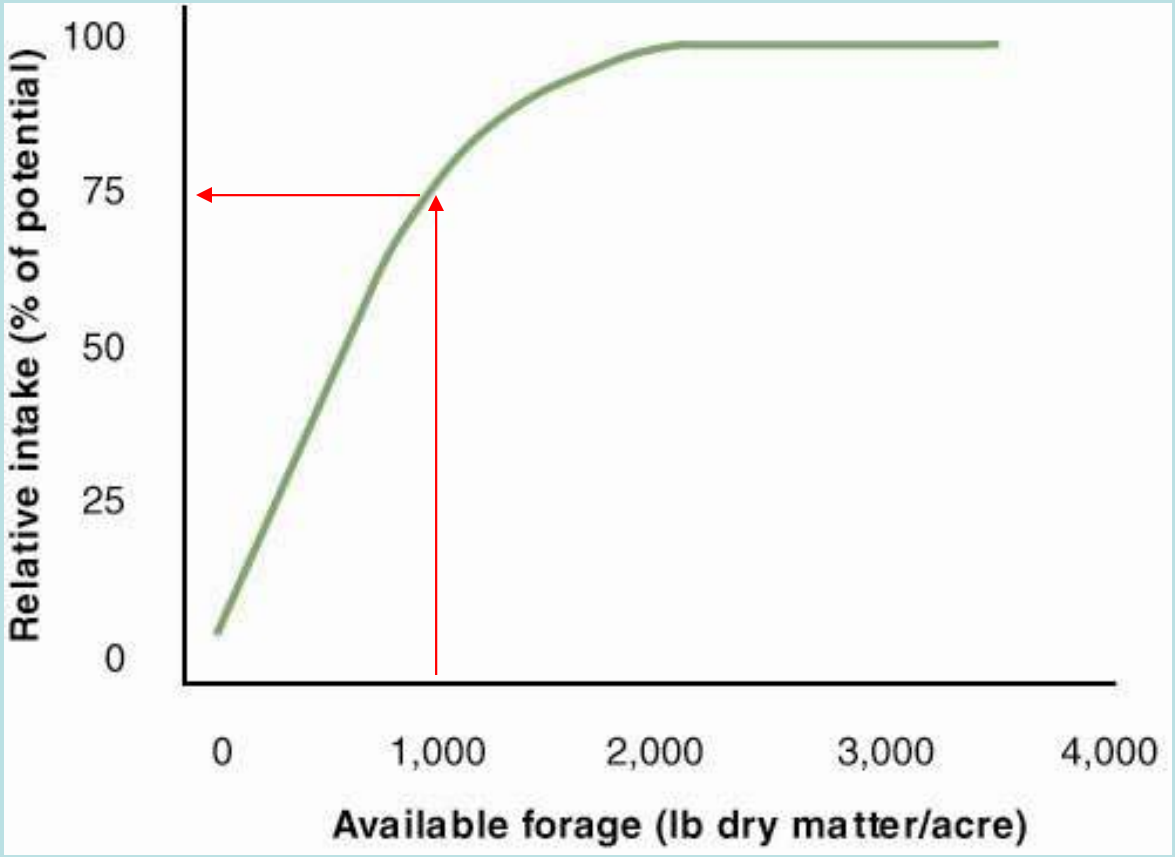

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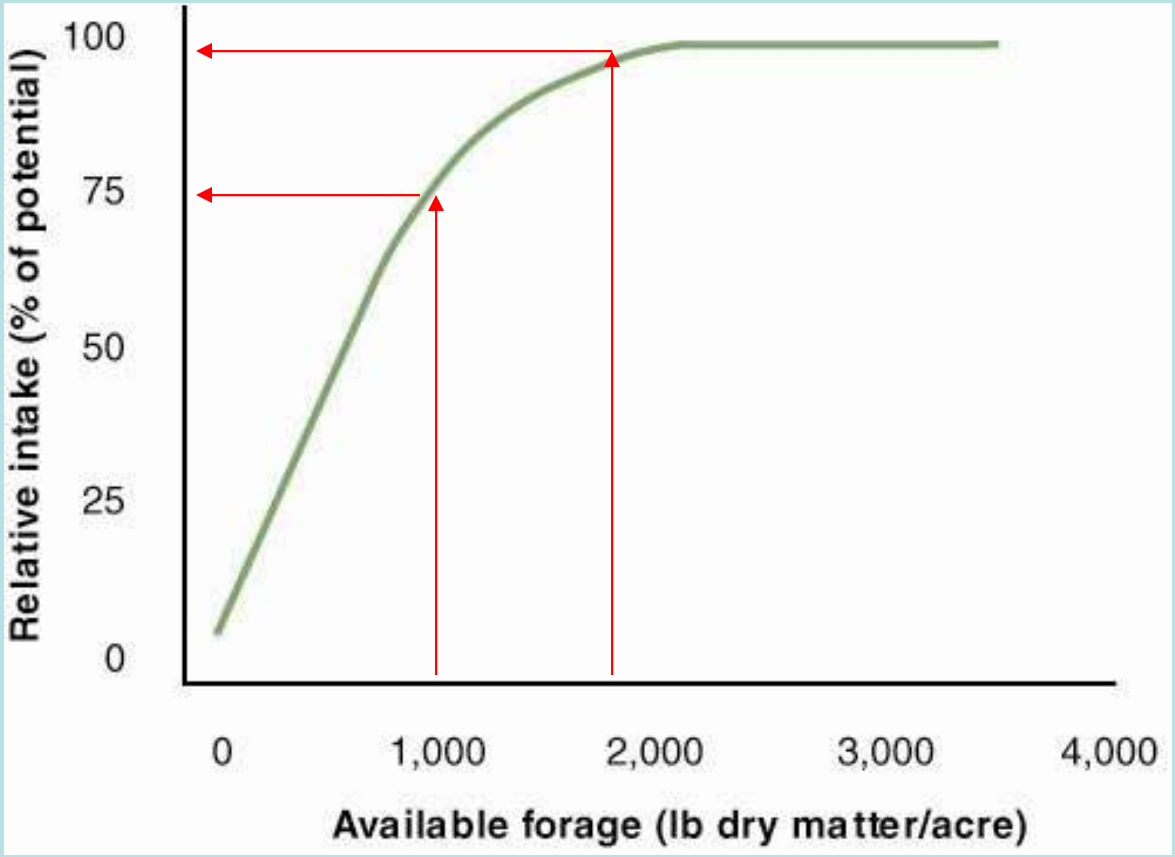

