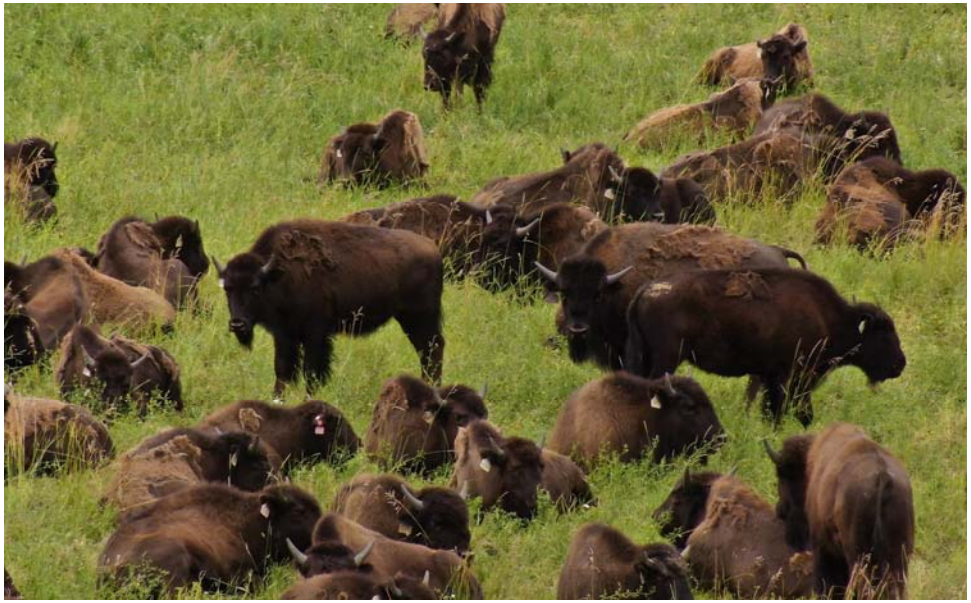
Food and Agriculture Organization of the United Nations

Assessing Rangelands Grazed By Bison

Outline

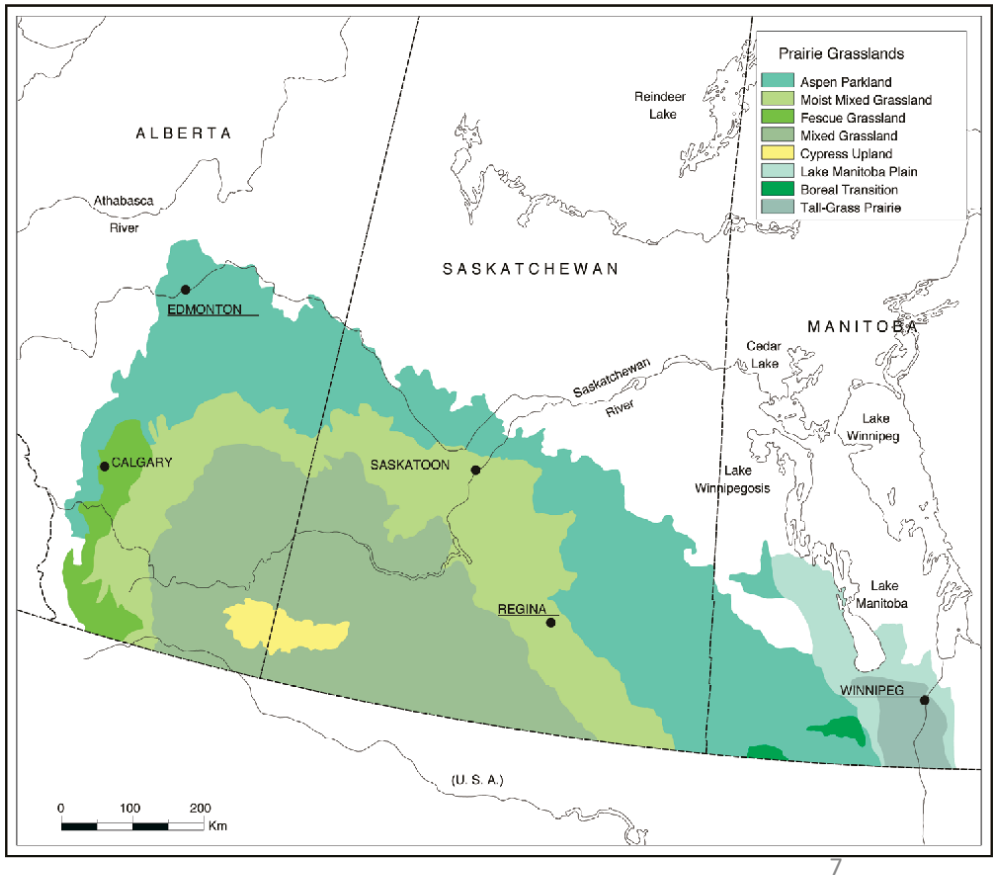
- Introduction
- In field demonstrations
- Project goals
- Materials & methods
- Preliminary results & discussion
- Further steps



Introduction

Assessing Rangelands

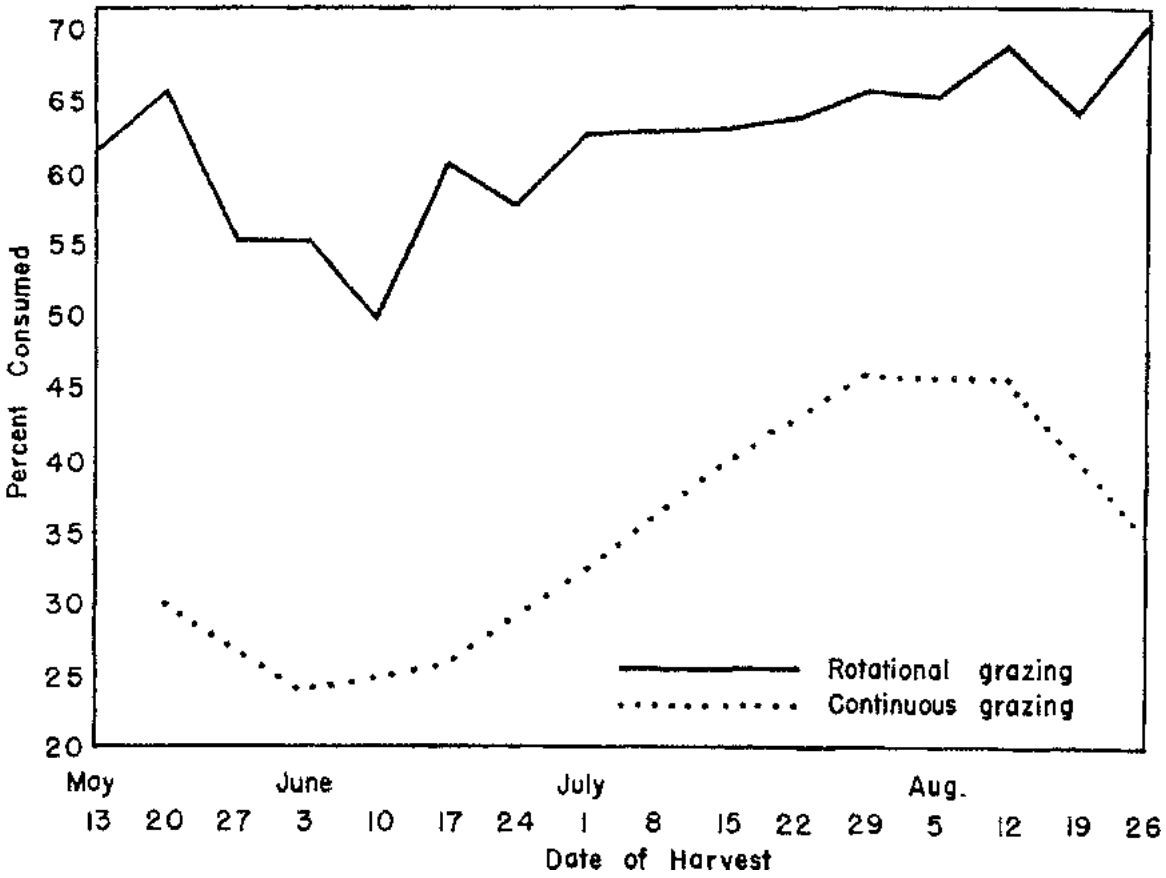
- Rangelands are native or tame vegetation.
- Rangelands are managed as a natural ecosystem.
- Grazing is the process that supports the health and function of the ecosystem.



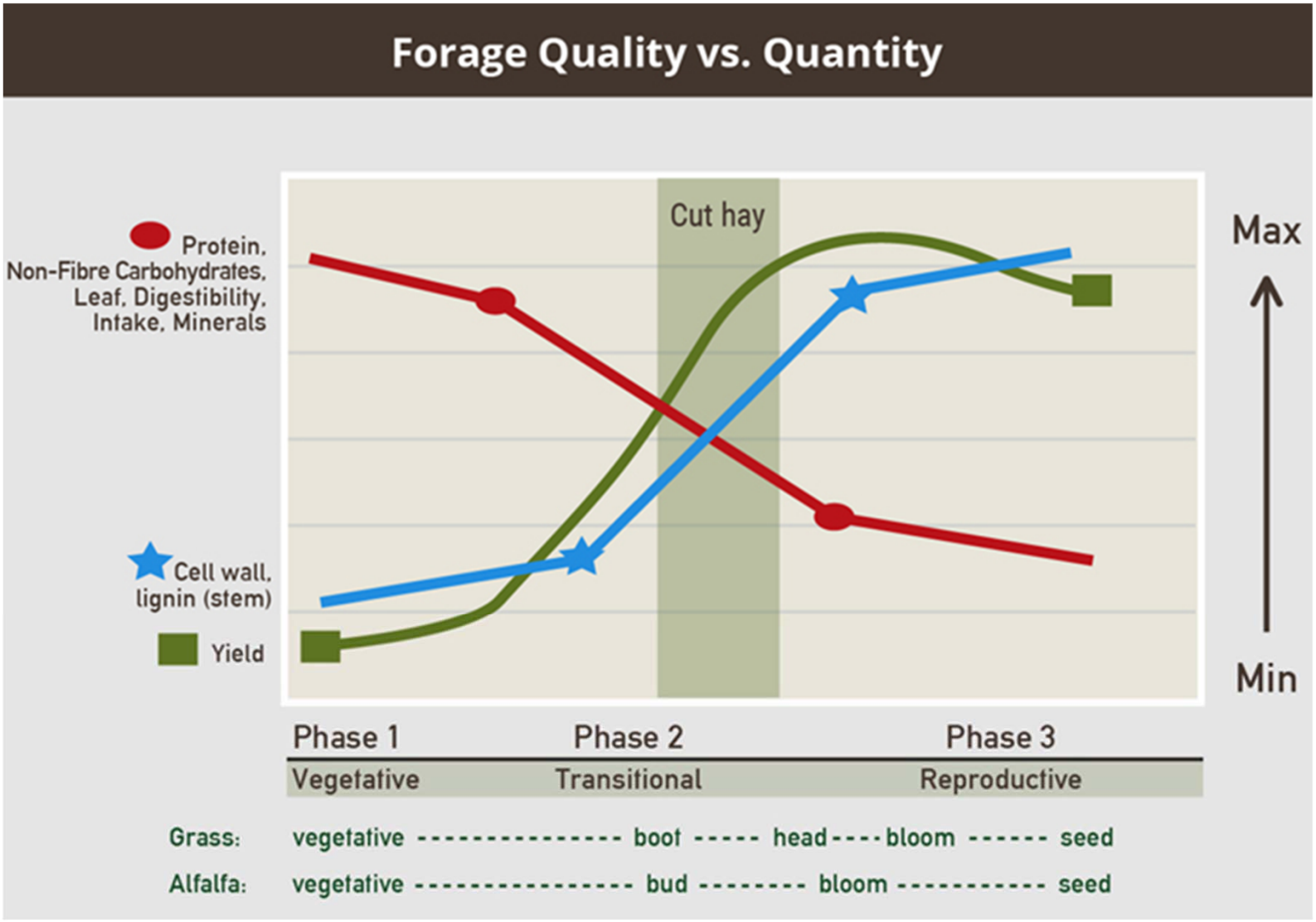
Strip Grazing

- Using electric fence is an option to maximize utilization of the pasture by implementing grazing methods.

Rotational Grazing



Davis, R.R., & Pratt, A.D. (1956). Rotational vs. continuous grazing with dairy cows.

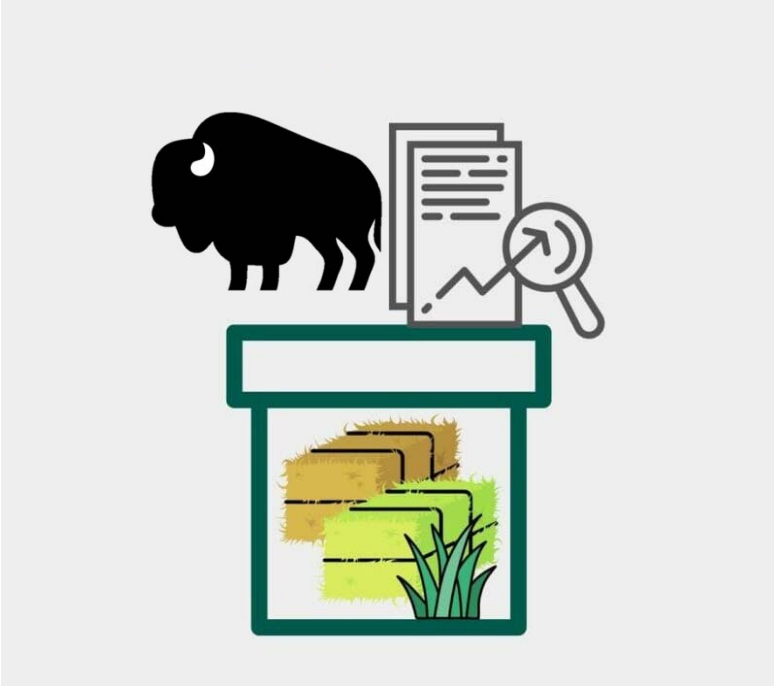


Stored forages (2023) Beef Research. https://www.beefresearch.ca/topics/stored-forages/

Bromatological Analysis

Forage Analysis

- Measures the nutrient content of hay or pasture.
- Comparing nutrient content with animal's requirements.
- Moisture, fiber, digestibility, protein and mineral values can be determined.

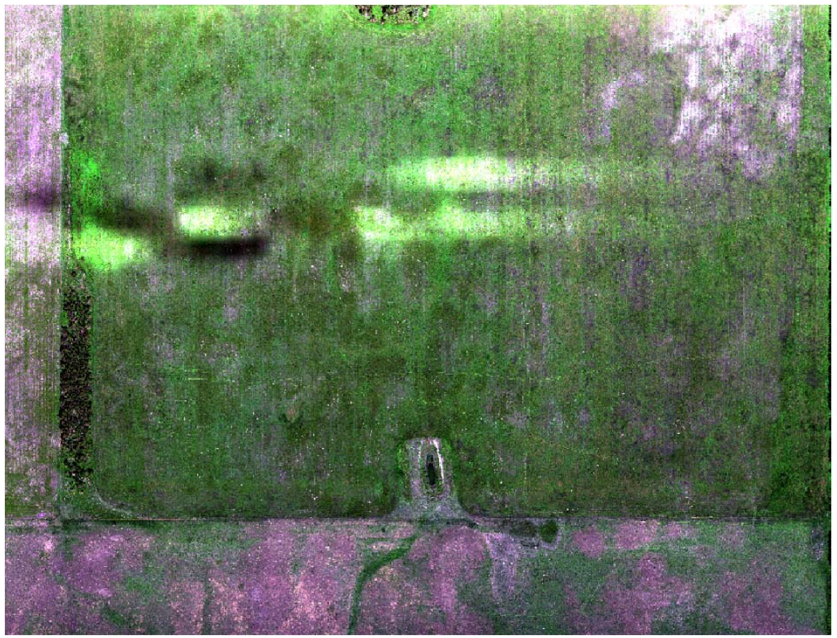


Drone Applications

Visual

Drone Applications

Multispectral



Goals

Evaluate animal performance through body weight gain.

Evaluate forage growth and quality throughout the season.

Check the suitability of multispectral images to access forage quality and quantity in Rangelands.

