# Bison Nutrition 101

Philip M. Urso, Ph.D., PAS
Assistant Professor of Bison Studies
South Dakota State University

# Philip Urso

## EDUCATION

**2020**
Ph.D., Animal Science
Ruminant Nutrition/Muscle Biology
Texas Tech University

**2017**
M.S., Agriculture
Animal Nutrition Focus
Sam Houston State University

**2015**
B.S., Animal Science
Biology Concentration
Sam Houston State University

**2011**
Kaufman High School

## SCHOLARSHIP

Mineral Usage

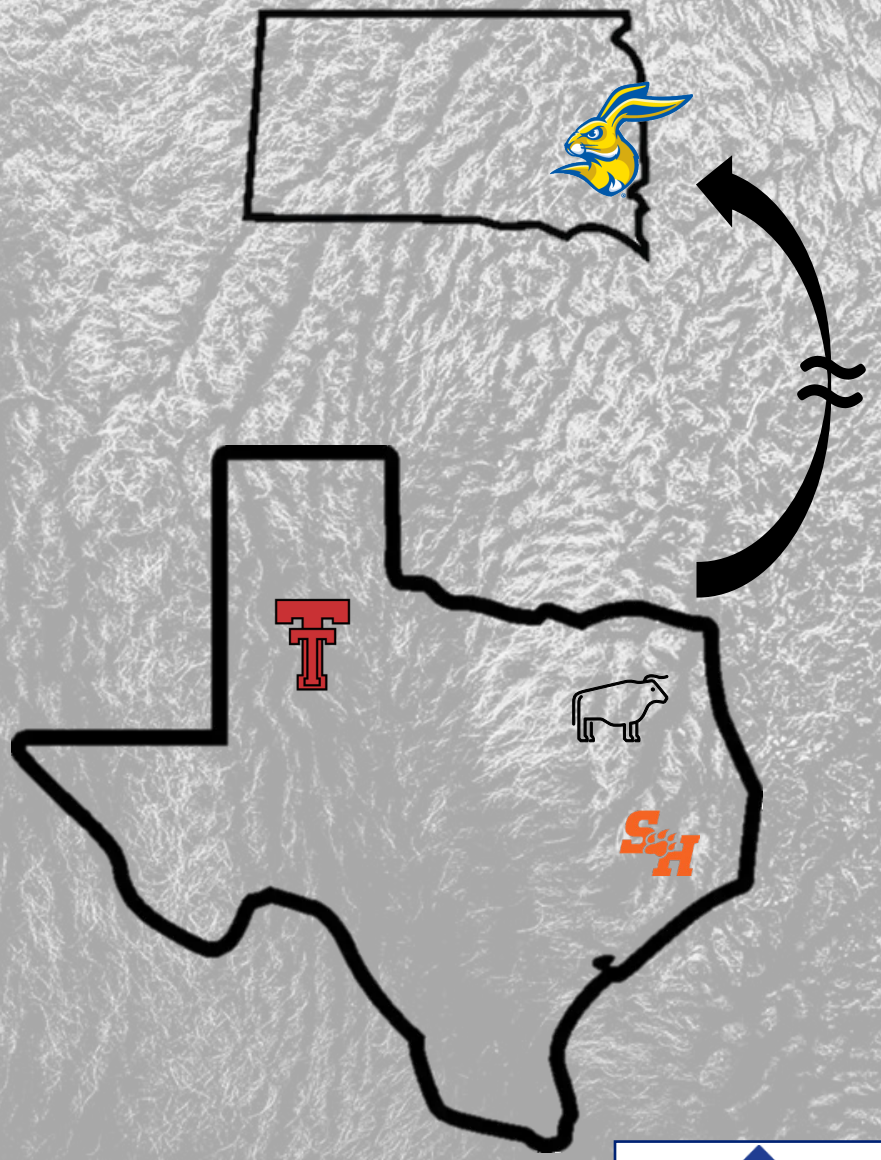
Wildlife

Beef Cattle

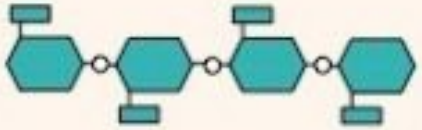
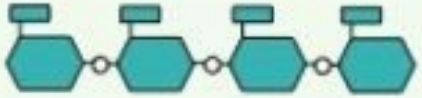
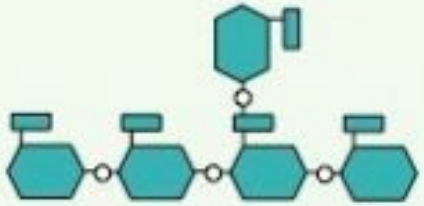
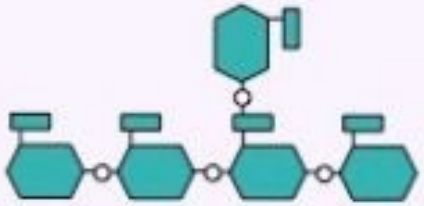
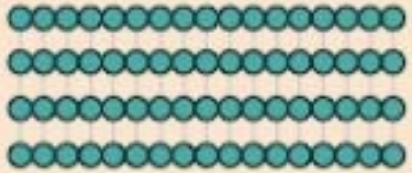
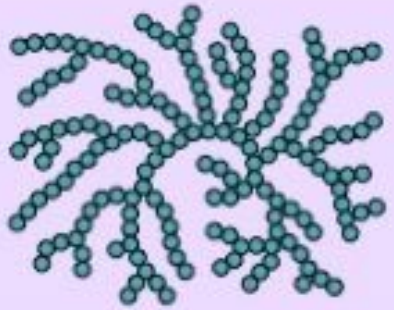
Animal Nutrition

## CLUBS AND ORGS.

- American Society of Animal Scientists
- American Registry of Professional Animal Scientists
- Delta Waterfowl
- SD Chapter of The Wildlife Society
- National Bison Association
- Dakota Territory Buffalo Association



# Discussion: What does nutrition mean to you?

| | Cellulose | Starch | | Glycogen |
|---|---|---|---|---|
| | | Amylose | Amylopectin | |
| **Source** | Plant | Plant | Plant | Animal |
| **Subunit** | β-glucose | α-glucose | α-glucose | α-glucose |
| **Bonds** | 1-4 | 1-4 | 1-4 *and* 1-6 | 1-4 *and* 1-6 |
| **Branches** | No | No | Yes (~per 20 subunits) | Yes (~per 10 subunits) |
| **Diagram** |  |  |  |  |
| **Shape** |  |  |  |  |