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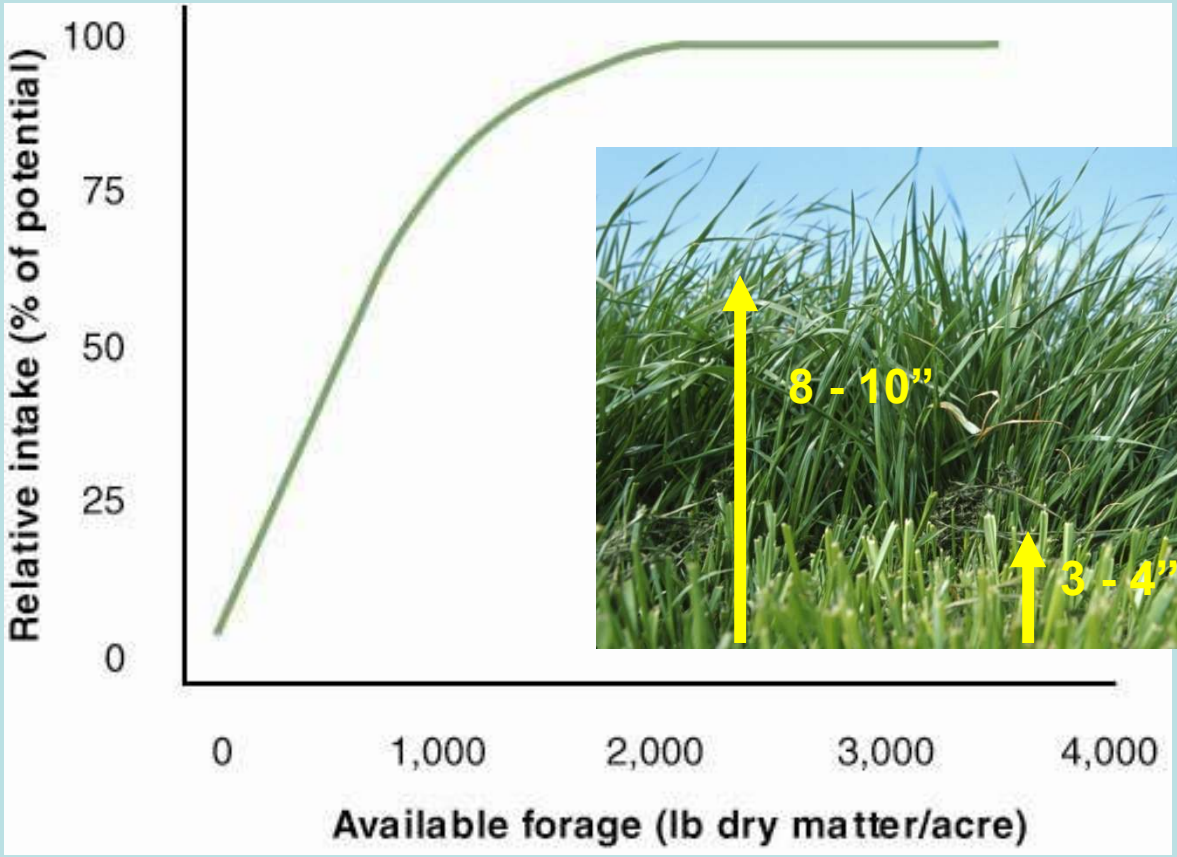

