# *"Building on Success"*

## Celebrating the 64th Annual

Florida Beef Cattle Short Course

# Proceedings

***May 13 - 15, 2015***

Department of Animal Sciences

*Alto and Patricia Straughn IFAS Extension Development Center*
*Gainesville, Florida*

UF UNIVERSITY of FLORIDA
IFAS Extension

Department of Animal Sciences

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Welcome to the 2015 Florida Beef Cattle Short Course:

The 2015 Florida Beef Cattle Short Course Program Committee and the Department of Animal Sciences would like to welcome you to this year's Short Course. We look forward to this week every year in anticipation of delivering the premier educational event for serious beef cattle producers in the Southeast. We hope that you enjoy the program and take away some new knowledge about the beef cattle industry's future direction, additional management decision making skills, and new information about specific production and management practices that impact your beef cattle enterprise.

Planning for the Florida Beef Cattle Short Course is a year-round event. Shortly after every Short Course we review the survey comments from those participants that return them to us. The surveys are one of our key mechanisms to get your feedback about the quality and content of the Florida Beef Cattle Short Course. We appreciate the feedback that we get and would welcome all of our participants to return the surveys and voice their opinion. Late in the summer we begin evaluating subject areas and specific topics for the next year's Florida Beef Cattle Short Course. Our program committee works hard to identify important, timely topics that impact our beef cattle producers. We then work through the fall to identify the best speaker for that topic area and invite them to speak at the Florida Beef Cattle Short Course. We are privileged to get nationally recognized individuals to speak at the Florida Beef Cattle Short Course and appreciate the limited time they have in their schedules. Our excellent speakers come from both out of the state and within UF/IFAS. Our UF/IFAS speakers are a valuable resource, with Florida specific experience and an investment in the Florida beef industry. Likewise partnering with our valuable Allied Industry partners we work to bring you a viable and diverse Tradeshow to share industry and product specific information.

Gainesville has been the home of the Florida Beef Cattle Short Course for the past 63 years. Survey responses consistently indicate that our participants prefer the Florida Beef Cattle Short Course to stay in Gainesville. Remaining in Gainesville offers certain advantages for us to deliver the excellent program that you have come to expect. We hope the Alto and Patricia Straughn Extension Professional Development Center location provides a comfortable and professional location, allowing us to provide a cost-effective, valuable learning experience for you.

The Program Committee has worked hard over the years to deliver a premier program at a reasonable cost to our participants. The Florida Beef Cattle Short Course is a self-sustaining program and receives no direct financial support from the UF/IFAS Department of Animal Sciences or UF/IFAS Extension. In as much, the Florida Beef Cattle Short Course has to meet costs associated with speakers' expense, meeting space, refreshment breaks, and material costs. Unfortunately, we have to pass those increased costs on to our participants. Just like the beef cattle industry, our costs of operation continue to increase in all facets.

Thank you for choosing to attend the 2015 Florida Beef Cattle Short Course. We hope that the program meets your expectations and provides you with valuable information to impact your beef cattle enterprise.

Best Regards,

Matt Hersom

Chair, 2015 Florida Beef Cattle Short Course

# 64th Annual Florida Beef Cattle Short Course

May 13 – 15, 2015

*Presented by*

Department of Animal Sciences

Cooperative Extension Service

Institute of Food and Agricultural Sciences

University of Florida, Gainesville, Florida

**2015 Florida Beef Short Course Committee**

Matt Hersom, Chair
Chad Carr
Joe Dillard
Ashley Fluke
Max Irsik
Henry Kempfer
Cliff Lamb
Phillip Lancaster
Joel McQuagge
Bob Simon
Todd Thrift
Jerry Wasdin
Tim Wilson

UF UNIVERSITY of FLORIDA IFAS

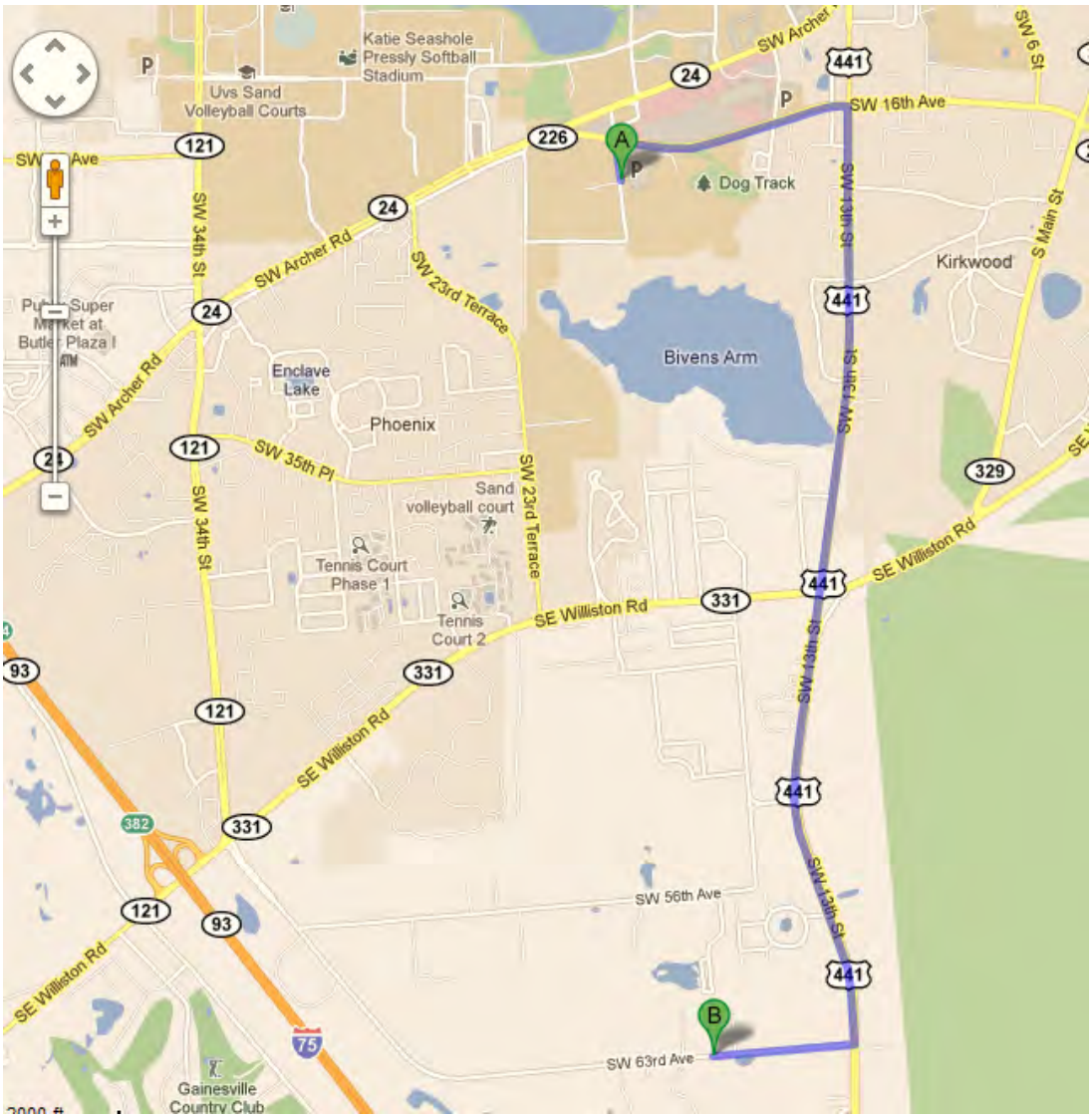
Florida Beef Cattle Short Course

# Directions

## From the Alto and Patricia Straughn IFAS Extension Professional Development Center

## 2142 Shealy Drive Gainesville, Florida 32611

## to the UF Horse Teaching Unit




- **Head north on Shealy Dr. to SW 16th Ave. (0.1mi)**
- **Turn right onto SW 16th Ave/Florida 24A. (0.7 mi)**
- **Turn right onto US – 441 S/SW 13th St. (2.9 mi)**
- **Turn right onto SW 63rd Ave. (0.4 mi)**

**(Destination will be on the right).**

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# Allied Industry Trade Show

Straughn IFAS Extension Professional Development Center
&
UF/IFAS Horse Teaching Unit

May 13 – 15, 2015

## *Exhibitors and Sponsors*

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***Thank you for your support!***

# 2015 Florida Beef Cattle Short Course

## *"Building on Success"*

***Wednesday, May 13***

1:00 Welcome – Geoffrey Dahl, University of Florida
1:15 Cattlemen Comments – Henry Kempfer, President of the FCA
1:30 What Kind of Beef Should We Be Producing – Fixing the Current Beef Industry Model – Bill Helming, Bill Helming Consulting
3:00 ***Break***
3:30 Perspectives on Production - Sustainability, Production, and Products – Ernie Meier, McDonalds Corp.
4:15 Market Outlook – John Michael Riley, Mississippi State University
5:00 Panel Discussion on Beef Production
5:45 Reception

***Thursday, May 14***

8:30 Impact of Heat Stress on Female Fertility – Pete Hansen, University of Florida
9:15 The Missing Piece of the Fertility Equation – Joel Yelich, University of Florida
10:00 ***Break***
10:30 What Does it Take to Start an AI Program – Cliff Lamb, University of Florida
11:15 Use of Early Weaning to Affect Cow Reproduction – John Arthington, University of Florida
12:00 ***Leave for Lunch, Horse Teaching Unit***

*Afternoon Demonstrations*

1:30 Session 1.
- Reproductive Anatomy

2:00 Session 2.
- Use of an AI Breeding Box
- Selection of Synchronization Protocols for the Cow Herd
- Pregnancy Testing-Blood Sample Protocol

3:30 ***Break***
3:45 Session 3.
- Appropriate Bull Selection & Management
- Cow Body Condition Score and Reproduction

6:00 ***Steak Out!***

***Friday, May 15***

8:30 North Florida REC Research Update
9:00 Agronomy Research Update
9:30 Economics of Herd Expansion – Chris Prevatt, University of Florida
10:15 ***Break***
10:30 Gainesville Research Update
11:00 Range Cattle REC Research Update
11:30 How Long Does This Production Model Work? – Trey Warnock, Amarillo Brokerage
12:15 Wrap and Adjourn

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# Speakers Biographies

*64th Annual Florida Beef Cattle Short Course*

***John Arthington***
**UF/IFAS Range Cattle Research & Education Center, Ona, FL**
Dr. John Arthington received his B.S. from Purdue University in West Lafayette, Indiana and his PhD. from Kansas State University, Manhattan, Kansas. He currently is a Professor in the Department of Animal Sciences at the University of Florida. He began at the University of Florida in 1998. He was appointed Center Director at the Range Cattle Research and Education Center in Ona, Florida in 2005. He is a member of the American Society of Animal Science, American Dairy Association and the American Registry of Professional Animal Sciences.

***Geoff Dahl***
**UF/IFAS Department of Animal Sciences, Gainesville, FL**
Dr. Geoff Dahl received a B.S. degree from the University of Massachusetts and a Ph.D. from Michigan State University in East Lansing, Michigan, both in Animal Science. He joined the University of Florida as Professor and Department Chair, 2006. Dr. Dahl conducts applied and basic research with direct impact on animal production and health. Specifically, his program focuses on understanding the physiological impact of management interventions at various stages of the lactation cycle, in an attempt to harness that knowledge to optimize cow health and performance. The fundamental aspects of Dr. Dahl's research have led to applications in other agriculturally important species including sheep, goats and pigs.

***Peter J. Hansen***
**UF/IFAS Department of Animal Sciences, Gainesville, FL**
Peter J. Hansen is a Distinguished Professor and L.E. "Red" Larson Professor of Animal Sciences in the Dept. of Animal Sciences at the University of Florida. His research interests center around the basic mechanisms controlling the establishment and maintenance of pregnancy and development of methods to improve fertility. Particular emphasis is placed on elucidating effects of elevated temperature on early embryonic development, identifying genes controlling embryonic survival and characterizing interactions between the immune system, the reproductive tract, and the embryo. Another focus is on development of methods to increase profitable uses of embryo transfer. Dr. Hansen joined the faculty at Florida 1984. His formal education was at the University of Illinois and University of Wisconsin. He received postdoctoral training in the Department of Biochemistry and Molecular Biology at the University of Florida and spent a sabbatical leave at the University of Guelph. During his career, he has published over 250 peer-reviewed papers. He is a Fellow of the American Association for the Advancement of Science, the American Dairy Science Association, and the Japan Society for the Promotion of Science. He currently serves as President of the International Congress of Animal Reproduction and is Past-President of the American Society for Reproductive Immunology and the International Embryo Transfer Society.

***Bill Helming***
**Bill Helming Consulting Services, Olathe, KS**
Bill Helming has 50 years of extensive experience with the U.S. cattle feeding and beef production industry and with agribusiness generally, including the pork, poultry and grain production sectors of the American agricultural and food industry. He was president of the American Society of Agricultural Consultants in 1984 and received the ASAC Distinguished Service Award in 1991. He has a thorough knowledge of the large-scale cattle feeding industry relative to supply and demand market outlook conditions, feedyard values, total investment requirements, bank financing, cost structure, profit margins, and other key feedyard business, financial and operational metrics.

***Matt Hersom***
**UF/IFAS Department of Animal Sciences, Gainesville, FL**
Dr. Matt Hersom is an Associate Professor and Extension Beef Cattle Specialist at the University of Florida. His specific area of emphasis includes development of strategic nutritional and supplementation programs to optimize beef cattle performance utilizing forage and roughage based diets and evaluation of calf production and growing practices to improve animal performance in integrated beef production systems. Extension areas address expanding education experiences in beef cattle nutrition, implementation of optimal supplementation strategies for Florida cow-calf production, and development of increased pasture and forage utilization and management.

***Henry Kempfer***
**President, Florida Cattlemen's Association, Kempfer Cattle Company, St. Cloud, FL**
Henry Kempfer is the current president of the Florida Cattlemen's Association. A 5th generation rancher from Deerpark, Florida, that has deep roots in the cattle industry. He is a 1992 graduate of the University of Florida, earning a degree in Animal Science. After college he returned home to work with his family and has helped manage Kempfer Cattle Company ever since. Kempfer Cattle Company is a diversified operation raising purebred Brahman, Angus and commercial cattle. The ranch also specializes in bahia and floritam sod, timber, and hunting leases. Henry has a wife, Heather, of 18 years, son Hyatt and daughter Sally.

***Cliff Lamb***
**UF/IFAS North Florida Research & Education Center, Marianna, FL**
G. Cliff Lamb is currently the Assistant Director and Professor at the North Florida Research and Education Center at the University of Florida. He received his B.S. in Animal Science from Middle Tennessee State University in 1992. He completed the requirements for the M.S. and Ph.D. degrees at Kansas State University in 1996 and 1998, respectively. His primary research efforts focus on applied reproductive physiology in cattle emphasizing synchronization of estrus in replacement heifers and postpartum cows. In 2013, Dr. Lamb and 6 colleagues received the USDA-NIFA Partnership Award for Multistate Efforts for their Extension efforts in reproductive management. His programs have received more than $9 million in grant funds or gifts. He has published more than 88 refereed journal articles, along with more than 370 extension and research reports. In addition, he has served as advisor or co-advisor to 15 graduate students and on the committees of an additional 14 students.

***Ernie Meier***
**McDonald's Corp., Oak Brook, IL**
Ernie Meier serves as the Director of Quality Systems, U.S. Supply Chain Management for McDonald's USA. In this role, Ernie develops quality assurance systems and processes to ensure food safety, food quality and responsible practices for beef, pork, poultry, dairy, and egg products and oversight of the quality programs for the Packaging suppliers. He establishes safety and quality requirements and is responsible for compliance among the company's primary and secondary suppliers in areas such as raw ingredient products, BSE and avian influenza firewalls, animal welfare, and raw material and finished product sampling and microbiological testing. Ernie leads a number of cross-functional teams including McDonald's Red Meat Safety and Quality Team – a group of individuals that focus on driving continuous improvement in the quality and safety of raw materials and finished product. Prior to joining McDonalds, Ernie served as the Corporate Director Regulatory Affairs for Keystone Foods. Ernie holds a Bachelor of Science in Animal Science from the University of Florida. Ernie lives with his wife and three children in Oswego, IL.

***Chris Prevatt***
**UF/IFAS Range Cattle Research & Education Center, Ona, FL**
Chris Prevatt joined the University of Florida at the Range Cattle Research and Education Center in February 2014. He graduated from Auburn University in 2011 with a Bachelor of Science in Accounting. He then continued his studies at Auburn University and received his Master of Science in Agricultural Economics in August of 2013. During his undergraduate and graduate studies at Auburn University he worked on numerous livestock and forage economic research and extension projects. He continues to be actively involved with his family's cattle ranching endeavors in Alabama and Florida. At the University of Florida he works extensively developing economic information that cattle and forage producers can use to make more profitable management and marketing decisions.

***John Michael Riley***
**Mississippi State University, Mississippi State, MS**
John Michael Riley focuses his extension and research efforts on the areas of commodity marketing, price analysis, risk management and agricultural policy. Specific research topics include the examination of costs in the commodity marketing process, assessment and management of marketing risk and grain market basis factors. Riley is well known both in Mississippi and across the country for his expertise in the areas of livestock production and marketing. He is a regular commentator on FarmWeek and has provided commentary and analysis to national television news media (NBC, CBS and Fox) and Aljazeer English; print media including The Economist, The Financial Times and Bloomberg News; and various radio and other types of media outlets. He received his B.S. and M.S. at Mississippi State University in Agricultural Economics and his Ph.D. at Kansas State University, also in, Agricultural Economics.

***Lynn Sollenberger***
***UF/IFAS Agronomy Department***
Lynn Sollenberger is Professor and Graduate Coordinator of Agronomy at the University of Florida where he has worked for 30 years. Dr. Sollenberger grew up on a dairy farm in Pennsylvania and received his M.S. from Penn State and his Ph.D. from University of Florida. He teaches graduate and undergraduate courses in forage management and utilization, and he and his graduate students have conducted research on many of the forages currently being used in Florida. Twelve of his former students are in forage teaching, extension, and research positions across the US, and more than 30 others are working in 13 countries worldwide. Dr. Sollenberger has received numerous awards for teaching, research, and graduate student mentoring.

***Trey Warnock***
**Amarillo Brokerage Company, Amarillo, TX**
Trey Warnock grew up in Central Florida and received both his B.S. and M.S. degrees from the University of Florida, in the Department of Animal Sciences. He is currently resides and works in Amarillo, Texas and along with others at Amarillo Brokerage Company helps operators manage risk in the post weaning sector of the beef industry.

***Joel Yelich***
**UF/IFAS Department of Animal Sciences, Gainesville, FL**
Joel V. Yelich, Ph.D., Associate Professor in Department of Animal Sciences, University of Florida, Gainesville. Dr. Yelich graduated from Montana State University with a B.S. in Animal Science. Earned M.S. in Animal Science from Colorado State University and received a PhD in Animal Reproduction from Oklahoma State University. Dr. Yelich is actively involved in undergraduate and graduate teaching as well as maintaining a production oriented research program. Current research interest include: manipulation of follicular growth and development to control ovulation in beef cattle to maximize the effectiveness of estrous synchronization and timed artificial insemination in cattle of Bos indicus breeding; effect of nutrition/management practices on the onset of puberty and fertility in yearling beef heifers; the influence of mineral source on reproductive efficiency in postpartum beef cows, yearling heifers, yearling bulls, and calf weaning performance; and the utilization of nutrition/management factors and forage type to enhance the productivity of yearling heifers, and suckled postpartum beef cows.

## The 2015 Florida 64th Three Day Annual Beef Cattle Short Course Meeting and Conference

**Gainesville, Florida**

**May 13, 2015**
**1:30 p.m.-3:00 p.m.**

## What Kind of Beef Should the U.S. Be Producing and How Can the U.S. Beef Industry Go About Fixing the Current One-Size-Fits-All Beef Industry Production Business Model


**By**
**Bill Helming**
**Economist, Agribusiness Consultant, Author and Speaker**
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**#302**
**Olathe, Kansas 66062**
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2

## Who is Bill?

Grew up in La Jolla, CA on a ranch and feedlot with two brothers in the 1940's and 50's.

Went to Oregon State University on a football scholarship.

Moved to Nevada to run the family ranch and received B.S. and M.S. in Ag Economics at University of Nevada at Reno.

Moved to Denver - First Chief Economist for the National Cattlemen's Beef Association in 1965, launched CattleFax as its first general manager.

Moved to Kansas and launched a macro economic & Ag consulting firm in 1972, "Bill Helming Consulting Services."

3

## Who is Bill?


Bill &Wife Kathleen


Son Nathan


Daughter Tammy & Family


Son Troy & Family

4

## A Brief Review of The U.S. and Global Economic and Financial Market Outlook and Key Trends

5

### The Long Term 75 to 80 Year U.S. Boom and Bust Business Cycles

| Time Periods | Number of Years | Average Annual Rate of GDP Growth | Bust | Boom |
|---|---|---|---|---|
| 1929-1939 | 10 | 1.32% (The Great Depression) | Major Bust (CPI Deflation) | No |
| 1940-2007 | 68 | 3.82% (with 11 Recessions) | No | General Boom (CPI Inflation) |
| 2008-2014 | 7 | 1.18%* The Great Recession | Partial Bust (Historically low CPI Inflation) | No |
| 2015-2021** | 7 | 1.15% (The next U.S. Depression) | Very Significant Bust CPI Deflation | No |

***Special Note**: The average annual rate of GDP growth for the U.S. in the seven years of 2008-2014 was 70% less than for the 68 years of 1940-2007.

****Forecasted by Bill Helming.**

6

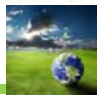
The Japanese economy has generally been in a recessionary and price and asset deflationary mode for the past 23 years or during the 1992-2014 time period. This will continue and get worse within the next seven years. Japan economically and demographically is struggling and is in decline.

7

The overall Western and Eastern European economy is now flat and/or in a recession that will get worse within the next seven years. Europe will experience price and asset deflation during this period. Europe economically and demographically is now struggling and unfortunately this reality will highly likely continue for most of the next seven years.

8

China continues to have the biggest and worst real estate debt bubble that the world has ever seen. This bubble is going to burst within the next five years. The Chinese economy continues to substantially slow down and is headed for a hard landing within the next five to seven years. This will be negative for the world and for the U.S. economy and will also be bearish on U.S. and global crude oil and on commodity prices generally as is the case now.



9

The four largest economies in the world are (1) the U.S., (2) Western and Eastern Europe on a combined basis, (3) Japan and (4) China. These four major global economies (on a combined basis) account for 75% of the world's GDP. All four of these major economies will be trending south over most of the next seven years.

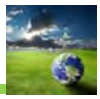
10

Price, cost and asset deflation is coming back to the U.S. economy for most of the next seven years and for the first time since the Great Depression in the 1930's.

11

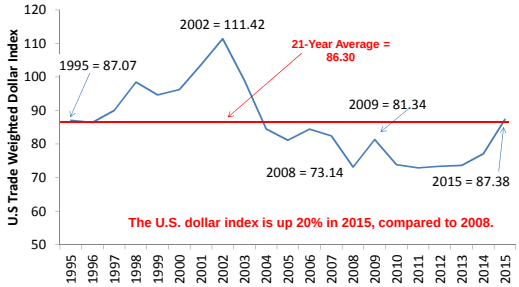
**Key Indicators that Are Telegraphing That Price, Cost and Asset Deflation Is Coming Back to the U.S. Economy**

- Much slower than normal U.S. and Global Economic GDP growth.
- The much stronger U.S. dollar.
- The major decline in crude oil, gold and other commodity prices.
- The record low interest rate yield on 10-year U.S. Federal Government Treasury Bonds.



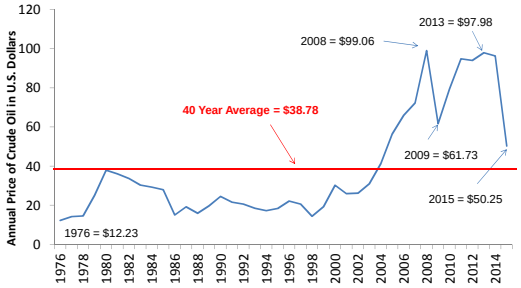
12

## The U.S. Trade Weighted Dollar Annual Index As of January 1st for the 21 Years of 1995-2015



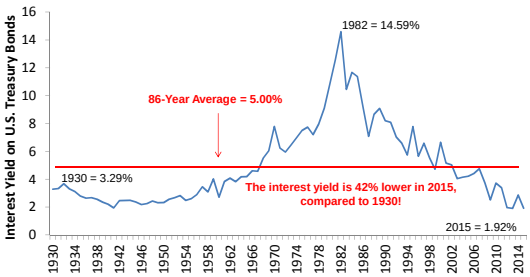

13

## The Average Price of West Texas Intermediate Crude Oil In U.S. Dollars for the 40Years of 1976-2015



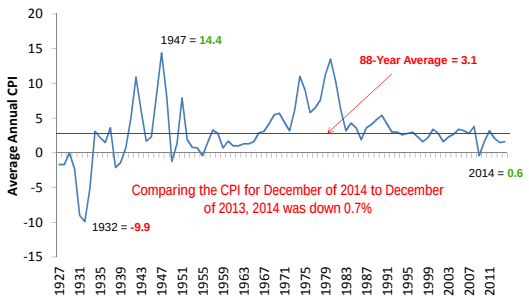

14

## The Average Annual Interest Yield on 10-Year U.S. Federal Government Treasury Bonds as of January 1st For the 86 Years of 1929-2015, Plus February, 2015




15

## The Average Annual Percentage Consumer Price Index (CPI) for the 88 Years of 1927-2014




16

## Very Important Trends and Facts Regarding U.S. Beef Cow Inventory Numbers and Per Capita Consumption and Market Share Numbers and Trends for Beef, Chicken and for Competing Proteins

17

## Key U.S. Consumer Red Meat and Chicken Purchasing Facts and Trends that U.S. Beef Cattle Producers Need to Be Aware of

- **Beef retail consumer purchases account for 15% of average consumer wages.**
- **Pork retail consumer purchases account for 9% of average consumer wages.**
- **Chicken retail consumer purchases account for 5% average consumer wages.**

**Source: Urner Barry Calculations are based on Bureau of Labor Statistics.**

18

## Key U.S. Consumer Red Meat and Chicken Purchasing Facts and Trends that U.S. Beef Cattle Producers Need to Be Aware of

- **One hour of average U.S. wages in 2014 purchased 3.7 pounds of beef.**
- **One hour of average U.S. wages in 2010 purchase 4.7 pounds of beef.**
- **This amounts to a 22% reduction in beef purchased per hour of average wage earnings.**
- **Substantial consumer beef demand destruction has and continues to take place in 2013, 2014 and 2015.**

**Source: Andrew Gottschalk's *hedgersedge.com* extensive database.**

19

## Key U.S. Consumer Red Meat and Chicken Purchasing Facts and Trends that U.S. Beef Cattle Producers Need to Be Aware of

- **Price per pound remains the number one factor and top priority for U.S. meat and poultry shoppers.**
- **Affordability is a key and major driver and the reason why U.S. consumers and shoppers are purchasing more and more chicken and less and less beef year after year.**
- **Over 40% of U.S. shoppers are now shifting their protein buying behaviors in order to save money and they are showing more flexibility in what proteins they purchase because of the need to save money.**

**Source: The *Power of Meat* study published by the Food Marketing Institute and the North American Meat Institute.**

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## Key U.S. Consumer Red Meat and Chicken Purchasing Facts and Trends that U.S. Beef Cattle Producers Need to Be Aware of

- **U.S. real average annual worker wages have declined by more than 9% over the past six years.**
- **Forty-seven percent (47%) of all Americans have no savings and live from paycheck to paycheck.**
- **Most new U.S. jobs involve part-time workers and many more U.S. workers than normal are significantly underemployed.**
- **Changing U.S. demographics are a real big deal. According to the U.S. Census Bureau, by 2045 or 30 years from now, 50% of the U.S. population will be Caucasian and the other 50% will be Hispanic, Asian and African Americans. This 50% will be purchasing even more and more chicken and ground beef in the years ahead.**

21

## Key U.S. Consumer Red Meat and Chicken Purchasing Facts and Trends that U.S. Beef Cattle Producers Need to Be Aware of

- **U.S. consumers continue to show their love for restaurant burgers despite tough competition from other types of sandwiches and a continuing drop in U.S. restaurant traffic.**
- **U.S. consumers purchased 9 billion burgers in 2014. This was a 3% increase over 2013 levels.**
- **U.S. consumers have been steadily purchasing and consuming more and more ground beef at home and away from home since 1970.**

**Source: The NPD Group Annual Survey.**

22

## Key U.S. Consumer Red Meat and Chicken Purchasing Facts and Trends that U.S. Beef Cattle Producers Need to Be Aware of

- **From 1970 through 2014 (45 years), of the total pounds of U.S. beef consumption which consisted of ground beef (hamburger) was 42% in 1970 and was at least 58% in 2014. This represents a 38% increase in ground beef consumption. These facts and this trend are price, cost and affordability driven.**
- **From 1970 through 2014 (45 years), of the total pounds of U.S. beef consumption that consisted of whole muscle beef cuts (middle meats) was 58% in 1970 and was at least 42% in 2014. This represents a 28% decrease in the consumption of whole muscle beef cuts. These facts and these trends are price, cost and lack of affordability driven.**

**Source: Based on USDA annual cattle slaughter mix and per capita consumption data for at home and away from home consumption.**

23

## Key U.S. Consumer Red Meat and Chicken Purchasing Facts and Trends that U.S. Beef Cattle Producers Need to Be Aware of

- **From 1976 through 2014 (39 years), per capita beef consumption declined 43% or 40.2 pounds per person. This represents an average annual decline in per capita beef consumption of 1.03 pounds per person per year. The U.S. beef industry has lost 46% in total competing market share over the past 39 years!**
- **From 1976 through 2014 (39 years), per capital chicken consumption increased 101% or 42.5 pounds per person. This represents an average annual increase in per capita chicken consumption of 1.09 pounds per person per year at the obvious expense of the U.S. beef industry.**
- **These facts and trends are cost, price and consumer affordable driven.**

**Source: USDA Economic Research Service, U.S. Department of Commerce and U.S. Census Bureau.**

24

## Key U.S. Consumer Red Meat and Chicken Purchasing Facts and Trends that U.S. Beef Cattle Producers Need to Be Aware of

- **The present and longstanding U.S. beef production model and USDA Beef Cattle Quality Grading system are designed to produce whole muscle beef cuts that more and more U.S. consumers cannot afford to purchase and are purchasing less and less of each year.**
- **The U.S. beef production model and system obviously considers ground beef production as a *by-product.***
- **The vast majority of American consumers (by virtue of how and on what they are purchasing for their protein needs) obviously believe that more affordable ground beef is what they want and need.**

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## Key U.S. Consumer Red Meat and Chicken Purchasing Facts and Trends that U.S. Beef Cattle Producers Need to Be Aware of

- **The majority of American beef consumers do not look at or consider ground beef as a *by-product*. They look at good quality and safe ground beef as the beef product of choice and one that they can more easily afford.**
- **It is obvious (based on the data and the facts) that U.S. protein consumers are purchasing and consuming more and more chicken and more and more ground beef. This has been consistently true and the case for the past 39 years. These facts and trends are clearly cost, price and consumer affordability driven.**

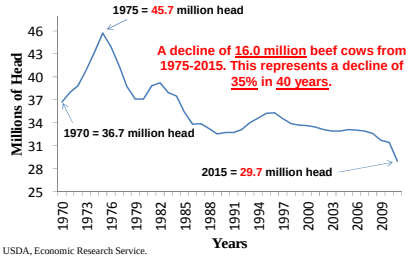
26

## Key U.S. Consumer Red Meat and Chicken Purchasing Facts and Trends that U.S. Beef Cattle Producers Need to Be Aware of

- **IF the present and longstanding U.S. beef production system, business model and the USDA Beef Quality Grading system remain the same and are not changed and fixed, then 35 to 50 years from now beef in America will clearly become a specialty and luxury product much like lamb and lobster are today.**
- **The U.S. beef industry at large is simply *not* paying attention to what U.S. beef and competing protein consumers are spending their incomes on and why?**
- **The U.S. beef production *one-size-fits-all* business model is clearly broken. The beef industry must implement ways to very significantly produce more ground beef at much lower costs and prices. The really good news is that this can be done in America.**

27

## Annual U.S. Beef Cow Numbers As of January 1st for the 46 Years of 1970-2015




Source: USDA, Economic Research Service.

