Model for developing breeding objectives for beef cattle used in different production systems

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Introduction

In beef cattle: A wide range of
- breeding systems
- production systems
- management conditions
- economic and marketing conditions

It will be useful to have a general tool for defining the breeding objective for most of the possible situations.
Aim of the study

To do a first step in the development of a general bio-economic model covering a wide range of breeding and production systems as well as a broad spectrum of management, marketing and economic conditions in which beef bulls are used.
Production systems (1/2)

**System 1**: Pure-bred beef cow-calf pasture system producing females and males for own replacement and for other systems.

**System 2**: Cross-bred beef cow-calf pasture system (rotational crossing) producing its own female replacement and buying breeding bulls or semen.
Production systems (2/2)

- **System 3**: Cross-bred cow-calf pasture system (terminal crossing) being supplied with female replacement by System 4.

- **System 4**: Dairy or dual purpose cow herds with milk production (indoor system), partially terminal crossing with beef bulls.
Marketing strategies for surplus calves and/or heifers

- Selling (export) of weaned calves outside the system
- Fattening of weaned calves
- Selling of surplus heifers before mating*
- Selling of pregnant surplus heifers*

*Only for systems 1 and 4
Structure of the cow herd

- Ten reproduction cycles (lactations)
- Six stages within each lactation cycle (only four stages in the 10th cycle)
- Number of categories for cows: 
  \[(9 \times 6) + 4 = 58\]
- Transition probabilities between categories
- Stationary state of a Markov chain
Economic efficiency of the production systems: Profit function

\[
\text{profit} = \sum_{i} \text{revenues}_i NDE_i^{[rev]} - \sum_{i} \text{cost}_i NDE_i^{[cost]}
\]

\[
NDE_i^{[\cdot\cdot\cdot]} = l_i (1 - u)^{-t_i^{[\cdot\cdot\cdot]}}
\]

- \(NDE_i\) – number of discounted expressions for category \(i\)
- \(l_i\) – number of animals in category \(i\) per cow and year
- \(u\) – annual discounting rate
- \(t_i\) – time interval between calving and realization of revenues/costs
Traits

- **Growth traits**: birth weight, average daily gain in different growth periods (weight at different ages), mature weight.

- **Carcass traits**: dressing percentage, mean class for fleshiness and fat covering.

- **Functional traits**: Conception rate, calving performance, calf losses, average lifetime of cows.
Marginal economic values of traits

Marginal economic value of trait $i$:

$$ e v_i = \left. \frac{\partial profit(x_1, \cdots, x_n)}{\partial x_i} \right|_{x_j = \mu_j \text{ for all } j} $$

$$ \approx \left. \frac{\Delta profit(x_1, \cdots, x_n)}{\Delta x_i} \right|_{x_j = \mu_j \text{ for all } j} $$
Number of discounted expressions for direct and maternal components of traits

- **Direct traits**: realized once in animal’s life.
- **Maternal traits**: realized repeatedly during the life of dams.
- Several traits have both components.
- Number of discounted expressions for breeding animals:
  1. Gene-flow method (Hill, 1974; Elsen and Mocquout, 1974)
  1. Procedure of Nitter et al. (1994)
Calculation of economic weights

i Systems 1 to 3:

\[ e_{w_{ljkp}} = e_{v_l}NDE_{jkp} \]

- \( e_{w_{ljkp}} \) – economic weight for trait \( l \) within trait group \( j \), for selection group \( k \) and for production system \( p \)
- \( e_{v_l} \) – marginal economic value of trait \( l \)
- \( NDE_{jkp} \) – number of discounted expressions for trait group \( j \), selection group \( k \) and production system \( p \)
- Trait groups: direct or maternal traits
Future development of the model

- Inclusion of meat quality traits
- Extension to further production systems (indoor beef)
- Inclusion of further traits
- Consideration of different paying systems
- Addition of situations with constraints and quota
- Other species (pigs, sheep)
Conclusions

The presented model is useful for:

- The definition of a general breeding objective
- The construction of subindices for different production systems
- Economic analyses of production systems and individual farms
- Calculation of economic weights for dairy cattle
More information

- Related papers on this meeting:
  1. Peškovičová et al.: Presentation C4.11
  1. Wolf et al.: Poster G4.53
- Program ECOWEIGHT (freely available with detailed manual)
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