Development of Conversion Formulae for Traits Related to Beef Production in Ireland

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Introduction

The Republic of Ireland has just over one million suckler and one million dairy cows (DAF-CMMS, 2006). Table 1 summarises the mating practice in Ireland: 59% of the calves born in 2006 were beef and/or dairy crossbred. Charolais (43%) was the most predominant sire breed used on suckler beef cows, followed by Limousin (30%), Angus (8%), Simmental (7%), Hereford (5%) and Belgian Blue (4%). The 'minor' beef breeds present in Ireland include the Blonde d'Aquitaine, Salers, Aubrac, Parthenaise, Piemontese and Maine Anjou. As most of these breeds originate from outside Ireland, a considerable amount of germplasm is imported annually to Ireland from Europe. In 2006, the Interbull centre in Uppsala (Sweden) extended its services to beef by creating InterBeef, the international genetic evaluation for beef cattle (InterBeef, 2007). Ireland is part of the InterBeef project and participated, in spring 2007, in the first international genetic evaluation for weaning weight between France, Ireland and The United Kingdom (Venot, 2007). While participating in the international genetic evaluation, Ireland has actively developed methods to give beef farmers, in the interim, access to foreign proofs on the Irish scale. The present paper will show the Republic of Ireland's approach to international genetic evaluation through conversion formulae. This approach will be phased out as AMACI for each trait becomes part of routine evaluations.

Material and Methods

French data

The data from France was extracted in April 2007 from the national database following the IBOVAL spring 2007 genetic evaluation. The data file contains the Estimated Breeding Values (EBV) and their accuracy for the following traits: direct (CNd) and maternal (AVel) calving difficulties, direct (CRsev) and maternal (ALait) weaning weights, muscle (DMsev) and skeletal (DSsev) composites. Data from the beef and progeny 2006-2007 evaluations was also extracted and the following traits were part of the study: carcass conformation (CONFjbs), carcass fat (GRASjbs) and carcass weight (PCARjbs).

Irish data

The Irish data was extracted from the ICBF database in May 2007 following the national genetic evaluation. The predicted differences (PD) and their reliabilities used for this study were: direct (DCAL) and maternal (MCAL) calving difficulties, direct (DWW) and maternal (MWW) weaning weights, muscle (MUSC) and skeletal (SKEL) composites, carcass weight (CWEI), carcass conformation (CCON), carcass fat (CFAT) and calf quality[1] (CQUA).

Conversion equations

To estimate the parameters of the regression and in order to limit the bias due to selection of foreign bulls on the basis of their French proof, the proofs calculated in Ireland were deregressed according to the method proposed by Goddard (1985):

$$PD'_{IRL} = \frac{PD_{IRL} - u_{IRL}}{rel_{IRL}} + u_{IRL}$$

where PD'_{IRL} is the deregressed form of the proof PD_{IRL} calculated in Ireland, rel_{IRL} the reliability computed in Ireland and u_{IRL} is the

[1] Calf quality = PD based, using marts data, on the animal weight and price per kilo predictors.

average of the genetic group or the population of bulls.

Stepwise regression using PROC REG (SAS, 2007) was used to develop the most parsimonious multiple-regression model. Multicollinearity between independent variables was quantified using the condition index and was avoided.

In order to detect possible outliers and leverage points and provide resistant (stable) results in the presence of outliers, regression coefficients for the generated model were also estimated using robust regression with PROC ROBUSTREG (SAS, 2007). The procedure computes some robust distances to detect outliers and leverage points (Colin, printed 2006, Weigel *et al*, 1999).

In order to maximise the number of animals included in the estimation of the parameters of the model as well as obtain confidence in the estimated parameters, the regression coefficients were estimated using sires with a reliability in Ireland of >10%, >20%, >30%....>90%. The chosen dataset is described in Table 2. The choice of the final population of bulls is guided by the analysis of the residuals, the observed correlations and the number of bulls in the sample of population.

Genetic correlations between traits across countries were estimated when applicable from the correlations between Irish estimated predicted differences and French breeding values and their reliabilities (Calo *et al.,* 1973).

Comparison of ranking

This method is a mean and standard deviation approach to integrate foreign proofs in the national evaluation where conversion equations could not be developed due to poor correlation and/or insufficient number of sires. It is solely designed for breeds who wish to have foreign proofs used in the national evaluation but whose population size does not facilitate the generation of conversion formulae. This approach applies only to convert similar traits in the foreign country to proofs in Ireland. The principle is to apply the standard deviation from the mean of the trait from the foreign country to the Irish scale of the trait to obtain an 'equivalent' ranking. This non genetic approach will be phased out as soon as conversion equations for each trait can be developed.