28

## Beef Cattle Inventory Numbers Are Starting to Increase Modestly

**For January 1, 2015, compared to January 1, 2014**

- **Total beef and dairy cattle numbers up 1%**
- **Total beef cow numbers up 2%**
- **Total Calf crop up 1%**

However, 10 years from January 1, 2015, total U.S. beef cow inventory numbers will very likely be down significantly from present levels

29

## Some of the Reasons Why U.S. Beef Cow Numbers Will Be Lower 10 Years from Now

- **The elevated average age of U.S. beef cow-calf operators.**
- **The total costs of U.S. beef cow-calf operations are at record high levels.**
- **Less grass available for cow-calf operations, such as more land being used for crop production and new home construction.**
- **It is more difficult for younger cow-calf operators to get started.**
- **Regional drought conditions.**
- **Large numbers of very small U.S. beef producers.**

30

## The U.S. Beef Cow-calf Industry Consists of Large Numbers of Small Operators

| Number of Beef Cows Per Operator | Percent of the Total U.S. Beef Cow Owners |
|---|---|
| Those that have less than 10 beef cows | 33* |
| Those that have less than 20 beef cows | 55* |
| Those that have less than 50 beef cows | 80* |
| Those that have 50 or more beef cows | 20 |
| The average number of U.S. beef cows per owner is 40 head | 100 |

*These are typically hobby and part-time beef cow-calf operations.

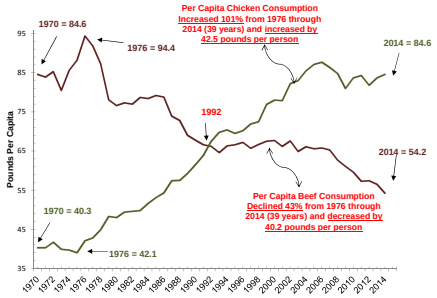
31

## The Major Significance of the Very Large Number of Small U.S. Cow-calf Operators

- **Most of these cow-calf operators who have 50 beef cows or less are hobby and part-time operators.**
- **Many have very high costs of operation. Many are baby boomers, dying off, retiring, slowing down and want less financial risks.**
- **Many are selling their beef cows and taking advantage of the record high cattle prices.**
- **These and other realities will result in continued net U.S. beef cow herd liquidation in the years ahead.**

32

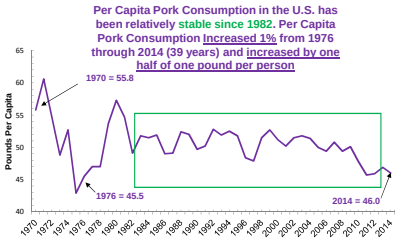
## The Annual U.S. Per Capita Consumption of Beef and All Chicken over the 45 Years of 1970-2014 (Based on Retail Weight)




Source: USDA Economic Research Service; U.S. Department of Commerce; U.S. Census Bureau

33

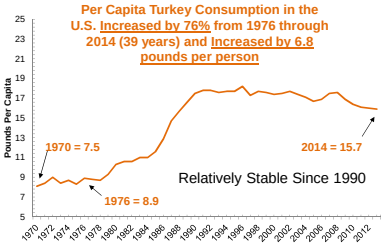
## The Annual U.S. Per Capita Consumption of Pork over the 45 Years of 1970-2014 (Based on Retail Weight)




Source: USDA Economic Research Service; U.S. Department of Commerce; U.S. Census Bureau

34

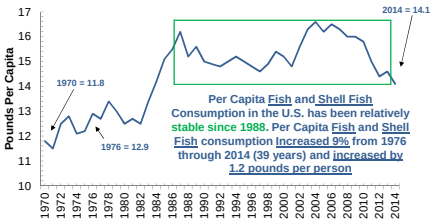
## The Annual U.S. Per Capita Consumption of Turkey over the 45 Years of 1970-2014 (Based on Carcass Weight)




Source: USDA Economic Research Service; U.S. Department of Commerce; U.S. Census Bureau

35

## The Annual U.S. Per Capita Consumption of Combined Commercial Fish and Shell Fish over the 45 Years of 1970-2014 (Based on Retail Weight)




Source: USDA Economic Research Service; U.S. Department of Commerce; U.S. Census Bureau

36

## The Per Capita Consumption and Market Share Percentages for All Chicken, Turkey, Beef, Pork and For Combined Commercial Fish and Shell Fish for the Year 1976

| The Major Protein Categories | The Annual Per Capita Consumption Numbers for 1976 | The Market Share Percentage Numbers for 1976 |
|---|---|---|
| 1. All Chicken | 42.1 | 20.7 |
| 2. Turkey | 8.9 | 4.3 |
| 3. Beef | 94.4 | 46.4 |
| 4. Pork | 45.5 | 22.3 |
| 5. Commercial Fish and Shell Fish | 12.9 | 6.3 |
| Total | 203.8 | 100.0 |

Source: USDA Economic Research Service; U.S. Department of Commerce; U.S. Census Bureau

37

## The Per Capita Consumption and Market Share Percentages for All Chicken, Turkey, Beef, Pork and For Combined Commercial Fish and Shell Fish for the Year 2014

| The Major Protein Categories | The Annual Per Capita Consumption Numbers for 2014 | The Market Share Percentage Numbers for 2014 |
|---|---|---|
| 1. All Chicken | 83.7 | 39.4 |
| 2. Turkey | 15.7 | 7.4 |
| 3. Beef | 54.2 | 25.2 |
| 4. Pork | 46.0 | 21.4 |
| 5. Commercial Fish and Shell Fish | 14.1 | 6.6 |
| Total | 214.6 | 100.0 |

Source: USDA Economic Research Service; U.S. Department of Commerce; U.S. Census Bureau

38

## The Market Share Percentages for the Competing Proteins for 2014, Compared to 1976

| The Major Protein Categories | The Percentage Gains and Losses in Market Shares for These Competing Proteins for 2014, Compared to 1976 |
|---|---|
| 1. All Chicken | + 91 |
| 2. Turkey | + 72 |
| 3. Beef | -46 |
| 4. Pork | -4 |
| 5. Commercial Fish and Shell Fish | + 5 |

Source: USDA Economic Research Service; U.S. Department of Commerce; U.S. Census Bureau

39

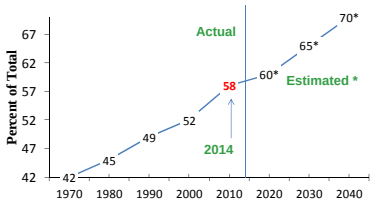
## The Per Capita Consumption Percentage Increases and Decreases for All Chicken, Turkey, Beef, Pork and for Combined Commercial Fish and Shell Fish in the Year 2014, Compared to 1976

| The Major Protein Categories | The Percentage Increases and Decreases Per Capita Consumption in 2014, Compared to 1976 |
|---|---|
| 1. All Chicken | + 101 |
| 2. Turkey | + 76 |
| 3. Beef | - 43 |
| 4. Pork | +1 |
| 5. Commercial Fish and Shell Fish | + 9 |

Source: USDA Economic Research Service; U.S. Department of Commerce; U.S. Census Bureau

40

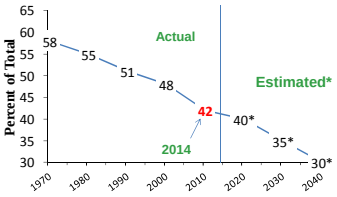
## Actual and Estimated Percentage of the Total Pounds of U.S. Beef Consumption that Consists of Ground Beef (Hamburger) Over Time (1970-2040)




Source: Based on UDSA annual cattle slaughter mix and per capita consumption data for at home and away from home consumption.
*Estimated by Bill Helming.

41

## Actual and Estimated Percentage of the Total Pounds of U.S. Beef Consumption that Consists of Non-Ground Beef (Whole Muscle Beef, Including *Middle Meats*) (1970-2040)




Source: Based on UDSA annual cattle slaughter mix and per capita consumption data for at home and away from home consumption.
*Estimated by Bill Helming.

42

## Simply Follow the Money

- **Consumers in the U.S. have many protein choices. The protein purchases that Americans are making are primarily driven by price and affordability or the lack thereof. This has been true since 1970 and for the past 45 years.**
- **This is why U.S. consumers have been buying and consuming more and more ground beef (hamburger) and why they have been buying and consuming more and more chicken for their protein needs since 1970.**
- **The probability of these key U.S. and Canadian consumer protein buying and consumption trends continuing for at least the next 30 years is 100%.**

43

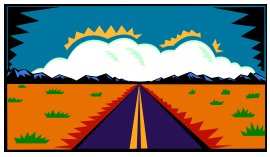
## Where Does The Very Large Supply of Ground Beef (Hamburger) that is Consumed in the U.S. Presently Come From?


Source: Based on private beef industry data and the USDA, Economic Research Service.

44

## Both U.S. and Canadian Beef Producers and Cattle Feeders Have Been and Remain Committed to Going Down Only One Super Interstate Highway or With a One-Size-Fits-All Business Model

**The Broken *One Size Fits All* North American Business Model**



- Full fed cattle only.
- One size fits all and a one trick pony.
- High input costs.
- Ground beef consumption and demand is going up.
- Middle meat (steaks) consumption and demand is going down.
- Total per capita beef consumption and domestic beef demand and market share are declining.

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## Conclusion and Some Important Observations

- Great opportunities exist for producing much more U.S. ground beef at significantly lower and more affordable prices and costs for U.S. consumers.
- The record high beef prices in 2013, 2014 and 2015 will end up resulting in major consumer demand destruction for the U.S. beef industry for many years into the future.
- For many solid reasons, the U.S. beef cow inventory will be significantly less 10 years from now.

46

## Very Important U.S. Beef Industry Realities

- The longstanding one size fits all U.S. beef production business model was primarily designed and put in place by the U.S. beef cattle feeding and by the beef packing segments of the overall U.S. beef industry beginning 50 years ago.
- This U.S. beef production business model is based on (1) finishing cattle with grain (corn), (2) producing center of the plate and expensive whole muscle middle meat beef cuts and (3) encouraging larger and larger beef carcasses and increased weights, which substantially increases beef production costs.

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## Very Important U.S. Beef Industry Realities

- The fix to the present U.S. beef production business model is for the U.S. beef industry to produce much more ground beef at much lower costs.
- This can successfully be done by (1) the U.S. beef industry placing substantially fewer cattle on feed, (2) by producing much more high quality ground beef with more grass and forages and no grain and (3) cow-calf operators in the U.S. making a major commitment to produce beef cattle that have frame scores of 3 to 5 over time as soon as practical.

48

## Very Important U.S. Beef Industry Realities

- **For the U.S. beef cow-calf operators and for stocker cattle operators – bigger is not necessarily better.**
- **Much improved dry matter feed conversion and substantially lower production and maintenance costs is better.**
- **This means smaller framed beef animals with much lower frame scores, i.e. smaller is better.**
- **Lower production costs are much better.**

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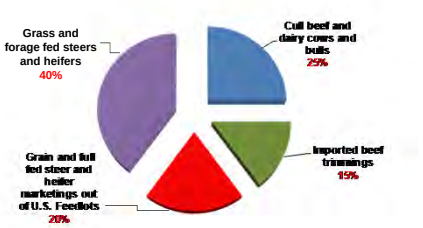
## The Frame Scores for About 90% of the U.S. Beef Cattle Herd Are Much Higher Today Than What They Were in 1965-1969 or Should Be Today In Order For the Beef Cattle Industry to be Significantly More Cost Competitive

| Key Beef Production Categories | Typical Dry Matter Feed Conversion Data |
|---|---|
| 1. Today at least 90% of the U.S. beef cattle herd frame scores fall within the range of 6.0 to 9.0. | 8.5 to 1.0 |
| 2. Today less than10% of the U.S. beef cattle herd frame scores fall within the range of 3.0 to 5.0. | 5.0 to 1.0 |
| 3. Those beef cattle that have frame scores of 3.0 to 5.0 (like was typically the case in 1965-1969) usually have an improvement in dry matter feed conversion of 40% to 42%, compared to those beef cattle that have frame scores of 6.0 to 9.0. | |
| 4. In order to significantly reduce beef cow maintenance and beef cattle production costs through improved dry matter feed conversions, the size and weight of beef cattle needs to be reduced significantly from what typically is the case today. The U.S. beef cattle herd needs to have frame scores within the 3.0 to 5.0 range. The good news is that this can be done. | |

Source: Leading U.S. beef cow-calf producers who have the solid data to support these numbers are people like **Jim Lents** from Indiahoma, Oklahoma (phone number is **(580) 704-3560**), **Kit Pharo** of the Pharo Cattle Company in Cheyenne Wells, Colorado (phone number is **(800) 311-0995**) and **Carol House** (the House Hereford Foundation) in Arkansas city, Kansas (phone number is **(620) 442-9159**).

50

## Where Will The Very Large Supply of Ground Beef (Hamburger) that is Consumed in the U.S. Come From in the Years Ahead?




Source: Based on private beef industry data and the USDA, Economic Research Service.

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## America Has Clearly Become a *Hamburger Society*

- **Based on meatingplace.com and a very recent survey by the NPD Group, there were 9 billion burgers consumed at U.S. restaurants and food service establishments in calendar year 2014, compared to 2013. Burger sales were up 3.0% in 2014, compared to 2013, while overall restaurant and food service establishment servings were down by 2.0% in 2014, compared to 2013.**
- **Today, 58% of all beef consumed in the U.S. is consumed away from home and 42% is consumed at home. Away from home and at home consumption of ground beef will continue to increase in the years ahead.**

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## My Recommendation to the U.S. Beef Industry and the USDA Policymakers

- **What the U.S. beef industry very much needs is two beef production models. One already exists, i.e. the prime, choice and select beef carcass quality grades for young beef cattle that are both grass, forage and grain fed. The added and new beef carcass quality grade that is very much needed is a grass and forage fed beef carcass quality grade (with the use of no grain) that results in producing high quality, safe and nutritious 88% to 90% chemical lean ground beef in the U.S. at much lower and more affordable prices.**

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## My Recommendation to the U.S. Beef Industry and the USDA Policymakers

- **The U.S. beef industry and the USDA should embrace and establish a very important and the much needed addition to the USDA young cattle carcass quality grading standards that is based on beef and dairy cattle that are grass and forage produced only with no grain and whose carcasses produced 88% to 90% chemical lean ground beef. These cattle would typically have live slaughter weights of 1100 to 1200 pounds for steers and would typically be under 30 to 36 months of age.**

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## My Recommendation to the U.S. Beef Industry and the USDA Policymakers

- **Simply stated, the U.S. beef industry is today and for the past 45 years trying to put a square peg into a round hole. It is *not* working.**
- **The net result is continued declines in per capita beef consumption, major loss of market share and U.S. protein consumers purchasing and consuming more and more chicken.**
- **The U.S. beef industry and the USDA Beef Grading policymakers consider ground beef as a *by-product*.**
- **The vast majority of American beef and protein consumers consider ground beef as a mainstream product of choice, not a *by-product*. Consumers in America want more ground beef at lower prices.**

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## The Actual Dollars Per CWT For 2009 and 2014 for the Six Key Items Shown in This Table

The Six Year Comparison Between 2009 and 2014

| The Six Items | 2009 | 2014 |
|---|---|---|
| 1. Texas Panhandle Fed Cattle ($/cwt) | 84 | 154 |
| 2. Oklahoma City 750-800 lb. Feeder Steers ($/cwt) | 96 | 203 |
| 3. Oklahoma City 600-650 lb. Feeder Calves ($/cwt) | 102 | 225 |
| 4. Iowa and Minnesota Barrows and Guilts ($/cwt) | 46 | 82 |
| 5. 12-City Broilers (cents/lb.) | .78 | 1.05 |
| 6. USDA Retail Choice Consumer Beef Prices (cents/lb.) | 3.89 | 5.60 |

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## The Actual Dollars Per CWT Increase and the Percentage Increases from 2009 Through 2014 for the Six Key Items Shown in This Table

The Six Year Comparison Between 2009 and 2014

| The Six Items | Dollars per CWT Increase | The Percentage Increase |
|---|---|---|
| 1. Texas Panhandle Fed Cattle ($/cwt) | 70 | 84 |
| 2. Oklahoma City 750-800 lb. Feeder Steers ($/cwt) | 107 | 112 |
| 3. Oklahoma City 600-650 lb. Feeder Calves ($/cwt) | 123 | 121 |
| 4. Iowa and Minnesota Barrows and Guilts ($/cwt) | 36 | 79 |
| 5. 12-City Broilers (cents/lb.) | .27 | 35 |
| 6. USDA Retail Choice Consumer Beef Prices (cents/lb.) | 1.71 | 44 |

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## Questions and Answers

**God Bless You**
**and**
**Keep Smiling**

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# Perspectives on Production-Sustainability, Production, and Products

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*Notes:*

# Market Outlook

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**Cattle Market Dynamics**
While a cooling off has occurred since the start of 2015, to say the cattle market was on a hot streak throughout much of 2014 should be viewed as an understatement. The reasons behind the seismic run-up can be boiled down to limited supplies and robust demand. The story line of tight supplies was not new, nor earth shattering, in 2014. In fact, the large majority (if not all) of the livestock/beef market economists had been highlighting this for a number of years. The surprising market event was beef demand, helped in part by limited competition at the meat case.

**Supply**
The U.S. beef herd is at it's lowest levels since 1962 at 29.70 million head, while Florida's beef cow herd is at 916,000 head. Even prior to 2014 market signals called for herd expansion, but other factors constrained expansion, specifically intense drought. This has created limited inventories in U.S. feedlots as noticed in Figure 1, which have fed through the supply chain and created smaller supplies of beef.

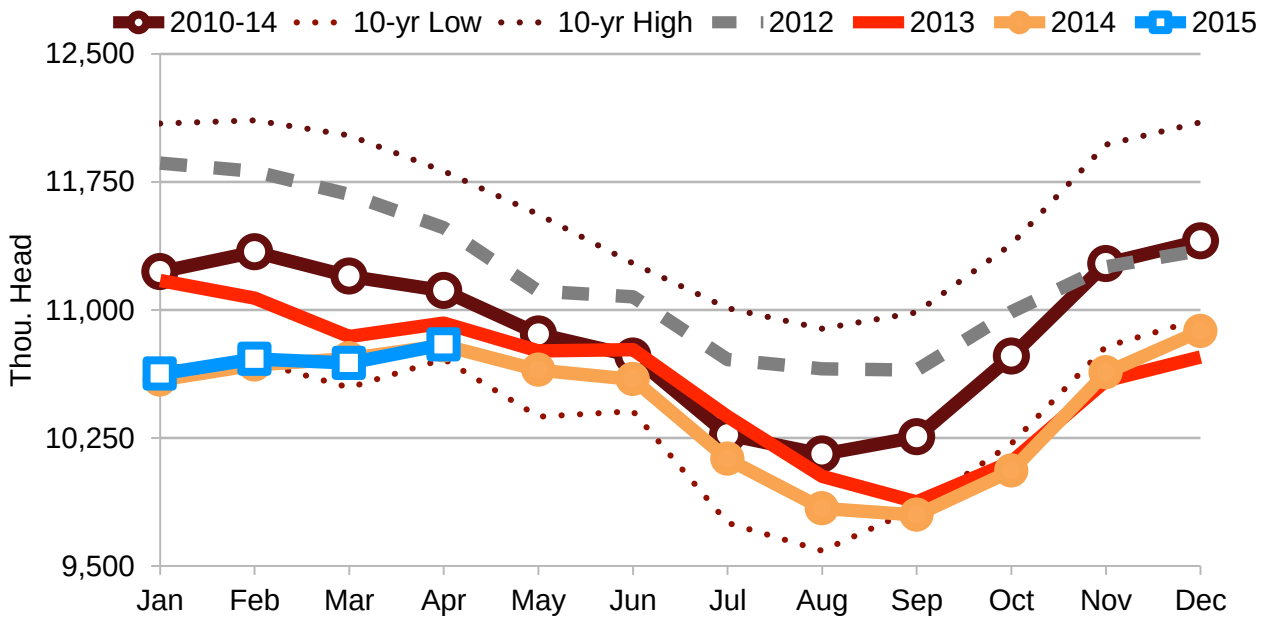


**Figure 1.** Cattle in U.S. Feedlots (minimum of 1,000 head capacity)

While this has been partially offset by increased weights of cattle in feedlots, overall beef supplies in 2014 totaled 24.323 billion pounds, down 5.7% compared to 2013. Projected beef supplies for the current year, 2015, are 24.281 billion pounds (down 0.2% from 2014).

Signs do point to beef herd expansion. The annual Cattle Inventory report indicated 5.78 million head of heifers were held back with the intention of replacement by U.S. beef producers as of January 1, 2015. Granted, this has shown up in prior years, but market forces have often changed producers' mind and

many heifers were moved from heifer development to beef development (i.e., placed into feedlots). However, it does appear that expansion is finally holding ground, as the April 2015 Cattle on Feed report showed heifers on feed down 10% compared to one year ago but mostly on par with the the five year average.

**Demand**

As noted, demand was the catalyst that created the "perfect storm" in 2014. Figure 2 depicts beef demand as an index. This is the best way to capture beef demand since it takes into account actual beef consumption, beef prices and the prices of competing meats. This provides a comparison of beef demand today versus previous years. Figure 2 highlights that beef demand in 2014 improved 7.5 percentage points compared to 2013, the second largest year-over-year gain since 1980, with growth in 2014 exceeding any expectations by industry experts. This phenomenon was aided by smaller broiler supplies, which kept chicken prices elevated, and smaller pork supplies due to the PEDv epidemic, which kept pork

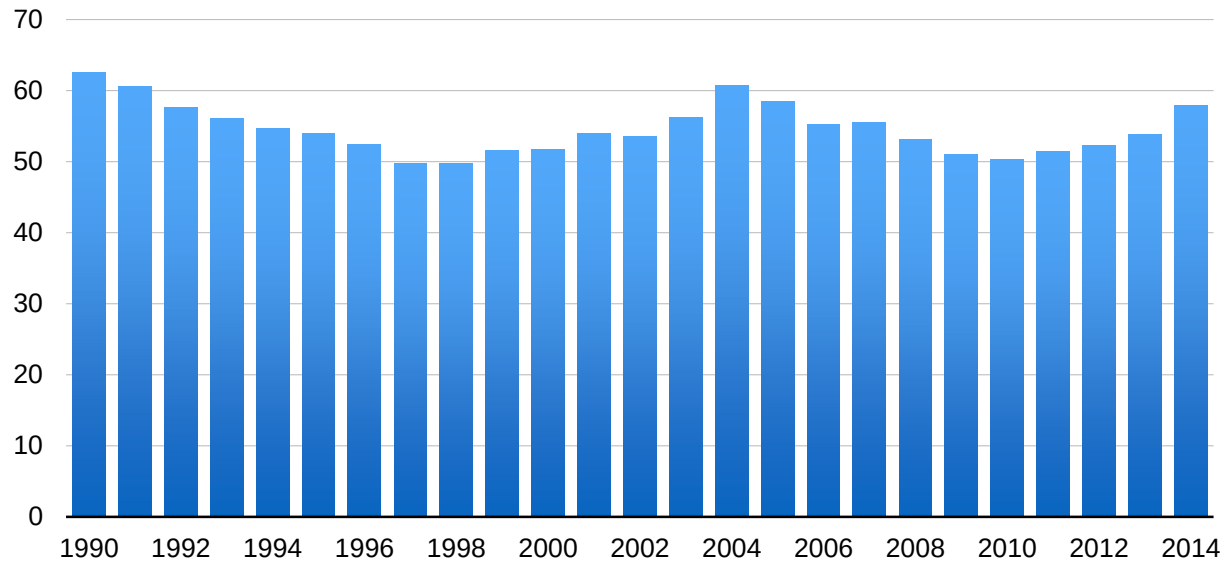


**Figure 2.** Beef Demand Index (1980=100; 2014=57.89)

prices elevated. As a result, the concern of "sticker shock" for beef products at the meat case was stymied, for the most part, in 2014.

**Prices**

Prices in 2014 did not maintain any degree of normalcy, meaning the typical seasonal pattern that cattle (and to a smaller extent beef) prices experienced were not noticeable. This was a result of tight supplies in the face of growing beef demand. Thus far in 2015, cattle prices have not maintained their trend higher and beef prices have continued higher. The steadying off of cattle prices has come at the dismay of producers. Keep in mind, though, these remain above year ago levels.

**Outlook**

The "perfect storm" that brought about the record prices of 2014 appears to have been downgraded to a "tropical depression". Despite cattle prices continuing to be at higher year-over-year levels, producers are depressed that they have not continued to move higher. The aiding factors in 2014 are slowly being erased. Broiler supplies are growing (up until the recent avian influenza outbreaks) and the pork industry now has a vaccine for PEDv. Both are heating up the competition at the meat case.

It is expected that cattle prices will gradually trend lower throughout the year, ending 2015 below the fourth quarter 2014 prices. Herd rebuilding takes time, but available feeder supplies should begin to show up in the first half of 2016 and continue to build moving forward, which will add pressure to prices as the 2010's come to end.

The silver lining will be beef trade. The U.S. dollar was rather expensive — when compared to other currencies across the globe — during the 2014 price increase. This only hindered the overall potential of beef and cattle prices since the result often reduces exports and increases imports. The U.S. dollar has slid lower since mid-March, and current projections point to a good year for beef exports. If this forecast is realized, the pressure on prices will be less severe.

Finally, lower prices at the pump should be viewed as a positive since this would result in more dollars for consumers. First quarter results indicate that some of these dollars landed in savings accounts as opposed to spending — more than expected anyway — but the overall gains of lower fuel and energy prices are generally a good thing for beef and cattle prices.

# Impact of Heat Stress on Female Fertility

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## The Nature of the Problem

Heat stress has two major actions on physiology of the female that reduce the probability of a cow becoming pregnant. First, heat stress reduces ability to detect estrus. On one dairy in Florida, only about 18-24% of estruses in hot months were detected by herdsmen while 45-56% of estrus periods were detected in cool months (Thatcher and Collier, 1986). The reduction in estrus detection is the result of effects of heat stress on cow behavior (for example, reduced walking time; López-Gatius et al., 2005) and on reduced circulating concentrations of the hormone estradiol-17β that causes estrous behavior (Gilad et al., 1993). Secondly, heat stress causes a large reduction in fertility. In lactating dairy cows, pregnancy rates per insemination in the summer can be as low as 10-20% (Hansen and Aréchiga, 1999). Fertility is reduced because heat stress can damage both the oocyte and early embryo (Hansen, 2013). The oocyte can be compromised by heat stress as early as 105 days before ovulation (Torres-Júnior et al., 2008) and as late as the peri-ovulatory period (Putney et al., 1989b). The early embryo is also initially sensitive to heat stress but quickly becomes resistant so that heat stress on day 1 after estrus reduced embryonic development whereas heat stress at day 3 had no effect (Ealy et al., 1993). The times in the reproductive cycle in which the cow is sensitive to heat stress are illustrated in Figure 1.

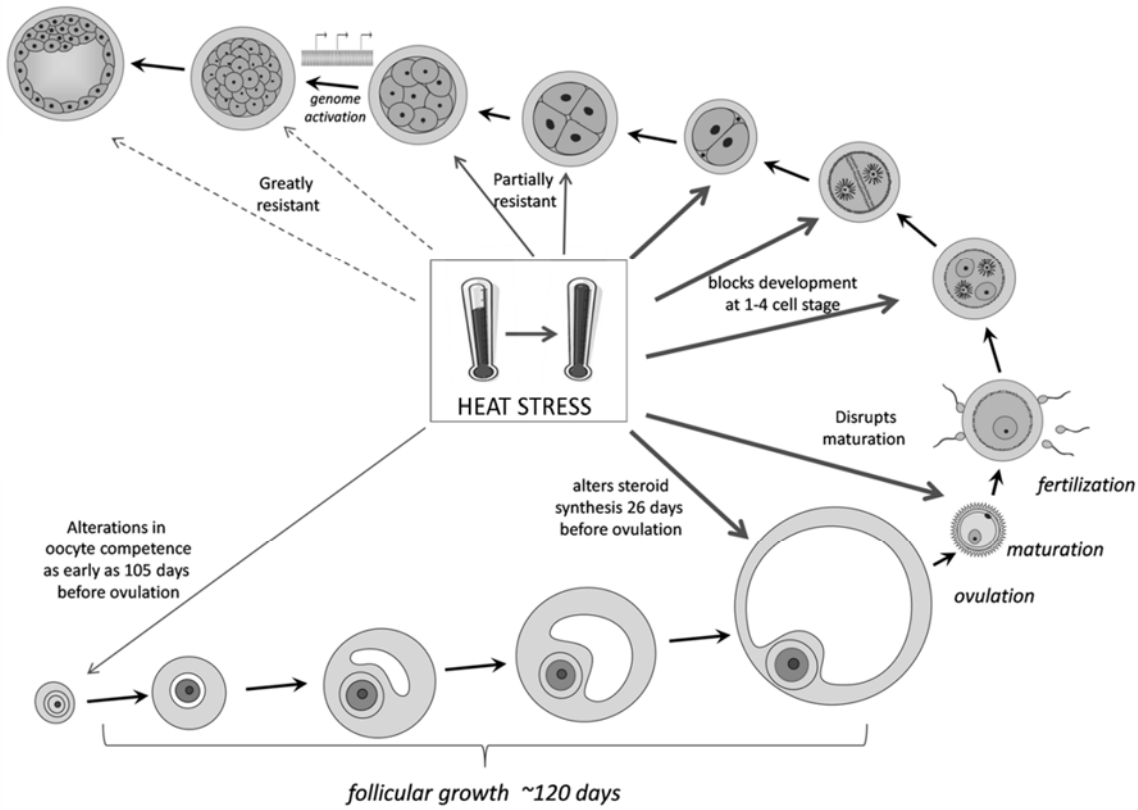


**Figure 1.** Diagram illustrating the timing of effects of heat stress on reproductive events that affect fertility. Heat stress during follicular growth can affect oocyte competence for fertilization and development. It is not known how early in the process of folliculogenesis that heat stress is disruptive to oocyte development but it could be as early as 105 days before ovulation. Oocyte maturation around the time of estrus is also compromised by heat stress. The early cleavage-stage embryo remains susceptible to heat stress during the first 1-2 days after estrus (1-cell to 4-cell stage) but the embryo then begins gaining resistance to maternal heat stress. By the blastocyst stage at Day 7 after estrus, the embryo is largely resistant to heat stress.

