



North Central Highland Cattle Association
Annual Meeting
7 Feb 2026

Considering Carcass Data
as part of
Highland Bull Selection

Quick History

Understanding of where we came from and how we arrived here helps to shape where we are heading

*U.S. Beef Industry Development
Beef Carcass Inspections Emerge
Grading Introduced*

Pre-Inspection Period

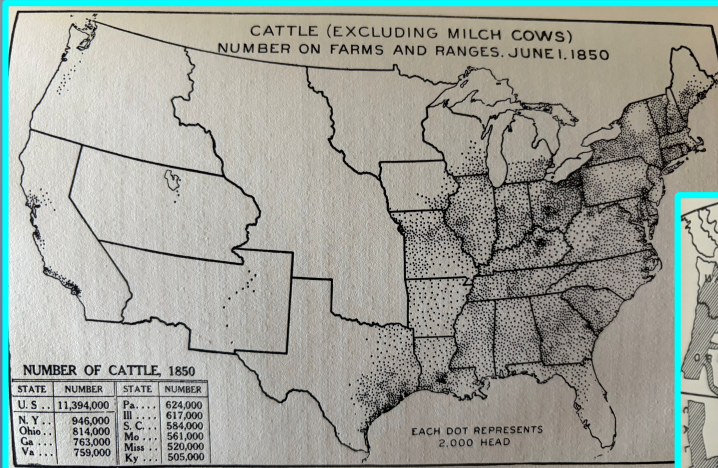
- *Post Civil War period*
- *West is becoming settled (KS, NE, MO)*
- *Large Cattle ranches developing in the West*
- *Railroads spreading west (Land Grants)*
- *Large city/metropolitan areas emerging*
- *Refrigeration emerging but not productized*
- *Most cattle shipped to Chicago and distributed to major population centers*
- *Chicago Packing companies develop branch stockyards in the West*

(Kansas City, Wichita, Denver, Omaha, Sioux City, Fort Worth, etc)

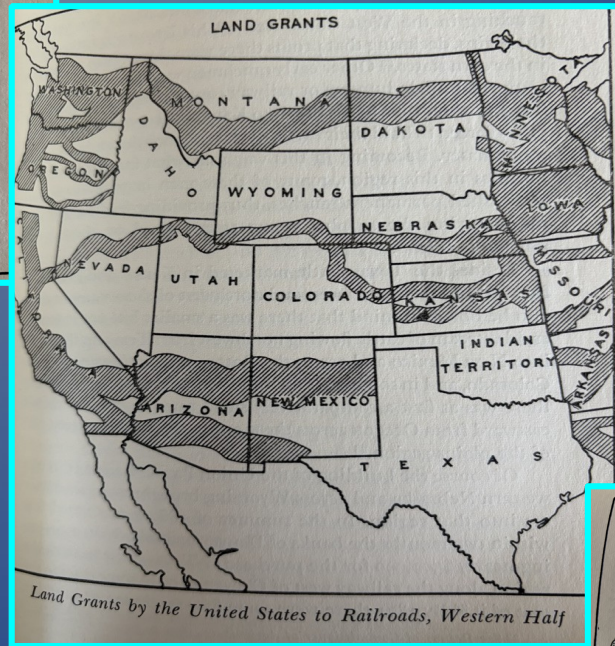
U.S. Beef Cattle Industry Development

US Cattle Population 1850

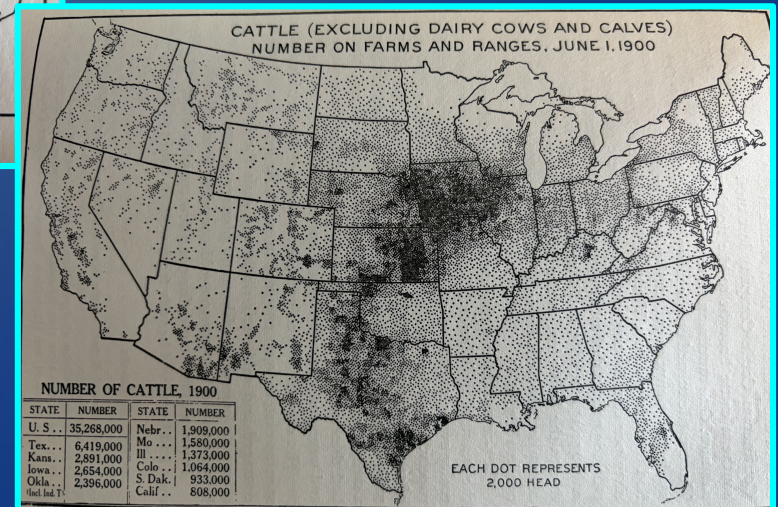
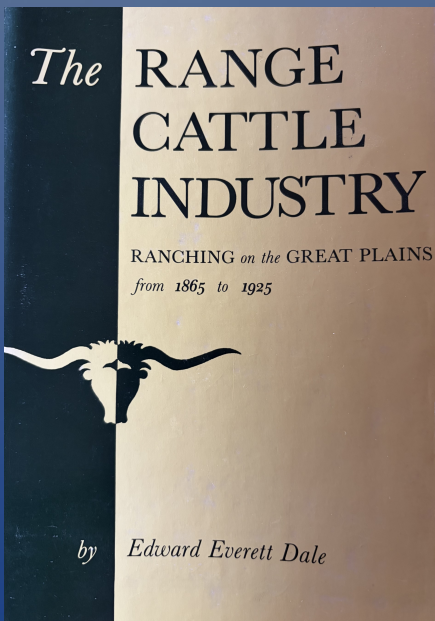
1850 - 1900



