Animal & Grassland Research & Innovation Programme

Grange

Suckler Cow Breeding Conference

'Setting a New Direction for Suckler Cow Breeding'

Tullamore Court Hotel, Tullamore, Co. Offaly - Thursday, 11 October 2012

Teagasc
Agriculture and Food Development Authority

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Foreword

Central to efficient and profitable suckler beef production is animal breeding. Due to the high cost of maintaining the suckler cow, breeding an efficient female is an essential component of cost-effective, sustainable, grass-based beef production systems. There is considerable on-going debate as to the ideal suckler cow type. However, in most cases this debate may be distilled down to a number of core principles and desirable traits.

Beef breeding in Ireland is now at a new crossroads. There is increasing concern about maternal traits in the suckler herd, and there is evidence that fertility of beef females is declining. To date, there is no obvious breeding index for selecting maternal attributes in males or females. To enable progress in beef cattle breeding it is necessary to assign economic values to the breeding traits that affect profitability so that breeding indexes can accurately reflect economic gains made at farm level by improving these traits. ICBF and a stakeholder group have recently reviewed existing beef breeding indexes and revised the economic values of the breeding traits using the Teagasc, Grange Beef Farm Systems Model. Three new indexes were developed, namely, “Maternal”, “Terminal” and “Dairy beef”.

This conference will provide an overview, both national and international, of current published information pertaining to suckler cow types and traits of importance. It then focuses on latest developments in Irish beef breeding indexes, especially new economic values and maternal traits, and the potential payback to the breeder/farmer from selecting animals based on genetic indexes. Finally, it provides a forum to discuss the most efficient way to proceed with rolling out the new genetic indexes.

Conference Programme

09.15 – 10.00 am: **Registration – Tea/Coffee**

10.00 am: **Conference Opening**. **Professor Gerry Boyle**, Director, ***Teagasc***

Session 1:
Suckler Cow Types - The current situation
Chairperson: Dr. Frank O'Mara, *Teagasc*

10.05 am: *Review of Irish suckler cow types: Research perspective* – Mark McGee (Teagasc)
10.30 am: *Review of Irish suckler cow types: Commercial perspective* – Andrew Cromie (ICBF)
10.55 am: *Review of suckler cow types: International perspective* – Steve Morris (Massey University, New Zealand)
11.25 am: Discussion

Session 2:
New Beef Breeding Indexes – Maternal trait focus
Chairperson: Dr. Brian Wickham

11.50 am: *Building Genetic Indexes; a brief summary* – (B. Wickham)
11.55 am: *Economic appraisal of performance traits in Irish suckler beef production systems* – Paul Crosson (Teagasc)
12.15 pm: *Genetic evaluations & indexes for Irish suckler beef production systems* – Ross Evans (ICBF)
12.35 pm: Discussion

1.00 – 2.15 pm: **Lunch**

Session 3:
Implementing Beef Genetic Indexes – What is the payback?
Chairperson: Bernard Eivers, *NCBC*

2.15 pm: *Genetic evaluations, do they work?* – Noirin McHugh & Denis Minogue (Teagasc)
2.35 pm: *Application of genetic indexes in Irish suckler herds* – Pearse Kelly (Teagasc) & Pat Donnellan (ICBF)
2.55 pm: Discussion

Session 4:
Efficient Adoption of Beef Breeding Indexes
Chairperson: Justin McCarthy, *Irish Farmers Journal*

3.30 pm: Open Forum – Cattle Breeding Industry representatives

5.00 pm: Close

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Editors: M. McGee and N. McHugh

Review of Irish suckler cow types: Research perspective

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Summary

- The main replacement breeding strategies available to farmers are sourcing replacement heifers from the dairy herd or from the suckler herd.
- From all the cow breed comparisons carried out at Teagasc Grange to date, the Limousin × Holstein-Friesian remains the benchmark cow breed type. However, crossbred beef breed cows with good maternal traits can achieve an almost comparable performance.
- To date, using cow breeds and breed types was the primary approach available, albeit very crude, of identifying desirable maternal traits.
- With the advent of the new beef breeding indexes, especially the Maternal Index (see subsequent papers in this Conference Proceedings), coupled with higher reliability beef bull genetic evaluations, increased rates of genetic gain and production efficiency will be possible in the national suckler cow herd.

Introduction

In Ireland approximately 50% of total beef production, and a greater percentage of output value, is derived from suckler beef production (Crosson and McGee, 2011).

Beef suckler cow numbers almost trebled in Ireland during the past 25 years and they now comprise half (1.06 m) of the national cow population (CSO, 2012). Simultaneously, an ever increasing proportion of the genotype of both the dams and sires in the beef herd has come from late-maturing breeds such as Charolais and Limousin (Drennan, 1994; 1999a; AIM, 2011). These changes have facilitated a dramatic increase in the proportion of our beef exports going to the higher-priced European markets. The scale of change that has occurred means that 47% of Irish beef exports now go to higher-value markets of mainland Europe (Bord Bia, 2012), where the quality specifications require lean carcasses of good conformation (i.e. a high proportion of meat in the carcass with a high percentage as high-value cuts). This evolving breed substitution has also permitted the development of a valuable live export market for high quality weanlings to mainland Europe.

Evolution of female breeding stock

The main replacement breeding strategies available to farmers are sourcing replacement heifers from the dairy herd or from the suckler herd, with the latter either bred from within the herd or purchased from another suckler herd.

Traditionally the heifers selected as replacement breeding stock for the national beef suckler cow herd were the product of crosses of early-maturing British beef breed bulls (e.g. Hereford, Shorthorn) and Friesian dairy cows. The increased size of the national beef herd relative to the dairy cow herd has meant that proportionately fewer of the replacement breeding heifers have come from the dairy herd. This process has been accelerated by the dominance of Holstein genetics within the national dairy herd since the progeny of these cows produce carcasses of lower beef value (McGee et al., 2005d) and for bio-security reasons, whereby selecting replacement heifers from within the herd reduces the risk of introducing disease. Currently, about 25% of replacement heifers come from the dairy herd with the remainder coming from the suckler herd, either homebred (60%) or purchased (40%) (Cromie, 2011).

Progressively, bulls of later-maturing "continental" breeds have predominated and *ca.* 85% of beef suckler cows are now bred to such sires. Presently, Charolais, Limousin, Belgian Blue and Simmental breeds comprise 36, 32, 8 and 5% of suckler beef cow sires, respectively (AIM, 2011). A national breeding policy increasingly based on selecting replacement heifers from the suckler herd (rather than the dairy herd) will inevitably result in the genotype of many beef cows being composed almost exclusively of late-maturing continental beef breeds and in some cases, of a single breed. Thus, for example, in 2011 *ca.* 148,000 Limousin crossbred cows were bred to Limousin sires and 140,000 Charolais crossbred cows were bred to Charolais sires (AIM, 2011).

In 1992, approximately 30% of suckler cows were late-maturing breed crosses and by 1998 this had increased to 52% (Drennan, 1994; 1999a). Presently, about 75% of cows are late-maturing breed crosses and the remainder are early-maturing breed crosses (AIM, 2011).

This change in replacement heifer breeding strategy means a significantly greater emphasis on selecting for maternal milk traits within beef breeds is required.

Suckler Cow Breed Type Comparisons

Production Systems context

Over the past several decades a number of studies have been undertaken at Teagasc Grange to evaluate alternative suckler cow breed types. Due to the considerably lower comparative cost of grazed grass as a feedstuff these cow type evaluations were operated within spring-calving (commencing mid-February), lowland, grass-based systems managed at a moderate to high stocking rate (e.g. Drennan, 1999b; Drennan and McGee, 2008; 2009; Minchin and McGee, 2011). The production systems comprised of a grazing season (March/April to October/November) and a corresponding indoor winter period.

In these systems the diet of the cow was confined to grazed grass or grass silage plus minerals/vitamins with the exception of first-calvers (heifers) who also received 1.0 to 2.0 kg of concentrate daily from calving until turnout to pasture. Central to feeding suckler cows is having them in optimum body condition at various stages during the annual production cycle; namely weaning, calving and breeding. Achieving target body condition scores is critical for good performance, especially reproduction (Drennan and Berry, 2006). Mainly for economic reasons mobilisation and deposition of body reserves is a key component to suckler cow nutrition, whereby cows mobilise body fat during the expensive indoor winter period and replenish it again on the cheaper produced grazed grass. Energy restriction pre-calving was achieved by offering moderate digestibility (ca. 660 g/kg DMD) grass silage ad libitum (or where silage nutritive value was high, the silage allowance was restricted or straw was included). After calving, cows were always offered the same or higher digestibility grass silage to appetite until turnout to pasture. To match feed demand to feed supply mean calving date (*ca.* mid-March) coincided with the start of the grass grazing season.

All cows used in the studies were first bred to calve at 2 years of age (unless stated otherwise) and were introduced into the herd in spring, at turnout to grass. Cows were bred using artificial insemination (A.I.) and/or natural mating to late-maturing sire breeds. The breeding season was typically 12 weeks in duration.

The cow reared her own calf through to weaning at the end of the first grazing season. They were rotationally grazed together on predominately perennial ryegrass pasture. The only concentrates offered to calves pre-weaning was that necessary as part of weaning management i.e. ~1.0 kg/head daily introduced *ca*. 4 weeks pre-weaning.

At the end of the first grazing season the weanling progeny were housed indoors and offered first harvest, high digestibility (DMD), grass silage ad libitum plus 1 to 2 kg of concentrate per head per day. The objective was to grow the animals at ~0.5 to 0.6 kg live weight per day and to avail of compensatory growth during the subsequent grazing season. Weanlings were generally taken through to beef within the production and finishing system operated at the time. Males were produced as steers at 24 months of age or bulls at 15/18 months of age, and heifers were produced at 20 months of age as described previously (Drennan and McGee, 2009; McGee and Minogue, 2012).

The proportional DM contribution of grazed grass, grass silage and concentrates per cow unit per year within these calf-to-beef systems is currently *ca.* 0.57 to 0.64, 0.26 to 0.28 and 0.08 to 0.15 (McGee et al., 2012). Equivalent values for the calf-to-weanling component is *ca.* 0.73, 0.26 and 0.01.

Beef × Dairy cow breed comparisons

The earliest of these studies compared beef × Friesian (Drennan and More O'Ferrall, 1989; Drennan et al., 1989; Drennan and McGee, 2004) and more recently beef × Holstein-Friesian (McGee et al., 2008) suckler cow breed types. These data are summarised in Tables 1 and 2. Late-maturing "continental" breed × dairy cows were 2.5 to 7.5% heavier than Hereford × Friesian cows (Table 1). Calving difficulty was similar for Hereford × Friesian and late-maturing × Friesian cow breed types. Milk yield of Hereford × Friesian and Charolais × Friesian was not significantly different resulting in similar pre-weaning growth rate of their calves. Likewise, calf pre-weaning growth was not significantly different between Hereford × Friesian and the other beef breed × dairy cows implying that generally, these breed types have similar milk yield. A preliminary study of calving difficulty in first-calving, Belgian Blue × Friesian (BBF) and Limousin × Friesian cows showed that cow live weight pre-calving (524 v. 521 kg), gestation length (290 v. 290 days) and calf birth weight (45 v. 43 kg) was similar for both breed types but that calving difficulty score and incidence of caesarean sections was significantly higher for BBF cows, which is undesirable (Drennan, 1999c).

The benefits of beef suckler cow replacements from the dairy herd having moderate size, late-maturing "continental" breed than early-maturing British beef breed genetics was demonstrated in a comparison of Limousin × Friesian and Hereford × Friesian dams in the context of a calf-to-beef production system. Cow feed intake, calving difficulty, reproductive performance and calf pre-weaning growth was similar (Table 1) but the male progeny from the Limousin × Friesian had higher lifetime growth rates and, better killing-out rates resulting in leaner carcasses of heavier weight. The breed differences for heifer progeny were in the same direction but were not as great (Table 2).

These differences in post-weaning performance and carcass traits due to cow breed type are entirely consistent with findings from Irish (and international) studies comparing progeny from early and late-maturing sire breeds bred to beef suckler (e.g. Leavy et al., 2010) and dairy (e.g. Keane, 1996) cows.

Table 1: Comparison of beef × Friesian or beef × Holstein-Friesian suckler cow breed types and pre-weaning performance of their progeny*

Study	Drennan & More O'Ferrall (1984)		Drennan et al. (1989)		Drennan & McGee (2004)		McGee & Drennan (2008)	
Cow Breed Type**	**HF**	**CF**	**HF**	**SF**	**HF**	**LF**	**LH-F**	**SH-F**
Cow								
Live weight: autumn (kg)	536[a]	565[b]	538[a]	578[b]	525[a]	538[b]	547	568
Body condition score: autumn (0-5)	3.3	3.3			3.1	3.0	2.3	2.1
Silage dry matter intake								
Pre-partum (kg/day)					7.1	7.4	7.7[a]	8.9[b]
Relative to mean live weight (%)					1.24	1.26	1.46	1.58
Calving difficulty (1-5)	Similar	Similar			2.3	2.1	1.6	1.3
Milk yield (kg/day)	8.5	8.7						
Calving interval (days)	364	368	Similar	Similar	368	368		
Pregnancy rate (%)					92.7	92.5		
Calf *(mean of males & females)*								
Birth weight (kg)	39.5	42.3	39.4	39.5	42.9	42.8	41.1	41.9
Pre-weaning daily live weight gain (kg)	0.95	0.99	1.03	1.03	1.10	1.13	(288)***	(292)***

*Means, within experiment, with different superscripts differ significantly (P<0.05)

**HF = Hereford × Friesian; CF = Charolais × Friesian; SF = Simmental × Friesian; LF = Limousin × Friesian; S-HF = Simmental × Holstein-Friesian (SH-F); LH-F = Limousin × Holstein-Friesian.

*** Weaning weight (kg)

Table 2: Performance of progeny of Hereford × Friesian and Limousin × Friesian cows to slaughter as bulls at 15 months of age and heifers at 20 months of age*.

	Cow breed type	
	Hereford × Friesian	**Limousin × Friesian**
Daily live weight gain: birth-to-slaughter (kg)	1.00	1.02
Slaughter weight (kg)	579	587
Carcass weight (kg)	321	332
Carcass weight per day of age (kg)	0.60	0.62
Kill-out %	55.4	56.3
Carcass conformation score[1]	9.5	9.5
Carcass fat score[2]	10.5[a]	9.3[b]

*Means with different superscripts differ significantly (P<0.05)

[1]Scale 1 to 15 (best) [2]Scale 1 to 15 (fattest).

Source: Drennan and McGee (2004)

Subsequent to the findings from this study, a research demonstration herd comprising of Limousin × Friesian cows (benchmark cow breed type) was used in the development of planned systems of suckler beef production at Teagasc Grange from 1991 to 1998 (Drennan, 1999a). The breeding system operated optimised heterosis (hybrid vigour). Data from this herd formed a large part of a 13-year study (1987-1999) on reproductive performance of spring-calving cows at Grange, which showed an overall pregnancy rate of 93.6% and a mean calving interval of 367 days (Drennan and Berry, 2006).

Heterosis (Hybrid vigour)

The advantages of heterosis or hybrid vigour for reproduction and maternal traits in beef suckler cows have been widely demonstrated and there are further advantages in progeny performance from using a sire from a third breed (Buckley et al., 2005).

Heterosis is defined as the superiority of the crossbred over the average of the two parents breeds for a particular trait (Fallon and Drennan, 1999). The benefits of hybrid vigour from crossbreeding are due to a combination of: enhanced reproductive performance, lower calf mortality and higher calf growth to weaning. International research shows that the expected benefit from using a cross-bred suckler cow as opposed to a purebred, in terms of kg of calf weaned per cow submitted for breeding, is about 13% (Fallon and Drennan, 1999). In addition, using a sire from a third breed (of at least equivalent genetic merit) increases the weight of calf weaned per cow submitted for breeding by approximately a further 8%.

Ideally, therefore, suckler cows should be crossbred and should be mated to a bull from a third breed (Fallon and Drennan, 1999).

Comparison of Charolais and Beef ×Holstein-Friesian cows

With the advent of a national breeding policy increasingly based on selecting replacement heifers from the suckler herd (rather than the dairy herd) and the predominant use of Charolais as a sire breed in suckler herds, a subsequent study was designed in the early 1990s to reflect and quantify the effect of increased retention of replacements from within the beef suckler herd by comparing upgraded Charolais dams with beef (Hereford and Limousin) × Holstein-Friesian dams (Drennan and Fallon, 1998; McGee et al., 2005 a, b and c; Drennan et al., 2005). The Charolais cows were 7/8 Charolais and were the result of an up-grading programme commencing with Charolais × Friesian. This data is summarised in Table 3.

Table 3: Comparison of upgraded Charolais and beef × Holstein-Friesian suckler cow breed types and pre-weaning performance of their progeny*

	Cow breed type	
	Charolais	**Beef × Friesian**
Cow		
Live weight: autumn (kg)	733^{a}	630^{b}
Body condition score: autumn (1-5)	3.3	3.3
Grass silage dry matter intake		
Late pregnancy (kg/day)	8.9	9.0
Relative to mean live weight (%)	1.2^{a}	1.4^{b}
Early lactation (kg/day)	9.4	9.3
Relative to mean live weight (%)	1.4^{a}	1.7^{b}
Calving difficulty (1-5)	1.4	1.6
Colostrum yield: first milking (L)	2.6^{a}	3.9^{b}
Colostrum quality: Ig Total (mg/ml)	166^{a}	196^{b}
Milk yield (kg/day)		
Indoors	7.1^{a}	9.3^{b}
Pasture	7.3^{a}	11.1^{b}
Calf *(mean of males & females)*		
Birth weight (kg)	47.5	46.0
Passive immunity: serum Ig total (mg/ml)	44^{a}	63^{b}
Pre-weaning daily live weight gain (kg)	1.07^{a}	1.17^{b}

*Means with different superscripts differ significantly (P<0.05)

Source: McGee et al. (2005 a, b and c)

Although upgraded Charolais cows were ca. 100 kg heavier than beef × Holstein-Friesian cows, daily dry matter intake of grass silage during late pregnancy was similar for both genotypes and when expressed relative to weight, was lower for Charolais (Table 3). Similarly, daily silage intake did not differ between the genotypes in early lactation. During the indoor winter period Charolais cows generally lost more weight (-106 v. -89 kg) and during the grazing season generally gained more weight (111 v. 94 kg) than Beef × Friesian cows, (the latter likely a reflection of the differences in milk production) resulting in a comparable annual weight change (McGee et al., 2005a). Body condition score changes were generally similar between the breed types. Based on feed intake and live weight changes it was estimated that the energy requirements of a 600 kg beef × Friesian cow during late pregnancy was equivalent to that of a 660 kg Charolais cow (McGee et al., 2005a).

However, replacement of the beef × Holstein-Friesian with the upgraded Charolais cow resulted in a reduction in the passive immunity of the calf (due to a lower colostrum immunoglobulin mass produced, a reduction in cow milk yield (due to the reduction in the proportion of dairy genetics in the cow) and, as a result, reduced calf weaning weight (Table 3). Thus, in an adverse environment calves from upgraded Charolais may not be able to withstand disease as readily as the progeny of the beef × Friesian due to a lower immune status (McGee et al., 2005b). The lower milk yield of Charolais compared to beef × Friesian cows resulted in *ca*. 20+ kg lighter calves at weaning. A 1 kg increase in daily milk yield was shown to increase daily live weight gain of the progeny of Charolais and beef × Friesians by 69 g and 30 g, respectively; reflecting a diminishing growth response at higher yields (McGee et al., 2005c). Nevertheless, there is a feed energy cost to milk production and more information is required on grazed herbage intake and nutrient requirements (including nutrient partitioning) of suckler beef cows divergent in milk yield.

Collectively, these data show that cow "size" alone is not a reliable indicator of intake and/or energy requirements, nor is cow size necessarily related to calf weaning weight - differences and efficiencies between (and within) breeds need to be accounted for (McGee et al., 2005a, c). Additionally, although there were obvious breed type differences in maternal traits such as colostrum yield and milk yield, there was substantial variation within the breed types implying that there is enormous scope for genetic progress in beef breeding programmes. For example, within the upgraded Charolais cow breed type, first-milking colostrum yield ranged from less than 1 litre to in excess of 5 litres and daily milk yield in early lactation (indoors) ranged from less than 5 kg to over 10 kg.

The steer progeny of Hereford × Holstein-Friesian and Charolais cows (by Charolais sires) were taken to slaughter at 24 months of age. This data is summarised in Table 4. While post-weaning growth did not differ between the genotypes, the progeny of Hereford × Holstein-Friesian dams had a heavier slaughter weight (due to greater pre-weaning gains) but lower kill-out proportion resulting in a heavier (numerically) and fatter carcass compared to those from Charolais cows (Table 4). However, carcass hind-quarter (more valuable) as a proportion of carcass weight and the proportion of meat in the carcass were higher for progeny from the Charolais dams.

The limited capacity of the suckler calf to compensate post-weaning for growth retardation experienced pre-weaning (due to lower milk yield of the cow) means that in spring-calving, pasture-based systems most of the differences in calf live weight at weaning (due to milk yield of the cow) are largely retained until slaughter (Drennan and McGee, 2004; Drennan et al., 2005; Murphy et al., 2008b). This demonstrates the importance of milk yield as a driver of life-time live weight gain in a spring-calving suckler calf-to-beef system.

However, in terms of carcass, the superior kill-out proportion and carcass quality of cattle with a greater amount of late-maturing breed ancestry was evident. This means that the magnitude of the breed difference apparent as live weight at slaughter was reduced when expressed as carcass weight and reduced even further when expressed as meat yield.