Heat stress is largely a problem of the lactating dairy cow. Non-lactating dairy animals and beef cattle are much less likely to experience infertility during heat stress. In Florida, for example, conception rates in Holsteins declined in the summer for lactating cows but not for non-lactating heifers (Badinga et al., 1985). The lactating cow is very susceptible to heat stress because the large amounts of heat produced as a result of lactation makes it difficult to regulate body temperature during heat stress. Hyperthermia (elevated body temperature) in lactating cows can occur at air temperatures as low as 77-284°F (Berman et al., 1985; Dikmen and Hansen, 2009).

Beef cattle can also be affected by heat stress, particularly in feedlot situations (Mitlöhner et al., 2002) or when grazing fescue-infected pastures (Caldwell et al., 2013), but several factors mitigate against large effects on reproduction in beef cattle. An example of the lack of seasonal effects on reproductive function of beef cattle is shown in Figure 2 for beef cattle in Oklahoma. The factors that limit the impact of heat stress on beef cattle reproduction include the existence of beef breeds that are genetically resistant to heat stress (Gaughan et al., 2010), seasonal breeding patterns that ensure that cows are not bred at the warmest time of year, and relatively low amounts of metabolic heat production as compared to lactating dairy cows.

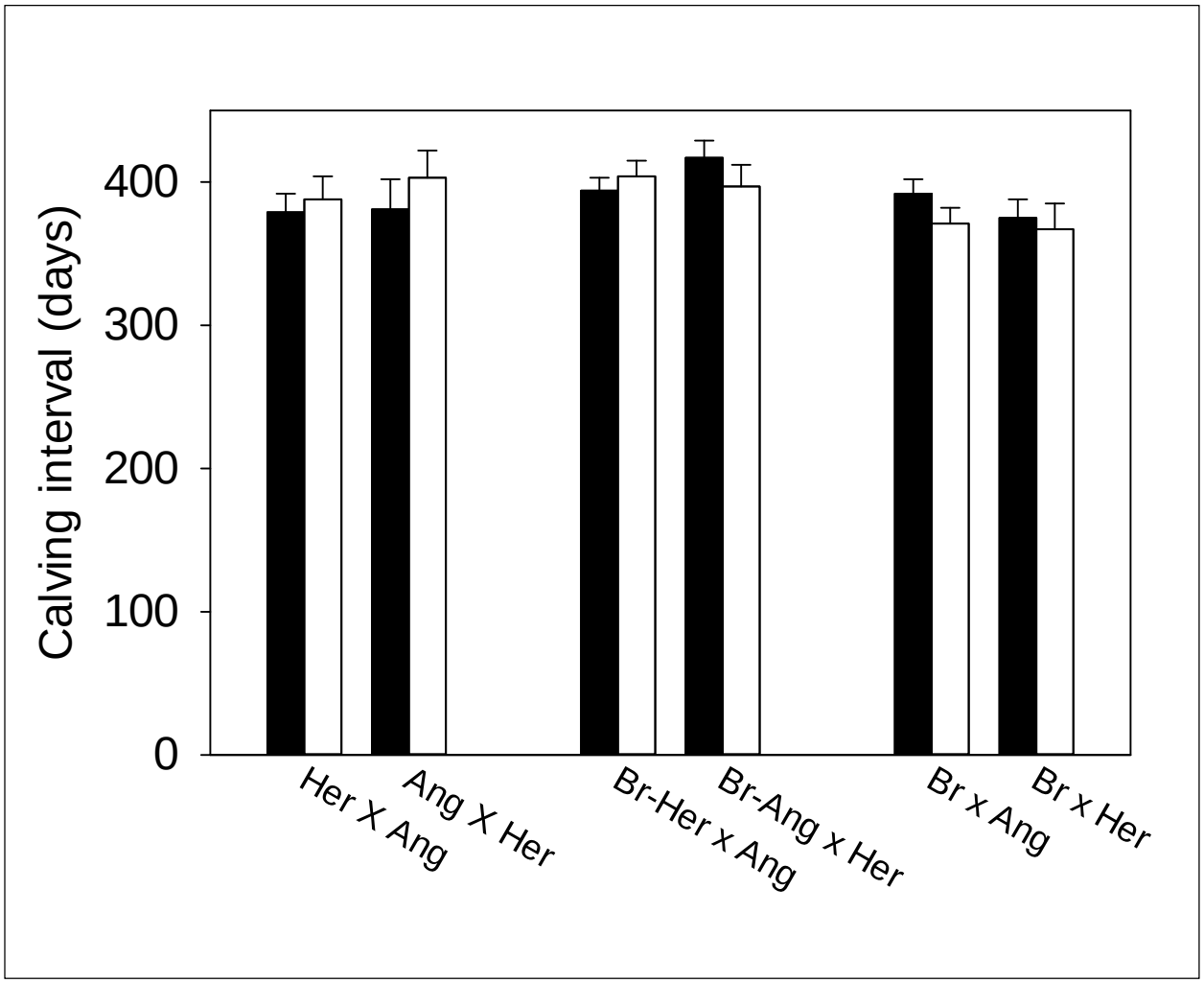


**Figure 2.** Lack of seasonal effect on calving interval in Oklahoma. Shown are calving intervals for cows calving in spring (black bars) and fall (white bars) for various types of cattle. Abbreviations: Ang, Angus, Br, Brahman, Her, Hereford. Data are from McCarter et al. (1991).

Despite the fact that beef cattle are much more resistant to heat stress than dairy cattle, it is important not to be complacent about the problem but rather to be aware of approaches to reduce the negative consequences of heat stress. Global climate change may well increase the severity of heat stress in many regions of the world where beef cattle are currently raised. Genetic selection for increased growth could also result in cattle being more susceptible to heat stress because of the associated increase in heat production.

Alleviating actions of heat stress on reproductive function is difficult. The most common approach for dairy cattle is to provide housing that minimizes heat stress. Incorporation of features such as shade structures, fans, and sprinklers, and misters or foggers can be seen in many dairies in hot regions of the world. While very important, cooling cows does not totally prevent reduced reproductive function during heat stress. In Florida, for example, seasonal variation in pregnancy rate persisted in a herd where cows were cooled with sprinklers and fans (Hansen and Aréchiga, 1999). In Israel, pregnancy rate per insemination in intensively-cooled herds was 19% in summer vs 39% in winter for high-producing herds and 25% in summer vs 40% in winter for low-producing herds (Flamenbaum and Ezra, 2006). Cooling is not a very attractive option for cattle managed on pasture.

In this paper, I will put forward two methods for reducing the impact of heat stress that can be applied to cattle managed intensively or on pasture. The first method, incorporation of timed artificial insemination (AI) protocols, eliminates the need for estrus detection and therefore prevents loss of reproductive performance caused by poor estrus detection. The second method is embryo transfer. While not always practical economically, this technique bypasses pregnancy losses caused by effects of heat stress on the oocyte and early embryo.

**Timed AI**

Protocols for timed AI can completely bypass problems associated with detecting estrus during heat stress because timing of ovulation is synchronized and insemination can be implemented at a fixed time without the need for estrus detection. What timed AI does not do is reverse damage to the oocyte or embryo caused by heat stress. Nonetheless, implementation of timed AI programs during heat stress can increase the rate at which at which cows get pregnant after calving because of an increase in the number of eligible cows that are inseminated.

The effectiveness of timed AI during heat stress can be examined by looking at results from two experiments with dairy cows conducted in the summer (Table 1). The first experiment was conducted in south Florida by Aréchiga et al. (1998). Cows were assigned to either be bred at first detected estrus after the voluntary waiting period of 70 days or were subjected to the Ovsynch timed AI procedure to be inseminated at 70 days after calving. Implementation of timed AI reduced the interval from calving to first service by 10 days. There was no difference in the proportion of cows that became pregnant after first insemination between treatments. Moreover, few animals became pregnant, undoubtedly because of the high degree of heat stress. Nonetheless, more cows were pregnant by 90 days postpartum in the timed AI group, presumably because more cows had been inseminated.

**Table 1.** Effectiveness of timed insemination protocols for increasing pregnancy rates of lactating Holsteins when implemented during periods of heat stress in Florida and Kansas.

| Experiment[a] | Treatment[b] | No. of cows | Interval, calving to first service, days | Cows bred within 7 d after PGF | Pregnancy rate at first service | Pregnancy rate at 90-d postpartum |
|---|---|---|---|---|---|---|
| Florida | Estrus | 184 | 82.4 | -- | 12.5% | 9.8% |
| | TAI | 169 | 72.4*** | -- | 13.6% | 16.6%* |
| Kansas | SS | 128 | -- | 57% | 32.0% | 17.9% |
| | TAI | 207 | --- | 100% | 33.3% | 33.3%** |

[a] Florida: Aréchiga et al. (1998); Kansas: Cartmill et al. (2001).
[b] Estrus = breeding at each observed estrus beginning at Day 70 postpartum; TAI = timed artificial insemination followed by breeding at all observed estrous periods thereafter; SS=Select Synch; GnRH followed by prostaglandin F-2α (PGF) 7 d later and breeding at detected estrus for the next 21 d .
* $P<0.05$ ** $P<0.01$ *** $P<0.001$

Similar results were obtained in Kansas by Cartmill et al. (2001). In this experiment, one group of cows were subjected to an estrous synchronization regimen (Select Synch) whereas another group was inseminated using the Ovsynch protocol. The overall level of fertility was higher than for the Florida study. Like for the Florida experiment, timed AI did not increase the percent of cows pregnant at first insemination after calving. However, more cows were inseminated within 7 days after the TAI treatment than after the estrous synchronization treatment. As a result, the percent of cows pregnant at 90 days postpartum was almost twice as high for the timed AI group (Table 1).

While timed AI can increase the number of heat-stressed cows that are inseminated, it cannot increase the percent of inseminated cows that become pregnant. Unfortunately, no pharmacological treatment has been identified that can consistently increase pregnancy rate per AI during heat stress (see Hansen, 2011 for review). Among the treatments that have been examined are treatment with human chorionic gonadotropin at day 5 of the estrous cycle to increase circulating progesterone concentrations, treatment with bovine somatotropin to increase secretion of the embryoprotective molecule insulin-like growth factor-1 and treatment with gonadotropin releasing hormone to extend lifespan of the corpus luteum. The ineffectiveness of hormonal treatments is probably related to the broad period of time in which the oocyte and early embryo are susceptible to disruption by heat shock. Treatments that might reverse effects of heat stress at one physiological window cannot reverse effects at others. Consider, for example, use of chorionic gonadotropin to increase output of progesterone by the corpus luteum. Such a treatment might be effective at reversing effect of heat stress on circulating progesterone concentrations after ovulation (Wolfenson et al., 2000) but this effect would not improve fertility in a cow whose oocyte was already damaged by heat stress occurring at some time before ovulation.

**Embryo Transfer**

Embryo transfer was developed as a tool to increase the number of offspring from genetically-superior females. This technology can also be used for improving fertility during heat stress (Figure 3). Embryo transfer is, in fact, the best method available for increasing pregnancy rate in lactating cows exposed to heat stress.

As shown in Figure 1, fertility is low in the summer largely because of damage to the growing follicle, oocyte and embryo caused by exposure to maternal hyperthermia. The oocyte can be damaged by heat stress as early as 105 days before ovulation (Torres-Júnior et al., 2008) and remains sensitive to heat

stress on the day of ovulation (Putney et al., 1989b). The early embryo, too, can be damaged by heat stress but soon acquires biochemical mechanisms that protect it from elevated temperature (Hansen, 2013). Thus, heat stress at day 1 after estrus reduced embryonic development but heat stress at days 3, 5, and 7 had no effect (Ealy et al., 1993).

In embryo transfer protocols, the only embryos typically transferred are those that have developed normally. Thus, the embryo that is transferred into a heat-stressed recipient has, for one reason or another, escaped effects of heat stress. In addition, embryos have become resistant to heat stress by the time they reach the stage of development where they are ready to be transferred into a recipient (the morula or blastocyst stage). Thus, it is unlikely that maternal hyperthermia will kill an embryo after day 7 of pregnancy.

Embryos can be produced by either superovulation or in vitro fertilization. For superovulation, cows are injected with follicle stimulating hormone to cause the growth and ovulation of multiple follicles. For in vitro fertilization, oocytes are harvested either from growing follicles using transvaginal, ultrasound guided aspiration (called oocyte pickup or OPU) or from ovaries recovered at slaughter or ovariectomy. Oocytes are then fertilized with sperm and the resultant embryos allowed to develop in the laboratory until transferred into recipients. Embryos produced by superovulation are superior to those produced in vitro in terms of ability to establish pregnancy after transfer and survive cryopreservation for long-term storage. As shown in Figure 3, transfer of superovoulated embryos improves fertility during heat stress regardless of whether embryos are cryopreserved or transferred fresh. However, the poor survival of in vitro produced embryos to cryopreservation means that transfer of in vitro produced embryos improved fertility only when embryos were transferred without cryopreservation.

Despite the problems caused by poor embryo freezability, in vitro production systems are superior to superovulation in terms of the maximum number of embryos that can be produced from a cow per year. In addition, sexed semen can be used very efficiently for in vitro fertilization since one straw can be used to inseminate dozens of oocytes. Production of in vitro produced embryos using oocytes collected at a slaughterhouse is much less expensive than production of embryos by superovulation or by in vitro fertilization of oocytes harvested using OPU.

The decision as to whether to use embryo transfer during the summer depends on the magnitude of the reduction in fertility caused by heat stress, the degree of improvement in fertility caused by embryo transfer and the cost of the embryo available for transfer. Ribeiro et al. (2012) estimated the cost to produce a female pregnancy in lactating cows as a function of the pregnancy rate per AI or embryo transfer. As an example, consider the case where pregnancy rate in the summer is 15% to AI using conventional semen and 25% using embryo transfer with sexed semen. In this scenario, embryo transfer would be profitable. It would cost $1,157 to produce a female pregnancy using timed AI, $1,042 to produce an embryo using an oocyte harvested by ultrasound, and $820 to produce an embryo using an oocyte recovered from a slaughterhouse ovary.

Embryo transfer will become more profitable during heat stress as improvements in the process increase the competence of the embryo to establish pregnancy and survive cryopreservation. In addition, cost advantages of using embryos derived from oocytes recovered from the slaughterhouse should not be overlooked. Embryos of high genetic merit can be produced by using elite bulls because one straw of semen can produce dozens of embryos. Improvements in cryopreservation will also make embryo biopsy for genotyping more practical.

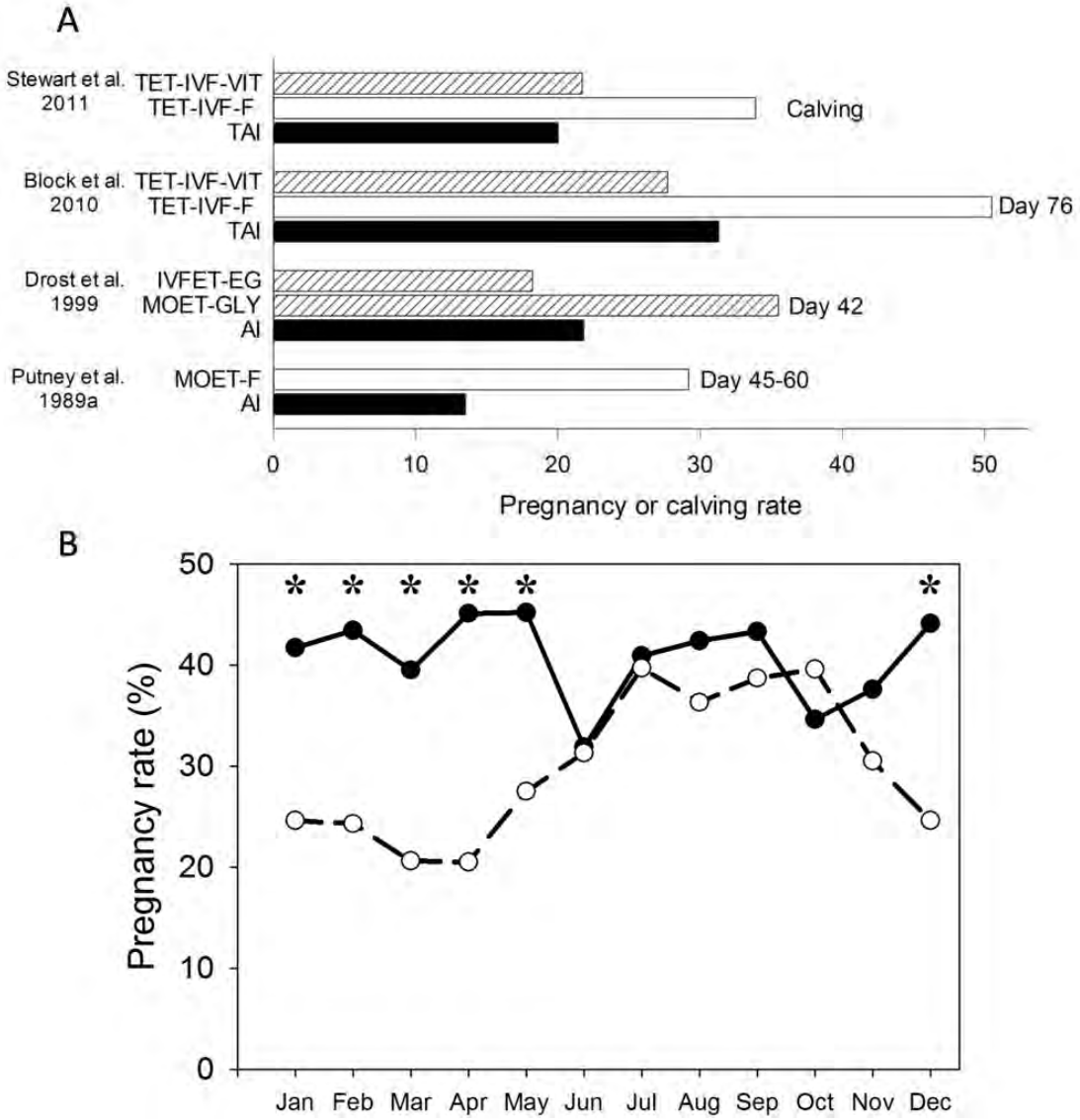


**Figure 3.** Enhancement of pregnancy rates during heat stress using embryo transfer. Data in Panel A represent results from various experiments in the summer in Florida. Abbreviations are as follows: AI: artificial insemination; EG, frozen in ethylene glycol; F, fresh; Gly, frozen in glycerol; IVFET, embryo transfer with an in vitro produced embryo; MOET, multiple ovulation embryo transfer; TAI, timed artificial insemination; TET-IVF, timed embryo transfer with an in vitro produced embryo; VIT, vitrified. The numbers in the graph represent the day of gestation at which pregnancy diagnosis was carried out. Panel B represents data from a commercial dairy in Brazil in which cows were either inseminated or received an embryo produced by superovulation (Rodriques et al., 2004). Asterisks represent months in which pregnancy rate was different between AI (open circles) and ET (filled circles). The figure is reproduced from Hansen (2013).

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# The Missing Piece of the Fertility Equation?
# Scrotal circumference effect on female fertility - is it real.

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One of the most difficult traits to select for in a beef cattle enterprise is reproduction since most fertility traits are lowly heritable and it can be difficult and time consuming to measure traits like cow longevity. It has been well documented that herd reproduction can be improved through crossbreeding or one can enhance the onset of puberty or pregnancy rates through increased nutrition during critical times of the production cycle. Although, the later is usually not cost effective and there is a point where feed cost are too great to over come and it no longer becomes economically viable for the producer. Consequently, producers look for traits that are easy to measure and have been shown to have some relationship with fertility. One of those traits is scrotal circumference.

Scrotal circumference is one of the most accurate indicators of puberty in bulls with the average scrotal circumference at puberty of 28 cm (range 25 to 30 cm), which can be both within breeds and across breeds. Scrotal circumference is an accurate predictor of sperm output in young bulls, as well as the future sperm producing characteristics of the testes. Increased yearling scrotal circumference size is positively related to increased sperm motility, increased normal sperm numbers, and a decrease in abnormal sperm numbers observed in an ejaculate.

In general, scrotal circumference is highly heritable in *Bos taurus* cattle, with estimates ranging from 0.36 to 0.71 (Latimer et al., 1982; Bourdon and Brinks, 1986; Morris and Wilson, 1997). In contrast, scrotal circumference is moderately heritable in *Bos indicus* based cattle with estimates ranging from 0.16 to 0.29 (Meyer et al., 1990; Kriese et al., 1991; Morris et al., 1992). In Nellore bulls, Boligon et al. (2011) reported heritability estimates of 0.24 at 229 days of age, 0.47 at 300 days of age, and 0.52 at 500 days of age, suggesting that scrotal circumference should be measured between 400 to 500 days of age in this population of Nellore bulls. Likewise, Silva et al. (2013) reported a heritability estimate of 0.40 in Nellore bulls at 18 months of age. Consequently, with a moderate heritability for scrotal circumference, selection and utilization of scrotal circumference EPD can probably still be used as a tool to improve male fertility. Having fertile bulls available to breed cows through multiple breeding seasons is essential for herd profitability.

Although, the heritability of scrotal circumference is moderately heritable, the heritability of traits associated with sperm in an ejaculate is more variable. Kealey et al. (2006) reported heritability estimates of the percentage of live sperm to be 0.22 and percentage of normal sperm in an ejaculate to be 0.35 in Hereford bulls. Primary abnormalities are typically reflective of abnormal sperm development within the testes and thought to be at least partially genetic in origin. Likewise, percentage of sperm with primary abnormalities had heritability estimates of 0.30, which was similar to 0.31 reported by Smith et al. (1989) in Hereford bulls. Meanwhile, Silva et al. (2013) reported heritability estimates of 0.02 for primary abnormalities in Nellore bulls. The heritability of secondary abnormalities (reflective of faulty epididymal sperm maturation) has low heritabilities ranging from 0.00 to 0.30 (Kealey et al., 2006) and 0.02 (Smith et al., 1989) in *Bos taurus* cattle and 0.16 in Nellore cattle (Silva et al., 2013). With such low heritabilities for both primary and secondary abnormalities, environmental effects may play a more important role in inducing primary and secondary abnormalities than genetics. Hence, developing a selection program to make progress on improving seminal characteristics of an ejaculate may prove challenging.

The seminal work completed by Dr. Jim Brinks group at Colorado State University reported that increased scrotal circumference in sires resulted in decreased age at puberty in daughters, which was a negative but favorable genetic correlation (See Martin et al., 1992). The genetic relationship ranges from -0.15 (Martinez-Velazquez et al., 2003) to -0.39 (Morris et al., 1992) in *Bos taurus* based heifers. In contrast, Johnston et al. (2014) reported a genetic correlation between scrotal circumference in 12 month old Brahman bulls and age at puberty in female progeny of -0.41. Additionally, Johnston et al. (2014) reported a genetic correlation between scrotal circumferences in 6-month-old Brahman based tropical composite bulls and age at puberty in female progeny of -0.30. Even though these correlations are low (*Bos taurus*) to moderate (*Bos indicus* based), it still suggests that selecting for increased scrotal circumference may lead to decreased age at puberty in the female progeny.

Although one may argue that there is minimal economic benefit to decreased age at puberty in females, there is an advantage to getting > 70% of the heifers reaching puberty before the start of the breeding season and getting as many heifers pregnant as early as possible during the breeding season since cattle that calve early in the subsequent calving season tend to calve early the remainder of their lifetime and have greater lifetime productivity. Additional economic benefits could include reduced feed cost in developing replacement heifers if the producer knows that a majority of their heifers will reach puberty at younger ages.

Another important question; is scrotal circumference related to other female reproductive traits such as heifer pregnancy rate? Heifer pregnancy rate is an important measurable trait that can have a significant economic endpoint. Most of the research suggests that the genetic relationship between scrotal circumference and heifer pregnancy rates is either non-existent or minimal and may depend on breed type. In *Bos taurus* breed types, Martinez-Velazquz et al. (2003) reported a genetic correlation of 0.00, whereas McAllister et al. (2001) reported a relationship of 0.05. In contrast, Eler et al. (2004) reported a genetic relationship of 0.20 in Nellore cattle; whereas, Johnston et al. (2014) reported a genetic relationship of 0.19 in Brahman cattle. It should be noted that in all of these studies, heifer pregnancy rate is reported as a breeding season pregnancy rate, where the breeding season is typically 60-90 days. In all of these studies, where during the breeding season heifers became pregnant is not reported. As indicated earlier, this is important since cattle that conceive early in the breeding season tend to calve early the remainder of their lifetime and have greater lifetime productivity.

Additional research must be conduced to determine if there is a genetic relationship between yearling scrotal circumference and age of puberty in heifer progeny particularly in cattle of *Bos inducus* breeding. Additionally, the relationship on when in the breeding season heifers became pregnant and its long-term effects on cow longevity and herd economics must also be examined.

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# What does it Take to Start an AI Program?

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## Introduction

Artificial insemination (AI) is one of the most effective tools available to cattle producers to improve productivity and profitability of their cattle operations. This reproductive technology has been commercially available for more than 65 years and utilized very effectively in the dairy industry, with more than 70% of all dairy cows in the United States inseminated by AI. However, AI tends to be somewhat underutilized in the beef industry, especially in the SE United States. However, in recent years development of estrus synchronization systems that allow cattlemen opportunities to inseminate all females on the same day, at a predetermined time, has enhanced the opportunities for AI to be used by more beef producers. Traditionally, the majority of producers utilizing AI were those producers raising seedstock offspring; however, technology improvements have continued to make the use of AI in commercial operations more attractive.

The primary reason U.S. beef producers cite for the lack of widespread AI use to breed heifers and cows is limited time and labor (NAHMS, 1998). Development and methods of implementation of timed artificial insemination (TAI) protocols are essential for producers, because they reduce the "hassle" factors associate with estrous synchronization and AI. Unless, owners of commercial cowherds aggressively implement reproductive and genetic improvement, the U.S. will lose its competitive advantage in high-quality beef production. International players that are more technically astute and competitively advantaged will position themselves to dominate the production and sale of beef worldwide. For example, the adoption of TAI systems in Brazil has increased exponentially (592%) during the past 17 years, whereas as the increase in beef semen available for use in the United States has only increased moderately during the same time period. Most of the cattle operations in Brazil implanting estrous synchronization systems and TAI are large, extensive commercial operations using *Bos indicus* (mainly Nelore cattle) breeds. Which is quite similar to operations in Florida. Brazilian cattle producers have realized: 1) the value of estrous synchronization to overall fertility of beef herd; and 2) the increased value of a calf sired by a bull with enhanced performance and carcass characteristics.

The use of AI also has become more attractive to commercial producers with changes in the current cattle market in the Unites States. The cost of herd sires has increased by more than 50% in the last three years, yet the cost of semen, labor, and pharmaceuticals has not increased at the same rate. Therefore, the cost per pregnancy with AI tends to be less than that with natural service. Nonetheless, the obstacles of time and labor, facilities, skill to administer products and perform AI, and confusion associated with bull and estrus synchronization system selection need to be taken into account. Most producers use these reasons as reasons not to AI their heifers and cows; however, the economic outlook for AI should stimulate the consideration for AI as a potential reproductive management tool.

## What are the Advantages of AI?

1) The ability to use sires of superior genetic merit (the best bulls of the breed). In most cases producers have access to semen from the most genetically superior sires in a given breed at a cost far below what they would be required to pay if they were to purchase the natural service sire.

2) Use of proven sires with high accuracy. From a commercial standpoint, highly proven sires allows commercial cattlemen the opportunity to obtain genetics that is repeatable and provides a

high degree of accuracy for traits that they find desirable. This is especially important when using AI in replacement heifers. Selecting semen from highly proven sires allows producers to identify matings that reduce calving difficulty.

3) Producers have the ability to mate specific sires to individual cows. This way producers may match desirable traits of cows and bulls for genetically superior calves.

4) AI provides an opportunity to reduce the number of herd bulls needed in cattle operation. One of the largest expenses that the average beef cattle operation incurs is the cost of maintaining a bull and repairing damage done by bulls to existing pastures and facilities. Reducing the need for herd sires reduces these maintenance costs.

5) Improved genetics of offspring. The offspring from cows that became pregnant to AI are usually genetically superior to natural service. These offspring are later maintained in the herd as replacement females and will transmit improved genetics to their offspring.

6) Improved reproductive performance of the cow herd. When used in conjunction with estrus synchronization the impact on reproductive performance of the cow herd is extensive. Producers can have a reduced calving season, cows become pregnant earlier in the breeding season, and offspring are healthier and larger at weaning.

**How do I Determine Whether AI will be Cost Effective in My Operation?**

Recently we performed an experiment using partial budget analysis to determine the economic outcome of estrus synchronization and TAI in commercial cow/calf production (Rodgers et al., 2012). Suckled beef cows (n = 1,197) from 8 locations were assigned randomly within each location to 1 of 2 treatment groups: 1) cows were inseminated artificially after synchronization of ovulation using the 7-day CO-Synch + CIDR protocol (TAI; n = 582); and 2) cows were exposed to natural service (NS) without estrous synchronization (Control; n = 615). Within each herd, cows from both treatments were maintained together in similar pastures and were exposed to bulls 12 h after the last cow in the TAI treatment was inseminated. Overall, the percentage of cows exposed to treatments that subsequently weaned a calf was greater for TAI (84%) than Control (78%) cows. Weaning weights per cow exposed to treatments were greater for cows in the TAI treatment (425 lb) than those cows in the Control treatment (387 lb). Overall, increased returns plus decreased costs ($82.32), minus decreased returns plus increased costs ($33.18) resulted in a $49.14 advantage per exposed cow in the TAI treatment compared to the Control treatment. Location greatly influenced weaned calf weights, which may have been a result of differing management, nutrition, genetic selection, production goals, and environment. We concluded that estrus synchronization and TAI had a positive economic impact on subsequent weaning weights of exposed cows.

In the process of developing the model in the study above, utilizing a partial budget analysis, we developed a model that may be useful to beef producers to incorporate their own costs and determine the value of estrous synchronization in their own operations. This model has been converted into a smartphone application for Android and iPhone/iPad users and is called the **'AI Cowculator'** (Figure 1). The **AI Cowculator** may be downloaded free of charge and is a decision aid tool to assist producers to determine whether they should consider TAI rather than purchasing herd sires for their cow herds. We encourage producers and members of the allied industry to download the **AI Cowculator** and utilize this tool to assist in making bull buying and breeding season decisions.
In addition, the application contains a locator to determine where products may be purchased and technicians who can provide the service, along with additional resources and a link to the **AI Cowculator** social media. For users who do not have an Android or iPhone/iPad Smartphone device or would prefer to use a personal computer, an Excel-based version (Figure 2) is available and can be

downloaded. For more information on the **AI Cowculator**, including a guide on how to use it, visit the webpage at http://nfrec.ifas.ufl.edu/programs/AICowculator.shtml.

