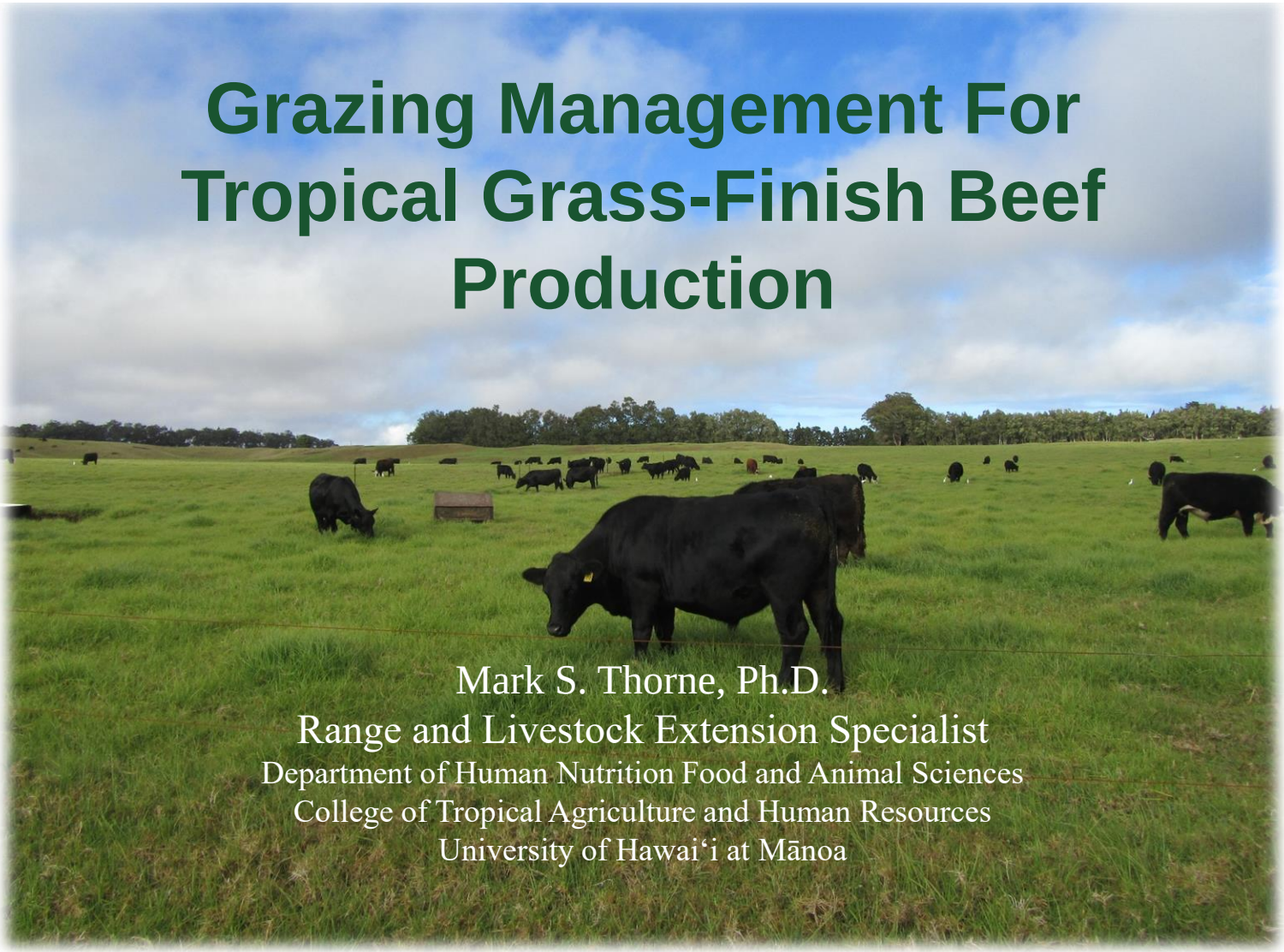
Grazing Management For Tropical Grass-Finish Beef Production



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Presentation Outline

1. Brief History of Ranching/Cattle Production In Hawaii
    1. History of Cattle production in Hawaii not really appreciated on the mainland
    2. Hawaii Cattle Industry has been responsive to changing economic conditions
    3. Hawaii Cattle Industry has been resilient
2. Current status of the industry and emerging marketing opportunities
3. Basics of Grass-Finish Beef Production
    1. Carcass Quality Traits – Tenderness
    2. Age of Animal at Slaughter
    3. Genetics vs. Forage Environment
    4. Forage Quality, Quantity, and the Animal Production Cycle

History of Ranching in Hawaii

- First cattle and sheep brought to the islands by Capt. Vancouver in 1793 as a gift to King Kamehameha I
- A Kapu was put on the livestock until around 1810 to allow for increase.
- Organized ranching in the islands was well established by the mid 1830's.
- 1830's – 1950's local slaughter and salted beef products.
- Ranching in Hawaii has generally followed the trends on the mainland.

History of Ranching in Hawaii

- Hawaii feedlot operations established in the 1950's and 60's.
- Peak cattle production reached in the 1970's at 240,000 head of cattle.

- In early1990's most feedlots close due to the high cost of shipping concentrate feeds into the state.
- Ranches begin to ship wean-off calves (400 lbs) to the mainland (nearly 100%).

