

Phenotypic data collection for reproductive traits in heifers



Jared E. Decker
David J. Patterson

Division of Animal Sciences
University of Missouri

As we consider herd expansion...

What practices or procedures are currently available and being used by the industry to support improvements in the way we manage and develop replacement females?



Selected Management Procedures Used on Replacement Beef Heifers

Management practice	% of operations (1994)	% of operations (2007)
Feed separately	32	---
Pelvic measurements	3	4
Reproductive tract scores	1	---
Breed prior to mature cows	13	---
Estrous synchronization	3	8
AI	3	8
Body condition score	5	14
Weigh	8	---
Pregnancy diagnosis	16	18



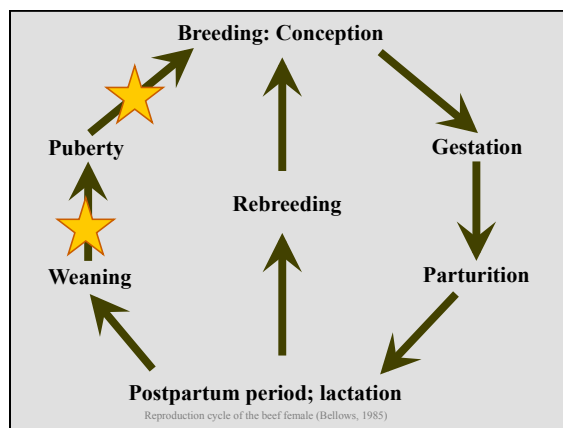
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Heritability of Reproductive Traits

TRAIT	HERITABILITY
Age at puberty	.41
Weight at puberty	.40
First service conception	.22
Conception/estrous cycle exposed	.27
Failure to conceive	.09
Calf born alive	.00
Calf alive at two weeks	.03
Calf alive at weaning	.01



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The Missouri SHOW-ME-SELECT™ Replacement Heifer Program



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The SHOW-ME-SELECT™ Program *for more information*

- Google "Show-Me-Select Replacement Heifers"
- PBS Affiliates
 - Friday, June 6, 2014
 - www.MarketToMarket.org
 - "Better Beef Prices Through Improved Animal Husbandry"

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DEVELOPING A PLAN

1. Create an understanding of the importance of heifer development based on reproductive outcomes.
2. Changes in heifer development spill over into the cow herd.
3. Importance of reproductive management becomes apparent.
4. Focus expands to genetic improvement.
5. Creation of a value-added product requires a re-evaluation of marketing strategies.

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SHOW-ME-SELECT™ PROGRAM OBJECTIVES

- Improve existing development programs through a Total Quality Management approach
- Provide a reliable source of quality replacements (genetics and management)
- Increase marketing opportunities for and add value to Missouri-raised heifers

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SHOW-ME-SELECT™ ACCOMPLISHMENTS AND IMPACTS

- **Since 1997.....**
 - 805 farms
 - 257 veterinarians
 - 116,034 heifers enrolled
 - 10 regional livestock coordinators
 - 17 regional livestock specialists
 - Contributed > \$90 M to Missouri's economy

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SHOW-ME-SELECT™ ACCOMPLISHMENTS AND IMPACTS

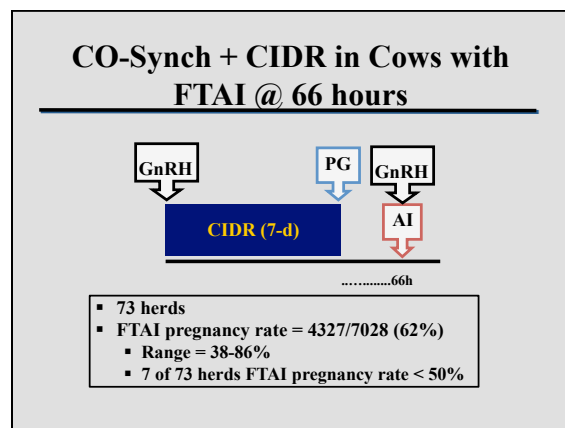
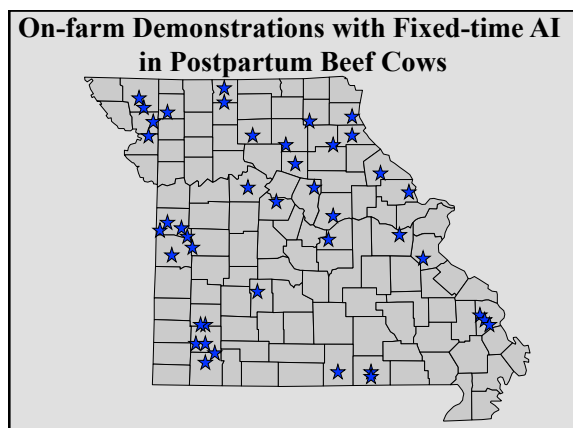
- **The marketing component.....**
 - 131 sales at 10 locations
 - 27,960 heifers sold
 - \$36,024,475 in gross sales
 - 9,032 prospective buyers
 - > 700 out of state
 - 3,101 successful buyers
 - > 200 out of state
 - 18 states



