International Bull Evaluation Service
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BEEF CATTLE GENETIC EVALUATION FOR BEEF TRAITS - ADJUSTED WEANING WEIGHT AND CALVING EASE IN EUROPEAN COUNTRIES

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The aim of this report is to give an overview of the information about performance recording and national procedures for genetic evaluation, that was provided by the countries participating in beef international evaluations. Making this overview was possible when the information was gathered from free-text forms and standardized as a part of including Adjusted Weaning Weight and Calving Ease traits in Performance Recording, Evaluation and Publication (PREP) database.

Twelve European countries (10 being EU members) are participating in the beef cattle genetic evaluations and share their performance recording information with Interbull Centre.

National information shared contains trait definition, data collection and handling procedures, conditions for inclusion of the records in the evaluation, publication criteria, detailed information about evaluation models, including specific factors and scientific base for the procedures used. Availability of this information does allow the other countries and their evaluation centres to update and harmonize their methodology, if needed, but also makes it easier for them to expand their evaluation with new breeds and traits, by gaining awareness on the methods and procedures most commonly used by other organizations.

At the same time, the traditional way of sharing national information with Interbull Centre is done in the form of free text replies to the standard questions. Because the information provided in this format is not standardized, any comparisons between the national systems is cumbersome and, sometimes impossible, due to incomplete and/or unclear replies.

Interbull Centre as an EU reference center has a great interest in having this information standardized and therefore comparable. Since promoting the harmonization within EU national systems is one of the key duties of EU Reference Centre, Interbull Centre is looking into best way to make the national information presented in the standard, clear and accessible way, so the process of harmonization for the countries is more visible.

In 2021 Interbull Centre, under the auspices of European Union, opened the Performance Recording, Evaluation and Publication (PREP) database, that contains the information gathered from the currently provided free text information in the standard format and standard expressions per breed and trait combination.

In the current report we collected and compared the information about national evaluation systems, sent to Interbull Centre by the countries participating in the international evaluation for beef adjusted weaning weight (AWW) and calving ease (CAE). The report focuses on twelve (12) European countries which are currently EU members and participate in Interbeef evaluations. All twelve countries participate in the adjusted weaning weight international evaluation while 10 of them also take part in calving international evaluation.
We looked closely at several categories that are known to vary within these traits between the countries:

- *Trait Definition*
- *Adjustment Procedures and Calculations*
- *Evaluation Model*
- *Categories of phenotyped animals used in the evaluations*

OVERWIEV OF THE INFORMATION FOR ADJUSTED WEANING WEIGHT (AWW)

BREED STRUCTURE

Interbeef evaluations are carried out for several beef breeds: Limousin is evaluated in all 12 countries, Charolais in all but two. Only Spain and United Kingdom did not report any information about Charolais. The third most common evaluated breed is Aberdeen Angus (6 countries)followed by Simmental/Fleckvieh (5 countries) and Hereford (5 countries) (Table 1). Not enough information was provided by countries to determine how often such breeds are evaluated in a single- rather than multi-breed model. New form structure promotes providing this information, as well as including the information about other breeds.

TRAIT DEFINITION, RECORDING AND ADJUSTMENTS

Adjusted Weaning Weight (AWW) is a trait that is calculated from Live Animal Traits, usually by determining the daily growth between measured live weights, assuming this growth to be linear and then estimating the weight at the defined age. Live weight measurement can be taken just once or several times within the suckling period. Each calf may be weighted separately at the given age or according to a general scheme for suckling herd. ICAR Guidelines do provide the recommended procedures for each scenario. ICAR also defines the weaning age as 200 days.

Currently, the information provided by countries regarding the exact adjustment procedures and equations is very limited (only 2 countries provided the equation and 2 use live weaning weight instead of calculated AWW). More complete information is provided for the adjustment age (the age the AWW is calculated for). The majority of considered countries do adjust the weight to 200 (4) or 210 (4) days of calf age. Two countries – Switzerland and United Kingdom reported using Live (actual) weaning weight and, similarly Italy is reporting using live weight within age range of 120 to 210. That means that these countries do not use the standardized weight. Another outlier is Ireland, calculating the AWW for much later age of 225 days (Table 1).

Majority of the countries that use the calculation procedures for AWW use the live animal weight for AWW estimation. Only one country – Spain reported using Chest Circumference, which method is also recognized by ICAR for weight estimations.

Table 1 Breeds, traits and evaluation models that are included in the beef cattle genetic national evaluation system of EU members' countries, United Kingdom and Switzerland for adjusted weaning weight (AWW).

