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 x 6) + 4 = 58

¡ Transition probabilities between categories

¡ Stationary state of a Markov chain

Economic efficiency of the production systems: Profit function

$$profit = \sum_i revenues_i NDE_i^{[rev]} - \sum_i \cos t_i NDE_i^{[\cos t]}$$

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

- 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

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

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

i **Functional traits**: Conception rate, calving performance, calf losses, average lifetime of cows.

Marginal economic values of traits

Marginal economic value of trait i:

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

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

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:
  - Gene-flow method (Hill, 1974; Elsen and Mocquout, 1974)
  - Procedure of Nitter et al. (1994)

Calculation of economic weights

ᵢ Systems 1 to 3:

$$ew_{ljkp} = ev_l NDE_{jkp}$$

- ew_{ljkp} – economic weight for trait l within trait group j, for selection group k and for production system p
- ev_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:
  - Peškovičová et al.: Presentation C4.11
  - Wolf et al.: Poster G4.53
- Submitted papers to Livest. Prod. Sci., Czech J. Anim. Sci., Züchtungskunde, Computers and Electronics in Agriculture
- Program ECOWEIGHT (freely available with detailed manual)
- Contact: wolfova@vuzv.cz, wolf@vuzv.cz

Thank you for your attention

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