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- SHOW-ME-SELECT™**
- Centralized data base allows us to track data generated from the program.
 - Allowed us to compete effectively for USDA-NIFA funded integrated project awards.


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- SHOW-ME-SELECT™**
USDA-NIFA FUNDED PROJECTS
- An integrated approach to development and application of precise methods of estrous cycle control for beef heifers and cows
(Animal Reproduction; Award No. 2005-55203-15750; \$367,806).
 - An integrated approach to expand marketing opportunities for small- and medium-sized beef producers from value-added heifers and steers
(Prosperity for Small- and Medium-sized Farms; Award No. 2007-55618-18238; \$496,986).
 - Identification and management of alleles impairing heifer fertility while optimizing genetic gain in Angus cattle
(Translational Genomics for Improved Fertility of Animals; Award No. 2013-68004-20364; \$2,997,040).


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- PROJECT OUTCOMES**
- Integrating extension and research projects**
- Draws on the fundamentals upon which Extension and the Land Grant System were founded: the use and application of what we know to create knowledge.
 - Transfers science-based knowledge that enables participants to make practical production and management decisions based on economics.



What we learned ...


- The concept of fixed-time AI made sense
- Selection of sires to use in AI programs for many commercial producers was overwhelming
 - How do I begin to choose?






**SHOW-ME-SELECT™
TIER TWO**

<u>Minimum Accuracies for Sires of Tier Two Heifers</u>	
<u>Trait</u>	<u>Accuracy</u>
▪ Calving ease (direct)	▪ .65
▪ Calving ease (maternal)	▪ .30
▪ Weaning weight	▪ .75
▪ Carcass Weight	▪ .20
▪ Marbling	▪ .20




- Differentiate AI from bull breeding
 - Early diagnosis
 - Fetal sexing




Reproductive Management ...

Prior to & after the first breeding season


- 1) Create a platform for long-term reproductive health
- 2) Nutritional development
- 3) Prebreeding reproductive exam
 - Weight, Reproductive tract score, and pelvic area
- 4) Estrous synchronization
- 5) Sire selection
 - CE EPD
- 6) Early pregnancy diagnosis
 - Fetal age





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Intervention points for veterinarians

- **HEALTH**
 - WEANING
 - PREBREEDING
 - PRE-SALE
- **REPRODUCTIVE EVALUATION**
 - **PREBREEDING**
 - Reproductive tract scores
 - Pelvic measurements
 - **BREEDING**
 - Estrous synchronization
 - AI
 - **PREGNANCY EVALUATION**
 - Early pregnancy diagnosis/fetal aging
 - Fetal sexing
 - Pre-sale pregnancy confirmation



**SHOW-ME-SELECT™
DATA COLLECTED**

Prebreeding	Breeding	Pregnancy
Heifer ID	Synchronization method - Protocol, heat detection, FTAI	Days pregnant
Breed	AI date	AI bred
Sire (Reg. no.)	Bull in – date	Fetal sex
Birth date	Bull out - date	Pelvic area
Weight	AI sire (Reg. no.)	
Hip height	Natural service sire (Reg. no.)	
RTS		
Pelvic area		

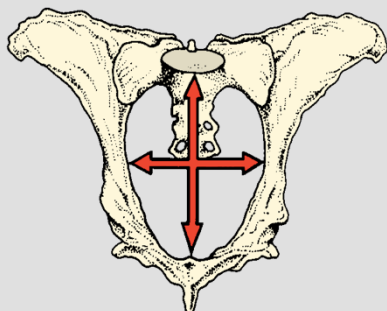
Reproductive Tract Scores

RTS	Uterine horns	Ovarian length (mm)	Ovarian height (mm)	Ovarian width (mm)	Ovarian structures
1	Immature, < 20 mm diameter, no tone	15	10	8	No palpable follicles
2	20-25 mm diameter, no tone	18	12	10	8 mm follicles
3	20-25 mm diameter, slight tone	22	15	10	8-10 mm follicles
4	30 mm diameter, good tone	30	16	12	> 10 mm follicles, CI possible
5	> 30 mm diameter	> 32	20	15	Corpus luteum present