Table 4: Performance from weaning to slaughter of steer progeny of upgraded Charolais and Hereford × Friesian cows*

	Cow breed type	
	Charolais	**Hereford × Friesian**
Weaning weight (kg)	304[a]	330[b]
Slaughter weight (kg)	677[a]	710[b]
Daily live weight gain: birth-slaughter (kg)	0.86[a]	0.90[b]
Carcass weight (kg)	372	385
Carcass weight per day of age (kg)	0.51	0.53
Kill-out %	55.0[a]	54.2[b]
Carcass conformation score[1]	11.1	10.2
Carcass fat score[2]	11.4[a]	12.6[b]
Hind-quarter as a proportion of carcass weight (%)	46.7[a]	45.4[b]
Meat (%)	67.6[a]	64.2[b]
Fat (%)	15.1[a]	18.2[b]
Bone (%)	17.2	17.6

*Means with different superscripts differ significantly (P<0.05)

[1]Scale 1 to 15 (best conformation); [2]Scale 1 to 15 (fattest)

Source: Drennan et al. (2005)

A further consequence of no strategic replacement breeding heifer policy is the loss of heterosis or hybrid vigour (advantage to crossbreds over the average of the parent breeds) resulting from crossbreeding (Fallon and Drennan, 1999). At the time, this raised the question of how replacement heifers with desired attributes of heterosis, good reproductive performance, milkiness and moderate size can be produced within a suckler herd where the main objective is the “production of high quality meat animals” (Keane and Diskin, 1996).

Comparison of Limousin × Holstein-Friesian and Simmental × (Limousin × Holstein-Friesian) cows

As evidenced from the previous study there are disadvantages associated with loss of dairy ancestry, particularly in terms of milk (and colostrum) production from the genetic makeup of the suckler cow. Due to their origins some beef breeds, such as Simmental, have a relatively high milk yield. Incorporation of Simmental genetics may be a within-herd breeding strategy for maintaining milk production. In this context, pre-partum intake and performance of spring-calving Limousin × Holstein-Friesian (LH-F) and Simmental × (Limousin × Holstein-Friesian) (SLF) cows during the winter indoor period and the immune status of their calves was compared (McGee et al., 2008). Data are summarised in Table 5.

Dry matter intake (kg/day) was 7% higher and live weight 60 kg heavier for SLF than LF cows. Incidence of calving difficulty was lower for SLF than LF cows. Calf birth weight and concentration of IgG_1 in colostrum and calf serum were similar for both cow breed types. Use of Simmental genetics when selecting replacements from within the suckler herd, results in preservation of calf passive immunity, a lower calving difficulty score but this must be offset against a higher dry matter intake.

Table 5: Intake and performance during pregnancy of Limousin × Holstein-Friesian (LH-F) and Simmental × (Limousin × Holstein-Friesian) (SLF) cows*.

	Cow breed type	
	LH-F	**SLF**
Cow		
Live weight: autumn (kg)	536[a]	596[b]
Body condition score: autumn (0-5)	2.5	2.6
Silage dry matter intake		
Pre-partum (kg/d)	6.9[a]	7.3[b]
Relative to mean live weight (%)	1.22[a]	1.17[b]
Calving difficulty (1-5)	2.3[a]	1.3[b]
Colostrum IgG_1 (mg/ml)	148	137
Calf *(mean of males & females)*		
Birth weight (kg)	42.4	44.3
Passive immunity: serum IgG_1 (mg/ml)	55	53

*Means with different superscripts differ significantly (P<0.05)

Source: McGee et al. (2008)

Comparison of Beef × Holstein-Friesian, ¾ beef ¼ Holstein-Friesian and purebred beef suckler cow types

A subsequent study compared replacement heifers from the dairy herd (Limousin × Holstein-Friesian) with a range of replacement heifer breed types from the suckler herd (Murphy et al., 2005; 2008a and b). The cow genotypes involved were spring-calving, Limousin × Holstein-Friesian (LH-F), Limousin × (Limousin × Holstein-Friesian (LLF), Limousin (L), Charolais (C) and Simmental × (Limousin × Holstein-Friesian) (SLF) and their progeny to slaughter as bulls at 15 months of age and heifers at 20 months of age. The study evaluated the effect of a stepped increase in the proportion of late-maturing "continental" breeding (or a reduction in the proportion of dairy breeding) in the cow (i.e. beef × Holstein-Friesian v. ¾ beef ¼ Holstein-Friesian v. purebred beef – LH-F vs. LLF vs. L), contrasting late-maturing crossbred and purebred beef cow types (C, L v. LH-F, LLF, SLF), and late-maturing cow types of contrasting genetic potential for milking ability (LLF v. SLF). Within the ¾ late-maturing beef crossbreds, Simmental was used to reflect high maternal milk. Cows were bred to Limousin sires as heifers and Charolais sires subsequently. It is important to bear in mind that the proportion of late-maturing breed ancestry in all the progeny was 0.75 or greater. Results of the study are summarised in Tables 6 and 7.

Table 6: Intake and performance of five cow genotypes and pre-weaning performance of their progeny*

	Cow Breed Type				
	LH-F	**LLF**	**L**	**C**	**SLF**
Cow					
Live weight: autumn (kg)	552[a]	574[a]	616[b]	702[c]	582[ab]
Body condition score: autumn (0-5)	2.3[a]	2.7[b]	2.7[b]	2.5[ab]	2.7[b]
Muscularity score: autumn (1-15)	5.5[a]	6.8[b]	8.0[c]	7.8[c]	6.2[b]
Intake (kg DM/day)					
Grass silage: pre-partum	8.3[ab]	7.8[a]	7.0[a]	8.7[b]	9.2[b]
Zero grazed grass: mid-lactation	11.0	10.4	9.9	12.5	11.6
Calving difficulty score (1-5)	1.9[ab]	1.4[a]	1.6[a]	2.2[b]	1.6[a]
Colostrum IgG_1 (mg/ml)	80	76	76	96	89
Milk yield (kg/day)	9.7[b]	7.0[a]	5.5[a]	6.9[a]	8.7[b]
Calf *(mean of males & females)*					
Birth weight (kg)	47.9[b]	43.4[a]	48.7[bc]	50.5[c]	46.2[ab]
Passive Immunity: serum IgG_1 (mg/ml)	27.1[b]	21.6[a]	20.6[a]	18.1[a]	24.2[ab]
Pre-weaning daily live weight gain (kg)	1.12[c]	1.0[ab]	0.92[a]	0.98[a]	1.07[bc]
Weaning weight (kg)	285[c]	254[a]	243[a]	258[ab]	271[bc]
Muscularity score: weaning (1-15)	7.8	7.8	7.9	8.1	8.1

* Within rows, means without a common superscript differ significantly ($P < 0.05$)
Source: Murphy et al. (2005) and (2008a)

Charolais cows were heavier than all other breed types. Live weight of L was greater than LH-F and LLF with SLF being intermediate (Table 6). Live weight loss over the indoor winter period was greater for L and C cows than LLF and SLF, with LH-F being intermediate. Live weight gain during the grazing season was greater for C cows than LH-F, LLF and SLF, with L cows being intermediate. Annual live weight changes did not differ between the breed types. Body condition score was lower for LH-F cows than LLF, L and SLF, with C cows being intermediate. There was no affect of cow breed type on body condition score changes for any of the periods examined throughout the year. Silage intake was highest for SLF and C, lowest for LLF and L, and intermediate for LH-F. Overall, calving difficulty score was low but highest for C cows. Birth weight of calves from C cows was greater than all other breed types except L.

Colostrum IgG_1 concentration did not differ significantly between the breed types but passive immune status was higher for calves from LH-F than all other breed types except SLF. Therefore, calves from the LH-F and to a lesser extent SLF were better protected against disease in early life.

Milk yield of LH-F and SLF cows was similar and higher than the other breed types, which did not differ. Daily live weight gain from birth to weaning was greater for progeny of LF cows than all other breed types except SLF, who in turn, were greater than progeny of L and C cows. A 1 kg increase in daily milk yield for LH-F, LLF, L, C and SLF cows was associated with an increase of 41, 52, 51, 59 and 45 g, respectively, in daily live weight gain from birth to weaning of their progeny. This indicated that the response in calf live weight gain to milk yield is greater at lower yields.

There was no effect of cow breed type on daily live weight gain of progeny from weaning-to-slaughter (Table 7). Daily live weight gain from birth-to-slaughter was however, highest for progeny of LF and SLF cows, lowest for L and LLF, with C being intermediate, reflecting breed type differences in pre-weaning growth. Similarly, slaughter weight and carcass produced per day of age were greater for progeny of LF and SLF cows than for L and LLF, whereas C cows were intermediate. Carcass conformation score was highest for progeny of L and C dams, lowest for LF and LLF progeny, with SLF being intermediate. Carcass fat score was lowest for the progeny of L and C cows. Genotype effects were relatively small for carcass composition. This may be attributed to the fact that all the progeny compared in the current study contained at least 0.75 late-maturing beef breed ancestry.

Table 7: Performance from weaning to slaughter of the bull (slaughtered at 15 months of age) and heifer (slaughtered at 20 months of age) progeny combined of five cow genotypes*

	Cow Breed Type				
	LH-F	**LLF**	**L**	**C**	**SLF**
Slaughter weight (kg)	573[b]	536[a]	532[a]	553[ab]	568[b]
Daily live weight gain (kg)					
Weaning-slaughter	0.96	0.95	0.96	0.99	0.98
Birth-slaughter	1.01[c]	0.95[a]	0.93[a]	0.97[ab]	1.00[bc]
Carcass weight (kg)	318[b]	302[a]	304[a]	310[ab]	317[b]
Carcass per day of age (kg)	0.61[b]	0.58[a]	0.59[a]	0.60[ab]	0.61[b]
Kill-out %	55.4[a]	56.2[ab]	57.1[b]	55.9[a]	55.8[a]
Muscularity score: Pre-slaughter (1-15)	9.1[a]	9.1[a]	9.7[ab]	9.9[b]	9.5[ab]
Carcass conformation score[1]	8.7[a]	8.7[a]	9.7[b]	9.6[b]	9.1[ab]
Carcass fat score[2]	7.6[c]	7.6[bc]	6.6[ab]	6.4[a]	7.5[b]
Hind-quarter as a proportion of carcass (%)	49.0	49.7	50.0	50.1	48.8
Meat (%)	74.3	74.4	76.5	74.6	74.2
Fat (%)	7.2	7.4	5.9	6.3	7.5
Bone (%)	18.5	18.4	17.5	19.1	18.2
Meat to bone ratio	4.0	4.1	4.4	3.9	4.1

* Within rows, means without a common superscript differ significantly ($P < 0.05$)
[1, 2] EU Beef Carcass Classification Scheme Scale: [1]Scale 1 to 15 (best) [2]Scale 1 to 15 (fattest)
Source: Murphy et al. (2008a and b)

Overall the data demonstrate the superiority of crossbred cows with good maternal (milk) traits (LH-F and SLF) in terms of producing progeny with a higher passive immune status, weaning weight and carcass produced per day of age, which was however, associated with a higher dry matter intake of the cow genotype. Nevertheless, in spring-calving, lowland pasture situations, good reproductive performance has been achieved from cow genotypes with high milk production potential. Furthermore, the additional pre-weaning growth achieved by calves suckling spring-calving cows with higher milk production on grass-based systems is more cost-effective than growth attained by feeding additional concentrates. On the other hand, the purebred late-maturing “continental” dams produced progeny with superior carcass classification traits.

Additionally, the advantages of heterosis due to enhanced reproductive performance and lower calf mortality (not captured in this study) amounts to approximately 8% in terms of weight of calf weaned per cow, per annum. This would further favour the crossbred dam genotypes over the purebreds. Thus, it is desirable that the replacement programme in a suckler beef cow herd should have cross breeding in addition to milk production potential as important considerations.

A comparison of Beef × Holstein-Friesian and crossbred beef suckler cow types

The most recent and ongoing suckler cow type evaluation at Grange is the "Derrypatrick herd". The cow breed types selected broadly represent about two-thirds of the suckler "cow types" in the country and also the main replacement breeding strategies available to farmers i.e. sourcing replacement heifers from the dairy herd (i.e. Limousin × Holstein-Friesian) or from the suckler herd (i.e. Limousin × Simmental, Charolais × Limousin and Charolais × Simmental). The breeds used also correspond to *ca.* 80% of sires bred to suckler cows, nationally.

The three beef crossbred cow types represent replacements sourced from within the suckler herd using a two-breed rotational crossing breeding programme (Drennan and Fallon, 2001). The Limousin × Simmental is the "end result" of an "upgrading" of the Simmental × (Limousin × Simmental) cow type used in previous studies. Within the beef crossbreds, Simmental was used to demonstrate high maternal milk. Data from the first production cycle of the study is presented in Table 8. All cows were first calvers (mean calving age *ca*. 30 months) and bred to Blonde d'Aquitaine sires.

At weaning, LH-F cows were lighter and thinner than the beef crossbred cows. Milk yield was highest for LH-F and lowest for CL with genotypes having Simmental ancestry being intermediate. Calf pre-weaning live weight gain was higher for LF than LS and CS, who in turn, were higher than CL. These genotype differences in pre-weaning growth largely reflected differences in milk yield. Intake during pregnancy and calf birth weight was similar for all genotypes.

Calf live weight gain from weaning to slaughter did not differ between the cow breed types. However, weaning weight and live weight gain from birth to slaughter was greater for LH-F than CL with breed types having Simmental ancestry being intermediate. Carcass weight per day of age did not differ between the breed types. Carcass conformation score was lowest for progeny from LH-F.

Table 8: Intake and performance of primiparous Limousin × Holstein-Friesian (LH-F), Limousin × Simmental (LS), Charolais × Limousin (CL) and Charolais × Simmental (CS) cows, and growth and carcass traits of their bull (slaughtered at 18.5 months of age) and heifer (slaughtered at 20.5 months of age) progeny.

	Cow Breed Type			
	LH-F	**LS**	**CS**	**CL**
Cow				
Live weight: autumn (kg)	576[a]	654[b]	667[b]	654[b]
Body condition score: autumn (0-5)	2.8[a]	3.2[b]	3.2[b]	3.2[b]
Silage intake pre-partum (kg DM/day)	6.7	7.1	7.2	7.2
Milk yield (kg/day)	8.8[a]	6.6[b]	6.6[b]	5.7[b]
Calf				
Live weight (kg)				
Birth weight	44.9	42.3	44.4	42.8
Weaning	317[a]	284[b]	283[b]	265[c]
Slaughter	649[a]	636[ab]	627[bc]	606[c]
Daily live weight gain (kg)				
Pre-weaning	1.18[a]	1.06[b]	1.07[b]	0.97[c]
Weaning-slaughter	0.93	0.98	0.96	0.95
Birth-slaughter	1.03[a]	1.00[ab]	0.99[ab]	0.96[b]
Carcass weight (kg)	371	365	365	355
Carcass weight /day of age (kg)	0.63	0.62	0.62	0.60
Kill-out proportion (g/kg)	572	581	573	586
Carcass conformation[1]	9.2[a]	10.5[bc]	10.1[b]	10.7[c]
Carcass fat[2]	7.1	6.9	6.7	6.5

* Within rows, means without a common superscript differ significantly ($P < 0.05$)

[1, 2] EU Beef Carcass Classification Scheme Scale: [1]Scale 1 to 15 (best) [2]Scale 1 to 15 (fattest)

Source: Minchin and McGee (2011); McGee and Minogue (2012)

Results to date from this study are entirely consistent with the cow breed type studies outlined earlier and further substantiate those findings. Additionally, the post-weaning performance and carcass traits of the progeny from the contrasting suckler cow breed types evaluated are in broad agreement with the breed ranking obtained in late-maturing sire breed comparisons carried out in Ireland on progeny from the dairy (e.g. Keane, 1996) and suckler (e.g. Clarke et al., 2009; Crowley et al. 2010) herd, and internationally.

Suckler Cow Genotype Comparisons in Northern Ireland

A large scale on-farm study in Northern Ireland evaluated the influence of cow genotype on performance attributes (Kirkland and Keady, 2004). Findings from this study showed that: Cows with Angus or Hereford "genes" produced progeny with lighter, lower value carcasses with poorer carcass conformation and higher fat classification; Fewest calving difficulties were recorded with Angus crossbred cows while "real problems" were identified with use of cows with a high proportion of Belgian Blue; Dam genotype had no effect on calf survival; "Continental" × Holstein-Friesian cows produced progeny with similar carcass weight and value to ¾ or more Continental cows; Limousin × Holstein-Friesian and Simmental × Charolais produced progeny with high carcass values whilst maintaining good levels of fertility.

Collectively, these results are generally in agreement with the findings from the cow breed type research comparisons carried out at Teagasc Grange.

Discussion and Conclusion

The main replacement breeding strategies available to farmers are sourcing replacement heifers from the dairy herd or from the suckler herd. From all the cow breed comparisons carried out at Teagasc Grange to date, the Limousin × Holstein-Friesian remains the benchmark cow breed type. This "cow type" has a moderate feed intake, good reproductive performance and produces progeny with (i) a high passive immunity (ability to fight-off disease) due to higher colostrum production of the dam, (ii) a high weaning weight due to higher milk production of the dam, (iii) high carcass weight per day of age, mainly due to higher pre-weaning growth and (iv) good carcass classification (conformation and fat score) and composition characteristics. However, crossbred beef breed cows with good maternal traits can achieve an almost comparable performance.

It is evident that the cow breed structure in Ireland is very mixed, comprising of many breed types and countless combinations of these. Although there is an average cow breed type ranking for different traits, there is huge variation within genotype and consequently, large overlap between genotypes in these traits. Efforts to improve the genetics associated with suckler beef production traits must be based on selection according to individual animal performance (within the breed type chosen where appropriate). The challenge is, reliably identifying these high performing animals and proliferating them. To date, using cow breeds and breed types was the primary approach available, albeit very crude, of identifying desirable maternal traits. With the advent of the new beef breeding indexes, especially the Maternal Index (see subsequent papers in this Conference Proceedings), coupled with higher reliability beef bull genetic evaluations, increased rates of genetic gain and production efficiency will be possible in the national suckler herd.

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Review of Irish Suckler Cow Types: A commercial perspective

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Summary

- The objective of this paper was to examine the ideal type of cow for Ireland based on information from the Irish Cattle Breeding Federation database. The paper has served to highlight a number of important points in this regard including:

1. There has been a significant increase in the use of traditional breeds within the national suckler herd, as a potential source of suckler female replacements for the future.
2. Phenotypic differences between main breed groupings were minimal, due to an apparent high level of confounding between breed, herd, age and parity.
3. Genetic differences were significant across breeds and were larger than the observed phenotypic differences. Furthermore, the trends in suckler cow type (towards the traditional breeds) were consistent with the genetic differences, with theses breeds generally superior for cost of production traits such as calving, milk and female fertility.
4. Within breed differences were generally larger than across breed differences, especially for cost of production traits. This is critical for future genetic improvement programs, as understanding and exploiting within breed genetic differences will deliver greater long term genetic gain for our beef industry than focusing the debate on just breed differences.

- In addition it is hoped that the paper will help form the basis for a better understanding of the new €uro-Star Maternal and Terminal indexes, including their application and roll-out to the industry.

1. Introduction.

The ideal type of suckler cow is an often vigorously debated topic amongst suckler beef farmers, whether around mart rings, at open farmers meetings or within discussion group forums. Invariably the debate centres around the value of the cow traits (e.g. milk, female fertility, size and feed efficiency) compared to the calf traits (e.g. ease of calving, weight gain, and conformation), with strong opinions presented to support both opposing views.

Whilst overall farm profitability invariably depends on both components, the relative weighting on each will change depending on the available land type and prevailing economic circumstances. As a consequence of these facts we generally have larger, later maturing cows in Europe where beef prices are high and land is of good quality, and smaller, earlier maturing cows in America and Australasia where beef prices are lower and land generally of poorer quality. The flattening of beef prices around the world, coupled with increasing costs of production in Europe, including increased competition for land from dairying, is forcing a major re-think on the ideal type of suckler cow for Ireland.

The objective of this paper is therefore to examine the ideal type of cow for Ireland based on information from the Irish Cattle Breeding Federation database. The paper will focus on three main areas:

- Trends in breed preferences, including relevant phenotypic data
- Strengths and weakness of each breed, including genetic trends for key profit traits
- The potential role of genetic evaluations (as opposed to breed) as the primary source of information when selecting suckler female replacements.

In this way, we hope to introduce some further objectivity into the suckler cow type debate, as well as form the basis for later papers in the conference, particularly those focused on the establishment of the new €uro-Star indexes for suckler beef farmers.

2. Trends in breed preference including phenotypic performance.

The number of suckler cows with a beef calving has increased significantly in the past 12 months, from 859,396 in 2011 to 914,195 in 2012, an increase of some 6% in overall terms. Even larger improvements have been observed for the number of heifer replacements (+22%) and number of replacements with a known sire (+32%), with the latter increase being a direct consequence of the introduction of the Suckler Cow Welfare Scheme in 2008.

Table 1: Trends in Suckler cow numbers (2007 to 2012).

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**% change (11-12)**
Number of cows calved	924,872	976,754	945,255	873,489	859,396	914,195	6%
Number of heifer replacements % total	165,450 17.9%	187,843 19.2%	167,610 17.7%	137,679 15.8%	145,786 17.0%	178,091 19.5%	22%
Number heifers with known sire % total	35,476 21.4%	44,035 23.4%	44,827 26.7%	56,859 41.3%	99,872 68.5%	131,511 73.8%	32%

Whilst trends from Table 1 highlight a general positive increase in suckler cow numbers (especially in the last year), they tell us nothing about the individual breed preferences. Have they changed and if so what are the key factors driving the change?

Table 2 gives an overview of trends in beef female replacements for the past 6 years for key breed combinations. The breed combinations have been broken into 3 groups for ease of comparison and discussion. These are: (i) the existing Teagasc Derrypatrick breed groups, (ii) the traditional early-maturing breeds (Hereford and Angus) crossed onto various breed types and (iii) ¾ bred beef animals (note: this excludes any pedigree animals). Within each of these categories the following breed combinations were considered:

- LM-HF – Limousin Sire and Holstein-Friesian Dam.
- LM-SI – Limousin sire and Simmental dam (and vice versa).
- CH-SI – Charolais sire and Simmental dam (and vice versa).
- LM-CH – Limousin sire and Charolais dam (and vice versa).

- AH-HF – Angus or Hereford sire and Holstein-Friesian dam.
- AH-LM – Angus or Hereford sire and Limousin dam (and vice versa).
- AH-CH – Angus or Hereford sire and Charolais dam (and vice versa).
- AH-SI – Angus or Hereford sire and Simmental dam (and vice versa).

- LM – ¾ bred or greater Limousin (excluding pedigree animals).
- CH – ¾ bred or greater Charolais (excluding pedigree animals).
- SI – ¾ bred or greater Simmental (excluding pedigree animals).
- AH – ¾ bred or greater Angus or Hereford (excluding pedigree animals).