Current Status of Beef Industry in Hawaii

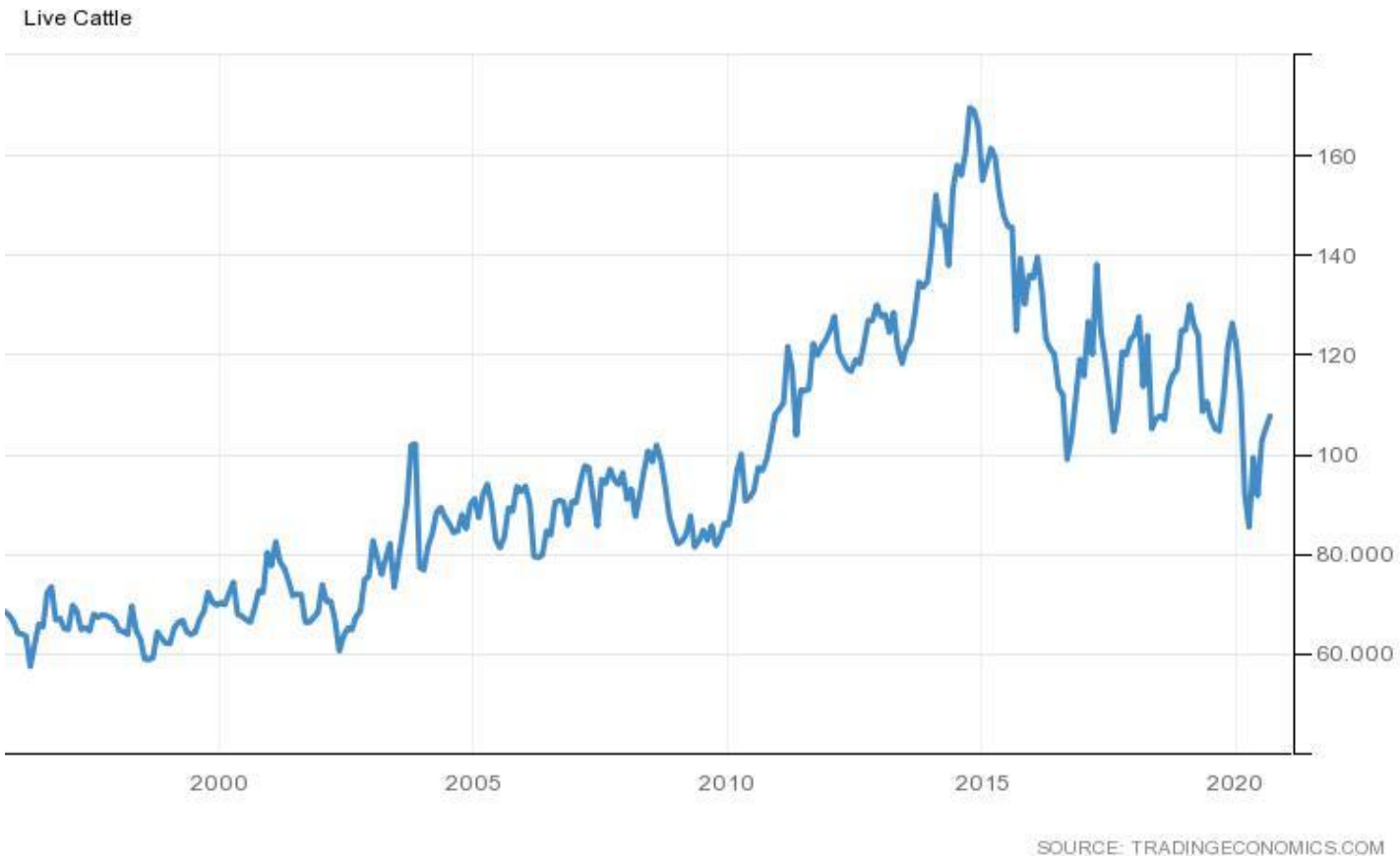
- Currently approximately 140,000 head of cattle (w/calves) in the islands.
  - 2009 – 150,000 head; drought causes herd contraction
  - 2013 – 132,000 head;
  - 2014 – 133,000 head, herd expansion begins.
  - 2016 – 135,000 head
  - 2017 – 142,000 head, expansion slows
  - 2019 – 142,000 head
  - 2020 – 140,000 head

- Diminished slaughter capacity as a result of the industries shift from local grain finish to export to mainland (late 1990's).

- Increasing cost and challenges of shipping live cattle to the mainland has sparked interest in grass-finish beef production in Hawaii

Current Status of Beef Industry in Hawaii

- Live Cattle Prices on the mainland are volatile and can range widely



25 Year history of Live Cattle prices in the U.S.

Current Status of Beef Industry in Hawaii

Questions for the industry:

1. How long will current mainland beef prices continue to make it profitable to ship to the mainland?
    1. Beef prices fluctuate over time (herd expansion, high demand)
    2. Shipping costs will go up (oil prices; labor; regulations, etc.)
    3. Cost of Production goes up

2. What would happen to the Hawaii Beef Industry if mainland beef prices no longer covered the cost of shipping, or if shipping stopped?
    1. Slaughter capacity would need to increase
    2. More pasture acreage would be needed
    3. Commodity beef imports will always be cheap, abundant, and in demand

- Grass-finish beef production market opportunities:
    - Buy local movement
    - Changing purchasing decisions (natural/organic)
    - Health benefits of grass-fed (Omega-3, CLA's)
    - Produce a premium product demand a premium price

Basics of Grass-Finish Beef Production in Hawaii

Finishing Cattle on Grass is a Science and an Art

- **Science**:
  - Grass-finish beef quality is a function of:
    - Animal genetics,
    - forage quantity and quality over the production cycle,
    - age of animal at slaughter, and
    - climatic conditions that affect forage production and animal performance.
- **Art**
  - understanding the interaction between these factors to consistently produce a quality meat product

Basics of Grass-Finish Beef Production in Hawaii

- Carcass Quality Traits: The Big Three
  - **Marbling** – i.e. intramuscular fat content; juiciness, flavor – a function of high energy to protein ration late in finish phase; animal genetics.
  - **Rib-eye area** - related to carcass size, 12 – 15 sq. in. yields an 8-12 oz. steak 1 in. thick – more or less a function of genetics (as it affects carcass size).
  - **Tenderness** – consumers identify more with tenderness than any other trait. – a function of animal age at slaughter, also highly heritable and correlated to high butterfat content of milk.

Basics of Grass-Finish Beef Production in Hawaii

- Grain fed vs. Grass-fed (Genetic Potential being equal):

  - **Marbling** is the result of a diet high in energy later in the animal's production cycle
    - Intramuscular fat deposits only after the animal has reached 65-70% of mature body weight; (65 -70% of 1200 lbs. MBW = 780 - 840 lbs. 12 – 16 moths of age)
    - High concentrate feeds (i.e. grain/corn), are higher in energy than forages so easier to deposit IM fat on grain than on forage.
    - Most grass forages have half or less energy than fed grains.
    - Grass-finished beef will always be leaner than grain fed beef.
    - Energy content of forages is highest in the early-maturing (reproductive phase) to boot stage.
    - Grass-finish animals should be on a high rate of gain on high energy forage going into slaughter to assure a quality marbled, tender product.

Basics of Grass-Finish Beef Production in Hawaii

- Grain fed vs. Grass-fed (Genetic Potential being equal):
    - **Rib eye area** is related to carcass size, and a function of the animal genetics.
    - Lager animals will have a larger rib eye area, but also a higher energy requirement
- Grain Fed Standard:
    - Ideal rib eye area is between 12 and 15 sq. in. which should yield an 8 to 12 oz steak, 1 in. thick.
    - Larger rib eyes are too expensive for the consumer
    - The U.S. Grain Fed Beef Industry has resulted in large frame animals since finishing on grain is more efficient than on grass
- Grass Finish Standard:
    - To finish at an early age (20-24 months; related to tenderness) at around 1200 lbs. on grass, beef animals should be early maturing, moderate framed animals.
    - This means that the standard rib eye area for grass-finish animals may have to be smaller than the ideal (at Mealani we average about 11.6 sq. in).