US Land Grants



US Cattle Population 1900



Problems in the Beef Industry

Beef Trust Created

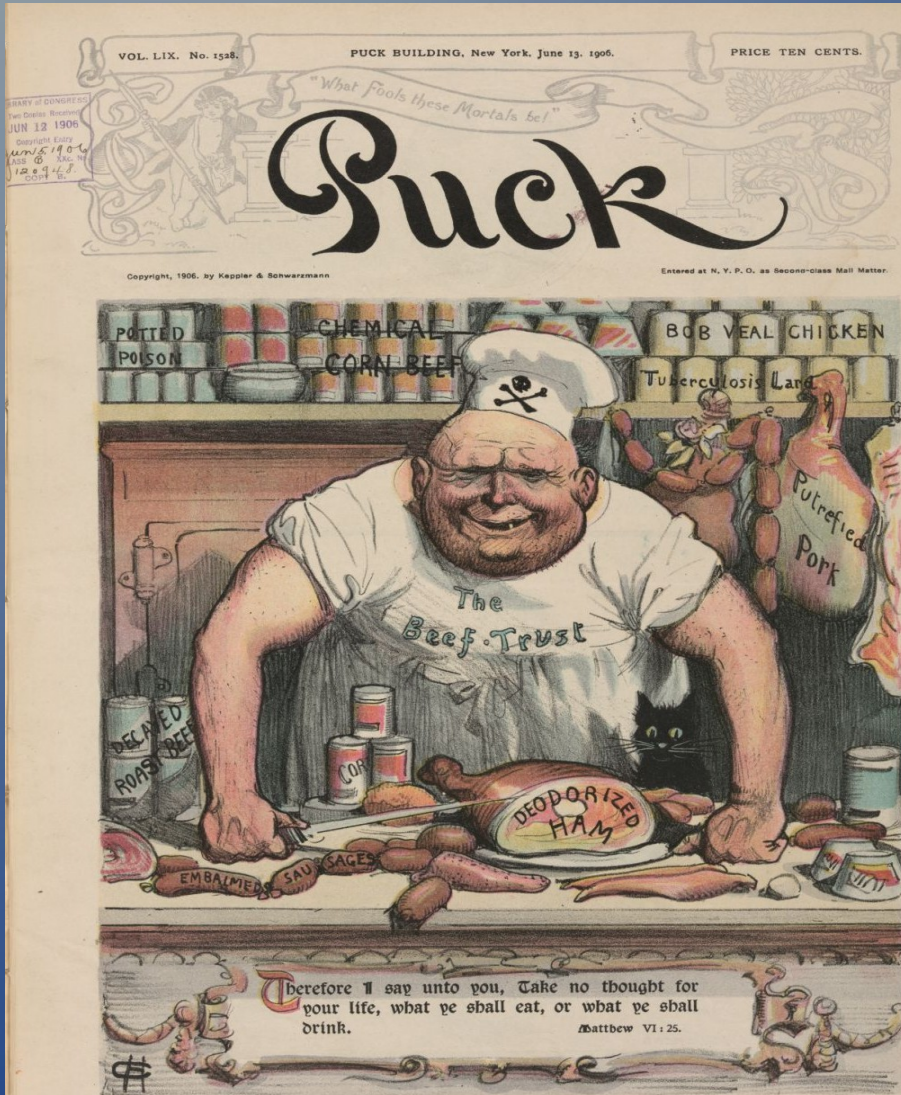
- Conglomeration of the 6 major beef packing enterprises
- Developed a non-compete system that optimized their profits disadvantaging producers and consumers and controlled the industry

