

Interbull and 10 years of cattle breeding progress - what's next?

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Summary

In the ten years since Interbull introduced its international genetic evaluation service for dairy cattle a great deal of progress has been made. Interbull has succeeded and is growing its range of services. The dairy cattle breeding industry has made substantial changes to its breeding objectives and is now placing greatly increased emphasis on non-production traits. The quantity and quality of data available have increased substantially.

Genetic evaluation activities are being facilitated through the availability of greatly improved databases, vastly improved computing facilities, more data, more accurate data and more relevant data. Interbull and its members have many opportunities to provide improved genetic evaluation services to the cattle breeding industry, while at the same time having to compete for resources. We must, therefore, continue to be innovative in all aspects while at the same time exploring all options for reducing costs and sharing overheads.

Keywords: Interbull, database, genetic evaluation, beef, dairy

Introduction

It is ten years since Interbull decided to extend its activities to the provision of a routine international genetic evaluation service. This was an important milestone for dairy cattle breeding. The service, which was in effect a co-operative arrangement between national genetic evaluation units, enabled national organisations to provide evaluations for international bulls, for the use of local industry. That the service has achieved its objectives and been a great success is beyond question.

This paper provides a personal perspective on the development of cattle breeding over the last ten years and reflects on the future prospects for Interbull. During this time I have been fortunate to participate in developing Interbull services, while concurrently taking part in leading the development of cattle breeding in firstly New Zealand and, for the last seven years, Ireland.

The approach I have taken is to briefly describe the state of cattle breeding at the time the Interbull service was established in 1995, then moving on to discuss a number of current trends and to speculate about the future and implications for Interbull. My perspective is that of an executive focused on ensuring optimal rates of genetic progress in the cattle populations of the countries where I have been employed. The examples in this paper are drawn from Ireland, the current focus of my work.

The Past

It is useful, as a measure of progress, to reflect on the state of cattle breeding at the time that Interbull commenced its international evaluation service.

In 1995, some of the main features of dairy cattle breeding were:

- A concerted effort in many countries to implement Animal Model genetic evaluations for milk production traits.
- The use of conversion equations, on a pair-wise country basis, to identify bulls for both import and export.
- Within breed and within country evaluations were the norm.

- Multiple trait economic indexes were used in few countries outside the Nordic region. Selection criteria in most countries was primarily protein yield and to a lesser extent traditional “type” traits.
- Holstein Friesians dominated international semen trade with large quantities of semen originating from North America.
- BSE was not yet a major issue. That occurred in 1997 when it was confirmed that it was the probable cause of new variant Creutzfeldt-Jakob Disease (vCJD) in humans.

At this time the Irish cattle breeding industry, and here I am deliberately extending my terms of reference to include both beef and dairy, featured multiple databases, multiple breeding companies, multiple identification systems, and a genetic evaluation unit within a state body (DAF – Department of Agriculture & Food). International evaluations were, by 1998, being used for the milk production traits. However, for beef, there were three different genetic evaluation systems each covering different traits and different segments of the breeding population, for a limited range of breeds. Irish farmers, beef and dairy, were not happy with the information available to help them make their breeding decisions.

The Present

Ten years later these are the features of the cattle breeding industry internationally:

- Interbull’s international genetic evaluation service is well established and widely used. It covers 30 countries, six breeds, production, fertility and other traits.
- Increased within country use of integrated shared databases.
- Many countries are using or implementing multiple trait genetic evaluation models using test-day records.
- Intellectual property issues have become a substantive issue for cattle breeders.
- A major fertility decline has been demonstrated in black & white populations.
- Multiple trait selection indexes are widely used in dairy breeding programs and are increasing in beef breeding programs.
- Across breed evaluations are increasing for both dairy and beef in order to accommodate increased usage of cross breeding in commercial cattle populations.
- BSE is has declined as an issue in Europe, but has become a significant issue in North America.
- Molecular genetics is consuming large amounts of research funds.

Now, to relate some of these to recent experiences in Ireland.

1. Integrated Shared Database

Over the last few years we have established a fully integrated shared database for Irish cattle breeding. Apart from the technical issues associated with computer systems, this development has required major developments in the way cattle-breeding organisations operate in Ireland. A new organisation, the Irish Cattle Breeding Federation Society Limited (ICBF) was formed in 2000 to establish and operate the database as well as to provide genetic evaluations. The establishment of ICBF has many parallels with the establishment of the Interbull services. A number of organisations coming together with the goal of using genetics as a tool to improve commercial cattle, each contributing data and finance, agreeing on roles and responsibilities and then putting in place a team of people to undertake the required work. ICBF’s focus, and the scope of the database, is limited to the 26 counties that make up the Republic of Ireland.