Basics of Grass-Finish Beef Production in Hawaii

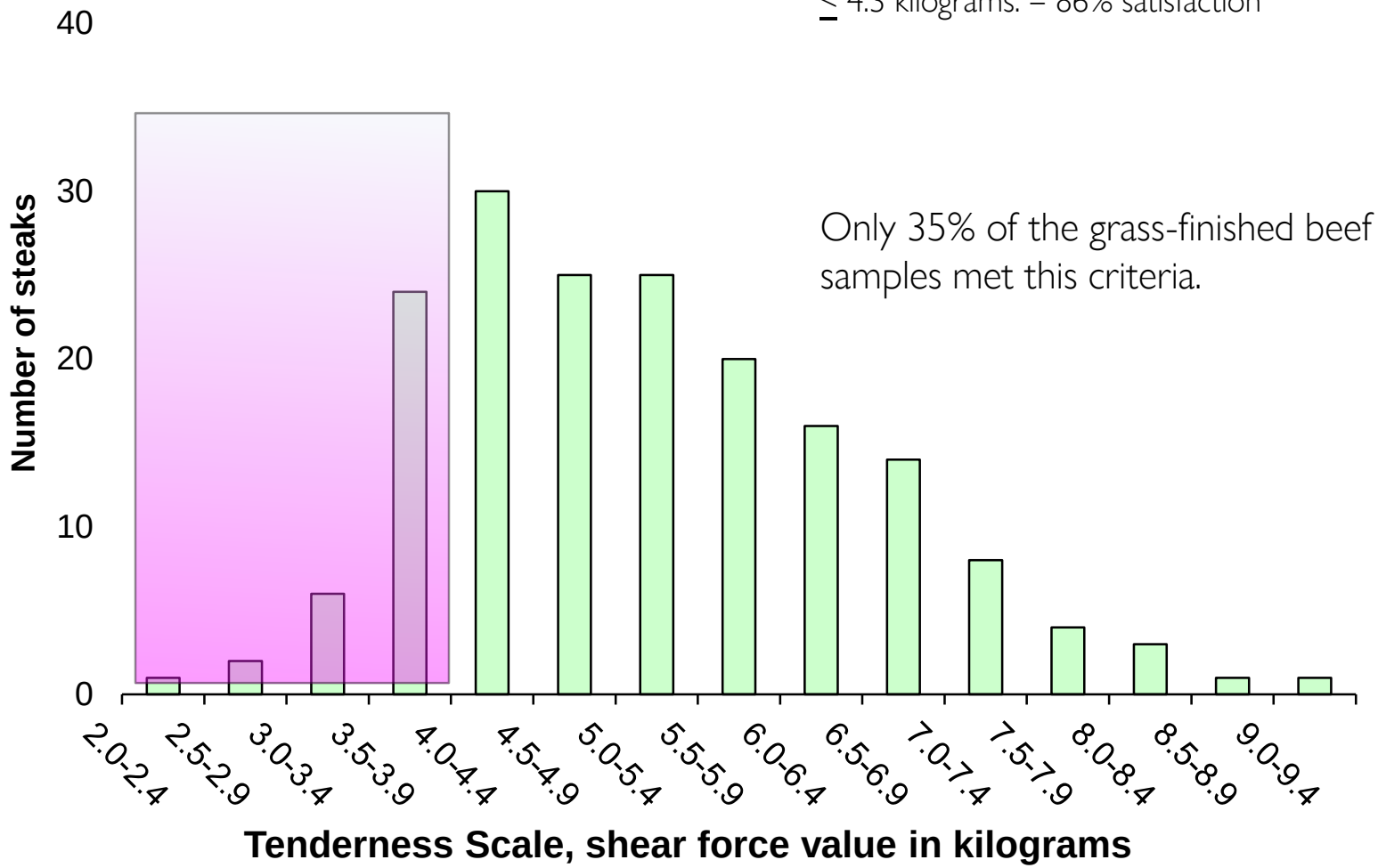
- Grain fed vs. Grass-fed (Genetic Potential being equal):

- **Tenderness**
  - Meat quality trait most consumers identify with.
  - Highly heritable, possibly correlated with high butterfat content in milk
  - Genetics being equal, tenderness is a function of **age of animal at slaughter**
  - Tenderness can be affected by:
    - Periods of no gain or weight loss at any point in the production cycle of the animal (birth to slaughter) will result in loss of tenderness
    - Periods of fasting/lack of water immediately prior to slaughter (increases glycogen, pH) will decrease tenderness.
    - Too rapid of cooling post slaughter. Lean carcasses are prone to cooling too rapidly causing muscle to be cold shortened and toughened.
  - UH studies on Tenderness of Grass-finish beef in Hawaii:

Results: Tenderness of Grass-finished Beef in Hawaii
n=191 (Kim et al. 2007)

Research by Miller et.al. in 2001.