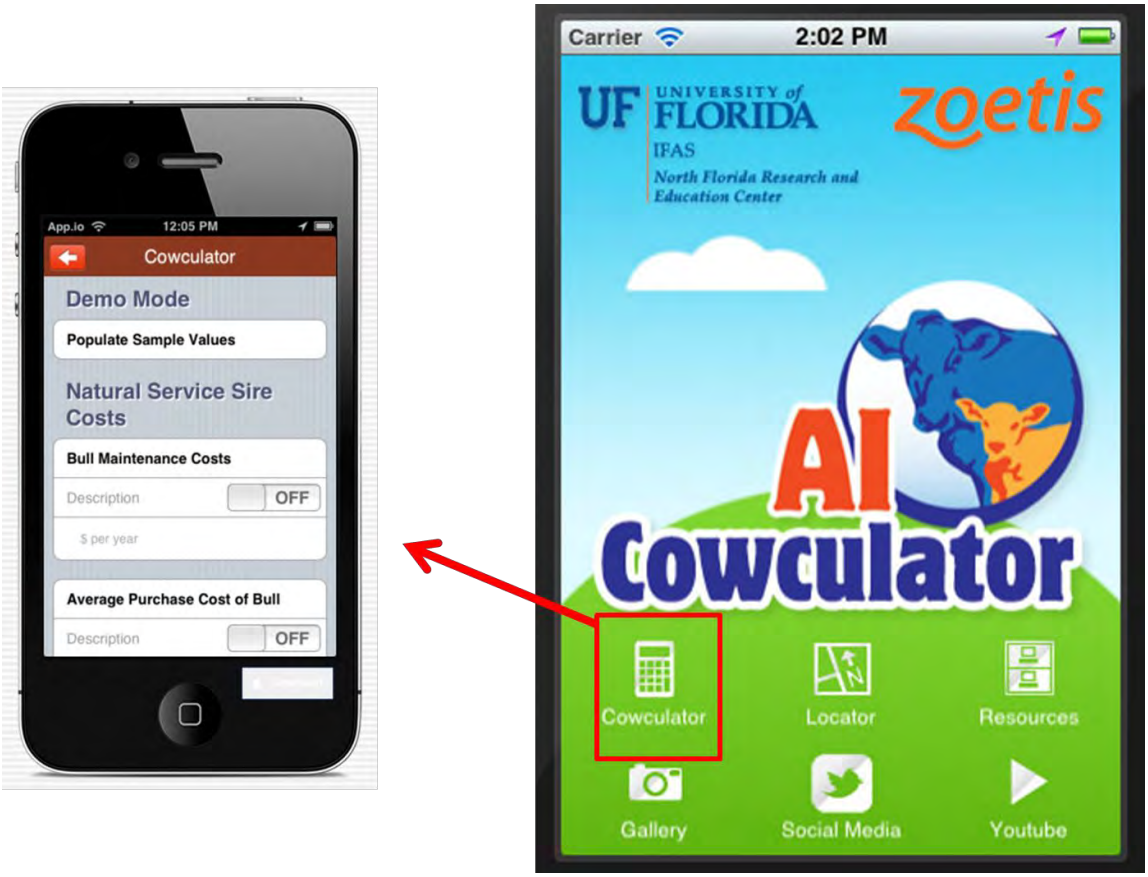
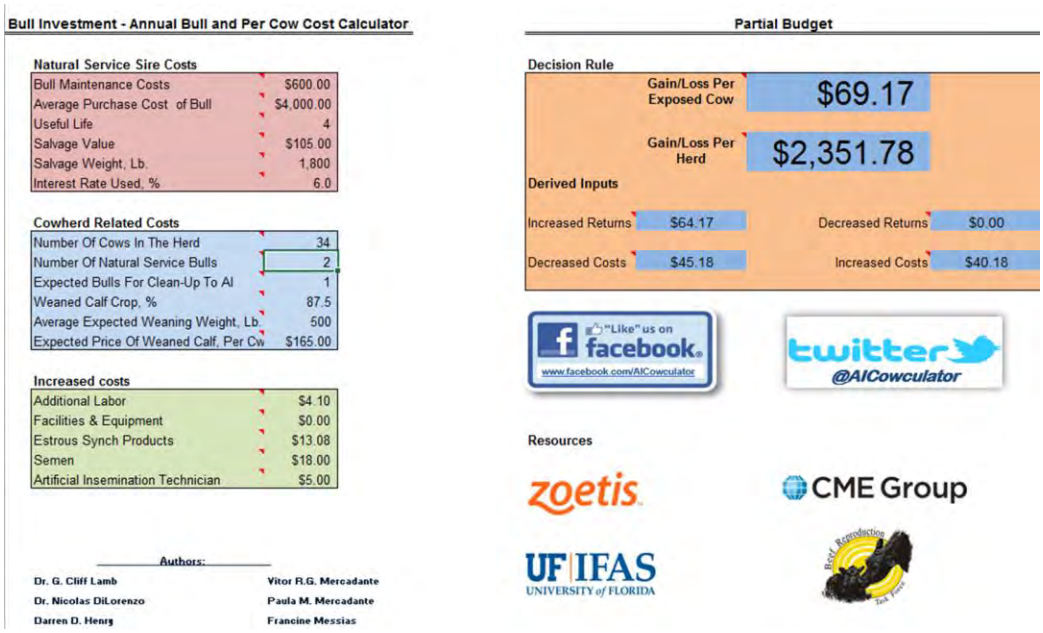



**Figure 1.** The **AI Cowculator** Smartphone Application front page.



Bull Investment - Annual Bull and Per Cow Cost Calculator

Natural Service Sire Costs

| | |
|---|---|
| Bull Maintenance Costs | $600.00 |
| Average Purchase Cost of Bull | $4,000.00 |
| Useful Life | 4 |
| Salvage Value | $105.00 |
| Salvage Weight, Lb. | 1,800 |
| Interest Rate Used, % | 6.0 |

Cowherd Related Costs

| | |
|---|---|
| Number Of Cows In The Herd | 34 |
| Number Of Natural Service Bulls | 2 |
| Expected Bulls For Clean-Up To AI | 1 |
| Weaned Calf Crop, % | 87.5 |
| Average Expected Weaning Weight, Lb. | 500 |
| Expected Price Of Weaned Calf, Per Cw | $165.00 |

Increased costs

| | |
|---|---|
| Additional Labor | $4.10 |
| Facilities & Equipment | $0.00 |
| Estrous Synch Products | $13.08 |
| Semen | $18.00 |
| Artificial Insemination Technician | $5.00 |

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Partial Budget

Decision Rule

Gain/Loss Per Exposed Cow: $69.17

Gain/Loss Per Herd: $2,351.78

Derived Inputs

| | | | |
|---|---|---|---|
| Increased Returns | $64.17 | Decreased Returns | $0.00 |
| Decreased Costs | $45.18 | Increased Costs | $40.18 |



**Figure 2.** The **AI Cowculator** Excel version front page.

**Items that are NOT Necessary for Establishing an AI Program**

1) You do not need to be proficient at AI. There are currently experts in the field available with the ability to inseminate all cows at a predetermined date and time.

2) There is no need to own a nitrogen tank for storing semen. With experts in the field available they can provide short-term semen storage and also work with individual producers on only ordering the required number of units of semen.

3) It is not necessary to have AI supplies, such as an AI kit with sheaths, AI guns, and sleeves available. In most cases the AI technicians will provide all supplies.

**What are Some Important Requirements to Developing a Sound AI Program?**

1) Have an established breeding season. Without an established breeding season it is difficult to incorporate estrus synchronization and AI with a high degree of success.

2) Ensure that the nutritional status (including mineral nutrition) of the herd targets for cows to reinitiate estrous cycles soon after birth, or ensures that heifers have the capability of obtaining puberty prior to the breeding season

3) Facilities that allows producers to restrain cattle in such a way that they can administer pharmaceutical products and AI cows. In some cases, experts have portable facilities to assist with cattle handling. Producers should be aware of these opportunities and take advantage when available.

4) Know which traits are important for your herd and, with the help of an expert, identify proven AI sires to purchase at least one month prior to initiating the AI program. With the increased use of AI there is also a greater demand on proven sires. In many cases, semen from desired bulls is not available or back ordered. Planning ahead will allow producers to find alternatives.

5) Utilize semen from a major semen company rather than using custom collected semen. Pregnancy rates of semen from the major genetics companies tends to be more strictly evaluated and provides more consistent, desirable results.

6) Familiarize yourself with the pharmaceutical products used in the estrus synchronization protocol and be sure that the correct product is administered at the correct time. This is one of the largest causes of failure in many AI programs.

7) Utilize good animal handling techniques, since stress has negative effects on fertility. Reducing female stress around the time of AI will enhance the response to the program.

8) Use good Beef Quality Assurance techniques. Use the correct syringe and needle size and length for each product. Inject these products in the muscle according to the best BQA techniques. There is no evidence that administering products in the neck muscle is less desirable than other muscles, such as the thigh, or rump.

**Conclusion**

Incorporating an AI program into a beef operation has numerous benefits, especially in today's beef market climate. The use of AI is an attractive tool to decrease some of the input costs associated with breeding cattle, especially since the two largest factors that affect the cost of pregnancy are the bull:cow ratio and the cost of natural service sires. Using AI reduces the bull:cow ratio and decreases the number of bulls that a producer needs to own. In addition, the development of estrus synchronization systems that allow producers to plan to inseminate all females on a single day at a predetermined time eliminates the need for the producer to have the skill to AI or to require semen storage. Producers may now work with independent experts or experts from genetics companies to plan and implement an AI program that was not possible in the past.

When trying to understand more about AI and familiarizing yourself with reproductive management techniques it is a good idea to bookmark the Beef Reproduction Task Force website (http://beefrepro.unl.edu/ ). This website provide significant resources for beef cattle producers who need additional information on reproduction in beef cattle. The primary objectives of this group are: 1) to improve the understanding of the physiological processes of the estrous cycle, the procedures available to synchronize estrus and ovulation and the proper application of these systems; and, 2) to improve the understanding of methods to assess male fertility and how it affects the success of AI programs.

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# Early Weaning Beef Calves at 70 to 90 Days of Age
## *An overview of recent research*[1]

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**Summary**
The benefits of early weaning during instances of environmental strain, usually witnessed by a shortage of summer forage, has been understood and practiced for many years. However, the use of early weaning as a normal, annual management practice for beef cows is not common. Our interest in the topic originated from the common production practice in the Southeast, which allowed heifers to develop for two years before being bred the first time. Calving heifers for the first time at three years of age is quite common across production regions that utilize a high percentage of *Bos indicus* lineage (i.e. Brahman). Compared to heifers of traditional English lineage (*Bos taurus*), Brahman-crossbred heifers have been shown to have lower calving rates when developed to calve at 24 months of age (DeRouen and Franke, 1989). The reason relates to the slow rate of maturity common to *Bos indicus* cattle, witnessed by both delayed onset of puberty (Rodrigues et al., 2002) and increased time required to achieve mature body size (Martin et al., 1992). Nevertheless, heifers that calve for the first time at three years of age have reduced lifetime economic efficiency than those managed to calve at two years of age. Although, calving at three years of age may increase repeatability of pregnancy, forcing all two year olds to remain non-productive an entire year decreases the overall economic efficiency of the cowherd (Nunez-Dominguez et al., 1991).

**Introduction**
In beef production systems, early weaning lacks an appropriate definition. In most regions of the US, beef calves are weaned from their dams at approximately six to eight months of age. Therefore, any calves weaned prior to six months of age may be considered, "early weaned". For our purposes, early weaning refers to the permanent separation of the calf from its mother at 70 to 90 days of age. This target age is used to ensure that the process of early weaning has an opportunity to impact the reproductive performance of the cow. Calves weaned at four and five months of age may be mistakenly referred to as "early weaned", but this is truly a misnomer, as the cow will benefit little reproductively within a fixed breeding season. By this age, the breeding season has likely ended or almost over once the calf is weaned. To harvest the most efficiency from the effort, early weaning should always occur at the start, or very near the start, of the normal breeding season. It has been our experience that beef calves should not be weaned when they are less than 50 days of age. When weaning at ages less than 50 days, we have found that calves perform poorly and appear to be stunted, never recovering their normal body weight even many months later. This age threshold is supported by the common age at which dairy calves begin consuming significant amounts of dry feed. Dairy producers begin the transition process from liquid milk to complete dry feeds when calves reach 45 to 50 days of age. Therefore, the target age for early weaning beef calves should be > than 50 days with a target range of 70 to 90 days of age.

**The Cow**
***Body Condition***
Assuming the beef herd is otherwise healthy, nothing impacts cowherd reproductive performance more than prolonged post-partum anestrus – and nothing impacts post-partum anestrus more than cow body condition. Low cow body condition is the primary reason for reduced conception rates and overall poor cowherd productivity. Cow body condition is a subjective estimate of the amount of fat on a cow and is the most reliable method for evaluating a nutritional program. Body condition typically declines after calving, when the nutritional demands of the cow are at a maximum. It is during this time that

[1] This manuscript is a revision/update of a previously published document by the same authors. Proceedings of the 2013 Southwest Nutrition Conference, Tucson, AZ. Significant updated portions include data related to early weaning of mature beef cows.

supplemental nutrition is most needed. Research from the University of Florida (Rae et al., 1993) has shown that cows with low body condition scores (≤ 4.0) have a 30% reduction in pregnancy rate compared to cows in optimum body condition (5.0 to 6.0). The low body condition score cows that do conceive often do so late in the breeding season. This increase in post-partum interval results in later calves the following year. This is most pronounced in young cows, which possess higher nutritional demands to support both lactation as well as their own continued growth. When managing these young cows, producers are faced with a limited number of options, including, 1) provide adequate nutrient-dense supplementation, 2) early weaning, therefore removing the nutritional demands associated with lactation, or 3) breed heifers at 3 years of age when their own growth demands are lessened. We examined the influence of early weaning on first-calf cow body weight and body condition score change over two consecutive years (Arthington and Kalmbacher, 2003). In our study, early weaning resulted in a 2-point increase in cow body condition score compared to contemporary cows nursing their calves up to the time of normal weaning. (Table 1). This difference in body condition score allows the cows to calve in the following year with greater condition, which optimizes their chances to rebreed early resulting in older, heavier calves at weaning the next year.

**Table 1.** Effect of early- versus normal-weaning on first-calf heifer BW and body condition (average of two consecutive years).

| | Treatment | | |
|---|---|---|---|
| Item | EW | NW | SEM |
| Heifer BW, lb [a] | | | |
| January | 922 [c] | 955 [d] | 11.2 |
| April | 988 [d] | 946 [c] | 9.7 |
| August | 1,083 [d] | 997 [c] | 11.0 |
| Change | 161 [d] | 42 [c] | 7.1 |
| Heifer BCS [b] | | | |
| January | 4.28 | 4.28 | 0.10 |
| April | 5.42 [d] | 4.46 [c] | 0.11 |
| August | 6.34 [d] | 4.75 [c] | 0.07 |

[a] Individual heifer BW collected at the time of early weaning (EW; January), when calves came off ryegrass (April), and at the time of normal calf weaning (NW; August) (n = 50 and 58 for EW and NW, respectively).
[b] Heifer body condition score (BCS) recorded as an average of two technicians at each collection date using a 1 to 9 scale (1 = emaciated and 9 = obese).
[c,d] Treatment means within a row without a common superscript letter differ ($P < 0.05$).

***Feed Intake***

As early-weaned cows begin to stop lactating, their dry matter intake decreases by as much as 30%. Results from our research (Arthington and Minton, 2004) have shown that early-weaned, first-calf cows require approximately 50% less TDN to achieve and maintain a body condition score of 5.0 compared to lactating heifers of the same age and body condition (Figure 1). The intake values represented by these data show the amount of TDN consumed by a lactating first-calf cow, plus her calf, compared to an early-weaned first-calf cow without her calf. These data suggest greater than a 40% improvement in converting TDN into calf gain as a result of early weaning**.**

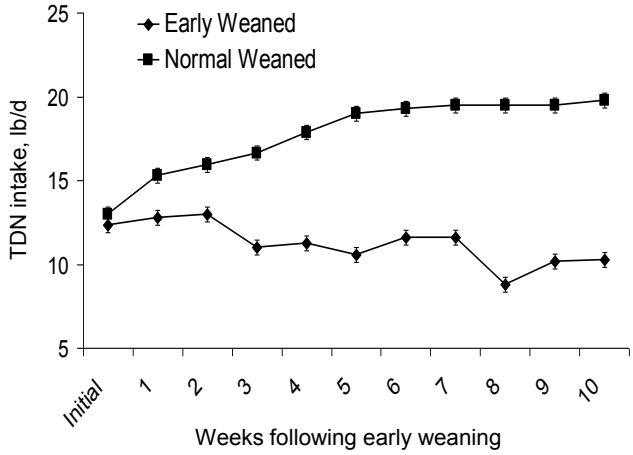


**Figure 1.** Effect of early calf weaning on voluntary dry matter intake of TDN in first-calf cows. Early-weaned calves were removed on the first d of wk 1.

This voluntary decrease in dry matter intake has important practical implications for the cow/calf producer, whereas the cow can maintain or gain body weight with almost 30% less forage. In one study (Galindo-Gonzalez et al., 2007), the effect of cow parity (primi- versus multiparous) and early weaning on hay intake, cow body weight and condition change, and pregnancy rate was investigated. In that study, there was very little difference in the effect of parity when measuring cow response to early weaning. Our original hypothesis stated that young, primiparous cows would realize a greater production response to early weaning versus mature, multiparous cows when each were compared to normal-weaned contemporaries of a similar parity. This was not the case, as mature cows also experienced a considerable decrease in hay dry matter intake concurrent with an increase in body condition and pregnancy rate. In this study, cows with their calves consumed approximately 18% more hay than early-weaned cows. This value differs from the 30% decrease suggested earlier due to the presence of winter perennial pasture. The hay was a supplement to pasture and pasture forage intake was not measured. The pooled response summary over two yeas (n = 96 cows) for both primi- and multiparous cows is provided in Table 2. Considering a 100 day winter hay supplementation period and hay valued at $100/ton, early weaning can save nearly $12 per cow in hay costs alone. This production efficiency estimate does not take into account the value of increased pregnancy rate and decreased post-partum interval, which are the primary benefits realized by early weaning.

**Table 2.** Effect of early weaning on supplemental hay intake and performance of beef cows wintered on perennial bahiagrass pasture (average of two years; n = 96 cows).

| Item | Early-weaned | Normal-weaned | SEM | P = |
|---|---|---|---|---|
| Hay intake, lb/cow/d [a] | 14.2 | 16.7 | 0.5 | < 0.01 |
| Body condition change [a,b] | + 0.5 | - 0.5 | 0.08 | < 0.01 |
| Pregnancy rate, % | 80.4 | 69.6 | ----- | 0.23 |

[a] Calves early weaned at an average age of 85 days. Hay intake and body condition change calculated for 75 days after early weaning, after which all cows were exposed to mature bulls as a single group for 45 days.
[b] Body condition scored on a 1 to 9 scale (1 = emaciated and 9 = obese).

***Reproductive Performance***

The removal of a calf from a post-partum, anestrous cow results in an endocrine response initiating estrus. The common management system involving a 48-hour calf removal is targeted at initiating this response by removing the suckling stimuli. Early calf weaning creates the same scenario, but in this case the calf is not returned to the dam. In one study, we evaluated the post-partum interval of thin, first-calf heifers which were early-weaned or allowed to remain with their calf (Arthington and Minton, 2004). We fed each heifer individually to ensure similar amounts of body weight gain over 70 days. By the end of the feeding period, cows from both treatments gained a similar amount of body weight and body condition; however, more early-weaned cows were cycling compared to normal-weaned contemporaries (Figure 2). These data suggest that the calf-removal response is an important factor affecting post-partum anestrus, independent of nutrition.

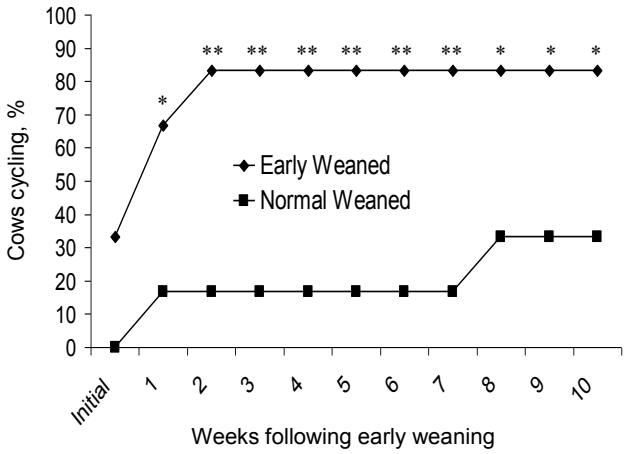


**Figure 2.** Effect of early calf weaning on post-partum cyclicity of first-calf heifers. Early-weaned calves were removed on the first d of wk 1. Date of return to estrus was determined as the first wk when progesterone concentrations were greater than 1 ng/mL for two consecutive weekly samples. * and **; P < 0.10 and 0.05, respectively.

In some situations, producers may be unable or unwilling to permanently separate beef calves at these early ages. To address this, we compared the reproductive effects of 5 consecutive 48-h calf withdrawals (20 d apart) to permanent calf withdrawal (early weaning) and a traditional single 48-h calf withdrawal (Martins et al., 2012). In that study, first-calf cows that were exposed to multiple calf withdrawals attained post-partum cyclicity at the same rate as early-weaned cows and sooner than first-calf cows that were submitted to a single 48-h calf withdrawal (Figure 3). Although, the multiple calf withdrawals mimicked permanent separation in terms of hastened post-partum anestrus, cows with unweaned calves had lesser body weight gain and a greater body condition decline compared to early-weaned cows throughout the breeding season.

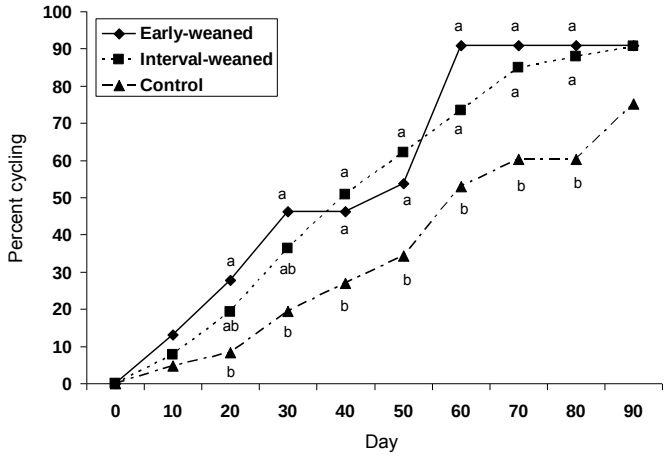


**Figure 3.** Percentage of cows cycling during the 90-d breeding season. Early-weaned cows had their calves permanently removed at the start fo the breeding season (day 0); control cows had their calves removed for 48 h once at the start of the breeding season; interval-weaned cows had their calves removed for 48 h five times, 20 d apart throughout the breeding season. a,b; $P < 0.05$.

In any given year, the majority of cows in a producer's non-pregnant category are young cows (i.e. first and second calf cows). The use of early weaning will allow these females to regain their lost body condition, and do so with less forage and supplemental feed. As well, the decrease in post-partum interval means these females will become pregnant earlier in the breeding season and produce calves that will be older and heavier at next year's weaning. In a two-year study, investigating two-year old first calf heifers, we reported a greater pregnancy rate and a 21-day shorter calving interval in early-weaned versus normal-weaned cows of a similar age (89.5 versus 50.0 % pregnant for early- and normal-weaned cows, respectively; Arthington and Kalmbacher, 2003). The greatest economic advantage of early calf weaning is realized through hastened post-partum cyclicity and increased pregnancy attainment of otherwise anestrous cows. Although our data suggests that early weaning also improves the performance of mature cows, the major advantage to the system is allowing heifers to be bred as yearlings, calve at two-years of age without suffering losses in body weight and poor subsequent fertility as a lactating two-year old.

**Early Weaning Mature Cows**

The data presented henceforth was collected primarily from first calf cows. In our one study including both primiparous and multiparous cows, we realized similar reductions in voluntary forage dry matter intake and improved cow body condition change among both parity groups as a result of early weaning. Therefore, we designed a systems-approach study to evaluate the effects of early weaning among mature beef cows in optimal body condition. Based on our previous findings, we sought to capitalize on the observed 30% reduction in voluntary forage dry matter intake among early-weaned cows by increasing stocking density in pastures containing early-weaned cows. The study was conducted over three consecutive years. Cows were originally stocked at 2 acres of bahiagrass/cow (8 pastures; 40 acres/pasture; 20 cows per pasture). The study began in January of year 1 at the time of the first early weaning. Stocking rates remained the same from January to July (normal weaning) and available forage was estimated monthly. As expected, available forage was approximately 30% greater within pastures containing early-weaned cows. Therefore, in July stocking rates were increased by 25% for herds assigned to the early-weaned management treatment. These herds were maintained over three continuous

production cycles with early weaning occurring in January at the start of the breeding season and normal weaning occurring in mid-July (Figure 4). Amounts of supplemental forage, molasses+urea, and free-choice mineral offered to the pastures were held similar among both management systems.

Within 2 months following the 25% increase in stocking rate among pastures of early-weaned cows, there were no longer differences in available forage between treatments. However, throughout the remainder of the 3-year study, this response was variable. For example, in the following summer, pastures with early-weaned cows once again had greater available forage compared to normal-weaned cows, with no differences observed in the Fall or Spring months of the final year (Figure 4). Throughout the entire 3-year study, measurements of available forage were either the same or greater for pastures with early-weaned cows. At no time was available forage greater for pastures containing normal-weaned cows, despite a lesser stocking rate, which suggests that our 25% increase in stocking rate for pastures with early-weaned cows may have not been great enough.

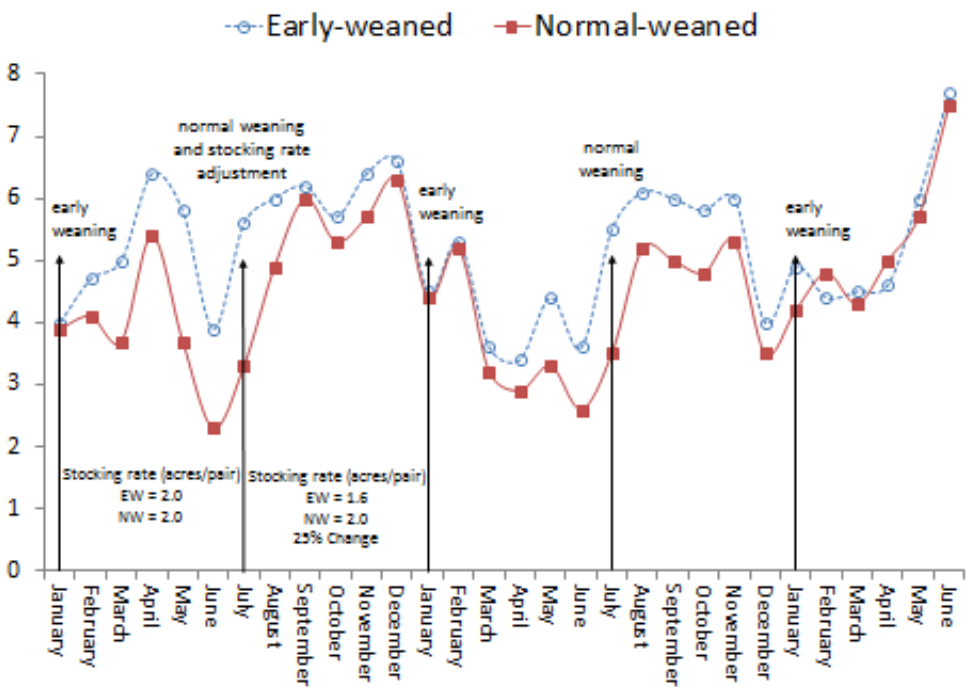


**Figure 4.** Effects of early calf weaning and stocking rate on available forage (1000 kg DM/ha).

Cow body condition score did not differ (P = 0.47) in January at the time of early weaning for the first production cycle; however, approximately 90 days later at the end of the breeding season, early-weaned cows had increased body condition while normal-weaned cows remained unchanged (Table 3). These differences in cow body condition continued in the subsequent two production cycles with early-weaned cows retaining greater body condition scores and at all months of measurement. At times, particularly at normal weaning (July), cows assigned to the early-weaning treatment were considered obese (BCS > 7.5). These results further support the supposition that pastures assigned to the early-weaned cows may have supported a greater stocking density than used in this experiment. Further, our experimental design focused on using differences in stocking density to account for the expected reduction in forage intake due to early weaning. All other factors were held similar among treatments, such as the amount of winter

supplementation offered to the herds. Reducing winter supplement offered to early-weaned cows may have reduced over conditioning and better equalized herbage allowance among treatments.

**Table 3.** Effect of early weaning mature cows on subsequent cow body condition over 3 complete production cycles.[a]

| Year | Month[b] | Early-weaned | Normal-weaned | Largest SEM | P = |
|---|---|---|---|---|---|
| 1 | January | 4.8 | 5.0 | 0.11 | 0.47 |
| | April | 6.3 | 4.7 | 0.18 | < 0.001 |
| | July | 7.7 | 6.1 | 0.16 | 0.001 |
| 2 | January | 5.3 | 4.9 | 0.15 | 0.07 |
| | April | 6.7 | 5.1 | 0.19 | 0.001 |
| | July | 8.2 | 6.6 | 0.23 | 0.002 |

Pregnancy rates among early- and normal-weaned cow groups were high and were not impacted by early weaning (3-year average = 92 and 93% for early- and normal-weaned cows, respectively). This result is not necessarily surprising since pregnancy rates among mature cows in optimal body condition are expected to be high; however, we anticipated the early-weaned cows to become pregnant sooner, as revealed by previous studies evaluating early weaning in first-calf cows. This was not the case. Mature cows in optimal body condition became pregnant later in the breeding season when early-weaned (Figure 5), which shifted the calving distribution to a later date in the following year. Day of the calving season corresponding to the birth of half of the season's calf crop was sooner ($P < 0.05$) in years 1 and 2 for normal- vs. early-weaned cow (Figure 6).

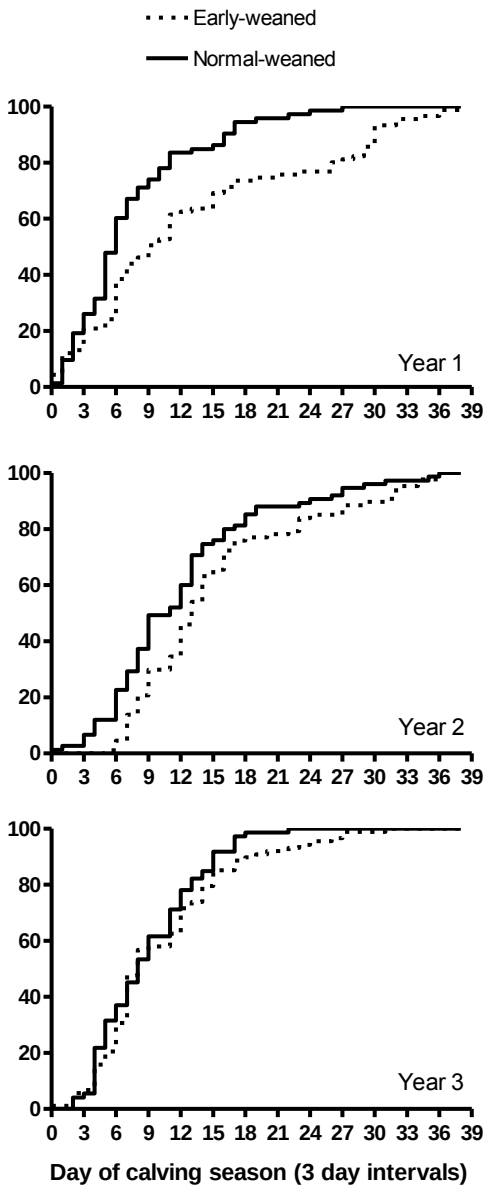


**Figure 5.** Effect of early weaning on subsequent calving distribution (% of total calves born) over 3 consecutive production cycles.

