

A Systems Approach to Beef Improvement

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Outline

- To introduce to you a novel way of looking at the world.
- To review with you the principles of complex systems.
- To look at beef improvement through different lenses.
- Offer examples of systems thinking in beef improvement.

Goal for today

Challenge you to think about beef improvement not as a puzzle to be solved, but as a mystery to be unraveled!

Why?

- Because:
 - In spite of growing world wide population and demand for beef, the US beef industry is contracting.
 - Basic assumptions are naïve.
 - Elasticity of “demand” is not constant.
 - We can’t invest our way to profitability.
 - Understanding of profit drivers is limited.

Barry’s brief synopsis of beef improvement

- Most popular strategies have focused on ways to increase gene frequency of economically relevant traits.
- Once identified, to speed their diffusion through a population.

Barry’s brief synopsis of beef improvement , cont’d

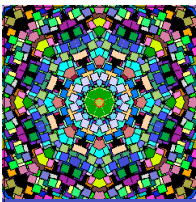
- Tools:
 - Identification
 - Quantitative genetics
 - Molecular genetics
 - Diffusion
 - Breeding systems
 - Generation turnover
 - Artificial insemination
 - Estrus synchronization
 - Sexed semen

So.... how's that going for us?

- We certainly have created change.
- But....has the beef industry become the ultimate game of



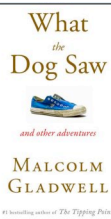
What if we changed our views about the world around us, and specifically about beef improvement?



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"Gladwellian" Philosophy



"What the Dog Saw"

- Collection of Gladwell's essays
 - Title: "Open Secrets"
 - Suggests that there are two ways to look at a problem:
 - As a Puzzle:
 - "transmitter dependent, they turn on what we are told"
 - As a Mystery:
 - "receiver dependent, they turn on the skills of the listener"



Beef Improvement as a "Puzzle"

Beef improvement as a “Puzzle”

Dependent on constant flow and adoption of techniques and technologies:

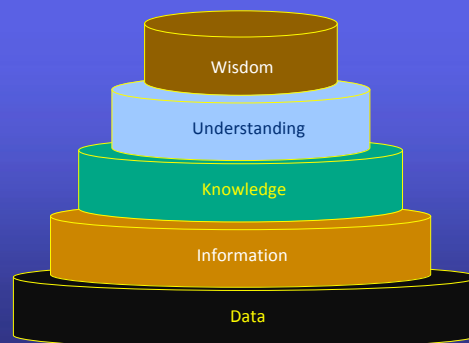
- Gene Frequency
 - Ratios
 - Breeding values
 - EPDs
 - Markers
 - SNPs
 - Genomically enhanced EPD
 - Whole Animal Panels
- Breeding systems
 - Crossbreeding
 - Composites
- Diffusion
 - AI
 - Sexed semen
 - Estrus sync



Beef Improvement as a “Mystery”

Beef improvement as a “Mystery”

- Dependent upon:
 - Our ability to view the world around as a **system** rather than a series of events:
Ranch Feedlot Packer Retailer Consumer
RanchFeedlotPackerRetailerConsumer
 - Our ability to collect, synthesize, and make sense of an wide array of data and information:
 - Optimization modeling
 - Study of “interactions”
 - Differences in scale (time)
 - Differences in scope (firm vs. industry).



Dee Hock, 1999

The call went out long ago.....

In the 1970s Cartwright argued for **optimization** of :

- Nutrient allocation (across entire system)
- Herd structure (age and marketing)
- Growth rate, milk production, and mature size for a given set of variable resources
- Stocking rates and supplementation

Long et al., 1975; and Joandet and Cartwright, 1975

Characteristics of Complex Systems

Jay Forrester

- Tightly coupled
- Dynamic
- Policy resistant
- Counterintuitive
- Exhibit tradeoffs

Why do complex systems behave the way they do?

Jay Forrester

- The nature of feedback misleads.
- We cannot understand complexity.
- Most difficulties are internally caused.
- Corrective actions often are the cause of problems.

Voices in our culture

“The definition of insanity is doing the same thing over and over again expecting different results”

Einstein

“The first thing you need to do to get out of a ditch is to stop digging”

“Unintended consequences”



Systems Thinking in Action:

Epigenetics

Definition: the mechanisms that allow an organism to respond to its environment through changes in gene expression.

Jaenish and Bird, 2003

Epigenetics cont'd

- Fetal Programming:
 - Protein supplementation of cows improved:
 - ww of calves.
 - Fertility of female progeny.
 - Some carcass characteristics of male progeny.
 - Health of male progeny.

Stalker et al., 2006; Martin et al., 2007; Larson et al., 2009

Lowering feed costs during 2nd and 3rd trimester may improve short-term profitability but decrease long-term profitability!