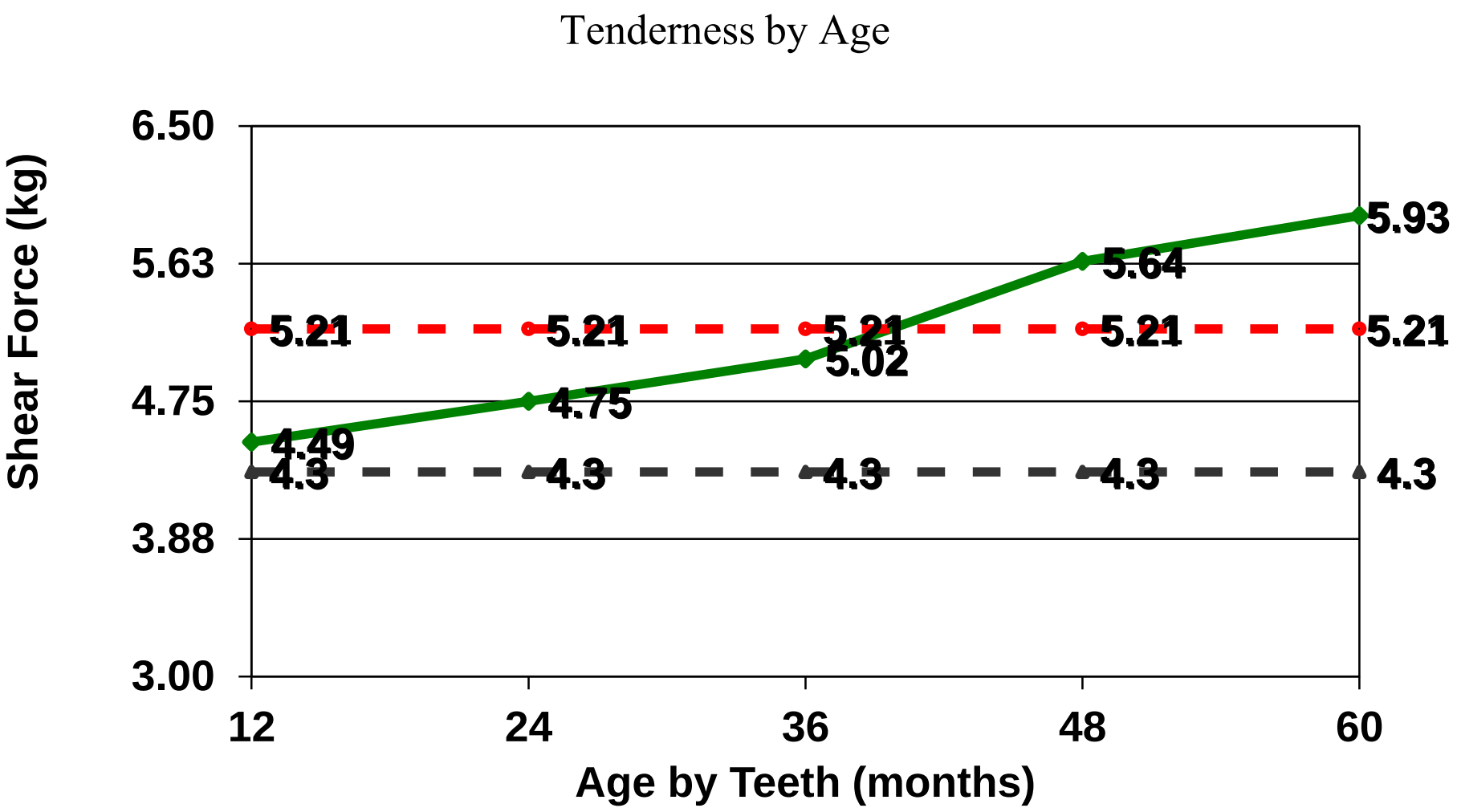
≤ 4.3 kilograms. = 86% satisfaction



Only 35% of the grass-finished beef samples met this criteria.

Average Shear Force = 5.21 kg

Results: Tenderness of Grass-finished Beef in Hawaii
n=191 (Kim et al. 2007)



Basics of Grass-Finish Beef Production in Hawaii

- Genetics vs. Forage Environment
- Transitioning into a grass finish program will require selecting and breeding for appropriate genetic traits:
- Large frame animals mature slowly and utilize a larger percentage of energy for maintenance

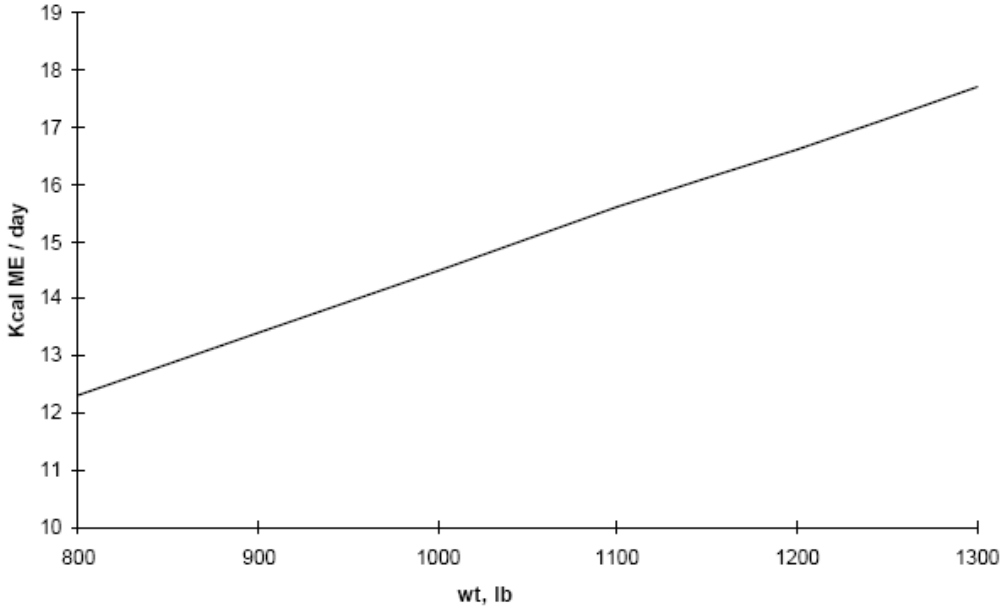


Figure 1.1. Body size (weight in pounds) and subsequent maintenance energy needs (Kcal) in dry beef cows.

- Grass-finish animals should be:
  - Early maturing
  - Moderate frame size (between 3 and 6, or 45” and 51” at 12 months of age for steers).