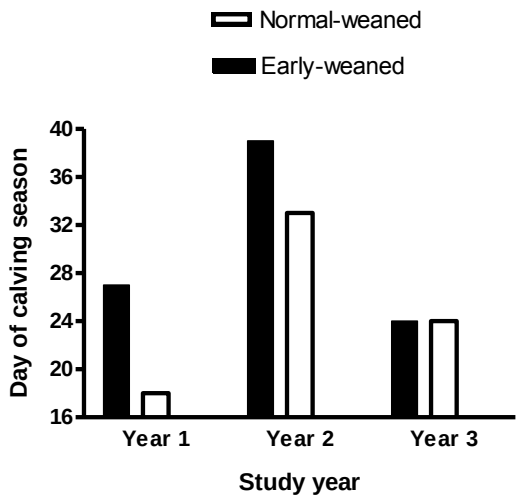


**Figure 6.** Effect of early weaning on subsequent calving distribution; day calving season corresponding to the birth of 50% of total calves born that year. Date of calving season corresponding to the birth of > 50% of the calf crop was sooner ($P < 0.05$) in Years 1 and 2 for normal- vs. early-weaned cows.

This reproductive response was most pronounced in the first year diminishing in year 2 with very little difference in year 3. We attribute this response to a delay in the attainment of pregnancy in cows that were early-weaned, which is likely explained by the stress-impacts of cow and calf separation. Although the stress may be similar in first-calf cows, the vast majority of these females are anestrus at the time of early weaning. In contrast, in the current study, nearly 2/3 of the cows were already cycling at the time of early weaning. We surmise that the stress of early weaning delayed attainment of pregnancy among cows that were already cycling and prepared to become pregnant at the start of the breeding season. This delay pushed their average calving date back in year 1 and again in year 2, therefore shortening the period between calving and the start of the breeding season. Thus, by year 3, a larger percentage of early-weaned cows were likely acyclic at the start of the breeding season when compared to the same cows in years 1 and 2. Our results were unexpected and create additional questions regarding the suitability of adopting early calf weaning as a management option for mature beef cows in adequate body condition.

## The Early-Weaned Calf

### *Nutritional Management*

Depending on the region of production, producers may or may not have forage resources to graze early-weaned calves. Some of the research studying the effects of early weaning on calf productivity in the Midwest and High-plains regions of the US have focused on drylot feeding of the early-weaned calves. In warmer climates, producers may be able to graze calves on perennial or annual pastures throughout the year. In our experiences, opportunities to rear early-weaned calves on high-quality pasture forage provide an important value toward the costs of maintaining an early-weaned calf.

Early-weaned calves respond favorably to supplemental concentrate, even when they are grazing highly nutritious pastures, such as annual winter ryegrass. In a study investigating the performance of early-weaned calves grazing winter ryegrass pastures (Vendramini et al., 2006), voluntary forage intake

decreased and calf ADG increased as the rate of supplementation increased from 1.0, 1.5, and 2.0% of body weight (Table 4).

**Table 4.** Performance of early-weaned calves grazing winter rye-ryegrass pastures and supplemented with different levels of concentrate. [a]

| Item | Concentrate, % BW | | | SEM | Response | P = |
|---|---|---|---|---|---|---|
| | 1.0 | 1.5 | 2.0 | | | |
| Average daily gain, lb/d | 1.63 | 1.79 | 1.96 | 0.07 | Linear | < 0.05 |
| Forage OM intake, % BW [a] | 1.8 | 1.3 | 1.1 | 0.01 | Linear | < 0.01 |

[a] Forage organic matter intake determined on grazing calves by the use of a sustained release bolus containing an indigestible residue.

Recently, we evaluated the effects of 3 different early-weaned calf management systems on measures of calf performance and economic return. In this study (unpublished data), calves were early weaned at approximately 70 days of age and reared in 1 of 3 management systems for 84 days. The systems included; 1) grazing dormant winter perennial grass pasture (Bahiagrass) with 2% body weight concentrate supplementation, 2) drylot with concentrate limit-fed at 3.5% body weight, or 3) annual pasture grazing (Ryegrass) with 1% body weight supplementation. Our findings show that greater body weight gain can be achieved with drylot rearing on concentrate diets, however the efficiency and value of this gain is dependent upon the cost of feed and price/lb of calf gain (Table 5). Despite the method of calf management system adopted, each of these systems produced profitable performance results. Beef producers adopting early weaning systems with their young cows should consider harvesting the value of efficient feed conversions of these young calves by designing a 3 to 4 month rearing system that best fits their local resources.

**Table 5.** Evaluation of management systems for the rearing of early-weaned calves.[1]

| | Treatment[1] | | | |
|---|---|---|---|---|
| Item | Bahiagrass | Drylot | Ryegrass | SEM |
| BW, lb | | | | |
| d 0 | 197 [a] | 215 [b] | 225 [b] | 7.4 |
| d 28 | 245 [a] | 276 [b] | 270 [b] | 8.9 |
| d 56 | 269 [a] | 342 [b] | 322 [b] | 10.1 |
| d 84 | 336 [a] | 417 [b] | 367 [c] | 10.9 |
| ADG, lb/d | | | | |
| d 0 – d 28 | 1.94 [a] | 2.27 [b] | 1.66 [a] | 0.125 |
| d 28 – d 56 | 0.87 [a] | 2.36 [c] | 1.89 [b] | 0.141 |
| d 56 – d 84 | 2.29 [a] | 2.58 [c] | 1.56 [d] | 0.136 |
| d 0 – d 84 | 1.69 [a] | 2.40 [b] | 1.70 [a] | 0.080 |
| Feed Intake, lb/calf daily | | | | |
| d 0 – d 28 | 4.4 [a] | 8.8 [b] | 2.8 [c] | 0.13 |
| d 28 – d 56 | 5.0 [a] | 12.6 [b] | 3.5 [c] | 0.22 |
| d 56 – d 84 | 6.0 [a] | 12.4 [b] | 4.2 [c] | 0.19 |
| d 0 – d 84 | 5.1 [a] | 11.3 [b] | 3.5 [c] | 0.15 |
| Economics | | | | |
| Feed cost, $/ lb BW gain [2] | 0.60 | 0.94 | 0.41 | . |
| Value of BW gain, $/calf [3] | 481 | 565 | 525 | . |
| Return, $/calf [4] | 269 | 315 | 299 | . |

[1]Calves ealy-weaned at approximately 70 days of age. Bahiagrass = calves grazing bahiagrass pastures and supplemented with concentrate at 2% of BW (n = 5 calves/pasture; 4 pastures); Drylot = calves in drylot and limit-fed concentrate at 3.5% of BW (n = 5 calves/pen; 4 pens); Ryegrass = calves grazing ryegrass pastures and supplemented with concentrate at 1.0% of BW (n = 4 calves/pasture; 4 pastures).
[2]Feed cost ($/lb BW gain). Feed estimated at $0.20/lb or $400/ton.
[3]$2.50 per lb of calf BW gain (April/May market).
[4] Return = Value of BW gain ($/calf) - feed cost ($/calf).

In Florida, our fall-born, early-weaned calf management systems often involve the establishment of winter annual ryegrass. Over the past 13 years, we have grazed early-weaned calves at an average stocking rate of four to six calves/acre with concentrate supplement provided at a rate of 1% of body weight. Despite both dry and wet winters this stocking rate has proven acceptable. Optimal stocking rate should be defined as the rate which best utilizes the available forage for maximum animal body weight gain. On non-irrigated land, this target rate is highly dependent upon the amount of effective precipitation received during pasture establishment. Over six consecutive years, we have found a great deal of variability among ryegrass yield and calf performance (Table 6); however, a stocking rate of four to six calves per acre has proven to be acceptable to achieve rates of body weight gain similar to or greater than the gain achieved by non-weaned calves of a similar age. In each of the studies reported in Table 6, early-weaned calves were provided supplemental concentrate feed at a rate of 1% of body weight. Although we utilize annual ryegrass or rye-ryegrass blends in our Florida early-weaned calf studies, this system will not be practical for all regions of the country. For temperate regions of the US, other grass varieties should be considered. It is important to note that high-quality forage varieties that may not be tolerant to

cow grazing may work well in an early-weaned calf grazing system. Young calves are much gentler on the pasture, consuming forage much like a deer or goat. As well, because the calves are smaller their dry matter intake is much less than a mature cow; therefore, moderate yielding, high-quality forages may be good candidates for use in an early-weaned calf rearing system.

**Table 6.** Performance of early weaned calves in both winter and summer grazing seasons over six consecutive years (average daily body weight gain ± stnd. dev.).[a]

| Year | Winter grazing[b] | Summer grazing[b] | Stocking rate, calves/acre | |
|---|---|---|---|---|
| | | | Winter | Summer |
| 2000 | 1.89 ± 0.04 | 1.21 ± 0.07 | 3.3 | 3.3 |
| 2001 | 2.08 ± 0.06 | ------- | 3.3 | ------- |
| 2002 | 1.35 ± 0.07 | 1.31 ± 0.18 | 4.4 | 2.4 |
| 2003 | 1.60 ± 0.06 | 1.34 ± 0.06 | 4.0 | 1.2 |
| 2004 | 1.73 ± 0.11 | 1.48 ± 0.05 | 6.7 | 2.0 |
| 2005 | 2.15 ± 0.10 | ------- | 5.3 | ------- |
| Average | 1.80 ± 0.07 | 1.34 ± 0.09 | 4.7 | 2.2 |

[a] Calves are approximately 60 to 90 days of age at the time of early weaning. All calves are provided supplemental feed at a target rate of 1.0% of body weight during both grazing seasons. A commercial feed (14 and 65 % CP and TDN, respectively) was utilized in 2000, 2001, 2002, and 2003 and a commodity blend of soybean hulls and cottonseed meal (85:15) was used in 2004 and 2005.
[b] Winter and summer grazing periods each are approximately 100 days. Winter grazing always occurred on annual ryegrass. Ryegrass was typically fertilized twice using a complete fertilizer, once upon emergence and again approximately 50 days into grazing. Summer grazing consisted of established limpograss in 2000 (Arthington and Kalmbacher, 2001) and established stargrass in all other years.

In our system, a major shortcoming of the management of an early-weaned calf occurs once the winter annual ryegrass dies out in the spring. Once early-weaned calves are moved onto perennial, summer pastures their performance declines rapidly. Our annual ryegrass is grazed out by early to mid-May, leaving a 100 day deficit period until the time of normal weaning (late July). In our studies, performance of early-weaned calves drops by an average of 25% in the summer versus winter periods. Although performance in the winter is similar among early-and normal-weaned calves, performance in the summer period is usually inferior for the early-weaned calf compared to those left with their dams. This decline in performance often results in a greater overall ADG for normal-weaned compared to early-weaned calves when calculated from January (time of early weaning) to August (time of normal weaning). We attribute this decline in summer performance to the lesser digestibility of our summer perennial pastures compared to the winter annual ryegrass (Figure 7). For Florida producers, these data would support the marketing of early weaned calves in late April or early May. Historically, calf markets are at their greatest at this time of the year. Consideration of regional variation in forage quality, quantity, and annual trends in market value should be considered when determining the optimal marketing time for early-weaned calves.

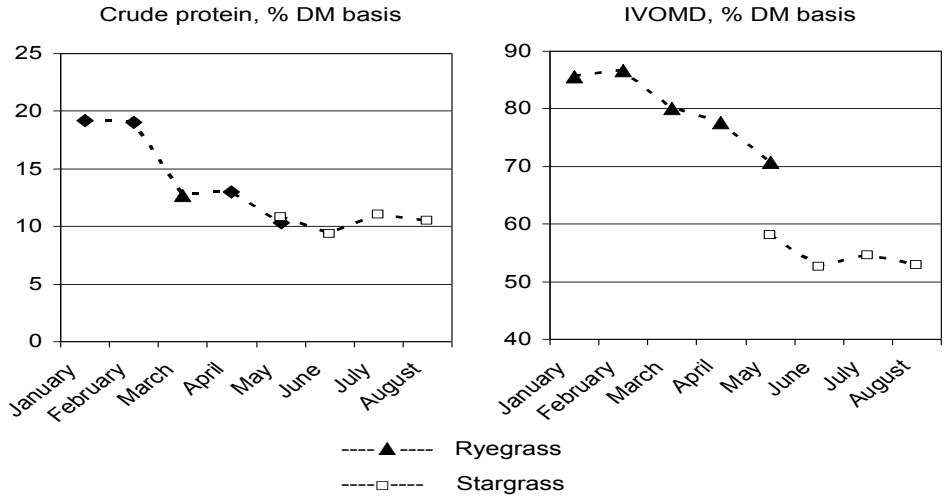


**Figure 7.** Average ryegrass and stargrass quality over two consecutive seasons (2003 and 2004). Average stocking rate = 1.6 calves/acre. Average SEM = 0.65 and 0.29, and 1.37 and 1.27 for ryegrass and stargrass crude protein and in vitro organic matter digestibility (IVOMD), respectively.

***Feedlot Performance of Early-Weaned Calves***

Early weaning also has positive implications on the value of calves post-weaning. Researchers from the University of Illinois (Myers et al., 1999) investigated the effect of early weaning on carcass merit. In their studies, they reported that early weaning improved the percentage of calves grading USDA Choice or higher by over 30% compared to normal-weaned calves. In a comparison of weaning age (90, 150, or 210 days), they found that calves weaned at 90 days tended to produce higher quality carcasses.

In many ranch settings, normal-weaned calves are shipped immediately after separation from the cow. When shipped as a complete group (not commingled) these calves typically perform well, nevertheless, buyers often discount fresh-weaned calves due to the potential for stress-related disease. The use of early weaning, followed by a growing period of 60 to 90 days, produces calves that have recovered from the stress of weaning and understand how to eat. Once received into the feed yard, these calves are likely to have fewer incidences of illness. In a study conducted in collaboration with North Carolina State University, we examined the productivity of early- versus normal-weaned calves in the feedlot (Arthington et al., 2005). In that study, early-weaned calves were lighter at the time of normal weaning (492 versus 611 lb), but gained body weight at a faster rate during the feedlot receiving period (Figure 8). By day 28, body weight was similar (538 versus 617 lb for early- and normal-weaned calves, respectively). Overall, early-weaned calves gained over 1 lb/d more than normal-weaned calves (Figure 8), despite no differences in daily feed dry matter intake (Table 7).

**Table 7.** Effects of early- versus normal weaning age on calf feedlot performance[a]

| Period[b] | Early-weaned | Normal-weaned | SEM [c] | *P* = |
|---|---|---|---|---|
| Receiving | | | | |
| ADG, lb/d | 1.92 | 0.88 | 0.22 | 0.03 |
| DMI, lb/d[d] | 12.5 | 11.6 | 0.62 | 0.36 |
| G:F[e] | 0.154 | 0.076 | 0.010 | 0.01 |
| Growing | | | | |
| ADG, lb/d | 3.04 | 2.60 | 0.11 | 0.05 |
| DMI, lb/d | 19.4 | 19.6 | 0.77 | 0.84 |
| G:F | 0.157 | 0.133 | 0.006 | 0.06 |
| Finishing | | | | |
| ADG, lb/d | 3.02 | 2.91 | 0.12 | 0.77 |
| DMI, lb/d | 19.2 | 20.2 | 0.64 | 0.33 |
| G:F | 0.157 | 0.144 | 0.007 | 0.35 |
| Overall | | | | |
| ADG, lb/d | 2.71 | 2.76 | 0.24 | 0.82 |
| Total BW gain, lb | 650 | 589 | 20.5 | 0.10 |
| Total DMI, lb | 4,231 | 4,357 | 165.2 | 0.62 |
| G:F | 0.154 | 0.135 | 0.004 | 0.02 |

[a] Early-weaned calves were removed from their dams at 85 d of age. Normal-weaned calves remained with their dams until the day of normal weaning (average age = 300 d).
[b]Receiving diet = d 0 to 28; Growing diet = d 28 to 112; and Finishing diet = d 112 to harvest. Table values are least square means. ADG = average daily body weight gain.
[c]Largest SEM of least square means (n = four pens/treatment).
[d]dry matter intake
[e]gain:feed

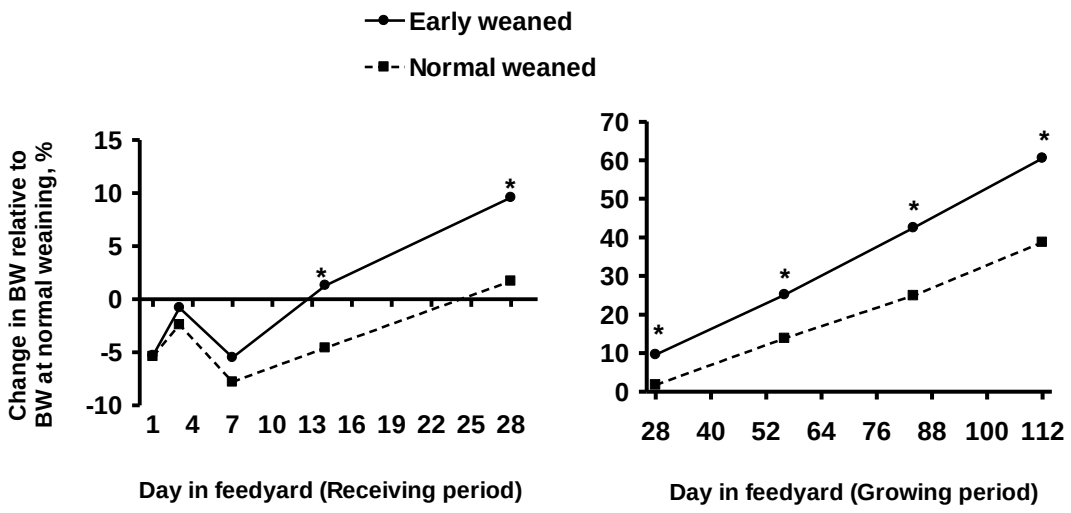


**Figure 8.** Percent change in body weight relative to weaning weight for early- and normal-weaned calves. Calves were shipped during the first week in August. Early-weaned calves were weaned (early January) and retained on the ranch of origin until the time of normal weaning. Normal weaned calves were shipped the day of weaning. (Arthington et al., 2005).

The most striking response to early weaning in our feedlot study was the significant improvement in feed efficiency (Table 7). We have attributed this response to a lesser inflammatory reaction in early- versus normal-weaned calves in response to the stressors associated with weaning and transport. During normal stress events the early inflammatory reaction results in the production of acute phase proteins. In our study, early-weaned calves had a lesser acute phase protein response following transport and entry into the feedlot. Further, a relationship between plasma acute phase protein concentrations and daily body weight gain was observed in normal-weaned steers during the feedyard receiving period, whereas average ceruloplasmin concentrations were negatively associated with body weight gain in normal-weaned ($P < 0.01$; $R^2 = 0.59$), but not early-weaned ($P > 0.05$; $R^2 = 0.21$) calves. Similarly, average haptoglobin concentrations were negatively associated with body weight gain in normal-weaned ($P < 0.01$; $R^2 = 0.40$), but not early-weaned ($P > 0.05$; $R^2 = 0.10$) calves. Other researchers have shown that feeder calf plasma haptoglobin concentrations, upon entry into the feedlot, are positively associated with the incidence of morbidity and subsequent number of medical treatments required (Berry et al., 2004; Carter et al., 2002).

***General Healthcare of the Early-Weaned Calf***

One common question related to weaning calves at this young age is health status. It is understandable that producers may be concerned with the viability of calves of this age. In fact, ranch-derived calves early-weaned at 70 to 90 days of age have a very high health status. This is related to the passive immunity that they obtained from their mothers through colostrum at birth. This colostrum provides important immunity to calves of this age. In comparison, calves of normal weaning age (6 to 8 months) have little to no remaining passive immune protection. If normal-weaned calves are not properly vaccinated they will be more susceptible to succumbing to disease at the time of weaning compared to 70 to 90 day old early-weaned calves. We do not recommend vaccinating calves at the time of early weaning, as the vaccine will likely be neutralized by the calf's own passive immunity. Early-weaned calves should be vaccinated according to the same schedule used for the normal-weaned calves in the herd. One exception to this rule relates to producers that may "gather" early-weaned calves from multiple sources. In this situation, the producer often does not know the health status of the herds from which the calves are sourced. Further, the stress of transport and commingling may elicit the onset of disease. In these situations the producer should work with their veterinarian to develop a health-care plan that will take into consideration the balance between disease pressure and immune protection.

One important difference that we have noticed in early-weaned calves is their susceptibility to internal parasites. We typically treat our early-weaned calves for internal parasites two to three times during the 200-day grazing period – depending on the product being used. By following this management schedule, we have noticed significant improvements in calf body weight gain following anthelmetic treatment.

**Summary**

1. Early weaning must occur prior to the start of the breeding season to gain the full reproduction benefits associated with this management practice.

    a. Calves should *not be less than 50 days of age* at the time of early weaning.

    b. Attempt to breed yearling heifers 30 days before the mature cowherd so that the calves will be old enough to early wean at the start of the regular breeding season in the following year.

2. Early-weaned cows will voluntarily consume approximately 30% less dry matter following early weaning. Their decrease in dry matter intake coupled with their concurrent decrease in nutrient demands translates into a > 40% increase in nutrient efficiency of calf gain following early weaning.

3. Early weaning management systems should be focused on young cows (first- and second-calf cows). Having a longer post-partum interval, a larger percentage of these cows are typically acyclic at the start of the breeding season. Thus, the reproductive benefits of early weaning (i.e. eliciting post-partum estrus) are more apt to impact these young cows. In our study, early weaning mature cows in optimal body condition resulted in a delay in the attainment of pregnancy causing an extended calving distribution the following year.

4. Early-weaned calves grow well on high quality annual pastures such as ryegrass, when provided supplemental grain at a rate of 1% of body weight. When high-quality pastures are not available, early-weaned calves will grow well when provided access to a high-quality concentrate feed at a target rate of 3.5% of body weight along with supplemental hay. At the time of early weaning (70 to 90 days of age), the crude protein requirement of the early-weaned calf diet may be as high as 20% on a dry matter basis. We generally recommend starting calves on a 20% crude protein diet, reducing to 18% crude protein 60 days later.

5. If planning to ship early- and normal-weaned calves at the same time, vaccinate the early-weaned calves on the same schedule as the normal-weaned calves. Calves should not be vaccinated at the time of early weaning, as the vaccine will be neutralized by the calf's own passive immunity. Early-weaned calves are highly susceptible to internal parasites. Consider anthelmetic treatment at the time of early weaning and again every 50 to 60 days, depending on the product being used.

6. In our experiences in Florida, we have been unable to maintain the high growth rate of the early-weaned calf into the summer. Depending on the region of the country, producers should carefully examine their pasture forage options and consider the efficiency of moving the calf to regions closer to feeding and finishing.

7. When received into the feedlot at the time of normal weaning, early-weaned calves have greater feed efficiency compared to normal-weaned contemporaries. This is an important production response for producers to consider when evaluating retained calf ownership opportunities.

8. Early-weaned calves have been shown to have carcasses of greater USDA quality score compared to normal-weaned contemporaries. This response is likely the result of being placed onto concentrate diets at an earlier age. Our early-weaned calves have similar USDA carcass quality scores as normal-weaned calves when grazed on pasture until the time of normal weaning,

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# North Florida Research and Education Center Updates

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*Notes:*

# Agronomy Department Forage Management Research Update

**L. Sollenberger[1], J. Vendramini[2], and J. Dubeux[3]**

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The Agronomy Department has a highly integrated statewide team conducting research and extension programs in forage management. Dr. Dubeux works at the North Florida Research and Education Center at Marianna, Dr. Vendramini is at the Range Cattle Research and Education Center at Ona, and Dr. Sollenberger is at Gainesville. The following is an overview of the primary areas of forage management research at each location.

**Forage Management Program at the Beef Research Unit – Gainesville**

***Limpograss Variety Development***

In cooperation with Dr. Vendramini's group at Ona, the forage management team at Gainesville evaluated 51 new breeding lines of limpograss (*Hemarthria altissima*). These numbers were reduced over time by testing, and in 2014 the best two breeding lines were released as Kenhy and Gibtuck limpograss varieties. Gibtuck is more productive and considerably more persistent under grazing than Floralta limpograss. Kenhy is higher yielding and more persistent than Floralta, though perhaps not as persistent as Gibtuck, but Kenhy performs extremely well under stockpiling management and achieves higher digestibility than Floralta and is generally higher in digestibility than Gibtuck. So, initial research observations suggest that Gibtuck may be the best variety for more intensively grazed pastures while Kenhy will do very well when stockpiled. Material of these varieties should be available for producers later this year.

**Comparison of Jiggs and Tifton 85 Bermudagrass and Mulato Brachiariagrass**

Productive and high quality forages are critical to the success of beef cattle operations, but this combination of high yield and quality has been difficult to find among warm-season perennial grasses adapted to Florida. Mulato II brachiariagrass and Jiggs bermudagrass have characteristics that make them attractive options, but additional plot and on- farm evaluation is needed. The objective was to assess the potential of Jiggs and Mulato II grasses for use as warm-season forages by measuring yield, persistence, and nutritive value in two research station experiments and on-farm demonstrations at three farms. On station, Experiment 1 treatments were two grasses (Jiggs and Tifton 85), two cutting heights (3 and 6 inches), and three potassium fertilization rates (0, 20, and 40 lb potash/acre per harvest). The plots were planted in 2013 at the Beef Research Unit and were harvested five times at a 28-day interval during 2014. Plots were fertilized in spring and after each harvest but the last with 40 lb nitrogen/acre (total of 200 lb N/acre/year). Experiment 2 treatments were two grasses (Jiggs and Mulato II) and two N rates (120 and 240 lb N/acre/year). Plots were planted in 2013 at the Beef Research Unit and were harvested every 28 days beginning in May 2014. Plots were fertilized with phosphorus and potassium according to soil test. In the on-farm evaluation, the grasses were planted in side-by-side, 0.5-acre strips on three farms in the north Florida/south Georgia region between July 24 and August 6, 2014. Establishment success was followed throughout the remainder of the growing season.

On farm, dry weather at time of planting was a challenge to the grasses at two locations and annual grass weeds were a challenge at one location. In all locations, Jiggs establishment was superior to either Tifton

85 or Mulato. In Experiment 1 conducted on station, the average total production of Jiggs and Tifton 85 was the same, but they responded differently to cutting height. Jiggs performed better when cut to 3 inches (5 tons/acre) versus 6 inches (4.2 tons/acre) while Tifton 85 performed best when cut to 6 inches (5.1 tons/acre) versus 3 inches (4.3 tons/acre). There was no effect of rate of potash on yield in the first year. In Experiment 2 conducted on station, Mulato II was superior to Jiggs in yield (4.8 vs 4.0 tons dry matter/acre), but their seasonal pattern of production was different. Jiggs started growth earlier in the spring than Mulato II, but Mulato II was more productive during the summer and fall.

The experiments and on-farm observations will continue through the 2015 growing season. Persistence is a response of major interest for Mulato and Jiggs, and that response will not be effectively quantified until at least the end of the second year (2015). Through the end of the first year it is clear that Jiggs bermudagrass is the best suited of these three grasses for establishment in suboptimal conditions, particularly drought stress and weed pressure. It is also apparent that Mulato is slower to initiate forage growth during spring than Jiggs and Tifton 85. It is also clear that Jiggs performs better when using a shorter cutting height than does Tifton 85, most likely a function of their growth habit. Currently the role of potassium fertilizer on production and persistence is not yet clear, and these results are expected to become more apparent throughout the 2015 growing season.

**Rhizoma Peanut Establishment in Bahiagrass**

In a state-wide collaborative research effort among Ona, Gainesville, and Marianna, studies have been conducted to evaluate strip planting of rhizoma peanut in bahiagrass pastures as a less costly approach to getting legumes in pastures than planting the entire area to peanut. Research has shown that spraying the strips with roundup prior to planting followed by no-till planting of peanut works very well. Use of Impose and 2,4-D in the strip is the most successful post-plant weed control strategy. It is recommended that these areas be harvested for hay during the year of planting and the year after planting because cattle prefer the planted strips and will overgraze them if given access to the pasture. Avoiding grazing allows the peanut time to become established. Ecoturf looks like a very promising peanut variety when using the strip planting approach. We are currently testing this approach on four farms throughout Florida and plan to scale up to larger planted area in on-farm studies in the near future.

**Legume-Based Forage Systems**

We are now completing our fourth year of evaluation of the effect of method of utilization (grazing or hay production) and type of year-round forage system (based either on legumes or on nitrogen-fertilized grasses) on soil health. The legume systems include rhizoma peanut in summer and clover-ryegrass in the winter and the grass systems include bermudagrass in summer and rye-ryegrass mixtures during winter. Early data indicate advantages in soil carbon accumulation associated with use of legumes vs. nitrogen fertilized grasses and for grazed systems vs. hay production systems.

**Forage Management Program at the Range Cattle REC – Ona**

***Pintoi Peanut (Arachis pintoi) in South Florida***

The use of warm-season legumes has been suggested as an effective alternative to fertilizer for supplying nitrogen to warm-season grass pastures via biological N2 fixation. However, there are few warm-season perennial legumes that are persistent under grazing and adapted to South Florida. Pinto peanut is a warm-season perennial legume, propagated by seed, with documented persistence on acidic soils with low fertility, and it may be feasible to incorporate it into extensively grazed pastures based on warm-season

perennial grasses in Florida. In general, all Arachis species produce reasonable forage quantity and quality, compared with other legumes. In addition, pinto peanut produces a considerable amount of seed that enhances persistence and allows spread under grazing.

The objective of this research is to identify management practices to increase productivity of pinto peanut in South Florida. Two experiments have been conducted at the Range Cattle Research and Education Center in 2014 and 2015. The objective of Experiment 1 is to evaluate the relationship of grazing intensity with forage and soil characteristics when pinto peanut is intercropped with Jiggs bermudagrass. Established pastures of Jiggs were overseeded with pinto peanut at 12 lb seed/acre in 2014. Treatments are Jiggs bermudagrass alone or Jiggs bermudagrass overseeded with pinto peanut and grazed to a 7 or 10-inch stubble height. Preliminary data have shown that pinto peanut maintained or slightly increased plant population when grazed at 7 inches from May to November. In addition, pastures grazed at a 7-inch stubble height had greater herbage accumulation and fewer weeds. In Experiment 2, the objective was to evaluate planting strategies for establishing bahiagrass and pinto peanut. Treatments were bahiagrass seeded alone, bahiagrass + pinto peanut, or pinto peanut seeded alone, with or without 50 lb N/ac at planting. Preliminary data indicate that establishing pinto together with bahiagrass is a feasible management practice to have faster soil cover and fewer weeds at establishment. Pinto peanut germinated in approximately 7 days and bahiagrass occupied the open spaces in the subsequent 3 months.

**Bahiagrass and Bermudagrass Response to Potassium Fertilization**

Potassium is an important macronutrient for production and persistence of warm-season grasses. Repeated applications of N fertilizer and lack of potassium fertilization in pastures in Florida for several years may lead to decreased forage production and persistence. Two experiments have been conducted in 2014 and 2015. Experiment 1 was conducted in three locations at Deseret Ranch in St Cloud, FL. Plots were installed in established bahiagrass pastures and received no nitrogen, one application of 50 lb N/acre in the spring, or two applications of 50 lb N/acre, one each in spring and summer. Plots also received either zero or 50 lb $K_2O$/acre. Soils at the research site had low or very low levels of K at the start of the experiment. Preliminary data shows that forage production increased due to K application in 1 out of 3 locations and the increase in forage production was independent of the N treatments tested in this study. Experiment 2 has been conducted in a greenhouse with the objective to determine the critical levels of tissue K concentrations in bahiagrass and bermudagrass. Treatments were three N fertilization levels (0, 44 and 88 lb/acre), and four K fertilization levels (0, 17, 34 and 68 lb/acre). The forage samples for N and K concentrations are being analyzed and results from year 2014 will be available soon.