Materials & Methods

Land

- 20 minutes - south of Vermilion (2 half sections)
- Duration: June to October

North Pasture

Alsike Clover: *Trifolium hybridum*

Meadow Brome: *Bromopsis biebersteinii*

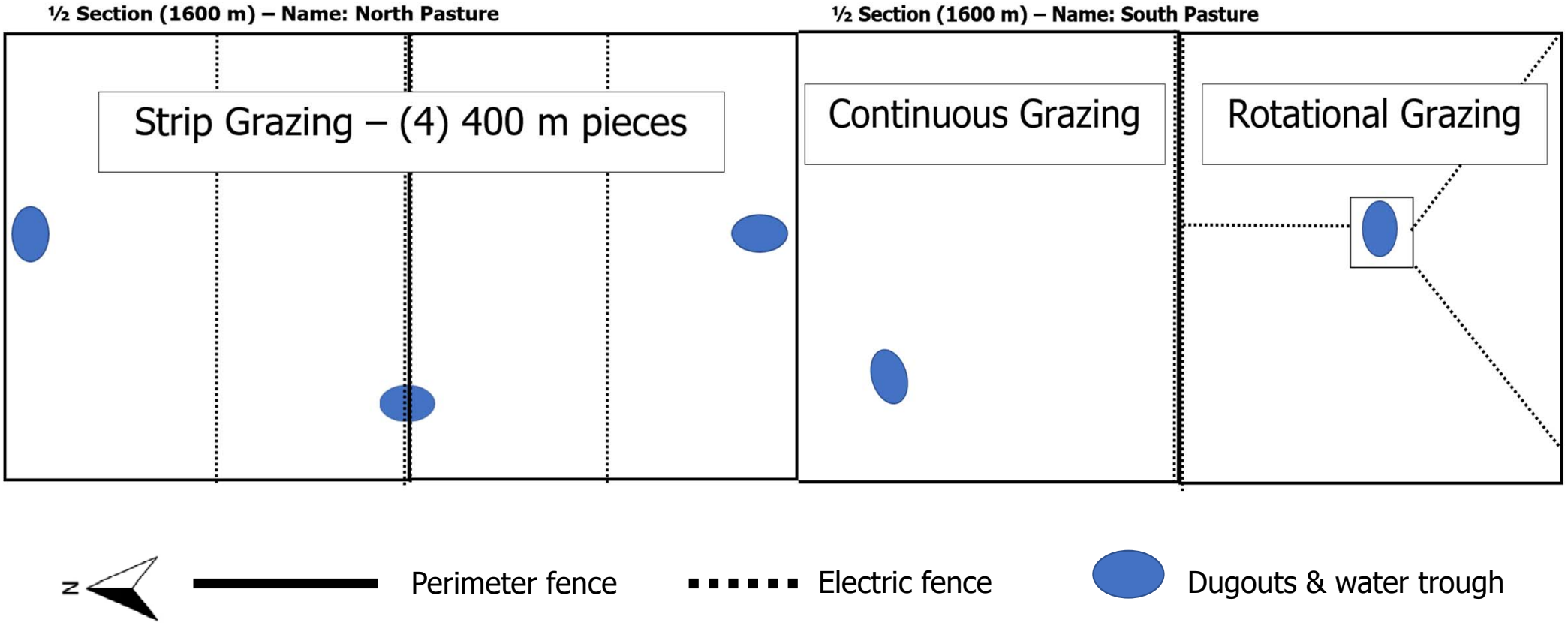
Alfalfa: *Medicago sativa*

Tall Fescue: *Festuca arundinacea*

South Pasture

Meadow Brome: *Bromopsis biebersteinii*

Smooth Brome: *Bromus inermis Leyss*


½ Section (1600 m) – Name: North Pasture
½ Section (1600 m) – Name: South Pasture
Strip Grazing – (4) 400 m pieces
Continuous Grazing
Rotational Grazing
N
Perimeter fence
Electric fence
Dugouts & water trough

Timeline

Processing bison

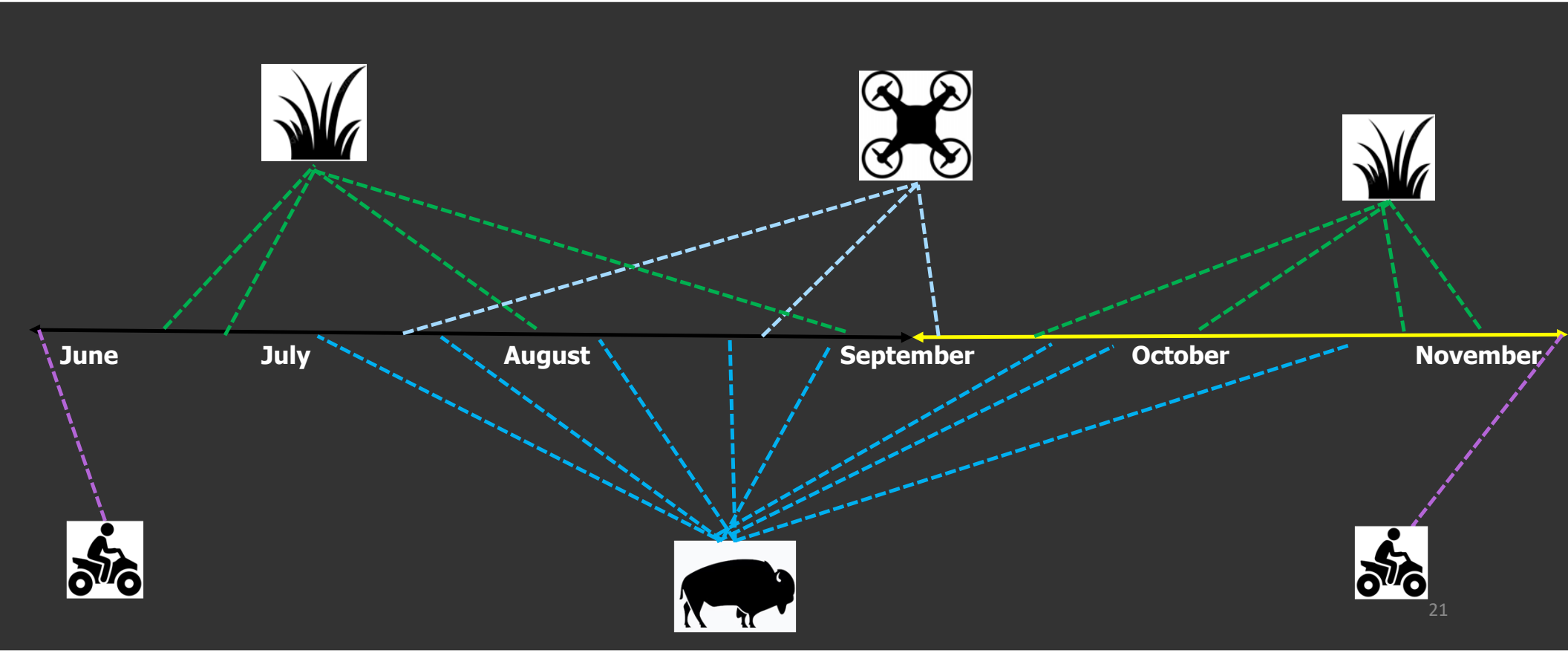
Moving bison

Visual flights

Grass sampling & multispectral

Continuous & rotational grazing

Strip grazing

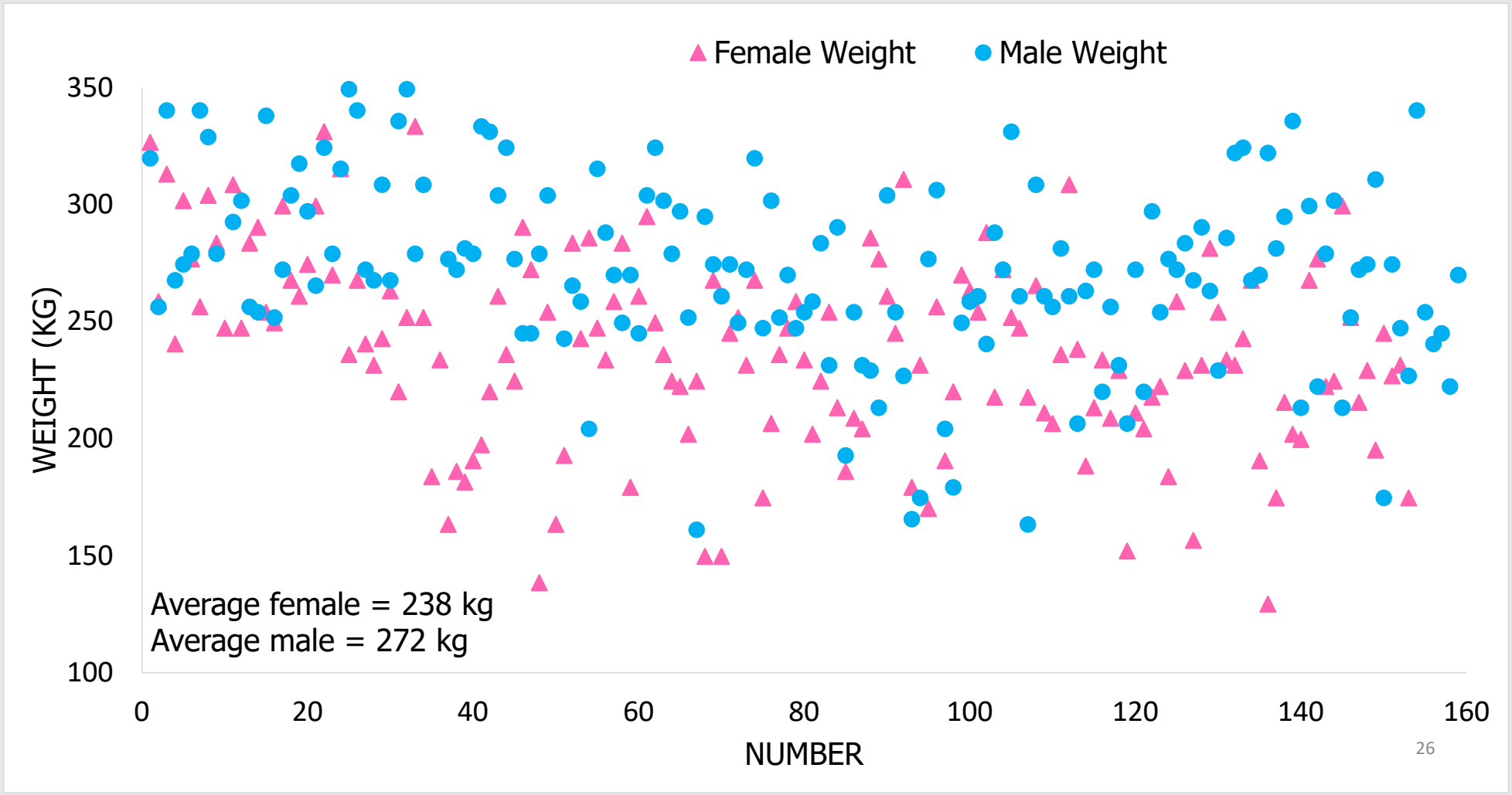


Bison

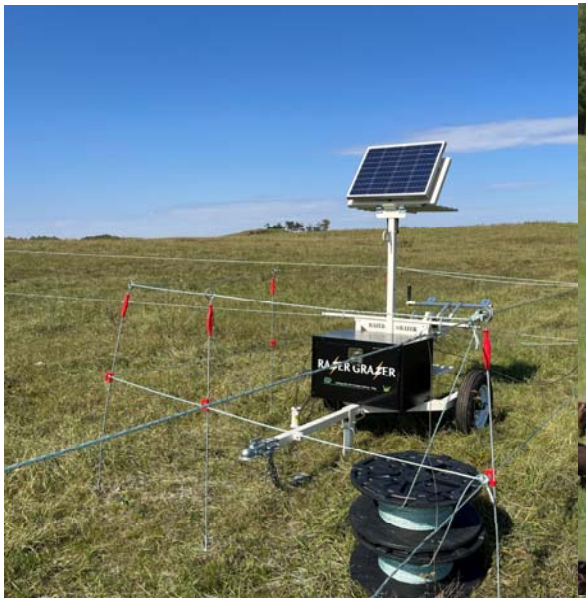
- Total of 319 yearlings
  - 153 females
  - 166 males
- K & L Quarter Horses
  - Kitscoty - Alberta
- Nil-Ray Farms Ltd
  - Fort St. John - British Columbia


913
908 907
906
905
59

Commercial Name	Active Ingredients
7 way®	Clostridium Chauvoei-Septicum-Novyi-Sordellii-Perfringens Types C and D-Mannheimia Haemolytica Bacterin- Toxoid
Vista One®	Bovine Rhinotracheitis-Virus Diarrhea-Parainfluenza 3-Respiratory Syncytial Virus-Mannheimia haemolytica Pasteurella multicide Vaccine
Hemostam®	Vitamin B-12,Iron Ammonium Citrate ,Thiamine Hydrochloride (B-1), Riboflavin (B-2) as 5-phosphate, Sodium,Pyridoxine HCL (B-6),Niacinamide (B-3), d-Panthenol (B-5) , Cobalt Gluconate, Copper Gluconate, Chlorobutanol, Benzyl Alcohol
Bio-Mycin®	Oxytetracycline


Female Weight
Male Weight
350
300
250
200
150
100
WEIGHT (KG)
Average female = 238 kg
Average male = 272 kg
0
20
40
60
80
100
120
140
160
NUMBER

Electric Fence



Surveillance Camera

- **C$225.99**
  - Solar and battery-powered
  - PIR motion detection
  - IP66 waterproof
  - 2K IR night vision
  - 2-way audio


CANADIAN BISON ASSOCIATION
ASSOCIATION CANADIENNE DU BISON

Grass Sampling

Bromatological Analysis

Wet Chemistry

- Undegradable intake protein
- Acid detergent fiber
- Neutral detergent fiber
- Lignin