Country/Region	Breeds	AWW trait definition
Denmark-Finland-Sweden	Charolais (CHA), Limousin (LIM), Simmental/Fleckvieh (SIM), Aberdeen Angus (AAN), Hereford (HER)	Calculated from live weight to 200 days
France	Charolais (CHA), Limousin (LIM)	Calculated from live weight to 210 days
Germany	Charolais (CHA), Limousin (LIM), Aberdeen Angus (AAN), Hereford (HER)	Calculated from live weight to 200 days
Ireland	Charolais (CHA), Limousin (LIM), Simmental/Fleckvieh (SIM), Aberdeen Angus (AAN), Hereford (HER), Belgian Blue (BBL), Blonde d'Aquitaine (BAQ), Salers (SAL), Aubrac (AUB), Piedmont (PIE), Beef Shorthorn (BSH), Parthenaise (PAR), Romagnola (ROM)	Calculated from live weight to 225 days
Czech Republic	Charolais (CHA), Limousin (LIM), Simmental/Fleckvieh (SIM), Aberdeen Angus (AAN), Hereford (HER), Belgian Blue (BBL), Blonde d'Aquitaine (BAQ), Salers (SAL), Piedmont (PIE), Galloway (GLW), Gascon (GAS), Highland Cattle (HLA)	Calculated from live weight to 210 days
Slovenia	Charolais (CHA), Limousin (LIM)	Calculated from live weight to 210 days
Estonia	Charolais (CHA), Limousin (LIM), Simmental/Fleckvieh (SIM), Aberdeen Angus (AAN), Hereford (HER), Blonde d'Aquitaine (BAQ), Highland Cattle (HLA)	Calculated from live weight to 200 days
Italy	Charolais (CHA), Limousin (LIM)	Live weight between 120 and 210 days of age
Latvia	Charolais (CHA), Limousin (LIM)	Calculated from live weight to 200 days
Spain	Limousin (LIM)	Calculated from chest circumference to 210 days
United Kingdom*	Limousin (LIM)	Live weight at weaning
Switzerland*	Charolais (CHA), Limousin (LIM), Simmental/Fleckvieh (SIM), Aberdeen Angus (AAN), Aubrac (AUB), Brown Swiss (BSW)	Live weight at weaning
* Not EU member		

DATA SELECTION

Six out of twelve countries presented in this report, do include only purebred animals in their evaluations, either by restricting performance recording to such animals only, or by data selection at a later stage. Nearly all the countries restrict the data inclusion to certain animal age, but the actual age range is huge – from 90 to 450 days (Table 2). However it looks like in reality, ICAR Guidelines recommend Weaning Weight measurement as close to the actual (herd average) weaning age (200 days) and give warning about possible inaccuracy of Adjusted Weaning Weight calculations if the weighting date differs significantly from this value. To some extent, possible outliers resulting from inaccuracy of weaning age might be eliminated at the population level by excluding the data outside defined range of measurement or Standard Deviation. Such procedures were reported by seven countries (Table 2).

Other factors for inclusion of the data into an evaluation are related to the recording of additional information such as: dam being known (5 countries), national registration, herd information, dam age, birth type and date, calf sex and grazing type (Table 2).

Table 2 Conditions required for including the data in evaluation for adjusted weaning weight (AWW) across the EU members' countries, United Kingdom and Switzerland

	Conditions for data recording and inclusions					
Country/Region	PUREBRED	MEASUREMENTS or SD WITHIN RANGE	AGE RANGE	AVAILABILITY OF PARENTAL INFORMATION	ADDITIONAL INFORMATION	MINIMAL NUMBER OF OBSERVATIONS
Denmark-Finland-Sweden	Yes	WW 50-600kg	140-260 days	Dam Required		
France					Herd (Contracted)	
Germany	Yes		90-500 days			
Ireland		SD by Breed x Sex ±3			National registration	
Slovenia		Min SP 4 months	105-315 days	Dam Required	Herd Sex ID Birth date	
Estonia	Yes	BW 20-75kg WW 100-550kg DG 0.3-3kg	150-250 days	Sire & Dam Required		
Italy		SD by Age Class ±3.5	Max 365 days			More than 1 TD
Latvia	Yes	SD by Breed ±3				
Spain	Yes		Max 300 days			
Czech Republic			Max 450 days		National registration	
United Kingdom*		Max WW 500kg	170-300 days	Dam Required	Month Sex Foster Status Birth Type Dam Age	
Switzerland*	Yes	BW 10-80kg DG 0.3-2.5kg	90-320 days	Dam Required	Dam Age Birth Date Herd Grazing National registration	Min 2501 per Breed Min 11 per Herd Min 6 per Herd*Year

* Not EU member; BW – Birth Weigh; WW – Weaning Weight (Live); DG – Daily Gain; SP – Suckling Period

EVALUATION MODELS

The models used in national genetic evaluations for Adjusted Weaning Weight (AWW) are all based on Animal Model and Best Linear Unbiased Prediction (BLUP) (Table 3).