Table 2: Trends in breed preferences (2007 – 2012).

Breed Group	2007	2008	2009	2010	2011	2012	Annual change 7-11	Change 11-12
Derrypatrick								
LM-HF	12,101	14,364	13,533	10,851	12,243	15,814	0%	29%
LM-SI	8,876	10,154	9,371	7,873	8,727	11,192	0%	28%
CH-SI	9,045	9,686	8,460	7,013	7,289	8,896	-4%	22%
LM-CH	14,042	16,091	14,639	12,537	14,616	20,039	1%	37%
Traditional								
AH-HF	18,154	20,184	17,587	13,398	12,986	15,286	-6%	18%
AH-LM	12,928	14,116	11,937	9,425	10,365	13,435	-4%	30%
AH-CH	11,955	12,014	9,986	7,883	8,381	10,242	-6%	22%
AH-SI	5,308	5,624	4,716	3,782	3,666	4,255	-6%	16%
3/4 bred								
LM	6,110	6,466	5,628	4,166	4,880	5,219	-4%	7%
CH	7,407	7,255	5,678	4,359	4,113	4,277	-9%	4%
SI	3,487	3,462	2,600	2,063	2,077	2,080	-8%	0%
AH	3,373	3,140	2,447	1,968	1,993	1,940	-8%	-3%

A number of important observations can be taken from Table 2.

- The LM-CH is the most popular breed combination in terms of suckler herd replacements, reflecting the dominance of these two breeds within the Irish sucker herd. This is then followed by the LM-HF, AH-HF, AH-LM and LM-SI, respectively.
- Despite a growing level of discussion and interest in sourcing 1st cross replacements from the dairy herd (especially LM-HF and AH-HF), there appears to be no real shift towards these breed combinations, when compared with other combinations. This would tend to suggest that Irish suckler beef farmers are generally happier to: (i) breed their own replacements, or (ii) purchase replacements bred from the suckler herd.
- There has been a rapid turnaround in the usage of the traditional breeds as a potential suckler cow replacement. This is reflected in the fact that during period 2007 to 2011, usage of these breeds decreased by some 4 to 6%/year, compared to a 16 to 30 % increase between 2011 to 2012. Whilst this level of increase in not quite as high as the main continental breeds (LM, CH and SI), it is the turnaround that is of significance.
- There has been a definite shift away from ¾ bred or greater animals as potential replacements for the suckler herd. This is despite assertions from some quarters that “pure-breeding” results in greater uniformity, with consequential improvements in management, saleability and hence profitability. Trends from the Irish suckler herd suggest this is not the case, with Irish beef farmers preferring to cross different breeds as a means of generating maternal replacements.

So what has prompted the changes in breed preference as outlined in Table 2? Looking at phenotypic performance for each of the 12 breed groups (Table 3) suggests little difference between each of the breed groups for two of the key profit traits; daughter calving interval and steer carcass weight. Indeed whilst the results are largely consistent with results observed from Teagasc Grange, including the Derrypatrick herd, they give little justification for the apparent shift away from: (i) using ¾ bred females as potential suckler female replacements, and (ii) the use of the traditional breeds as potential suckler replacements, especially when one considers the very small differences in female fertility for each of the breed groupings.

Table 3: Trends in breed preferences (2007–2012) and phenotypic performance for two key profit traits*

Breed Group	Annual change 7-11	Change 11-12	Carcass weight (kg)	Calving Interval (Days)
Derrypatrick				
LM-HF	0%	29%	375.7	398.3
LM-SI	0%	28%	371.9	398.3
CH-SI	-4%	22%	378.4	397.7
LM-CH	1%	37%	375.1	399.0
Traditional				
AH-FR	-6%	18%	357.1	399.3
AH-LM	-4%	30%	360.1	397.9
AH-CH	-6%	22%	379.2	398.0
AH-SI	-6%	16%	368.3	398.0
3/4 bred				
LM	-4%	7%	376.0	400.9
CH	-9%	4%	380.5	403.0
SI	-8%	0%	375.5	400.9
AH	-8%	-3%	344.0	402.6

** Analysis was based on 153,418 steer carcass records (for steers slaughtered between 24 and 30 months in the past 3 years) and 1.83 million calving interval records for suckler cows calved in the ICBF database in the past 5 years.*

A number of criticisms could be levelled at data from Table 3, including the fact that: (i) no account is given of other key profit traits, most notably maternal milk, calving difficulty and feed intake/efficiency and (ii) the analysis is based on phenotypic data, which could mask true genetic differences due to confounding of many factors such as breed, age, parity and herd type. To help answer the question more fully, a more rigorous genetic analysis of the data is required.

3. Strengths and weaknesses of each breed, including genetic trends for key profit traits.

To help understand the apparent shift in breed preferences as outlined in Table 2, we must first understand: (i) strengths and weakness of the various breeds presented and (ii) the direction the breed is taking in terms of average genetic level for key profit traits.

Table 4. Average genetic merit (including top and bottom 1%) for key profit traits for a range of beef breeds.

	Traditional			Mainly Terminal					Mainly Dual purpose		
Trait	**AA**	**HE**	**SH**	**BB**	**BA**	**CH**	**LM**	**PT**	**AU**	**SA**	**SI**
Calving Difficulty (% 3 & 4)	2.4	4.3	3.7	13.8	5.7	8.3	5.3	5.5	4.1	3.3	5.8
Across breed rank	1	5	3	11	8	10	6	7	4	2	9
Top 1%	0.9	1.9	1.7	4.8	2.5	3.7	2.5	2.4	1.8	1.3	2.8
Bottom 1%	5.7	9.2	8.0	25.8	12.2	16.7	11.1	12.2	10.3	5.4	12.4
Docility (1-5 scale)	0.01	0.10	0.04	0.16	-0.03	0.04	-0.06	0.00	-0.02	-0.09	0.03
Across breed rank	6	2	3	1	9	3	10	7	8	11	5
Top 1%	0.26	0.33	0.25	0.31	0.15	0.23	0.14	0.28	0.20	0.11	0.24
Bottom 1%	-0.23	-0.13	-0.18	-0.05	-0.30	-0.19	-0.30	-0.23	-0.32	-0.37	-0.24
Carcass Weight (kg)	2.8	2.5	1.4	27.8	23.1	27.9	18.6	17.3	13.4	13.1	16.0
Across breed rank	9	10	11	2	3	1	4	5	7	8	6
Top 1%	14.2	13.3	14.4	38.7	34.6	39.4	29.3	29.1	22.6	25.0	28.0
Bottom 1%	-9.0	-7.7	-11.2	14.0	10.7	14.5	7.2	6.0	2.5	1.0	-1.4
Carcass Conf (1-15 scale)	0.7	0.6	0.5	2.3	1.7	1.7	1.8	1.3	1.5	0.9	1.14
Across breed rank	9	10	11	1	3	3	2	6	5	8	7
Top 1%	1.1	0.9	0.9	2.8	2.1	2.0	2.2	1.9	2.0	1.3	1.6
Bottom 1%	0.4	0.2	-0.1	1.5	1.0	1.2	1.3	0.7	0.9	0.5	-0.5
Feed Intake (DMI kg/day)	0.26	0.29	0.39	-0.42	-0.27	0.06	-0.28	-0.07	-0.12	-0.03	0.35
Across breed rank	8	9	11	1	3	7	2	5	4	6	10
Top 1%	0.02	0.06	0.18	-0.75	-0.49	-0.19	-0.51	-0.33	-0.38	-0.28	0.02
Bottom 1%	0.54	0.5	0.58	-0.05	-0.02	0.34	-0.04	0.14	0.1	0.22	0.66
Dau Calving Interval (days)	-4.5	-3.1	-4.4	3.2	1.5	0.5	1.3	-1.1	-2.2	-3.0	-0.5
Across breed rank	1	3	2	11	10	8	9	6	5	4	7
Top 1%	-8.1	-6.0	-7.8	-0.6	-3.0	-4.0	-2.4	-4.0	-4.8	-6.1	-4.1
Bottom 1%	-1.1	0.2	-0.9	7.8	7.4	5.2	5.6	2.4	1.3	-0.2	3.3
Daughter Milk (kgs)	7.5	4.3	10.6	3.1	-6.2	-5.8	-0.3	-3.8	-1.0	10.3	9.6
Across breed rank	4	5	1	6	11	10	7	9	8	2	3
Top 1%	16.5	9.8	17.4	10.6	0.9	2.6	7.5	3.4	7.2	17.4	23.8
Bottom 1%	1.4	-1.4	4.5	-5.7	-13.4	-12.9	-6.9	-11.6	-8.4	1.9	1.8
Dau Calving Diff (%3 & 4)	8.6	7.0	8.3	10.3	6.2	5.8	5.9	7.1	7.2	7.3	6.0
Across breed rank	10	5	9	11	4	1	2	6	7	8	3
Top 1%	6.5	4.9	6.4	5.2	3.7	3.3	3.8	4.1	4.5	5.3	2.8
Bottom 1%	10.8	9.0	10.2	16.5	8.1	8.4	8.0	9.2	9.5	9.0	8.8

Data presented in Table 4 indicates that, in general, the traditional breeds (i.e. Angus, Hereford and Shorthorn) perform best for the cost of production traits, most notably cost of calving, daughter calving interval and daughter milk. In contrast, the continental terminal breeds (i.e. Belgian Blue, Blonde d'Aquitaine, Charolais, Limousin and Parthenaise) perform best for carcass weight and conformation, including feed efficiency (given the strong relationship between growth and feed efficiency). In addition, the continental dual-purpose breeds (Aubrac, Salar and Simmental) tend to perform well for both sets of traits (i.e. both terminal and maternal).

Given the current focus on costs of production at farm level (as outlined earlier), it is therefore not surprising to see a shift in interest towards the traditional breeds as outlined in

Table 2. This is further confirmed by an examination of the genetic trends for key beef breeds, which generally indicate that the continental terminal breeds (and most notably Charolais and Belgian Blue) have selected heavily on carcass traits, at the expense of cost of production traits such as maternal milk (Figure 1 and 2).

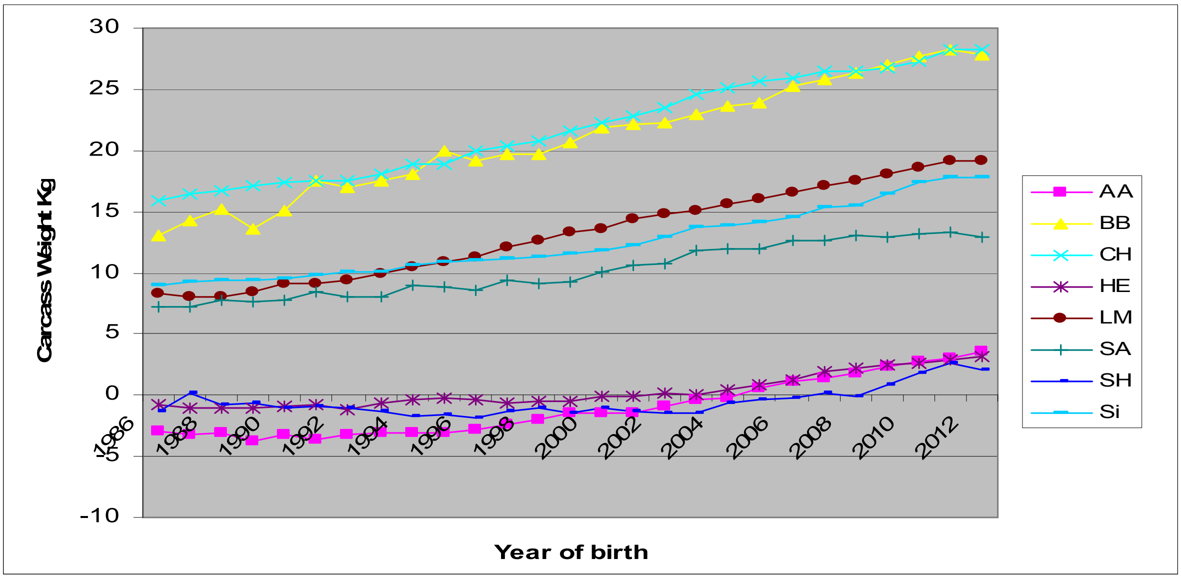

Figure 1: Trends in genetic merit for carcass weight for pedigree animals born between 1986 -2012.

In contrast, the traditional and dual-purpose breeds have made much less progress in the carcass traits, resulting is no major negative effect on traits such as maternal milk, although the downward trend in maternal milk for the Simmental breed should be an issue of concern given that this is seen as one of the major strengths of this breed. Indeed some of the traditional breeds (most notably Angus) are now reporting a strong upward trend in maternal milk yield, with consequential effects on its popularity as a breed for generating potential suckler herd replacements.

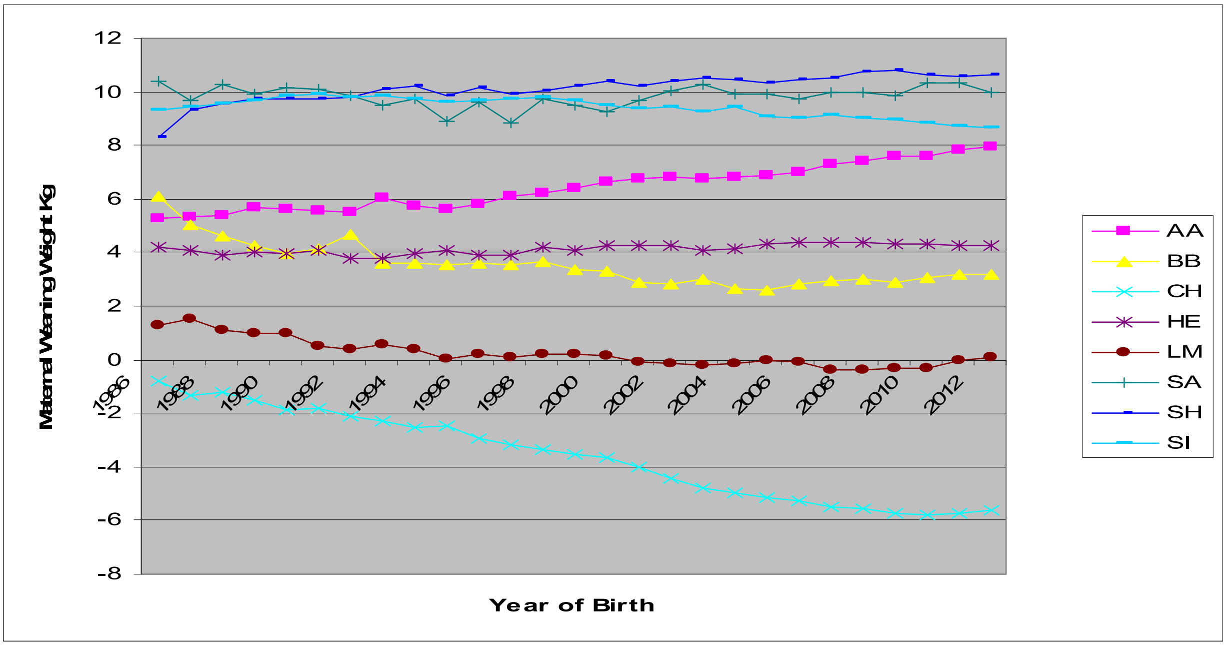

Figure 2: Trends in genetic merit for maternal milk for pedigree animals born between 1986 - 2012.

Another point to note from Table 4 is the extent of the genetic differences between the breeds, compared to what was observed earlier based on phenotypic data only (Table 2). For example, data from Table 4 would suggest a difference of some 50 kg carcass weight between the Charolais and Angus breeds (27.9 – 2.8 * 2) = 50.2, whilst the phenotypic data indicates a difference of only 36 kg (note: the genetic index difference is multiplied by 2 to reflect the fact that each animal has 2 sets of genes, only one of which is passed onto its progeny). Similar trends are apparent for calving interval (with the genetic data indicating a 10 day difference between these two breeds) suggesting that the more rigorous genetic analysis is better able to account for other confounding effects such as breed, age, parity, herd, resulting a truer picture of the strengths and weaknesses of each particular breed.

4. The potential role of genetic evaluations (as opposed to breed) as the primary source of information when selecting suckler female replacements.

Whilst across breed differences are of interest and certainly provoke much debate when discussing the merits (or otherwise) of each individual breed, they are of limited value when discussing the importance of genetic improvement programs, principally because the majority of genetic gain is generated from exploiting genetic differences within the various breeds. The importance of the statement "there is as much genetic variation within breeds, as there is across breeds" can be vividly demonstrated with data from Table 4, which clearly indicates the extent of the genetic differences within each of the major beef breed for the range of key profit traits. For example, the difference in carcass weight between the Angus and Charolais breed is 25.1 kg (as outlined earlier). Looking at differences within each of these breeds indicates a difference of 23.2 kg within the Angus breed and 24.9 kg within the Charolais breed. The trends are even more striking for cost of production traits such as female fertility, which indicate a difference of 5 days between the Angus and Charolais breeds for this important trait, compared to a difference of 7.0 and 9.2 days when each of these breeds are considered on a within breed basis. Similar results are apparent for other breeds and traits, thereby serving to highlight the importance of focusing on these differences (as opposed to breed differences) when discussing any future genetic improvement programs. It is for these reasons that ICBF will focus its future genetic improvement programs on highlighting and exploiting within breed differences for the range of key profit traits. By focusing farmers on within breed differences we ensure much greater understanding of the role and potential value of genetic evaluations as opposed to reducing the debate to one which is based purely on breed.

In simplicity, the suckler cow of the future will be a cow with good milk, fertility, feed efficiency and with a good calf at foot, produced at minimal cost. Quite which breed this calf will emanate from will be dependent on how quickly and efficiently each of the breeds is able to respond to the changing market requirements regarding the ideal suckler cow of the future. At the moment the traditional (and dual-purpose) breeds appear to have a head start over some of the more continental breeds with regard to some of these traits. However, the large differences demonstrated in Table 4, coupled with the fact that some of these populations are coming from numerically large bases (e.g. Charolais and Limousin) means that generating additional genetic gain for these new traits is easily do-able. However, it will require a shift in mindset away from the traditional terminal traits (and bloodlines) towards maternal traits and a different set of bloodlines.

Review of suckler cow types: An international perspective with particular reference to New Zealand

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Summary

- Suckler beef cows are increasingly farmed in challenging environments where farmers perceive the importance of cows being able to fluctuate in live weight and energy reserves whilst still maintaining an annual production cycle.
- In New Zealand, the beef cow is farmed with sheep often of secondary importance in terms of profit generation but they play a major role in pasture grooming in hill country.
- Cow size is important as 70 to 75% of the feed used by a beef (suckler) herd is required for maintenance requirements of the cow herd.
- It is imperative to match cow nutrient requirements with the feed resources (pasture growth) or reproduction will be compromised.
- Pregnancy rates are related to level of fatness in heifers and interact with nutritional level.
- Cows with high milk potential wean heavier calves than cows with low milk potential, regardless of the live weight of the cow.
- Cow size needs to fit the environment where cows are farmed and in marginalised environments with restricted energy available moderating cow size and milking ability should assist in maintaining reproductive performance.

Beef production occurs throughout the world under both extensive and intensively farmed situations. Under extensive and usually grazing conditions the cow is expected to consume low grade roughage and convert it into a saleable product, the calf. The role of maternal productivity in beef production is becoming increasingly important as breeding operations migrate to more varied and challenging production environments. In these environments the farmers perceive the importance of cows being able to fluctuate in weight and energy reserves whilst still maintaining an annual production cycle (Lee et al., 2011). In response, many cattle breeders throughout the world have shifted from simply selecting for increased output toward selecting for optimum conversion of available food resources to a marketable product across the entire production system (Jenkins and Ferrell, 2007).

Most of the improvement to date in weight of saleable product (the calf) has come from growth potential of the calf rather than for milk yield improvement. An exception is the beef cross dairy cow which of course has substantially greater milk potential (Morris et al., 1994). There is a ceiling to milk production in the commercial beef cow (suckler) herds which is the natural selection for reproductive performance (Willham, 1972). However, under extensive situations maternal ability assumes more importance for increased calf weights and yet this is tied to a level that ensures reproductive performance is met. More intensive situations are less dependent on maternal ability because of creep feeding, and the use of concentrates to ensure cow condition is such to achieve satisfactory reproductive performance.

The question of optimum cow size of beef cattle has been debated for many years. Feed cost though represents by far the major expense in beef cattle production. Therefore, efficiency of feed use should be a major goal. Unfortunately rate of gain is positively related to mature size, thus when we select for rate of gain we obtain larger cattle. This may not be ideal as it relates to mature cow size as a large proportion (70 to 75%) of feed used by the cow herd is required for just for maintenance of the cow (Jenkins and Ferrell, 2007).

In New Zealand, beef cattle and sheep are usually farmed together, and are complementary to one another especially under hill country conditions (Bell et al., 2011). It is relatively easy for farmers to alter their mix of sheep and cattle to suit prevailing economic conditions and preferences. The main driving force behind this substitution is the relative profitability between cattle and sheep. It is generally recognised that beef breeding cows (suckler cows) play an important role in maintaining pasture quality on many farms, benefiting other livestock (Morris and Smeaton, 2009). Cows can also loose live weight during winter, freeing up feed for other less resilient stock. High levels of performance are routinely achieved on some farms with the cow still carrying out her complementary role of pasture management, provided the cow can regain any lost weight during the crucial calving to mating period.

There are around 1 million suckler breeding cows in New Zealand and the cow herd is dominated by two breeds the Angus and Hereford. The European breeds were imported from the late 1960's onwards and some, especially Simmental, Charolais, South Devon and Limousin, have made an impact as Terminal sires, where all progeny (both male and female) are sold for slaughter or to finishing farms. There has also been an increased use of the Hereford × Friesian as a beef cow, the Friesian introducing genes for higher milk production.

The national calving percentage (the number of calves weaned as a percentage of cows mated) is between 80 and 85%. The top third of herds in any year average 90% calving or better (Smeaton et al., 2008). Age of first calving can be at 2 years (approximately 40% of all heifer replacements) in well grown heifers farmed on easier or more developed country, whereas the rest calve first at 3 years of age (Hickson et al., 2008, 2012a).