Epigenetics cont'd

- Post partum mgt. and gene expression:
 - Creep feeding (energy):
 - Improves marbling.
Meyers et al., 1999
 - Decreases lifetime productivity of females.
Martin et al., 1981
 - Aggressive implants affect marbling differently depending on age of the animal.
Bruns et al., 2005

Regardless of genetic potential, post partum management affects biochemical processes that control gene expression!



Epigenetics Cont'd

Interactions between Mgt. and Genetics

Zilpaterol affected marbling differently, depending on genotype of steers
(16% reduction, $P > 0.01$) Engler et al., BIF 2009

Knowing simple genotype & Choice/Select spread and could make \$

Summary

Is it more cost effective to increase gene frequency or to find an optimum level and "turn genes on and off" with management?

What is the marginal cost of changing phenotype by increasing gene frequency vs. the marginal cost of applying an epigenetic strategy?

Examples of systems thinking in beef improvement



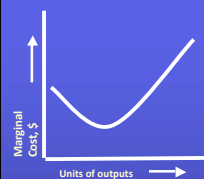
Systems Thinking in Action:

Economics/Genetics

In 1995, BIF was challenged to incorporate economic relevance into its genetic evaluation of beef cattle.

Melton, BIF 1995

Today, all major breed assoc. have economic selection indices



Systems Thinking in Action:

Microeconomics/Technology

In 2004, BIF was challenged to incorporate principles of microeconomics into its evaluation and application of technology.

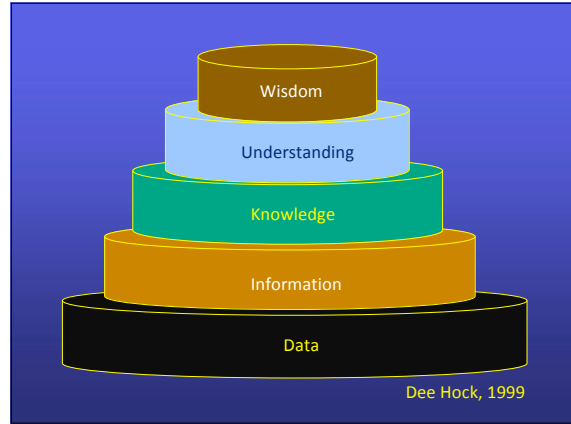
Dunn, BIF 2004



Systems Thinking in Action:

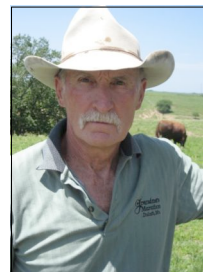
Interactions between Production Environment and Genetics

USDA-MARC researchers Jenkins and Williams develop "DECI," a beef systems model that is based upon known relationships and clearly exhibits that there is "no free lunch."



Dee Hock, 1999

Creative Systems Thinking



Creative Systems Thinking

Unintended Consequences

"Since maintenance energy is used for bodily function and repair, if we reduce maintenance energy requirements by selecting for low maintenance cows, do we reduce their longevity?"

Steve Radakovich, 2010



Creative Systems Thinking

Learned Animal Behavior and Production

Variation within pasture treatments in animal performance could be the expression of an animal's innate ability to adapt to its environment.

Provenza, 1995

And may allow for selection?



Creative Systems Thinking

Are our assumptions correct?

Widely held that heritability for weaning weight is 0.40. Heritability estimates for Santa Gertrudis cattle on King Ranch calculated to be 0.10. Could heritability estimates for cattle raised in extreme environments be different than those raised in more optimum or controlled environments?



Creative Systems Thinking

Are our business models correct?

If variation is the key, why are we trying to be homogenous? Our customers are not.

Scarcity creates value! Adam Smith



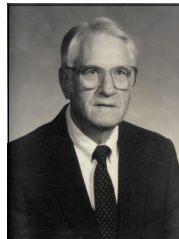
Creative Systems Thinking

Do we fully understand drivers of profit?

Depreciation is the second largest single cost in commercial beef production. One key way to lower depreciation is to lower replacement rate (improve longevity). What is a major strategy for increasing gene frequency by seedstock producers? Roll generations as fast as possible.



Beef Improvement as a "Mystery"?



On Beef Improvement:

"I doubt if we stand a chance of achieving understanding of the components, and the interactions among them, as long as we insist on **maintaining the comfort of our specialist or discipline zones**. All indications to me are that we need more integrations of our disciplinary efforts both within and among beef cattle problem areas if we are to make the greatest contribution to developing technology for maximizing the amount of edible beef, of a given quality, per unit of resource use."

Keith Gregory, 1972

For stabilization and growth of the US Beef Industry, beef improvement will have to...

- Go beyond waiting for the "next new thing."
- Go beyond parochial interests of breeds, disciplines, and careers.
- Be broader and deeper than generally acknowledged.
- Synthesize existing data and information.
- Reward risk taking.



Thank You!