Endocrine and Ovarian Changes Associated with Puberty Onset

	Prepubertal	Peripubertal	Pubertal
Estradiol secretion			
Estradiol feedback			
LH secretion			
Follicle diameter			
Reproductive tract score	1	2	3



Considerations related to pelvic area

- Puberty positively influences pelvic width and resulting pelvic area in yearling age heifers, however these differences do not carry through to calving as 2-year-olds.
- Selection/culling decisions based on pelvic measurements and contemporary grouping for genetic analysis of pelvic measurements should include consideration of pubertal status at the time of the examination.
- Pelvic area is an indicator of puberty

Bullock and Patterson, 1995

Heifer Management

- RTS: 4 to 6 weeks before breeding or 2 weeks before estrous synchronization
- Begin synchronization when $\geq 50\%$ of the heifers have RTS of 4 or 5



Why use estrous synchronization?

- More heifers will become pregnant early during the breeding season
 - Progestin-based programs can induce estrous cyclicity in pre- or peripubertal heifers (MGA, or CIDR)



Reproductive Tract Score (RTS) Summary

RTS	n	Weight (lb)	Pelvic Height (cm)	Pelvic Width (cm)	Pelvic Area (cm ²)	Estrous Response (%)
1 infantile	61	594 ^a	13.9 ^a	10.9 ^a	152 ^a	54 ^a
2 prepubertal (> 30 days from puberty)	278	620 ^b	14.1 ^a	11.2 ^a	158 ^a	66 ^b
3 prepubertal (< 30 days from puberty)	1103	697 ^c	14.5 ^b	11.4 ^b	166 ^b	76 ^c
4 cycling (follicular phase)	494	733 ^d	14.7 ^c	11.7 ^c	172 ^c	83 ^d
5 cycling (luteal phase)	728	755 ^d	14.7 ^c	11.7 ^c	172 ^c	86 ^d

^{a,b,c,d} Numbers with different superscripts within a column differ (P < 0.05)
Patterson and Bullock, 2000

**Pregnancy rates of heifers in natural service versus synchronized and AI'd herds**

RTS	Exposed		21-d pregnancy rate	
	Natural Service (n)	Synchronized & AI'd (n)	Natural Service (%)	Synchronized & AI'd (%)
1	8	55	38 ^a	42 ^a
2	108	661	31 ^a	52 ^b
3	336	3320	41 ^a	58 ^b
4	322	3629	48 ^a	62 ^b
5	242	2835	50 ^a	64 ^b
Total	1,016	10,500	44 ^a	61 ^b

^{a,b} P < .05
Adapted from Randle and Patterson, 2005

**SHOW-ME-SELECT REPLACEMENT™ HEIFER PROGRAM**
Reproductive tract score and subsequent FTAI pregnancy rate

FTAI Protocol	RTS and FTAI Pregnancy Rate					
	1	2	3	4	5	Total
7-Day CO-Synch + CIDR						
MGA - PG						
14-Day CIDR - PG						
Total	8/103 8%	203/336 32%	2389/5216 46%	2998/6111 49%	3490/6714 52%	9088/18780 48%



Thomas et al, 2015

**SHOW-ME-SELECT REPLACEMENT™ HEIFER PROGRAM**
Reproductive tract score and subsequent FTAI pregnancy rate

FTAI Protocol	RTS and FTAI Pregnancy Rate					
	1	2	3	4	5	Total
7-Day CO-Synch + CIDR	0/4 0%	16/58 28%	96/248 39%	145/328 44%	133/284 47%	390/922 42%
MGA - PG	0/3 0%	2/9 22%	79/221 36%	165/388 43%	100/176 57%	346/797 43%
14-Day CIDR - PG	8/96 8%	185/569 33%	2214/4747 47%	2688/5395 50%	3257/6254 52%	8352/17061 49%

**SHOW-ME-SELECT REPLACEMENT™ HEIFER PROGRAM**
Reproductive tract score and subsequent FTAI pregnancy rate

FTAI Protocol	Pre-Breeding Cyclicity and FTAI Pregnancy Rate		
	Non-Cycling	Cycling	Total
7-Day CO-Synch + CIDR	112/306 37% ^{a,x}	278/612 45% ^{b,x}	390/918 42% ^a
MGA - PG	81/230 35% ^{a,x}	265/564 47% ^{b,x}	346/794 44% ^a
14-Day CIDR - PG	2399/5316 45% ^{a,y}	5945/11649 51% ^{b,y}	8344/16965 49% ^a

^{a,b} Percentages within rows with different superscripts differ P < 0.01.