**Stockpiled Gibtuck and Floralta Limpograss Performance During Winter in South Florida**

Stockpiled limpograss pastures are important sources of forage for cow-calf pairs during the winter in South Florida. Productivity and nutritive value of stockpiled pastures has been shown to vary greatly during the grazing season, and the supplementation program needs to match the forage nutritive value to be effective. The objective of this project was to relate forage height and nutritive value of stockpiled limpograss pastures and create a practical tool for producers to estimate nutritive value of stockpiled limpograss pastures. The experiment has been conducted from January to March 2014 and 2015. Gibtuck and Floralta limpograss pastures were fertilized with 80 lb N/acre and stockpiled from mid-October to January. Pastures were grazed by mature cows at the stocking rate of 1 cow/0.75 acres from January to March. Preliminary data indicated that there is a sharp decline in limpograss nutritive value during the first 4 weeks of grazing, primarily due to the decrease in leaf/stem ratio. During this period, pasture height

decreased from 24 to 20 inches and CP decreased from 11 to 8.5%. During the subsequent 2 months, pasture height decreased from 20 to 8 inches and CP concentration from 8.5 to 5.3%. Gibtuck had greater herbage mass than Floralta at the start of the grazing season. It is expected that supplementation may be necessary to maintain cow body condition score starting approximately 4 weeks after initiation of grazing of stockpiled limpograss pastures.

**Forage Management Program at the North Florida REC – Marianna**

***Reducing Nitrogen Fertilizer Inputs***

The overall goal of the forage management program at NFREC is to reduce off-farm inputs and to increase sustainability of forage production systems in Florida. A primary goal is to reduce the dependence of cattle production systems on N fertilizer, a major source of greenhouse gas emissions. We are actively seeking to reduce N fertilizer inputs by evaluating the potential of year-round cattle production systems based on grass-legume mixtures. Reduction in off-farm inputs such as fossil fuels used in hay production operations will also be targeted by evaluating alternative options for feeding cattle during the period of forage shortage, such as cool-season pastures and stockpiled forage. Carbon footprint from rangelands, hayfields, improved warm-season and cool-season pastures will be assessed by measuring greenhouse gas emissions and soil C stocks. After assessing their contributions, strategies will established to reduce greenhouse gas emissions from each system.

**Warm-season Grass-Legumes Mixtures**

Currently, several experiments are established with a common goal to assess biomass production, nutritive value, and biological N2 fixation of warm-season, grass-legume mixtures. Establishment of rhizoma peanut (Arachis glabrata Benth.) in perennial warm-season grasses such as bahiagrass (Paspalum notatum Flugge) or bermudagrass (Cynodon spp.) is one of the major areas of focus of this program. On-farm research funded by USDA-SARE is being carried at four locations across Florida in a collaborative research effort among UF forage management researchers, producers, and extension faculty. In this project, two rhizoma peanut (RP) cultivars (Florigraze and Ecoturf) were planted using different seedbed preparation methods including either tilled or no-tilled soil following application of glyphosate herbicide. The study is completing its first year in June 2015.

In another research effort, Florigraze and Ecoturf along with pinto peanut (Arachis pintoi Krapov. & W.C. Greg.) and annual peanut (Arachis hypogea L.) are being tested in Pensacola bahiagrass and Tifton 85 bermudagrass sods. The latter two peanuts were planted by seed. The trials were established in spring 2014. The pinto peanut overwintered well in Marianna in the first year and the annual peanut seedlings are emerging well from seeds produced in the 2014 season. Plots were harvested every 35 days during the summer of 2014 and they will continue to be harvested in 2015.

Other research activities with rhizoma peanut include a variety trial with seven different peanut varieties, a harvest trial combining different frequencies and intensities of harvest on a long-term mixture of rhizoma peanut and bahiagrass, and a grazing trial. The grazing experiment is currently being established in Marianna, FL in order to evaluate animal performance in three production systems: 1) rhizoma peanut + bahiagrass during the warm-season plus a cool-season grass-legume mixture during the cool season; 2) bahiagrass + N fertilizer during the warm season plus cool-season grass + N fertilizer during the cool season; 3) bahiagrass during the warm season plus a cool-season grass-legume mixture during the cool season. In all these studies, biological N2 fixation (BNF), productivity, and forage nutritive value are

being assessed. Aspects of C and N cycling are also part of these trials, including greenhouse gas emissions and C and N stock in the soil.

**Cool-season Grass-legume Mixtures**

The cool-season program includes an intensive collaboration with the legume breeding program coordinated by Dr. Patricio Munoz. As part of the collaboration, variety trials of red clover (Trifolium pretense L.), white clover (Trifolium repens L.), and alfalfa (Medicago sativa L.) are currently being carried out in Marianna for the second year. Cool-season legumes are also being evaluated under different mixtures with cereal rye (Secale cereale L.) or annual ryegrass (Lolium multiflorum Lam.). Legume species include red clover, ball clover (Trifolium nigrescens L.), crimson clover (Trifolium incarnatum L.), balansa clover (Trifolium michelianum Savi), berseem clover (Trifolium alexandrinum L.), and vetch (Vicia villosa Roth). The reseeding potential of these legumes is also being assessed in some of the trials to determine the legumes' ability to regenerate stands without replanting. All trials are assessing BNF and biomass yield of the mixture and individual components, contrasting with N-fertilized grass.

**Warm-season Grasses and Cool-season Mixtures to Increase the Grazing Season**

As part of a collaboration among members of the UF forage team, a new collection of 265 bermudagrass entries and a bermudagrass variety were established in Marianna in 2014. The new limpograss varieties (Kenhy and Gibtuck) were also established along with Floralta and Bigalta and their forage potential are currently being assessed in Marianna. The objective is to find perennial grasses with longer growing period and greater forage yield and nutritive value for North Florida. Reducing feeding costs is the ultimate goal. During the cool-season, different mixtures of small grain-annual ryegrass were tested under grazing in 2014 and 2015. Results indicated a great potential for stockers, with an average daily gain of 2.1 lb/steer and seasonal production of 300 lb/acre in 112 days.

**Carbon and N Balance of Different Land-Use Systems**

We are assessing C and N stocks and greenhouse gas (GHG) emissions from different land-use systems in North Florida. Land-use systems include natural vegetation, grazed bahiagrass, the sod-based rotation system, conventional tillage, and hayfields. Deep soil cores (20 ft. deep) were collected in these different systems in 2014 and 2015. The ultimate goal of this project is to evaluate major sources and sinks of C and N and propose management practices to reduce GHG emissions. Diversification of the production system is one of the options, including forested areas to offset emissions from agriculture fields.

**Educational Tools**

The overall goal of our extension program is to develop educational and decision support tools directed toward county extension faculty, producers, policy makers, and the allied industry audience to increase awareness of potential cattle production systems for different regions of Florida and to increase legume adoption.

# The Economics of Herd Expansion

**C. Prevatt, Regional Specialized Agent, Livestock and Forage Economist[1]**

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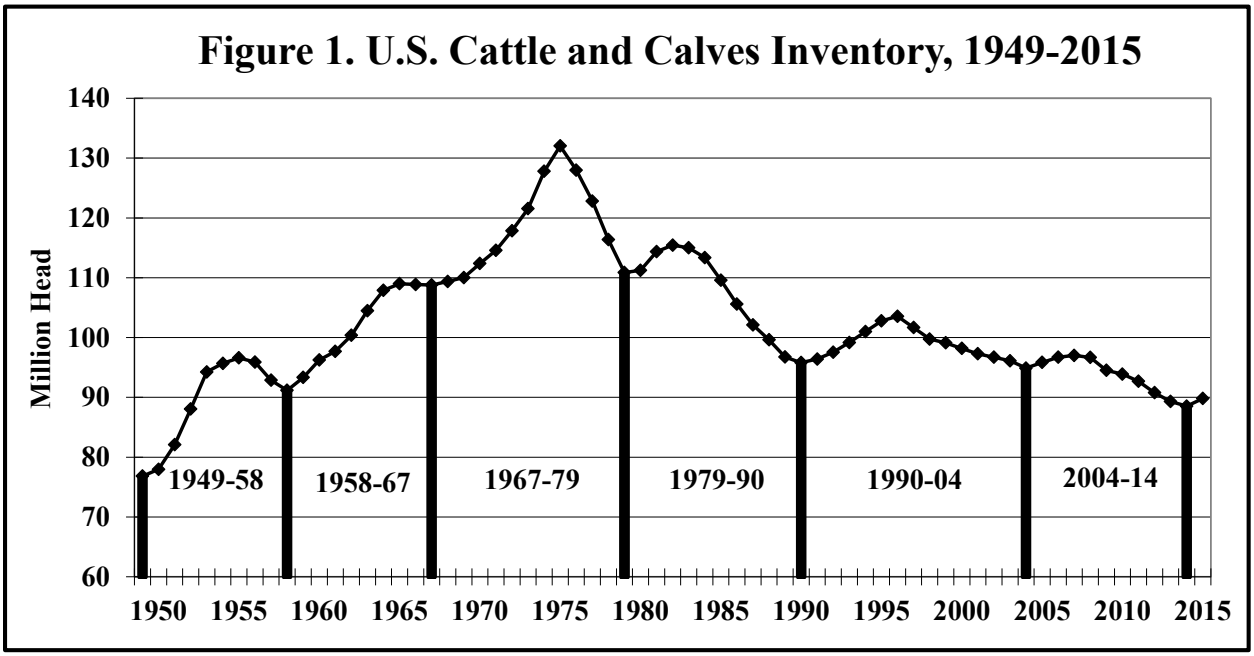
Most cattle producers usually feel one of two ways about long-term price and profitability projections. They either feel long-term projections are worthless because no one can accurately predict the future, or they feel long-term projections aren't exactly accurate but they can be a useful guide in the decision-making process over the long run. Which one are you?

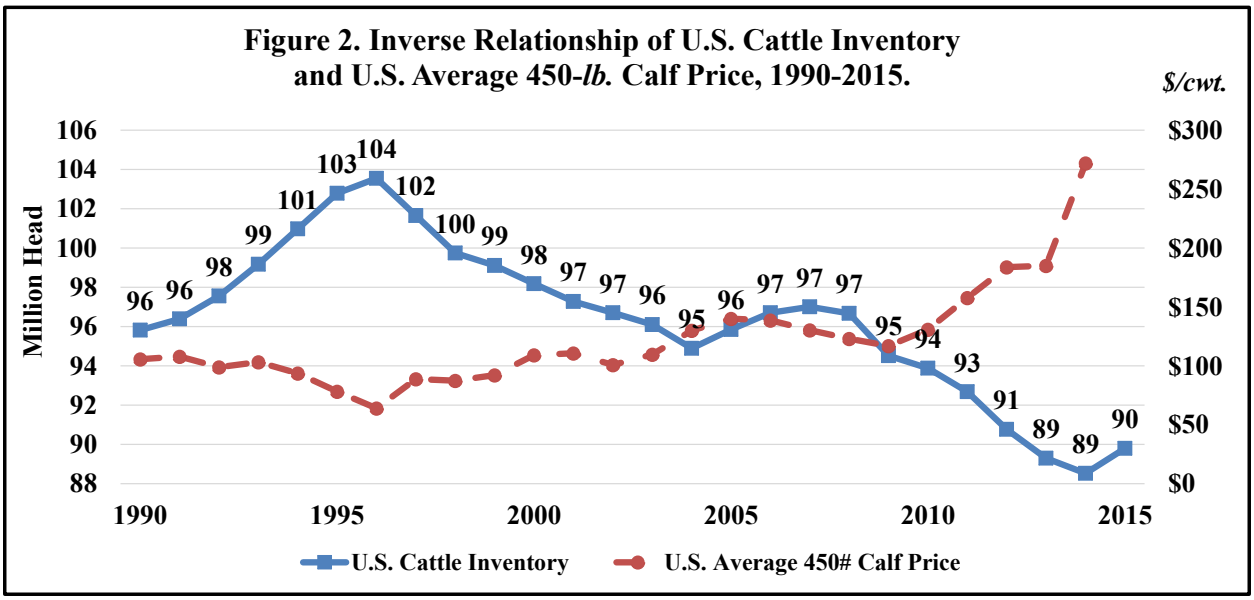
The only way to make long-term projections that actually mean something is to define the assumptions and methodology used to make the projections. Then, when more certain and realistic information is realized, adjustments can be made to the projections. This is a time consuming and repetitive process, but it will improve the decision-making and competitiveness of your cattle operation.

**The Infamous U.S. Cattle Cycle and its Relationship to Expansion and Profitability**

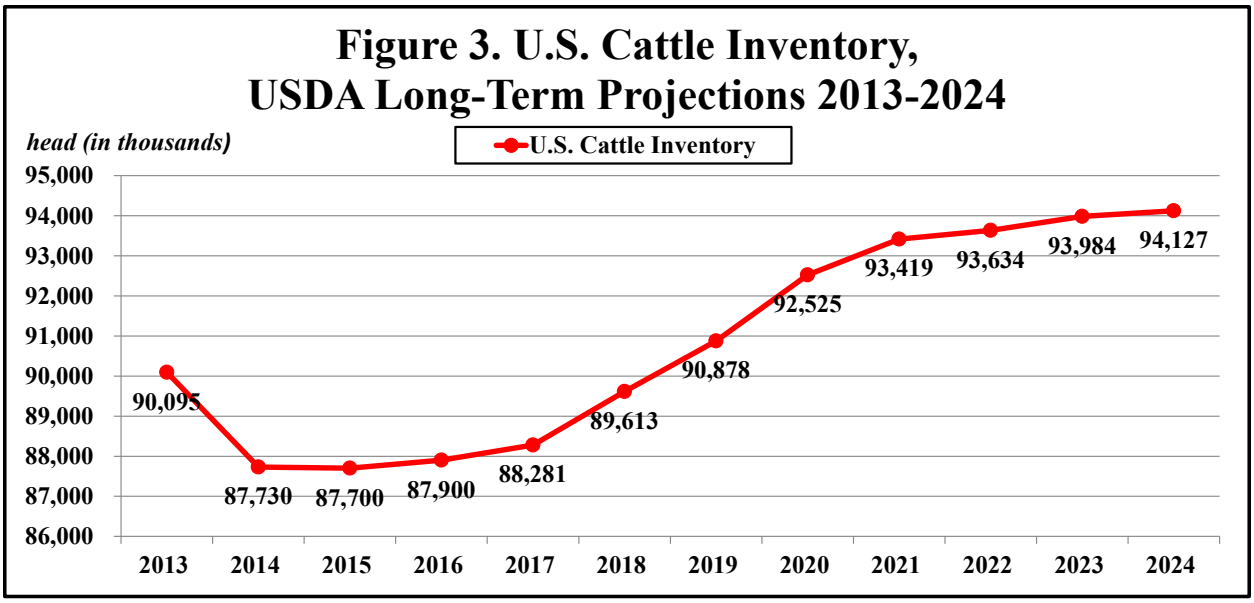
The U.S. cattle cycle is best described by the inventory of cattle and calves on farms over time. The United States Department of Agriculture (USDA) conducts two surveys per year (January 1 and July 1) to estimate the number of cattle and calves on U.S. beef and dairy operations (Prevatt, et al.). A cattle cycle documents a pattern of expansion and contraction of the inventory of cattle and calves over time. Thus, a cattle cycle is measured as the period of time from the lowest cattle and calves inventory number to the next lowest inventory number over time. Some cattlemen describe the cattle cycle as being from trough to trough. It is generally believed the cattle inventory increases over time due to higher market prices (profits) and then declines due to lower market prices (losses from over supply, etc.). Graphically, each cattle cycle is mound shaped (1949-58, 1958-67, 1967-79, 1979-90, 1990-04, and 2004-14, 2014-?), as shown in Figure 1. This data provides an overview of U.S. Cattle and Calves Inventory and Cattle Cycles from 1949-2015.



The relationship between U.S. cattle inventory and average U.S. feeder calf price is shown in Figure 2. The U.S. cattle inventory and U.S. average feeder calf prices move in opposite directions. As cattle inventory builds, average feeder calf prices decline. Likewise, after cattle and calves inventory numbers decline, average feeder calf prices increase.




The Food and Agricultural Policy Research Institute (FAPRI) based at the University of Missouri and Iowa State University and the United States Department of Agriculture (USDA) each publish a set of 10-year baseline cattle projections for production, inventory, and price (FAPRI and USDA, 2015). Each set of projections are updated and published annually in February. The USDA Cattle Inventory projection is shown in Figure 3. In 2015, the USDA projected U.S. Cattle Inventory to be 87.7 million head of cattle and calves. They expect this inventory to grow to 94.1 million head in 2024. This is a gain of approximately 7.4 million head over 10 years. Of course, this is simply a projection and as cattle and other livestock market prices, input costs, governmental policies, weather, etc. change over time, so will the projected inventory numbers. But, this provides us with a starting baseline we can make projections from.

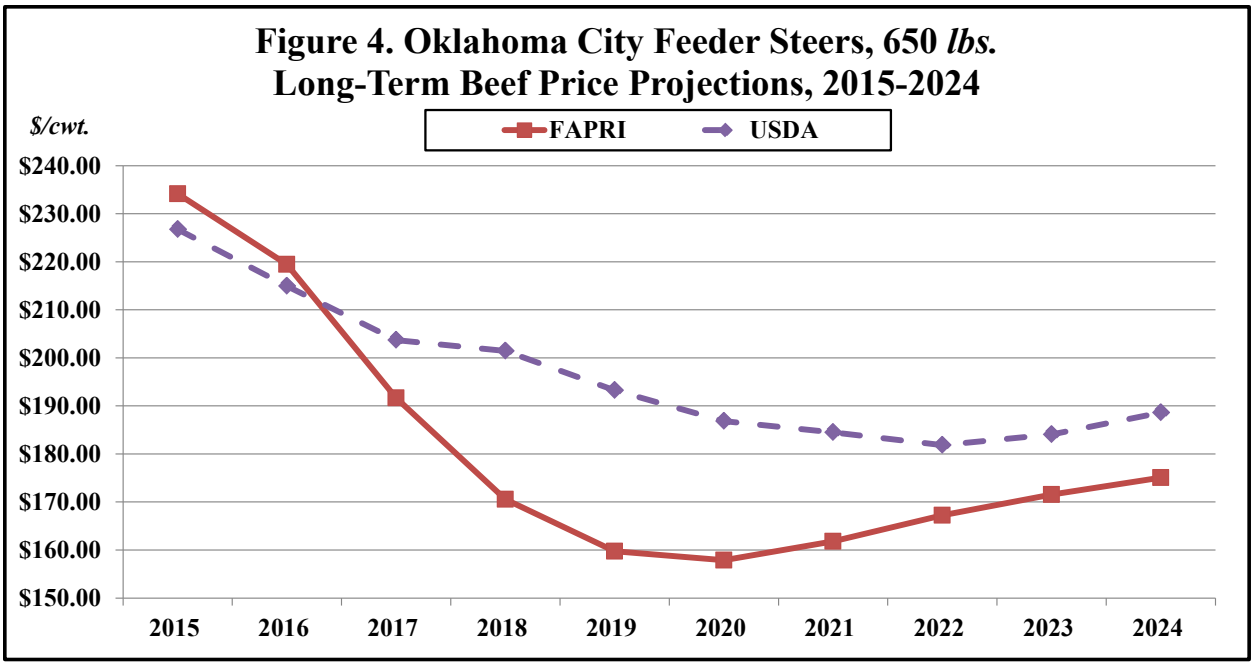



Associated with the long-term cattle inventory projections, FAPRI and USDA have made long-term projections on U.S. cattle market prices. Table 1 contains both the FAPRI and USDA's long-term planning prices for fed cattle, feeder steers, and slaughter cows. Notice as inventory increases over time, there is a similar decline realized in market prices for the various classes of cattle.

**Table 1. U.S. Beef Prices, Long-Term Baseline Projections 2015-2024**

| Item | Units | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fed Cattle, Steers, 5-area (1250 *lbs.*)** | | | | | | | | | | | |
| FAPRI | *$/cwt.* | $156.07 | $149.83 | $136.29 | $126.33 | $121.87 | $121.62 | $123.68 | $126.24 | $127.89 | $129.31 |
| USDA | *$/cwt.* | $159.50 | $163.70 | $165.03 | $163.86 | $158.42 | $155.22 | $153.38 | $152.48 | $155.46 | $158.11 |
| **Feeder Steers, Oklahoma City (600-650 *lbs.*)** | | | | | | | | | | | |
| FAPRI | *$/cwt.* | $234.16 | $219.45 | $191.68 | $170.55 | $159.74 | $157.87 | $161.80 | $167.23 | $171.53 | $175.05 |
| USDA | *$/cwt.* | $226.75 | $214.96 | $203.70 | $201.46 | $193.23 | $186.83 | $184.50 | $181.85 | $184.05 | $188.59 |
| **Slaughter Cows, Breaking Utility, Sioux Falls** | | | | | | | | | | | |
| FAPRI | *$/cwt.* | $107.09 | $97.81 | $85.31 | $77.83 | $74.14 | $73.85 | $74.94 | $76.64 | $77.40 | $77.99 |

Figure 4 contains both the FAPRI and the USDA's long-term planning prices for Oklahoma City 650-pound feeder steers. Each set of prices follow the same general cyclical pattern observed in previous cattle cycles. However, the forecasted feeder steer prices of FAPRI are much lower than those of the USDA report during the years 2017-2021.

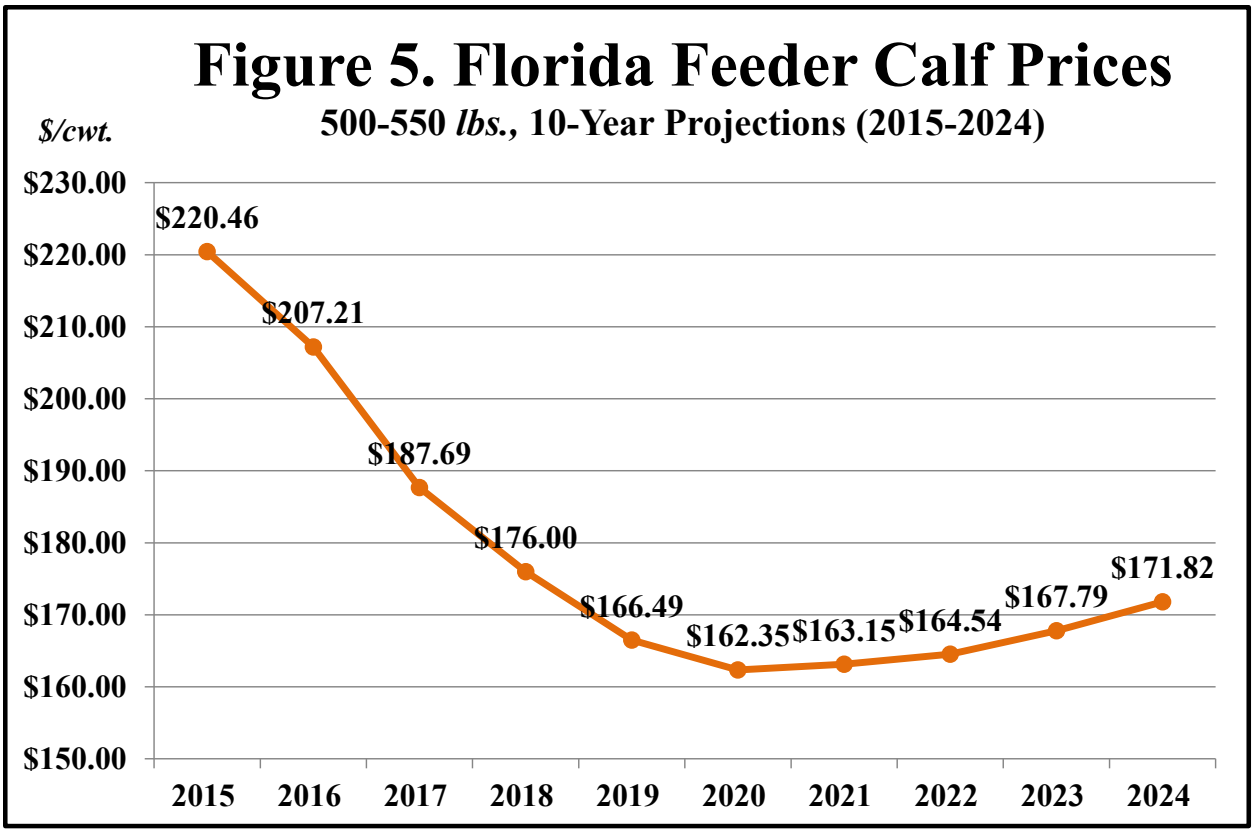



These two sets (FAPRI and USDA) of 10-year baseline price projections will serve as the foundation for the long-run planning prices for Florida beef cowherds (Hughes, 2013). The average of the two price projections for Oklahoma City feeder steer prices were modified based on projected transportation and handling costs between Oklahoma and Florida to project Florida feeder calf prices for 2015 to 2024. The projected feeder calf prices represent blended prices for feeder steers and heifers as reported in Table 2.

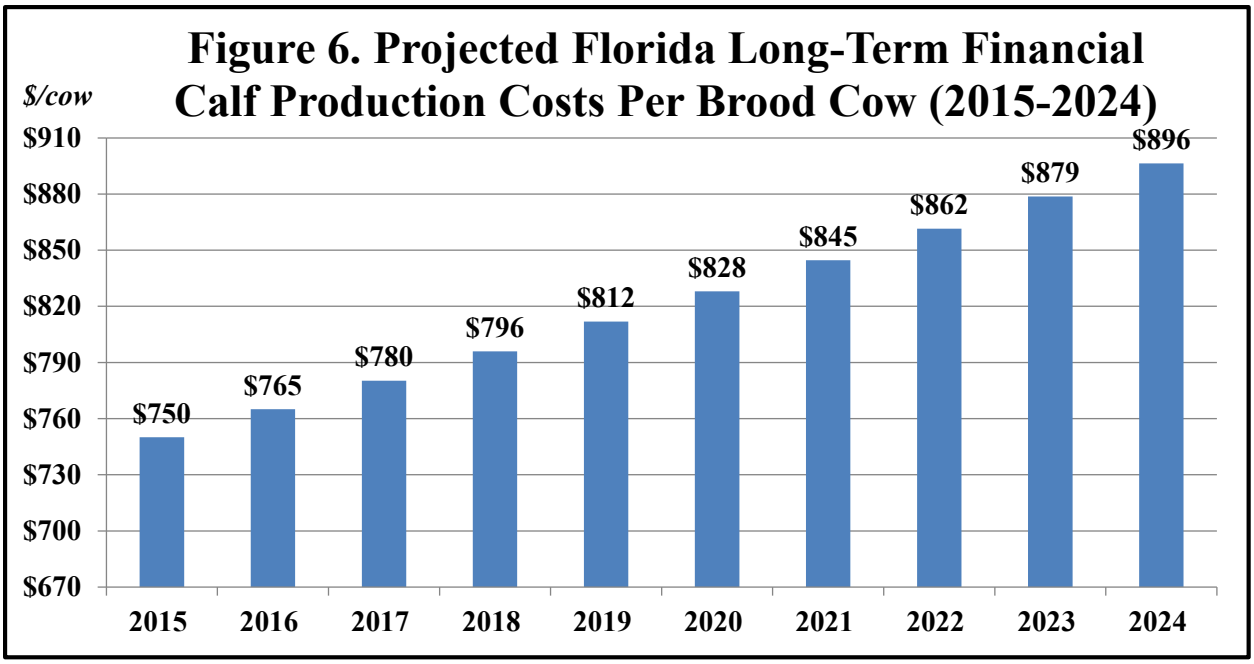
**Table 2. Projected Florida Feeder Calf Prices, Med. & Lg., #1-#2, 525 *lbs.***

| Units | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|---|
| *$/cwt.* | $220 | $207 | $188 | $176 | $166 | $162 | $163 | $165 | $168 | $172 |
| *$/hd.* | $1,157 | $1,088 | $985 | $924 | $874 | $852 | $857 | $864 | $881 | $902 |
| *$/truckload* | $110,228 | $103,603 | $93,846 | $88,002 | $83,243 | $81,176 | $81,576 | $82,271 | $83,896 | $85,911 |

The projected Florida feeder calf prices for medium-large frame, number 1-2 muscle score, 525-pounds are presented in Figure 5. The largest decreases in projected prices correspond to the largest increases in projected inventory numbers between 2015 and 2020. At theses lower prices, some cattle producers will become unprofitable and begin to reduce any expansion efforts. Beyond 2020, marginal increases in inventory are expected and projected market prices possibly improve due to other economic factors (growing population, rising disposable income, etc.).




Matching feeder calf market prices with what it costs to produce 100-pounds of calf production is essential to evaluate profitability. Calf production costs per brood cow were projected in Figure 6 for the years 2015-2024. The base calf production costs per brood cow of $750 were projected to increase by 2% annually over the next 10 years. This amounts to an increase in calf production costs of $149 per brood cow over the 10 year period. Even with this conservative projected cost increase of 2 percent annually, costs are going to be a large contributing factor to determine profitability.




*Calf production costs per brood cow are total production costs minus cull animal revenue divided by the total number of brood cows.

Based on the projected feeder calf prices and calf production costs per brood cow and assuming 525-pound weaned feeder calves, profits/losses may be evaluated. Table 3 presents feeder calf revenue per brood cow, calf production costs per brood cow and profits/losses per brood cow. Profits per brood cow using these projected estimates continue to be realized through 2017. Losses per brood cow are realized from 2018 through 2024. The reader should understand these profits and losses are similar to what you report on line 34 of your Federal Income Tax return, Schedule F. Many cattle operations have periods of negative net farm income, but find a way to live off of depreciation, other income, and capital gains from sales of other assets on their farms. Worse losses have been realized in previous cattle cycles than those projected in this paper.