Blending the new proofs in the national evaluation

This method for blending the converted proofs into the Irish national proofs was described by Olori *et al.* (2002). When a foreign bull has a proof in Ireland based on its progeny, the Irish proof is official if its reliability is at least 50%; otherwise, the converted foreign and the Irish proofs are blended according to the following equation:

$$PD_b = \frac{\frac{1}{1-rel_{IRL}} \times PD_{IRL} + \frac{1}{1-rel_{CONV}} \times PD_{CONV}}{\frac{1}{1-rel_{IRL}} + \frac{1}{1-rel_{CONV}}}$$

and the reliability of the blended proof is:

$$rel_b = 1 - \frac{1}{\left(\frac{1}{1-rel_{IRL}} + \frac{1}{1-rel_{CONV}}\right) - 1}$$

<u>where</u> PD_b = *blended proof*
PD_{IRL} = *Irish proof*
PD_{CONV} = *converted proof*
rel_{IRL} = *reliability of the Irish proof*
rel_{CONV} = *reliability of the converted proof*
rel_b = *reliability of the blended proof*

Results

Only the French proofs using birth to weaning on-farm performances have been used; the carcass proofs extracted from the beef progeny programs could not be used because of insufficient number of beef progeny in Ireland (n<8, n<12 for Charolais and Limousine, respectively). Thus, the on-farm based French proofs could not be converted for carcass fat in either breed.

Table 2 gives the details about the connection between Ireland and France used in the conversion equations.

The estimated genetic correlation was low in the Limousine breed for maternal weaning weight (r_g = 0.39) and averaged approximately

0.60 for the direct calving difficulty and carcass weight in both breeds. Strong genetic correlations (>0.70) were observed for direct weaning weight, the muscle and linear composites, carcass conformation and calf quality.

Table 2. Number of bulls (N), average reliability of the trait in Ireland (rel_{IRL}) and estimated genetic correlation (r_g) between Ireland and France for the Charolais and Limousine.

		Charolais			Limousine		
		N	rel_{IRL}	r_g	N	rel_{IRL}	r_g
Irish Predicted Differences	DCAL	25	60	0.59	24	80	0.59
	MCAL	18	50	0.78	10	70	0.55
	DWW	58	60	0.80	54	70	0.83
	MWW	12	60	0.61	22	30	0.39
	MUSC	54	70	0.77	64	70	0.83
	SKEL	53	70	0.81	64	70	0.77
	CCON	47	60	0.92	65	50	0.82
	CWEI	26	60	0.55	53	50	0.51
	CQUA	37	50	0.70	58	40	0.82

In May 2007 and according to the rule of blending, the proofs of 6,904 Charolais and 5,802 Limousine animals originated in France and present in the Irish genetic database were converted to the Irish scale. Because of insufficient data and/or low correlation, the maternal weaning weight proofs for Charolais and Limousine and maternal calving difficulty for Limousine were converted using the comparison of ranking approach instead of conversion formulae.

Table 3 and Table 4 give the parameters of the conversions for each of the trait for the Charolais and Limousine breeds, respectively.

Discussion

The beef farmers and industry in Ireland have seen the benefit and are very keen to use the converted/blended proofs. It has been introduced successfully in May 2007 in the national genetic evaluation process for the Charolais and Limousine breeds as a first step towards international genetic evaluation. The use of conversion equations will stop when AMACI for each trait becomes part of routine evaluations.

Other breeds have shown great interest in making use of foreign breeding values: Hereford, Simmental, Angus, Blonde d'Aquitaine, Belgian Blue, Salers, Aubrac, Parthenaise and Piemontese. Depending on the size of their population in Ireland and on the degree of connection between Ireland and the foreign country(ies), conversion equations or comparison of ranking will be used. The Hereford breed is already participating in the international Hereford evaluation conducted by the University of Armidale in Australia.

This study has also clearly shown the importance of the animal identification and of the management of identification database.

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Table 1. Number of purebred (diagonal) and crossbred calves born in 2006 by breed of sire and breed of dam as recorded through CMMS and published by the Irish Department of Agriculture.