- Price Controls (input / output)
- Quality Controls
- Production Controls

Industry Logistics

- Refrigeration technology is just emerging
- Cattle have to be transported to local slaughter facilities driving up costs

- Housing
- Feeding
- Water
- Managing



History – USDA Inspection Program



Stimulus for an Regulated Inspection Program

- The Jungle (Upton Sinclair) illustrated working conditions in the production chain
- Public disgust with the lack of industry standards regarding the treatment of animals and meat
- Congressional action due to public's discontent with the status of the meat processing industry

Result

The Meat Inspection Act of 1906 signed into law by President Theodore Roosevelt

- Granted USDA the authority to inspect livestock before and after slaughter
- Extended authorities to foreign products
- Observable improvement in conditions across the industry



Beef Carcass Grading

History - USDA Grading Program

- 1920s - Government experiencing difficulty acquiring uniform quality of beef from their contracts
- Other industry consumers experience similar dissatisfaction
 - Hotels
 - Railroads
 - Shipping
 - Retail
- USDA Department Bulletin 1246 "Market Classes and Grades of Beef"
 - Published 1923
 - 1st Beef grading standards
 - Commercial industries followed
- 1924 - USDA Grading & Stamping leads to consumer confidence in beef quality and marketing opportunities for quality beef producers
- The program has been continuously tuned and improved over the decades

Grade Types & Measurement Methods

Grade Types

Yield Grade

- Backfat
- Ribeye Area
- Kidney, Pelvic, Heart Fat
- Hot Carcass Weight

Quality

- Maturity
- Marbling

Measurement Methods

Carcass Grading

- Predicted Yield
- Predicted Quality

Ultrasound

- Predicted Yield
- Predicted Grade



<https://extension.psu.edu/understanding-beef-carcass-yields-and-losses-during-processing/>



<https://www.farmersweekly.co.za/agri-technology/farming-for-tomorrow/ultrasound-how-to-get-an-inside-view-of-genetic-carcass-traits/>