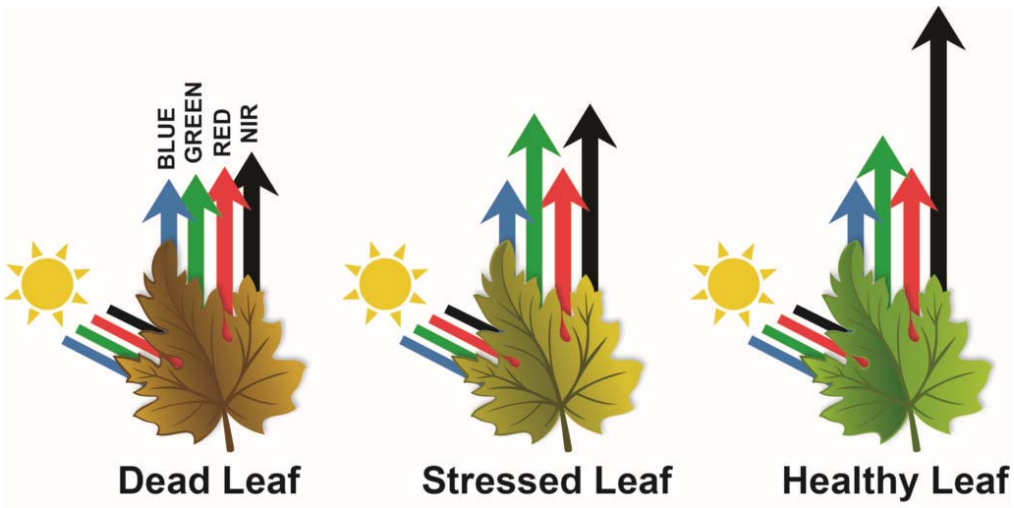
Minerals

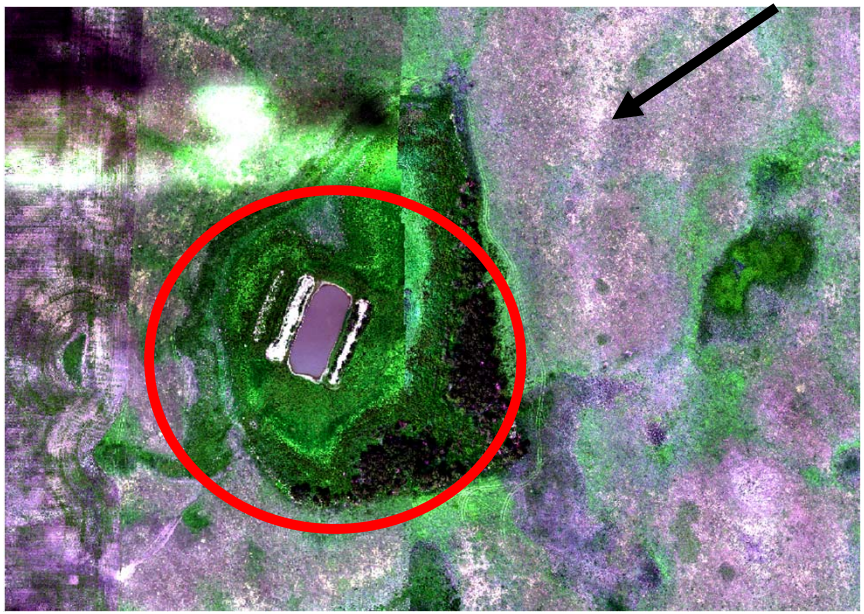
- Ca
- P

Drone Application

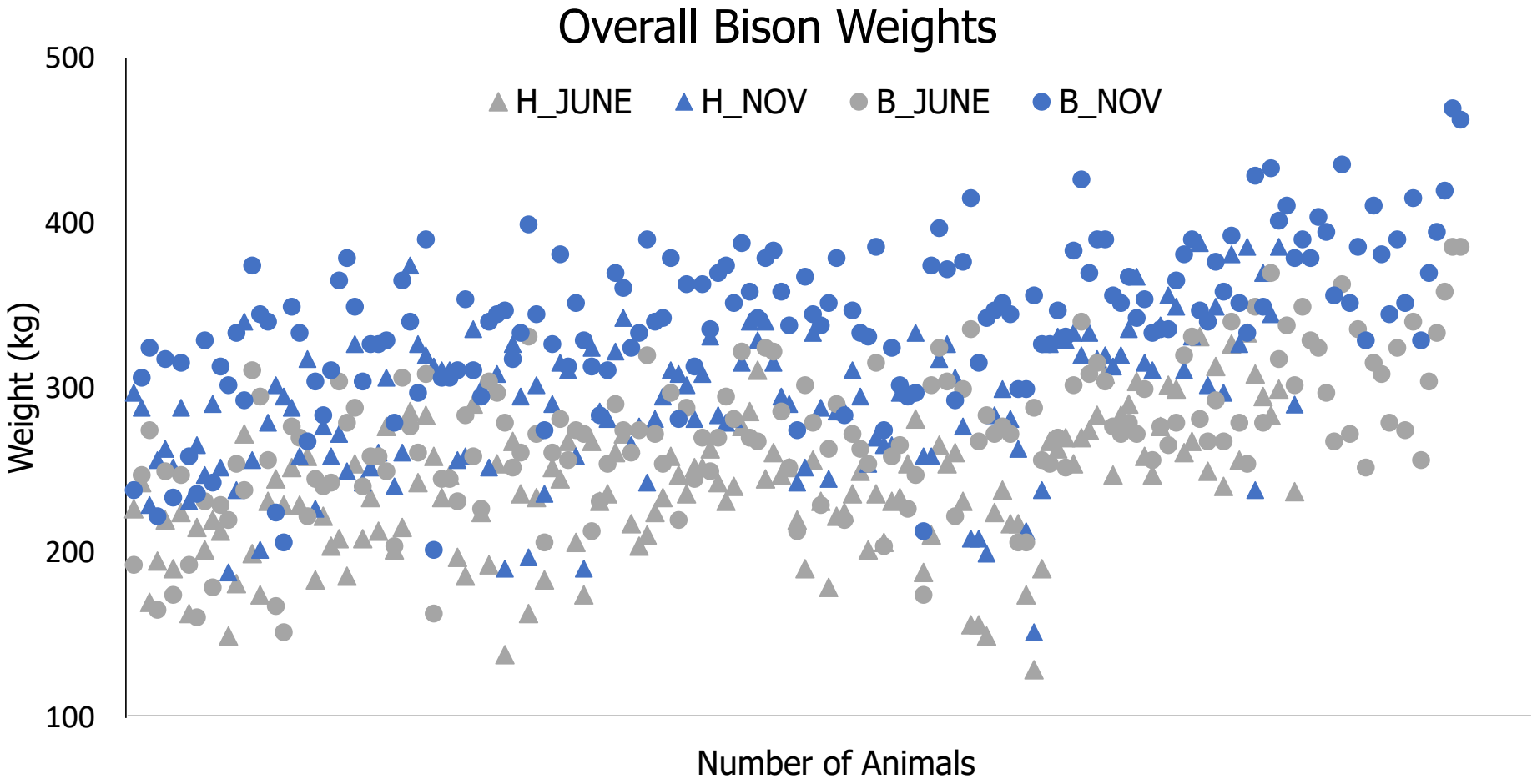
Multispectral Imaging

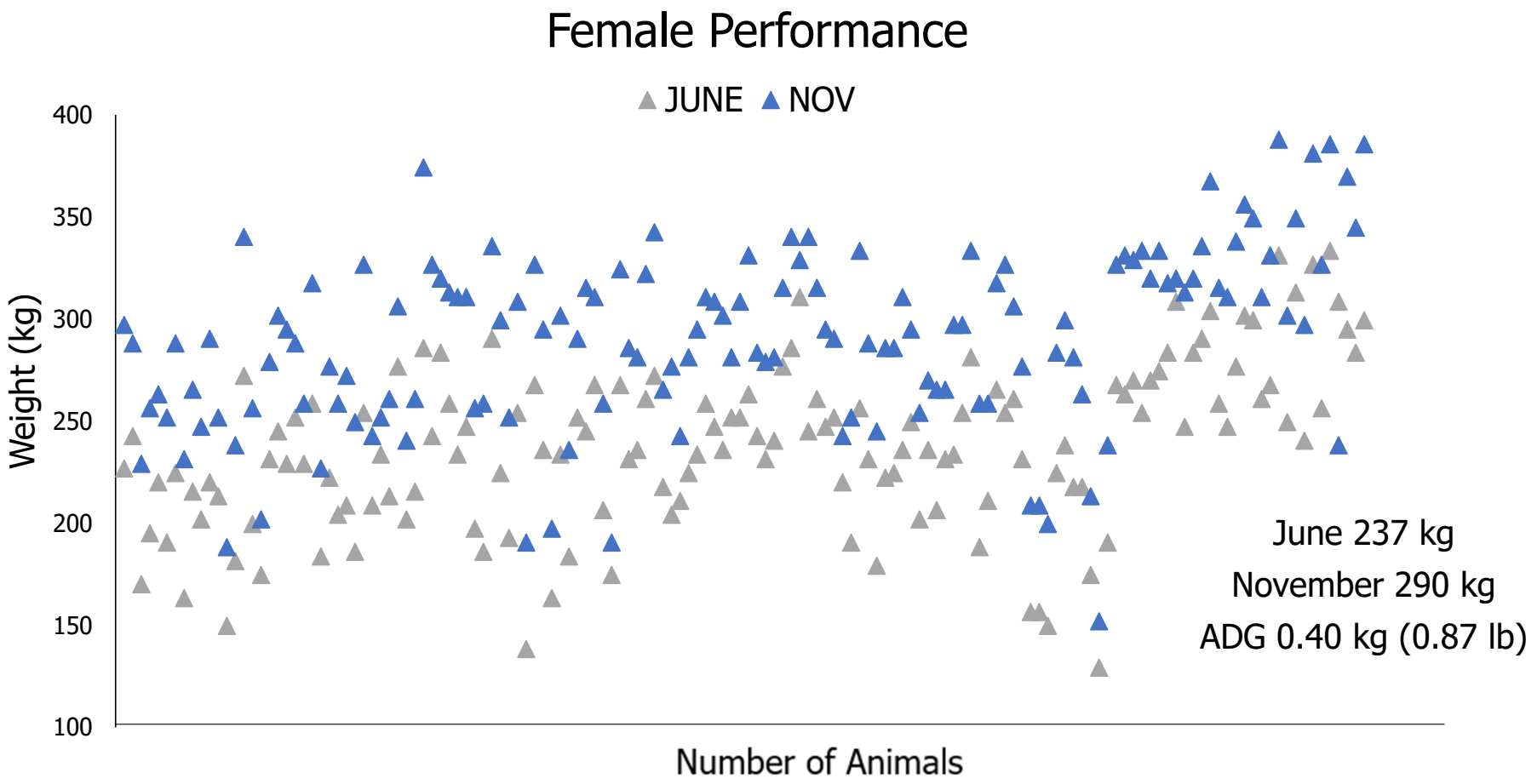
- A multispectral camera has multiple lens that takes pictures of the vegetation. The sun reflects wavebands off the vegetation in visible and invisible light.

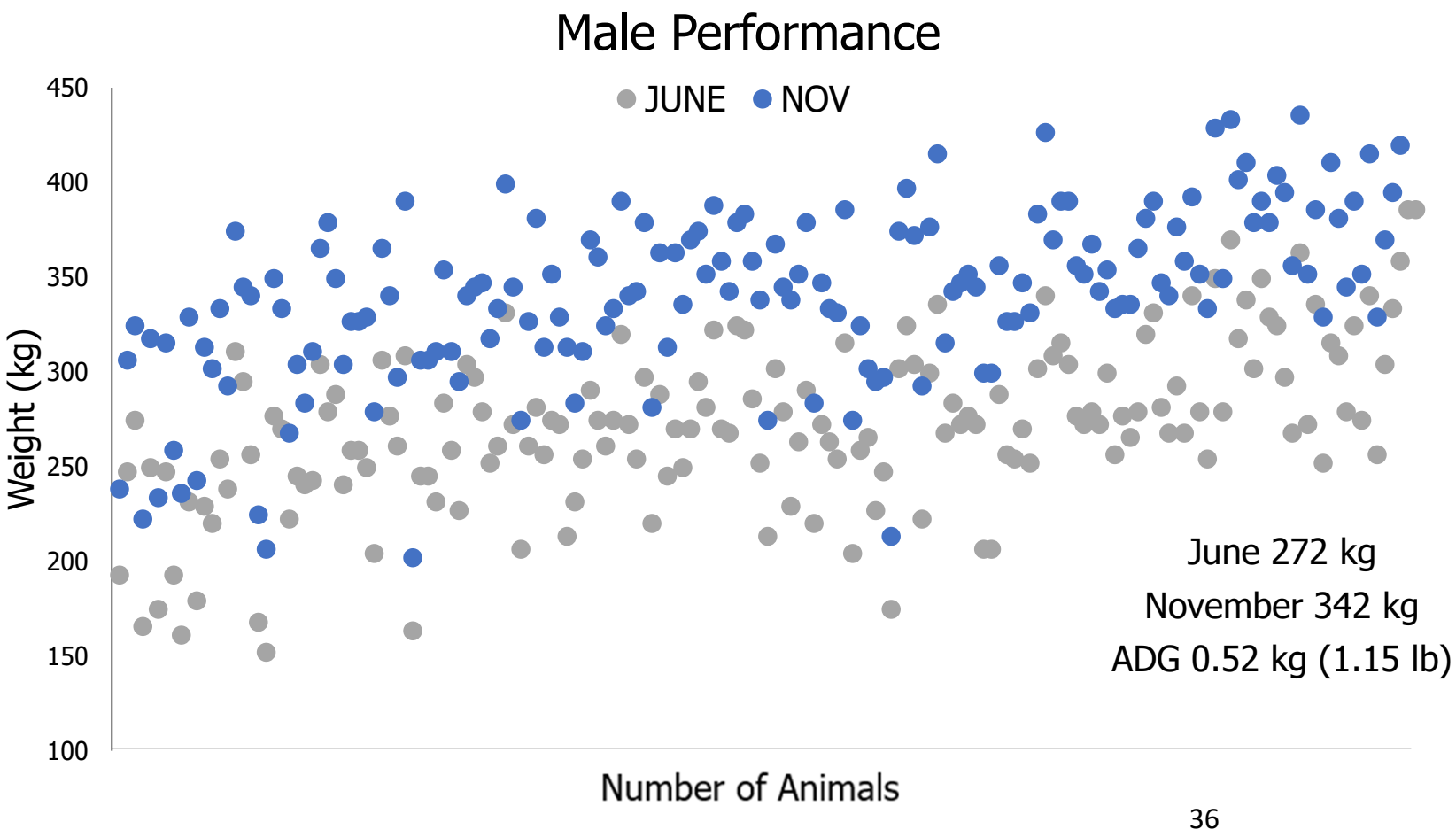




Results & Discussion

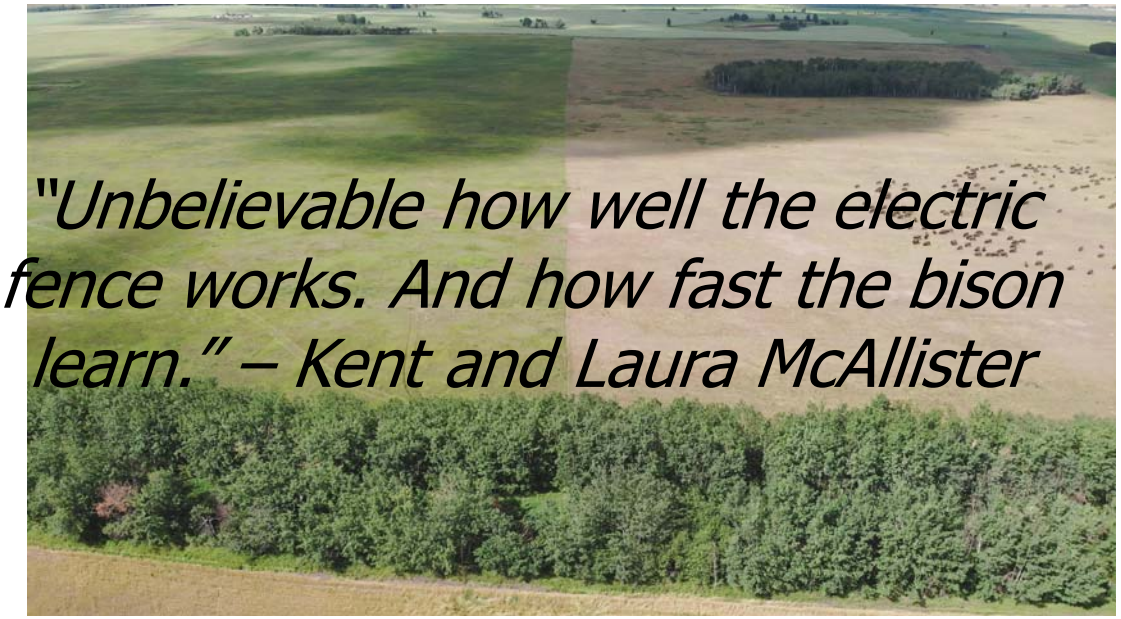

Overall Bison Weights
H_JUNE
H_NOV
B_JUNE
B_NOV
500
400
300
200
100
Weight (kg)
Number of Animals


Female Performance
JUNE
NOV
400
350
300
250
200
150
100
Weight (kg)
Number of Animals
June 237 kg
November 290 kg
ADG 0.40 kg (0.87 lb)


Male Performance
JUNE
NOV
450
400
350
300
250
200
150
100
Weight (kg)
Number of Animals
June 272 kg
November 342 kg
ADG 0.52 kg (1.15 lb)

Strip Grazing

- The electric fence was effective in keeping bison contained in desired areas.



Multispectral Imaging

Mosaic Map – July 21st

Mosaic Map – August 25th

Dry Matter (kg/ac)

	Strip 1
June 19th	903
June 28th	1052
July 21st	485
Aug 25th	337
Sept 15th	459

BEFORE grazing

July 3rd to July 17th

Consumed 54%

Stocking Rate & Dry Matter

- The tools used to have accurate acre count
- QGIS & Google Earth

Stocking Rate

Carrying Capacity

Available forage

- 1,549 lb/ac x 305 ac x 0.25 =118,111 lb

Calculating the number of animals

- 118,111 lb ÷ 26 lb/day = 4543 AUDs
- 4543 AUDs ÷ 30 days = 151 AUMs
- 151 AUMs ÷ 0.5 animal unit = 302 animals for one month

Stocking Rate

Acres Available per Animal

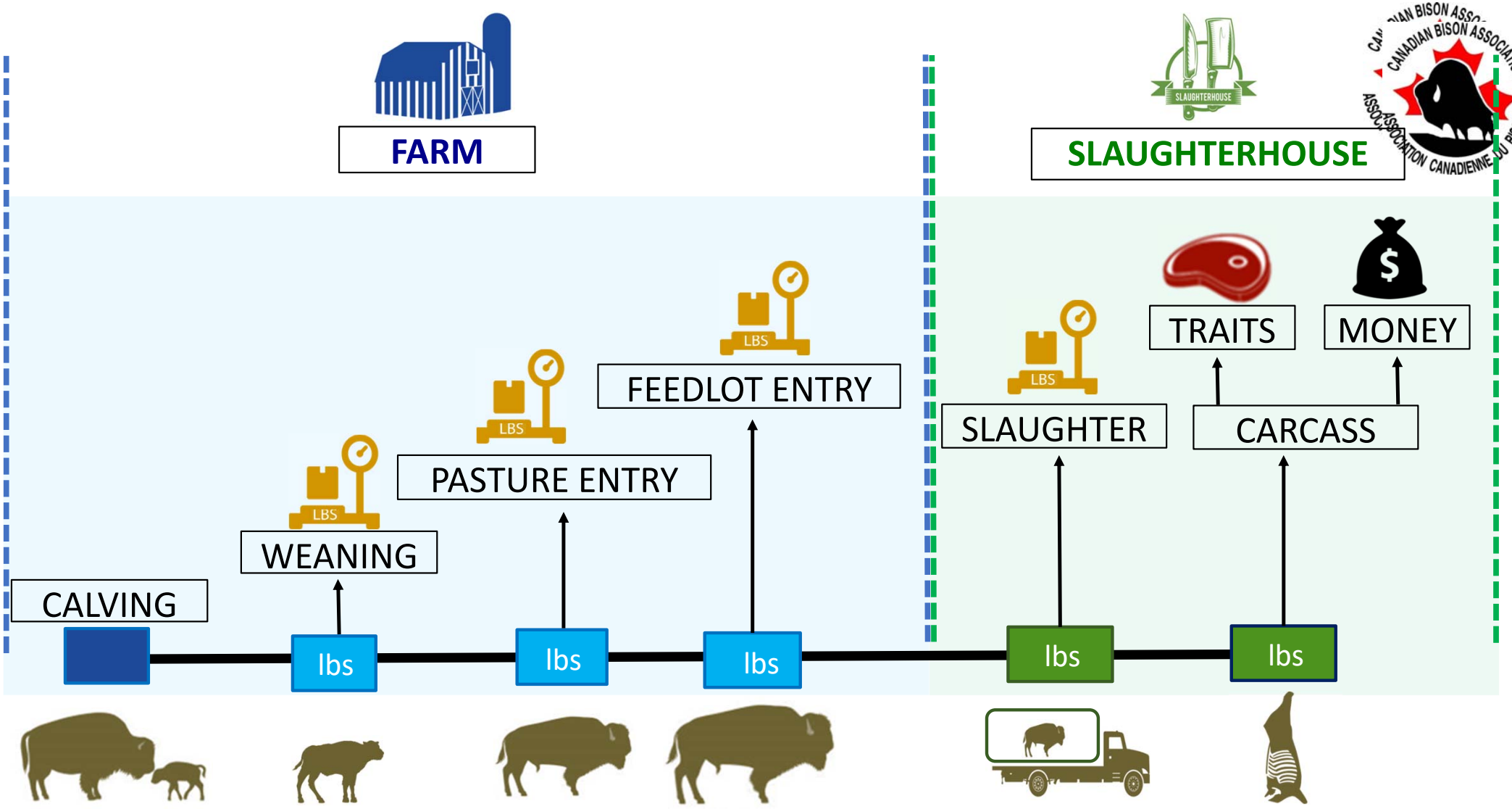
Total Land Area ÷ [(# AUs) x (grazing season)] = Stocking Rate

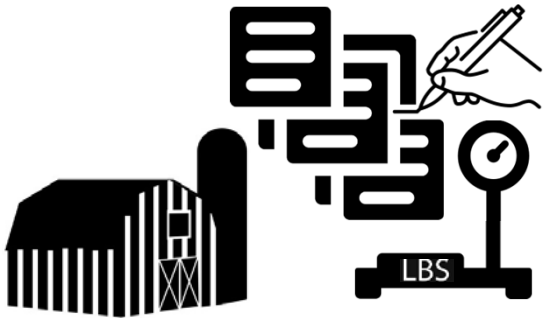
- 305 ac ÷ (159.5 * 2 months)
- 319 AUMs ÷ 305 ac = 1.05 acres per AU

Further Steps

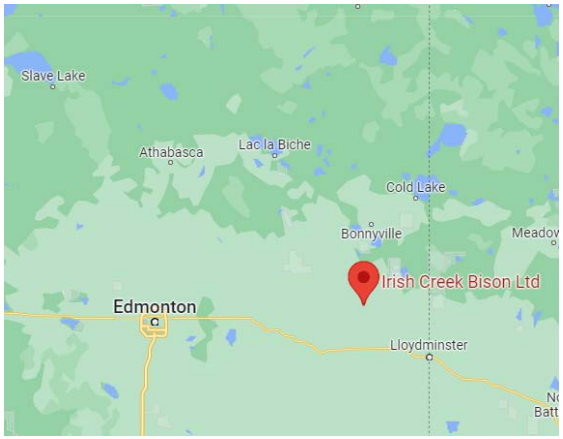
- 2-year project
- Continue testing drone imaging on pasture forage quality.
- Continue assessing the multispectral results to traditional methods.