The largest difference in the basic model is using either Single Trait (5 countries) or Multi Trait (7 countries) models. Not all countries applying a Multi Trait model have provided detailed information on the other traits analysed together therefore it is not possible, at this very moment, to draw any further conclusion on this matter.

The overview statistical model applied by countries do show a high variety in the environmental effects considered. Majority of the countries (10) do include calf's Sex as fixed effect, either by itself or in interaction with other variables. Eight countries included either Dam age and/or Parity as fixed effect. Year was considered in eight countries, either as separate fixed effect or in interaction with other variables, most often herd and/or season, in which cases it is treated as random effect.

Genetic groups are used in eight (8) countries and they are mostly based on Breed (5) and Birth Year (6) (Table 3).

Table 3 Evaluation models for adjusted weaning weight (AWW) across the EU members' countries, United Kingdom and Switzerland

Country/ Region	Evaluation Model	Fixed Environmental Effects	Random Environmental Effects	Other Factors	Genetic Groups	Traits in AWW evaluation
Denmark -Finland- Sweden	BLUP AM MT DAM MPE	Herd*Year*Season Sex*Country Twin*Country Dam age*Country *Year group Country*Year*Month		Weighting age nested in Sex Weighting age^2 nested in Sex	Country of origin Birth year	Birth Weight (BWT); Adjusted Weaning Weight (AWW); Post-Weaning Growth (PWG); Yearling Weight (YW); Carcass daily gain (CDG); Carcass conformation score (CCO); Carcass fat score (CFA)
France	BLUP AM ST DAM MPE	Contemporary group Parity*Dam age Season Individual situation			None	Adjusted Weaning Weight (AWW)
Germany	BLUP AM MT	Sex Birth type Month Parity*Dam age	Herd*Year	Regression of Weighting age nested in Sex	Breed Selection path Birth year	Incomplete information
Ireland	BLUP AM MT MB	Sex Weighting age Parity Herd*Year*Season Previous Herd*Year *Season	Heterosis Recombination	Weighting age nested in Sex Weighting age*Age nested in Sex Weighting age*Age^2 nested in Sex	Main Breed	Incomplete information
Czech Republic	BLUP AM MT DAM MPE MB	Sex Dam age Heterosis Dam heterosis Year	Herd*Year*Season Heterosis Dam heterosis Maternal Permanent Environment		Breed	Calving Ease (CAE); Birth Weight (BWT); Weight 120d; Weaning Weight (WW); Yearling Weight (YW)
Slovenia	BLUP AM ST DAM MB	Breed Year Sex Parity	Herd		None	Adjusted Weaning Weight (AWW)
Estonia	BLUP AM ST	Breed Herd*Year Season Parity Sex*Twin Year			Breed Sex Birth year	Adjusted Weaning Weight (AWW)
Italy	BLUP AM MT				Country of origin Sex Birth year	Incomplete information
Latvia	BLUP AM ST	Sex Year*Season Parity	Herd*Year Animal ID Dam ID		None	Adjusted Weaning Weight (AWW)
Spain	BLUP AM ST DAM MPE	Contemporary group: Sex Dam age	Maternal Permanent Environment		None	Adjusted Weaning Weight (AWW)
United Kingdom *	BLUP AM MT FR DAM MPE	Contemporary group* *Herd*Management Month Sex Embryo transfer code Birth type Dam age			Birth year	Incomplete information
Switzerland*	BLUP AM MT DAM MPE	Sex Year Month	Herd*Year Animal ID Permanent Environment Dam ID	Covariables: Weaning age Dam age	Birth year Country of origin Breed Selection path	Incomplete information

** Not EU member; ST- single trait, MT- multi trait, MB- multi-breed, FR- fixed regression, DAM- Maternal genetic effect, MPE- Maternal Permanent Environmental Effect, AM- animal model, BLUP- best linear unbiased prediction.*

CONCLUSIONS

In this section we presented an overview of the current methods and procedures in recording and evaluating Adjusted Weaning Weight as it was documented by ten EU countries, United Kingdom and Switzerland.