Yield Grading Traits

Hot Carcass Weight

%KPH Fat

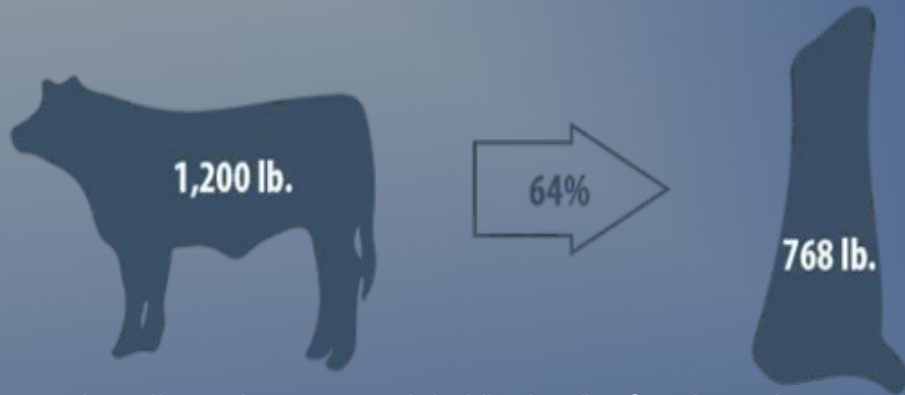
Backfat/Fat Cover

REA Size

Yield Grades



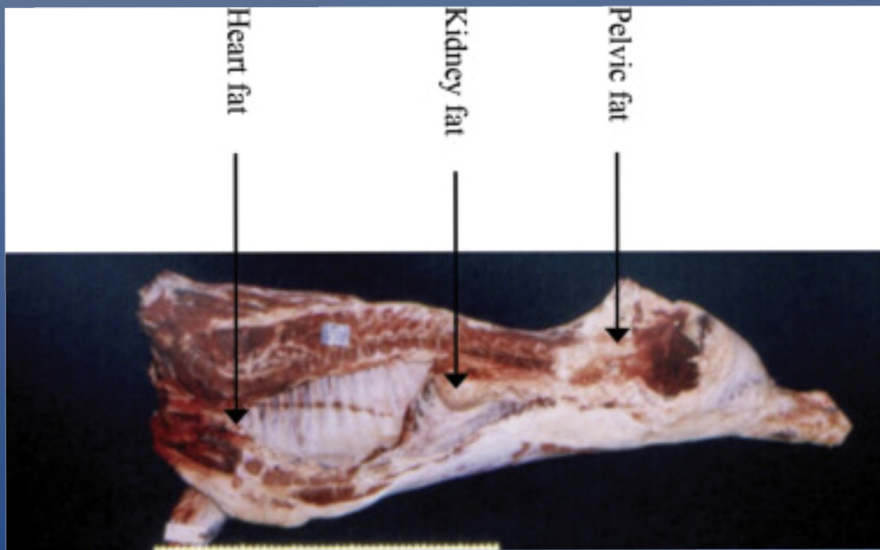
Yield Grading Traits



<https://extension.msstate.edu/publications/beef-grades-and-carcass-information>

Hot Carcass Weight

- Hot carcass weight is the weight of a carcass as it is leaving the harvest area, before entering a cooler to be chilled.
- This number can usually be found on the identification tag of the carcass.



<https://www.sciencedirect.com/topics/veterinary-science-and-veterinary-medicine/pelvic-kidney>

Kidney, Pelvic, Heart (KPH)

- % KPH - percentage of total fat found in the body cavity of a carcass specifically in the regions of the kidneys, pelvis, and heart.
- Estimated visually by a USDA grader or it can be calculated based on the change in carcass weight following removal of fat from these areas on the carcass.
- Most carcasses have 1 to 4 percent KPH. It is the last factor used to determine yield grade.



Yield Grading Traits

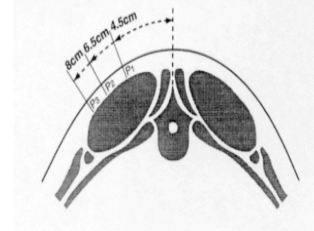
Backfat

- Measured between the 12th & 13th rib
- Optimal range .2 - .4 inches
- Used to determine the Preliminary Yield Grade (PYG)

Fat opposite ribeye	PYG
0	2.00
.2	2.50
.4	3.00
.6	3.50
.8	4.00
1.0	4.50

Backfat & PYG values

Figure 13.4 Point of measurement on the rib site for cattle. Source: AUS-Meat.



The point of measurement taken with an optical probe (intrascanner) at the level of the head of the last rib. P1 and P3 apply to split or unsplit carcasses and P2 to split carcasses.

<https://www.woolwise.com/wp-content/uploads/2017/07/MEAT-418-518-13-T-13.pdf>

Figure 13.3 P8 fat depth in a beef carcass. Source: AUS-Meat.

FAT MEASUREMENT P8 SITE

MANUAL MEASUREMENT

Fat depths may be measured manually using a cut and measure knife. The measurement is taken at the P8 site and is recorded on the Feedback Sheet as consistent indication of the fatness of the carcass.

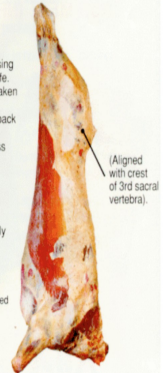
AUTOMATIC MEASUREMENT

Fat depths may be measured electronically at the P8 site using a Hennessey Grading Probe. The reading is fed into a computer and the measurement recorded on the Feedback Sheet.

FAT CLASS

Table shows mm of fat at P8 site.

1 up to 2	4 over 12 and up to 22
2 over 2 and up to 6	5 over 22 and up to 32
3 over 6 and up to 12	6 over 32



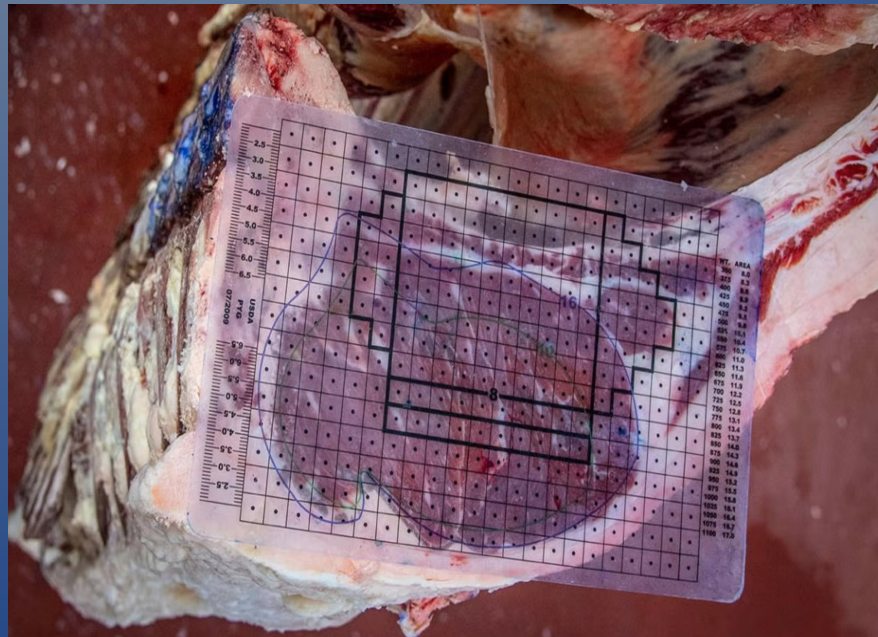
Measuring Backfat on a beef ribeye



Yield Grading Traits

Ribeye Area (REA)