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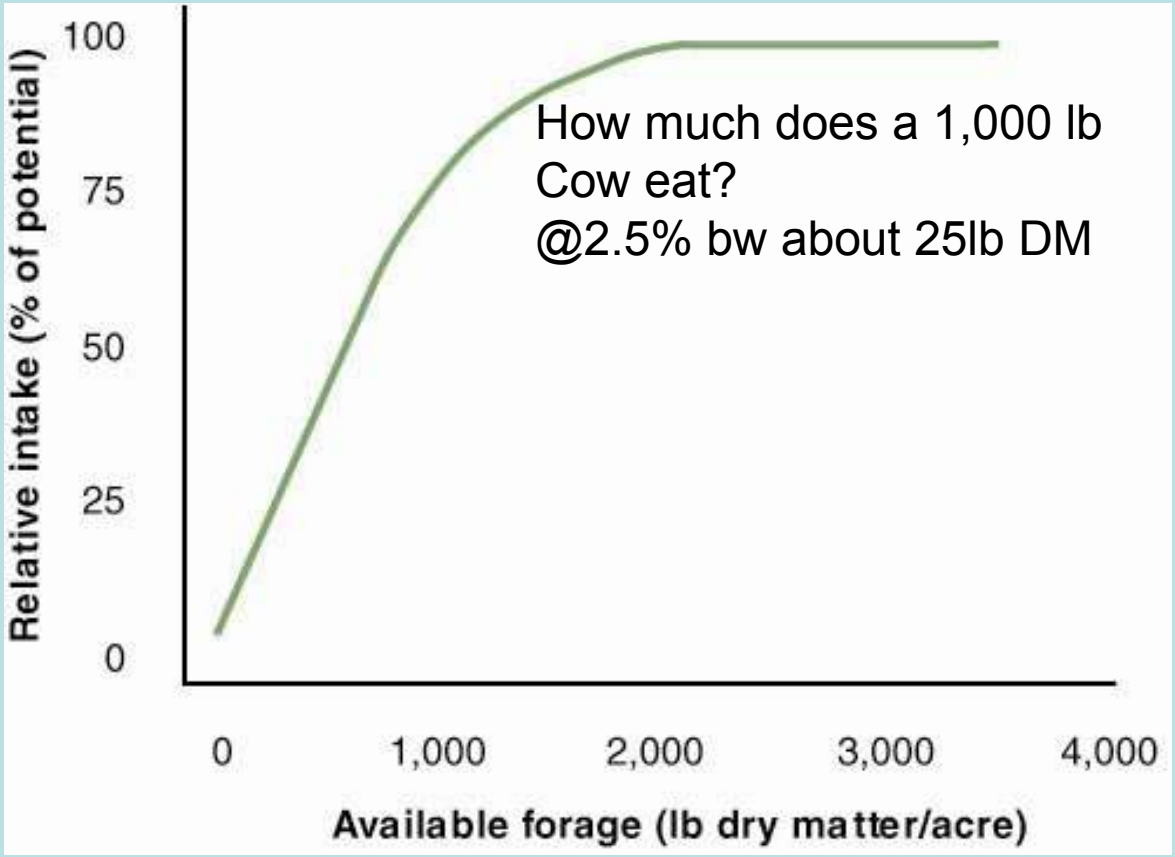

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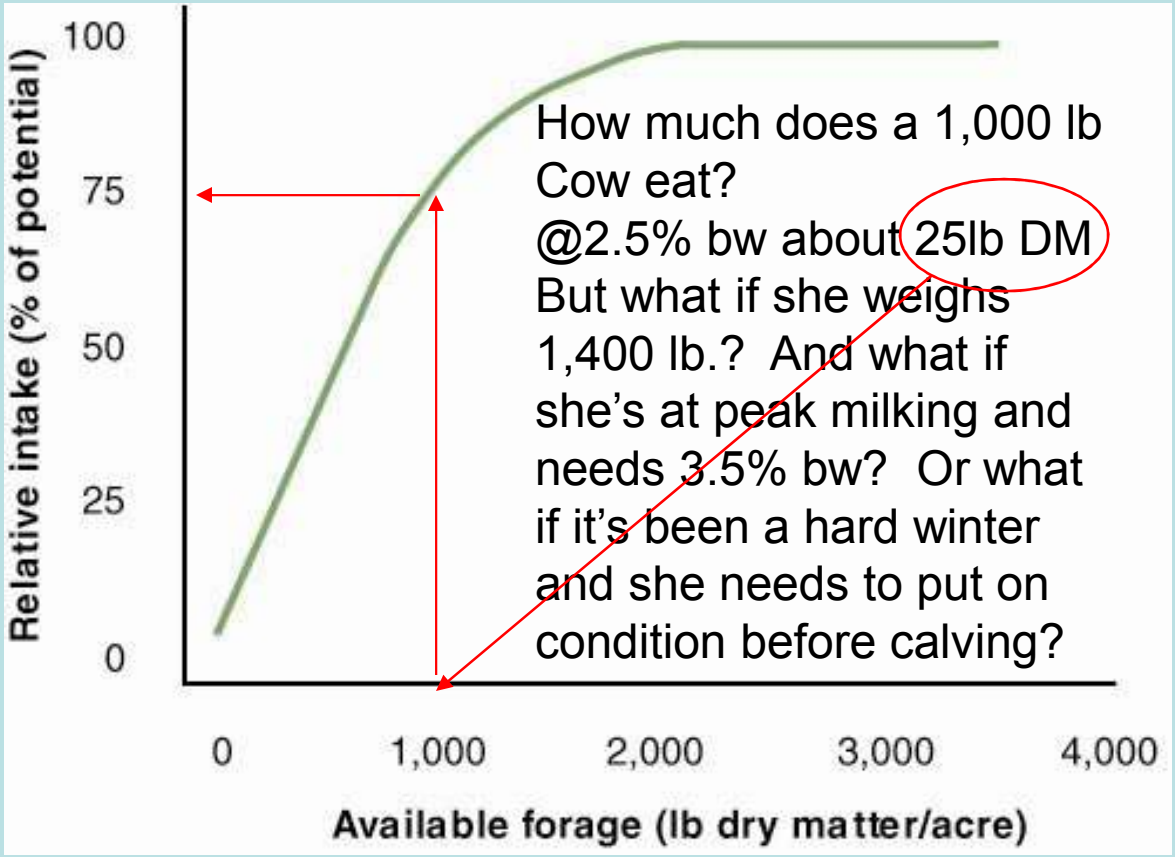