Calving date usually coincides with the onset of the spring flush of pasture growth, thus ensuring adequate feeding levels post-calving, which encourages maximum cow milk production. Calving date on easy hill country (earlier spring grass growth) will occur in August while on hard hill country (later spring grass growth) it will be late September. Calf growth rates of 0.8 to 1.0 kg/head/day are usual while calves are suckling their dams. This requires provision of suitable pasture typically a pasture mass greater than 1500 kg DM/ha or 6 to 8 cm sward surface height.

The biological efficiency of the breeding (suckler) cow is low compared with that of other domestic livestock (Morris et al., 1994). This reflects the compounded results of a relatively low reproductive rate and the conversion of grass to milk and then to (calf) meat with loss of energy at each stage of the process.

The live weight of cows is important as maintenance energy makes up a large proportion of the input into the cow herd. Ferrell and Jenkins (1984a, b, 1985) and Jenkins and Ferrell (2007) have suggested that requirements for maintenance were positively related to productive potential. They attributed this in part to the higher-milking cows' internal organs and faster metabolism compared with lower milking cows. Reproductive traits, as they are currently measured, tend to be low in heritability, making the environment in which a beef female is reared of critical importance to assure reproductive success. Large cows with high milk production result in increased feed requirements for the cow. It is important that cow nutrient requirements match feed resources or reproduction will be compromised (Short and Adams, 1988). The energy required to initiate oestrous cycling after calving is only available after requirements for maintenance, grazing, growth, milk production have been met (Boggs et al., 1980; Short et al., 1990). Therefore, it is important that adequate energy (forage) is available and that's the cows feed demands are not so high that there is enough energy to support rebreeding.

It has also been demonstrated in USA (Jenkins and Ferrell, 1994) and in New Zealand (Morris et al., 1993) that at restricted levels of energy intake, smaller cows with lower levels of milk production are more efficient than larger, higher milking cows. However, the advantage in production efficiency of the smaller, lower milking cows diminishes as energy intake increases. Thus, if you have higher genetic potential cows then they need to be fed to reach their potential if they are to be more efficient at converting forage to beef.

The Australian beef industry is concerned about the impact on breeding herd efficiency of adopting selection strategies influencing body composition, such as selection for improved feed efficiency or increased carcass yield, especially in variable nutritional environments (Donoghue et al., 2010). Their beef industry requires resilient cows that can efficiently utilise variable feed resources. In response, they have instigated the "Maternal Productivity Project" involving 8,000 recorded females (6,000 Angus and 2,000 Hereford) from conception to weaning of their calves. The females have live weight and body condition score measured as well as ultrasound scans for eye muscle area and fatness recorded pre-calving and at weaning. These measurements will indicate the amount of body tissue accumulated or mobilised depending on feed supply (pasture throughout the year) and energy demand. There is also a research component to this project where four lines of cows representing a high and low fat EBV (estimated breeding value), a high and low NFI (net feed intake or residual feed intake) each fed two nutritional treatments (high and low) and are run at two locations.
Heifer pregnancy rates from this experiment indicate there was a significance difference between the fat lines where the high fat line had a pregnancy rate of 91%, whereas the low fat line had an 83% pregnancy rate. There was no difference in pregnancy rate between the residual feed intake lines. Once calved, the lines were allocated to two stocking pressures (high nutrition and low nutrition) until weaning. At the next pregnancy the low fat line under a low nutrition regime had a pregnancy rate of 86% compared with 96% the high fat high nutrition line. These differences had all disappeared at the third pregnancy. Differences between the high and low NFI lines were minimal. Preliminary conclusions from this study (Pitchford W., 2012 personal communication) suggest that maternal differences between lines were related to fatness and that it was most noticeable in the low fat line heifers.

A lifetime productivity and efficiency study at Massey University, New Zealand is comparing the performance of breeding cows of differing body size and milk production potential. Four lines of heifers were generated for this experiment: a control line of straightbred Angus (AA) heifers to represent the high live weight, low milk potential beef breeding cow that predominates in New Zealand at present; Angus cross Holstein-Friesian (AF) heifers, a high live weight, high milk line; Angus cross Kiwicross (AK) heifers, a moderate live weight, high milk line; and Angus cross Jersey (AJ) heifers, a low live weight, high milk line. Heifers were generated through the use of semen from four Angus bulls inseminated into commercial herds of the relevant dam breeds.

Heifers were assessed for the onset of puberty (defined as the first of three consecutive oestrus events) from April to December 2009 (16 months of age) (for more details see Hickson et al., 2011). Hereford bulls were joined with the heifers for seven weeks from 8th December 2009. Pregnancy diagnosis was conducted in February 2010 and non-pregnant heifers were removed from the experiment. During lactation, milk intake was assessed using the weigh-nurse-weigh method at a mean of 39, 81 and 123 days of lactation. Post-partum anoestrus interval (defined as the period from calving until the first overt oestrus) was assessed at 4 to 5 day intervals beginning within 20 days of calving, using trans-rectal ultrasonography (Hickson et al., 2012b).

Simmental or Angus bulls were joined with all heifers at their second mating in December 2010 and Charolais bulls were used at the third mating in 2011. Cows were weighed at approximately monthly intervals throughout the experiment. Body condition scores were assessed quarterly using the 1 to 10 scale and rib fat depth was assessed at quarterly intervals beginning prior to first calving in September 2010. Live weights of calves were taken at birth and approximately monthly intervals during the rearing period.

AA heifers were heaviest and AJ heifers lightest when they reached puberty and at first joining (Table 1). Pregnancy rate to first joining did not differ amongst the lines.

Table 1: Age and live weight at puberty and pregnancy rate to first joining for heifers with different potential for live weight and milk production*

	AA	**AF**	**AK**	**AJ**
Age at puberty (days)	395 ± 7	388 ± 7	385 ± 9	383 ± 7
Live weight at puberty (kg)	297 ± 4^{c}	274 ± 5^{b}	263 ± 5^{b}	242 ± 5^{a}
Live weight at start of joining (kg)	379 ± 4^{a}	364 ± 5^{b}	359 ± 5^{b}	338 ± 4^{c}
Pregnancy rate (%)	87	95	90	92

* abc Values within rows without superscripts in common are different at the P<0.05 level.

Source: adapted from Hickson et al. (2012c).

The heaviest cows pre-calving were the AF and AA lines, and the AJ line was the lightest (Table 2). The heaviest calves were born to the AK lines, and the lightest to the AJ line. Rate of assistance at calving and survival of calves to weaning did not differ amongst the lines. Colostrum intake (as indicated by IgG and GGT activity) did not differ among lines.

Milk production at all-time points was least for the AA cows. Among the high milk potential lines, AF cows out-produced AK cows in early lactation but there were no other differences at any other time points. The AF calves were heavier than the AJ calves at weaning, whereas the

AA calves were the lightest of all the lines at weaning and had the slowest growth from birth to weaning (Table 3). The AA cows, which weaned the lightest calves, were the heaviest cows at weaning. This made them the least efficient line when efficiency was expressed as kg calf weaned per kg of cow live weight at weaning. The differences in live weight of the cows at weaning of the high milk lines were mirrored in the differences in the weaning weights of their calves, so that there was no difference in the efficiency of these lines.

Table 2: Calving parameters for first calves born to cows with different potential for live weight and milk production*.

	AA	AF	AK	AJ
Cow live weight pre-calving (kg)	429 ± 4^{ab}	437 ± 5^{a}	415 ± 6^{b}	394 ± 4^{c}
Birth weight (kg)	32 ± 1^{ab}	32 ± 1^{ab}	34 ± 2^{a}	29 ± 1^{b}
Assistance rate (%)	8	4	2	4
Survival[1] (%)	87	95	95	92

* [ab]Values within rows without superscripts in common differ at the P<0.05 level.
[1]Percentage of calves born that were alive at weaning
Source: adapted from Hickson et al. (2012c).

Table 3: Live weight of first born calves at weaning, average daily live weight gain from birth to weaning (ADG), and 'efficiency ratio' measured as weaning weight of calf as a percentage of live weight of cow at weaning*.

	AA	AF	AK	AJ
Weaning weight of calf (kg)	196 ± 3^{c}	231 ± 4^{a}	221 ± 5^{ab}	213 ± 3^{b}
ADG (kg)	0.98 ± 0.01^{c}	1.16 ± 0.02^{a}	1.13 ± 0.02^{ab}	1.10 ± 0.01^{b}
Weaning weight of cow (kg)	477 ± 6^{a}	454 ± 6^{b}	433 ± 8^{c}	415 ± 6^{c}
Efficiency ratio (%)	41.6 ± 0.7^{b}	50.9 ± 0.8^{a}	51.9 ± 1.0^{a}	52.5 ± 0.7^{a}

*[abc]Values within rows without superscripts in common differ at the P<0.05 level.
Source: adapted from Hickson et al. (2012c).

AJ cows had the shortest post-partum anoestrus interval and this was accompanied by the highest pregnancy rate (although they were not different to the AK cows for either measure)

Results for the second calving are given in Table 4 with the AJ and AK being marginally better than the AF in terms of efficiency of calf production, whereas the AA was the worst performer. There is now an 85 kg difference in live weight between the AA and AJ lines, and as the cows enter their 3rd calving it will be interesting to observe how the lines perform as they reach maturity. At all times the AA cows have maintained a higher condition score throughout the experiment and under outdoor grazing conditions the question remains will this benefit their long-term robustness.

Table 4: Second calving live weight calves at weaning, average daily live weight gain of the calves from birth to weaning (ADG), and 'efficiency ratio' measured as weaning weight of calf as a percentage of live weight of cow at weaning.

	AA	AF	AK	AJ
Weaning weight of calf (kg)	197	221	229	215
ADG (kg)	1.06	1.20	1.23	1.16
Weaning weight of cow (kg)	542	516	489	457
Efficiency ratio (%)	36	43	47	47

The similar efficiencies of the three high milk lines illustrate that changing cow size does not guarantee a change in efficiency – if the change in cow size simply translates to a comparable change in calf size due to the maternal genetic contribution to the calves, there is no effect on efficiency of calf production. However, an increase in milking potential resulted in a considerable increase in efficiency of calf production as increased milking potential increased the weaning weight of the calf whilst simultaneously decreasing the live weight of the cow at weaning due to her thinner body condition. The thinner body condition presumably resulted from energy intake being partitioned to milk rather than to cow live weight gain. It should be remembered, however, that the true efficiency of a breeding cow is concerned with her calf production per unit of feed eaten, and maternal live weight serves only as a proxy for feed intake.

The heavier weaning weights of calves from the high milk lines are consistent with previous studies comparing dairy-cross with beef-breed cows (Morris et al., 1993; Arthur et al., 1997). The differences in weaning weights of the calves among the high milk lines most likely reflect differences in the genetic potential for growth inherited from the dams of various sizes. In addition, to weaning weight of calves, number of calves weaned is also a key component of the productivity of a beef breeding cow herd. The four lines did not differ in weaning rate (calves weaned per cow joined) after two calvings. Throughout this experiment to date, the AA cows were fatter and heavier than the high milk lines, contributing to their lesser efficiency of calf production. A notable difference between the groups is that the AA cows gained body condition during lactation, whereas the high milk lines did not. The impact of this on lifetime productivity and efficiency needs to be evaluated before conclusions regarding the most efficient line can be drawn.

Conclusions

Cows with potential for high milk production wean heavier calves than cows with low milk production potential, regardless of the live weight of the cows. Within high milk lines, live weight of the cow was reflected in the live weight of the calf, such that the efficiency of calf production of these lines was similar to each other, and superior to the low milk line. A greater body condition score at weaning may have implications for the lifetime efficiency and subsequent performance especially when suckler cows are farmed under conditions where feed availability is costly over winter. For beef suckler cow farmers in increasingly marginalised environments with restricted energy availability moderating cow size and keeping milk production relatively low should lower the herd feed demand and assist in minimising the time between calving and rebreeding.

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Economic appraisal of performance traits in Irish suckler beef production systems

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Summary

- A study was carried out to derive economic values for performance traits for Irish suckler beef production systems using a bioeconomic suckler beef cow systems model – the Grange Beef Systems Model.
- The baseline production system was a grass-based, spring-calving suckler calf-to-beef production system finishing steers and heifers at 24 and 20 months of age, respectively, at a stocking rate of 210 kg organic nitrogen per hectare.
- Compared to the economic values for the various traits used in the previous ICBF beef indexes, using the Grange Beef Systems Model resulted in:
    - Output traits (live weight per day of age and maternal weaning weight) increasing marginally.
    - Production cost traits becoming substantially more negative, particularly for the calving difficulty traits.
    - Fertility cost traits becoming more negative.
- The new economic values are more representative of the impact that advances in production traits have on the profitability of Irish suckler beef production systems than the previous values used.

Introduction

To facilitate progress in beef cattle breeding it is necessary to assign economic values to the breeding traits that affect profitability so that breeding indexes can accurately reflect economic gains made at farm level by improving these traits. Previous economic values used in Irish beef breeding indexes (Byrne and Amer, 2010) were based on research carried out and published by Amer et al. (2001). From this initial work an overall breeding index, comprised of five beef sub-indexes, was developed. Each sub-index consisted of a number of traits ranging from two in the calving and weaning sub-indexes to 10 in the maternal or reproduction sub-index. The economic values for the individual goal traits were derived using component analysis, independent of an overall farm system. While trait independence is an important principle of deriving independent economic values, it is preferable to quantify the impact of traits in a whole-farm production systems context. This is the approach adopted to derive economic values for dairy cattle breeding indexes in Ireland. The methodology used is described by Veerkamp et al. (2002) and involves the application of a farm systems model to quantify the impact of traits by simulating improvement in that trait while keeping other traits constant and comparing the result with a default scenario. The whole-farm systems model used initially has been improved since (Shalloo et al., 2004).

Given that such a systems modelling approach was absent for suckler beef systems, a study was carried out to derive economic values for performance traits for Irish suckler beef production systems using a bioeconomic suckler beef cow systems model. The purpose of this paper is to: (1) describe the modelling approach adopted and baseline scenario on which economic values are based and, (2) outline the traits for which economic values were revised and the new values generated.

Model description and baseline scenario

The analysis was carried out using the Grange Beef Systems Model (GBSM: Crosson et al., 2006; Crosson, 2008). This is a single-year, static simulation model and provides the capacity to model uncertainty using stochastic variables and running the model for a fixed number of draws using Monte Carlo simulation. The GBSM runs on a monthly time-step and assumes a steady state system over a calendar year. Animal numbers and weights for each animal group (cows, calves, yearlings and 2 year olds) are specified. Default values for the proportion of grazed grass and grass silage in the animals' diet are specified on a monthly basis. Using the French net energy system (Jarrige, 1989) modified for Irish conditions (O'Mara, 1996), animal feed requirements are calculated and, based on the feed requirements, grass and silage intake is calculated. Supplementary concentrates are fed where the energy supplied in the forage diet is not sufficient to meet the target live weight gain. For all animal groups estimations of live weights and kill out percentage at slaughter were taken from Murphy et al. (2008a, b). In this analysis, the GBSM was modified to derive economic values for the ICBF beef indexes.

The selected suckler beef production system was considered to be the current prototype suitable for immediate implementation on farm and for which evaluation has been completed (by means of systems research experiments at Teagasc, Grange). Thus, the production system modelled was based on that reported by Drennan and McGee (2004), Drennan et al. (2005), McGee et al. (2005a,b) and Murphy et al. (2008a,b). This spring-calving grass-based production system involved finishing steers and heifers at 24 and 20 months of age, respectively, and was operated at a stocking rate of 210 kg organic nitrogen (N) per hectare. Some key differences between the modelled system and the corresponding research farm system were: 1) mean calving date was advanced from mid-march to 3 March, which was represented within the model as a February/March/April calving pattern of 0.4/0.5/0.1 and, 2) replacement heifers were bred from within the herd rather than purchased as calves or breeding heifers. To facilitate full economic evaluation of the modelled systems, a land charge of €354/ha and labour charges at €20.18/hr (Farm Relief Survey adjusted for wage inflation, personal communication; 2012), were included. Price assumptions were taken from Teagasc, Rural Economy Research Centre (Kevin Hanrahan, personal communication; 1 February 2012) and pertain to projected 2020 values under a "business-as-usual" scenario. Labour requirements were calculated using the analysis of Leahy (2003). Table 1 outlines the key descriptors for the base scenario.

Table 1: Details and results of the base scenario as modelled using the Grange Beef Systems Model for derivation of economic values for suckler beef breeding indexes for Irish suckler calf-to-beef production systems

Farm area (ha)	40.0
Number of cows calving	65.7
Farm stocking rate (organic N/ha)	210
Weaning weight[1] (kg)	317
Carcass weight[1] (kg)	372
Mature cow weight (kg)	611
Age at first calving (AFC; months)	24
Percentage grazed grass in the annual feed budget	62%
Percentage grass silage in the annual feed budget	30%
Percentage concentrate in the annual feed budget	8%
Mean annual R3 steer price (€/kg)	3.78
Gross output per ha (€)	1932
Gross margin per hectare (€)	809
Net margin per hectare (€)	213
Net margin per cow calving (€)	127
Net margin per cow calving[2] (€)	-942

[1]Mean of male and female progeny. [2]Includes full land and labour costs

To generate economic values for the performance traits of interest, it was necessary to generate scenarios whereby the scenario was identical to the baseline scenario with the exception of the trait of interest. The trait of interest was either increased or decreased within a realistic range and its economic value could be quantified by comparing the financial performance of the baseline scenario with the modelled scenario. Thus, the economic value is equal to the change in profitability divided by the change in the trait of interest.

Output traits

Output is a key driver of profitability in suckler beef production systems. Two breeding output traits that can be defined are the animal's own genetic capacity for growth (live weight per day of age) and live weight gain derived from milk consumption from the calf's dam (maternal weaning weight).

Live weight per day of age

The live weight per day of age trait (otherwise known as "carcass weight") describes the genetic potential of beef progeny to have a higher live weight at a given age or to have a lower age at slaughter at a given carcass weight. This trait is expressed as an increase in carcass weight. Research at Teagasc, Grange (Clarke et al., 2009) has shown that the pre-weaning component of increased growth rates is greater than the post-weaning component and this is accounted for in the modelling exercise. The economic value was calculated as the increase in prime beef sales per animal slaughtered divided by the increase in carcass weight (€/kg carcass). The economic value was calculated as €3.78/kg carcass.

Maternal weaning weight

The maternal weaning weight trait describes the impact of suckler cow milk yield on the weaning live weight (and consequently, carcass weight) of her progeny. Research at Teagasc, Grange has demonstrated that cow milk yield is a major determinant of calf live weight gain pre-weaning (McGee et al., 2005b; Murphy et al., 2008a; Minchin and McGee, 2011). These findings have indicated that the calf growth response to each additional kilogram of milk is *ca.* 0.07 kg live weight. However, higher cow milk yield is associated with increased feed energy requirements (Jarrige, 1989; O'Mara, 1996) and economically, this partially offsets the additional live weight advantage of calves from cows with higher milk yield. The additional cow feed energy costs were calculated based on the energy requirement (0.45 UFL) of each additional kg of milk (O'Mara, 1996) and the cost of grazed grass.

To generate an economic value for maternal weaning weight, pre-weaning calf performance was increased by 10% and, because differences in calf live weight at weaning are largely retained to slaughter, the carcass output from the corresponding calf-to-beef system also increased.

However, historical monthly price data from livestock marts indicates that there is a premium paid for weanlings at sale (150 to 300 days of age) compared to the prevailing beef carcass price i.e. the price per kg live weight at weaning is greater than the price per kg live weight at slaughter (Table 2). This price premium is not captured within integrated calf-to-beef systems and therefore, must be factored in. Thus, the maternal weaning weight economic value was calculated as the increase in output value taking account of the weanling premium minus the cost of added milk production divided by the increase in weaning weight. This equated to €1.81/kg live weight. As there was a monetary premium incorporated at the weaning stage, this must be discounted at the slaughter stage for integrated calf to beef systems. Therefore, the corresponding weight for age trait within the maternal index was adjusted accordingly.

Table 2: Weanling and beef price data (average monthly prices for 2007-2011 used) and weaning premium used in the adjustment of maternal weaning weight

	Male	**Female**
Weanling value (€/hd)	629	523
Weanling weight (kg)	323	286
Weanling value (c/kg)	1.97	1.84
Beef carcass price (c/kg)	3.19	3.26
Weanling premium	10.2%	1.1%

Production cost traits

A key factor determining profitability of suckler beef systems are overall costs of production. Feed costs are the largest variable cost on sucker beef farms accounting for approximately 75% of the total (Finneran et al., 2010; Hennessy et al., 2011). The impact of changes in feed requirements of suckler beef progeny on profitability is captured via the progeny intake trait. Correspondingly, effects of feed requirements for the suckler cow herd and associated replacement heifers, are captured in the mature cow live weight trait.

Progeny intake

The progeny intake trait describes the increase in feed intake associated with heavier animals. It is assumed for this purpose that feed intake is a constant proportion of live weight. The economic value generated in this case reflects the dietary proportions and relative feed costs of grazed grass, grass silage and concentrate ration in the feed budget of suckler beef progeny. Thus, the economic value was calculated as increased feed costs divided by increased feed demand and is computed as €0.16/kg DM.

Mature cow live weight

The mature cow live weight trait is based on varying the live weight of the mature cow herd and replacement heifers (again, assuming feed intake is a constant proportion of live weight) and quantifying the impact of this on feed costs. Changes in mature cow live weight also have implications for cull cow carcass weight and associated cull cow value. The additional income from sales of heavier cull cows partially offsets the added cost of heavier mature cow live weight; however, the overall impact is to reduce profitability. The analysis took into account higher mature cow live weight by increasing live weight by 10%. Given that carcass weight data rather than live weight data is routinely available for cull cows the economic value is expressed per kg carcass – the computed value was -€0.57/kg carcass.

Replacement heifer live weight also increased accordingly (required to be 90% of mature weight immediately post-calving) and this was quantified economically as the increase in heifer feed costs per unit change in intake requirements. Again this value is expressed on a carcass weight basis and also takes into account the replacement rate assumption since this will influence the number of replacement heifers required. The economic value was quantified as -€2.28/kg carcass.

To take into account the heavier cull cow, the increase in cull cow sales per kg change in cow mature weight was quantified on a carcass basis per cow culled as €3.04/kg carcass.