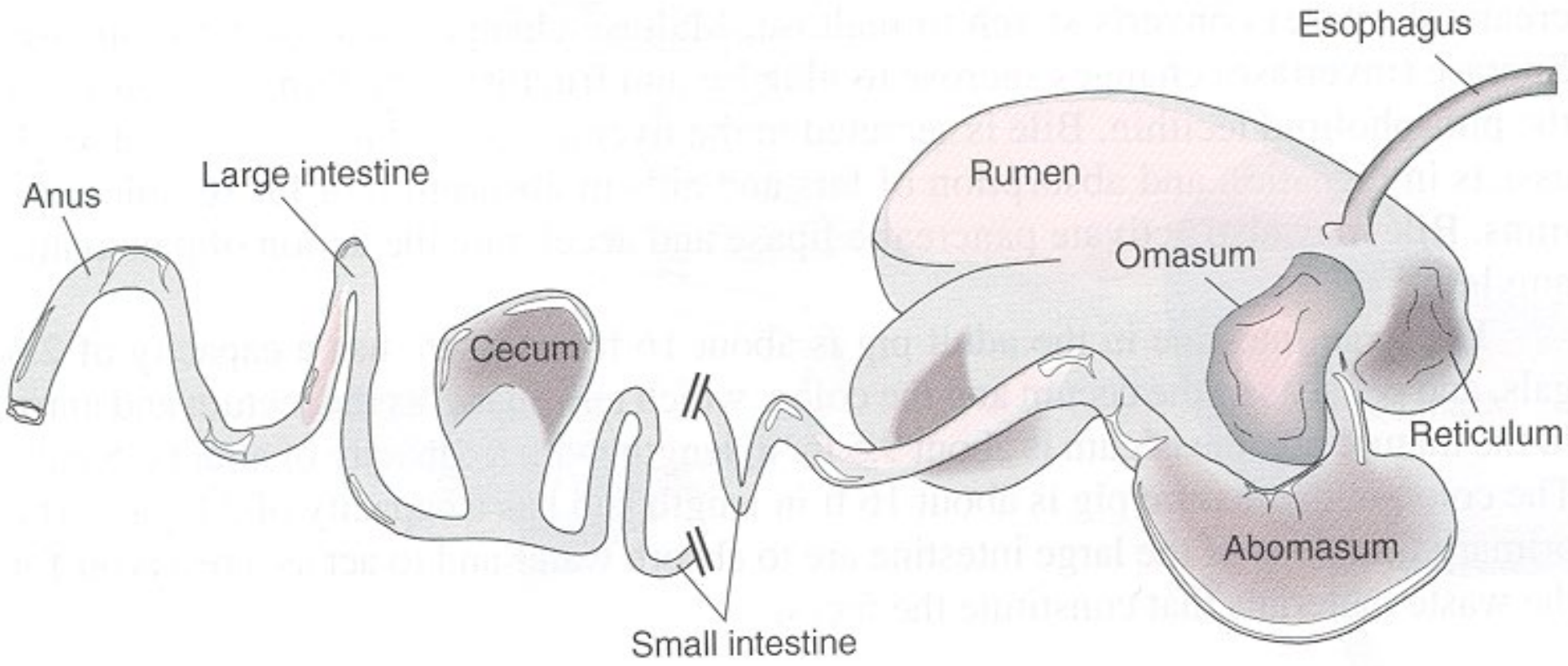
# Ruminant Digestive System

## Young ruminant animals

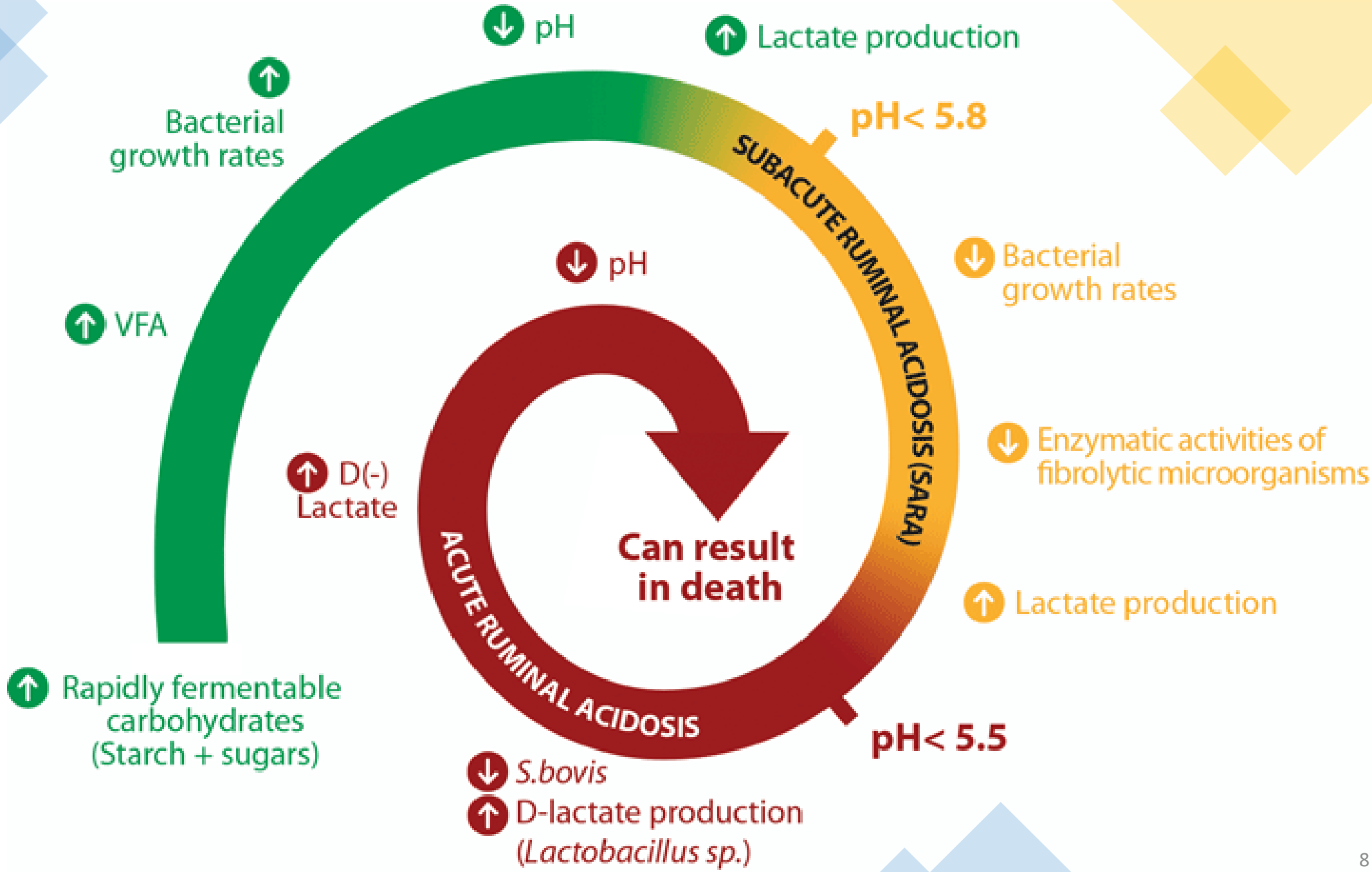
- Function as nonruminants

## Mature ruminant animals

- Four functional stomach compartments
  - Rumen
  - Reticulum
  - Omasum
  - Abomasum


Esophagus
Rumen
Omasum
Reticulum
Abomasum
Anus
Large intestine
Cecum
Small intestine

# Are we feeding the Bison or the Rumen?


pH
Lactate production
Bacterial growth rates
pH< 5.8
SUBACUTE RUMINAL ACIDOSIS (SARA)
pH
Bacterial growth rates
VFA
D(-) Lactate
Enzymatic activities of fibrolytic microorganisms
Can result in death
Lactate production
ACUTE RUMINAL ACIDOSIS
pH< 5.5
Rapidly fermentable carbohydrates (Starch + sugars)
S.bovis
D-lactate production
(Lactobacillus sp.)

# Bison Feeding

Greater ADG

Improved F:G

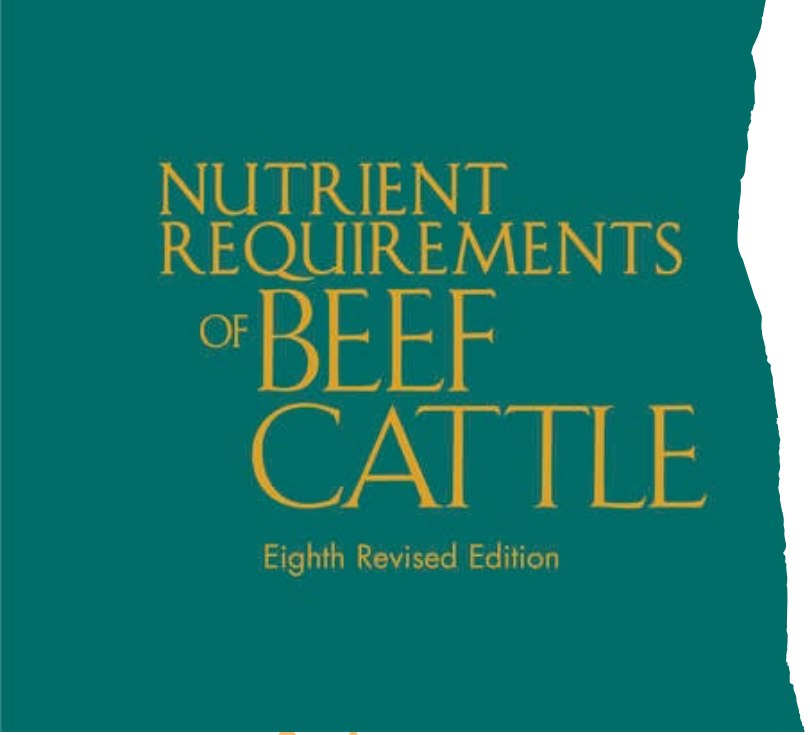
Improve marketability

Faster turn over

# Key Considerations

Little is known about the nutrient requirements of bison and optimum bison feeding systems.

- TMR? Free-choice?
- Season Effects?
- ADG? F:G? DMI?
- Behavioral Factors?

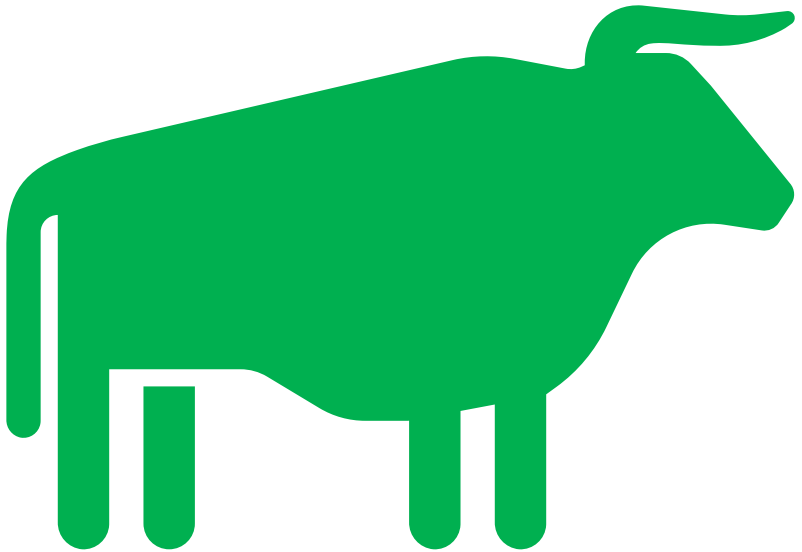



# How do we determine what to feed?

- What we know vs. What we have
  - Regional availability vs literature vs experience
- What is the best?
  - What's best for bison?
  - What fits the market?
- How do you decide?