Basics of Grass-Finish Beef Production in Hawaii

- Grass-finish animals should be:
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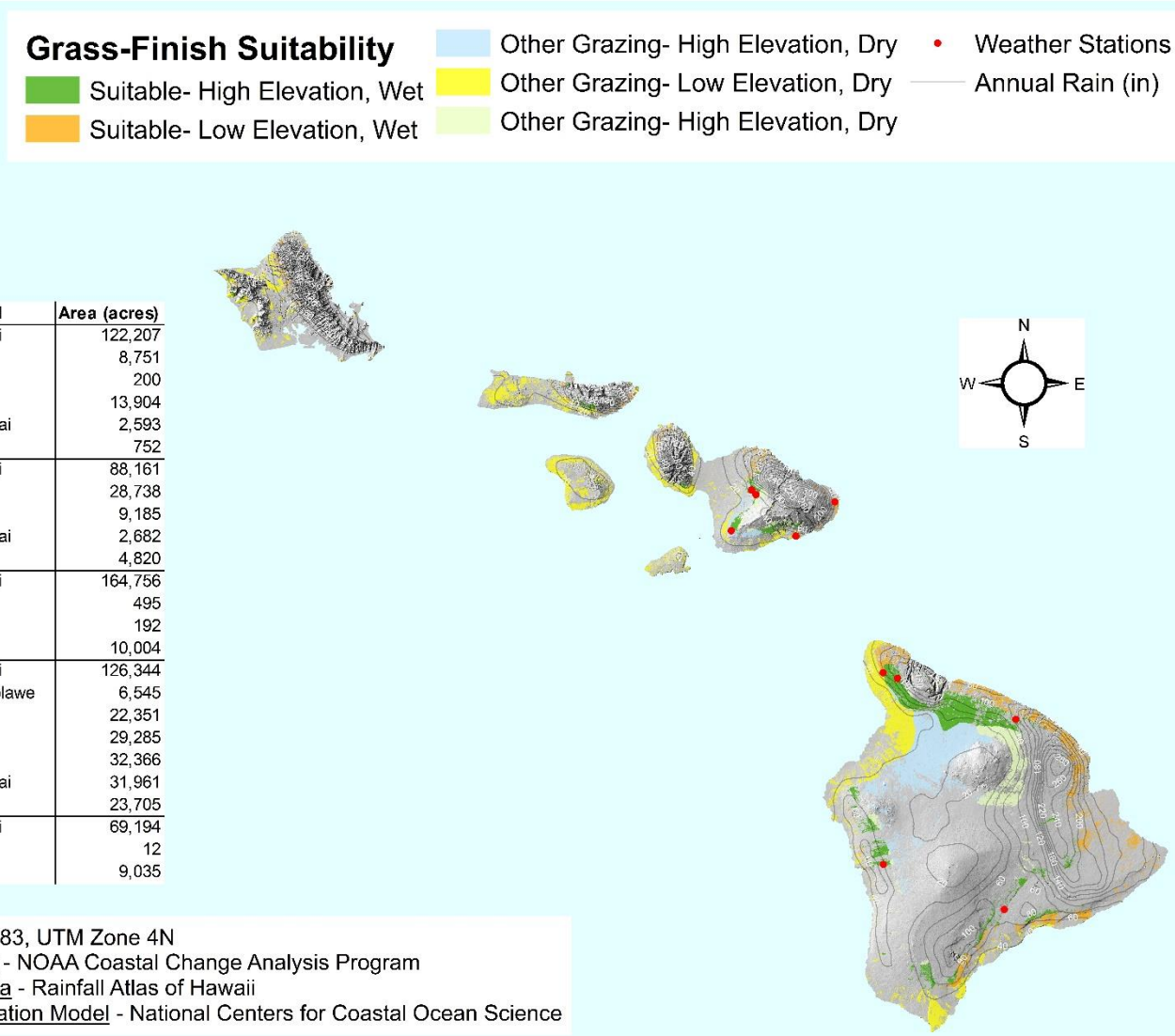
  - Moderate frame size (between 3 and 6, or 45” and 51” at 12 months of age for steers).

Frame Score	Hip Hieght (in) at 12 months	Hip Height (in) at Maturity	Expected Slaughter Weight (lbs) at 0.5" fat cover	Average Daily Gain (lbs. day)
3.0	45.0	52.3	1,000	1.37
4.0	47.0	54.1	1,100	1.51
5.0	49.0	55.9	1,200	1.64
6.0	51.0	58.0	1,300	1.78
7.0	53.0	60.0	1,400	1.92
8.0	55.0	62.0	1,500	2.05

Grass-finish beef production potential:

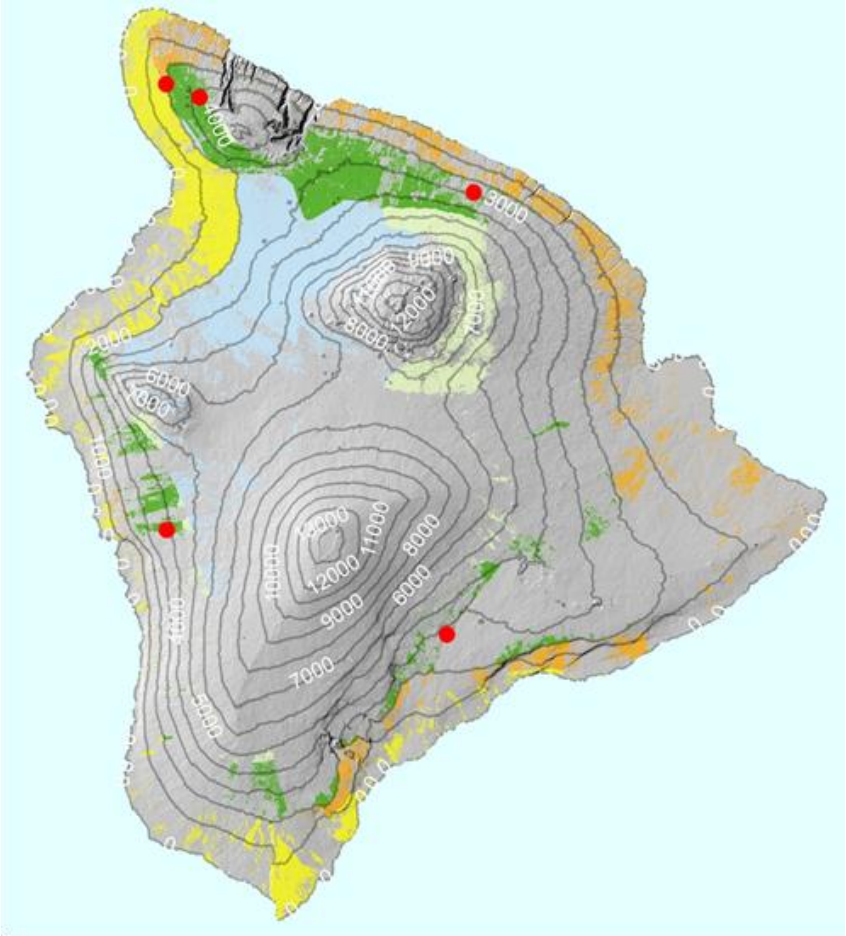


Suitability	Island	Area (acres)
Suitable High, Wet	Hawaii	122,207
	Kauai	8,751
	Lanai	200
	Maui	13,904
	Molokai	2,593
	Oahu	752
Suitable Low, Wet	Hawaii	88,161
	Kauai	28,738
	Maui	9,185
	Molokai	2,682
	Oahu	4,820
Other High, Dry	Hawaii	164,756
	Kauai	495
	Lanai	192
	Maui	10,004
Other Low, Dry	Hawaii	126,344
	Kahoolawe	6,545
	Kauai	22,351
	Lanai	29,285
	Maui	32,366
	Molokai	31,961
	Oahu	23,705
Other High, Wet	Hawaii	69,194
	Kauai	12
	Maui	9,035

Projection: NAD 1983, UTM Zone 4N
Soure: Land Cover - NOAA Coastal Change Analysis Program
Rainfall Data - Rainfall Atlas of Hawaii
Digital Elevation Model - National Centers for Coastal Ocean Science

Genetics must be matched to environment; environment must provide abundance of high-quality forage during entire production cycle of animal from birth to slaughter.

