Facilitating Enhanced Genetic Potentials for Cow Efficiency

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Define "Efficiency"

- ability to produce output without wasting inputs
  - It's about balance

- Doing the math:

$$\frac{Expense}{Product} = \frac{R_d + I_d + F_{md} + F_{pd} + N_o \left[D_o \left(I_o + F_{mo} + F_{po} \right) + S_o \right]}{P_d V_d \qquad + \qquad N_o P_o V_o}$$

per breeding female · per her offspring

- "Cow Efficiency" – an incomplete picture; but valuable nonetheless

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Rhetorical question:

*How well does the current suite of genetic evaluations serve our needs to improve efficiency?*

$$\frac{Expense}{Product} = \frac{R_d + I_d + F_{md} + F_{pd} + N_o \left[D_o \left(I_o + F_{mo} + F_{po} \right) + S_o \right]}{P_d V_d \qquad + \qquad N_o P_o V_o}$$

Greatest focus

Less focus   Missed opportunity

Even less focus

- **Aims**
  - Review aspects of current genetic evaluation systems for traits of the breeding female; and
 - Stimulate progress toward more effective systems of evaluation of her genetic potential

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Current tools
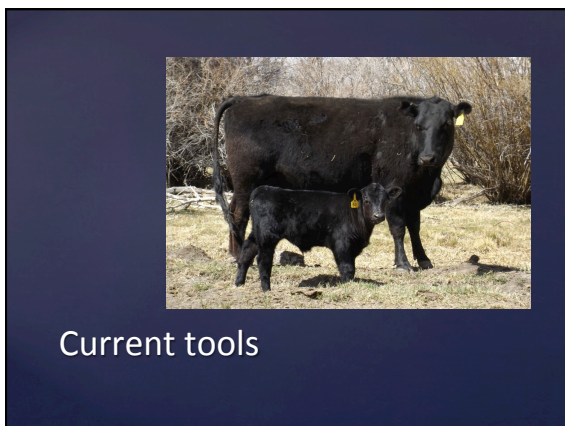
- **Number of offspring marketed (N_o)**
  - Probability of producing an offspring each year
  - Longevity

- **Stayability**
  - Binary
  - Inefficient use of contemporary groups
  - Partial records

- **Survival Analysis**
  - Time dependent contemporary groups
  - Censoring

Slide 1

➢Replacement cost (R_d)
- opportunity cost of weaning weight not marketed
  - Well evaluated
- postweaning growth and feed intake
  - Less data than weaning weight, adequately(?) evaluated
- pregnancy (calving) and culling rates
  - Issues with data recording

Slide 2

➢Feed requirements (F_{md}, F_{pd})
- Indicator traits and prediction models (R2 ≈ 75%)
- Challenge to simultaneously consider forage characteristics
- Opportunities for metabolomics?

Slide 3

➢Summary
- Some components related to breeding females are measured late-in-life and their evaluation could be facilitated by early-in-life indicator traits including genotypes
- Additional components of the objective are exceedingly expensive to measure and whose evaluation is greatly facilitated by indicator traits and genomic predictions
- Finally, evaluation depends on accurate recording and appropriate grouping of contemporaries.

Slide 4

Implementation

Slide 5
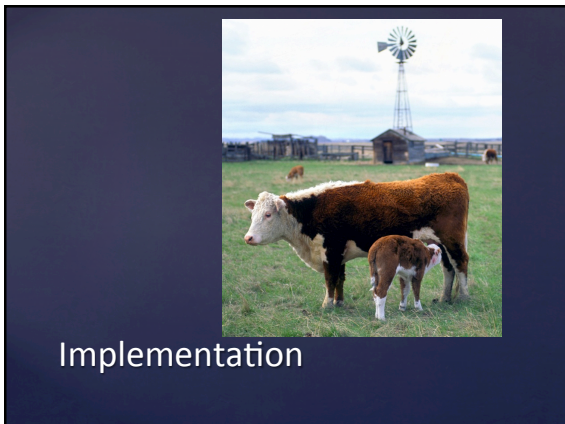
➢Successful evaluation of efficiency
- Requires capture of the full range in variation of underlying components
- Let's not make that data capture too onerous
  - Think through what data should be reported
- Whole-herd reporting should include information about females that "fail" and leave the system

Slide 6

Successful evaluation of efficiency
- Disposal date should be routinely reported and coupled with coded descriptors
  - e.g., age, open, bred late, sold for breeding use or unsoundness: teats, udder, feet, legs, mouth
- Measuring reproductive success and longevity could be enhanced by culling codes
  - limited in number
  - focused on the economically relevant traits.

Survival analysis (general)

- Time to event data
  - How old is she when she produces 4 calves?
  - How old is she when she is culled?
- Dynamic contemporary grouping changing over time
  - Environment – years are not all alike
  - Membership in contemporary group
- Censoring
  - Waiting for expression of trait
  - Left without expression of trait

Survival analysis (statistically enhanced)

- Categorical data
  - Cows calve at: 2, 3, 4, etc. years of age

- Incorporate frailty
  - Model within group (co)variation; relationships among mates

- Yields predicted stable age distribution

Geographic effects

- Economic values change with exposure levels
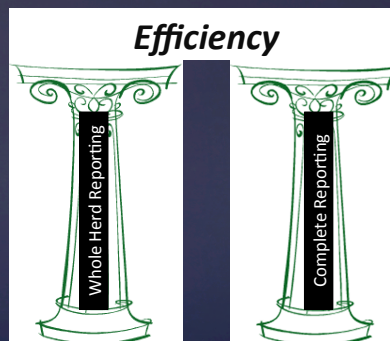 - Heat tolerance
  - Fescue tolerance
  - Calving ease

Cow efficiency only part of whole picture

- Adjust economic values to account for missing information

- Limited opportunity to break genetic antagonisms

- Past evaluations of cow efficiency
  - Focused on ratio measures
  - May not have accounted of reproduction

Vision

- Evaluate components from direct measures as indicator traits
- Combine results via multiple-trait selection indexes to predict efficiency
  - Restricted selection indexes – increase output without changing input
  - Microeconomic production theory as an alternative to simulation for estimating economic weights

- Limited opportunity to break genetic antagonisms

  Biggest impediment: lack of data to evaluate components

Efficiency

Whole Herd Reporting   Complete Reporting