# Balancing a Ration

Balancing in beef is done via math and complex requirements



A. *Using Two Feed Sources*

Formulate 100 lb of a complete swine diet containing 16% crude protein (CP). The feeds to be used are corn (8.9% CP) and a commercial supplement containing 36% CP.

1. Algebraic equations—a system of two equations in two unknowns
   a. Mathematical procedure

X = lb corn
Y = lb supplement
equation (1) $X + Y = 100$ lb diet
equation (2) $0.089X + 0.360Y = 16.0$ lb protein (16% of 100 lb)

A third equation is developed to subtract from equation (2) in order to cancel either X or Y; equation (3) is developed by multiplying everything in equation (1) by a factor of 0.089, thus

| | | | | |
|---|---|---|---|---|
| | equation (2) | $0.089X + 0.360Y =$ | | 16.0 |
| (subtract) | equation (3) | $-0.089X - 0.089Y =$ | | −8.9 |
| | | 0 | $0.271Y =$ | 7.1 |

$$Y = \frac{7.1}{0.271} = 26.2 \text{ (lb supplement)}$$

$$X = 100 - 26.2 = 73.8 \text{ (lb corn)}$$

   b. Check

| | | |
|---|---|---|
| 73.8 lb corn × 8.9% CP | = | 6.57 lb CP |
| 26.2 lb supplement × 36.0% CP | = | 9.43 lb CP |
| 100.0 lb diet | | 16.00 lb CP |

D. *Substitution Method*

A process of substituting amount of one ingredient for that amount of another or of substituting in a new ingredient.

1. Example of an original formulation

| Ingredient | Amount, lb | % CP | CP, lb |
|---|---|---|---|
| Smooth brome hay | 60.0 | 6.0 | 3.60 |
| Ground corn | 33.0 | 9.0 | 2.97 |
| SBM | 7.0 | 46.0 | 3.22 |
| | 100.0 | Total | 9.79 |

2. Assume you want to increase the crude protein content to 13% by substituting SBM for corn. Rather than using a trial-and-error approach, establish a one for one substitution

| | | |
|---|---|---|
| Add in 1 lb SBM | = | +0.46 lb CP |
| Remove 1 lb corn | | −0.09 lb CP |
| Net change in protein | = | +0.37 lb CP |

3. Since you want to increase from 9.79% to 13% CP, you will need 3.21 lb (13.0 − 9.79) additional protein in each 100-lb mixture.
4. Thus, if each one for one substitution increases CP by 0.37 lb, then

$$\frac{3.21}{0.37} = 8.68 \text{ lb SBM needed to substitute for } 8.68 \text{ lb corn}$$

5. The revised formulation follows

| Ingredient | Amount, lb | % CP | CP, lb |
|---|---|---|---|
| Smooth brome hay | 60.00 | 6.0 | 3.60 |
| Ground corn | 24.32 | 9.0 | 2.19 |
| SBM | 15.68 | 46.0 | 7.21 |
| | 100.0 | Total | 13.00 |

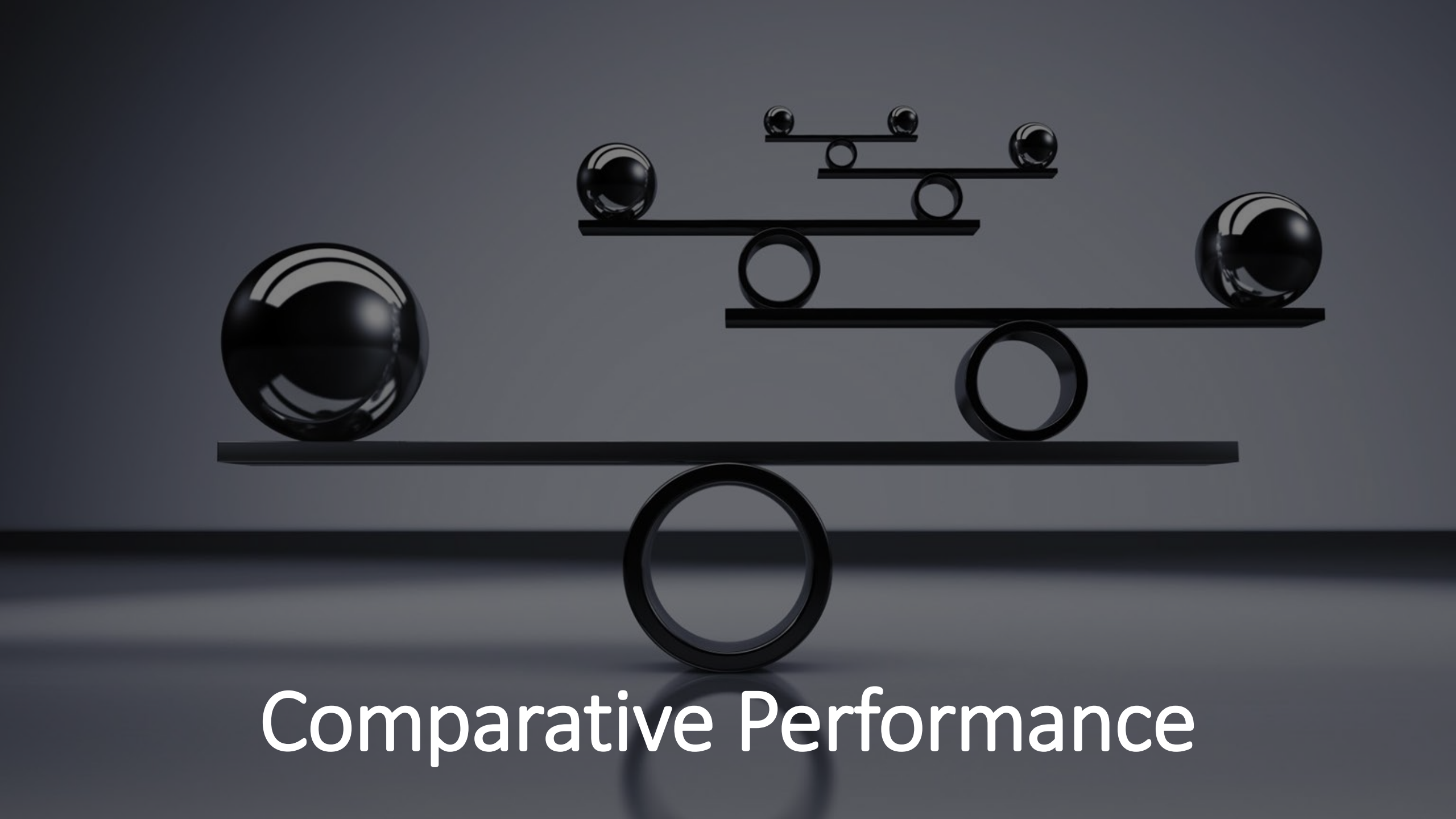
# Balancing a Ration

Balancing in beef is done via math and complex requirements

Bison don’t have these figures

- Bison do have an evolutionary advantage
- Bison are better able to self regulate and select what they need

# Discussion:
# What does this mean for the bison producer?



# Comparative Performance

# Performance of bison bulls by season

| | Season | | | |
|---|---|---|---|---|
| Item | **Spring** | **Summer** | **Fall** | **Winter** |
| Initial Wt, lb | 540 | 666 | 796 | 875 |
| Conc. Intake, lb/hd/day | 13.69[a] | 13.34 [a] | 19.62[b] | 15.96[ab] |
| Hay Intake, lb/hd/day | 5.93 [a] | 7.21[ab] | 8.29 [b] | 11.53[c] |
| DM Intake, lb/hd/day | 17.66[a] | 18.50[a] | 25.14[b] | 24.74[b] |
| DM Intake, % Body Wt | 3.28 | 2.78 | 3.18 | 2.83 |
| ADG, lb/hd/day | 1.72 [a] | 1.39 [a] | 1.76 [a] | 0.37 [b] |
| DM/Gain | 10.24 [a] | 13.51 [a] | 14.41 [a] | 66.00 [b] |

**Adapted from National Bison Association**

# Effect of feeding system on feedlot performance of bison bulls

| Item | Feeding System | |
|---|---|---|
| | **Spring** | **Summer** |
| | **TMR** | **Separate Grain/Hay** |
| Initial Wt, lb | 648 | 648 |
| Conc. Intake, lb/hd/day | 20.37[a] | 17.64[b] |
| Hay Intake, lb/hd/day | 6.79[a] | 11.82[b] |
| DM Intake, lb/hd/day | 24.26[a] | 26.35[b] |
| DM Intake, % Body Wt | 3.01[a] | 3.28[b] |
| ADG, lb/hd/day | 1.39 | 1.37 |

**Adapted from National Bison Association**

# Problems?

- In terms of metabolic body mass, bison have a reduced feed intake compared to cattle, **especially** during cold winter months.
- Intensive husbandry with very little space and rarely have access to pastureland to exhibit natural behavior
  - Can develop severe ruminal acidosis with concentrate finishing diets commonly used in cattle finishing.
  - TMR x Free choice Bison
- Slaughtered between 24 and 30 months of age
  - Longer turnover compared to cattle