The introduction of the database was associated with the introduction of Animal Events a new system for collecting, without duplication, all the data required from farms to meet the

needs of both the breeding industry and DAF. In 1997 under EU legislation, driven by the BSE crisis, DAF introduced a system of calf registration and animal movement monitoring which ensures full tracking of all cattle in Ireland. One of the keys to success in establishing the ICBF database has been the integration of the cattle breeding system with this tracking system thus avoiding duplication of effort by farmers.

The database has made genetic evaluation a much simpler and less costly task by removing much of the work and cost associated with data cleaning and data storage. By consolidating all data required for genetic evaluations into a single database, a large and complex genetic evaluation system, involving several hundred programs, was eliminated and replaced by data extracts and database updates. All the information required for the publication of genetic evaluations is held in the database and relatively simple extracts are all that is required to support this activity. The genetic evaluation system is focused primarily on the technical aspects of fitting the best possible model to the currently available data. Of course, ICBF's genetic evaluation system is an integral part of the international service provided by Interbull.

The ICBF database with its single copy of the truth, has reduced cost by removing duplication, produced an improvement in data quality due to reduced errors and resulted in a dramatic increase in the quantity of data. This is illustrated by calving ease data that increased from some 18,000 records per year, to 215,000 in 2002, the first year of operation, to 345,000 in 2004. The fact that the database covers beef and dairy breeds means data collected in dairy herds, many of which use beef bulls, can be readily used in the genetic evaluation of beef bulls. In 2004 the number of calving ease records collected, for each of the six main beef breeds found in Ireland, varied from 11,500, for Simmental, to 38,000, for Angus. Similarly, through an electronic link established with slaughterhouses, large numbers of slaughter records are now routinely entered into the database. The availability of this wealth of extra data has come about primarily as result of the shared database. It has dramatic implications for genetic evaluations in Ireland, and if similar trends are occurring in many other countries, then also for Interbull.

2. Fertility Trend in Holstein Friesians

Most Irish dairy farmers operate a seasonal, spring calving, milk production system using mainly Holstein Friesian cows. In the late 1990's a series of strain trials at the Moorepark research centre identified large genetic differences for fertility under Irish conditions. Subsequently, ICBF implemented genetic evaluations for fertility, using calving interval and survival as indicators. The genetic trend estimates from this work show a sustained downward trend in fertility over the period during which production showed a strong upward genetic trend. The practical implication of these trends was that much of the improved income associated with more productive cows was negated by increased costs associated with extended calving intervals and increased replacement rates. Only recently has the downward trend in fertility been reversed.

These trends illustrate the dangers of single trait selection and emphasise the need for Interbull to maintain an awareness of the genetic trends for all the important traits in the breeds for which it provides services.

3. Combined Indexes

The cornerstone of ICBF's genetic evaluation services for Irish dairy farmers has been the development of the EBI (economic breeding index) and the Active Bull List. The philosophy of the EBI, to identify the genetic potential of animals to contribute to dairy farm profitability, was established in consultation with the breeding industry and implemented for the first time in February 2001. Since then it has undergone a series of revisions and

enhancements to incorporate new understandings and improved genetic evaluations. The current EBI contains contributions from production, fertility, calving and beef traits. We are currently focusing on extending it to include udder health traits.

Interbull's genetic evaluation services greatly facilitate the provision of the EBI for bulls first progeny tested in other countries. As the range of traits incorporated in the EBI increases, so does our requirement for international genetic evaluation services. The organisations marketing semen in Ireland from bulls progeny-tested in other countries have a general expectation that the evaluations obtained in the country of progeny test should suffice for Ireland. Currently, in order to ensure we provide the best information for Irish farmers, we are frequently using conversion equations for a number of years while the relevant Interbull services become established. Interbull should give serious consideration to extending its range of service by providing at the very least a clearing house through which countries can exchange data files suitable for developing and supporting conversion equations. Such a service would also provide a good early indication of traits for which an international genetic evaluation service is required in the future.

The Active Bull List is published by ICBF and is designed to help farmers decide which AI sires to use for breeding replacements. The list contains the 75 highest EBI Holstein Friesian AI sires, with reliability of greater than 52%, irrespective of where they are progeny tested, and whose semen is readily available in Ireland. It has quickly become established and widely accepted and used by farmers and their advisers.