DAM / SIRE	CH	LM	HE	AA	SI	BB	SH	BA	SA	HO FR	MO	RB	MY	JE	Other	Total
CH	167454	90984	53022	47749	60376	20067	12114	1614	2615	35395	2176	192	350	127	815	**495050**
LM	55255	129415	36936	31132	40889	17868	8342	1736	1322	98115	3457	434	616	166	1013	**426696**
HE	4508	5253	26189	5135	4781	1745	1525	156	123	137625	2589	663	441	276	476	**191485**
AA	10814	13646	10715	32114	8624	4299	2966	275	321	167894	4001	1371	552	714	1419	**259725**
SI	11225	12154	10615	6305	32364	2958	1885	244	295	35977	1272	163	192	39	255	**115943**
BB	7216	12832	4750	5273	6325	7240	1183	595	247	37891	1491	126	204	137	276	**85786**
SH	1239	1674	1295	1540	1004	545	7617	30	83	3066	185	23	79	37	140	**18557**
BA	1400	2140	983	803	1297	825	191	1801	41	2099	143	36	6	1	40	**11806**
SA	1467	1605	698	959	879	425	485	143	2414	2181	120	44	26	4	73	**11523**
HO FR	560	994	1440	1295	1246	740	537	27	15	452589	4163	1779	871	1801	1169	**469226**
MO	73	124	113	124	282	69	48	7	0	11095	6460	130	264	70	133	**18992**
RB	16	23	15	17	36	34	18	3	1	3569	226	1829	173	12	71	**6043**
MY	13	45	22	19	24	9	17	0	1	730	58	17	988	3	6	**1952**
JE	1	5	7	9	6	7	4	0	1	3561	94	75	5	1282	95	**5152**
Other	866	1129	502	565	634	367	217	118	103	4870	272	110	100	94	3379	**13326**
Total	**262107**	**272023**	**147302**	**133039**	**158767**	**57198**	**37149**	**6749**	**7582**	**996657**	**26707**	**6992**	**4867**	**4763**	**9360**	**2131262**

CH Charolais LM Limousin HE Hereford AA Angus SI Simmental BB Belgian Blue SH Shorthorn

BA Blonde d'Aquitaine SA Salers FR Holstein Friesian MO Montbeliarde RB Rotbunt MY Meuse Rhine Yssel JE Jersey

Table 3. The parameters of the conversion equations calculated for the Charolais breed between the French IBOVAL 2007 and the Irish national genetic evaluation from May 2007.

CHAROLAIS			French Breeding Values					
			CNd	AVel	CRsev	ALait	DMsev	DSsev
		a	b_1	b_2	b_3	b_4	b_5	b_6
Irish predicted differences	DCAL	23.9078	-0.2139					
	MCAL	7.9506		-0.0956				
	DWW	-139.3825			0.7221		0.2543	0.5776
	MWW	-27.8724				0.1835		
	MUSC	-35.9924			0.4139		1.0157	
	SKEL	-2.4359					-0.2407	1.2966
	CCON	0.1361					0.0332	-0.0199
	CWEI	-64.0767			0.5011		0.4265	
	CQUA	20.1161					0.3061	-0.2966

Direct (CNd) and maternal (AVel) calving difficulties, direct (CRsev) and maternal (ALait) weaning weights, muscle (DMsev) and skeletal (DSsev) composites
Direct (DCAL) and maternal (MCAL) calving difficulties, direct (DWW) and maternal (MWW) weaning weights, muscle (MUSC) and skeletal (SKEL) composites, carcass weight (CWEI), carcass conformation (CCON), carcass fat (CFAT) and calf quality (CQUA)

Table 4. The parameters of the conversion equations calculated for the Limousine breed between the French IBOVAL 2007 and the Irish national genetic evaluation from May 2007.

LIMOUSINE			French Breeding Values					
			CNd	AVel	CRsev	ALait	DMsev	DSsev
		a	b_1	b_2	b_3	b_4	b_5	b_6
Irish predicted differences	DCAL	14.8982	-0.1341					
	MCAL	3.1460		-0.0555				
	DWW	-81.2322			0.6439		0.1927	
	MWW	-25.8734				0.2035		
	MUSC	14.9955					0.8798	
	SKEL	31.7378						0.7075
	CCON	1.1558					0.0233	-0.0182
	CWEI	-83.6654					0.4868	0.5142
	CQUA	33.3959					0.2880	-0.4038

Direct (CNd) and maternal (AVel) calving difficulties, direct (CRsev) and maternal (ALait) weaning weights, muscle (DMsev) and skeletal (DSsev) composites
Direct (DCAL) and maternal (MCAL) calving difficulties, direct (DWW) and maternal (MWW) weaning weights, muscle (MUSC) and skeletal (SKEL) composites, carcass weight (CWEI), carcass conformation (CCON), carcass fat (CFAT) and calf quality (CQUA)