# Finishing bison

- Finishing in feedlots usually takes place between 90 to 120 days pre-slaughter
- Commonly slaughter at 990lb to 1200lb
  - DP ~ 60%
- Finishing in a feedlot promote a light red color of the meat and uniform marbling
  - Increase marketability

# Bison vs Beef Growth

| | Bison | Hereford | Brahman |
|---|---|---|---|
| Initial BW, lbs | 408 | 550 | 672 |
| BW after 224 DOF, lbs | 787 | 1,093 | 1,110 |
| ADG, lbs | 1.7 | 2.5 | 1.9 |
| DMI, lbs | 14.0 | 21.6 | 19.4 |
| Feed:Gain, lbs | 8.2 | 8.6 | 10.3 |
| Avg Days to Slaughter | 336 | 239 | 239 |

**Koch et al. 1998**

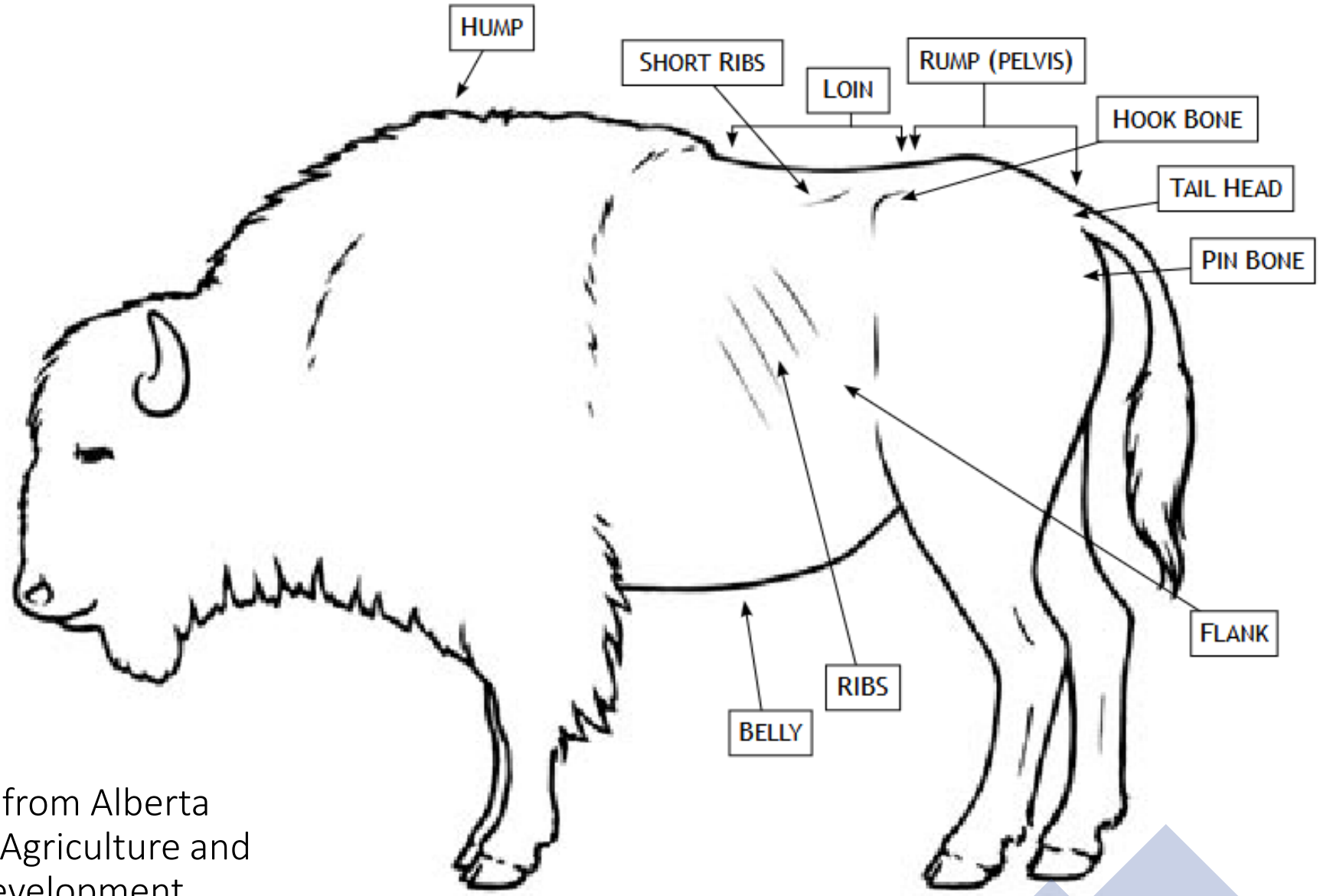
# Bison vs Beef Carcass

| | BISON | HEREFORD | BRAHMAN |
|---|---|---|---|
| Dressing % | 62.2 | 61.0 | 62.5 |
| Forequarter % | 53.5 | 51.4 | 50.4 |
| Retail Product % | 70.6 | 62.1 | 63.4 |
| Fat Trim % | 13.3 | 22.2 | 21.3 |
| Bone % | 16.1 | 15.7 | 15.3 |
| Marbling | 3.2 | 5.4 | 4.4 |
| Tenderness | 5.4 | 5.4 | 5.0 |
| Juiciness | 5.3 | 5.1 | 4.9 |
| Flavor | 2.3 | 3.0 | 3.1 |

Marbling: 1 = devoid, 5 = small, 10 = abundant. Tenderness: 1= extremely tough, 8 = extremely tender. Juiciness: 1 = dry, 8 extremely juicy. Flavor: 1 = intense, 4 = none.

**Koch et al. 1998**

# Body Condition Scoring




Adapted from Alberta Ministry of Agriculture and Rural Development.

# BCS 1

WHOLE BODY

- Thin

RIBS

- Prominent, many ribs visible in summer
- Visible but less distinct in winter

SPINE

- Backbone very sharp
- Steep angle of muscle

HIP BONE AND RUMP

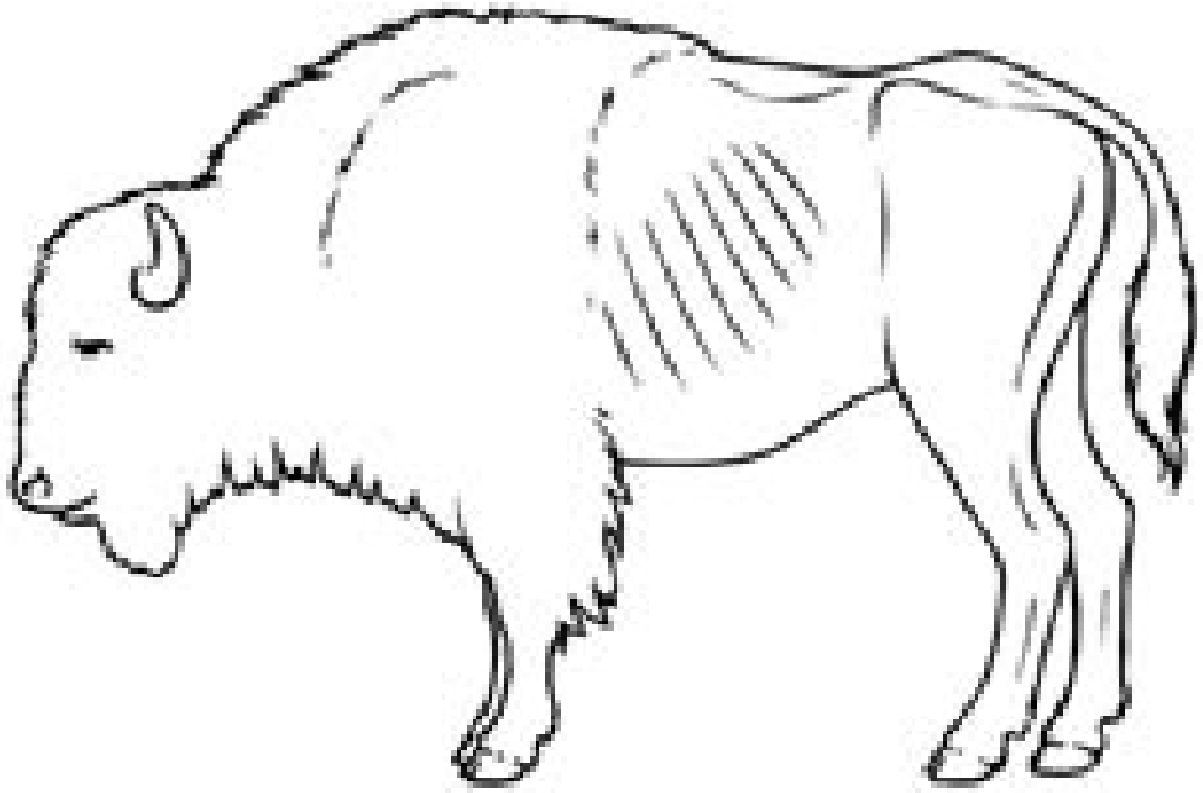
- Hip bone prominent, edges very sharp
- Rump muscles caved in