Gestation length

Gestation length refers to the duration of pregnancy. In the model sires of late-maturing continental breeding are assumed to have an average gestation length of 286 days. The impact of increasing gestation length is to:

- Increase replacement rate as a result of increased barrenness (empty rates). Where suckler cows have a longer gestation length, the amount of time available for breeding is less and therefore, the probability of becoming pregnant is lower. This results in a higher number of cows that are not pregnant at the end of the breeding season. Each day increase in gestation length increases barrenness/replacement rate by 0.24% (Amer et al., 2001).
- Reduce weaning and slaughter weights. Since it is assumed that weaning and slaughter date is fixed, then longer gestation lengths result in suckler progeny being younger (and lighter) at weaning and at slaughter.
- Reduce the length of the grazing season for suckler cows. As it is assumed that suckler cows are not turned out to grass until after calving therefore, increasing gestation length reduces the proportion of grazed grass in the total feed budget, a key factor influencing profitability, decreases.

The combination of these three factors means that longer gestation lengths result in lower profitability. The economic value was calculated as change in net margin per cow per day increase in gestation length. This was estimated at -€1.72/day increase in gestation length.

Calving difficulty

Calving difficulty can range from "no assistance", where the cow calves herself without intervention, to the other extreme where a caesarean section is necessary. Incidences of calving difficulty can have a substantial impact on farm profitability due to increases in labour costs (farmer and vet) and cow replacement costs (based on cows not going in-calf in the next breeding season due to calving difficulties and a small proportion that die as a result of calving difficulties). Impacts of calving difficulty on subsequent fertility are captured separately in the fertility traits. Calves that die during calving are not included in this trait but are instead captured in a calf mortality trait that is quantified separately.

Calving difficulty is partitioned into two components: direct calving difficulty and maternal calving difficulty. Direct calving difficulty describes the level of difficulty associated with the characteristic of the calf itself (e.g., body size and shape) inherited from its sire and dam. Maternal calving difficulty describes the level of difficulty associated the characteristics of the dam giving birth (e.g., pelvic size, calving ability and maternal effects on birth weight) and indicates how easily a sire's/dam's daughters will calve. The derivation of economic values for these traits are described in Tables 3 and 4.

Table 3: Description of the direct calving difficulty trait

Item	Caesarean	Vet assist	Severe assist	Slight assist	Herd cost
Stockman hours	6.00	4.00	4.00	1.00	
Stockman cost (€) per hour	20.18	20.18	20.18	20.18	
Stockman cost (€)	121.10	80.73	80.73	20.18	
Veterinary costs (€)	306.25	80.00	0.00	0.00	
Probability of a dead cow	0.08	0.03	0.03	0.00	
Cost of a dead cow (€)	150.98	50.33	50.33	0.00	
Reduced reproductive success	0.25	0.10	0.05	0.00	
Barren cow cost (€)	489.81	195.92	97.96	0.00	
Calving cost relative to no assistance	1068.13	406.98	229.02	20.18	
6% incidence of severe or worse calvings	1.02	2.50	2.48	20.29	30.84
7% incidence of severe or worse calvings	1.25	2.92	2.83	22.00	36.16
Economic effect (€) per cow of 1% change					**-5.31**

Table 4: Description of the maternal calving difficulty trait.

Item	Caesarean	Vet assist	Severe assist	Slight assist	Herd cost
Stockman hours	6.00	4.00	4.00	1.00	
Stockman cost (€) per hour	20.18	20.18	20.18	20.18	
Stockman cost (€)	121.10	80.73	80.73	20.18	
Veterinary costs (€)	306.25	80.00	0.00	0.00	
Calving cost relative to no assistance	427.35	160.73	80.73	20.18	
6% incidence of severe or worse calvings	1.02	2.50	2.48	20.29	14.47
7% incidence of severe or worse calvings	1.25	2.92	2.83	22.00	16.76
Economic effect (€) per cow of 1% change					**-2.29**

Fertility traits

Irish suckler beef production systems are predominantly grass-based and therefore, are based on seasonal spring-calving herds (Drennan, 1999; Drennan and McGee, 2009). This seasonality of calving contributes significantly to the importance of fertility traits.

Survival

Survival describes the ability of suckler beef cows to remain in the herd over a number of years. Thus, lower values for survival mean that the heifer replacement rate of a suckler herd is higher than a corresponding herd with higher survival rates. There are multiple effects of lower survival on the profitability of suckler beef production:

- The sales of prime beef are lower because: (1) more of the heifer progeny are needed as replacements rather than being sold as beef, and (2) average carcass weight for the herd is lower since more of the progeny are from primiparous (first-calvers) cows.
- The labour required for primiparous cows is greater, especially at calving time, than that required for multiparous cows.
- Offsetting the reduction in prime beef sales is the increase in sales of cull beef cows.
- The dietary proportions of grazed grass, grass silage and concentrate rations for the farm change because of differences in the numbers of replacement and finishing heifers which have different feed budget requirements.

Survival was modelled as a change in the number of heifer progeny required as replacements. The economic value was calculated as the difference in net margin per cow divided by the change in the number of heifer progeny bred for suckler replacements. This, equated to €4.00/% of heifer progeny bred as suckler replacements.

Calving interval

Calving interval describes the length of time between successive calvings for a cow. The target calving interval for a suckler cow herd is 365 days; however data from ICBF indicates that the average calving interval for suckler cows in Ireland is 406 days (Cromie, 2011). In the longer term, an increase in calving interval results in a different calving pattern for a suckler beef farm; in other words, the mean calving date for the farm will slip. Where mean calving date slips (and assuming it was originally at the optimum date for a particular farm) two factors must be taken into account:

- Weaning and slaughter weights are lower because progeny will be younger (and lighter) at weaning and at slaughter.
- The length of the grazing season for suckler cows is reduced because it is assumed that suckler cows are not turned out to grass until after calving. Thus, the proportion of grazed grass in the total feed budget decreases and feed costs increase.

The overall effect of longer calving intervals is to reduce profitability for suckler beef farms. The analysis was carried out using national breeding data (ICBF & AbacusBio, March 2012, personal communication) and stratifying herds based on varying percentages of the herd calved in the first 75 days and varying calving intervals. The effect of using industry-based data in the model is to delay mean calving date thus, reducing carcass weights and to increase feed costs when compared with the baseline Grange research farm scenario. The economic value was calculated as the change in profit divided by the change in calving interval equating to -€2.20/day increase in calving interval.

Age at first calving

Age at first calving is the age at which replacement breeding heifers calve for the first time. In economic terms the optimum age at first calving for seasonal calving suckler beef production systems breeding replacements from within the herd is 24 months of age (Crosson and McGee, 2012). In the modelling analysis, heifers calving for the first time at 24 months of age and 36 months of age (because of seasonality of calving) were compared. The economic value was calculated as the change in net margin per heifer calving divided by the difference in age at first calving with the resulting value of - €1.65/day obtained.

Summary and discussion

This paper describes the new approach used to quantify the economic values for breeding traits for beef cattle production in Ireland and outlines the impact of this on the economic values used in the beef breeding indexes. A comparison of economic values for the various traits as used in the previous ICBF beef indexes (Byrne and Amer, 2010) and the revised values modelled by the Grange Beef Systems Model (as described in this document) is shown in Table 5.

The most significant change has been for the calving difficulty traits which have increased substantially. This is a truer reflection that better captures associated increases in veterinary, labour and replacement heifer costs. Output traits have also increased but much more modestly. Production cost traits have also increased reflecting more accurate appraisal of costs on Irish suckler beef farms. Full economic costs are applied including the opportunity cost of labour and land. The labour cost in particular is a significant component of total costs in the analysis and provides a significant negative weighing on activities which require high labour input such as calving cows. In general, the new economic values provide an opportunity to develop breeding indexes that are more representative of the impact that advances in production traits have on the profitability of Irish suckler beef production systems.

Table 5: Comparison of current economic values as used in the ICBF beef indexes and the revised values modelled by the Grange Beef Systems Model

	Byrne and Amer, 2010	Revised
Output traits		
Direct weaning weight (€/kg live)	1.80	-
Direct weight for age (€/kg carcass)	3.20	3.78
Maternal weaning weight (€/kg live)	1.80	1.81
Maternal weight for age (€/kg carcass)	-	3.65
Production cost traits		
Progeny intake (€/kg DM)	-0.13	-0.16
Mature weight - heifer intake (€/kg DM)	-1.22	-2.28
Mature weight - cow intake (€/kg DM)	-0.41	-0.57
Cow weight - cull value (€/kg carcass)	2.80	3.04
Gestation length (€/day)	-2.12	-1.72
Direct calving difficulty (€/% change)	-2.96	-5.31
Maternal calving difficulty (€/% change)	-1.81	-2.29
Fertility traits		
Survival (€/% decrease)	-2.94	-4.00
Calving interval (€/day)	-1.37	-2.20
Age at first calving (€/day)	-0.96	-1.65

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Genetic Evaluations and indexes for Irish Suckler Beef Production Systems

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Summary

- New economic indexes have been introduced for the beef industry, which have replaced the previous Suckler Beef Value (SBV) index.
- The new economic indexes are designed to suit the diversification required in the selection of sires to breed progeny exclusively for slaughter (Terminal index), compared to the sire selected from whom some or all of his daughters will be returned as replacements to the herd (Maternal index).
- The new indexes contain revised up-to-date economic values derived from a typical beef production system.
- Farmers need to pay careful attention to the reliability attached to indexes and key traits as this is a valuable guide as to the likelihood that the genetic merit of the animal will stay the same or change in future evaluations.

Understanding the process of genetic evaluations

Genetics v. Management

The performance of any animal is determined primarily by two factors - genetics and environment (management). Often environment can affect an animal's performance as much (or more so) than the animal's genetic make-up. The key to a genetic evaluation process, and in turn the genetic improvement of livestock, is to distinguish between genetic and environmental factors influencing performance and select only those animals which are genetically superior. Performance resulting from good management will not be passed on to the next generation, whereas performance due to genetic superiority will be repeated. Genetic evaluations produce breeding values for every animal included in that evaluation.

Breeding Values v Predicted Transmitting Abilities

An animal's breeding value is its genetic merit. While we will never know the exact breeding value, for performance traits it is possible to make good estimates. These estimates are called Estimated Breeding Values (EBVs). In the calculation of EBVs, the performance of individual animals within a contemporary group is directly compared to the average of other animals in that group. A contemporary group consists of animals of the same sex and age class within a herd, run under the same management conditions and treated equally. However, in addition to this, indirect comparisons are made between animals reared in different contemporary groups, through the use of pedigree links between the groups. Only half of an animals EBV will be passed on to its progeny. This half is usually referred to as the Predicted Transmitting Ability or (PTA) of a trait. PTAs are expressed in the units of measurement for each particular trait. They are shown as positive or negative differences between an individual animal's genetics difference and the genetic base to which the animal is compared. The absolute value of any PTA is not critical, but rather the differences in PTAs between animals. Particular animals should be viewed as being "above or below breed average" for a particular trait.

What traits to evaluate?

Every country or breeding organization evaluates different traits. The type of trait is dependent on the type of animal data available and collected. Well known beef evaluation centers such as BREEDPLAN (multiple countries), INRA (France) and Egenes (UK) utilize pedigree herd data in their evaluations. This is driven by either the population structure (in France the majority of suckler beef produced originates from pedigree herds) or because there maybe very little access to commercial herd data (BREEDPLAN and Egenes produce EBVs in countries with sizeable non-pedigree populations). In Ireland the ICBF database collects and evaluates both pedigree and commercial herd data. The recording of calf registration data and the link with the Department of Agriculture database to capture subsequent movements is the same process for every animal irrespective of whether that animal comes from a pedigree or a commercial herd. This is vital for genetic improvement in Ireland as the majority of the suckler calvings (77%) occur in herds (40,482 herds) which are classed as commercial herds, which have no pedigree breeding element to the herd (Evans et al., 2008). The majority of the remaining calves (19%) are born in herds (5,905 herds) which have a mixture of crossbred and pedigree beef cows. There is only a small proportion of herds (1.45%) containing exclusively pedigree calvings (5,028 calvings). The type of data available from pedigree versus commercial cattle is very different with the exception of calving performance traits (calving difficulty, gestation and mortality).

Performance data from pedigree herds is usually collected through a voluntary but targeted participation in herd recording. Traits recorded include live-weight but also a linear appraisal of weanlings for muscle, skeletal and functionality traits. As these animals are intended for breeding purposes this is very often the last data collected on these animals themselves, which is useful for the purpose of genetic evaluations. The reason for measuring weight and, muscle and skeletal characteristics on these animals is to use these traits as early-predictors of carcass merit. Carcass value is the end result in terms of the output from a beef breeding perspective and this can only really be measured from commercial herds. However, the ICBF database has been developed to also pick up commercial herd data. This is achieved indirectly through industry links with marts and abattoirs for data such as mart weights, mart prices and carcass information. Maternal trait data such as fertility and longevity are available for evaluation through the linkup with the Department of Agricultures AIM database which provides calving dates and animal movement dates. The ICBF genetic evaluation combines the information from pedigree and commercial herds by evaluating traits which can be unique to one or other herd types in a series of multi-trait evaluations. The crossbred nature of the commercial suckler herd also allows the evaluation the ability to compare genetic merit across all breeds, which is also relatively unique in beef breeding. Table 1 shows the levels of data available for each trait in the ICBF evaluation, the source of that information and the level of farmer input.

Table 1: Level of data available for each trait in the ICBF evaluation, the source of that information and the level of farmer input in the recording of the trait.

Trait	Number of records evaluated	Source of information	% crossbreds in evaluations	Farmer input
Calving difficulty	4,175,040	On-farm, Animal Events	93%	Optional
Gestation	368,345	On-farm, Animal Events	75%	Optional
Mortality	4,107,160	On-farm, Animal Events	93%	Database linkup
150-300 day weight	532,550	On-farm, Marts	90%	Optional
300-600 day weight	570,795	On-farm, Marts	91%	Optional
Mart price per kg	325,134	Marts	100%	Database linkup
Calf quality score	616,165	On-farm, Suckler Welfare scheme	95%	Optional
Docility score	662,463	On-farm, Suckler Welfare scheme	83%	Optional
Linear scores	144,628	On-farm,Tully performance centre	23%	Optional
Feed intake	3,971	Tully performance centre	0%	Database linkup
Carcass (weight, grade, fat)	1,412,415	Abbatoirs, DAFF	98%	Database linkup
Age first calving	405,047	On-farm, AIM	78%	Database linkup
Calving interval	1,196,501	On-farm, AIM	65%	Database linkup
Survival	1,512,813	On-farm, AIM	63%	Database linkup
Maternal wean weight	158,796	On-farm, Marts	89%	Optional
Cull cow carcass weight	148,251	Abbatoirs, DAFF	60%	Database linkup
Birth weight	98,334	On-farm	9%	Optional
Cow docility	129,607	On-farm, Suckler cow survey	90%	Optional
Cow milkability	129,607	On-farm, Suckler cow survey	90%	Optional

Genetic variation

Genetic variation can be measured as the spread in PTAs both within and across breeds. Table 2 shows the variation in the PTAs for some of the beef traits evaluated by ICBF from the Bottom 1% across all beef breeds to the top 1% across all beef breeds. Each trait is evaluated based on the scale in which it is measured. For example, gestation is calculated as the number of days from insemination to calving so the PTA is expressed as the number of days that an animal is likely to add to the pregnancy compared to the average of the population when this animal is used as a sire or a dam. Similarly, carcass weight is expressed in terms of the kilograms of extra carcass weight the animal is likely to give to its progeny over and above the average of the population.

Table 2: Traits measured in ICBF evaluations, units of measurement and range in genetic merit of PTA for each trait.

Trait/Index	Units of measurement and expression	standard deviation	Btm 1pc	50 pc	Top 1pc
Calving Difficulty	Scale of 1 to 4, expressed as % difficulty	3.1	16.47	5.49	1.39
Gestation length	Days from insem to calving	1.5	4.84	2.31	-0.72
Mortality	Scale of 0 (alive) to 1 (dead)	0.5	1.78	0.66	-0.3
Docility	Scale of 1 to 5, expressed as unit change	0.1	-0.27	0	0.25
Feed Intake	kg DM intake per day on test	0.3	0.53	0.04	-0.5
150-300 day Weight	Kilograms	8.3	-13.84	1.79	23.47
300-600 day Weight	Kilograms	11.1	-16.21	6.19	35.07
Carcass Weight	Kilograms	10.6	-5.97	18.25	36.74
Carcass Conformation	EUROP scale changed to 1 to 15	0.5	0.31	1.57	2.33
Carcass Fat	EUROP scale changed to 1 to 15	0.5	-1.08	-0.37	0.98
Age 1st Calving	Birth to first calving	12.0	20.33	-6.99	-38.4
Calving Difficulty	Scale of 1 to 4, expressed as % difficulty	1.5	10.81	6.36	3.59
Calving Interval	Days between calvings	2.8	5.29	-0.2	-6.72
Milk	Kilograms of weaning weight	6.7	-11.3	0.47	18.88
Cow Survival	Scale of 0 (culled) to 1 (survived)	0.9	-2.1	0.33	2.44
Cull Cow Carcass Weight	Kilograms	16.7	-15.76	21.44	45.68

Combining traits into an Economic Selection Index

There are approximately 40 traits evaluated by ICBF related to beef breeding. Some are more economically important than others, whereas some are used as predictor traits to help with the prediction of the economically important traits. Selection indexes are a tool to select for several traits at once. An index approach takes into account genetic and economic values to select for economic merit. An index is challenging to develop, but the end result should be easy to use, adding simplicity and convenience to a multi-trait approach. Selection indexes combine information from an animal's PTAs into just a few numbers that reflect their relative economic value. Economic selection indexes are designed to assist farmers in comparing and selecting animals with the most favorable combination of PTAs to maximize profit in a given production situation.

The Suckler Beef Value Index (SBV) is an example of an Economic Selection index. The SBV was launched in 2007 along with 5 sub-indexes. Three of the sub-indexes (Calving Traits, Weanling Export, Beef Slaughter) described the genetic merit of the progeny of a bull whereas the remaining two (Maternal Milk & Fertility, Maternal Calf Quality) described the genetic merit of the bull's replacement daughters and their progeny.

The Suckler Beef Value was constructed based on the expected proportions of calves born which are: sold at weaning for live export (15%), retained for slaughter in Ireland (62%), sold or retained as replacement females (23%). Thus, the overall index was calculated as:

SBV = (0.15)*Weanling Export Index + (0.62)*Beef Carcass Index + (0.15 + 0.62)*Calving Traits Index + 0.23*(Milk & Fertility index + Calf Quality index)

Over time there were some revisions to the sub-indexes in terms of content and presentation. These included the dropping of the calving traits index from the presentation on the Bull Search and sales catalogues and, the splitting of the Maternal Milk & Fertility index into a Daughter Milk index and a Daughter Fertility index. The SBV was designed as an index for ranking sires for their genetic merit for a range of traits expressed by their progeny and daughter's progeny. This included the fact that when selecting a sire to breed replacements there will also be a by-product of male calves produced, which have an economic contribution to the farming enterprise.

Weakness of a single economic index

While there were certain benefits in ranking bulls for the full range of traits, there was a strong feeling in the industry for more specialised indexes which separated the genetic merit for progeny beef performance (terminal traits) versus genetic merit for progeny maternal performance (maternal traits). Sires selected for terminal traits can end up having none or very few daughters returned to the herd as replacements and hence an index which only evaluates the traits relevant to Terminal beef production would be more useful than the SBV. Alternatively, sires used specifically with maternal traits in mind may end up returning a much higher percentage of daughters as replacements than the 23% which was used in the construction of the SBV. Similarly, there was a need for an index to rank females for farmers to use when selecting female replacements.

A full review of beef breeding indexes was carried out which had 2 components:

1) Update of the economic values used for each trait

2) Exploration of alternative indexes to the SBV

1) New economic values were derived for all goal traits included in the SBV using a full farm systems bio-economic model developed at Teagasc Grange (For full details see paper by Crosson and McGee in this Conference Proceedings). Following an extensive analysis,

feedback and review with the €uro-star review group, the following changes to the economic values were recommended (Table 3)

Table 3: Change in economic values resulting from the switch to using the Grange bio-economic model.

Trait	Economic Value		change	% change	direction of change
	Old	New			
Direct calving difficulty (€/% change)	-€2.96	-€5.31	€2.35	79.4%	Increase
Gestation length	-€2.12	-€1.72	-€0.40	18.9%	Decrease
Progeny feed intake (€/kg DM)	-€0.13	-€0.16	€0.03	23.1%	Increase
Carcass weight (€/kg carcass)	€3.20	€3.78	-€0.58	18.1%	Increase
Replacement heifer feed intake (€/kg carcass)	-€1.22	-€2.28	€1.06	86.9%	Increase
Age 1st Calving (€/day)	-€0.96	-€1.65	€0.69	71.9%	Increase
Maternal calving difficulty (€/% change)	-€1.81	-€2.29	€0.48	26.5%	Increase
Maternal milk (€/kg weaning wt)	€1.80	€1.81	-€0.01	0.6%	Increase
Calving interval (€/day)	-€1.37	-€2.20	€0.83	60.6%	Increase
Survival (€/% decrease)	€2.94	€4.00	-€1.06	36.1%	Increase
Cow feed intake (€/kg carcass)	-€0.41	-€0.57	€0.16	39.0%	Increase
Cull cow weight (€/kg carcass)	€2.80	€3.04	-€0.24	8.6%	Increase

Impact of the new economic values

Figures 1 and 2 show the impact on SBV of a switch from the existing economic values to the Grange bio-economic model values by applying the new economic values to the extremes of genetic merit using the bottom and top one percentile for each trait. The figures also give a feel for the relative contribution of each trait to the SBV index. The bottom 1% of bulls for difficult calving would see a change in their average calving contribution to the SBV of -€92 instead of -€42. The difference between the bottom 1% and the top 1% on calving difficulty would increase from €61 to €131, representing an increase of 116%. Similarly, there would be increases in the differences between the top and bottom 1% for feed intake (27%), carcass weight (18%), daughter calving interval (61%), replacement heifer feed intake (86%) and cow feed intake (39%).

In summary, the changes would result in a significant increase in the importance of cost of production traits with a moderate increase in the economic value of output traits.