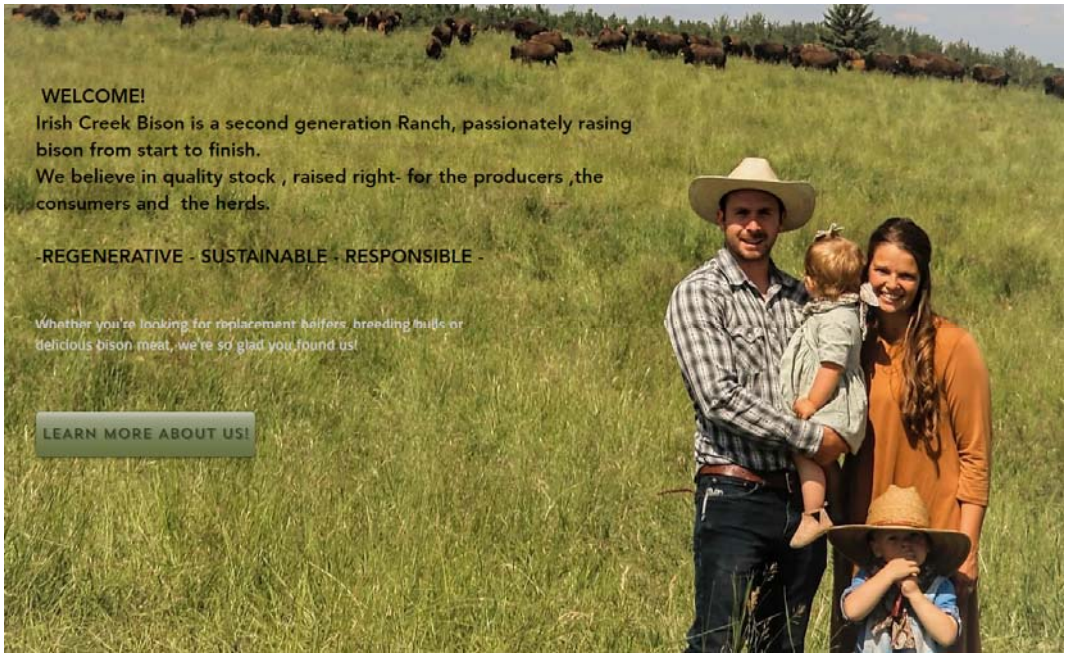
GROWTH & CARCASS


FARM
SLAUGHTERHOUSE
CANADIAN BISON ASSOCIATION
ASSOCIATION CANADIENNE DU BISON
LBS
FEEDLOT ENTRY
LBS
PASTURE ENTRY
LBS
WEANING
CALVING
LBS
SLAUGHTER
TRAITS
MONEY
CARCASS
lbs
lbs
lbs
lbs
lbs