TAIL HEAD

- Devoid of fat
- Deep, sunken depressions on either side of tail head
- No fat palpable if bison in squeeze

HUMP

- Sharp top line
- Narrow with flat sides when viewed from front
- Sharp contrast between hump and shoulder when viewed from side



# BCS 2

WHOLE BODY

- Moderately thin

RIBS

- Some ribs visible in summer and winter

SPINE

- Backbone evident, but not sharp
- Steep angle of muscle

HIP BONE AND RUMP

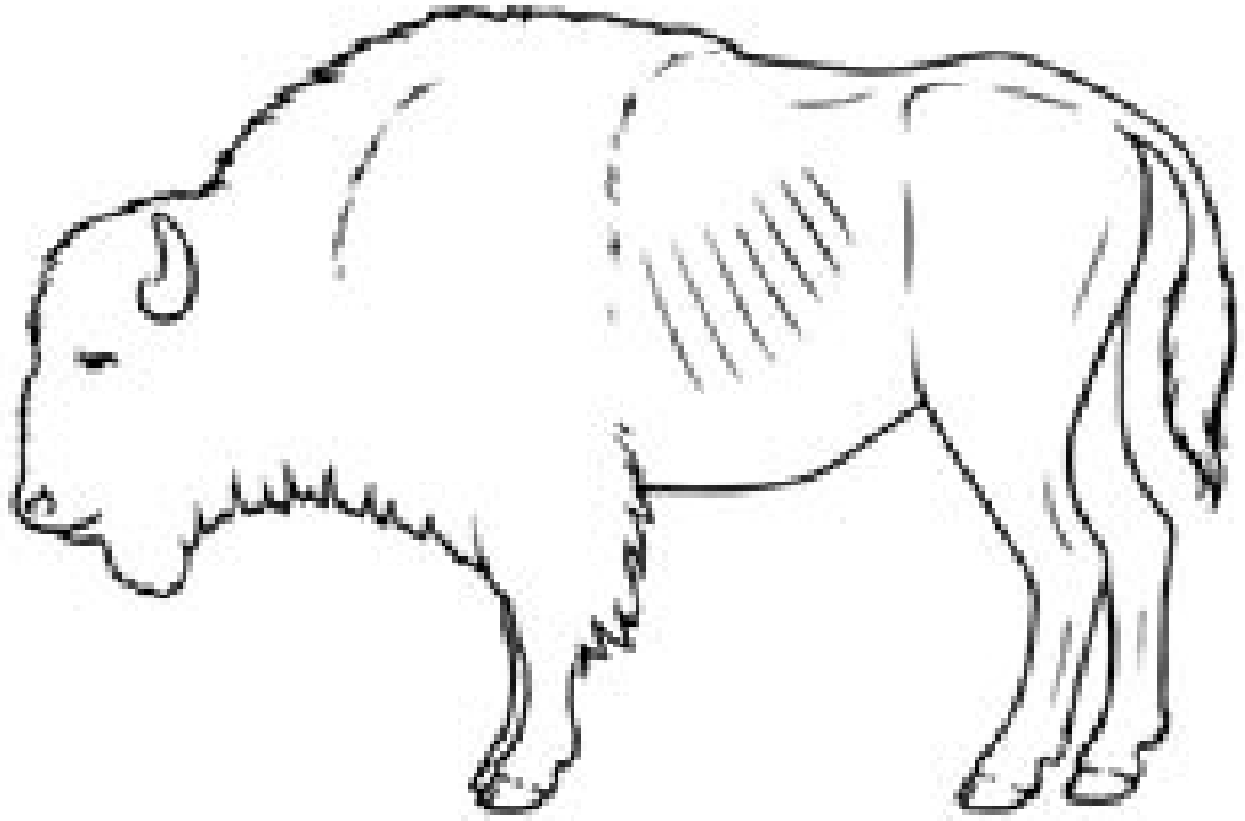
- Hip bone readily seen, edges sharp
- Rump muscles cave in slightly

TAIL HEAD

- Sunken depressions on both sides of tail head
- Small amount of fat palpable if bison in squeeze

HUMP

- Hump is narrow, but not sharp
- Sides flat when viewed from front
- Distinct contrast between hump and shoulder



# BCS 3

WHOLE BODY

- Moderate

RIBS

- Edges round, covered in flesh
- May be visible, but not sharp or distinct in summer
- Not visible in winter

SPINE

- Backbone visible, but not prominent
- Angle of muscle has moderate slope, similar to roof of tent

HIP BONE AND RUMP

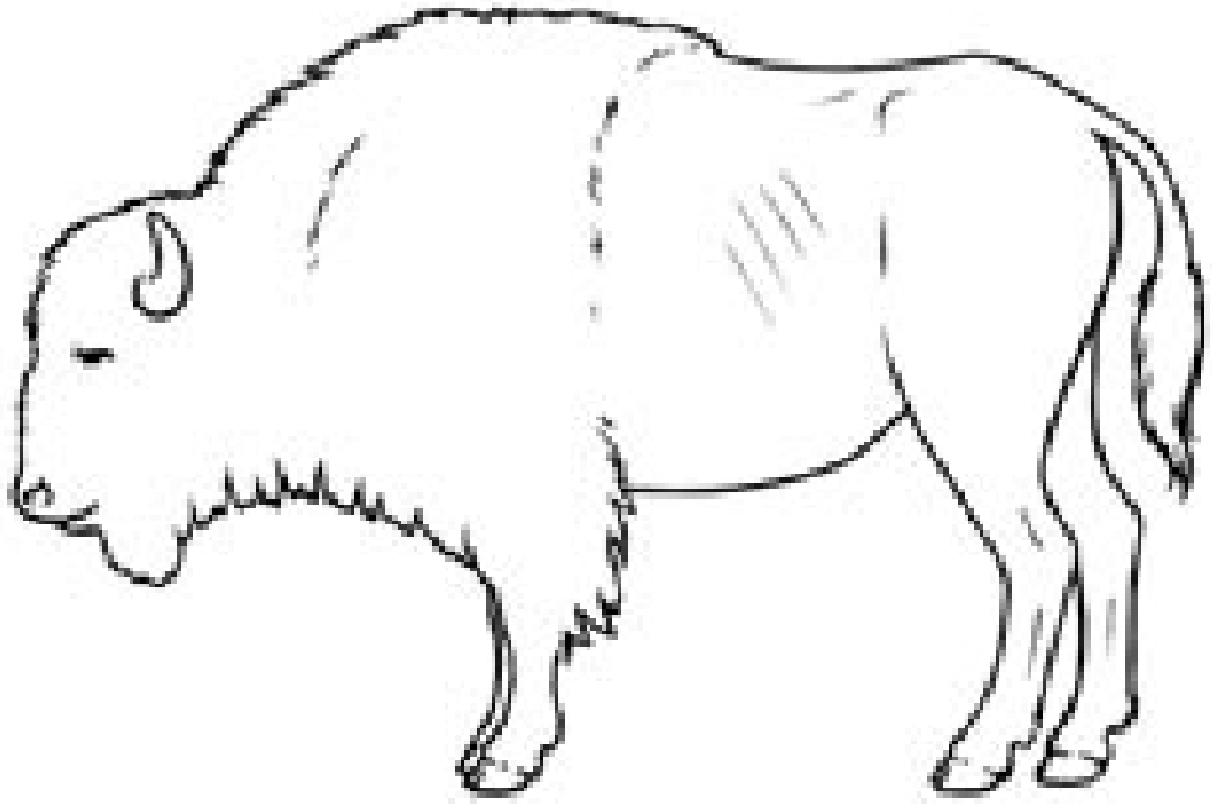
- Hip bone visible, but not sharp
- Rump muscles flat and angular

TAIL HEAD

- Slight hollowing on either side of tail head
- Some fat palpable if bison in squeeze

HUMP

- Well-developed but not bulging
- Noticeable distinction between hump and shoulder