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SHOW-ME-SELECT REPLACEMENT™ HEIFER PROGRAM
FTAI Service Sires and FTAI Pregnancy Rates

Most heavily utilized AI sires	FTAI exposed	FTAI pregnant	FTAI preg rate
A	1734	875	50%
B	1456	745	51%
C	1052	534	51%
D	772	395	51%
E	562	237	42%
F	535	238	44%
G	508	291	57%
H	485	277	57%
I	442	238	54%
J	409	181	44%

SHOW-ME-SELECT REPLACEMENT™ HEIFER PROGRAM

- Development of heifers during the postweaning to prebreeding period sets the stage for future reproductive success/failure
- Reproductive evaluation of heifers prior to the first breeding season is useful in determining success of the development period
- The program database provides a unique opportunity to collect reproductive data on large numbers of heifers across the state

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SHOW-ME-SELECT™
Accomplishments and Impacts

- First statewide, on-farm beef heifer development and marketing program in the nation
- Producers are utilizing available technologies for on-farm heifer development that are now spilling over into the cowherd
- Increased interest & adoption of estrus synchronization and AI
 - Successful application
 - Differential in sale prices
- A growing interest in expanded use of AI to the entire herd
 - Reproductive management
 - Genetic improvement

"Use and application of what we know to create knowledge"

HERD EXPANSION - LOOKING AHEAD

- Animal scientists (reproductive physiologists & geneticists) need to work more closely with veterinarians and the AI industry.
- The industry needs more and better reproductive data.*
- It all begins with heifers.



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The SHOW-ME-SELECT™ Program
Educational conduit....

- "We" (academia, producers, veterinarians, and allied industry) learn from data generated from the program.
- Web-based expansion of our data base will afford other states or organizations to provide similar opportunities to their clientele.

HERD EXPANSION - LOOKING AHEAD

- As we consider herd expansion and heifer retention, development and breeding.....
- *Isn't it time the industry begin considering standardization of development practices and procedures as they relate to reproductive outcomes?*
- *Is it feasible to consider connecting these data to the national cattle evaluation to improve the quality of reproductive data collection, reporting and analysis?*



Marius Becker/European Pressphoto Agency



GENETIC VARIATION

- American Angus Association Heifer Pregnancy EPD
- Heritability of 0.14
- American Hereford Association Heifer Calving Rate EPD
- Heritability of 0.27

GENETIC VARIATION

- Show-Me-Select Replacement Heifer Program
- 1,556 Angus-sired Heifers with complete information for sire, herd, year, age, and weight at time of prebreeding examination
- 180 Angus sires represented
- 6 generation pedigree of sires

GENETIC VARIATION

- Show-Me-Select Replacement Heifer Program
- RTS is a repeatable and accurate measure of pubertal status in heifers (Rosenkrans and Hardin, 2003)
 - Sensitivity = 82%
 - Specificity = 69%
- RTS with herd, year, age, and weight as covariates
- RTS heritability estimate of 0.26
- Very similar to estimate of 0.32 by Anderson et al. (1991)

GENETIC VARIATION

- Show-Me-Select Replacement Heifer Program
- Pelvic width with herd, year, age, and weight as covariates
- Pelvic width heritability estimate of 0.45
- Published estimates range from 0.38 to 0.82 (Morrison, Williamson, and Humes 1986; Nelsen et al. 1986)

GENETIC VARIATION

- Show-Me-Select Replacement Heifer Program
- Pelvic height with herd, year, age, and weight as covariates
- Pelvic height heritability estimate of 0.31
- Published estimates range from 0.10 to 0.59 (Morrison, Williamson, and Humes 1986; Nelsen et al. 1986)

FERTILITY INDICATOR TRAITS

- Reproductive Tract Scores
- Pelvic Measurements
- Ultrasound Pregnancy Diagnosis within 90 days of breeding
- BIF Guidelines to standardize reporting