IRISH CREEK BISON





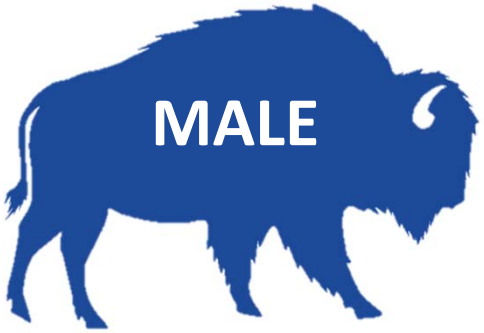
PRELIMINARY RESULTS

- STATS PROCEDURES
- MATHEMATICAL APPROACHES

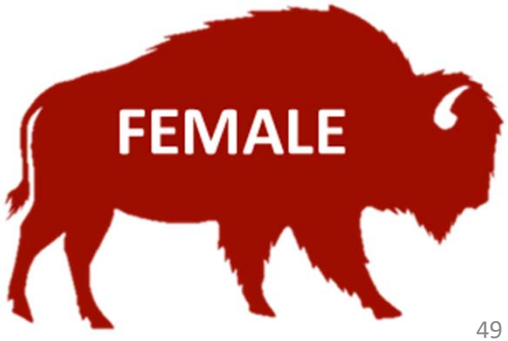
DATASET

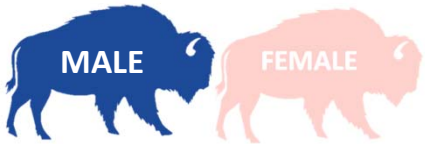
BISON SLAUGHTERED
BETWEEN 2019 AND 2023

610

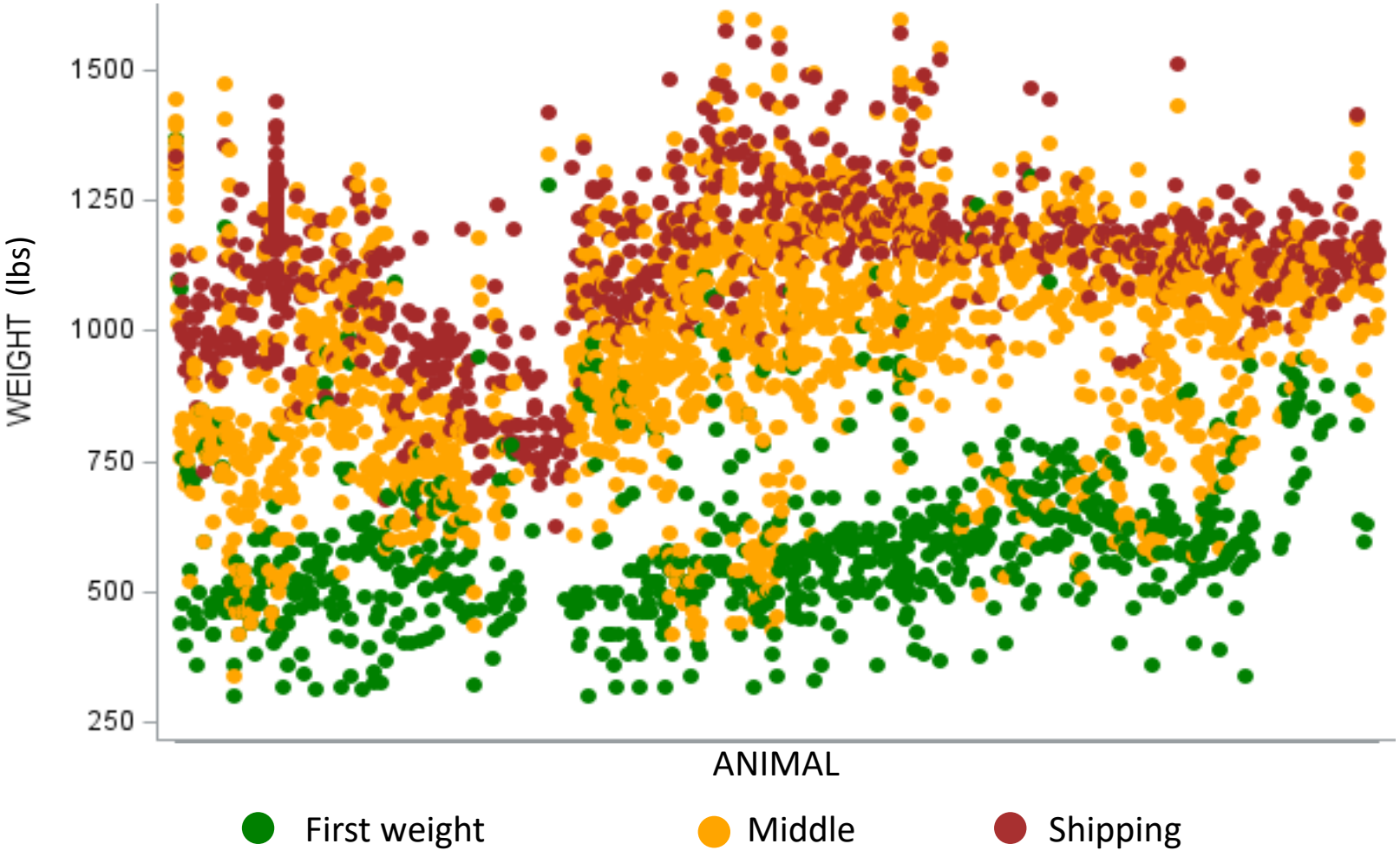


290





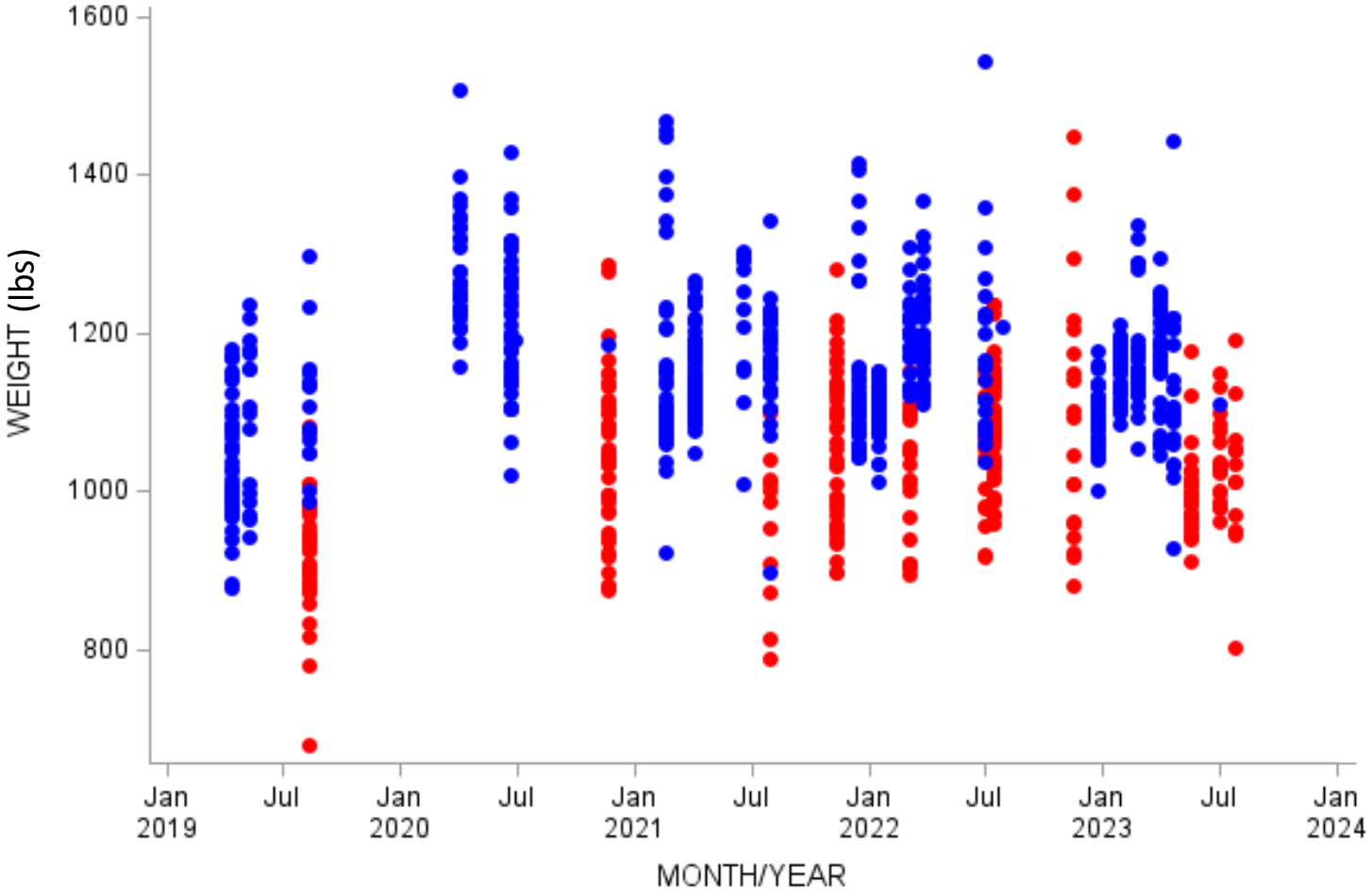
WEIGHT ON FARM



1129 lbs

603 lbs

LIVE WEIGHT AT SLAUGHTER

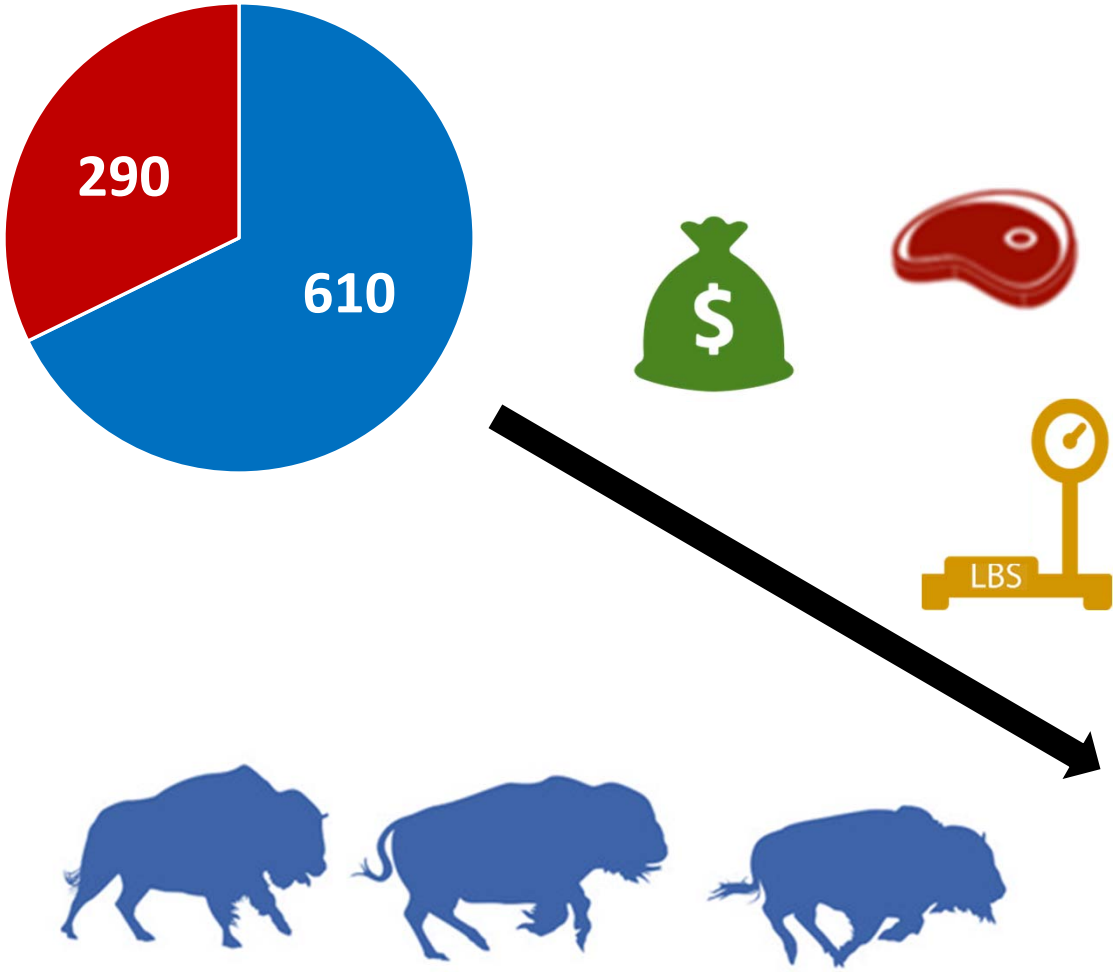


MALE

1152 lbs

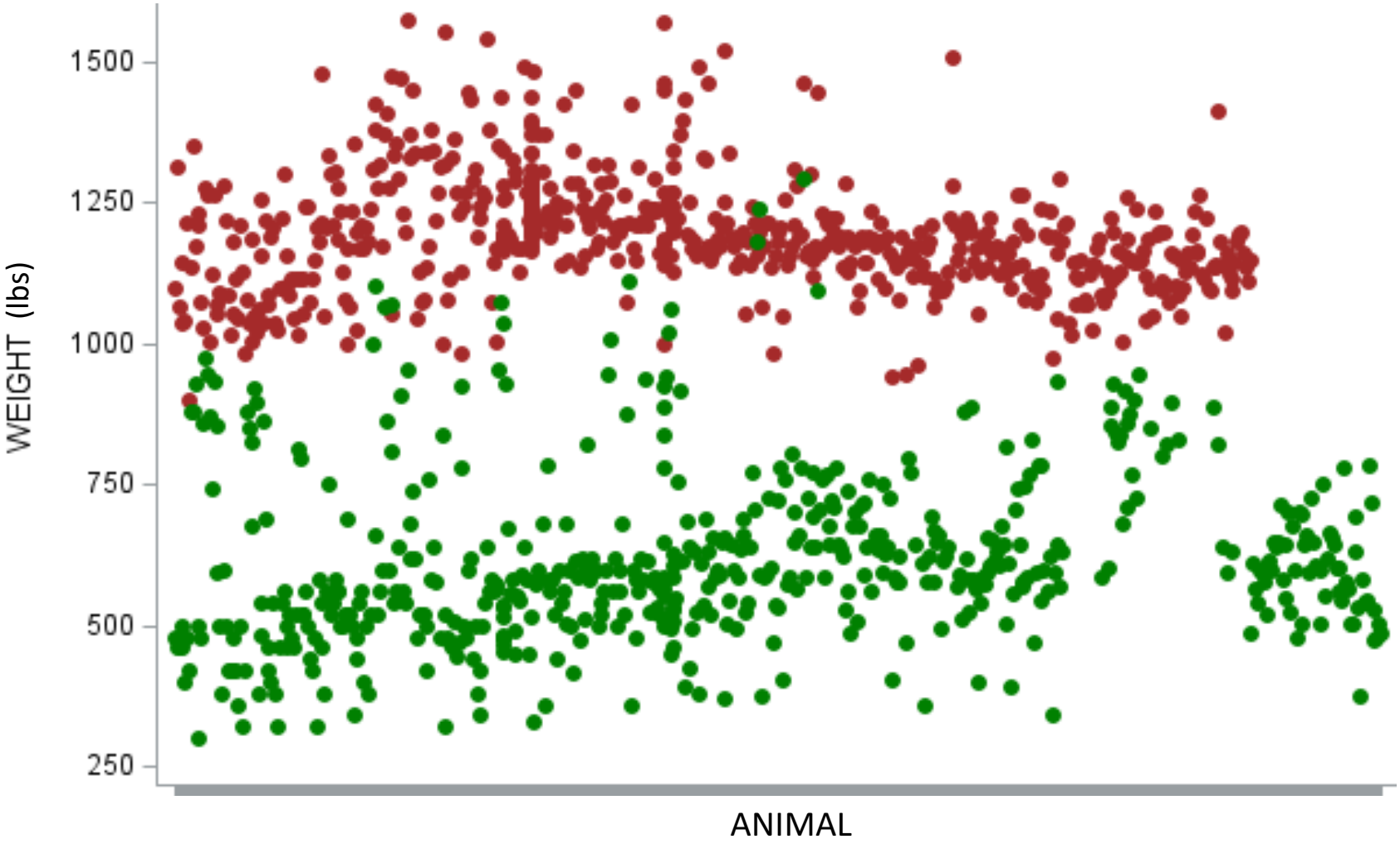
FEMALE

1030 lbs



MALES

FARM DATA



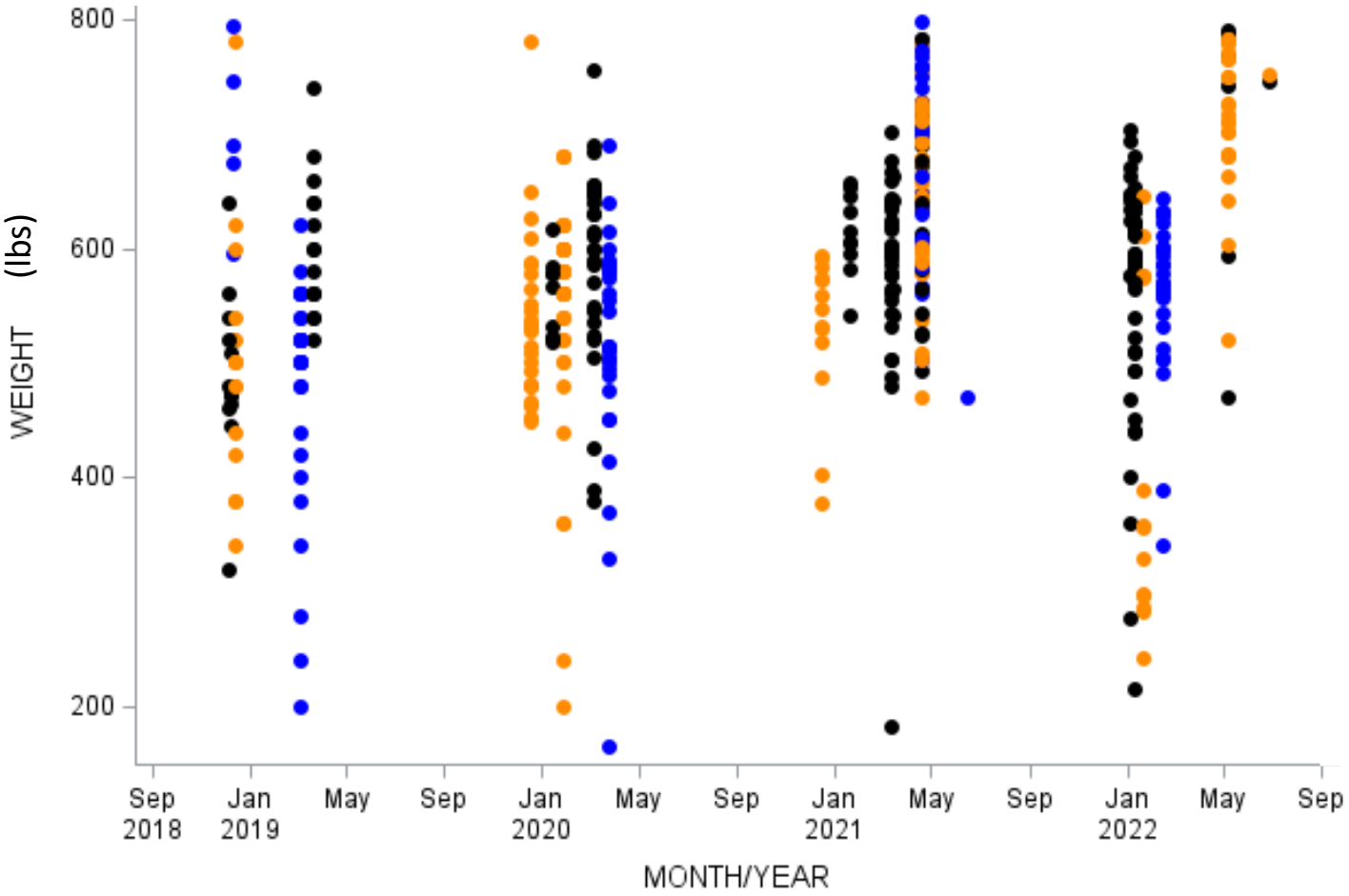
1197 lbs

Shipping weight

617 lbs

First weight

FIRST WEIGHT



Cross

589 lbs

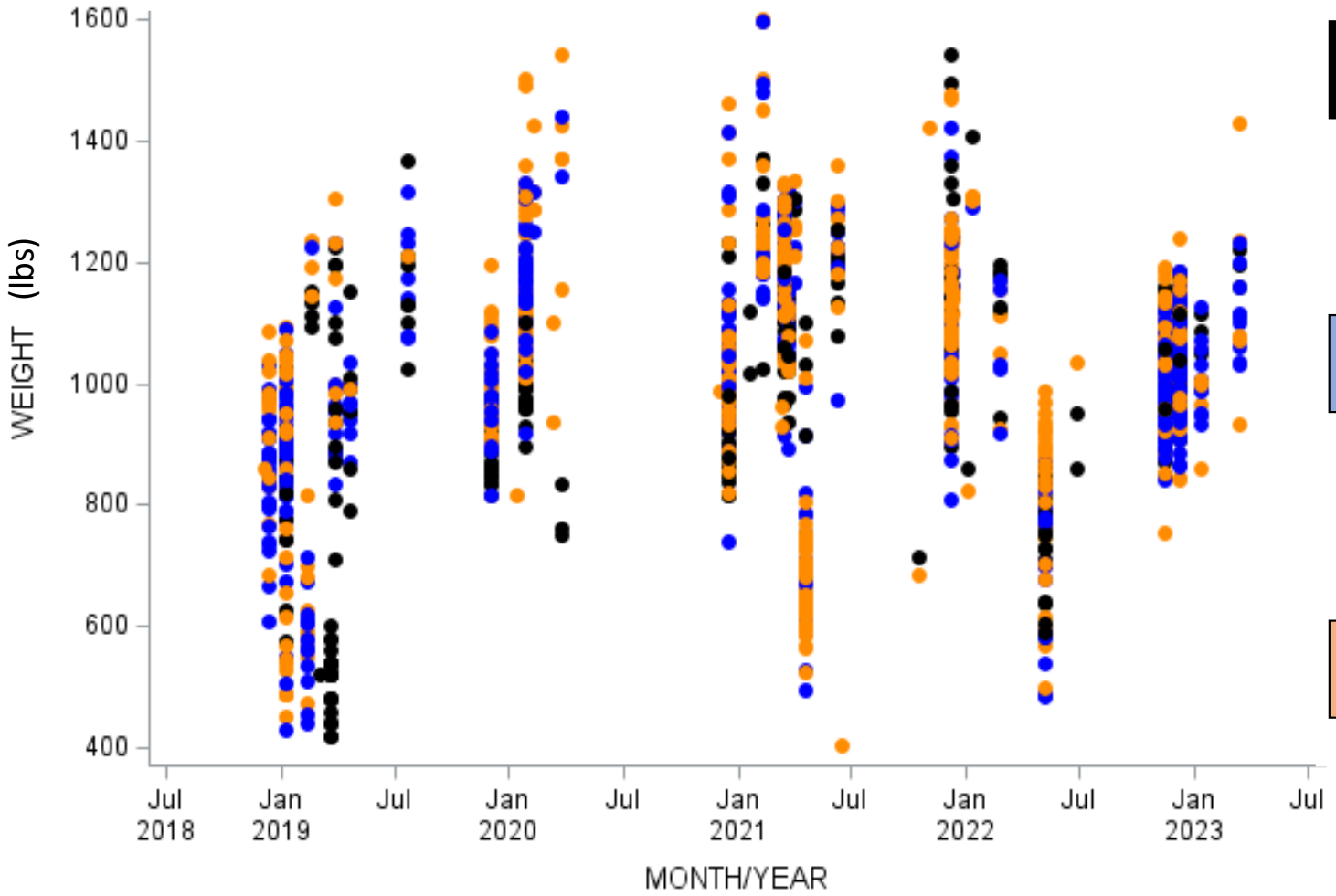
Wood

558 lbs

Plain

574 lbs

MIDDLE WEIGHT



Cross

1032 lbs

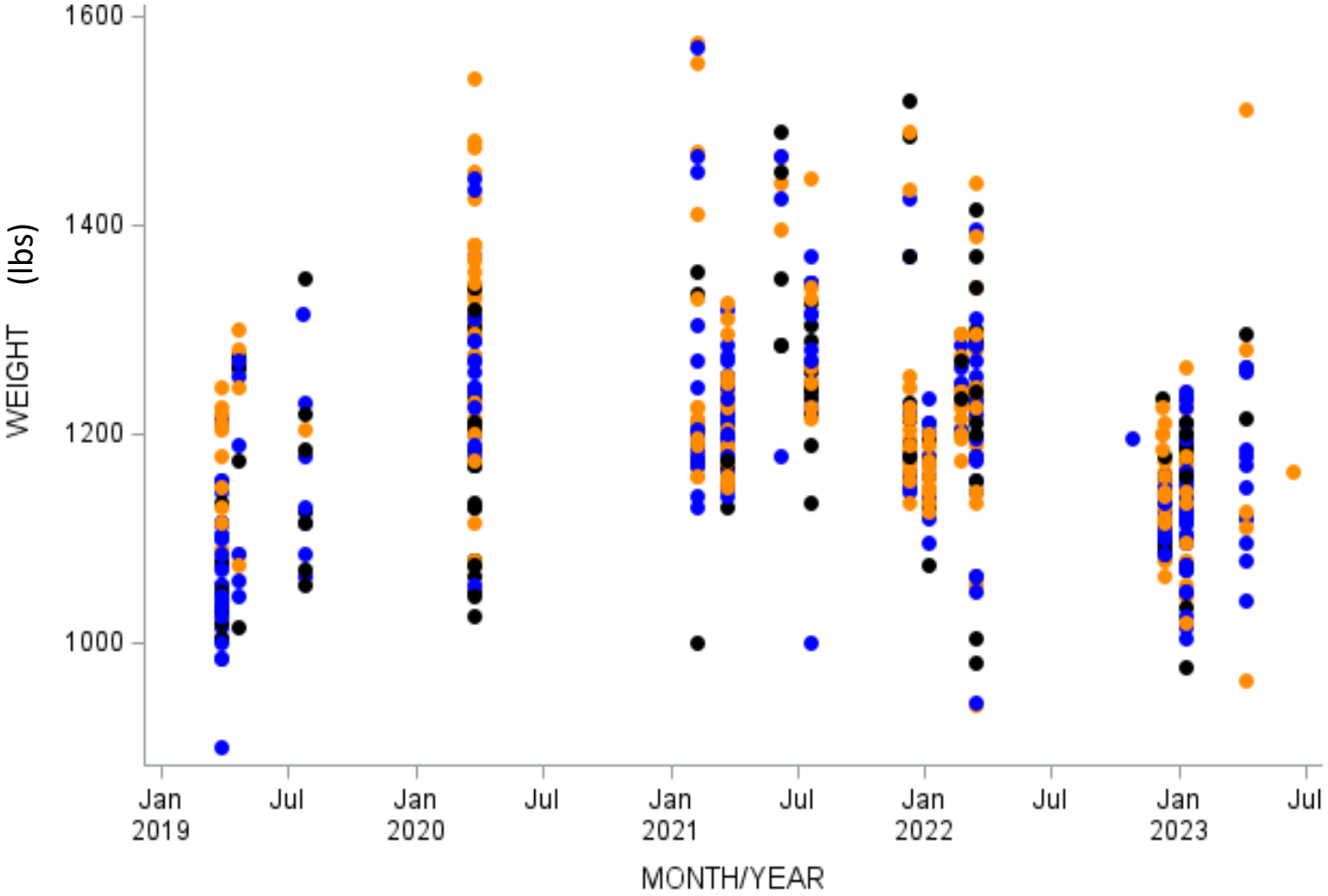
Wood

986 lbs

Plain

1020 lbs

SHIPPING WEIGHT



Cross

1214 lbs

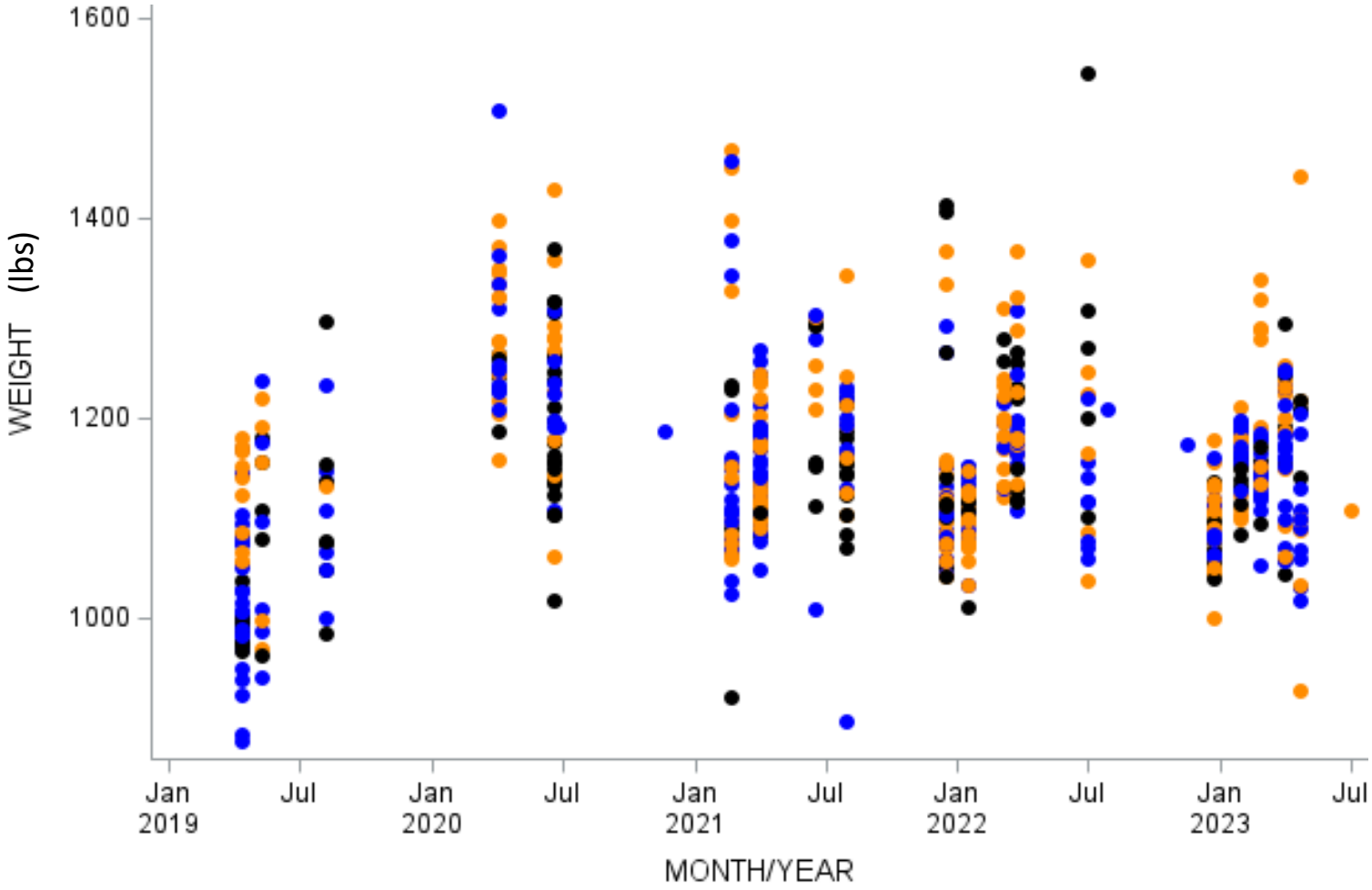
Wood

1189 lbs

Plain

1184 lbs

LIVE WEIGHT AT SLAUGHTER



Cross

1167 lbs

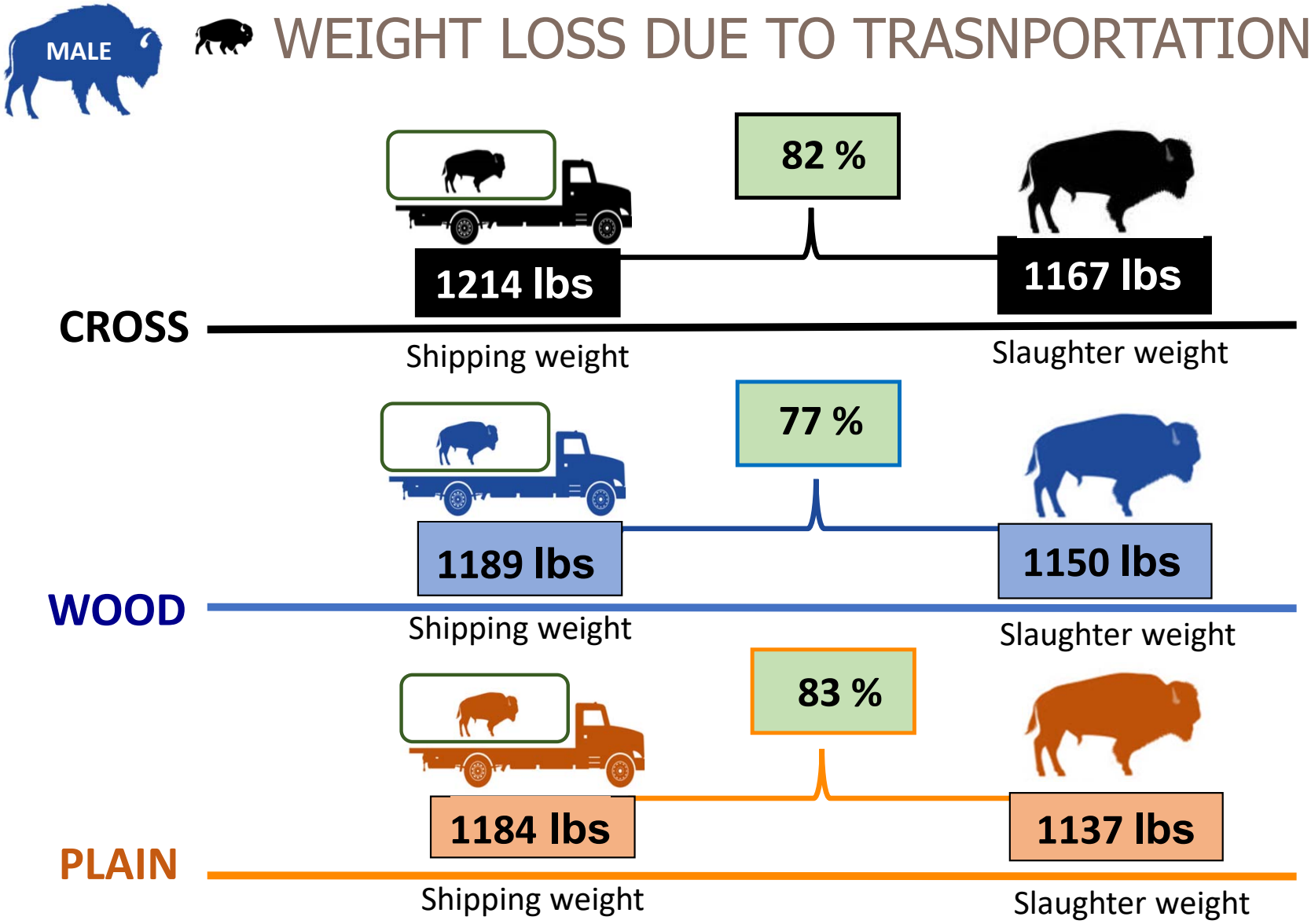
Wood

1150 lbs

Plain

1137 lbs

WEIGHT LOSS DUE TO TRASNPORTATION



MALE

CARCASS TRAITS

CROSS	1167	712	701	61%	0.6%
WOOD	1150	699	689	60%	0.5%
PLAIN	1137	696	685	61%	0.6%
ALL HERD	1152 lbs	704 lbs	693 lbs	61%	0.5%
	Live	HOT	COLD	YIELD	SHRINK