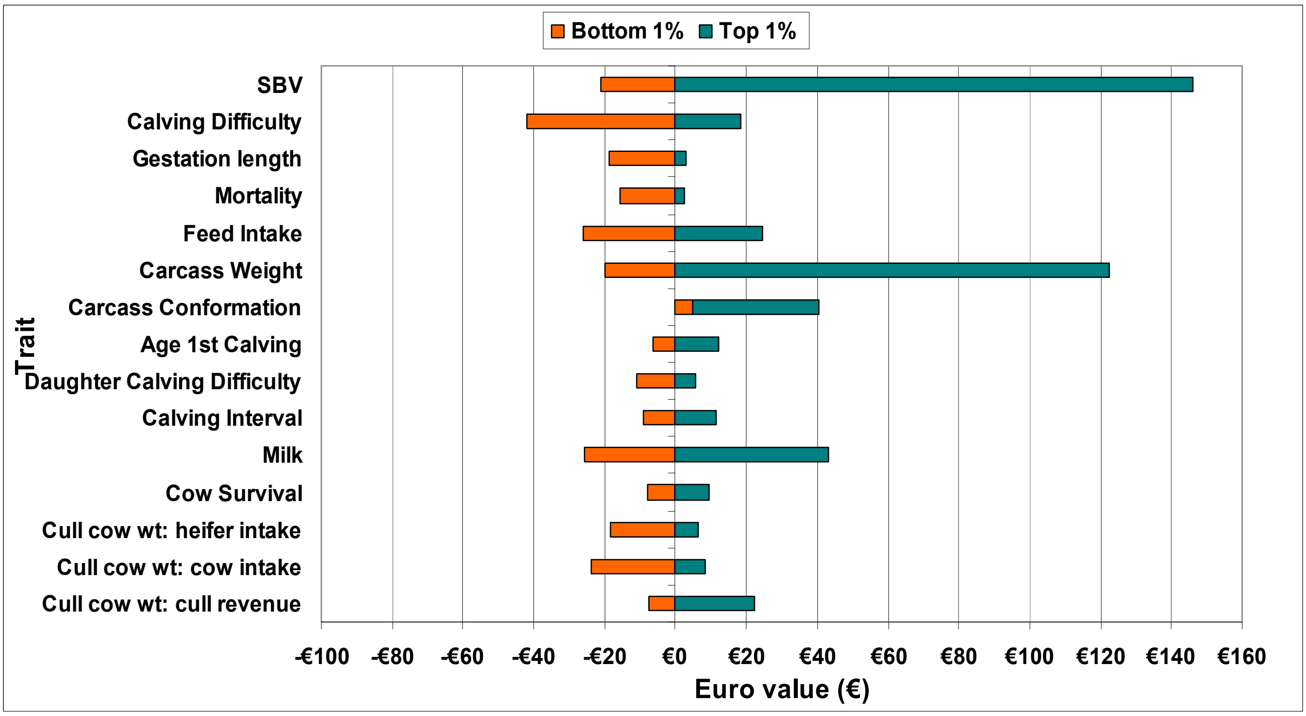


Figure 1. Extremes in emphasis of key traits in the SBV using old economic values

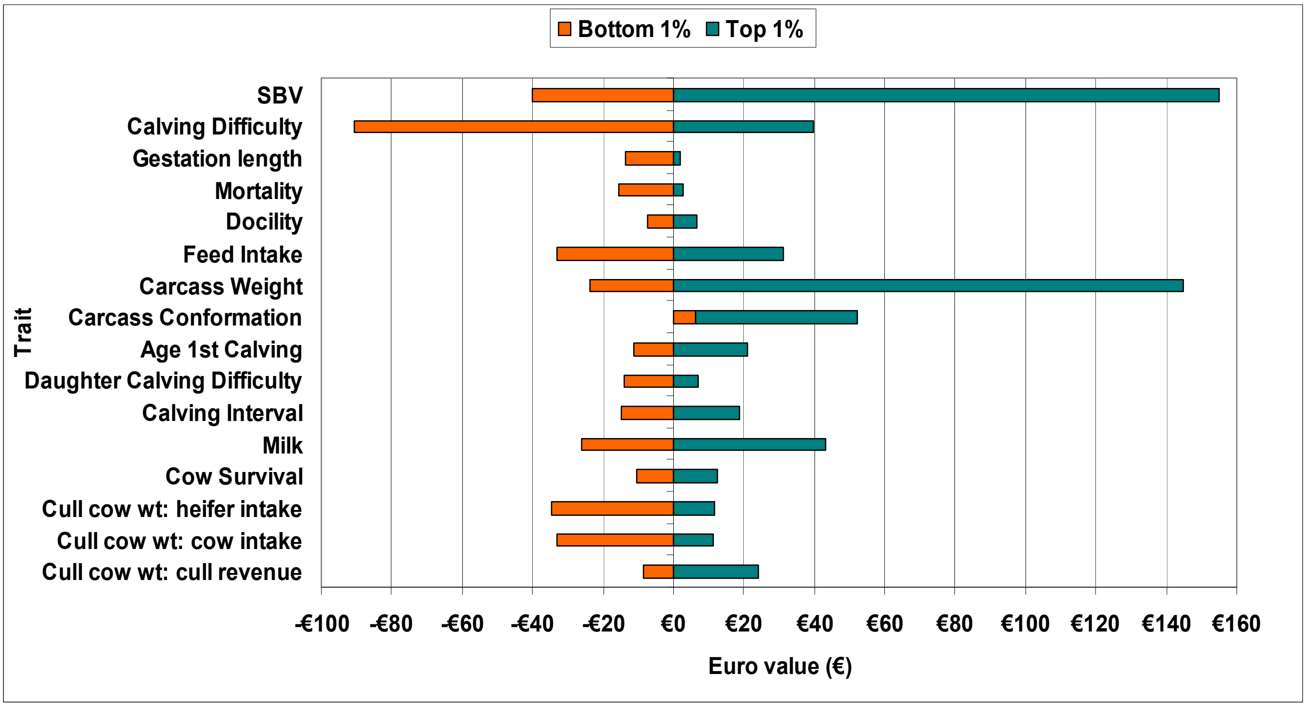


Figure 2. Extremes in emphasis of key traits in the SBV using new economic values

2) Exploration of alternative indexes to the SBV

The review recommended the replacement of the SBV with 3 new indexes:

A) Terminal index, B) Maternal index and C) Dairy-Beef index

Terminal Index

A Terminal index was recommended for selecting sires to breed calves which are destined for slaughter. This index is composed of eight traits of which, three are calving traits (calving difficulty, gestation and mortality), one is a management related trait (docility) and four are beef production related traits (feed intake, carcass weight, carcass conformation and carcass fat). Two additional traits are also added, which are Polledness and Meat Eating Quality. An economic value for polledness of €7.95 has been computed and this is applied to all Angus sires. Any sire from other breeds with evidence of a genetic test confirming polledness will also receive the economic benefit in his Terminal index. In addition, a reward for bonuses received from participation in Angus and Hereford prime schemes is also factored in. This is worth an additional €6.60 to the Terminal index of these breeds when the benefit of additional price is factored across all animals in these breeds receiving the bonus. The relative weighting of each of the traits in the Terminal index is shown in Table 4. Beef output traits at 50% have the largest emphasis on the index followed by the calving traits (29%), feed intake traits (18%) and weanling docility (2%).

Table 4: The weighting given to each of the traits in the new Terminal index.

Traits	Relative emphasis
Calving difficulty, gestation, mortality	29.3%
weanling docility	2.4%
Feed intake	18.4%
Carcass weight, conformation, fat	49.8%

Maternal Index

A Maternal index was recommended for selecting sires with the intention of keeping all daughters as replacement females in the herd. This index is composed of 25 traits of which, eight traits relate to the male progeny produced by a bull which are slaughtered (calving difficulty, gestation, mortality, docility, feed intake, carcass weight, carcass conformation and carcass fat). These are the same traits used in the Terminal index. Nine of the traits in the Maternal index are traits related to the daughters of the bull who become replacements (heifer intake, age at first calving, maternal calving difficulty, maternal milk, calving interval, survival, cow docility, cow intake and cull cow weight). The remaining 8 traits are the same as the Terminal index also but they relate to the calves which these daughters produce or the grand-progeny of the bull (calving difficulty, gestation and mortality, docility, feed intake, carcass weight, carcass conformation and carcass fat). So all the traits in the Terminal index are also in the Maternal index to reflect all the downstream consequences of selecting a Maternal bull (See Figure 3).

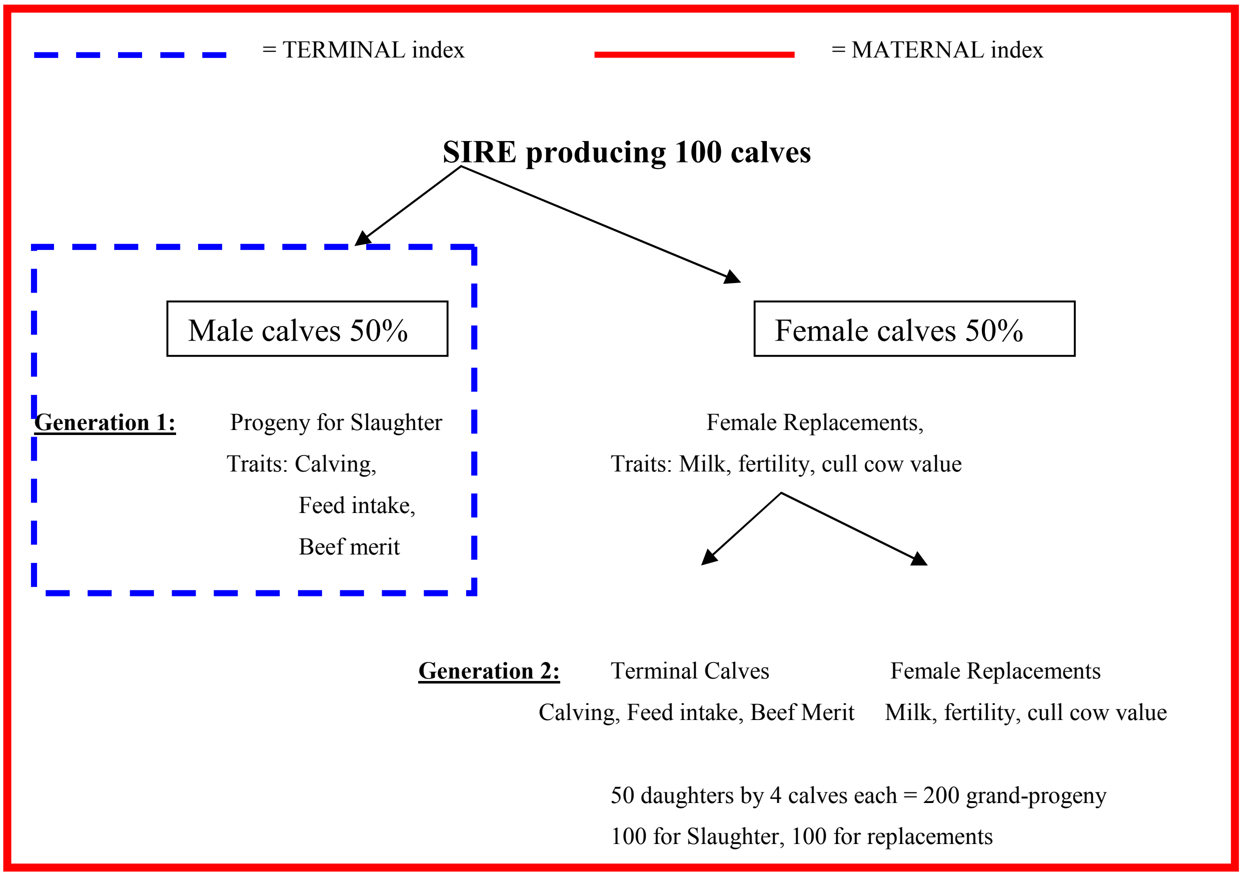


Figure 3. Structure of the Terminal and Maternal indexes for a sire of 100 calves

The relative weighting of each of the traits in the Maternal index is shown in Table 5. Beef output traits at 26% have the largest emphasis on the index followed by the calving traits (21%), feed intake traits (23%), fertility traits (17%) and milkability (9%).

Table 5: The weighting given to each trait type in the new Maternal index.

Trait type	Trait	Relative emphasis %
Calving traits	Calving difficulty (direct and maternal), gestation, mortality	21%
Docility	Weanling and cow docility	4%
Feed intake	Weanling, replacement heifer and cow intake	23%
Beef	Carcass weight, conformation and fat, cull cow wt	26%
Milk	Daughter Milkability	9%
Fertility	Age 1st Calving, calving interval, survival	17%

Figures 4 and 5 provide a graphical summary of the contribution of each trait to the Terminal and Maternal index by applying the economic values to the extremes of genetic merit using the bottom and top 1% for each trait. These indexes include the new economic values as discussed previously. The bottom 1% of bulls for difficult calving (PTA of +16.4%) would see an average calving contribution to the Terminal index of -€56 per calf born, whereas the same category of animals would have a calving contribution to the Maternal Index of -€132. The difference in euro terms between the bottom 1% and the top 1% (who have a calving difficulty PTA of +1.39%) would be €80 in the Terminal Index and €190 in the Maternal index. This indicates that profit in beef bulls when they are selected for Maternal use can be affected by genetic merit for calving difficulty in the order of magnitude of €190 per progeny when the calving genes of the progeny, the daughters ability to calve and the genes of the grand-progeny affecting calving are taken into account. Similarly, differences exist for traits like carcass weight (€218), milkability (€150), cow intake (€96) and calving interval (€73).

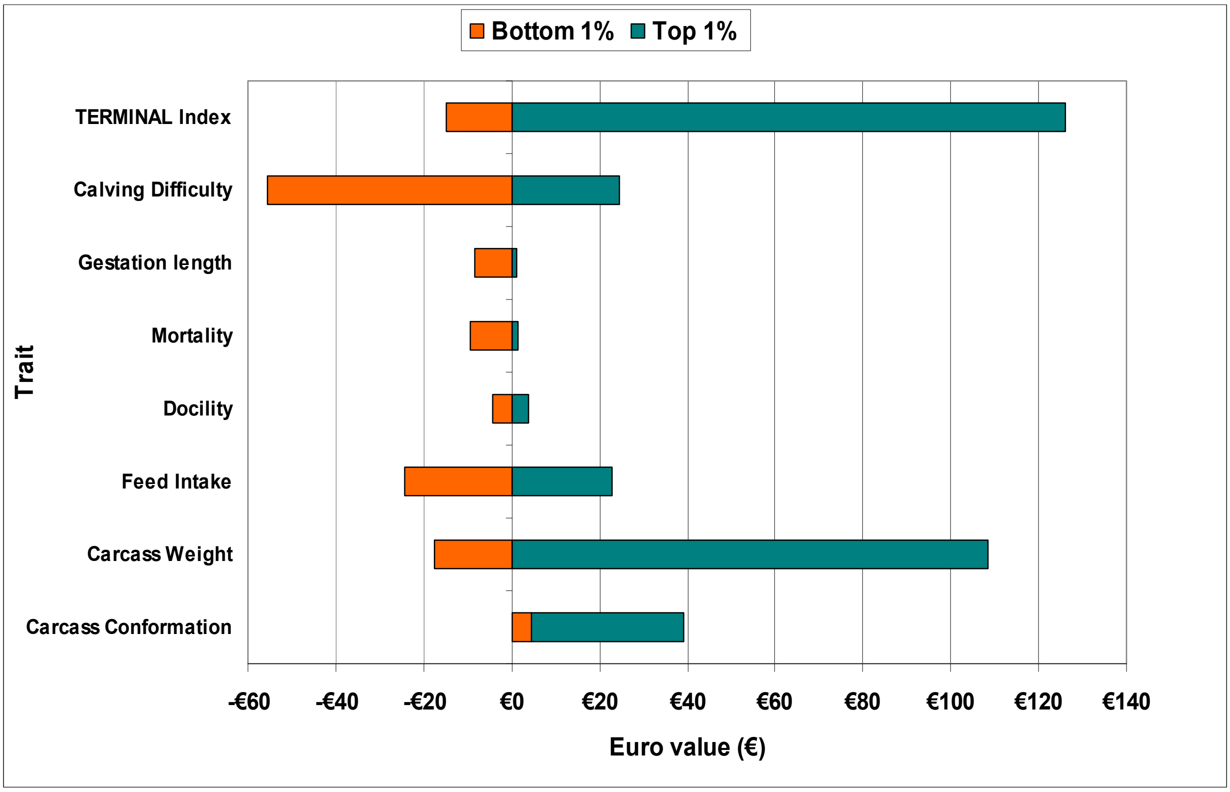


Figure 4: Extremes in emphasis of key traits in the Terminal Index

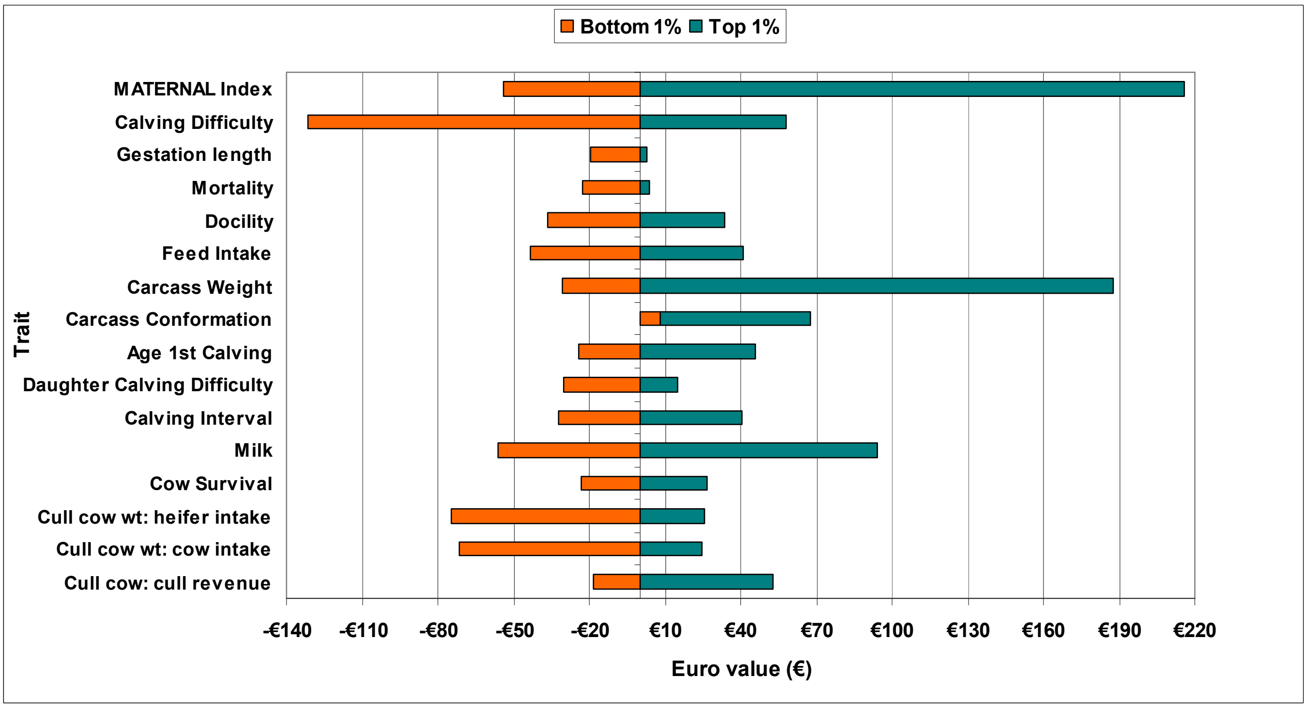


Figure 5: Extremes in emphasis of key traits in the Maternal Index

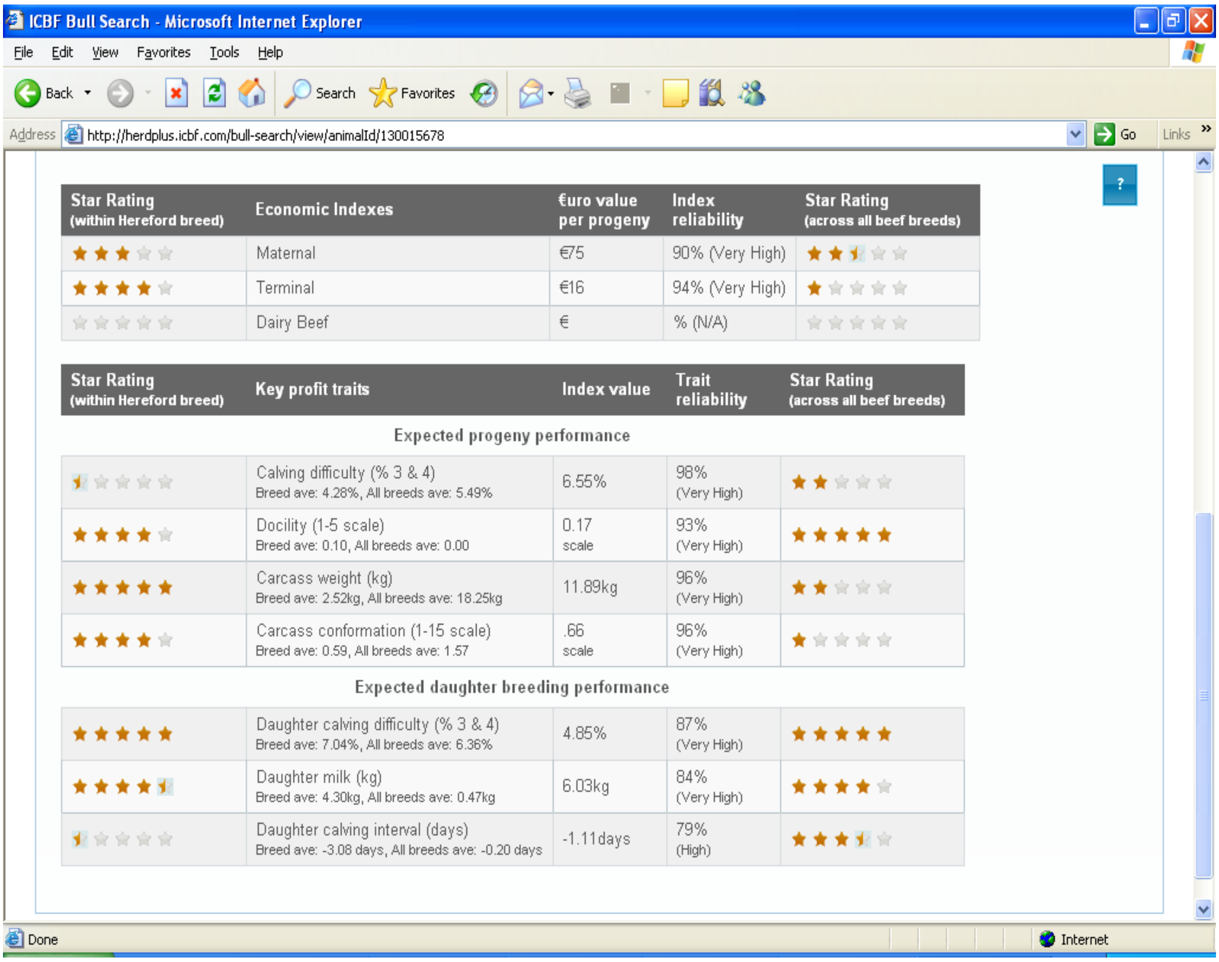
However, although Figures 4 and 5 indicate the effect of individual traits on the new Terminal and Maternal indexes they do not indicate the differentiation in breeds on the new indexes. Table 6 illustrates the difference between breeds on the new indexes by examining the contribution to the Maternal Index of the cow traits relative to the calf traits. Comparing two breeds with a similar average Maternal Index such as the Limousin and the Simmental; using Table 6 the Limousin as a breed is deriving all of its index from a strong calf component, whereas the Simmental has better balance from the cow traits and the calf traits. The more traditional breeds such as Angus, Hereford and Shorthorn are very strong on the cow side and not as strong on the calf side. Obviously individual bulls will all be different in their strengths and weaknesses and some will differ entirely from the average strengths of the breed. In that sense, it is very important for farmers not to select a bull on based on breed alone.