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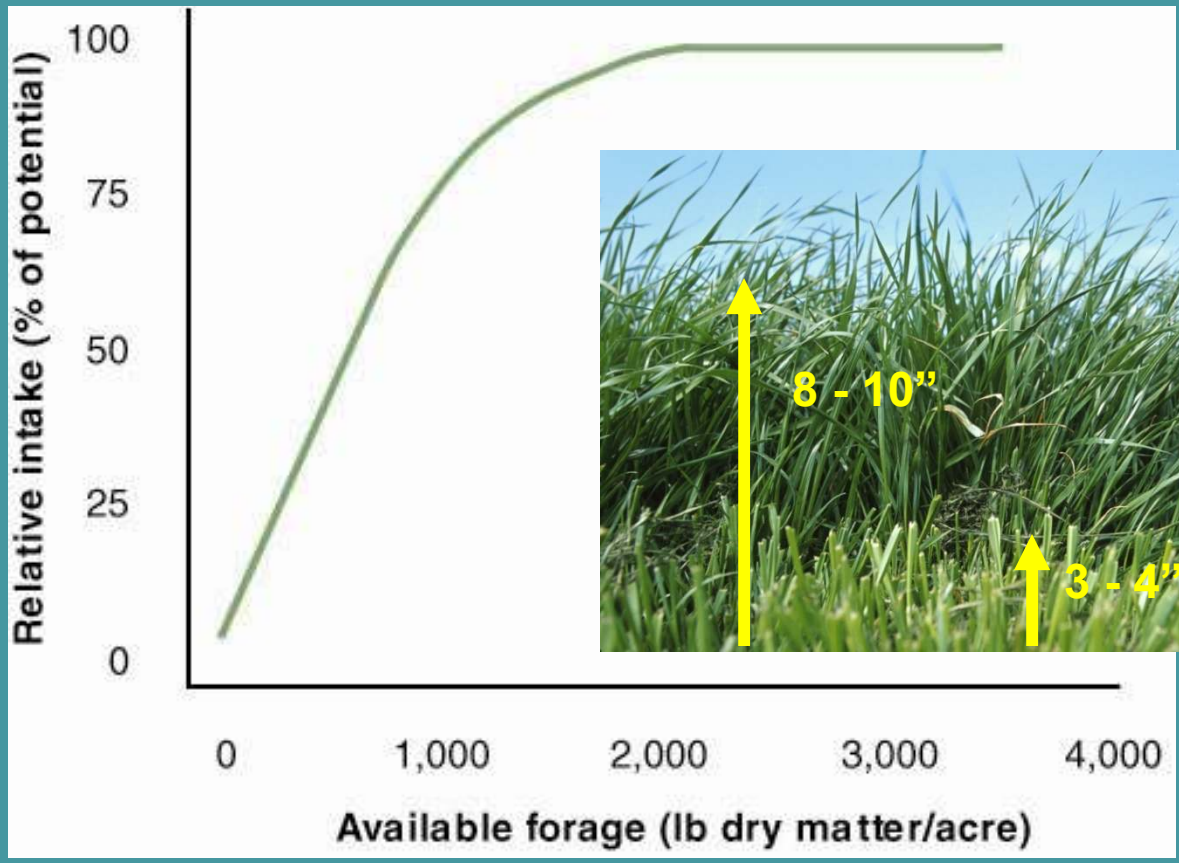


Factors Affecting Intake

BITING

BEHAVIOR

Factors Affecting Intake

BITING

BEHAVIOR

Dry matter intake =

Biting Rate x Biting (grazing) Time x Bite Size

Factors Affecting Intake

- Biting Rate
  - Can increase for short periods
  - Fatigue limits increase in intake
  - Cattle average 50 bites per minute

Factors Affecting Intake

- Biting Rate
- Biting (Grazing) Time
  - Cattle graze up to 10 hr (600 min) per day, influenced by herd behavior—boss cow
  - Rumination (cud chewing) up to 10 hr per day
  - Time ***not*** biting or chewing
  - Sleeping
  - Only 24 hours in a day

Factors Affecting Intake

- Biting Rate
- Biting (Grazing) Time
- Bite Size
  - Cattle average 0.3 g DM per bite
  - Measured range of 0.07 to 0.59 g per bite
  - Related to availability