- Measured in square inches between 12th & 13th rib
- 12-15 inches recommended for best dining experience
- Significantly contributes to the Yield grade score



Within the beef industry, ribeye size varies greatly. Both excessively small and excessively large ribeyes are quality challenges for the beef industry. An optimum range for REA is 11 to 15 square inches. REA targets should be approximately 1.6 to 1.8 square inches per 100 pounds of carcass weight. Results from the Mississippi Farm to Feedlot program show that REA averaged 12.95 square inches, and REA per 100 pounds of carcass weight (cwt) averaged 1.74 square inches.

Yield Grades

Indications of cutability or yield of boneless, closely trimmed retail cuts

Grade Standards

Yield v. Quality Grades

- Factors: External Fat, Kidney, Heart & Pelvic (KHP) fat, Ribeye Area & Hot Carcass Weight
- Yield Grade Formula (Rounded to the lowest whole number)
 - $2.50 + (2.5 \times \text{adjusted fat thickness in inches}) +$
 - $(0.2 \times \text{percent kidney, heart and pelvic fat}) +$
 - $(0.0038 \times \text{hot carcass weight}) -$
 - $(0.32 \times \text{ribeye area in square inches})$
- Yield Grade information is valuable to the breeder or carcass consumer. Not necessarily valued by the retail customer.



Yield Grade	Percentage of closely trimmed retail product
1	75.5%
2	71.5%
3	67.5%
4	64.9%
5	60.8%

Quality Grading Traits

Delivering the finest dining experience

Maturity & Marbling

Grade Standards

Yield v. Quality Grades



- Major Factors

- Age/Maturity
- Marbling

- 8 Beef Quality Grades

- Prime
- Choice
- Select
- Standard
- Commercial
- Utility
- Cutter
- Canner

Less than 42 months

USDA Beef Quality Grades

% IMF	Quality Grade	Marbling Degree	Marbling Score
2.0-3.0	Select -	Slight 00-40	4.0-4.4
3.1-3.9	Select +	Slight 50-90	4.5-4.9
4.0-5.5	Choice -	Small 00-90	5.0-5.9
5.6-6.9	Choice o	Modest 00-90	6.0-6.9
7.0-8.5	Choice +	Moderate 00-90	7.0-7.9
8.6-9.9	Prime -	Slightly Ab 00-90	8.0-8.9
10.0+	Prime o	Mod Ab 00-90	9.0+

RELATIONSHIP BETWEEN MARBLING, MATURITY, AND CARCASS QUALITY GRADE ¹					
Degrees of Marbling	Maturity				
	A	B	C	D	E
Slightly Abundant	PRIME				
Moderate			COMMERCIAL		
Modest	CHOICE				
Small					
Slight	SELECT		UTILITY		
Traces					
Practically Devoid	STANDARD			CUTTER	CANNER

Maturity in Months

A — 9 to 30 months

B — 30 to 42 months

C — 42 to 72 months

D — 72 to 96 months

E — more than 96 months

Quality Grading Traits

Maturity – Impact on Quality

USDA Beef Quality Grades

- Cross links of collagen become stronger as animals mature. This connective tissue becomes denser and leads to reduced tenderness
- USDA graders assess maturity by examining bone characteristics, muscle color, and texture.
- Physiological Age not Chronological Age
 - Degree of bone development in the vertebral column (Ossification)
 - Color and texture of the Ribeye
 - Shape and Condition of the rib bones