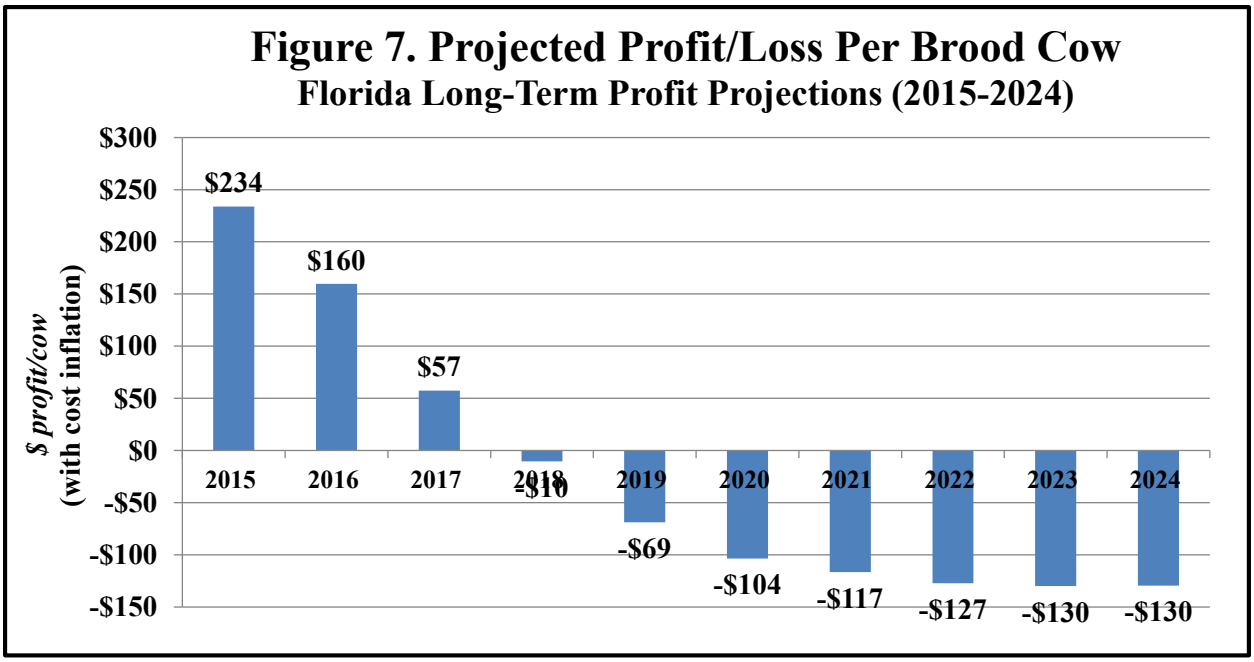
## Table 3. Florida Cow-Calf Long-Term Profit Projections

| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Feeder Calf Revenue Per Brood Cow, 525 *lbs., $/hd.**** | $983.78 | $924.66 | $837.57 | $785.42 | $742.94 | $724.50 | $728.06 | $734.27 | $748.77 | $766.76 |
| **Calf Production Costs Per Brood Cow, *$/hd.*** ** | $750.00 | $765.00 | $780.30 | $795.91 | $811.82 | $828.06 | $844.62 | $861.51 | $878.74 | $896.32 |
| **Profits Per Brood Cow, *$/hd.*** | $233.78 | $159.66 | $57.27 | -$10.49 | -$68.88 | -$103.56 | -$116.56 | -$127.25 | -$129.98 | -$129.56 |

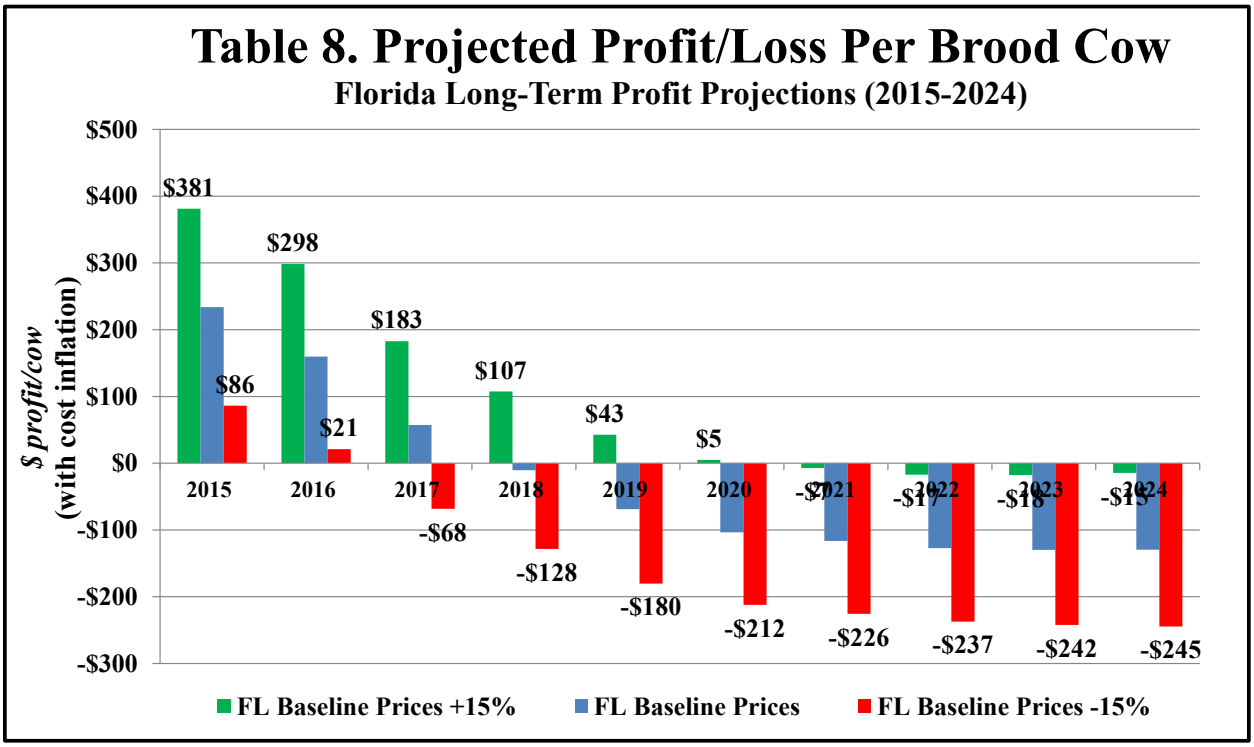
*Blended steer and heifer price for feeder calf revenue per brood cow and assumes a 85% weaning percentage.

**Assumes 2% inflation annually.

The long-run cow-calf profit/loss projections for beef cow producers are presented graphically in Figure 7. All values are expressed as dollars per brood cow. The profits generated during the years 2015-2017 are projected to be years with excellent profit potential as prices continue to be strong for cow-calf producers. After that, the projected expansion in the national beef cowherd and increases in cost of production result in losses per brood cow.




While these long-term price projections provide us with a good starting point, we all know that unanticipated events happen (drought, recessions, food safety issues, demand, inflation, etc.). Thus, it is practical to look at more optimistic and pessimistic scenarios as well. Florida feeder calf prices were evaluated with an assumed 15 percent increase and decrease from the projected base prices. The results are presented in Figure 8. If a 15 percent improvement was realized in Florida feeder calf prices, cow-calf producers would realize profits between 2015 and 2020 (6 out of 10 years). Alternatively, if a 15-percent decrease was realized, cow-calf producers would show losses for 8 out of the 10-years evaluated (2017-2024).



**Closing Remarks**
There is no doubt that ranchers face lots of tough questions on a daily basis. Some of these questions include.

- What will the future hold for my business?
- How much will cattle prices decline over the cattle cycle?
- What about the level of profits/losses over the cattle cycle?
- Where will your business be in 3, 5, or even 10 years?
- How will consumers respond to beef prices?
- Will the kids/family want to continue in the cattle business?
- What governmental policies and regulations help or hurt our cattle industry?

Obviously, no one can predict the future. We can't worry about everything or research everything. We can only listen and learn each day about the events that affect our cattle industry. By using this infusion of daily information and formulating reasonable projections about our cow-calf enterprise, we can adjust our individual cattle operations as we choose. Your decision is the only one that counts.

Certainly there are a multitude of factors affecting the future of the cattle industry. Here are some factors affecting beef cattle herd expansion we should keep in mind and follow.

- Market Prices (domestic and foreign beef demand, disposal income, exchange rates, competing meats, etc.)
- Production Performance (weaning percent, weaning weight, culling rate, stocking rate, etc.)
- Cost of Production (feed, fertilizer, labor, energy prices, interest rates, inflation, etc.)
- Profitability (cash, financial, and economic profitability)
- Government Regulations and Policies (environmental, water, taxes, etc.)
- Outliers (food safety, terrorist events, war, etc.)
- Weather (droughts, floods, hurricanes, severe temperatures, etc.)

These projected planning prices present a reasonable scenario that can be useful as we consider the long-term direction for our farms and ranches. Good luck with developing a plan to survive and thrive the next decade.

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# Gainesville Research Update - Comparison of Trace Mineral Source on Beef Cattle Performance and Reproduction

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## Introduction

Mineral nutrition for beef cows, replacement heifers, and bulls is a key component of the total nutritional profile for the cattle herd. Trace minerals are key components to many proteins and enzymes that are important to ruminant growth-performance, reproduction, health, and carcass characteristics. Improvements in any category of cattle performance could have a positive outcome on beef enterprise profitability. Several studies are currently being conducted to evaluate these outcomes.

Trace minerals have traditionally been supplemented to cattle diets as inorganic salts. In spite of this tradition, recent attention has been placed on the use of organic or chelated trace mineral supplementation in the rumen diets. Organic trace minerals differ from inorganic forms as a result of their chemical association with an organic ligand. Numerous groups of these organic trace minerals are formed from this mineral-organic ligand combination, which are available in the animal feeding industry and include chelates, proteinates, and complexes.

Previous research in beef cattle using organic sources of trace minerals has demonstrated some improvement in reproductive parameters important to whole herd efficiency; although, most of this research has focused on the postpartum cow. Stanton et al. (2000) reported beef cows had higher pregnancy rates when receiving organic trace minerals compared to inorganic trace minerals. It should also be noted that they observed an increase in calf ADG in the organic trace mineral treated cows (Stanton et. al., 2000). Likewise, Ahola et al. (2004) observed an increase in calf weight gain in organic compared to inorganic supplemented suckled cows. Swenson et al. (1998) reported decreased post-partum interval for mature cows that were provided organic trace mineral sources of Co, Cu, Mn, and Zn compared to sulfate sources. Ahola et al. (2004) also observed increases in reproductive performance of postpartum beef cows that were artificially inseminated and received organic trace mineral supplements compared to an inorganic mineral supplement. Likewise, Kropp (1990) reported supplementing chelated minerals to first-calf cows for as little as 30 days prior to initiation of the breeding season resulted in more cows exhibiting estrus and conceiving after first service. Fallon et al. (1993) showed significant increases in fertilization rate and numbers of fertilized embryos collected from super ovulated, crossbred heifers receiving organic Cu, Zn, and Mn supplementation.

There is even less research available on the effects of organic mineral supplementation in bulls and its effects on fertility. In a recent study by Rowe et al. (2010), Rowe reported that mature bulls treated with organic minerals for 123 days had improved semen quality both before and after freezing of the semen compared with bulls receiving inorganic minerals. Whether this positive effect results in greater embryo development and pregnancy rates in natural service, AI programs, or *in vitro* embryo production programs is unclear.

Multiple studies with either extensive or intensive managed cowherds are being conducted to compare the effect of organic and inorganic sources of trace minerals on mature cow liver mineral status throughout a cows production cycle, cow reproductive performance, and calf performance. Additional studies are being conducted that are evaluating the effect of maternal imprinting of mineral supplement sources on the performance of the subsequent generation of bull and heifer calves born from dams that were exposed to either inorganic or organic sources of mineral during pregnancy. The heifer calves born from imprinted

dams are being evaluated for growth from birth to onset of puberty, and pregnancy rates during the subsequent natural service breeding. In addition, bull calves from imprinted dams will be evaluated for growth and development from birth to onset of puberty, semen quality on regularly conducted breeding soundness exams, and the subsequent quality of semen collected and frozen for use in an artificial insemination program.

**Prenatal Mineral Supplement Source Research Project**

The overall study utilized Angus (AN, n= 95) and Brangus (BN, n = 96) pregnant mature cows that were supplemented their trace minerals through either Inorganic (ING, n = 98) or Organic (ORG, n = 93) sources in a manufactured pellet. Cows were supplemented 3 times/week at a rate of 1 lb per 1000 lbs of bodyweight per day starting approximately 90 d before expected parturition. A subset of 10 cows from each breed x supplement type (40 cows total) were utilized for intensive measures of cow colostrum, milk, neonatal calf response, and cow and calf liver biopsies. Cows were maintained on dormant bahiagrass pastures, fed hay, and supplemented with soybean hulls in addition to the trace mineral supplement in 8 groups during the winter. In the summer cows remained in their respective breed-mineral groups and grazed bahiagrass pastures and were supplemented with loose TM formulated for 4 oz per cow per day consumption. No additional trace mineral sources were supplied.

The ING trace mineral supplement was formulated to meet a cow's trace mineral requirement on a daily basis. The ORG trace mineral supplement was a yeast source and formulated to meet a cow's trace mineral requirement on a daily basis considering a greater bioavailability of the ORG mineral source.

**Effects on the composition of cow colostrum and 30 d milk**

The study's objective evaluated the influence prenatal mineral supplement source has on cow colostrum and milk composition. At parturition, colostrum were collected from cows prior to calves suckling and milk samples collected 30 d post-parturition. Colostrum and milk samples were analyzed for composition by a commercial laboratory. Colostrum analysis included % fat, % total protein, % total solids, % lactose, as fed % ash, % moisture, DM, and somatic cell count (SCC). Milk analysis included % fat, % true protein, % total solids, % lactose, milk urea nitrogen (MUN) and SCC. No effect of treatment or breed was observed for colostrum fat (5.06 ± 0.42 %), total protein (16.67 ± 0.44 %), lactose (2.97 ± 0.08 %), DM (4.38 ± 0.13 %) or SCC ($7.4 \times 10^6 \pm 1.0 \times 10^6$). Colostrum total solids were greater for AN (27.1 ± 0.89 %) than BN (24.56 ± 0.86 %). Breed also affected colostrum % moisture, BN (75.44 ± 0.89 %) was greater than AN (72.89 ± 0.86 %). The colostrum as fed % ash tended to be greater for AN than BN (1.15 vs 1.06 ± 0.03 %). Treatment and breed did not affect milk % fat (1.98 ± 0.23 %), true protein (3.07 ± 0.06 %), total solids (10.89 ± 0.24 %), lactose (5.11 ± 0.06 %) and SCC ($3.2 \times 10^5 \pm 1.7 \times 10^5$). However, BN had greater MUN concentrations than AN (12.12 vs 9.40 ± 0.75 mg/dL, respectively). These results demonstrate breed had more effect on colostrum and milk composition than prenatal mineral supplement treatment.

**Effects on cow colostrum and neonatal calf serum immunoglobulin concentration**

The objective of this study was to examine the effects of prepartum trace mineral supplement on neonatal calf serum and colostral Immunoglobulin. At parturition, colostrum was collected by hand-milking prior to calves suckling. Calf serum was collected at 0 (pre-suckling), 12, and 24 h and 30 d of age. Serum and colostrum quantification of concentrations of immunoglobulins: IgG, IgM, and IgA were determined, total immunoglobulin concentrations for calf serum and colostrum were calculated by summing of all immunoglobulin concentrations. Colostrum immunoglobulins were not affected by breed or TRT with

mean concentrations of 11,112 ± 491, 415 ± 30, 536 ± 41, and 12,063 ± 515 mg/dL for IgG, IgM, IgA and total immunoglobulin, respectively. At 0 h, calf serum had no detectable IgG, IgM, and IgA values. Calf serum IgG and IgM concentrations at 12 h and 24 h were not affected by treatment or breed. However, ORG calves had greater IgA concentrations than ING calves at 12 (ORG = 287.9 mg/dL, ING = 202.8 mg/dL) and 24 h (ORG = 290.3 mg/dL, ING = 195.2 mg/dL). Treatment had no effect on 12 h calf total immunoglobulin concentrations; but at 24 h, ORG calves tended to have greater total immunoglobulin than ING calves. There was no breed effect or interaction for total immunoglobulin at 12 or 24 h. At 30 d of age, ORG calves (1653 mg/dL) had greater IgG concentrations than ING (1,273 mg/dL) calves. Organic mineral supplementation provided to gestating cows increased calf immunoglobulin concentrations after birth and at 30 d of age. Enhanced immunoglobulin concentrations may provide calves greater protection from infectious disease agents during vulnerable time points in their life.

**Effect on neonatal and growing calf mineral status**

The effect of cow prenatal trace mineral (TM) supplement source on calf TM status from birth through 30 d of age was examined. Calf BW were collected at birth (n = 191). A subset of calves (n = 43) had BW, serum and plasma collected by jugular vein puncture at birth (0 h, prior to colostrum intake), 12 h, 24 h and 30 d of age. Samples were analyzed for TM (serum: Co, Cu, Fe, Mn, Mo, Se, Zn; plasma: Se. Breed, TRT, nor interactions affected BW at birth (79 ± 0.9 lb) and 30 d (152 ± 2.4 lb). Time affected all 0-24 h serum and plasma TM except for Co. Calf Mn concentrations were undetectable at 0-24 h, but were 1.9 ± 0.2 ng/mL at 30 d sample. Both serum Se (ING = 57.5 ± 1.7 and 44.7 ± 1.1 µg/mL vs. ORG = 46.5 ± 1.7 and 33.4 ± 1.2 µg/mL) and plasma Se (ING = 149.4 ± 3.2, 129.9 ± 3.2 vs. ORG = 118.7 ± 3.3, 95.4 ± 3.3 ng/mL) were affected by TM source at 0-24 h and 30 d, respectively. At 30 d, Co was greater for ING (2.0 ± 0.3 ng/mL) than ORG (0.6 ± 0.3 ng/mL). At 0-24 h, Fe and Se were greater in AN (87.1 ± 5.9 µg/dL and 54.7 ± 1.7 ng/mL) than BN (70.1 ± 5.8 µg/dL and 49.2 ± 1.7 ng/mL). At d 30, AN (40.7 ± 1.2 ng/mL) serum Se was greater than BN (37.4 ± 1.1 ng/mL). In contrast, BN had greater Cu (0.3 vs. 0.2 ± 0.01 µg/mL) than AN at 0-24 h and Mo (52.9 ± 8.5 vs. 10.0 ± 1.7 ng/mL) at 30 d, respectively. These data demonstrate calf TM status varies by time, prenatal TM source, and breed. Pre-calving nutritional strategies need to consider TM source and calf breed.

**Effect on pre-weaning and weaning calf liver and serum mineral status**

The effect cow prenatal trace mineral (TM) supplement source has on calf serum and liver TM status from 115 ± 21 d of age through weaning (206 ± 21 d) was investigated. All calf (n = 190) BW were collected at d 115 and weaning, while a subset of calves (ING, n = 12, 6/breed, ORG, n = 14, 7/breed) had liver biopsies performed and serum collected by jugular vein puncture. Serum and liver samples were analyzed for TM (Co, Cu, Fe, Mn, Mo, Se and Zn. Calf d 115 BW (328 ± 4.4 lb) were not affected by TRT. At weaning, ORG had greater BW (498 vs. 476 ± 7 lb), 205 d adjusted BW (500 vs. 476 ± 7 lb), BW gain (419 vs. 399 ± 7 lb) and ADG (2.05 vs. 1.96 ± 0.02 lb) than ING. Serum Co and Zn were affected by day, while all liver TM except for Co were affected by day. The ORG calves had greater serum Se (29.8 vs. 18.2 ± 1.1 ng/mL), liver Se (0.7 vs. 0.5 ± 0.1 µg/g) and Mn (9.3 vs. 7.8 ± 0.4 µg/g) than ING. The AN had greater serum Co (0.8 vs. 0.5 ± 1.2 ng/mL), Se (27.9 vs. 19.4 ± 1.1 ng/mL) and liver Co (0.2 vs. 0.1 ± 0.02 µg/g), Fe (573.5 vs. 435.9 ± 1.1 µg/g) and Zn (128.1 vs. 116.7 ± 1.0 µg/g), while BN had greater serum Mo (5.0 vs. 2.5 ± 0.6 ng/mL) and liver Mn (9.1 vs. 8.0 ± 0.4 µg/g). Calf BW and ADG at weaning were increased by prenatal ORG TM. These data indicate calf TM status varies by

day relative weaning, prenatal TM source and breed. Additional research is needed to determine how TM source affects calf immune function, performance, carcass traits and reproductive potential.

**Effects on cow performance and mineral status during a production cycle**

Effect of trace mineral (TM) supplement source on cow performance and TM status over the production cycle were examined. A subset of cows had liver biopsies and serum collected, frozen and analyzed for TM content (Co, Cu, Fe, Mn, Mo, Se and Zn), at 4 and 6 periods, respectively: start of TM (TMst), pre-calving (PreC), calving (C, serum only), post-calving (PostC, serum only), prebreeding (Pbrd) and weaning. Cow BW and BCS were recorded at each period. No 3-way interactions were detected except for serum Cu, Mn and Mo. At PostC, BN had 0.17 BCS greater than AN. Cow BW and BCS did not differ by TRT at each period. The AN had greater BW change from TMst to PreC (108 vs. 88 ± 4.4 lb) and from PostC to Pbrd (-97 ± 8.8 vs. -73 ± 7 lb) than BN. Change in BCS from PreC and Pbrd to weaning were greater in ING (-0.15 vs. -0.001 ± 0.05 and -0.36 vs. -0.10 ± 0.08, respectively) than ORG. Time affected all serum and liver TM concentrations except for serum Fe. Serum Co and liver Cu concentrations were greater in ING (1.7 vs. 1.3 ± 0.1 ng/mL and 266.4 ± 15.0 vs. 201.2 ± 14.1 µg/g, respectively), while serum Mo was greater ($P = 0.006$), in ORG (2.8 vs. 1.7 ± 0.3 vs. ng/mL). Serum Fe and liver Cu and Mn concentrations in BN (149.1 ± 5.5 µg/dL, 280.9 ± 15.2 and 11.7 ± 0.5 µg/g) were greater ($P < 0.03$) than AN (132.4 ± 5.3 µg/dL, 186.7 ± 13.9 and 9.5 ± 0.5 µg/g). Serum Se was greater ($P = 0.003$) in AN than BN (73.5 ± 1.7 vs. 65.4 ± 1.8 ng/mL). Cow TM status varies over time and is affected by breed and TM source; indicating development of nutritional management strategies can be based on cattle breed.

# UF/IFAS Range Cattle Research and Education Center Update

**J. D. Arthington[1]**

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*Notes:*

# How Long Does This Production Model Work?

**T. Warnock, Risk Manager/Commodity Broker[1]**

[1]Amarillo Brokerage Company, Amarillo, TX

Navigating commodity markets, physical or futures, has been nothing short of challenging over the last few years. Sharp and violent moves have been noted recently in hog markets, potentially due to Porcine Epidemic Diarrhea Virus. Additionally, we believe due to surpluses, crude oil has dropped to levels untested since 2008/2009. Interestingly, The U.S. dollar index has pushed into fresh 10 year highs recently on what seems to be anticipation of a higher interest rate environment. As we begin to think about those markets that more directly impact our cattle and beef environment, there was no lack of similar price advances, declines and volatility. Corn futures surged slightly over 50% in 2nd and 3rd quarter of 2012 and along with strong end-user basis caused extremely high feed cost and subsequently exorbitant feedlot cost of gain, this was followed by an approximate 60% break into the 4th quarter 2014 that allowed for cost of gain to ease and cattle to be fed longer in the face of rising replacement cost. Cattle futures and cash markets advanced well beyond what most analyst and producers could have ever imagined and brought about a much needed spell of record profitability across most sectors of the beef industry. Furthermore, the cattle feeder gained leverage over the beef packer resulting from a tight supply and generally good demand situation kept fed cattle basis very positive for all of 2014 (Table 1).

**Table 1.**

AMARILLO BROKERAGE COMPANY SINCE 1978

Average Monthly Live Cattle Basis*

| Texas | Year | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2012 | 0.68 | 0.02 | 0.22 | 1.49 | 4.23 | 1.94 | -3.51 | -1.15 | -1.16 | 0.82 | -0.01 | -2.33 |
| | 2013 | -4.39 | -2.77 | -1.04 | 0.49 | 4.85 | 1.15 | -3.01 | -1.09 | -3.01 | -0.89 | -0.79 | -0.54 |
| | 2014 | 2.63 | 0.64 | 4.37 | 2.09 | 7.14 | 4.60 | 5.53 | 3.00 | 4.76 | 0.14 | 0.47 | 0.48 |
| | 2015 | 5.00 | 4.68 | 6.75 | | | | | | | | | |
| AVG: | 5 year | 0.98 | 0.64 | 2.58 | 1.36 | 5.41 | 2.57 | -0.33 | 0.26 | 0.20 | 0.02 | -0.11 | -0.80 |
| **Kansas** | Year | January | February | March | April | May | June | July | August | September | October | November | December |
| | 2012 | 0.44 | -0.68 | 0.41 | 1.86 | 4.50 | 1.85 | -3.71 | -0.59 | -1.09 | 0.71 | -1.22 | -2.42 |
| | 2013 | -4.63 | -2.31 | -0.51 | 0.83 | 5.02 | 1.16 | -2.92 | -1.01 | -2.65 | -0.98 | -1.24 | -0.76 |
| | 2014 | 2.73 | 0.90 | 4.76 | 2.34 | 7.47 | 4.67 | 6.00 | 3.58 | 4.88 | -0.14 | 1.60 | 0.48 |
| | 2015 | 5.23 | 4.50 | 6.86 | | | | | | | | | |
| AVG: | 5 year | 0.94 | 0.60 | 2.88 | 1.67 | 5.66 | 2.56 | -0.21 | 0.66 | 0.38 | -0.14 | -0.29 | -0.90 |
| **Nebraska** | Year | January | February | March | April | May | June | July | August | September | October | November | December |
| | 2012 | 1.01 | -0.61 | 0.65 | 3.09 | 5.61 | 3.00 | -3.57 | -1.40 | -2.80 | -0.29 | -0.54 | -1.74 |
| | 2013 | -3.21 | -2.04 | -0.31 | 1.21 | 6.04 | 2.73 | 3.62 | 5.39 | -2.41 | -0.93 | -0.81 | 0.15 |
| | 2014 | 4.43 | 1.76 | 7.40 | 5.03 | 10.24 | 5.89 | 6.19 | 3.63 | 3.61 | -0.84 | 0.12 | -0.11 |
| | 2015 | 5.83 | 4.81 | 7.90 | | | | | | | | | |
| AVG: | 5 year | 2.02 | 0.98 | 3.91 | 3.11 | 7.30 | 3.87 | 2.08 | 2.54 | -0.53 | -0.69 | -0.41 | -0.57 |

*U.S.D.A. Weighted Avg. Cash Sales-Weekly Average Close

**Jan-Mar Averages are figured including 2015 Avg Basis Calculations

## Sector Profitability

Cattle markets advanced strongly from late 2013 through 2014 and currently remain at lofty levels, however less profitable due to increased calf and feeder cattle cost. Tighter fed cattle supplies due to a

smaller U.S. cow herd were some of the drivers that led to a highly profitable period for the beef industry (Figure 1). The short supply, good demand, and widespread profitability encouraged operators to expand into what is now quickly becoming a unprofitable market, mostly within the post-weaning sector at this time.

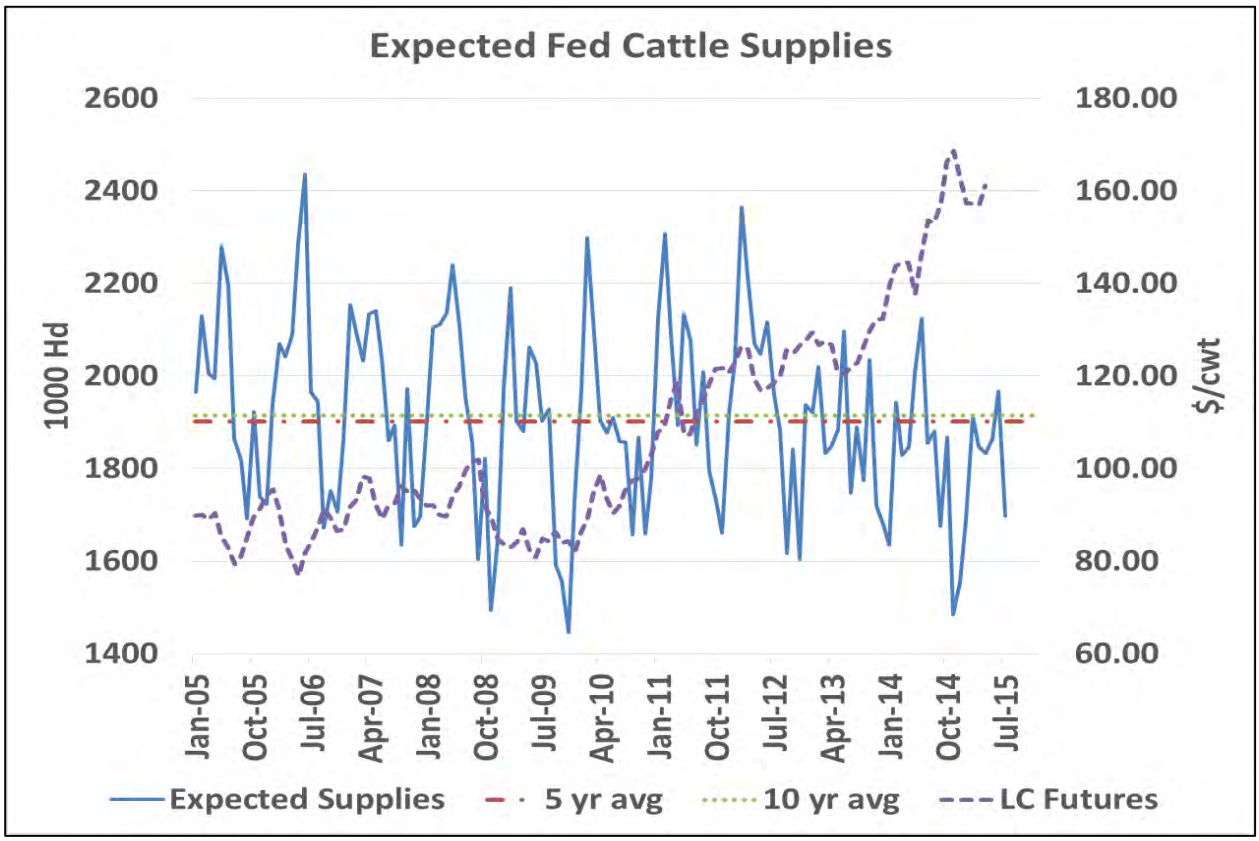


**Figure 1.**

Cow-calf producers were able to enjoy two-fold increases in profitability versus recent years due to advancing calf markets and downstream profitability (Figure 2). The calf-feeder spread firmed as feeding sector optimism combined with moisture and regionally plentiful forage encouraged grass operators to aggressively bid for light and medium weight cattle (Figure 3). Cattle feeders are estimated to have profited $140.00 per head on average throughout 2014, but have given some back recently, as we make our way into what could be very a negative margin period through 2nd quarter 2015 (Figure 4). Long term averages remind us that cattle feeding is very much a margin business and over time generally comes back to near breakeven (Figure 5). The beef packing sector worked strenuously during to 2014 to manage margin in the face of rapid beef price volatility and what seemed like an unmanageably tight cash fed cattle market (Figure 6). We must keep in mind that measuring and quantifying total packer profitability is most certainly not as simple as comparing spot beef prices to spot cash fed cattle prices.