Factors Affecting Intake

Dry matter intake =

50 bites/min x 600 min/day x 0.3 g/bite =

9.0 kg or 19.8 lb DM intake per day

Factors Affecting Intake

If bite size is only 0.07 g/bite

50 bites/min x 600 min/day x 0.07 g/bite =

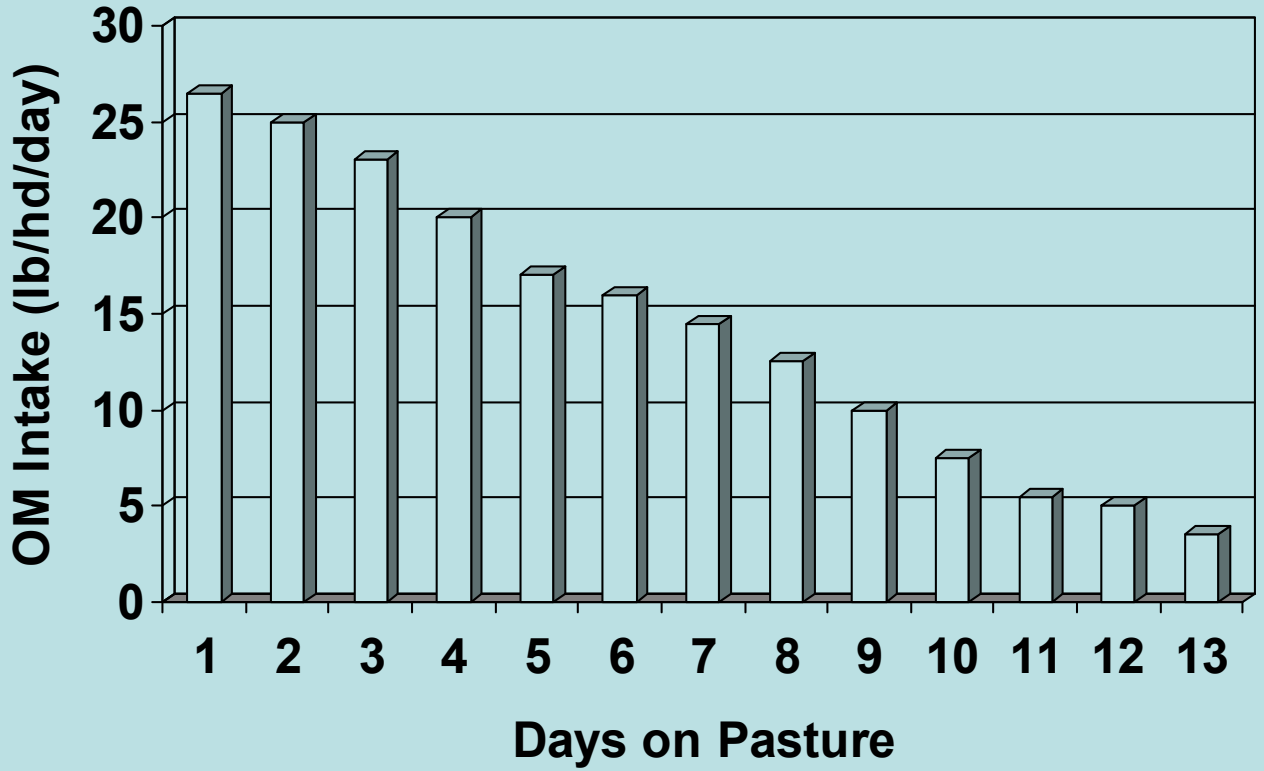
2.1 kg or 4.6 lb DM intake per day

If bite size is 0.59 g/bite

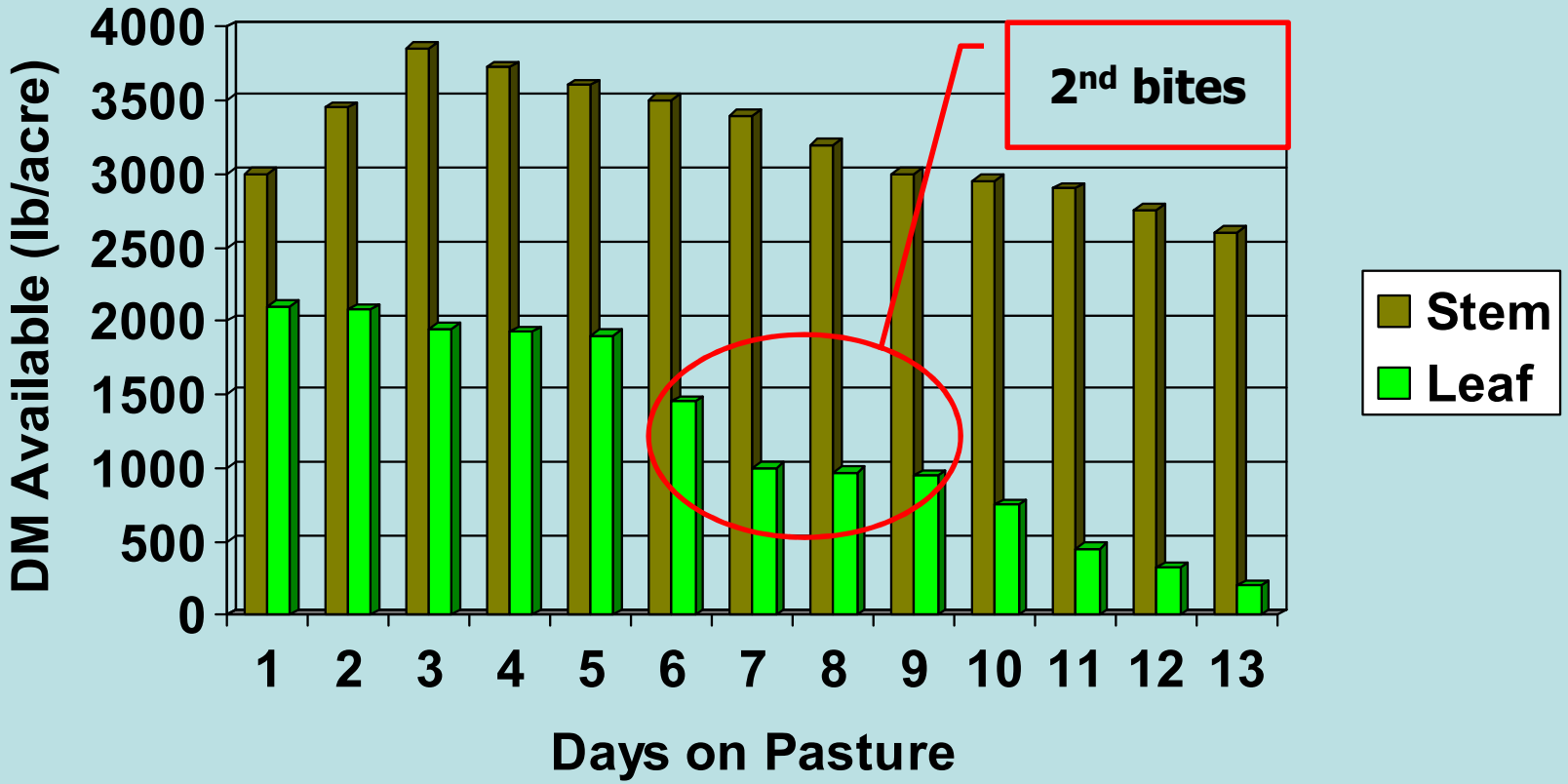
50 bites/min x 600 min/day x 0.59 g/bite =