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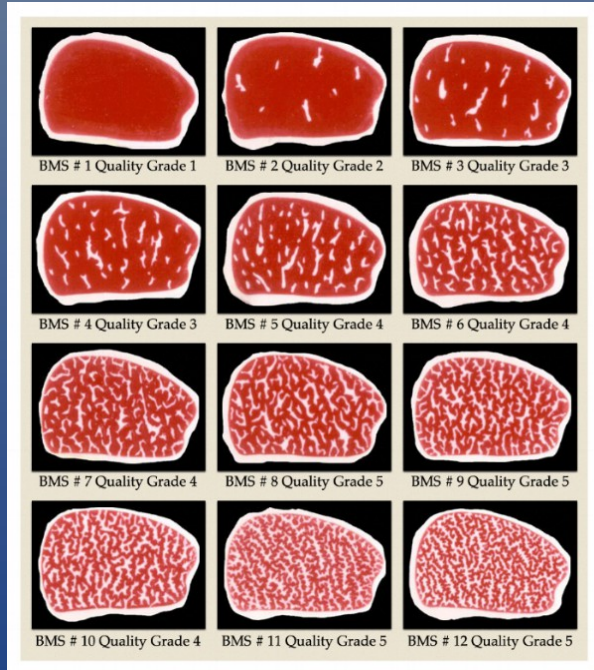
Quality Grading Traits

Ribeye %IMF / Marbling

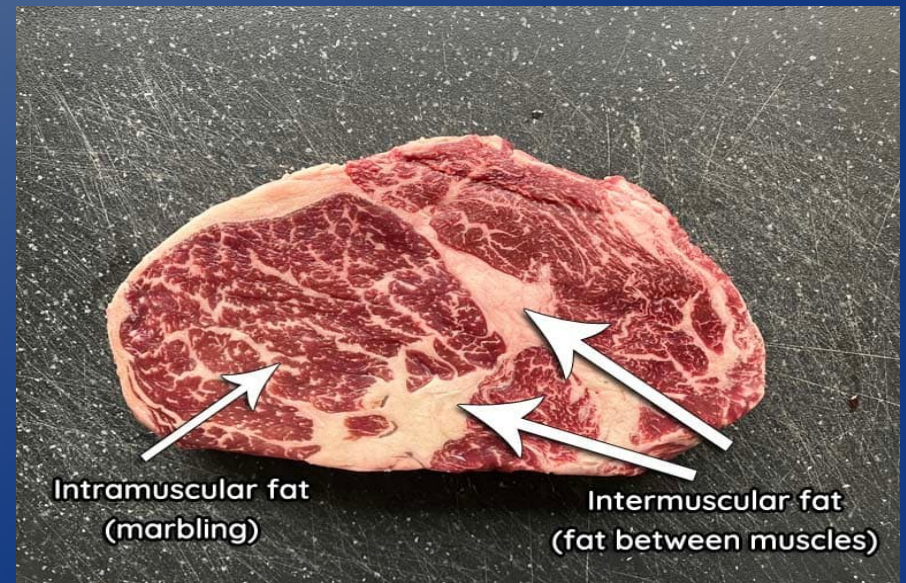
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7.0-8.5	Choice +	Moderate 00-90	7.0-7.9
8.6-9.9	Prime -	Slightly Ab 00-90	8.0-8.9
10.0+	Prime o	Mod Ab 00-90	9.0+

Types of Marbling

- *Fine marbling:* Small, thin, and evenly dispersed fat flecks that melt during cooking, resulting in superior tenderness and juiciness. This is the hallmark of high-quality beef such as Wagyu and Kobe.
- *Medium marbling:* Larger fat pieces with uneven distribution, leading to inconsistent cooking and a less pleasant mouthfeel, especially when cooked rare or medium rare.
- *Coarse marbling:* Large, irregular fat chunks that do not render well, resulting in tough, dry areas and an inferior eating experience.