# BCS 4

WHOLE BODY
- Moderately fat

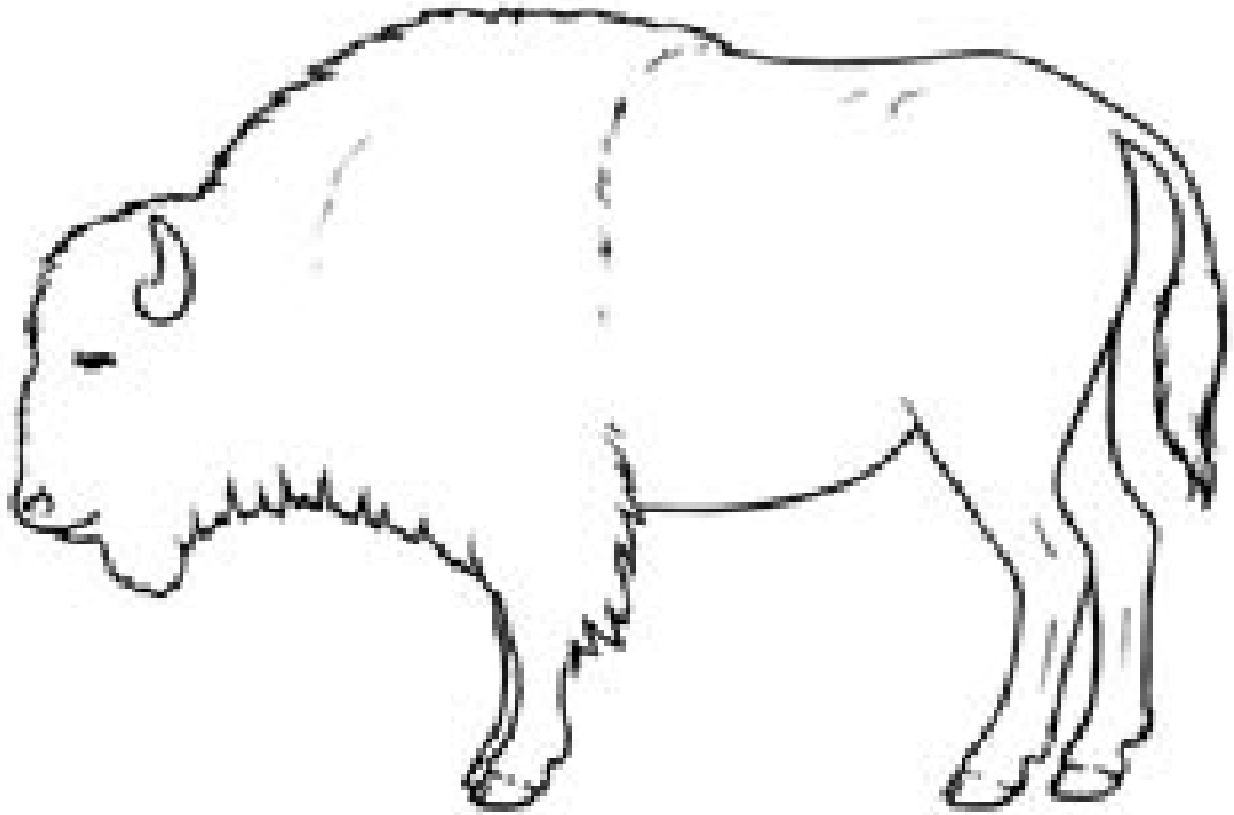
RIBS
- Individual ribs generally not visible in summer
- Not visible in winter

SPINE
- Backbone not readily seen
- Angle of muscle has gentle slope

HIP BONE AND RUMP
- Hip bone barely visible
- Muscles full, but not bulging

TAIL HEAD
- Slight depression in bulls
- No depression in cows

HUMP
- Full hump when viewed from front, but not round and bulging
- Little distinction between hump and shoulder when viewed from side



# BCS 5

WHOLE BODY

- Fat

RIBS

- Covered in fat
- Not visible in summer or winter

SPINE

- Buried in fat
- Backbone not visible
- Angle of muscle has little slope, flat

HIP BONE AND RUMP

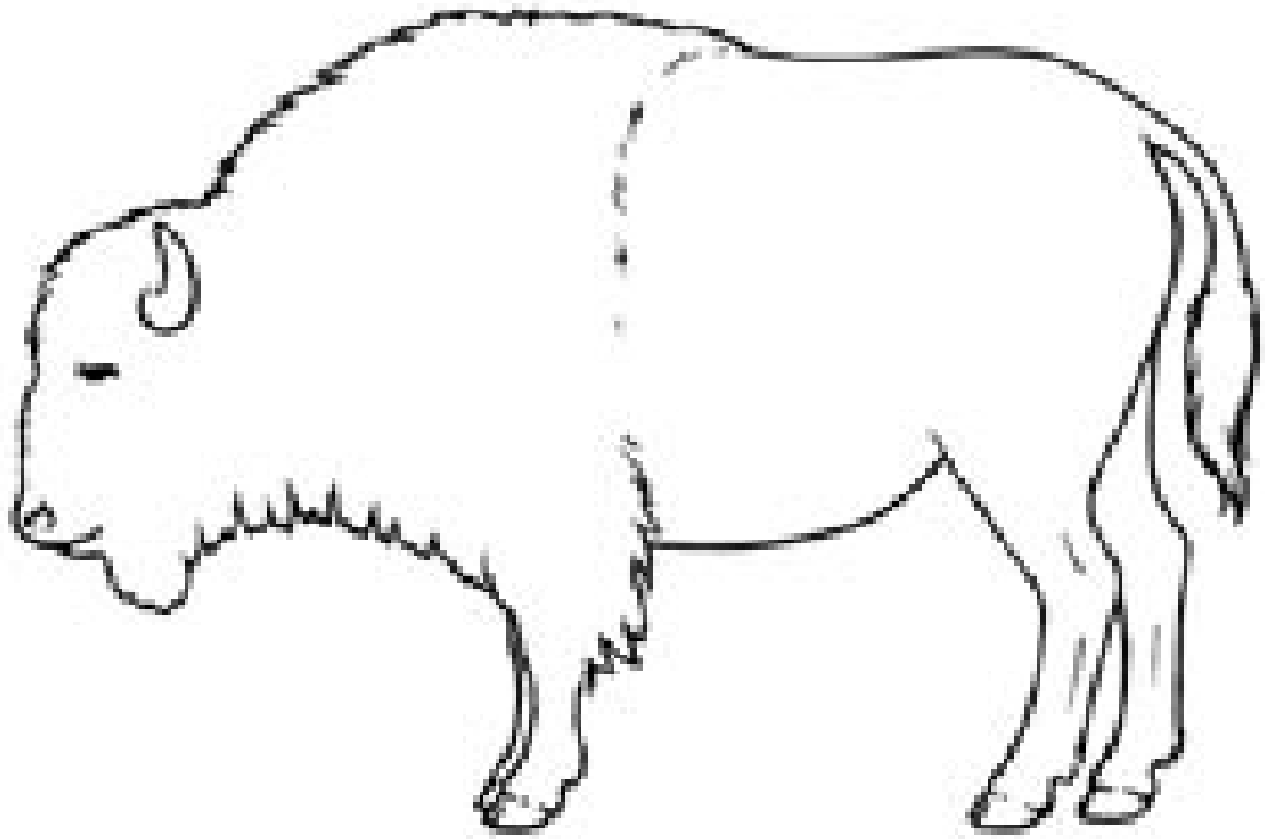
- Hip bone covered in fat, not visible
- Rump rounded out, full