Grass-finish beef production potential: Hawaii county example.



SUITABLE	Criteria	Color Code	Acreage	Percent
LO, Wet	0-2000 ft, > 50 "/yr		122,207	21.42
HI, Wet	> 2000 ft, > 30"/yr		88,161	15.45
	Sub-Total		210,368	36.86
OTHER GRAZING				
LO, Dry	0-2000 ft, < 50"/yr		126,344	22.14
HI, Dry	> 2000 ft, < 30"/yr		164,756	28.87
HI, Wet	> 4,500 ft, > 30"/yr		69,194	12.12
	Sub-Total		360,294	63.14
	TOTAL		570,662	

Basics of Grass-Finish Beef Production in Hawaii

- Dr Anibal Pordomingo - grass-finish beef production from Argentina.
- His parameters:
- An annual Average Daily Gain
  1.7 lbs./day (1.8 lbs./day last 90 d)
- Animal finishes at around 22 months
  (and not over 30 months)
- May want to consider weaning
  at an older age

Basics of Grass-Finish Beef Production in Hawaii

Using his parameters the following example was developed:

Model Assumptions:

- Avg. Birth Wgt. 80#
- ADG on mother 2.1 lbs./day
- 1,200 lbs finish weight for all models

Feed Lot Production Curve:

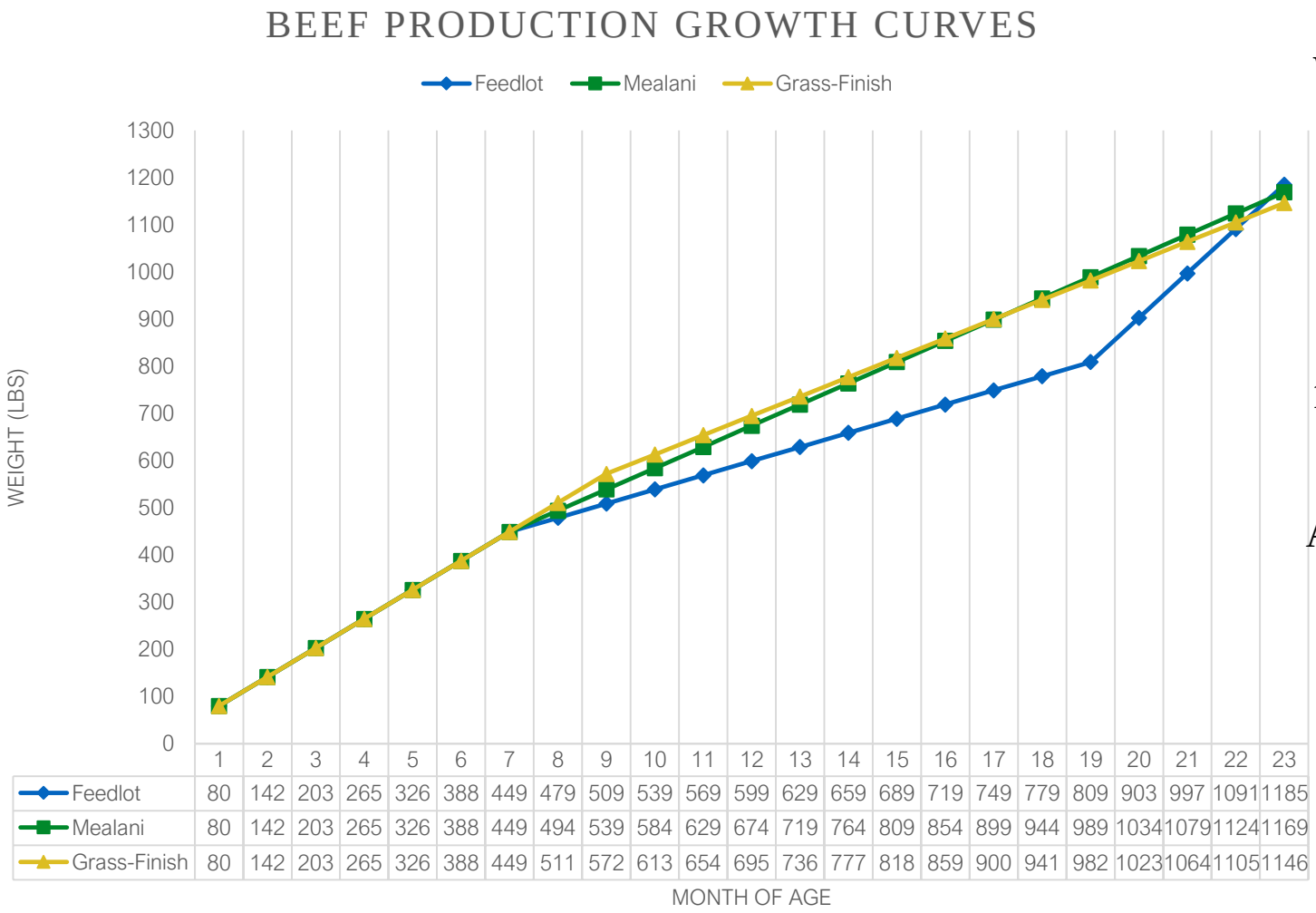
- Wean after 6 months at 450#
- Stocker phase: 6-18 months 390 days, 375 lbs., 0.96 lbs./day
- Feed Lot phase: 19-22 month, 120 days, 375 lbs., 3.12 lbs./day
- Birth to slaughter ADG = 2.06 lbs./day

Grass-Finish Production Curve (Pordomingo model:

- Wean after 8 months at about 630 lbs.
- 9-22 months, 420 days, 570 lbs., ADG 1.36 lbs./day
- Birth to Slaughter ADG = 1.73 lbs./day

We ran these two models against Mealani's production numbers:

Basics of Grass-Finish Beef Production in Hawaii



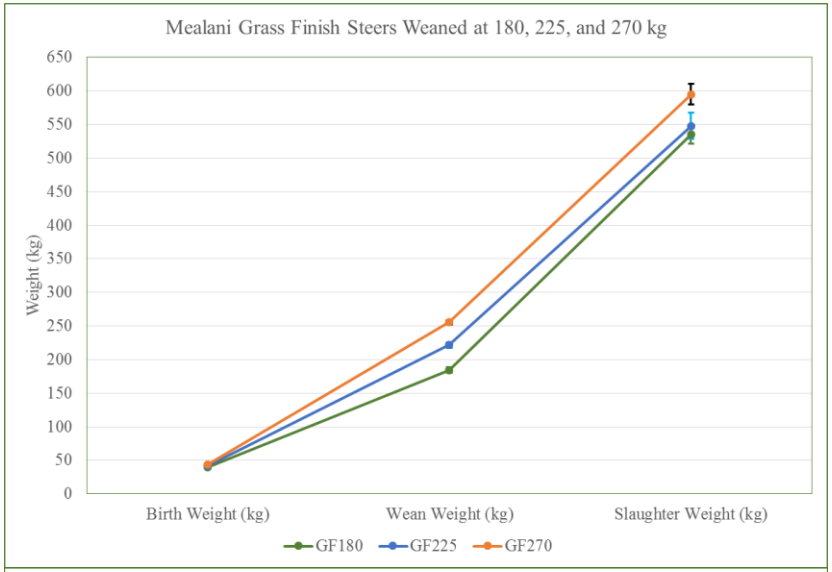
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Feedlot	80	142	203	265	326	388	449	479	509	539	569	599	629	659	689	719	749	779	809	903	997	1091	1185
Mealani	80	142	203	265	326	388	449	494	539	584	629	674	719	764	809	854	899	944	989	1034	1079	1124	1169
Grass-Finish	80	142	203	265	326	388	449	511	572	613	654	695	736	777	818	859	900	941	982	1023	1064	1105	1146

Mealani:
Wean at 6 months,
180 days,
450#,
2.1 lbs./day ADG
6-22 months,
510 days,
750#,
1.47 lbs./day ADG

Birth to slaughter
ADG, 1.78 lbs./day

University of Hawaii Research and Extension Outreach in Grass Finish Beef Production

- Weaning weight study
- Steers and heifers weaned at 180, 225, 275 kg (400, 500, 600 lbs.) over three years and finished on grass at Mealani Experiment Station.
- Objective: To determine if there is an advantage to weaning later for grass finish production.



University of Hawaii Research and Extension Outreach in Grass Finish Beef Production

	Steers			Heifers		
Variable	GF180	GF225	GF275	GF180	GF225	GF275
	Mean ± SE					
Marbling Numeric	420±30.6	478.3±16.2	443.3±23.5	434.2±30.1	488.3±40.5	492.5±23.5
Rib Eye Area (in^2)	11.4±0.31	11.6±0.5	11.5±0.24	11.3±0.3	11.1±0.28	11.9±0.4
Carcass Weight (lbs.)	619.3±16.8	641.3±21.8	677.7±18.7	565.5±8.8	579.4±8.6	591.1±14.3
Dressing %	53±1.0	53±1.0	52±1.0	52±1.0	52±1.0	54±1.0

Basics of Grass-Finish Beef Production in Hawaii

Grazing Management of Grass-Finish Beef Production:

- Guidelines for forage allocation should be based on two factors:
  1. Estimates of unrestricted daily intake
     - Calculated as a proportion of live body weight on a dry matter basis
     - Common values range from 2.6% to 3.3% for most beef cattle.
     - 3% is a good average value over the production cycle

  2. Estimates of forage harvesting efficiency
     - Depends on grazing pressure and residual forage desired.
     - Harvest efficiencies greater than 60% are detrimental to the rate of gain
     - A harvest efficiency of 50% has not been shown to be detrimental to ADG
     - Take half, leave half rule of thumb also good for the pasture

- Rotational grazing vs. continuous grazing
  - Continuous grazing difficult to manage for proper quantity and quality
  - Short-duration, rest-rotation grazing systems best for continuous budgeting of proper quantity and quality of forage for grass-finish beef production
  - Important to understand how stocking density influences harvesting efficiency and animal performance.