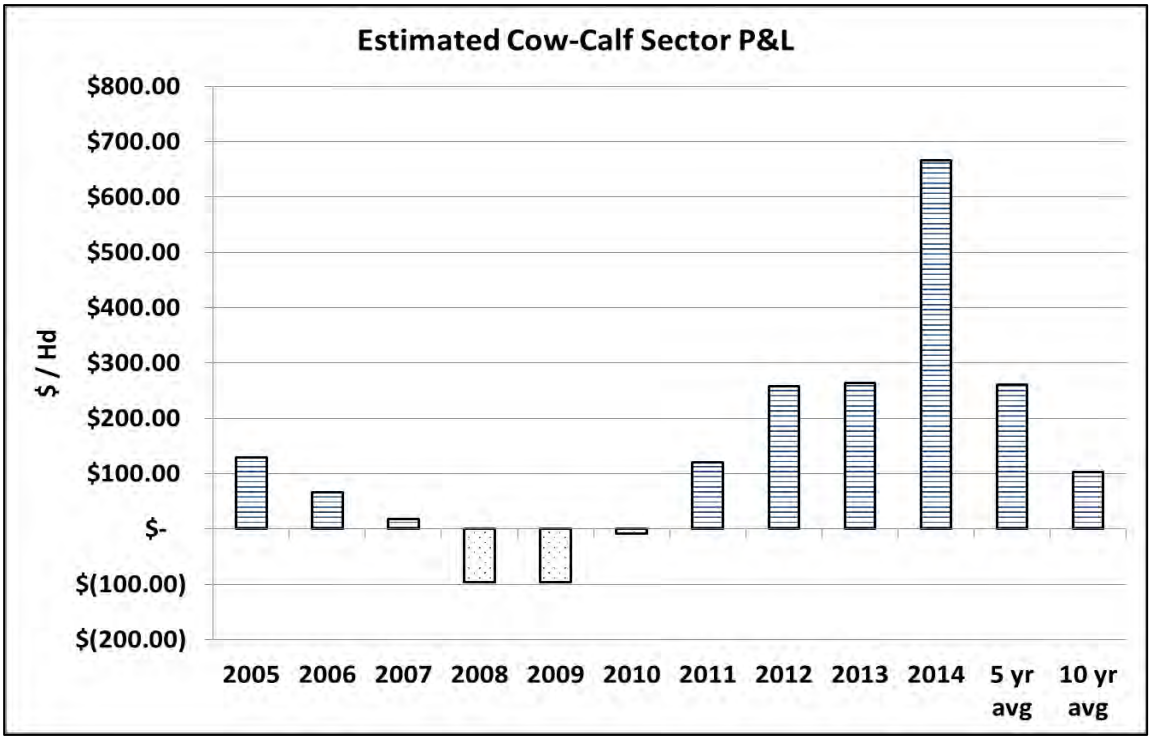


**Figure 2.**

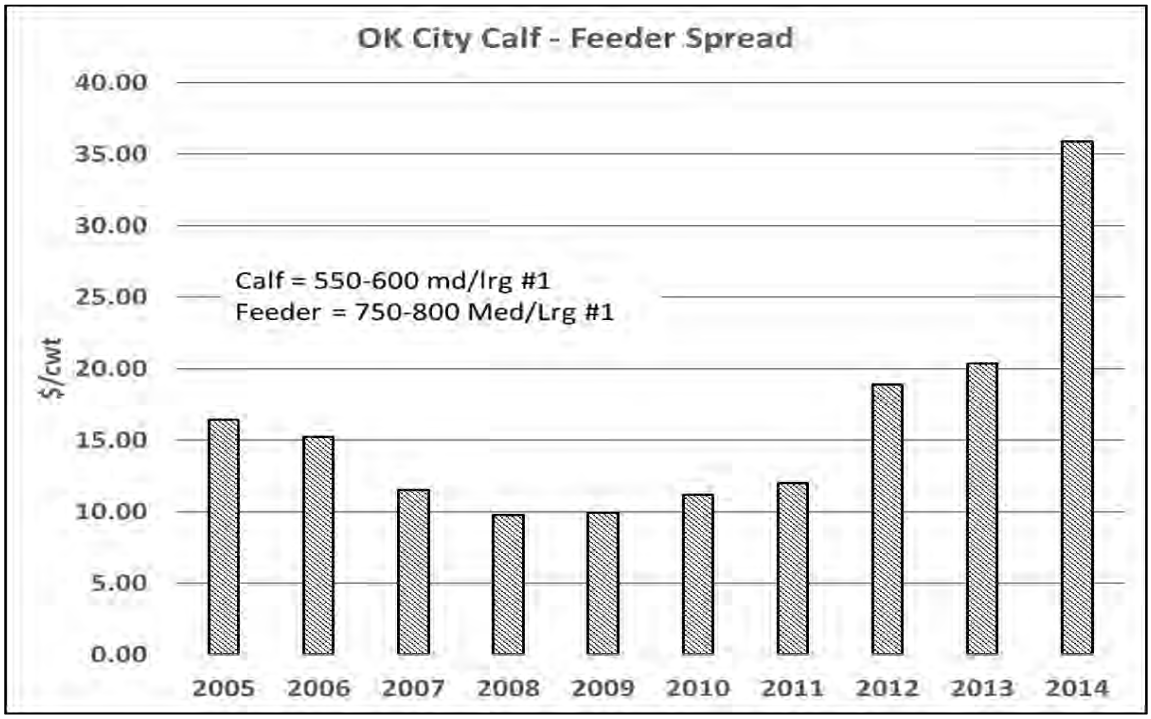


**Figure 3.**

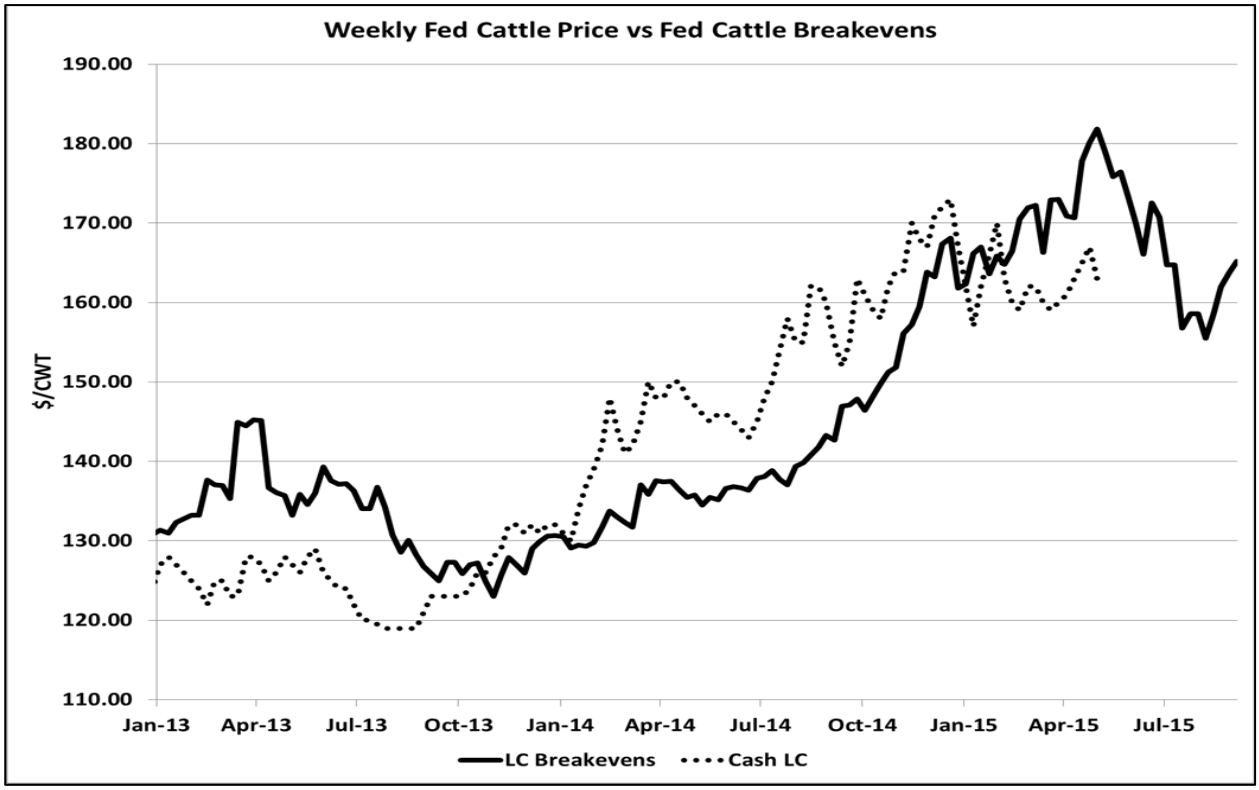


**Figure 4.**

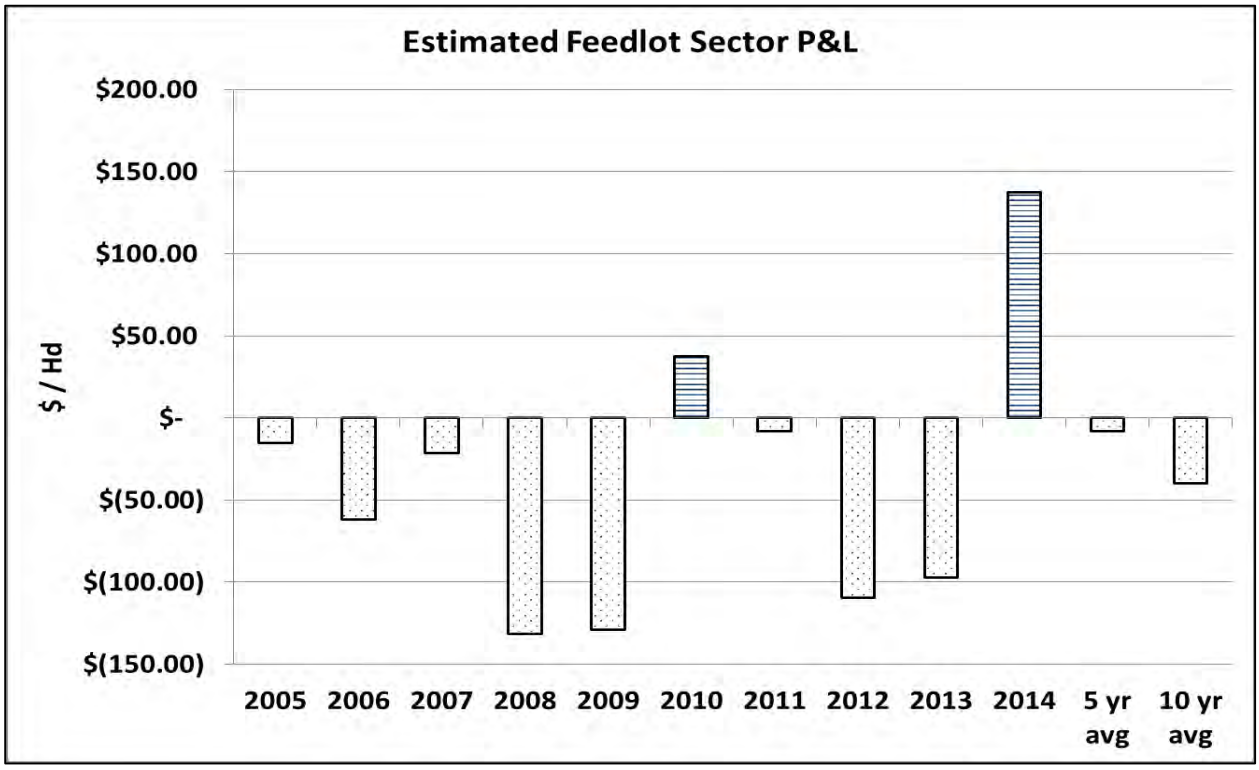


**Figure 5.**

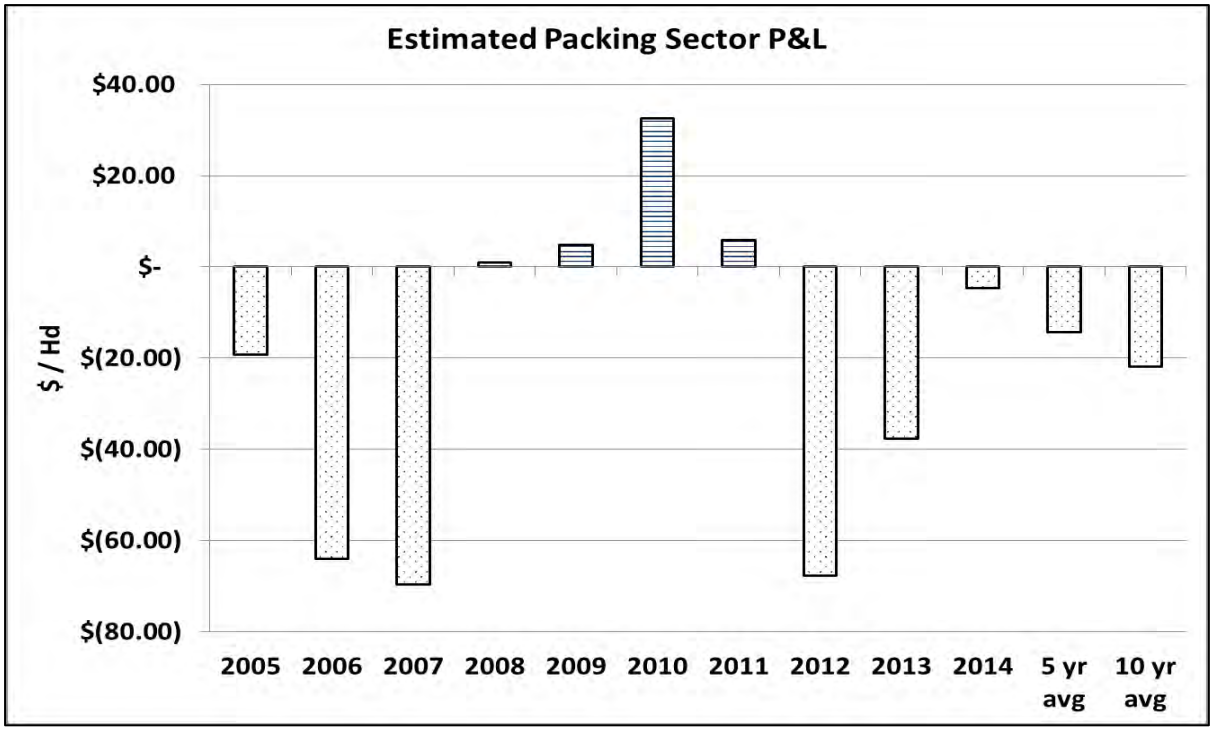


**Figure 6.**

The beef industry will most likely benefit from supported prices for the mid-term, as we are still working off of decreased cattle supplies and enjoying the benefit of robust domestic and international beef demand (Figure 7). Upstream profitability should remain positive for a longer period of time relative to downstream or post-weaning margins. From a producer standpoint, looking at each sector as a margin business and managing that potential margin will be imperative in preserving recent gains in equity or, at the very least reducing excessive losses.

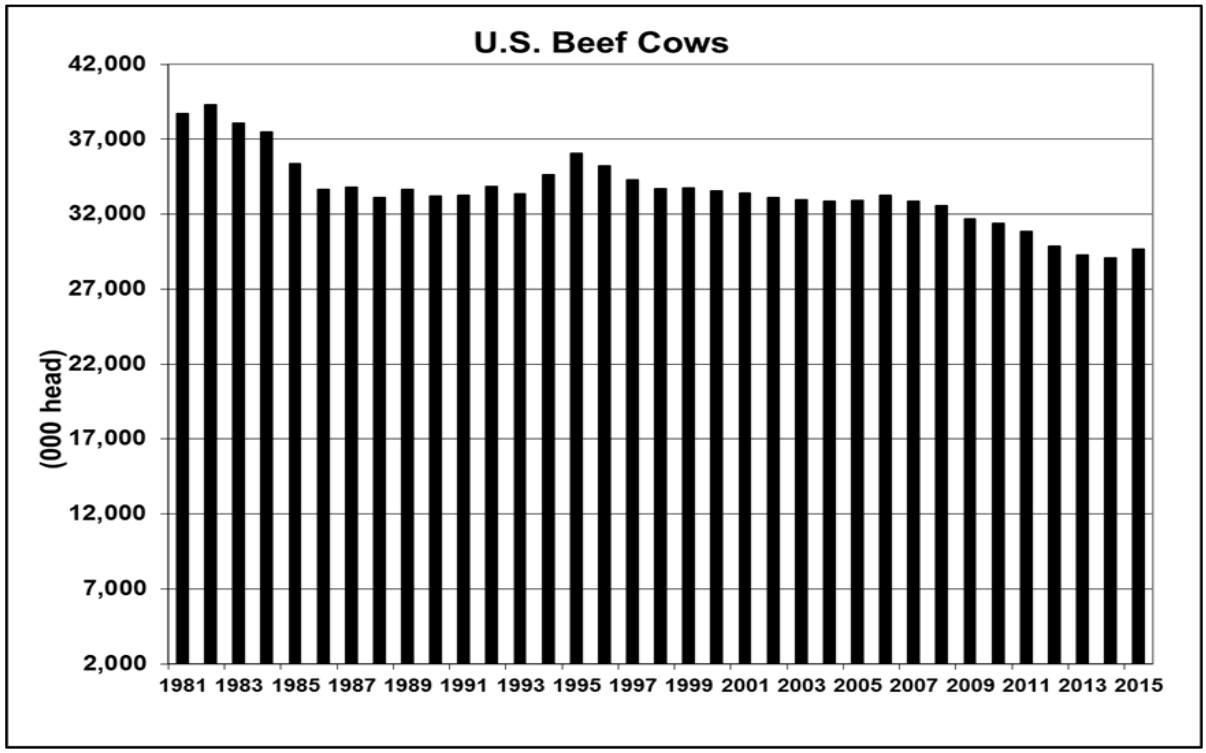


**Figure 7.**

**Fed Cattle Marketing**

The past ten years have brought about significant changes in how we market fed cattle to the packer. The majority of fed cattle sold up to 2005 were heavily spot cash oriented. From 2005 through present, the growth in alternative fed cattle marketing techniques has been astounding (Figure 8). Producers in the Texas/Oklahoma/New Mexico region have witnessed the most exaggerated swap in negotiated cash and formula sales (Figure 9). Some challenges that exist in this type of environment are: 1) the total cash fed cattle trade becomes highly leveraged on the very small percentage of cattle marketed through negotiated cash avenues, 2) in some regions there might only be traces or no qualified spot negotiated cash trade, this makes pricing the alternative marketing methods a little less clear and transparent, and 3) this process begins to limit the producer's ability to transparently and efficiently discover price on a consistent basis. As an industry, we will need to monitor and address this situation to prevent markets from becoming increasingly nontransparent and leveraged.

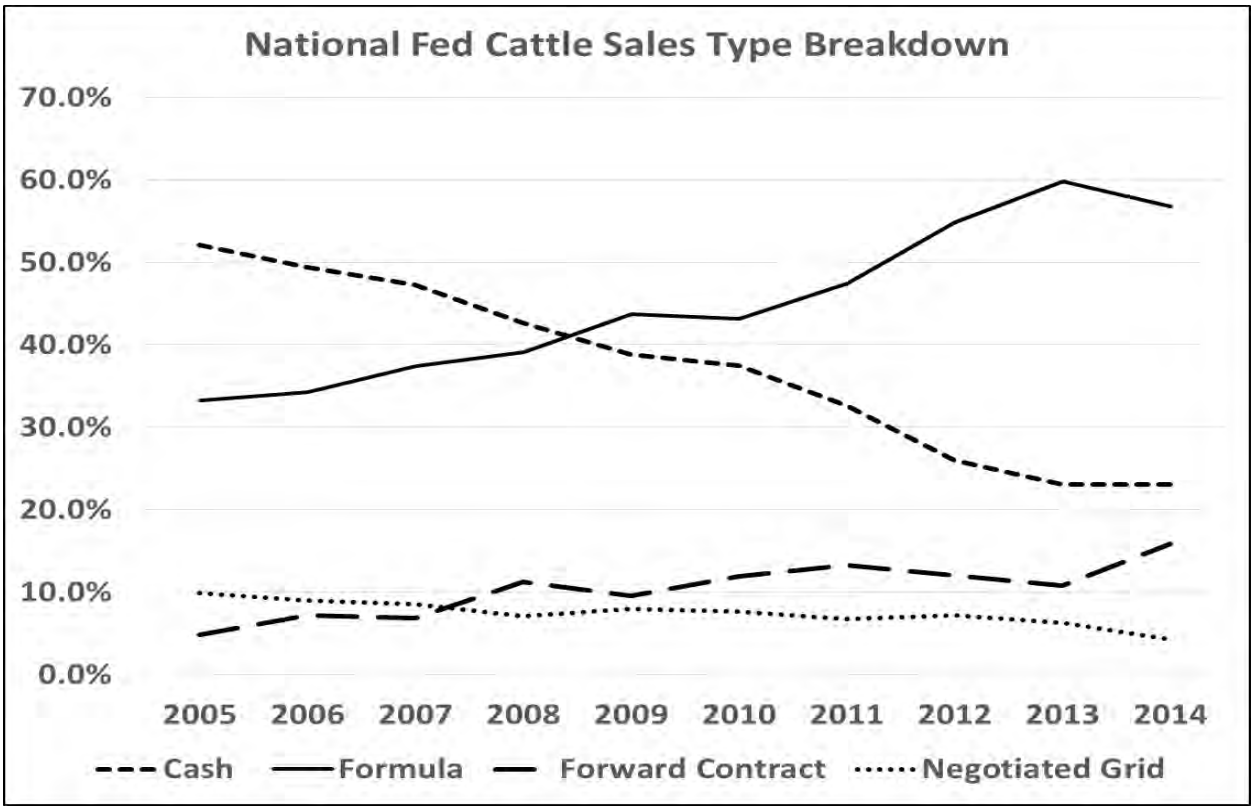


**Figure 8.**

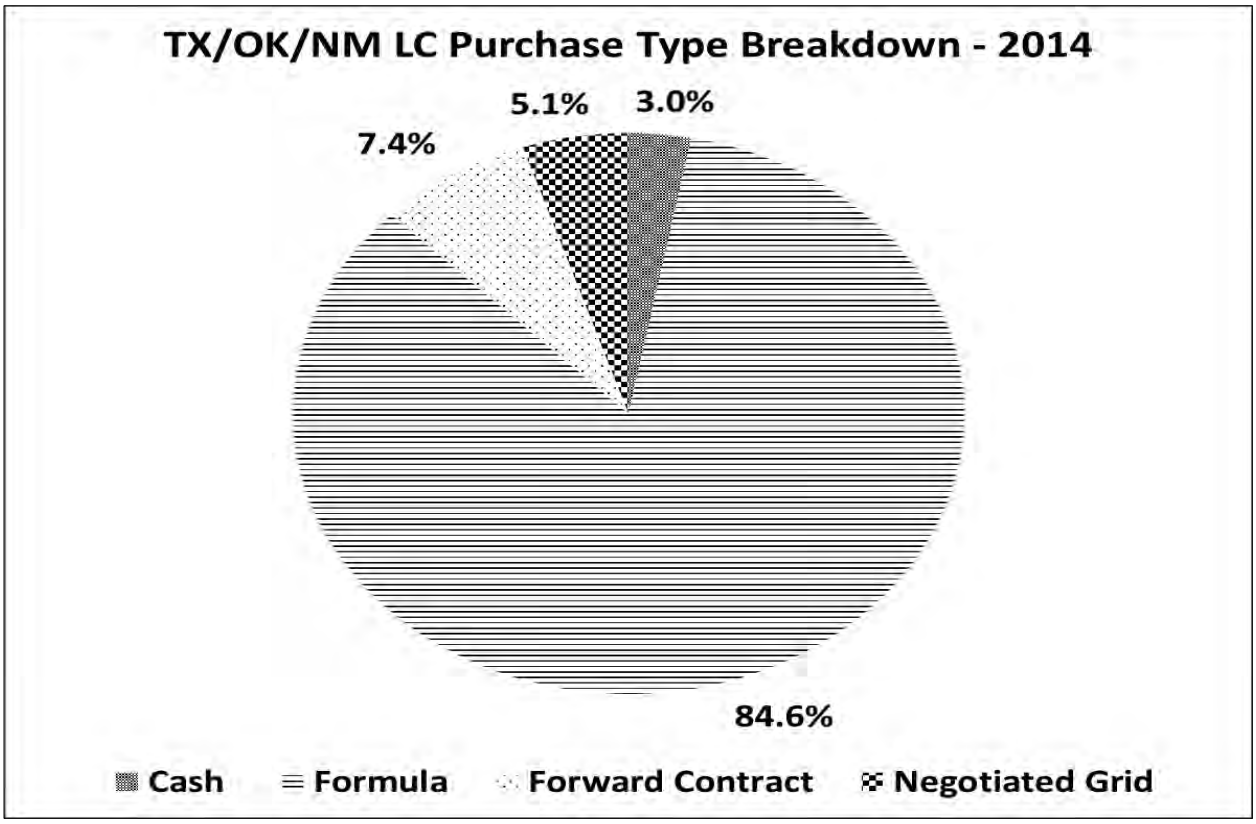


**Figure 9.**

**Feeding Regions**

Northern feeding regions have been consistently gaining on southern feeding regions in terms of cattle on feed numbers (Figure 10). Several factors seem to drive this fundamental shift, but corn basis and packing capacity/availability may be the largest. Extremely positive corn basis was paid in the southern feeding regions through much of 2013. This caused feedlot cost of gain to remain unexpectedly high and breakeven prices suffered as a result. The competitiveness of the northern regions are significant in this regard, although some normalization in southern corn basis has been noted recently. Tightening of beef packing capacity and some excess feeding capacity has been another challenge for southern operators. Marketing cattle in a heavily corporate environment requires smaller operators to take on different production strategies. The model of purchasing quality feeder/yearling type animals and consistently managing to produce positive margins is very difficult due to more aggressive and better capitalized competitors. The trend of increasing northern cattle on feed numbers relative to the south is strong and although the southern plains will always have a substantial corporate and private feeding presence, the northern plains may take a decidedly larger lead (Figure 11).

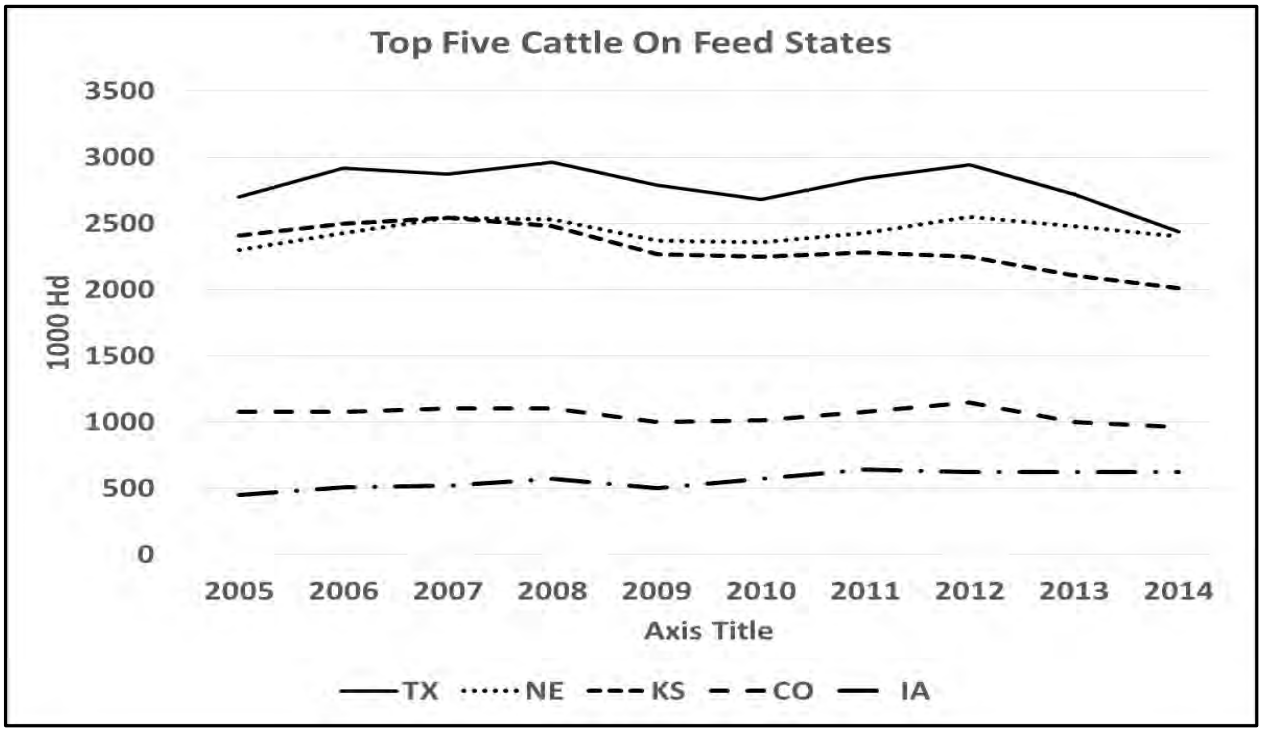


**Figure 10.**

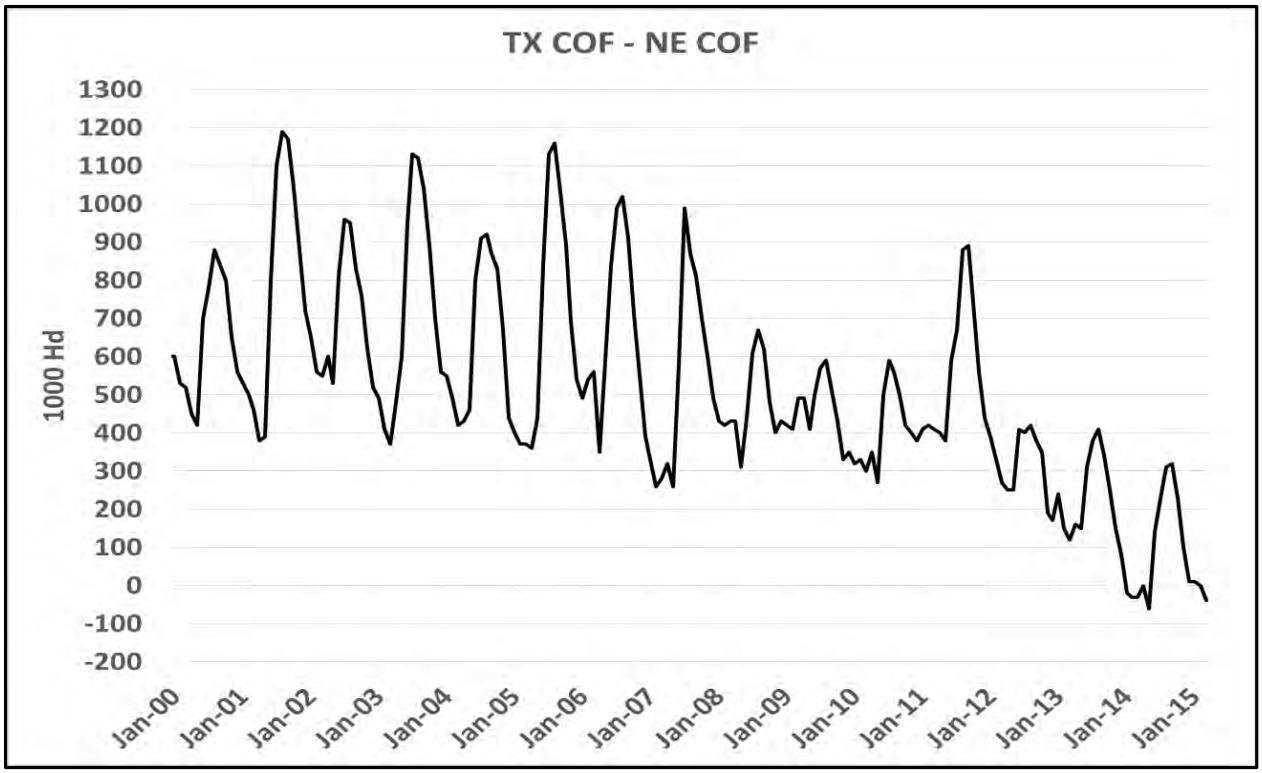


**Figure 11.**

**Beef Production Model**

Describing the beef production model cannot simply or briefly be put into a few words or examples. Analyzing the impact of the current model is, in some cases, even more difficult than just looking at supply-demand or fundamental models and outlooks. The traditional cow-calf production model has been generally favorable to producers in recent years. Liquidity in cash calf markets and competiveness among buyers through various marketing avenues aids the structure and allows the producer to spread out risk through sales in an efficient marketplace. As we ponder the post-weaning production models (stocker/backgrounder and feedlot), the production, marketing, and general operating techniques become even less uniform and the platform for marketing cattle becomes slightly less liquid and efficient. This concept of purchasing cattle, grazing or feeding cattle, and marketing at a particular end weight with no intermediate risk controls or management is very difficult and most likely not a business plan that will have longevity. Arguably, it is managing these sectors as a margin business that could be most the advantageous strategy in the long term, and allow for increased opportunities within the marketplace.

**Disclaimer**

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