Table 6: Contributions of the cow versus the calf to the Maternal index for AI sires > 50% reliability on Maternal Index

	Index		Euros (€)		Contrbution to the Maternal index	
Breed	Terminal Index	Maternal Index	Cow traits	Calf traits	Cow traits	Calf traits
AA	€29	€117	€73	€36	67%	33%
BA	€96	€43	-€114	€145	0%	100%
BB	€90	€68	-€73	€133	0%	100%
CH	€67	€31	-€70	€96	0%	100%
HE	€8	€54	€46	€6	88%	12%
LM	€79	€93	-€38	€121	0%	100%
PT	€71	€97	-€23	€111	0%	100%
SA	€66	€181	€61	€108	36%	64%
SH	-€7	€88	€95	-€7	100%	0%
SI	€29	€94	€48	€43	53%	47%

Presentation of indexes

The new Bull Search template (Figure 6) displays the new Terminal and Maternal indexes along with the key profit traits. While the Terminal and Maternal indexes indicate the overall profit likely from using a particular sire they do not differentiate what traits are likely to deliver that profit. Farmers will need to use the key traits in tandem with the indexes to identify the strengths and weaknesses of a male or female that they are considering investing in. The 7 key traits provide valuable information on the bull's genetic merit for that trait, both within and across breed. The traits range from calving difficulty through to the likely daughter fertility performance. Additional information on any other traits and the levels and type of information available on males is all available on the ICBF Bull Search. Similar information for females will also be available in other Herd-Plus reports which are currently being changed to reflect the new indexes.



Star Rating (within Hereford breed)	Economic Indexes	€uro value per progeny	Index reliability	Star Rating (across all beef breeds)
★★★☆☆	Maternal	€75	90% (Very High)	★★½☆☆
★★★★☆	Terminal	€16	94% (Very High)	★☆☆☆☆
☆☆☆☆☆	Dairy Beef	€	% (N/A)	☆☆☆☆☆

Star Rating (within Hereford breed)	Key profit traits	Index value	Trait reliability	Star Rating (across all beef breeds)
	Expected progeny performance			
½☆☆☆☆	Calving difficulty (% 3 & 4) Breed ave: 4.28%, All breeds ave: 5.49%	6.55%	98% (Very High)	★★☆☆☆
★★★★☆	Docility (1-5 scale) Breed ave: 0.10, All breeds ave: 0.00	0.17 scale	93% (Very High)	★★★★★
★★★★★	Carcass weight (kg) Breed ave: 2.52kg, All breeds ave: 18.25kg	11.89kg	96% (Very High)	★★☆☆☆
★★★★☆	Carcass conformation (1-15 scale) Breed ave: 0.59, All breeds ave: 1.57	.66 scale	96% (Very High)	★☆☆☆☆
	Expected daughter breeding performance			
★★★★★	Daughter calving difficulty (% 3 & 4) Breed ave: 7.04%, All breeds ave: 6.36%	4.85%	87% (Very High)	★★★★★
★★★★½	Daughter milk (kg) Breed ave: 4.30kg, All breeds ave: 0.47kg	6.03kg	84% (Very High)	★★★★☆
½☆☆☆☆	Daughter calving interval (days) Breed ave: -3.08 days, All breeds ave: -0.20 days	-1.11days	79% (High)	★★★½☆

Figure 6: An example of the new Bull Search showing the new Terminal and Maternal indexes and key profit component traits.

Importance of Reliability

There is a reliability figure beside each trait and index; this is a measure of how much information is behind the PTA or index for the animal. The more information (i.e. calvings, live weights, carcass records) included in the evaluation the higher the reliability for that trait or index. Reliability varies between 0% (no information) and 99% (huge volumes of progeny information). The higher the reliability figure, the less likely that the breeding values for an animal will change in future genetic evaluations. Indexes can still change as extra information is included in future evaluations but the chances of it changing are reduced with higher reliability.

In the new Bull Search there is a comment included with each reliability figure quoted so that farmers have a good idea as to where the information on that animal compares with other animals.

There are 5 comments varying from:

Very High (Reliability >80%)
High (Reliability 60% - 80%)
Average (Reliability 40% - 60%)
Low (Reliability 20% - 40%)
Very Low (Reliability <20%)

Table 7 shows the likelihood of a PTA changing for AI sires depending on the reliability in the previous run. The average change in index across all the reliability categories is low, at less than 1 kg difference. However, animals in the lower reliability categories will see much higher levels of change at the extremes. Converting this to the impact it would have had on the new indexes it can be seen that the changes for highly reliable sires is minimal (€3 and €5 maximum change for Terminal and Maternal Index, respectively). In contrast, there is large movement in the lower reliability categories for individual bulls. Table 7 also shows the level of progeny records needed to get to a certain level of reliability for carcass weight. Sires with <65% reliability will have very few progeny records for carcass weight and most of their genetic merit is coming from ancestors or correlated traits such as linear scores and weaning weights. In contrast, animals with >80% reliability will have a lot of progeny carcass records.

Table 7: The effect of previous reliability on the change in carcass weight PTA between the April 2012 and the August 2012 evaluations.

category of old reliability	Number of sires	Maximum loss in cwt PTA	Maximum gain in cwt PTA	Average difference in cwt PTA	Impact of largest change		Average progeny carcass records Apr'12	Average number of extra carcasses in Sep'12	Maximum number of progeny carcass records
					Terminal index	Maternal index			
99% +	170	-0.8	1.0	0.2	€3	€5	1,443	92	15,144
80% to 98%	623	-6.3	7.6	0.2	€23	€39	60	3	398
65% to 80%	272	-10.7	7.8	0.3	-€32	-€55	7	0.2	20
50% to 65%	243	-7.0	15.7	0.7	€46	€80	2	0.1	9
Less than 50%	1012	-8.1	16.6	0.7	€49	€85	1	0.0	5

Genetic evaluation improvements

Genetic evaluations are constantly evolving as more information and new traits are collected. The genetic relationships between traits are estimated based on a sample of information from the population and need to be updated over time to reflect any changes that occur in the national suckler herd such as a shift toward a certain breed type or movement toward a certain type of animal. A review of the calving and beef performance genetic relationships is on the horizon and may be included in the December evaluation update. In the Calving evaluation this will include improved relationships between: calving difficulty, maternal calving difficulty, gestation and mortality but also the potential addition of birth weight, carcass weight and carcass conformation as predictors of calving difficulty. The latter step is necessary to address likely under-reporting of calving difficulty in herds.

Planned improvements to the beef evaluation include: the evaluation of dairy herd calf price which will be a goal trait in the Dairy-Beef index. This is an index targeted towards dairy producers looking for a beef bull. Other improvements will include, the introduction of four new carcass traits related to meat yield and also improved ways of dealing with data from small pedigree herds.

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Genetic evaluations - do they work?

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Summary

- Accurate genetic evaluations are key to sustainable genetic gain.
- The contribution of the breeding cow to profitability in seasonal calving suckler herds is fundamental.
- Ample genetic variation exists for maternal traits in Ireland both across breed and within breeds.
- Previous beef breeding indexes in Ireland have facilitated large improvements in carcass traits but resulted in a decline in milk and fertility within the national population due to the unfavourable relationship between terminal and maternal traits.
- Cow genetic merit for maternal traits estimated from the ICBF was associated with superior on the ground performance in Irish herds.
- A new maternal suckler beef cow research herd will be established in Teagasc Grange to investigate the impact of the maternal index on individual component traits and overall herd profitability.

Introduction

Accurate genetic evaluations are key to sustainable genetic gain. However, genetic evaluations need to be constantly assessed to ensure that they are reflective of on-farm performance. Research at Teagasc Grange has clearly showed that genetic evaluations for carcass traits were reflected in differences in animal performance across traits such as growth rates, carcass weight (Campion et al., 2009; Keane and Diskin, 2007), kill out percentage and carcass value (Drennan and McGee, 2008). Furthermore, Clarke et al. (2009) have shown that the previously published beef carcass sub-index was also reflected through greater profitability of progeny of high genetic merit sires.

The contribution of the breeding suckler cow to overall efficiency and profitability within the beef herd and the beef sector can not be overstated. Recent industry figures from the ICBF have shown that, on average, suckler cows are 32 months of age at first calving, have calving intervals of greater than 406 days and are producing only 0.80 calves per cow per year

(Cromie, 2011). This level of performance is not sustainable. Accurate genetic evaluations will allow farmers to better select superior cows for breeding and thereby improve the national cow population. However, no comprehensive study has, to date, been undertaken to quantify the on-farm performance of cows divergent for genetic merit for a range of maternal traits as published routinely by the ICBF.

In this paper we will discuss the genetic influence on maternal traits, how the maternal genetic evaluations are conducted and also evaluate the usefulness of the national genetic evaluations to improve maternal traits in the national suckler herd.

The importance of genetics for maternal traits

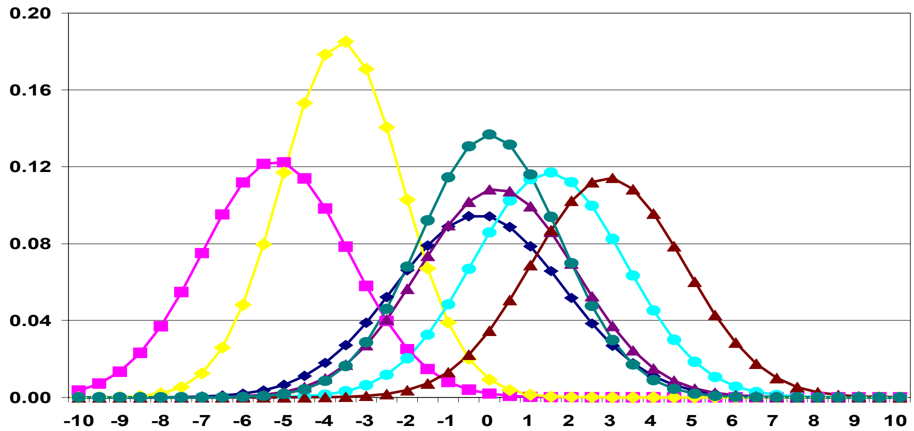
Genetic gain is cumulative and permanent so if you use an animal with "good maternal genetics" to breed replacements this will filter down through your herd and the "good genetics" will be reflected in the milk and fertility of the animal's progeny and subsequent descendants. However, the reverse is also true if you have an animal with "bad maternal genetics" then that genetics is there to stay in your herd.

There is a misconception that maternal traits, especially fertility traits, are not controlled by genetics but instead are influenced entirely by management. In reality, it's a combination of both genetics and management. Low heritability estimates for maternal traits means that a large quantity of on-farm records must be collected on these traits across large numbers of daughters to achieve high reliable proofs for sires that do not fluctuate. Although reported heritability estimates for fertility traits in Ireland (Berry et al., 2012) and other countries (Koots et al., 1994; Martinez-Velazquez et al., 2003; Donoghue et al., 2004) are low, the contribution of large quantities of accurately recorded data, as collected through the suckler welfare scheme in Ireland, can help alleviate this deficiency. For fertility traits, the low heritability estimates recorded maybe due to slight deviations in recorded calving dates of individual cows or pedigree errors. Therefore, if the quality of the data collected was improved then the heritability would increase and genetic gain would also improve.

Nonetheless, the current heritability estimates for fertility traits in Irish beef cows (Berry and Evans, 2012) are the same as in Irish dairy cows (Berry et al., 2012) and the EBI in dairying is now resulting in improvements in fertility in the Irish dairy herd. Therefore, fertility in the Irish suckler herd can indeed be improved through animal breeding, although it will take time. Also, in dairying, genetic merit for milk production is still increasing despite emphasis being placed on fertility, which is unfavourably correlated with milk yield. The same is possible in beef; placing emphasis on maternal traits in a national beef breeding scheme does not need to result in deterioration in genetic merit for terminal traits.

Another common misconception can be that the differences or variation in such traits (i.e. milk and fertility traits) is simply differences between breeds. Examples of this include, that all dairy crossbred heifers have superior milk yields and that it is possible to calve all early-maturing breeds at 2 years of age but not the late-maturing continental breed heifers. Although differences do exist between breeds in terms of milk and fertility performance (Martin et al., 1992) it is important to remember that there is as much genetic variation within breeds as there is across breeds. Figure 1 illustrates the genetic variation that exists between high reliable sires across a range of breeds for two fertility goal traits, calving interval and age at first calving.

a) Calving Interval



b) **Age at first calving**

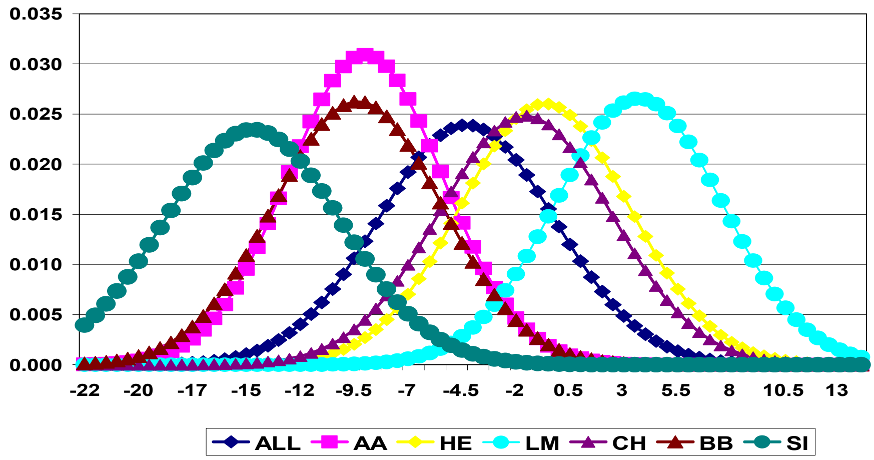


Figure 1. Proportion of sires with variation in EBVs across breed for: a) calving interval (in days) and b) age at first calving (in days). Where All = all breeds, AA= Aberdeen Angus, HE= Hereford, LM=Limousin, CH= Charolais, BB= Belgian Blue, and SI= Simmental.

Accurate genetic evaluations for maternal traits are dependent on exploitable genetic variation and access to routine accurately recorded on-farm data. Although maternal traits have been included in the beef national genetic evaluations since the formation of the Suckler Beef Value (SBV) index in 2007, these traits were somewhat masked due to the high emphasis placed on the terminal traits. Although large improvements were recorded for the carcass traits, milk and fertility within the national population declined due to the antagonistic relationship between terminal and maternal traits. The launch of a separate Maternal and Terminal index by the ICBF in autumn 2012 simplifies the selection of animals for farmers.

How genetic evaluations work

The genetic evaluations for maternal traits are composed of traits that are of key importance to profitability for beef farmers (i.e. goal traits). However, the feasibility of breeding for a given trait is dictated by the availability of data. For example, fertility data is now available on large numbers of suckler cows through the recording of calving dates, providing valuable information to help identify genetically elite animals for fertility. Through the recording of calving dates, traits such as age at first calving for heifers (i.e. days from birth to first calving) and calving intervals (i.e. number of days between calvings) can be calculated. Although milk yield can not be measured regularly on large numbers of beef cows, a predictor trait has been identified that provides an accurate indicator of the cows milk yield, maternal weaning weight. The live weight of a calf close to weaning can provide a good indicator of: 1.) the potential of the calf to grow due to the growth genes from the sire and the dam (i.e. direct weaning weight) and 2.) the growth of the calf due to the milk yield of the cow (i.e. maternal weaning weight). However, since the number of weaning weight records remains quite low, correlated traits including younger and older weight records and a cow milkability score recorded by farmers are also included in the evaluations to increase the accuracy of the evaluations.

So do genetic evaluations work for maternal traits?

The accuracy of the ICBF national genetic evaluations can be tested by comparing the genetic merit of a cow with her performance. The genetic merit of all animals was determined based on the genetic merit of their sire and maternal grandsire as published by the ICBF in April 2011.

For traits associated with the cow (i.e. age at first calving, calving interval, survival and maternal calving difficulty and milk yield), estimates of genetic merit were generated for the traits in the form of a pedigree index for each cow as 0.5 × sire EBV + 0.25 × maternal grandsire EBV. For traits of the calf (direct weaning weight, stillborn and direct calving difficulty) a calf index was generated as 0.5 × sire EBV + 0.25 × maternal grandsire EBV.

To assess the usefulness of the maternal genetic evaluations for improving fertility and milk yield in the national herd, sire breeding values for maternal traits were compared to the performance of their subsequent offspring. Only farm data after April 2011 was used so that the results are a truer reflection of the accuracy of the genetic evaluations.

Fertility traits

For the analysis of the fertility data three goal traits were examined separately: age at first calving, calving interval, and survival. Results are summarised in Table 1. For each cow the pedigree index for each of the traits were divided into four distinct levels, with level 1 (representing animals with the highest genetic merit), levels 2 and 3 (representing animals of intermediate genetic merit) compared to level 4 (representing animals with the lowest genetic merit). The values within the table correspond to the on-farm performance of the cows. Across all three fertility traits, a similar trend was noted whereby cows with the highest breeding values had better on-the-ground fertility performance. Cows with the highest (most favourable) breeding values for age at first calving calved, on average, 7.04 days earlier than cows with the lowest breeding values. Similarly, for calving interval, cows with high breeding values had a 1.29 day shorter calving interval than cows with the lowest breeding values.

Table 1: Phenotypic performance (with standard errors in parenthesis) for age at first calving, calving interval, and survival of the genetically high (Level 1) compared to genetically low (Level 4).

Trait		Age at first calving ▼	Calving interval ▼	Survival ▲
Level	**1**	-7.04 (3.49)	-1.29 (0.76)	0.16 (0.11)
	2	-7.50 (3.29)	-0.09 (0.86)	0.12 (0.10)
	3	-2.99 (3.18)	0.35 (0.74)	0.07 (0.10)
	4	0	0	0

▲= indicates a (more) positive value for this trait is desirable; ▼= indicates a lesser value for this trait is desirable.

Other maternal traits

Direct and maternal breeding values for weaning weight and calving difficulty, and the direct breeding values for calf mortality were examined. Results from Table 2 indicate that selecting animals with superior breeding values (Level 1) for calf mortality, calf dystocia (direct and maternal) and weaning weight (direct and maternal) will result in better on-the-ground performance. For example, for calf mortality, sires with high genetic merit for this trait are

35% less likely to produce a dead calf. Cows with a high genetic potential for milk yield (maternal weaning weight) will, on average, wean calves that are 7.99 kg heavier; sires with high genetic merit for weaning weight will on average wean calves that are an additional 19.06 kg heavier.

Table 2: Phenotypic performance (with standard errors in parenthesis) for calf mortality, direct and maternal calf dystocia and direct and maternal weaning weight of the genetically high (Level 1) compared to genetically low (Level 4).

Trait		Calf Mortality▼	Direct Calf Dystocia ▼	Maternal Calf Dystocia ▼	Direct Weaning weight ▲	Maternal Weaning weight ▲
Level	**1**	-0.35 (0.21)	-1.54 (0.14)	-0.33 (0.20)	19.06 (2.02)	7.99 (2.00)
	2	-0.18 (0.18)	-0.95 (0.12)	-0.40 (0.19)	9.98 (1.76)	1.26 (1.94)
	3	0.04 (0.17)	-0.66 (0.11)	-0.37 (0.18)	6.07 (1.73)	-0.16 (1.89)
	4	0	0	0	0	0

▲= indicates a (more) positive value for this trait is desirable; ▼ = indicates a lesser value for this trait is desirable.

Future research in genetics of maternal traits

Although the new genetic indexes for beef are more reflective of on-farm profitability for Irish beef farmers, genetic evaluations require continuous re-evaluation and refinement. With this in mind, a new maternal suckler beef cow research herd is currently being established in Teagasc Grange that will investigate the impact of the maternal index on milk yield and reproductive performance. Deep phenotyping will be undertaken in this herd on such traits not routinely measured at farm level (e.g. feed efficiency and health) to ensure that the new maternal index is not having a detrimental effect on such traits. The maternal herd will consist of 120 cows of diverse genetic merit for maternal traits that are sourced from both the dairy and suckler herd. Performance of the cow and their offspring will be evaluated and differences in profit compared to expectation based on predicted genetic merit will be determined. On-farm performance will also provide a demonstration tool for beef farmers on the importance of genetics for the breeding cow.