17.7 kg or 38.9 lb DM intake per day

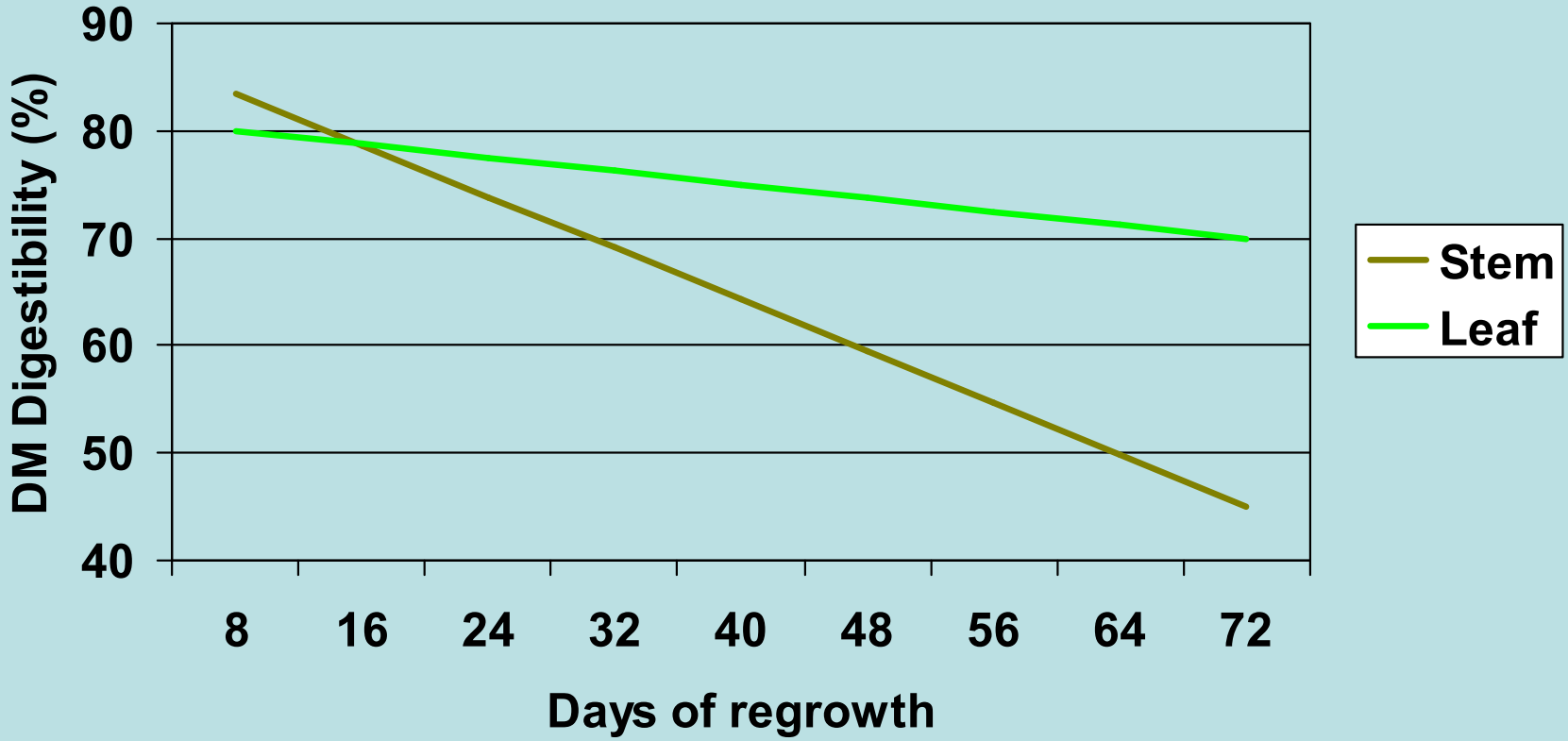
Impact of Days on Paddock on Organic Matter Intake



Impact of Days on Paddock on Change in Sward Composition



Change in Quality of Orchardgrass Stem and Leaf Regrowth with Time



Estimated Nutrient Content of Tall Fescue at Different Maturities

	NDF %	ADF %	CP %	NEm Mcal/lb	NEg Mcal/lb
Vegetative	49	27	20	0.70	0.39
Late boot	57	36	16	0.58	0.29
Mature	70	42	8	0.53	0.23

Animal Requirements vs Forage Quality at Different Maturities of Tall Fescue

1200 lb beef cow, superior milking ability, first 3-4 months post-partum

	Intake % bw	Intake lb DM	CP lb	NEm Mcal
Requirement	**2.0**	**23.8**	**2.7**	**15.5**
Vegetative				
Late boot				
Mature				