MALE

PRICE PER LBS

HIGHER

(Range: 3.15 U$ – 4.30 U$)

LOWER

PRICE PER LBS

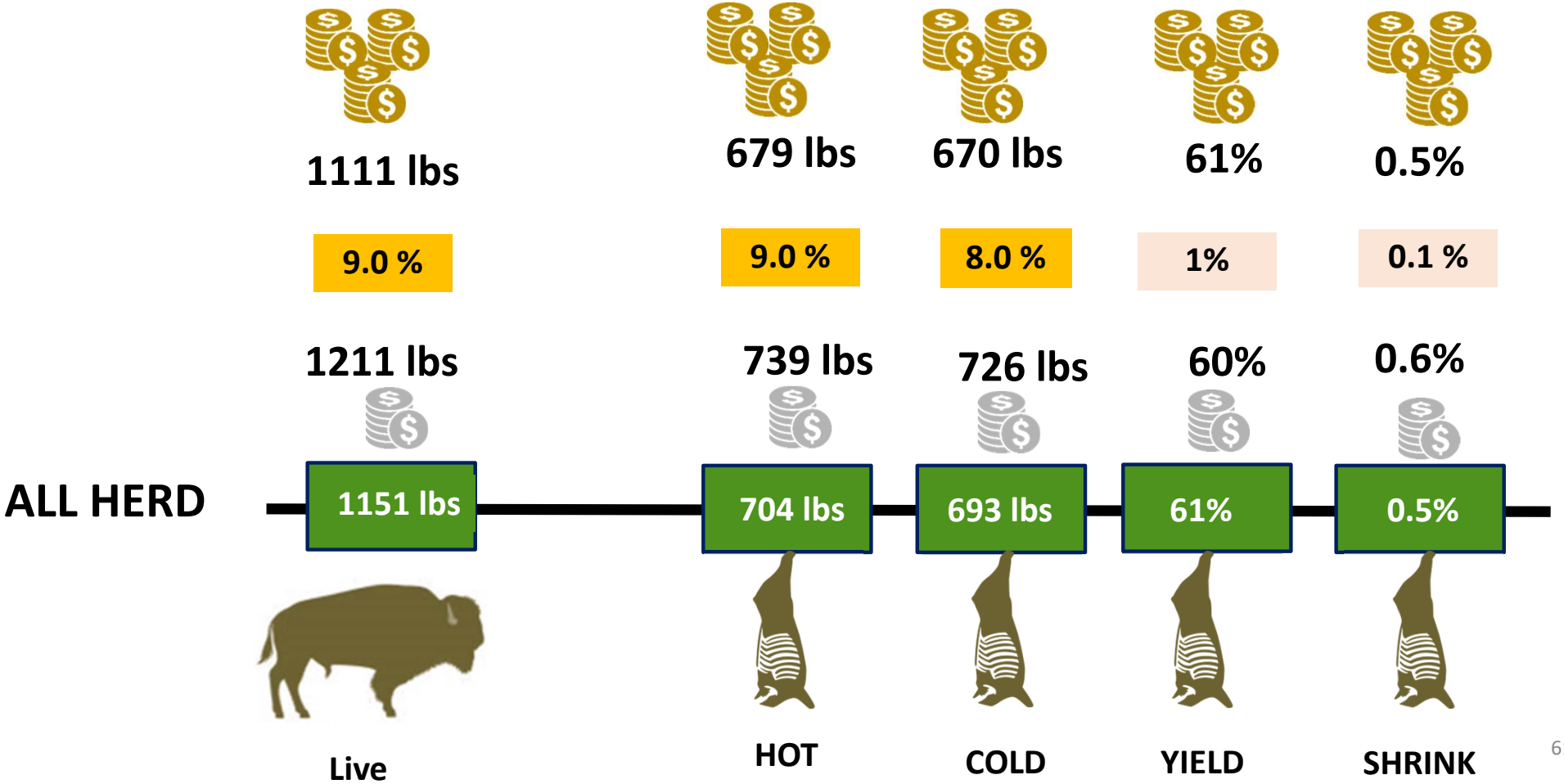
> 4.00

PRICE PER LBS

≤ 4.00

MALE

PRICE PER LBS



MALE

YIELD

HIGHER

> 62%

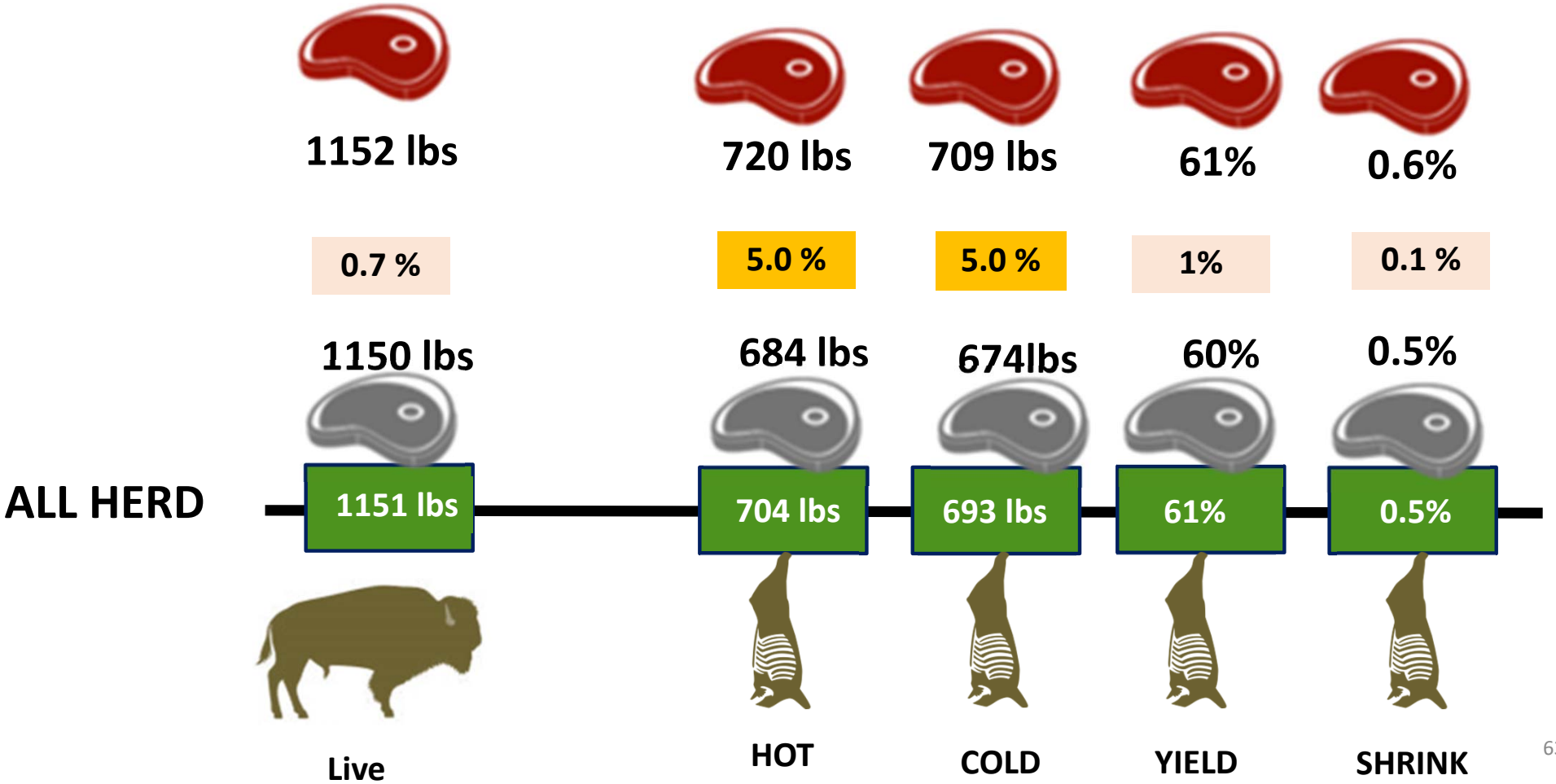
(Range: 55% – 66%)

LOWER

≤ 62%

MALE

YIELD


1152 lbs
720 lbs
709 lbs
61%
0.6%
0.7 %
5.0 %
5.0 %
1%
0.1 %
1150 lbs
684 lbs
674lbs
60%
0.5%
ALL HERD
1151 lbs
704 lbs
693 lbs
61%
0.5%
Live
HOT
COLD
YIELD
SHRINK

PRELIMINARY CONSIDERATIONS

In general, Cross animals were heaviested, followed by Wood and Plain.

Transport and handling factors may influence the final live weight at the slaughterhouse.

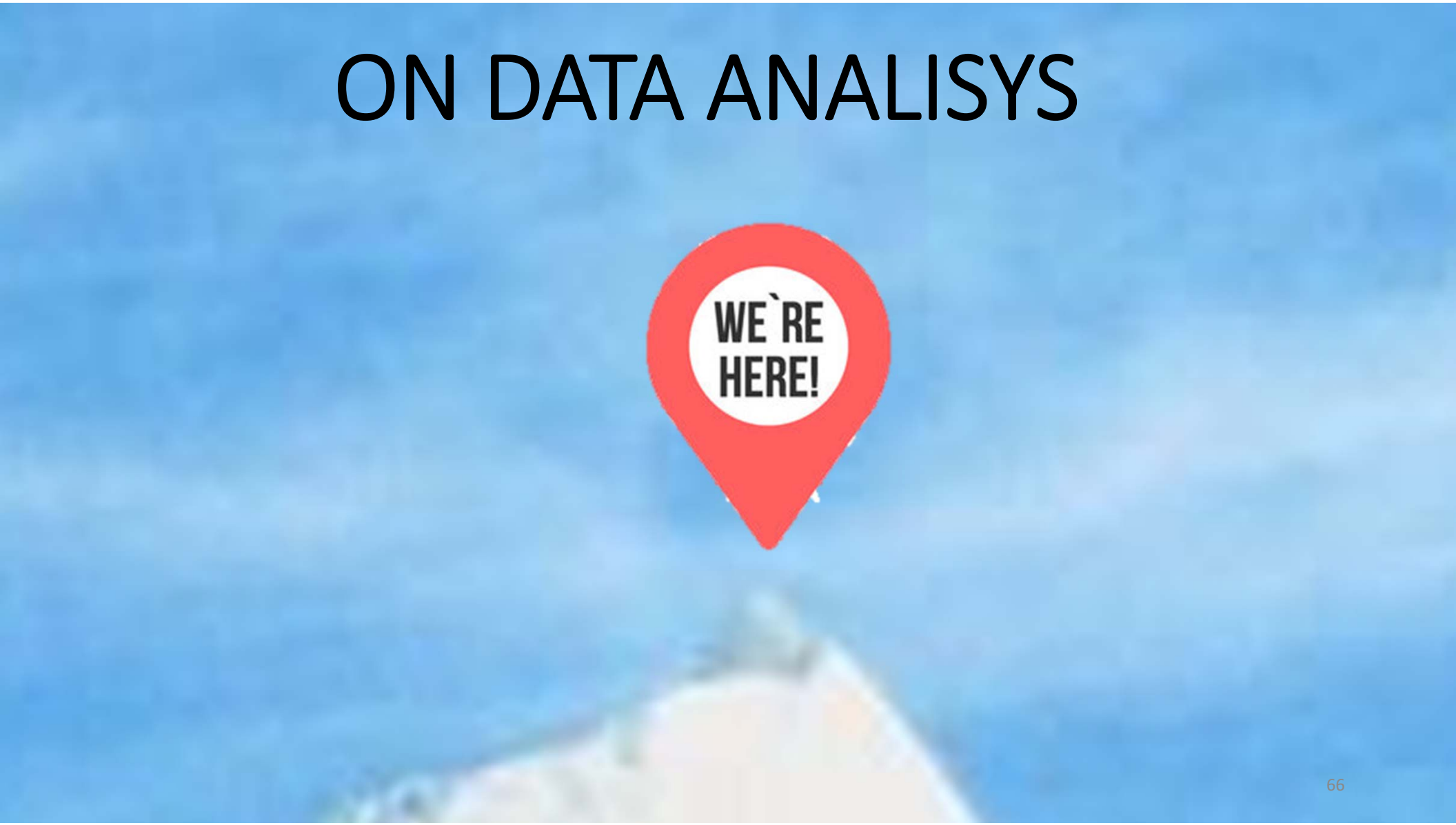
The highest paid carcasses may not be necessarily the heaviest ones.

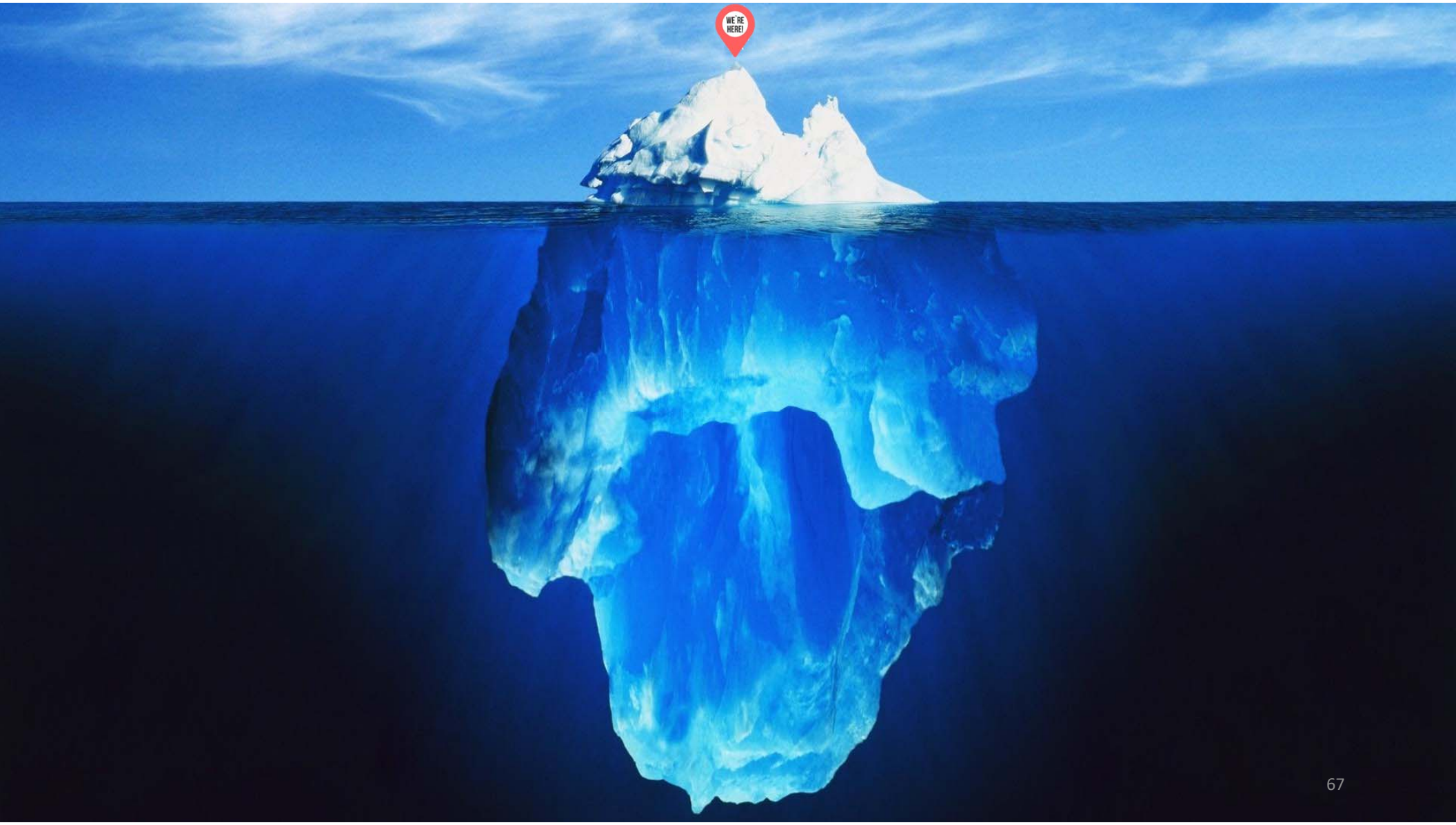
Animals with higher yield showed no variation in live weight but had the heaviest carcasses.