12 USDA Beef Marbling Scores

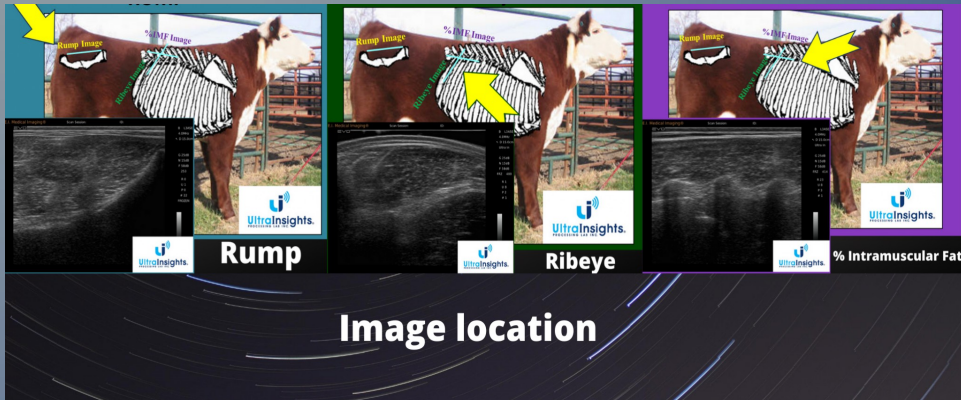


Grading Types

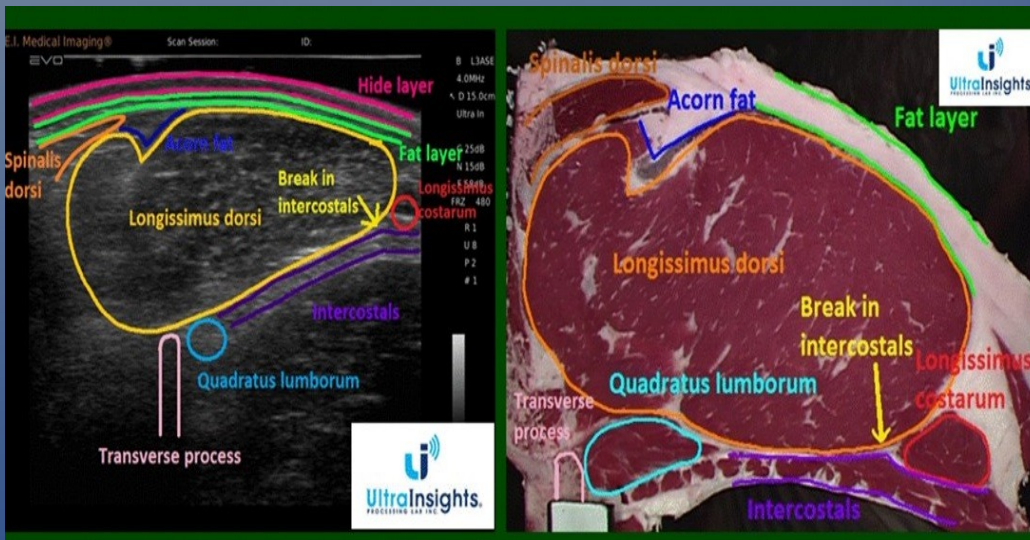
Ultrasound

Carcass Evaluation

Ultrasound



<http://wordpress.ultra insights.com/index.php/about-ultrasound/>



HCW - Estimated
KPH - Constant
Maturity - Reported DOB

- Ultrasound technology is an implementation of 'piezoelectric' research discoveries in the late 1880s
- Transmission of high frequency sound waves typically between 2 - 10 MHz into the live animal between the 12th & 13th rib
- Reflections vary in amplitude depending on the density of the flesh
 - Hide
 - Back fat
 - Muscle
 - IntraMuscular Fat (IMF)
- The collected reflections form a 'cross section' image based on the various brightness in the shades of gray
- Modern ultrasound uses 256 shades of gray
 - Human eye can only distinguish 30 - 64 shades
 - Computer processing improves shade detections
- Emergence of AI and ML will probably result in improved accuracy

Hot Carcass Grading

Measuring Backfat

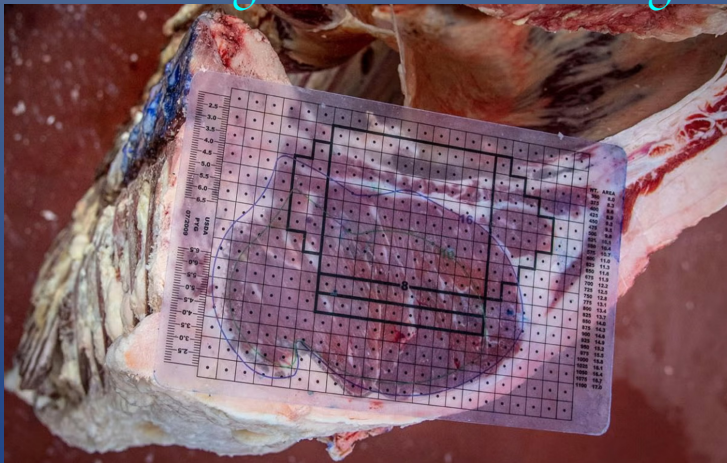


KPH

- Hot carcass is weighed
- KPH removed
- Carcass reweighed
- Provides the % of KPH to HCW

https://www.ams.usda.gov/sites/default/files/media/Procedures_for_Yield_Grading_of_Beef_Carcasses_After_Removal_of_the_Kidney_Pelvic_and_Heart_Fat_During_the_Harvest_Process.pdf

Measuring REA and Marbling



Cool!

So What?

How can we use this information?

What data do we have?

Highland bull carcass data

carcass data – what data and where is it?