Animal Requirements vs Forage Quality at Different Maturities of Tall Fescue

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	Intake % bw	Intake lb DM	CP lb	NEm Mcal
Requirement	2.0	23.8	2.7	15.5
Vegetative	**2.5**	**30.0**	**6.0**	**21.0**
Late boot				
Mature				

Animal Requirements vs Forage Quality at Different Maturities of Tall Fescue

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Vegetative	2.5	30.0	6.0	21.0
Late boot	**2.1**	**25.2**	**4.0**	**15.6**
Mature				

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Vegetative	2.5	30.0	6.0	21.0
Late boot	2.1	25.2	4.0	15.6
Mature	**1.7**	**20.4**	**1.6**	**10.8**

Animal Requirements vs Forage Quality at Different Maturities of Tall Fescue

600 lb beef steer, 2.0 lb ADG

	Intake % bw	Intake lb DM	CP lb	NEm Mcal	ADG lb/day
Requirement	**2.5**	**15.0**	**1.6**	**5.2**	
Vegetative					
Late boot					
Mature					

Animal Requirements vs Forage Quality at Different Maturities of Tall Fescue

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	Intake % bw	Intake lb DM	CP lb	NEm Mcal	ADG lb/day
Requirement	2.5	15.0	1.6	5.2	
Vegetative	**2.5**	**15.0**	**3.0**	**10.5**	**2.0+**
Late boot					
Mature					

Animal Requirements vs Forage Quality at Different Maturities of Tall Fescue

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	Intake % bw	Intake lb DM	CP lb	NEm Mcal	ADG lb/day
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Vegetative	2.5	15.0	3.0	10.5	2.0+
Late boot	**2.1**	**12.6**	**2.0**	**7.2**	**1.2**
Mature					

Animal Requirements vs Forage Quality at Different Maturities of Tall Fescue

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Requirement	2.5	15.0	1.6	5.2	
Vegetative	2.5	15.0	3.0	10.5	2.0+
Late boot	2.1	12.6	2.0	7.2	1.2
Mature	**1.7**	**10.2**	**0.8**	**5.4**	**<0.5**

Animal Requirements vs Forage Quality at Different Maturities

- Can use different stages of quality to our advantage
  - Adjust body condition score
  - Creep grazing
  - “Leader – Follower” or “First-Last” grazing

Water
The *MOST* Important Nutrient

- Serves as a vital nutrient
- Used by livestock as a means of regulating core body temperature

Water
The *MOST* Important Nutrient

- Average intake 5 – 10% of BW
  - For a 1000 lb cow = 50 – 100 lb water/day

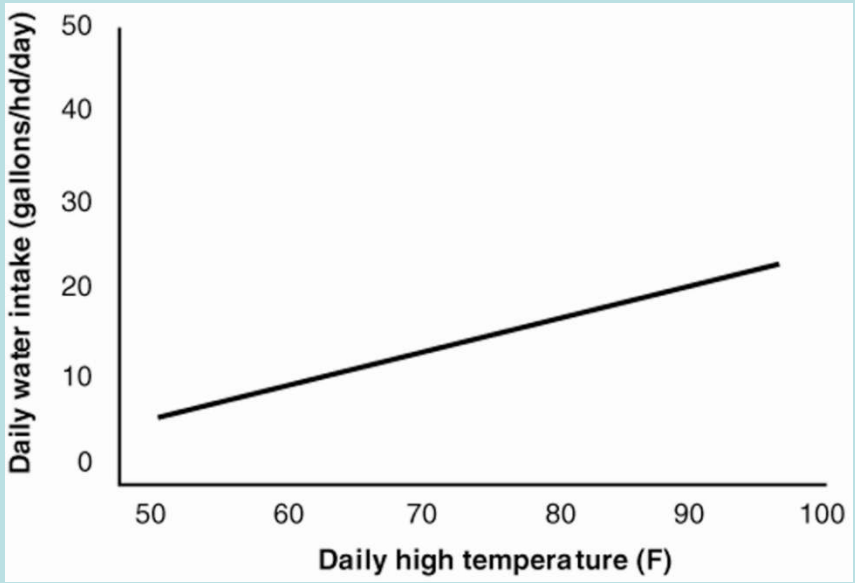
    or 6 – 12 gallons/day

Water
The *MOST* Important Nutrient

- Average intake 5 – 10% of BW
- Intake is affected by temperature

Water
The *MOST* Important Nutrient

- Average intake 5 – 10% of BW
- Intake is affected by temperature
  - Ambient (air) temperature
    - Cold may reduce water intake
    - Heat stress (including fescue toxicosis) may increase intake



Water
The *MOST* Important Nutrient

- Average intake 5 – 10% of BW
- Intake is affected by temperature
  - Ambient temperature
  - Water temperature
    - As water temperature increases from 32 to 105 degrees, water intake generally increases (in attempt to control core body temperature)
    - Cattle do not "prefer" cold water
    - Cool, but not cold, water offers cooling benefit and increases performance at the same time consumption decreases

Water
The *MOST* Important Nutrient

- Average intake 5 – 10% of BW
- Intake is affected by temperature
- Sources of water
  - Ground (well)
  - Surface (pond, stream)
  - Pasture (may contain up to 80% water by weight)
  - Dew, rain, snow

Water
The *MOST* Important Nutrient

- Average intake 5 – 10% of BW
- Intake is affected by temperature
- Sources of water
- Water quality
  - Offer the best quality of water that you can ***reasonably*** provide