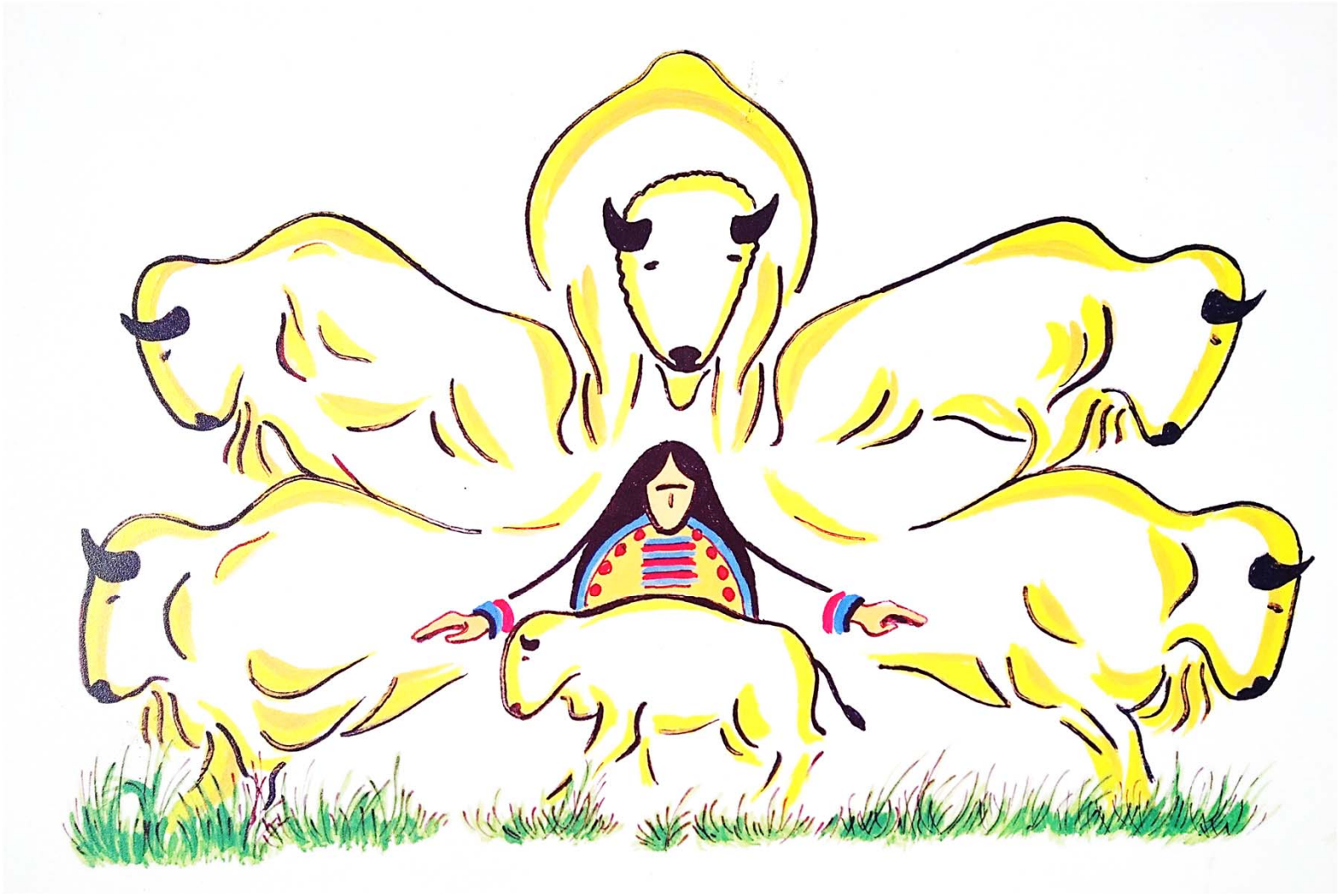
ON DATA ANALISYS

- More data
- Different approaches

ON DATA ANALISYS




WE'RE HERE!



Life Cycle Assessment of Canadian Bison Production

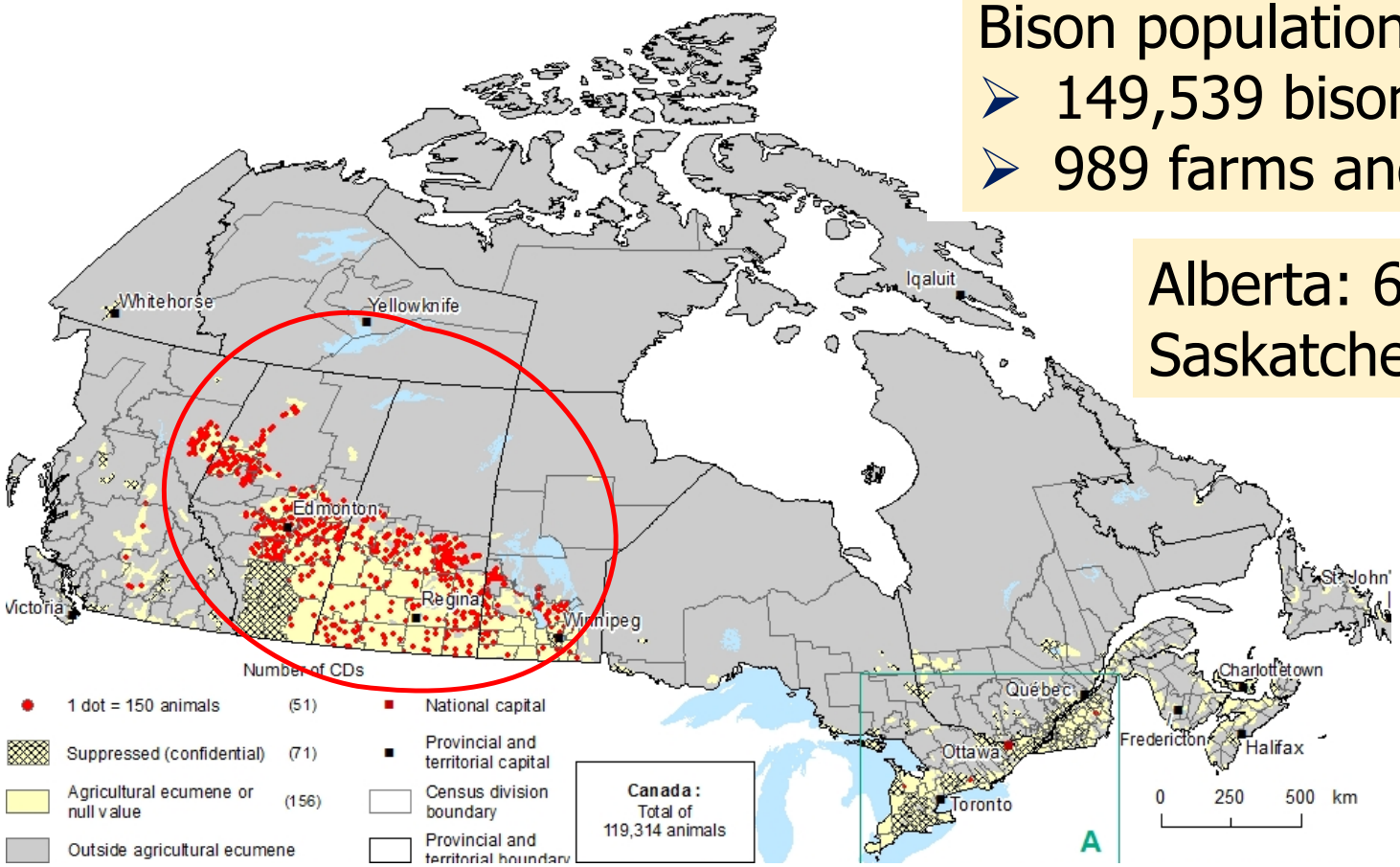
presented by Saranporn Poothong, DVM.

Outline

- Canadian bison production and carbon footprint
- The life cycle assessment (LCA) method
- Example: LCA of beef production
- LCA application in Canadian bison industry

Canada total bison

by Census division, 2016



Bison population 2016 – 2021

- 149,539 bison on
- 989 farms and ranches

Alberta: 65,405 bison
Saskatchewan: 52,860 bison

Statistics Canada, Agriculture Division, Census of Agriculture, 2016

Canadian Bison Association

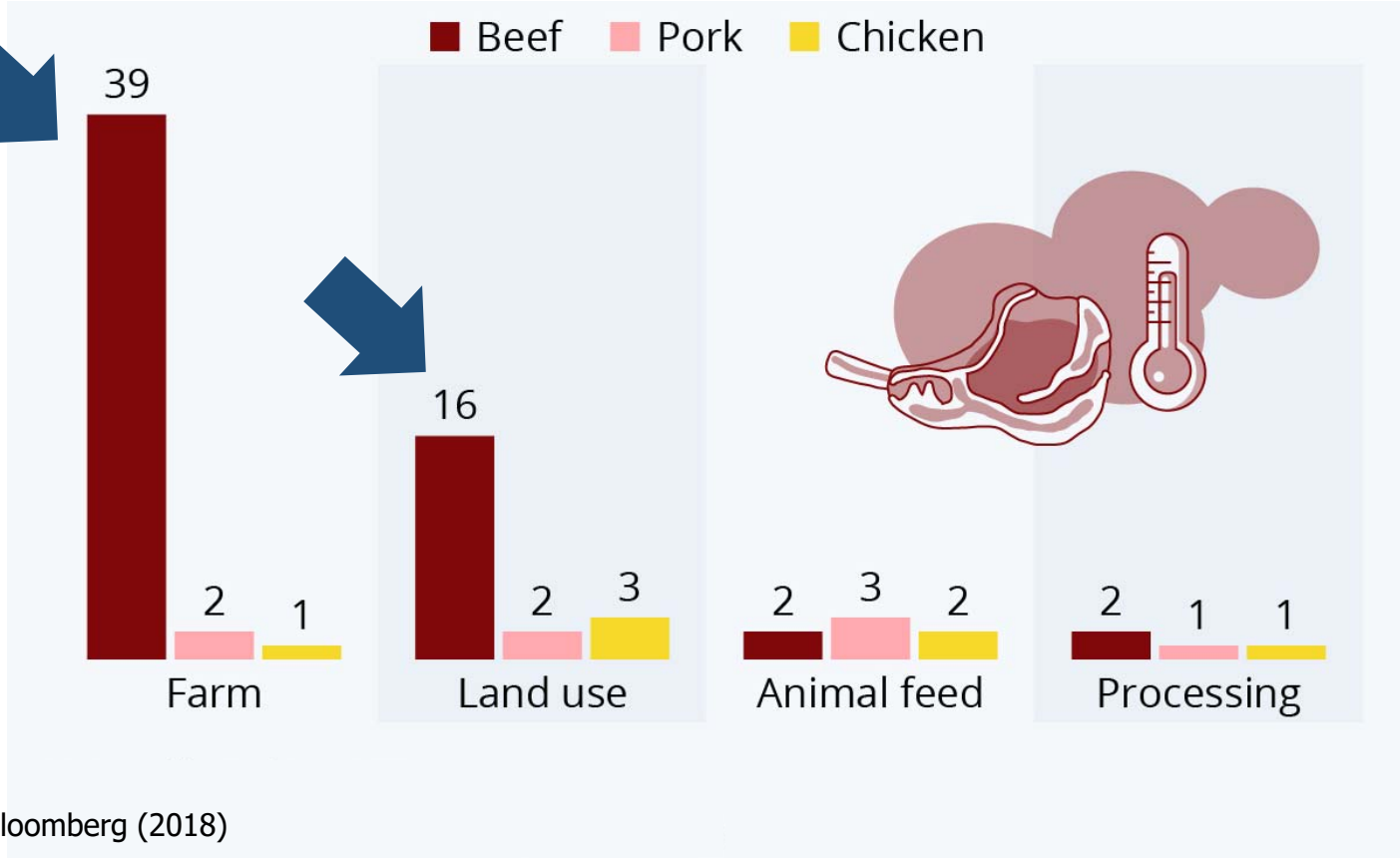
"The **industry's sustainability** might also make bison farming an interesting venture." Diego Flammini

"An important goal for Canada's bison producers. Clearly the shift from cultivation to pastoral pursuits like raising bison substantially is **good for the planet, our environment** and enhancing the diversity of our species."

"Working with people who have a passion for the animal and the industry makes my role a pleasure as I work with like-minded people wanting to grow the industry while focusing on **sustainability**" Les Kroger, Regina Saskatchewan (2020)

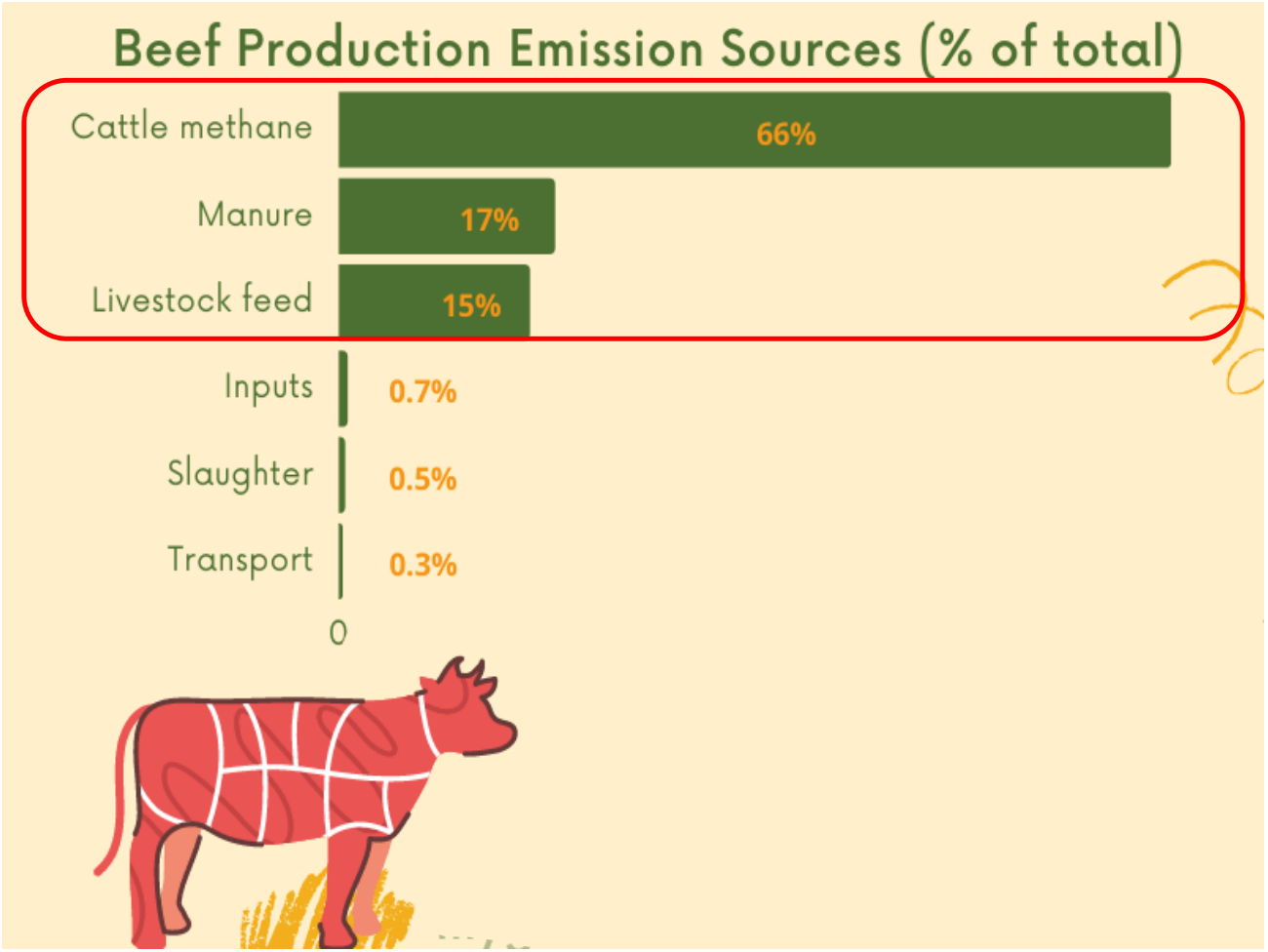
Beef contributing to climate change

GHGs emission from meat production
(kg CO_2e/ kg of product)



Poore and Nemecek, Bloomberg (2018)

Beef contributing to climate change



https://mygreentoddler.com/environmental-impact-of-meat/

Life cycle assessment methodology

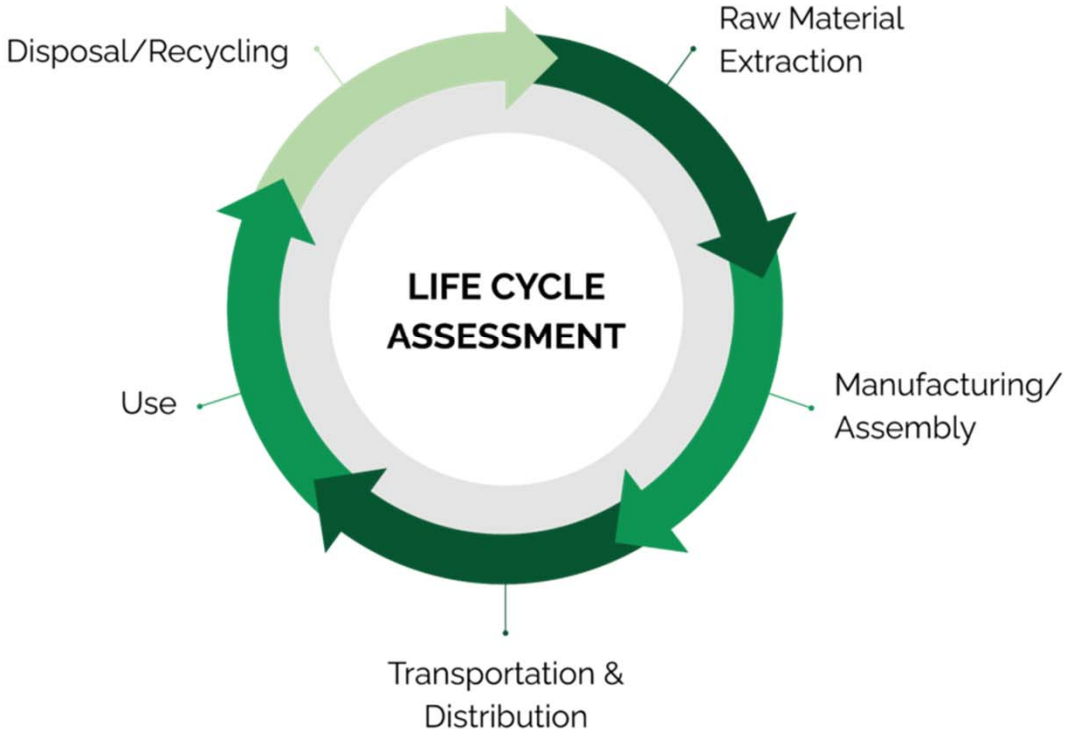
(LCA)

What is the Life cycle assessment method?

