Genetic Evaluation of Danish Beef breeds

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Abstract

The population sizes of the Danish beef breeds are all rather small. The largest breeds are Limousine, Simmental, Charolais, Aberdeen Angus and Hereford. The total numbers of registered purebred calves born in 2006 are 56,400 across all breeds.

Five trait groups are evaluated by multi-trait animal models. Evaluation is done separately for six breed groups. In total 18 traits are evaluated. They are summarized into seven sub indexes and a total merit index.

1. Introduction

The total population of beef cattle in Denmark amounts to 95,000 suckler cows in 8,900 herds. The Danish beef cattle industry is characterized by small herds. A large part of the herds are owned by part-time farmers or by dairy cattle farmers. In 1989-90 the registration system was technically reorganized and was joined with the dairy cattle registration system. All types of production and reproduction results as well as recordings of conformation are included. Up to 1998 registrations were only done in herds that actively wanted to participate (active breeding herds). Due to changes in legislation, all commercial beef cattle were included in this system in 1998. This meant that the number of animals in the recording system expanded heavily, but most of the commercial animals have only mandatory traits registered and many are crosses.

Since 1991-92 an Animal Model has been used for genetic evaluation of all traits and breeds. This evaluation includes all pure breed beef cattle with records in the registration system.

2. Beef breeds in Denmark

In total 16 different breeds are represented. The largest ones are Limousine, Simmental, Charolais, Aberdeen Angus and Hereford. The smaller breeds are Galloway, Dexter, Danish Salers, Blonde D'Aquitaine, Highland Cattle, Original Brown Swiss, Danish Shorthorn, Gelbvieh, Belgian Blue Cattle, Piemontese and Danish Grauvieh. The commercial herds are dominated by cross breed animals including crosses with dairy cattle.

Table 1. Breed of calves born in 2006. Calves with known pedigree and all calves.

	Pedigree[1]	All
Limousine	7,000	16,700
Simmental	3,400	8,900
Hereford	3,000	13,100
Charolais	1,900	5,600
Angus	1,700	6,000

[1] *Calves with known sire and maternal grandsire*

In table 1 the number of calves born in the larger breeds is shown. In table 1 the column denoted "pedigree" includes mainly calves from active breeding herds, whereas "all" include all animals with data in the recording system.

In Limousine, Simmental, Charolais, Aberdeen Angus and Hereford 17,000 purebred calves with pedigree information were born in 2006. These calves were born in 3,000 different herds.

As table 1 shows even the larger breeds are rather small. The table also shows that a large part of the calves lack pedigree information. Many of these calves have an unknown sire.

For the calves with "pedigree" in table 1 (known sire and maternal grandsire), 20-30 % were sired by a Danish insemination sire, less than 5 % had a foreign sire and 70-80 % had a natural mating sire. Exceptions were Simmental where 50 % of the calves had a Danish insemination sire and Charolais where 15 % of the sires were foreign. The use of foreign genetic material is limited in many breeds.

The herd sizes are small as shown in figure 1. This fact in combination with the relatively large extent of natural mating means that the progeny group size of sires also is limited.
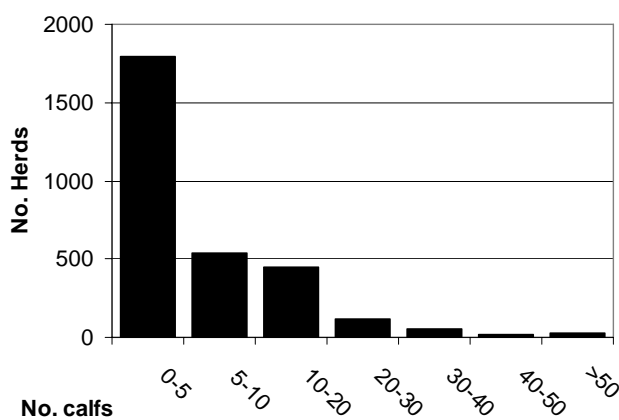

Figure 1. Number of calves per herd, for calves born in 2006.