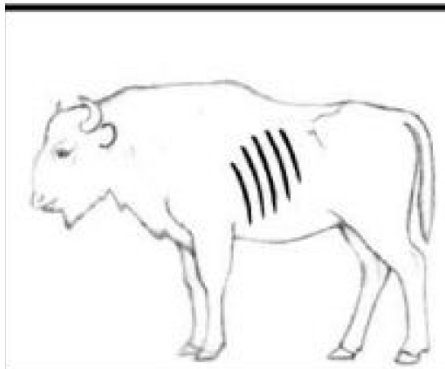
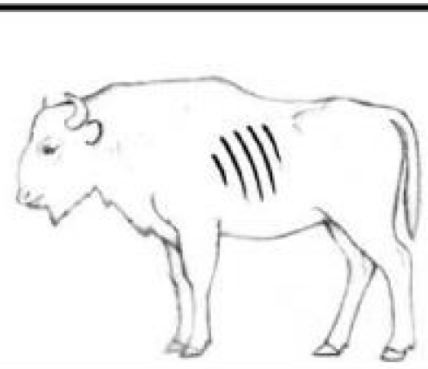
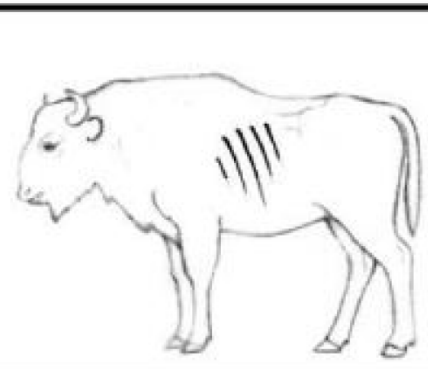
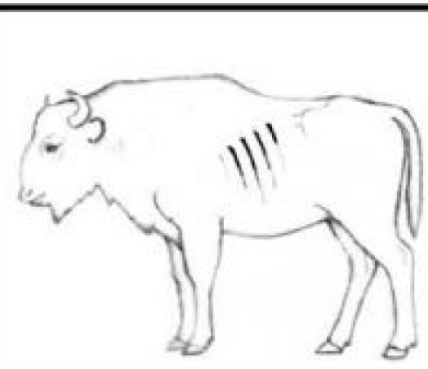
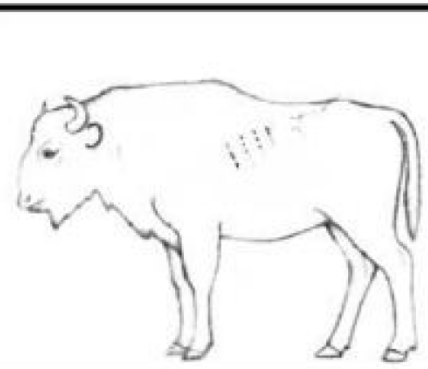
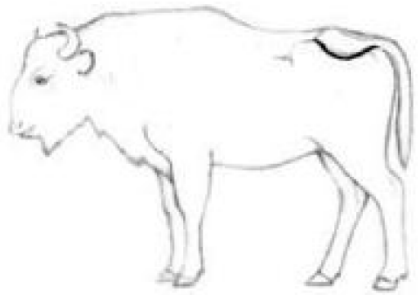
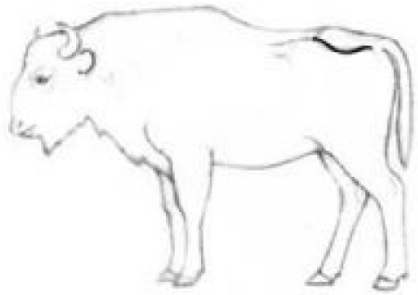
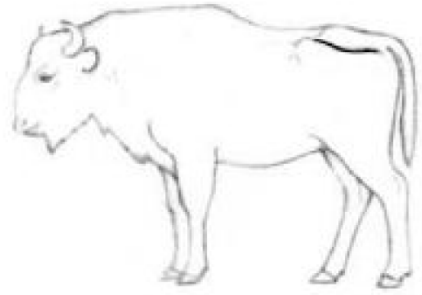
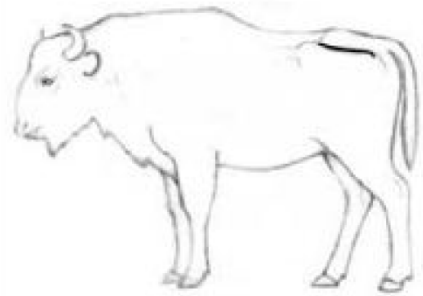
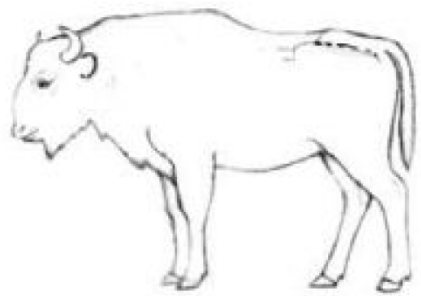
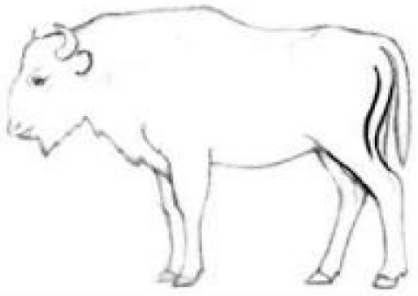
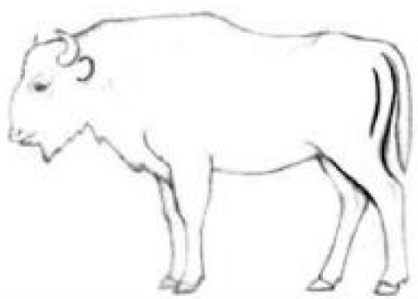
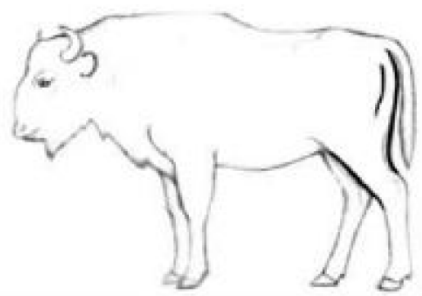
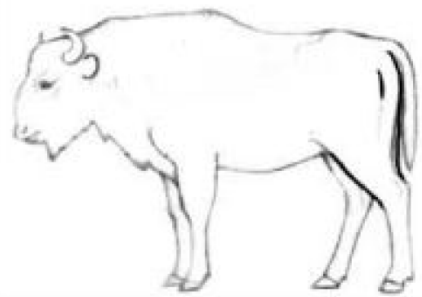
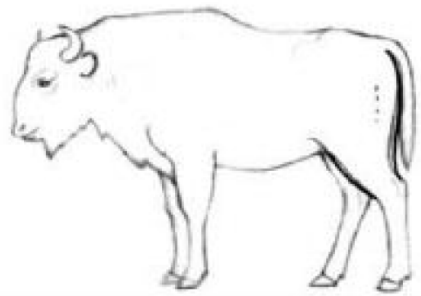
TAIL HEAD

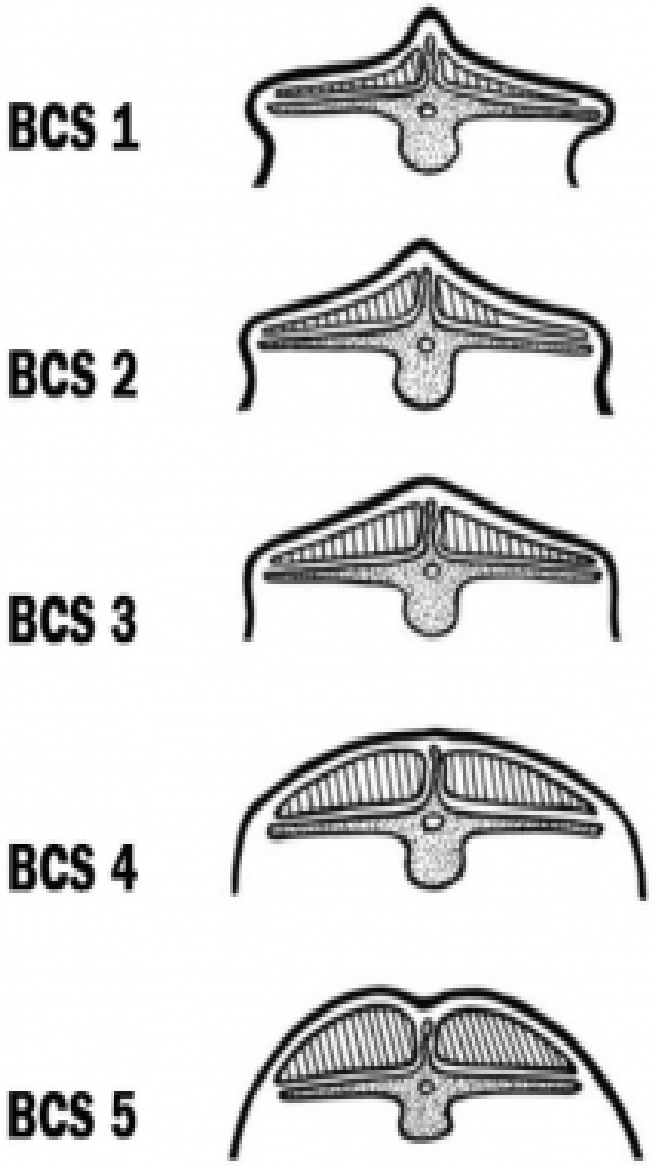
- In bulls, no depression on either side of tail head
- Either side is bulging with fat in cows

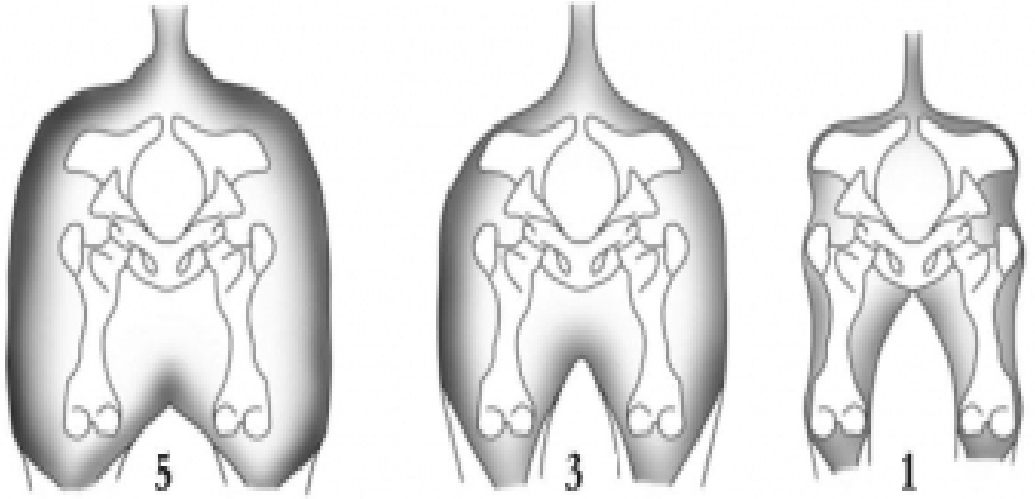
HUMP

- Thick, rounded top when viewed from front
- Blends into the shoulder when viewed from side



| 1 | 2 | 3 | 4 | 5 |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |


BCS 1
BCS 2
BCS 3
BCS 4
BCS 5


5
3
1


myloview

# Using BCS

- Low scores?
  - Most likely energy, protein, or parasite issues
  - Vitamins and minerals play a role
    - Can test for all of these
- High scores?
  - No problem?
  - Check your bottom dollar