Basics of Grass-Finish Beef Production in Hawaii

Solar Energy Capture

Harvest Efficiency

Assimilation Efficiency

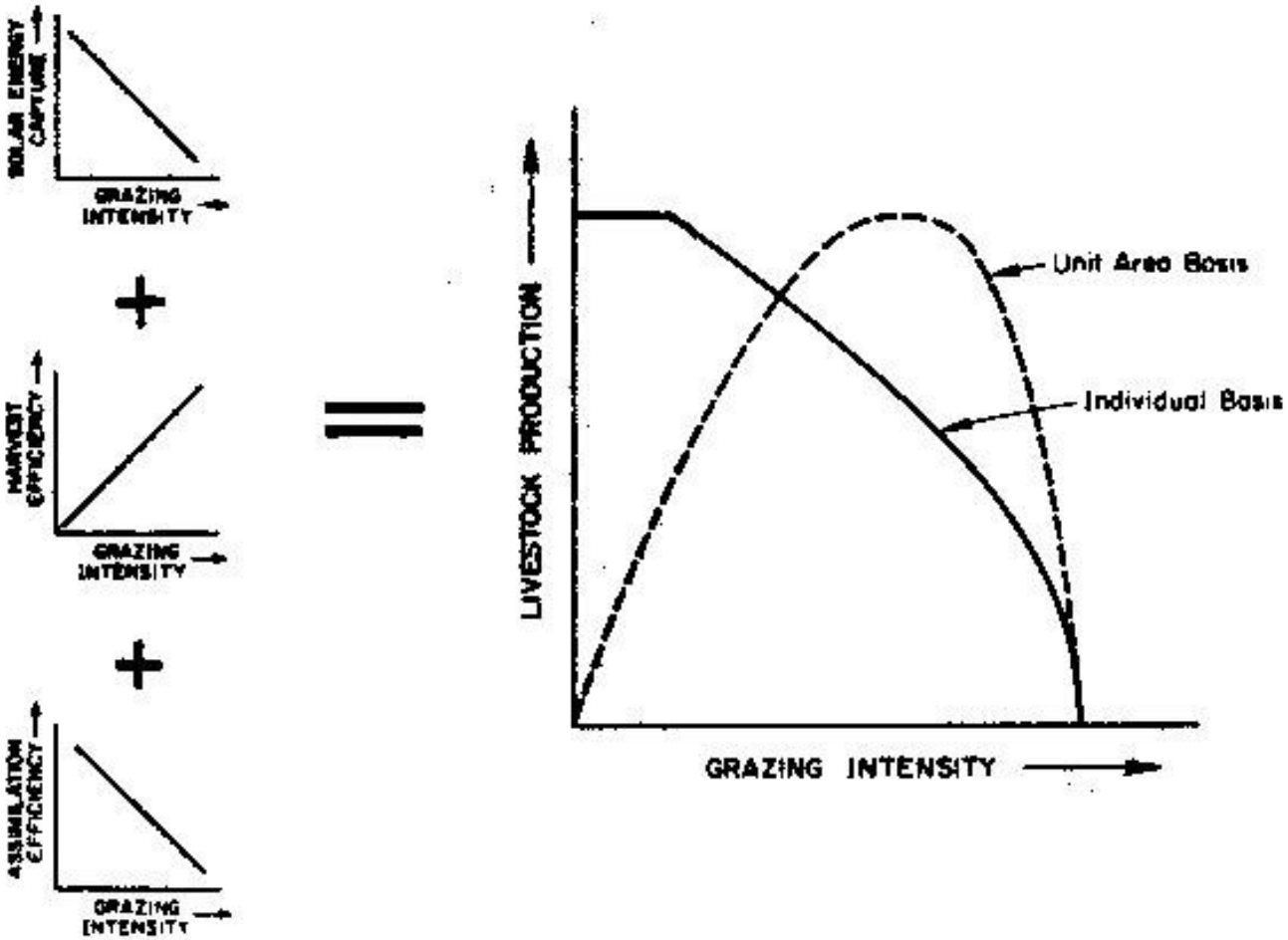
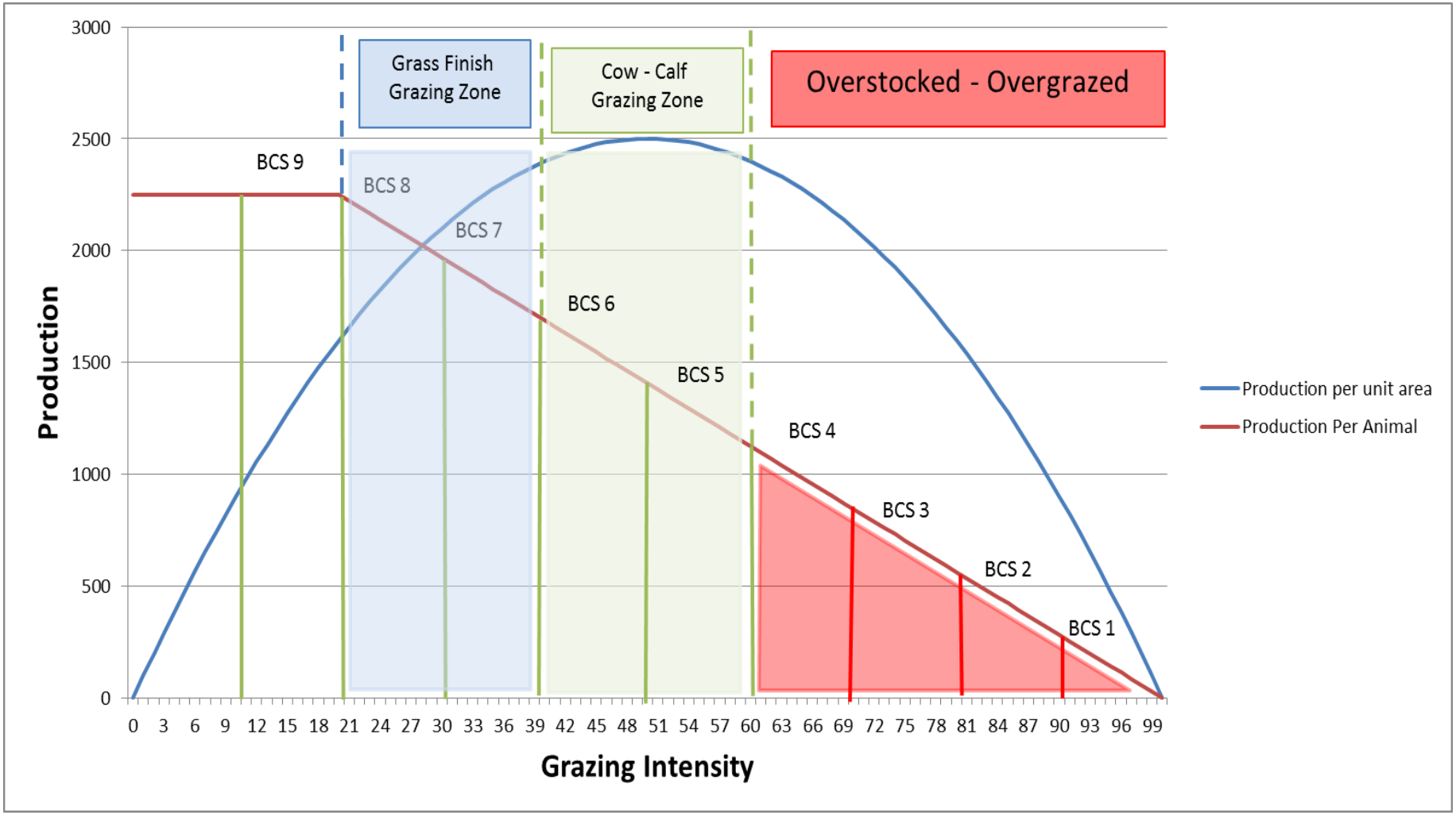


Figure 1.7. **Livestock production per individual and per unit area originate from the combined effects of efficient solar energy capture (i.e., primary production), forage harvest efficiency, and conversion efficiency in response to grazing intensity.**

Heitschmidt and Stuth, 1991

Body Condition Score as an Indicator of Production Goals



Adapted from Heitschmidt and Stuth, 1991

Summary:

- Grass finish beef production will become increasingly important
- Consistently finishing Beef on grass is both and Art and Science requiring understanding of the factors the influence animal growth and the forage environment
- Of the three main carcass quality traits, tenderness is the one most consumers identify with
- Tenderness is a mainly a function of the age of the animal at slaughter
- The ideal grass finish beef animal in Hawaii will be a moderate framed, early maturing, easy fleshing animal able to reach a 1,200 mature body weight with a 0.5-inch cover of fat within 24 months of age.
- Proper allocation of forage is essential for finishing cattle on grass as forage deficiencies will result in loss of tenderness and delayed finish.

Questions? Contact:

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