3. Data recording/registration

Data for many traits are recorded and used in genetic evaluation for the beef breed. Table 2 shows a list of the actual traits and in table 3 the numbers of records per trait per year are shown for the five largest breeds. Survival at birth is a mandatory registration and, therefore, the number of records for this trait is equal to the number of calves born. Calving ease and carcass classification are registered for most animals (60-70 %). Birth weight is registered for 20-30 % of the potential animals, whereas other weight traits are registered for less than 10 % of the animals. Conformation is scored for less than 5 % of the animals.

Table 2. Traits registered and used in genetic evaluation for purebred and crossbred.

Trait group	Purebreds	Crossbred
Growth	Birth weight, weaning weight, yearling weight, carcass weight, body gain from performance test	Carcass weight
Birth	Birth weight, calving ease, survival at birth, survival 200 days after calving	Calving ease, survival at birth
Carcass quality	Carcass classification, area of L.D. from performance test	Carcass classification
Fertility	Calving interval	
Conformation	Classification of body, muscling and feet & legs	

Table 3. Number of registrations from 2006-2007 for selected traits.

	Simmental	Aberdeen Angus	Hereford	Charolais	Limousine
Purebreed					
Birth weight	3,122	1,840	3,054	1,841	7,399
Weaning Weight	583	335	833	430	1,699
Yearling weight	504	293	711	452	1,552
Carcass classification	5,384	3,793	8,357	3,488	10,914
Survival at birth	10,794	6,651	13,871	5,760	18,972
Calving ease	7,682	4,641	9,269	4,160	14,527
Calving interval	7,637	4,991	10,346	4,424	14,726
Conformation	322	206	159	142	581
Dairy crosses					
Stillbirth	2,977	299	325	450	6,790
Net weight gain	1,498	189	174	251	3,161
Carcass classification	1,318	150	117	218	2,600

4. Genetic evaluation

An Animal Model is used to estimate all breeding values of all traits recorded for purebred beef cattle. A modified version of the Animal Model is used for the traits recorded on dairy crosses. All dairy crosses are considered repeated observations of the sire and the genetic parameters are modified accordingly. The EBVs are calculated separately for six different breed groups:

- Limousine, Blonde D'Aquitaine, Piemontese and Belgian Blue
- Hereford
- Charolais
- Simmental, Brown Swiss, Grauvieh, Gelbvieh, Galloway and Salers
- Aberdeen Angus and Shorthorn
- Highland Cattle and Dexter

All groups of traits that include more than one trait are evaluated by means of multi-trait models. The fixed and random effects of the models are:

Fixed effects
- *Breed within breed group*. When breed is included in this way, the dominant breed of the breed group determines the estimates of the other fixed effects
- *Herd x year* is assumed to be a fixed effect for all traits recorded on purebred animals. The performance test station is considered as one herd
- *Season of calving* is the month of calving. Months with few calvings are pooled
- *Age of dam* is 1st, 2nd and subsequent calvings. Additionally, 1st calving is divided into sub-groups according to age at 1st calving
- *Sex*. Male or female
- *Age of calf x sex* is included for weight and carcass records, because there are large differences between animals for these traits
- *Twin*. Single or twin calf
- *Breed of dam*. This effect is only used for results from dairy crosses and includes effect of heterosis
- *Artificial or natural insemination* in model for calving interval. If a cow has been inseminated at least once, it is classified in a special group. In addition, all calving intervals of donor cows are excluded from the calculations

Random effects
- *Herd x year.* Very often only one or two dairy crosses are born in a dairy herd per year. Therefore, this effect is considered random for all results on dairy crosses
- *Permanent environmental effect* is included for all maternal traits
- *Maternal animal effect* is an estimate of the maternal breeding value
- *Direct animal effect* is an estimate of the direct breeding value.

Pedigree is traced back as far as possible and genetic groups are formed. Genetic parameters have been estimated on Danish beef cattle records for growth and calvings traits whereas the genetic parameters of the remaining traits are based on analyses of other beef cattle populations. The genetic parameters are assumed to be identical for all breeds.

5. Presentation of breeding values

The estimated breeding values are summarized into seven sub-indices. The seven sub-indices are:
- Female fertility
- Calving ability as maternel traits
- Milk production, as maternal part of growth
- Birth, as a direct part of calving ability
- Weight gain, as direct part of growth
- Slaughter quality
- Conformation

Indices for fertility, calving ability, milk production and birth are added in the functional index, whereas weight gain and slaughter quality are added in the production index. The functional index and production index are added in the total merit index (S-index). The indices are calculated using breed specific economic weights.