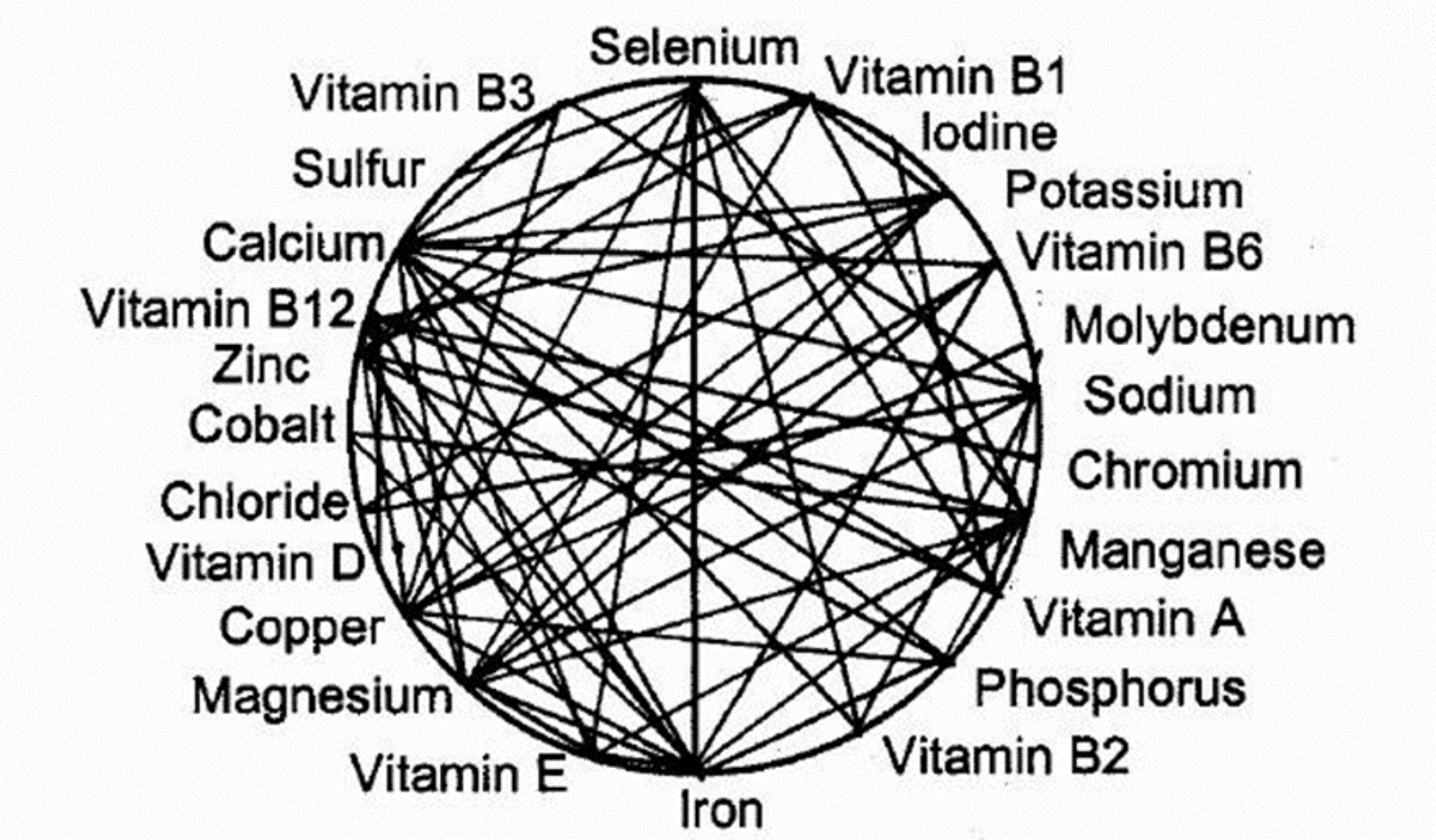
# Wintering

- Adapted for winter months
- Will face blizzard headfirst
  - Know that storm will end if they push through it
  - Shelter not needed
- Will lose ~10% of BW
  - Weight will bounce back in spring
  - Compensatory gain?

# Six Classes of Nutrients

- Water
- Protein – Anything with Nitrogen
- Carbohydrates – Follow $C_nH_{2n}O_n$ formula
- Lipids – Hydrophobic compounds
- Minerals – Found on periodic table
- Vitamins – Those who don’t really fit anywhere else

# Vitamin and Mineral Interaction



# Ratios Matter

Omega-6 : Omega-3


Zinc : Copper


Potassium : Sodium

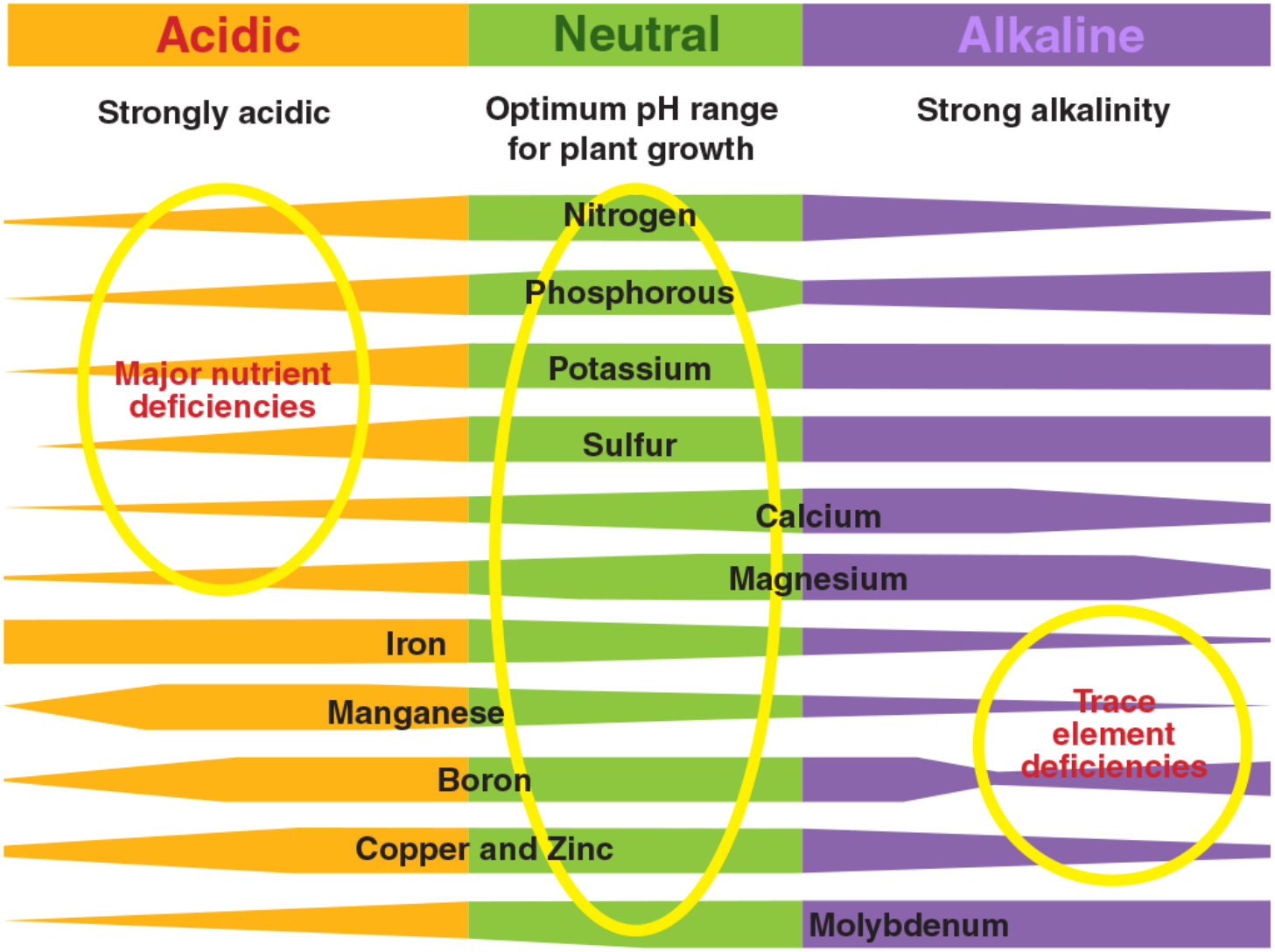

Calcium : Magnesium


Iron : Copper


Calcium : Phosphorus

# pH and mineral availability

- N, K, Ca, Mg, and S – pH = 6.0-6.5
- Micronutrients – pH = <7.0




Soil pH and Nutrient Availability
(Source: Bluedale - http://www.bluedale.com.au )

# Implications in Animal Health

- Cu – Increased susceptibility to bacterial infections, antioxidant
- Co – Poor parasitic resistance, rumen function
- Se – Antioxidant defense, thyroid, immune function, reproduction, and production efficiency
- Zn – Immune function, performance efficiency, reproduction
- Mn – Activation of metalloenzymes that affect lipid and carb metabolism, reproduction
- Toxic elements
  - As, Cd, Pb, Hg


# Conclusions

- Feeding animals is a dynamic venture
  - What works for you, may not fit your neighbor, the bison, etc.
- Consult your decisions with the animals and experts