A tool

to quantify, evaluate, compare and improve product counting for

Environmental impacts



DOI: 10.3390/agriculture8100165

Life Cycle Assessment method

Input

Feed

Water supply

Land use

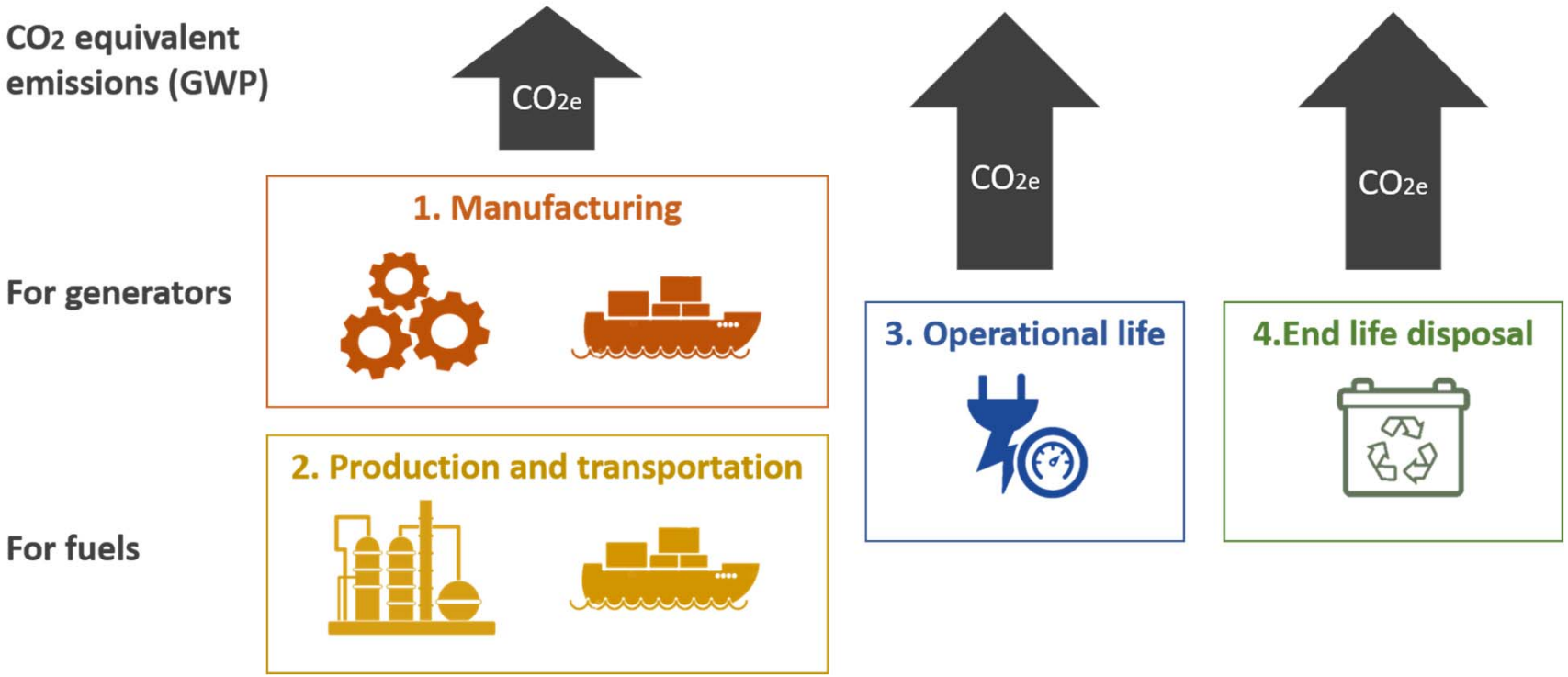
Vet products

Energy

Husbandry

Output

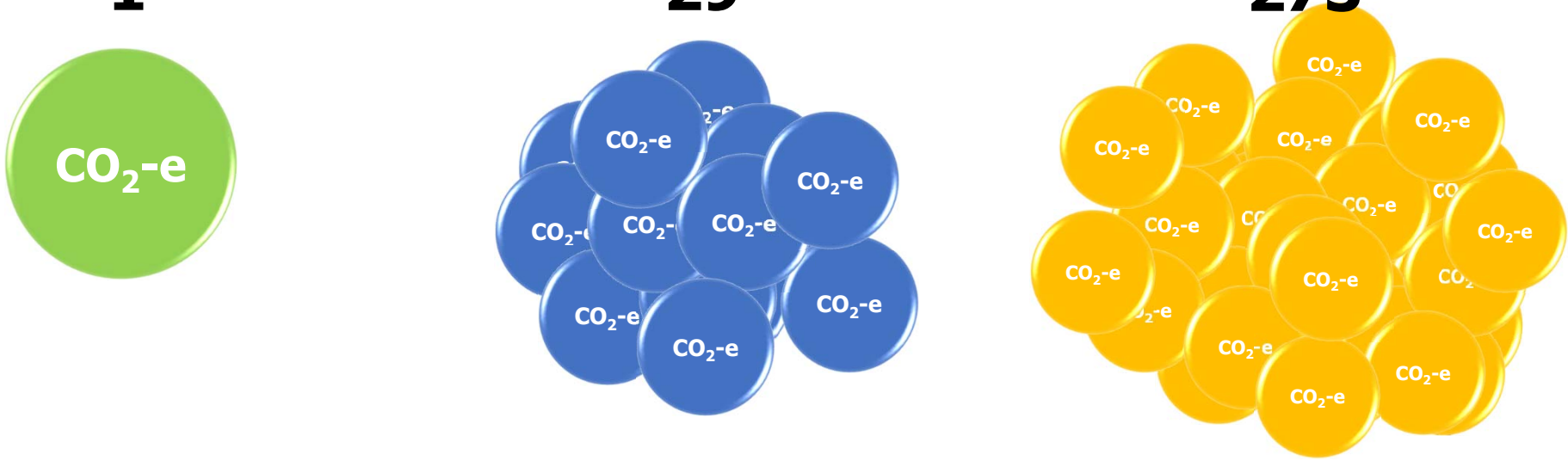
LCA result: Carbon footprint



LCA result: Carbon footprint

CO_2-e = The ability of heat absorption and longevity

CO_2	CH_4	N_2O
1	29	273



(IPCC 2021)

EXAMPLE
LCA of beef production

LCA of beef production

4

120 cows, 102 calves

Enteric CH_4
Manure CH_4
Manure N_2O
Soil N_2O
Energy CO_2

3.3 M Kg CO_2-e

19 M km

5

99 cows

Enteric CH_4
Manure CH_4
Manure N_2O
Soil N_2O
Energy CO_2

400K Kg CO_2-e

2.3 M km

6

98 cows

Enteric CH_4
Manure CH_4
Manure N_2O
Soil N_2O
Energy CO_2

600K Kg CO_2-e

3.5 M km

7

LCA of beef production

4

120 cows, 102 calves

5

99 cows

6

98 cows

19 M km

2.3 M km

3.5 M km

Carbon footprint and customer

How could we apply LCA in Canadian bison industry ?

Flow chart of the Bison supply chain

Farmer

Input

Production

Processing & Distribution

Retail

Feed

Veterinary services and husbandry

Breeding livestock

Cow-calf operations

Backgrounding

Feedlots

Slaughter

Packing

Wholesalers

Supermarkets

Restaurants

Local market

Consumer

Farmer pays for inputs

Farmer pays production costs

Packer pays farmer
Wholesalers pays packer

Retailer pays wholesales
Consumer pays retailer

Life cycle of bison production

1

Cow-calf

5

Backgrounding

6

Finishing

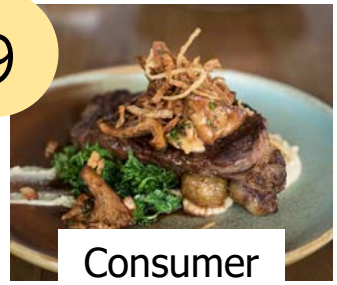
7

Slaughter/packer

8

Retail

9



Consumer

LCA of bison production

Input

- No. of cows, calves, bulls
- Feed, water supply
- Duration of stay
- Manure management
- Land use
- Power
- Transportation

Output

- Methane emission
  - Cows/calves
  - Manure
- Nitrous oxide
  - Manure, soil
- Carbon dioxide
  - Power
  - Transportation

Life cycle of bison production

1 Cow-calf

5 Backgrounding

6 Finishing

7 Slaughter/packer

8 Retail

9 Consumer

LCA of bison production

1

Cow-calf

Guideline: Bison cow-calf, MB

Data of average animal per farm 2012-2021

"The benchmark project"

No. of animals
- 136 cows
- 117 calves
- 8 Bulls

Backgrounding 200 days
- 614 ha
- Rangeland/native
- Add bison manure 140 kg/ha

Winter feeding 165 days
- Barley grain-based diet

5

Backgrounding

No. of animals
- 76 heifers
- 83 bulls

Backgrounding 200 days
- 614 ha
- Rangeland/native
- Add bison manure 140 kg/ha

6

Finishing

No. of animals
- 76 heifers
- 83 bulls

Winter feeding 165 days
- Barley grain-based diet

LCA of bison production

Stages	Enteric fermentation CH_4	Manure CH_4	Manure N_2O	Soil N_2O	Farm energy CO_2
			(kg CO_2e)		
Cow-calf	**418,793**	**50,364**	**87,670**	**56,517**	19,143
Backgrounding	263,665	1,717	**65,916**	**95,983**	14,972
Finishing	**90,741**	**50,640**	21,752	4,453	3,772

1

Cow-calf

136 cows
117 calves
8 Bulls

Feed efficiency

Manure management

Backgrounding

76 heifers
83 bulls

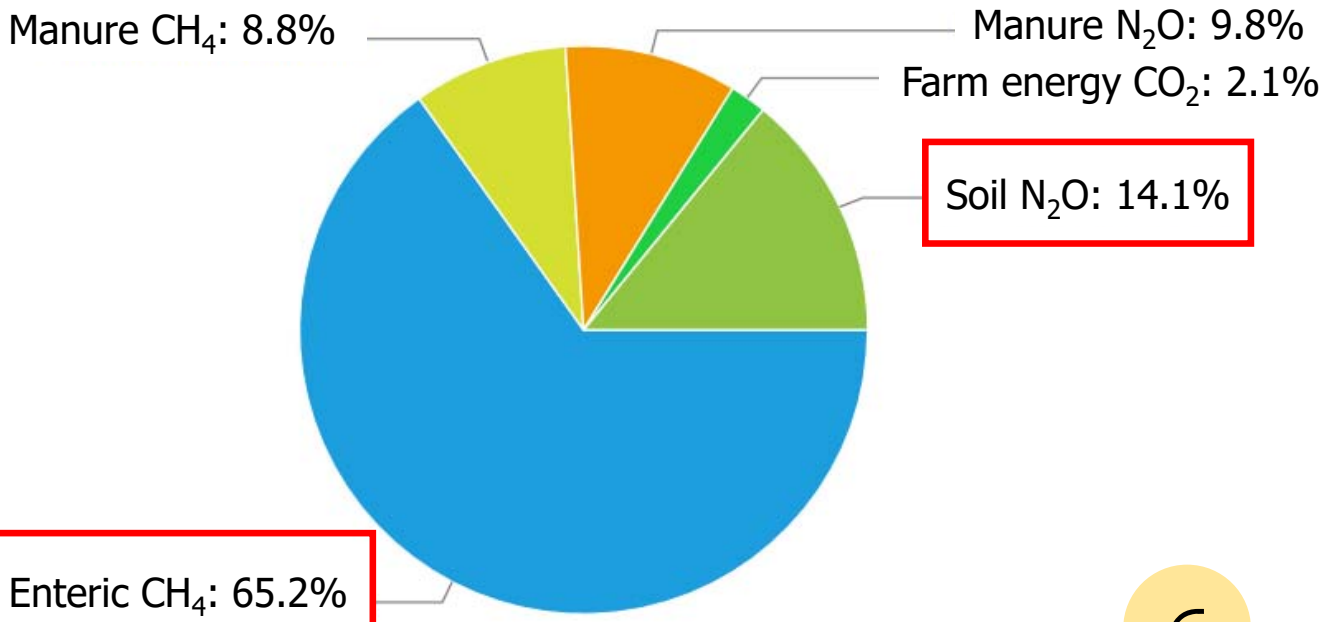
Pasture management

6

Finishing

76 heifers
83 bulls

LCA of bison production



1

Cow-calf

5

Backgrounding

6

Finishing

Life cycle of bison production

1 Cow-calf

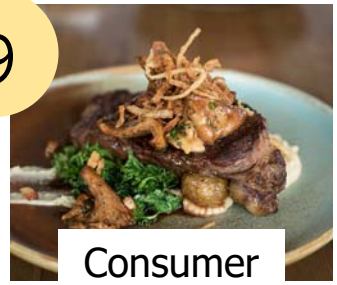
5 Backgrounding

6 Finishing

7 Slaughter/packer

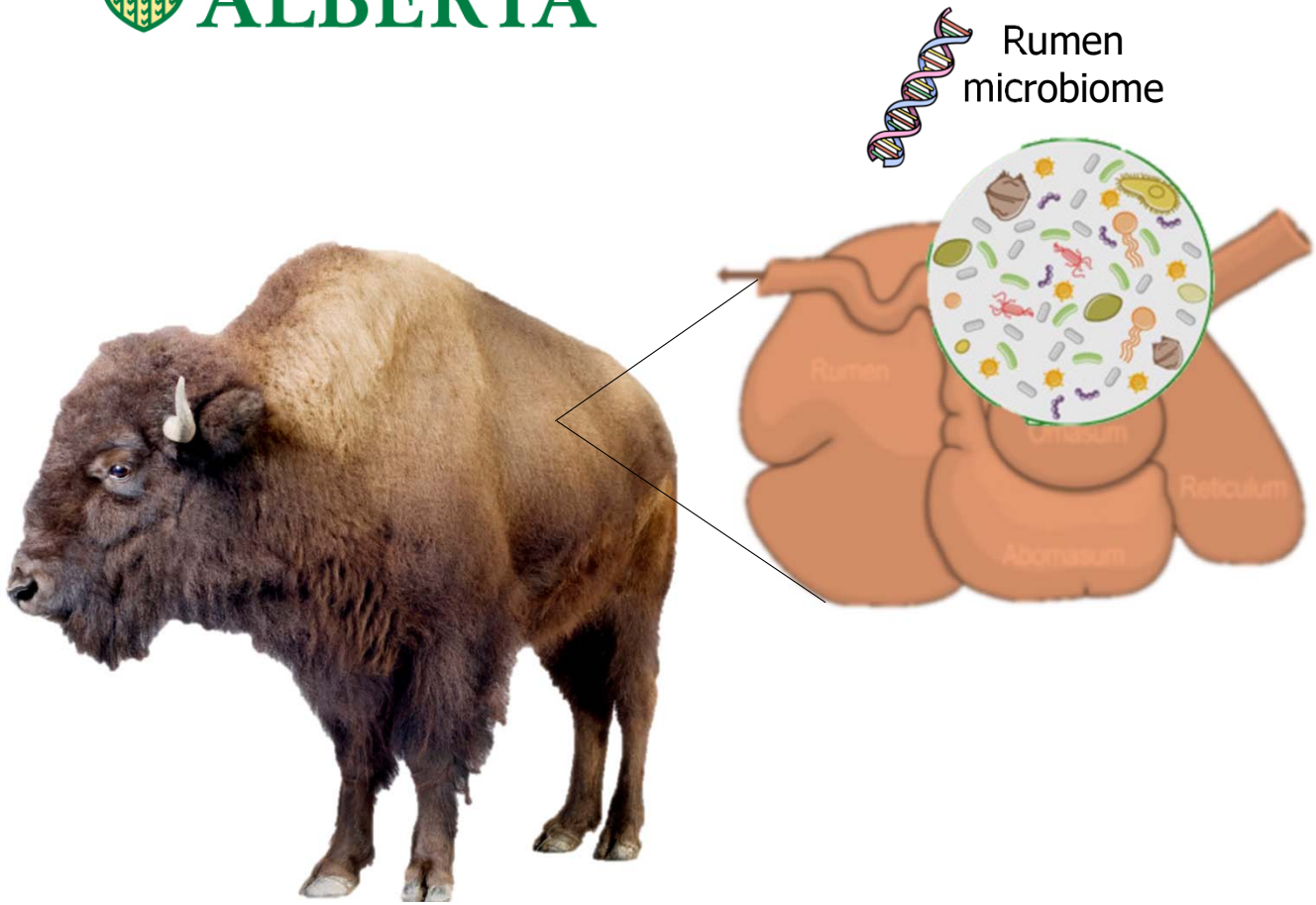
8 Retail

9 Consumer



"The benchmark project"

Microbiome & Carcass quality



Paints by Arnold Isbister