SW Center Water Quality Studies

	Pond Water	Well Water
Beef steers (average for 2 yrs, 64 steers in 16 pastures per year)		
Water intake (gal/hd/day)	9.0	8.8
Free-choice water intake	5.2	5.0
ADG (lb/day)	1.02	1.02
Cow/calf pairs (average for 2 yrs, 32 pairs in 16 pastures per year)		
Water intake (gal/pr/day)	21.6	20.0
Free-choice water intake	11.4	9.3
Cow weight change (lb)	-44.3	-60.1
Calf ADG (lb/day)	1.82	1.82

Water
The *MOST* Important Nutrient

- Average intake 5 – 10% of BW
- Intake is affected by temperature
- Sources of water
- Water quality
  - Reasons to keep cattle out of ponds
    - Udder health
    - Hoof health
    - Pond health

Mineral Needs on Pasture

- Salt
  - Most forages are low in sodium (Na)
    - Supplementing with common white or red salt (either loose or block) is cheap, easy insurance

Mineral Needs on Pasture

- Salt
- Macro-minerals (Ca, P, K, Mg)
  - Grasses are adequate source of P, not always so good for Ca & Mg
  - Legumes *are* good source of Ca & Mg
  - Mixed grass/legume pasture are complimentary and may meet most animal needs

Mineral Needs on Pasture

- Salt
- Macro-minerals
- Micro-minerals of greatest "concern" in MO:
  - Copper
  - Zinc
  - Selenium

  *Despite concern there is little solid data showing that supplementing on well-managed pasture is needed or improves animal performance

Mineral Needs on Pasture

- Keep it simple
  - Don’t supplement with things you don’t need

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- Keep it simple
  - Don’t supplement with things you don’t need
- On grass/legume pasture
  - 1 part TM salt
  - 1 part DiCal (22% Ca and 19% P)

Mineral Needs on Pasture

- Keep it simple
  - Don’t supplement with things you don’t need
- On grass only pasture
  - 1 part TM salt
  - 1 part DiCal (22% Ca and 19% P)
  - 1 part feed-grade limestone

Mineral Needs on Pasture

- Keep it simple
  - Don’t supplement with things you don’t need
- On lush late-winter, early spring pasture
  - Grass tetany (hypomagnesaemia)
  - Caused by low Mg in pasture forage
  - It is a seasonal problem
  - Affects older cows during cold wet periods

Mineral Needs on Pasture

- Keep it simple
  - Don’t supplement with things you don’t need
- On lush late-winter, early spring pasture
  - 1 part TM salt
  - 1 part DiCal (22% Ca and 19% P)
  - 1 part Magnesium Oxide
  - 1 part dried molasses or ground corn

Mineral Needs on Pasture

- Keep it simple
  - Don't supplement with things you don't need
- Other consideration for grass tetany
  - Fertilizing with Mg does not increase Mg in forage
  - Fertilizing with as little as 25 lb P on low-P soils *does* increase Mg in forage
  - Mg is *not* stored in the animal's body; feeding Mg supplements year-round will *not* build reserves

Other Pasture Nutrition Considerations

- In most situations, energy (not protein) is the most limiting nutrient—a lot of protein tubs get fed that aren't needed
  - A growing steer gaining 2.0 lb/day needs only 12-13% CP in the forage
  - A lactating beef cow needs only 10-13% CP
  - A dry beef cow needs only 2 lb CP per day; forages with 8-10% CP are usually adequate

Other Pasture Nutrition Considerations

- In most situations, energy (not protein) is the most limiting nutrient
- Energy sources
  - Grains (corn, milo, wheat, barley, etc)
    - High in starch
    - May result in acidosis
    - 0.6% bw (and possibly as little as 0.2% bw) as corn can depress fiber digestion
      - For a 500 lb calf, that's only 1 lb!

Other Pasture Nutrition Considerations

- In most situations, energy (not protein) is the most limiting nutrient
- Energy sources
  - Grains (corn, milo, wheat, barley, etc)
  - By-products (CGF, soy hulls, DDGs, etc)
    - Little or no starch
    - High in energy, digestibility
    - Do not inhibit fiber digestion like starch

Other Pasture Nutrition Considerations

- In most situations, energy (not protein) is the most limiting nutrient
- Energy sources
  - Grains (corn, milo, wheat, barley, etc)
  - By-products (CGF, soy hulls, wheat midds, etc)
  - Molasses (liquid or tub supplements)
    - Convenient
    - Expensive
    - Intake may be insufficient to really do much

Other Pasture Nutrition Considerations

- If protein *is* needed,
  - Test forages to see what you actually need
  - Feeding protein when it is ***not*** needed is expensive
  - ***Not*** feeding protein when it ***is*** needed is expensive

Other Pasture Nutrition Considerations

- If protein *is* needed,
  - Alfalfa hay
  - Oil seed meals
  - Non-protein nitrogen (urea)
    - Must have a readily available source of energy (usually molasses) to utilize NPN

Conclusions

- The simpler, the better
- The more nutrition you can get from pasture, the less you have to purchase from outside
- Know what you're feeding—both pasture and stored feeds
- Pasture nutrition doesn't just happen, manage so livestock eat what you want them to eat

Summary

- Plant maturity and species diversity affect diet quality
  - Both can and should be managed
  - Be aware that animal selectivity positively affects diet quality
- Animal nutrient requirements fluctuate with body size and physiological state
  - Make an effort to match peak periods of nutrient availability with peak periods of nutrient demand
- Supplemental feeding programs require careful evaluation of:
  - Type
  - Amount
  - Equivalent price comparison
  - Delivery system