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Application of genetic indexes in Irish suckler herds

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Summary

- The new beef indexes will significantly improve the selection of the most appropriate type of sires for different herds with different breeding aims and objectives.
- On average, bulls that have a high value on the new Terminal Index should produce progeny that have a high output with improved feed efficiency that are not overly difficult to calve.
- It is always advisable to monitor the calving difficulty trait along with whatever other key profit trait that is important for a particular herd to improve.
- The new Maternal Index allows farmers to easily identify sires that would be suitable to breed replacement heifers.
- It is essential that the key profit traits relating to both the beef and maternal traits are examined closely to see why individual bulls have a high Maternal Index value.
- All of the beef breed societies and a growing number of marts are using the ICBF catalogue software when generating their sales catalogues.
- By pooling together a team of 5 unrelated A.I. bulls whose individual Maternal index reliabilities are 60% each – the reliability for the average team genetic merit is 92%.
- The new Maternal Index will also help suckler farmers to choose replacement heifers by examining their values.
- One of the objectives of every suckler herd should be to increase its average Maternal index value each year as a new generation of higher Maternal index replacement heifers are brought into the herd.
- Increased weighing of weanlings in suckler herds will increase the reliabilities of the daughter milk key profit trait in both bulls and replacement heifers.
- Advances in sexed semen will allow even greater selection of bulls to produce replacement heifers.
- The reliability % figures are crucial as they are a measure of the accuracy of the genetic evaluation; the higher the reliability the more confident one can be that a bull's index will not change.

Introduction

The latest CSO figures show that there are 79,153 farms in the country that have a suckler herd. There are 1.14 million suckler cows in the country and the average herd size is 17 cows (CSO, 2010). Suckler cows are typically cross-bred. Fifty percent of the 1.1 million dairy cows are also bred to beef bulls. Annual beef meat output is 540,000 tonnes of which 85% is exported at a value of €1.8 billion; 50% of exports are to UK and 48% to continental Europe. Live beef cattle exports in 2011 were over 200,000 animals valued at €200 million, giving total beef exports of €2 billion for the sector (Bord Bia, 2012).

The annual beef calving statistics produced by the Irish Cattle Breeding Federation (ICBF) show that for the period July 2011 to June 2012 the average suckler herd had a calving interval of 396 days and the average number of calves per cow was 0.85 (ICBF, 2012) . Within the same period only 16% of the heifers that calved were between 22 and 26 months of age. The ICBF indicated in the Food Harvest 2020 report that the profitability of our existing suckler cow herd could be increased by €200 million per annum by 2020 through a combination of better quality cows and breeding, achieving slaughter carcass weights at a younger age and better carcass quality (DAFM, 2011).

Genetic indexes have a huge role to play in improving individual herd breeding figures along with improving growth rates and conformation in suckler progeny. Since the introduction of the Suckler Beef Value (SBV) index in 2007 there is a much greater understanding among suckler farmers of the importance of buying or choosing a bull to use within their herds on the basis of breeding values. Last year there were over 1.1 million hits on the ICBF Bull search and 700,000 of these were for beef bulls. The majority of pedigree beef bull sales and A.I. beef catalogues now publish the €uro-Star values for bulls and having a high genetic merit bull is one of the tasks that suckler farmers who are participating in the new Beef Technology Adoption Programme (BTAP) can choose to qualify for payment.

Over the past 6 months ICBF have undertaken a major review of how the €uro-Star indices are derived and presented. The main driver behind the change to the formulation of the indices is the use of a new economic model, the Teagasc Grange Beef Systems Model, to derive the economic values (and weightings) for the various traits within the relevant economic indexes (Maternal, Terminal & Dairy Beef). The new model has allowed a more comprehensive assessment of the true impact of each change in a unit trait on overall farm profitability, including a better understanding of the important role that cost of production traits have on suckler beef farms. As a consequence, the new indexes will see a general shift in weighting towards cost of production traits such as calving, female fertility and maternal milk. The new indexes that are now replacing the SBV Index on beef bulls will significantly improve the selection of the appropriate type of sire for different suckler herds with different breeding aims and objectives.

Choosing a Terminal Sire

Suckler farmers who are breeding their cows to produce calves that are destined for slaughter, either directly from farm of origin or on another farm should limit their selection first of all to bulls that are high on the new Terminal Index (Table 1). There are no maternal traits in the Terminal index with the emphasis of this index (68%) being on producing calves that have the potential to produce heavier carcasses, that are leaner and of better conformation with improved feed efficiency. The emphasis of the remaining 32% of the index is on direct calving traits (calving difficulty, gestation length and mortality).

Table 1: Composition of the new Terminal Index and the weightings on each trait group.

Terminal Index	
Trait group	**% Emphasis**
Calving	29%
Beef	68%
Docility	3%

On average, beef bulls that are high on the Terminal Index will produce progeny that have a high output in the form of carcass yield, with improved feed efficiency that are not overly difficult to calve. Suckler farmers looking to produce replacement heifers should **not** use the Terminal index to choose a sire to breed from. The Terminal Index is expressed in both monetary terms (€uro per progeny produced) and on a five star rating. Bulls can be compared both within and across breeds. Where there is no specific breed choice involved the across breed comparison should always be used.

After narrowing the selection using the overall Terminal Index, the individual key profit traits that are associated with the Terminal Index should be examined closely to see which of them are having the largest influence on the Terminal Index. The standard €uro-star template has four Key Profit Traits shown associated with the Terminal Index:

1. Calving Difficulty
2. Docility
3. Carcase weight
4. Carcase Conformation.

Each of the key profit traits has an individual value (per calf produced), along with the star rating, both within and across breeds, for easier comparison. However, all of the traits that contribute to the Terminal Index value of a bull can be found through the ICBF online "Bull Search" facility. When finalising sire selection individual suckler farmers must then choose which of these key profit traits are of most importance to them. For some farmers carcass conformation will be more important than calving difficulty and they will focus on it primarily. For others carcass weight will be the key trait to give most attention to. However, very few suckler farmers want very difficult calving problems and so it is always advisable to watch the calving difficulty trait. The reliability of each of the key profit traits is shown along side their values. This is an important figure and is a measure of the confidence you can put in the values shown for each bull. No index or key profit trait should be looked at without also looking at the reliability associated with it. Reliability figures and how they should be interpreted is covered in more detail later in this paper.

Choosing a Maternal Sire

The new Maternal Index now offers suckler farmers the choice of selecting a sire for their herd that has the potential to produce replacement heifers that will be above average for some of the key traits that are desirable in a suckler cow (Table 2).

Table 2: Composition of the new Maternal Index and the weightings on each trait group.

Maternal Index	
Trait group	**% Emphasis**
Calving	21%
Beef	49%
Fertility	17%
Milk	9%
Docility	4%

Similar to choosing a terminal sire the overall Maternal Index should be used to narrow down the choice of bulls that you are looking at. After that, it is essential that the key profit traits relating to both beef traits and maternal traits are examined closely to see why individual bulls have a high Maternal Index value. This is important because the Maternal Index still has 49% of its value made up from beef traits and feed efficiency. Bulls that are exceptionally high on these beef profit traits but below average on many of the maternal key profit traits can still have a high overall maternal index value.

The three key profit traits shown relating to the Maternal Index are:

1. daughter calving difficulty
2. daughter milk
3. daughter calving interval.

These are considered to be the most important traits to look at within the maternal traits. Other maternal traits can also be examined for every bull by using the ICBF online "Bull Search". As with choosing a terminal sire, the direct calving difficulty of the bull himself is one of the more important key profit traits to examine first. After that, it will depend on the different requirements for individual suckler herds. Where calving interval in a herd is poor or declining, producing heifers with an improved average calving interval might be a priority. Only choosing bulls that are high on the Maternal Index and high for the daughter calving interval will, over time, help to breed cows for the herd that will go back in calf quicker after calving. If however, cow milk production or calving difficulty are issues then these are the key profit traits that would take higher priority. Bulls that are very low (i.e. one or two stars) on any of the three key daughter profit traits in the Maternal Index should not be used to produce replacement heifers as over time they will lead to a decline in this trait in the herd.

The reliability figures associated with each of the maternal traits can often be quite low. This is because there is not enough data available on particular bulls or their parents to give higher confidence to the figures shown. Stock bulls can have quite low reliabilities for their maternal traits and it is only when their daughters produce calves, whose data then becomes available to the ICBF database that their reliabilities will increase. A.I. bulls may have higher reliabilities as they generally have many more daughters who are producing calves.

The introduction of the Suckler Cow Welfare Scheme in 2008 has led to a large increase in the number of heifer calves with a sire recorded at birth. These heifers are now calving since 2010 onwards; this has led to an increase in the reliability figures associated with maternal traits. However, reliabilities still remain relatively low and can often range from 40 to 45 % compared to terminal traits (where there is a lot more data), which are usually from 70% upwards. To increase the reliability figures associated with choosing a maternal sire, one option is to pool maternal AI bulls (covered in more detail later in this paper).

Selection Tools available to the Irish Beef Farmer

The development of new indices is one part of the initiative to help Irish beef farmers make better breeding selection decisions. However, making use of the various practical tools available, that permit these selection decisions to be made, is also hugely important:

"Bull Search"

The ICBF Bull Search is a search engine on the ICBF website (www.icbf.com) which gives the Genetic Evaluation information on any beef (or dairy) bull (See Figure 1).

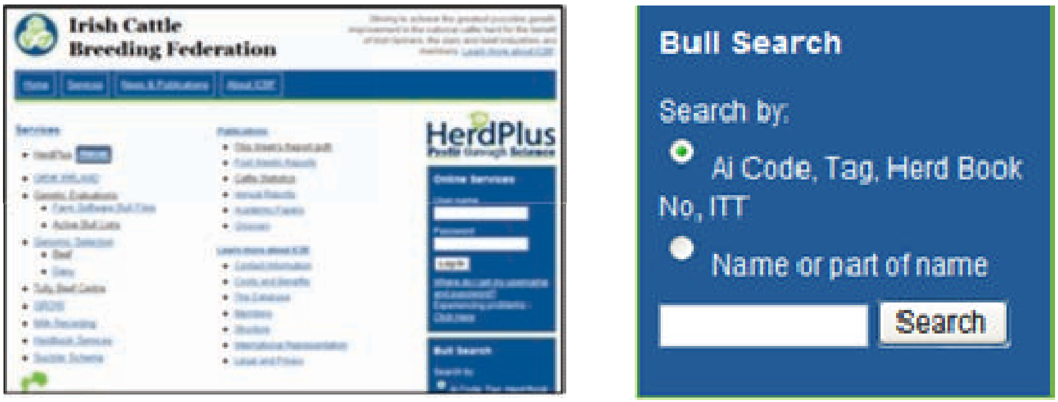

Figure 1: Screenshots of the ICBF homepage and the Bull Search option

Under Bull Search the most recent genetic evaluations are displayed for each bull (sire) and supplementary information is also shown. This additional information includes the number of progeny included in the genetic evaluations that make up the €uro-Star Index for a particular sire and also comparable data for the herd-mates of a sire's progeny. The breed profile of the cows (dams) that the progeny are out of is also shown. Furthermore, the 7 previous genetic evaluation runs are also shown which makes it easy to see how a Bull's index has progressed over time.

Catalogue Page

An extremely valuable tool for helping farmers make the correct bull purchasing decision is the information on a prospective stock bull in a Sales Catalogue (See Figure 2). All of the Beef Breed Societies and a growing number of livestock marts, in their own bull sales, use the ICBF Catalogue software when generating their sale catalogues. This means that there is great consistency across bull sales in terms of the genetic evaluation information provided.

Lot 41 Castleview Darren

ID: IE191567160454 **Breed:** Limousin
Sex: Male **DOB:** 30-Mar-2008

Owner: Timothy Corridan - Castlequarter House Fedamore Co Limerick
Breeder: John J O'Sullivan - Tobermaing Castleisland Co Kerry

Sire: Fieldson Alfy S511	Gunnerfleet Plunas	Tunnelby Monkeytricks / Gunnerfleet Luna
	Eden Natasha	Broadmeadows Cannon / Birtles Daisy
Dam: Palme FR2300545298	Heros	Diamant / Silette
	Demoiselle	Tarvis / Arlesienne

Star Rating (Within Limousin breed)	Economic Indexes	€ uro value per progeny	Index Reliability	Star rating (across all beef breeds)
★★★★★	**Maternal**	€ 191	34% (Low)	★★★★★
★★★★★	**Terminal**	€ 119	40% (Average)	★★★★★
	Dairy Beef			

Star Rating (Within Limousin breed)	Key profit traits	Index Value	Trait Reliability	Star rating (across all beef breeds)
	Expected progeny performance			
★★★★	Calving difficulty (% 3 & 4) Breed ave: 5.33%,All breeds ave: 5.49%	+4.63%	57% (Average)	★★★½
★★★★★	Docility (1-5 scale) Breed ave: -0.06,All breeds ave: 0	0.12 scale	52% (Average)	★★★★½
★★★★½	Carcass weight (kg) Breed ave: 18.61kg,All breeds ave: 18.25kg	+23.2kg	36% (Low)	★★★½
★★★★★	Carcass conformation (1-15 scale) Breed ave: 1.79,All breeds ave: 1.57	+2.08 scale	28% (Low)	★★★★★
	Expected daughter breeding performance			
★★	Daughter calving diff (% 3 & 4) Breed ave: 5.9%,All breeds ave: 6.36%	+6.2%	34% (Low)	★★★
★★	Daughter Milk (kg) Breed ave: -0.31kg,All breeds ave: 0.47kg	-1kg	26% (Low)	★★½
★★★	Daughter calving interval (days) Breed ave: 1.27days,All breeds ave: -0.2days	+1.13days	18% (V Low)	★★

Additional Information:

Linear composites	Value	Reliability
Muscle	114	61%
Skeletal	105	61%
Function	123	28%

Herd data quality index
N/A

Figure 2: An example of a bull sale catalogue detailing the bulls pedigree, the €uro-star value, reliabilities and star rating's for the indices and the key profit traits.

Pooling Maternal A.I. Bulls

Where a single A.I. sire is chosen based on a high Maternal Index value (i.e. to produce replacement heifers in a herd) but the reliability figure associated with his maternal index is only average (e.g. 40 to 45%) there is a risk that the maternal productivity of his daughters may not be as good as expected. In other words, over time, as that bull produces more and more daughters, who in turn produce calves themselves, his Maternal Index value, could increase or decrease. With more data, the reliability figure will increase and there will be less movement in the Maternal Index value of the bull. To reduce the risk of sires indices increasing or decreasing dramatically, it is better to choose a "team" of Maternal AI bulls to produce replacement heifers from – just as choosing a portfolio of shares is much less risky than putting all of your money into the shares of one particular company.

The team of maternal A.I. bulls should only be chosen from bulls that have a low calving difficulty with a high reliability figure for this trait. By doing this, young bulls that are not yet proven for calving difficulty, and which could cause serious harm in a herd, are avoided. After that, only bulls that are high on the key maternal traits for your herd should be chosen, while also ensuring that they score well (three to five stars) on the remaining maternal traits. By pooling together a team of 5 unrelated A.I. bulls whose individual maternal index reliability values are 60% - the reliability for the average team genetic merit is 92%. Example:

$$1 - \left\{ \frac{1 - 0.6}{5} \right\} = 0.92$$

Purchasing Replacement Heifers

The new Maternal Index will not only be of value when choosing a bull to produce replacement heifers it will also replace the SBV index values currently available on female stock. Suckler farmers who buy, rather than breed their own, replacements will now have an index that can help them select replacement heifers. As with choosing a maternal bull, the key maternal profit traits will be just as important to consider as the overall maternal index. By only choosing heifers that have a medium to high reliability figure (i.e. above 30%) for the Maternal Index and key traits, the risk of over or under estimating their maternal value will be lessened.

Increasing Herd Average Maternal Index

All suckler cows will have a new Maternal Index value, giving an estimate of their breeding value for maternal traits. The objective of every suckler herd should be to increase its average

Maternal Index value each year as a new generation of higher Maternal Index replacement heifers (either home reared or bought in) are brought into the herd annually. As the indexes are completely profit driven, suckler herds with higher Maternal Indexes have higher profit potential than herds with lower Maternal Indexes.

Where a suckler herd starts off with an average Maternal Index value of €100 per cow and the replacement heifers are bred within the herd from bulls whose average Maternal Index each year is €200, the herds' Maternal Index will increase to approximately €132 after five years, assuming an annual replacement rate of 15%. If the maternal bulls used to sire the replacement heifers have a Maternal Index value of €250, the average herd index will rise to €148 after five years.

If a suckler herd has low average Maternal Index value starting off, it might be better to purchase replacement heifers with a high Maternal Index rather than trying to breed them from within the herd. A herd that has an average Maternal Index value of €50 and using maternal bulls with an average value of €200, after 5 years the mean herd value will be €81 (three years before the first heifers calve down – assuming calving at two years of age). In contrast, a herd that that buys in replacements with Maternal Index values of €150 each year will achieve a herd average of €98 in the same length of time.

Choosing Easy-calving Bulls for Breeding Replacement Heifers

When choosing a bull for breeding maiden suckler heifers the most important key profit trait to look at first is calving difficulty. With A.I. bulls approved for widespread use, the reliability associated with this trait should be quite high which will give a high degree of confidence that it is an accurate measure for that bull. Young stock bulls will have a figure based on their parent's figures and so the reliability will not be very high. Depending on the size of the heifers it is not recommended to use bulls that have calving difficulty figures above 3 to 4 % for calving difficulty.

Weight Recording

A key profit trait, daughter milk is one the maternal traits that will be of significant interest to suckler farmers breeding replacements within their own herd. The values for this trait are generated from the recorded live weights of calves at or around weaning (i.e. the period of their life when their live weight gain is most influenced by the volume of milk supplied by their dam). Bulls producing heifers that, in turn, produce weanlings with above average weaning weight will have a high daughter milk figure. In contrast, weanlings with below average weaning weight will impact negatively on their dams milk trait.

As with any key profit trait, the more data that is used to generate the figure, the higher the reliability that will be associated with it. Weighing suckler calves between 150 and 250 days of age and supplying these weights to ICBF will generate much more accurate figures for the daughter milk trait of both the dam and the sire of the calf. Weighing at this age will also identify poorer performing groups of stock, and this information can help identify management changes that may be needed in future (e.g. better grassland management).
The ICBF now have a nationwide service to facilitate the weighing of cattle on farms which allows for more suckler farmers to supply cattle weights to them for a small fee. The data is automatically uploaded to the ICBF database and the performance per animal is given back to the farmer.

Sexed Semen

The ability to select the gender of offspring at the time of conception is one of the most sought after reproductive biotechnologies of all time (S. Butler, Teagasc, personal communication). Semen contains approximately equal numbers of sperm containing X or Y chromosomes, resulting in female or male offspring, respectively. A major breakthrough in the development of sexed semen came when it was observed that sperm containing X-chromosomes contain more DNA (~4.2 %) than sperm containing Y-chromosomes. Fluorescence activated cell sorting (FACS) is a reliable method of sorting sperm based on their DNA content, allowing the production of semen straws enriched in sperm bearing either X- or Y-chromosomes. Sorting bovine sperm is over 90% accurate, generating so called 'sexed semen'. The primary limitations of using FACS to sort semen are: (i) the slow speed of the process relative to the number of viable sperm required for artificial insemination in cattle; and (ii) the high proportion of sperm cells that are lost, cannot be oriented for sorting, or cannot be accurately identified as bearing an X or Y chromosome and pass through without being sorted (combined >75% loss). Of the remainder that are successfully sorted, only half are the desired gender. Consequently, only 10 to 15% of the original sperm population entering the sorting machine are recovered as marketable, sexed semen. As a result of sperm damage during the sorting process, poorer conception rates are generally noted for frozen-thawed sexed semen compared with frozen-thawed conventional semen (~80% of conventional), restricting its use to primarily on heifers. The existing sorting technology is currently being redeveloped and refined, and these changes are expected to increase sorting speed and reduce sperm damage. The ultimate goal with sexed semen technology is to create a product that allows offspring gender to be decided at the time of purchasing the straw, can be used on both cows and heifers, and results in little or no reduction in conception rate.

€uro-stars Reliability %

Reliability is a measure of the accuracy of the genetic evaluation. As more information is included in a bull's genetic evaluation, the reliability % of his genetic evaluation results increases – in other words the level of certainty in the genetic evaluation results increases. The reliability % figures are crucial to understanding how much confidence can be put in a bull's indexes. The following guide can be used as a rule of thumb for interpreting reliability figures:

Reliability % Guide		
Range		**Description**
0-20%	**Low**	Very Low - €uro-Stars mostly based on Ancestry data.
20-50%	**Low - Medium**	Increasingly useful. Bull's own performance affecting figures. Linear Scores & Weights could affect a Bull's figures at this stage if they are collected when animal is 150-300 days old and in a group of at least 5 animals.
50%	**Medium**	Best you will see in a young Bull with no progeny.
50-95%	**Medium - High**	€uro-Stars increasingly based on progeny records. This can be a period where most change is seen in a Bull's figures as records from new progeny are included in his evaluations.
>95%	**High**	€uro-Stars completely based on progeny records. Little change seen in Bull's evaluation figures.

When producers are selecting a bull to use on a cow they should always look at the 'Reliabilty %' figures associated with that bull's index and traits. Regardless of what a brochure or promotional flier may present, this data will always be displayed on the ICBF Bull Search (www.icbf.com).

Checking the 'Reliability %' close to the time of insemination is crucial, as if a bull is being sold at say, 15 months old, it is 2 years since his dam was inseminated for that mating. Over those 2 years, the sire would have gone through about 6 evaluation runs with new progeny included in these evaluations. If the sire had a 'Reliability %' figure of less than 95% at the time of the insemination then the additional data included in the more recent evaluations could have caused his breeding value figures to move – thus having the knock on effect of the young bull for sale's figures also changing. This can be the scenario for young test bulls or high-profile bulls that received a high sale price or had successful show career, without having many (if any) progeny on the ground. At that stage the €uro-Star figures of these bulls will be very much based on their own back pedigree. However, the 'Reliability %' figures will give an indication of how much confidence can be placed in the €uro-Star figures i.e. the likelihood of them changing in the future. The flipside of this is that many of these bull's €uro-Star figures will also improve and in order to bring in new bloodlines such bulls are very important.

As a general rule of thumb, when using such bulls it is advised to use a number of them (teams of five bulls are used by dairy farmers), thus spreading the risk of ending up with a lot of progeny out of one particular bull whose figures have fallen.

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NOTES

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