The data show several similarities e.g. trait definition and basic Evaluation model, but also numerous differences e.g. age and weight range for data inclusion, between the countries.

BREED STRUCTURE

Just like in AWW evaluations, two breeds – Limousin and Charolais are reported by almost every country. Only United Kingdom did not report any information about Charolais. The third most common evaluated breed was Aberdeen Angus (5 countries) and Hereford (5 countries), then Simmental/Fleckvieh (4 countries) (Table 4). Similarly to Adjusted Weaning Weight, there is not enough information provided to determine how often the breeds are evaluated in a single vs multi-breed model.

Table 4 Breeds, traits and evaluation models that are included in the beef cattle genetic national evaluation system of EU members' countries and United Kingdom for Calving Ease traits.

Country/Region	Breeds	CAE traits and definitions
Denmark-Finland-Sweden	Charolais (CHA), Limousin (LIM), Simmental/Fleckvieh (SIM), Aberdeen Angus (AAN), Hereford (HER)	Birth Weight (BWT) - Collected within 48 hours of birth Calving Ease (CAE) – 4-level scale Still Birth (STB) – 2-level scale
France	Charolais (CHA), Limousin (LIM)	Birth Weight (BWT) Calving Ease (CAE) – 5-level scale
Germany	Charolais (CHA), Limousin (LIM), Simmental/Fleckvieh (SIM), Aberdeen Angus (AAN), Salers (SAL), Galloway (GLW), Blonde d'Aquitaine (BAQ), Hereford (HER), Red Highland Cattle, Scottish Highland Cattle, Uckermärker	Calving Ease (CAE) Still Birth (STB) - rate Age at first calving (AC1) Calving interval (CI) Number of calvings (NC)
Ireland	Charolais (CHA), Limousin (LIM), Simmental/Fleckvieh (SIM), Aberdeen Angus (AAN), Hereford (HER)	Calving Ease (CAE) – 4-level scale
Czech Republic	Charolais (CHA), Limousin (LIM), Simmental/Fleckvieh (SIM), Aberdeen Angus (AAN), Hereford (HER), Belgian Blue (BBL), Blonde d'Aquitaine (BAQ), Salers (SAL), Piedmont (PIE), Galloway (GLW), Gascon (GAS), Highland Cattle (HLA)	Birth Weight (BWT) (Weight at age of 120 days Weight at age of 210 days Weight at age of 365 days)
Slovenia	Charolais (CHA), Limousin (LIM)	Calving Ease (CAE) – 5 level scale
Estonia	Charolais (CHA), Limousin (LIM), Aberdeen Angus (AAN), Hereford (HER), Blonde d'Aquitaine (BAQ), Highland Cattle (HLA)	Calving Ease (CAE) – 3-level scale
United Kingdom*	Limousin (LIM)	Calving Ease (CAE) = Calving difficulty score (CDS) – 5-level scale
* Not EU member		

TRAIT DEFINITION AND RECORDING

ICAR Guidelines recommend that Birth Weight is collected within 48h after birth. They also stress out the importance of Birth weight measurements, since oversized fetus is considered to be the main reason for dystocia.

In the current data set we only have information of Birth Weight Trait from three populations – Sweden/Denmark/Finland, Slovenia and Czech Republic with only the first ones (DFS) providing more detailed information of trait definition.

As for Calving Ease, ICAR Guidelines recommend a 5-level scale, where: 1- Easy calving without assistance; 2 - Easy calving with some assistance; 3 - Difficult calving (hard pulling, assistance by 2 or more persons, mechanical assistance); 4 - Cesarean section; 5 – Embryotomy

Seven (7) countries reported recording Calving Ease, but only six (6) provided the information about the scale applied. Three countries use the recommended 5-level scale, two use a 4-level scale and one a 3-level scale (Table 4).

Still Birth is not specifically defined by the ICAR Guidelines. This trait was reported only by two populations: Sweden/Denmark/Finland and Germany, but not many details were provided.

The new structure of the form is facilitating providing additional information (e.g. details about trait recording) by specifically prompting the user to add more details if they state this trait is recorded. Therefore, we expect that the gaps in trait definitions described above will be filled in with time.

DATA SELECTION

Three (3) of the countries , reported no restriction in recording animals (all animals are recorded for a given trait) and two of them also include all the data into the evaluation models (Table 5).