AHCA NWSS Show Results

<https://highlandcattleusa.org/national-show-sale-results/>

- *Ultrasound Results 2012 – Current*
- *Spring Bagpipes*
 - Ultrasound data collection on NWSS bulls began in 2001
 - Show results, weights and ultrasound data is published in the spring Bagpipes
- *Challenges with the show data*
 - Each year's data is in a separate link
 - Data is not normalized (pdf, .csv, web)
 - Difficult to analyze across years
 - Pre-2014 data needs to be manually evaluated

Thorbardin Bull Tests

<https://web.archive.org/web/20080704070433/http://www.thorbardinranch.com/bulltest.html>

- *Tests conducted 2000-2005*
 - Web summaries for each test
 - Data in .pdf format
- *Challenges with the test data*
 - Many bulls not in herd book
 - Most herd book bulls have no progeny
 - Some cross and non-Highland were tested

- Download from the AHCA website
- Develop PYTHON scripts to normalize data and write to a PYTHON dataframe
- Remove females, steers, scratches and animals without all measurements

Bull Data

Making the AHCA Data Useable

- Sort into NWSS divisions
- Scoring
- Visualization Dashboards
- User interaction features
 - Sorting tools
 - Analysis tools

Bull Analysis Dashboard
National Western Stock Show(NWSS) - American Highland Cattle Association(AHCA) Show Bulls

[NWSS Highland Bull Background Information](#) [NWSS Highland Bull Trends by Division](#) [NWSS Bull Division Analysis](#) [NWSS Selected Bull Analysis](#) [How old is my Bull?](#) [Feed Conversion Calculator](#)

Data

- All data employed in the analysis was obtained from results posted publicly online on the American Highland Cattle Association (AHCA) website: (<http://www.hIGHLANDCATTLEUSA.org/>)
- Unable to read year 2017
- Data - 133 Bulls Compared
- 2021 was cancelled due to COVID
- Each year's measurements document was converted to .csv and read into a JUPYTER notebook
- 2014 - 2021 with the above exceptions
- Only bulls with all measurements were included in the analysis
- Weight only, Scratch, etc were dropped

Background Information

Bulls Sorted into Age Groups based on NWSS Division Ages

- A quick observation of the data in the spreadsheets quickly reveals that comparing bulls across ages makes no sense.
- For this analysis, bulls were sorted by NWSS Division. In order to do this, the age in days (Days - DOB) was obtained based on the difference in days between the NWSS measurement date for each year's show and the Date of Birth (DOB).
- A 50 pound constant was subtracted from the Measurement Weight since birth weights are not reported. This impacted ADG, which was calculated by dividing the reported NWSS weight measurement by the newly created "days_Old" metric.

NWSS Divisions

- Intermediate Bull Calf (1 May - 31 Dec) → (DOB Year + Show year - 1)
- Junior Bull Calf (1 Jan - 30 Apr) → (DOB Year + Show year - 1)
- Senior Bull Calf (1 Sep - 31 Dec) → (DOB Year + Show year - 2)
- Intermediate Yearling Bull (1 May - 31 Aug) → (DOB Year + Show year - 2)
- Junior Yearling Bull (1 Jan - 30 Apr) → (DOB Year + Show year - 2)
- Senior Bull (1 Jan - 31 Dec) → (DOB Year + Show year - 3)

REA Information

REA (Ribeye Area) in cattle refers to the size of the muscle cross-section from the ribeye steak (located between the 12th and 13th ribs). It is a key measurement used in cattle grading and evaluation, especially when assessing the quality and yield of meat.

what's the plan?

The problem with dependence on show winnings for genetic improvement is the diversity of environments that the cattle come from and the fact that to maximize growth large amounts of grain are usually fed.

Some Farm strategy or objectives

- show stock
- breeding stock
- beef program
- regenerative grazing
- agribusiness
- breed preservation
- yard art

The business strategy helps identify the traits you want to try to improve your genetics

Final Thought

Diversity?

*“ There will always be a place for the show ring.
There, we boast the breed and inform the world.
There, our markets are enhanced.*

But showing must be kept in control, as one of the influence upon genetic diversity, and never allowed to become dominant.

Unfortunately, the competitive spirit of the ring too often now denigrates into a showing frenzy, where the participant must win whatever it takes.

North American Highland breeders can well do without that.

The show ring tends to narrow the genetic base of the breed, with the bloodlines of the winners being greatly in demand, to the exclusion of animals as fine or finer.

.....

Diversity is not exclusionary.

To the contrary, it necessarily includes something of everything.

Diversity is not served when one aspect becomes over emphasized.

The watch word, therefore, must always be ‘all things in moderation’. “

Questions / Discussion