The sub-indices and the total merit index are standardized to an average of 100 and a standard deviation of 10 for all animals belonging to the genetic base. A rolling genetic base is used. The base includes all animals born 3-7 years before the publication year.

Indices are calculated four times a year. Indices are loaded to a central database and can be found on different printouts. Furthermore top lists of the different breeds can be found on the internet.

Indices are used by breed societies in the selection of potential bulldams and sires of sons and also in their magazines

6. Conclusion

In conclusion the beef breeds in Denmark are all rather small. Herd size and progeny group size are also in most cases quite limited.

Many traits are used when estimating breeding values data. Data are from both pure breed animals and dairy crosses. The purpose is to obtain higher reliabilities and the breeding values. More information about genetic evaluation for beef breeds can be found on
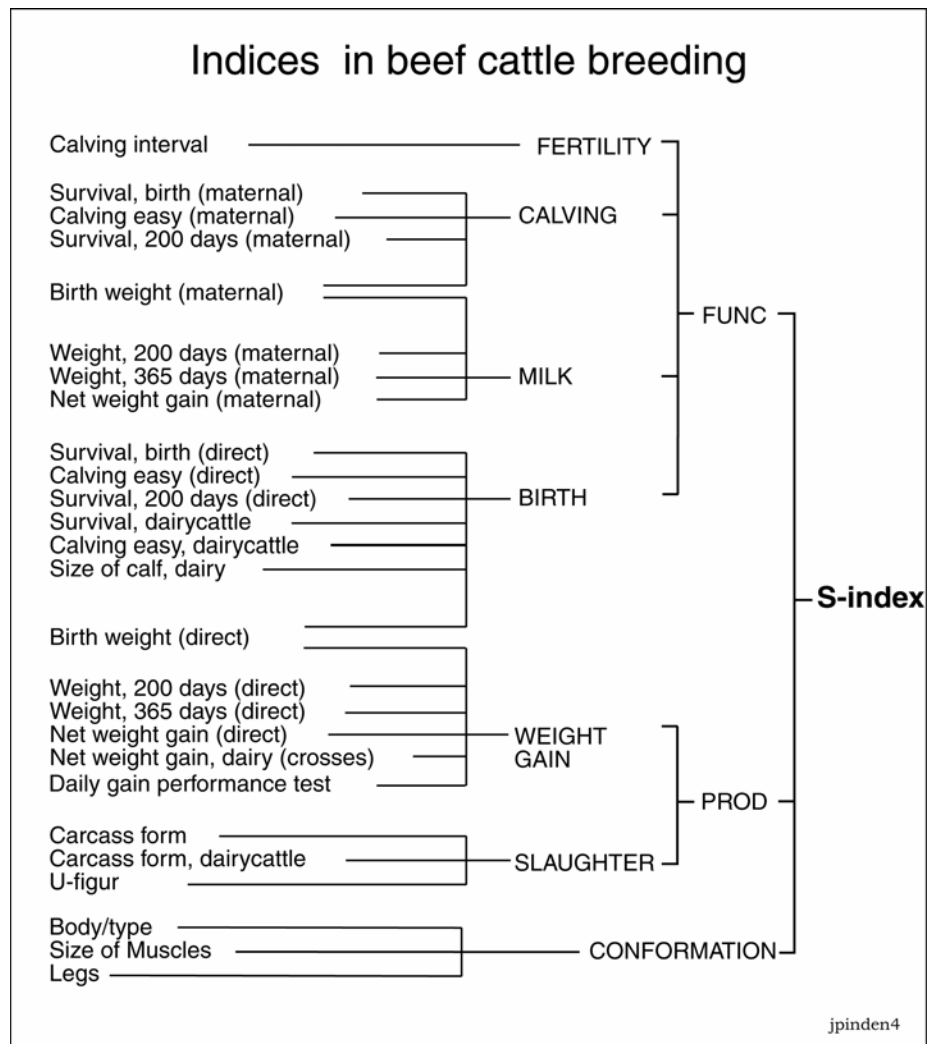 www.lr.dk/kvaeg/diverse/principles.pdf.

Figure 2.   Survey of traits and indices in the calculation of breeding values.