Table 5 Conditions required for including the data in evaluation for Calving Ease traits across the EU members' countries and United Kingdom

	Conditions for data recording and inclusions				
Country/Region	PURE BRED	AGE RANGE	AVAILABILITY OF PARENTAL INFORMATION	ADDITIONAL INFORMATION AND/OR CONDITIONS	MINIMAL NUMBER OF OBSERVATIONS
Denmark-Finland-Sweden	Yes		Sire & Dam Required		
France	ALL ANIMALS RECORDED, ALL DATA INCLUDED				
Germany	Yes			Known environmental effects	
Ireland			Sire & Dam Required		Minimum of 5 calving records per herd in a 6 month period
Czech Republic	ALL ANIMALS RECORDED, ALL DATA INCLUDED				
Slovenia				Born at the farm	
Estonia	Yes	Cow 18-50 months	Sire & Dam Required	Calving interval 10-24 months	
United Kingdom*	ALL ANIMALS RECORDED				
* Not EU member.					

Out of the other five (5) countries that reported some restrictions in recording or data inclusion, three do record only purebred animals. Also three countries require the information about sire and dam in order to include the data into the analyses. Only Estonia

has data inclusion requirements for a defined calving interval, while only Ireland eliminates all the herds that do not have a minimum number of recordings (Table 5).

EVALUATION MODELS

The models used in national genetic evaluations for Calving Ease are all based on Animal Model and Best Linear Unbiased Prediction (BLUP) (Table 6).

The largest difference in the basic model is using either Single Trait (3 countries) or Multi Trait (4 countries) models. The compositions of the traits included in Multi Trait models varies between these countries (Table 6).

There is also a large variety in the environmental effects included in the evaluation models, but all the countries use either Dam age or Parity as fixed effect, alone or within interactions.

Genetic groups are used in five (5) countries and they are mostly based on Birth Year (4) or Breed (3) (Table 6).

Table 6 Evaluation models for Calving Ease traits across the EU members' countries and United Kingdom

Country/Region	Evaluation Model	Fixed Environmental Effects	Random Environmental Effects	Genetic Groups	Traits in CAE evaluation
Denmark-Finland-Sweden	BLUP AM ST DAM MPE	Herd*Year*Season Sex*Country Twin*Country Dam age*Country*Year group Country*Year*Month		Country of origin Birth year	Calving Ease (CAE)
France	BLUP AM MT MPE	Contemporary group Dam age Season		None	Calving Ease (CAE); Birth Weight (BWT)
Germany	BLUP AM MT REP	Sex Birth type Month Parity*Dam age		Breed Selection path Birth year	Age at First Calving (AC1); Calving Interval (CI); Calving Ease (CAE); Still Birth (STB)
Ireland	BLUP AM MB DAM	Parity Herd*Year*Season			Incomplete information
Czech Republic	BLUP AM MT DAM MPE MB	Sex Dam age Year	Herd*Year*Season Maternal Permanent Environment	Breed	Calving Ease (CAE); Birth Weight (BWT); Weight 120d; Weaning Weight (WW); Yearling Weight (YW)
Slovenia	BLUP AM ST DAM MB	BWT: Breed Year Sex Parity CAE: Breed Season*Year Sex*Parity *Dam age	Herd*Year	None	Calving Ease (CAE)
Estonia	BLUP AM ST	Breed Herd*Year Season Dam age Sex*Twin Year		Country of origin Breed Sex Birth year	Calving Ease (CAE)
United Kingdom*	BLUP AM MT FR DAM MPE	Month Embryo transfer code Birth type Parity		Birth year	Incomplete information

** Not EU member; ST- single trait, MT- multi trait, MB- multi-breed, FR- fixed regression, DAM- Maternal genetic effect, MPE- Maternal Permanent Environmental Effect, REP- Repeatability model, AM- animal model, BLUP- best linear unbiased prediction.*

CONCLUSIONS

This section showed an overview of the current methods and procedures in recording and evaluating the Calving Ease traits as it was documented by seven EU countries and United Kingdom.

The data show the similarities in the criteria for data inclusion and basic Evaluation model, but also some differences in other areas like trait definition and environmental factors included in the model.

FINAL REMARKS

Gathering the information from current national evaluation forms and transferring it to a database structure, made it possible to present an overview of rules and procedures across the countries currently participating in the international evaluations offered by Interbeef.

This report clearly showed significant differences between countries within some areas representing a good starting point for information exchange and, further harmonization's procedure.

There is still a good amount of information that is missing or incomplete, but we are confident that the recent change in the reporting format, from free text to an electronic form, will help filling in the gaps and thus improving the quality of information recorded.