4. Across Breed Evaluations

The dramatic increase in the quantity of calving ease and carcase data for all cattle in Ireland has presented a unique opportunity to extend the genetic evaluation system to all breeds and crosses including beef. The relatively high incidence of cross-breeding provides the connectedness required for across breed evaluations. Across breed evaluations also provide the information essential for farmers to make informed breeding decisions where a choice of breeds is being considered. Results from the recently implemented across breed evaluations for beef traits highlight the biological differences between breeds; while at the same time facilitating within breed selection.

When across breed evaluations are incorporated into combined indexes for beef breeding, a very powerful tool for increasing the profitability of beef production from both dairy and suckler cattle is created.

These developments have created a substantial opportunity; some would say a challenge, for Interbull. They have also started to blur the distinction made so often between beef and dairy.

5. International Beef Evaluations.

Ireland, like many countries, produces beef from a combination of suckler and dairy cows. Eighteen breeds of cattle represented in Ireland with new breeds arriving every few years. All of the new breeds come from countries with substantial populations and often very efficient breeding programs. The challenge we are facing is how to provide Irish farmers with the best possible information to help them choose which breed to use, and to choose animals regardless of where they are located internationally. This problem has been partially solved by Interbull for six dairy breeds and for a limited set of traits.

ICBF's approach to the challenge has been two fold. Firstly, to establish a database of identification, ancestry and performance of animals resident in Ireland. Secondly, to facilitate the research needed to establish scientifically sound methods for combining data

from several countries into beef genetic evaluations relevant for Irish farmers. Results from this research have established the practicality of international evaluations for beef breeds and traits. The key issues being animal identification, connectedness and use of an appropriate statistical model. While considerable technical and scientific work is still required the missing element is organisational. Hopefully this gap will be filled in the near future through the combined efforts of ICAR and its members. Interbull has a very important role to play and its members much to gain.

The Future

There are three trends, two in technology and one in economics that are likely to have a dramatic impact on Interbull and cattle breeding in the future.

1. Information Technology

Progress in information technology in the last ten years has been exponential. Every aspect, from tele-communications, to data storage and data processing capacity, has improved in price and performance dramatically. The result is that our industry has many opportunities to improve many aspects – reduce costs, reduce errors, increase coverage and reduce time – of the information component of the business of cattle breeding. As a consequence we can expect some or all of the following:

- Greatly increased amounts and more accurate phenotypic data (including a large amount of information derived from DNA testing) for both dairy and beef cattle.
- Ready access to the computing resources required to fit ever more complex and comprehensive models for genetic evaluations.
- To be able to readily transfer ever increasing quantities of data to and from Interbull.
- To be able to deliver much greater quantities of information to farmers and breeders with minimal delay and cost.

2. Molecular Biology Knowledge & Technology

The impact of the currently massive investment in molecular biology is likely to be a rapid increase in knowledge about the way biological systems work and an associated surge in measurement technology. Interbull and cattle breeders can expect to face a range of challenges including:

- Ensuring the new knowledge and data is incorporated appropriately into genetic evaluation systems both nationally and internationally.
- Ensuring access to DNA “phenotypes” for all animals relevant to cattle breeding decisions.
- Ensuring breeders are well informed about the costs and benefits associated with exploiting the new knowledge and technology.

3. Economics

Cattle farming in Europe and much of the world is facing a reduction in profitability and for the same reason is becoming a less important activity for Governments. The implications of this for Interbull and the industry include:

- Reduced funding for genetic evaluation activities and further moves to privatise all aspects of cattle breeding. This is likely to lead to an increased number of cattle breeding organisations taking a “more commercial” approach to cattle breeding.
- Reduced funding of university based cattle breeding research and a reduced supply of suitably skilled scientists.

- There will be a need and opportunities for national genetic evaluation units to come together and reduce cost by sharing research, sharing software development and sharing management overheads. This could, for example, see more activities contracted to Interbull, the emergence of continental evaluation units and national units focused primarily on data collection, breeding objectives and extension activities.

Implications for Interbull in the future

The purpose of speculating about the future of cattle breeding is primarily to stimulate thinking and planning in an effort to ensure the best possible outcome for our cattle populations, our farmers and our organisations. Interbull and its services have a very important role to play both now and in the future. Based on my experience during the establishment of the current services, recent progress made in Ireland and some of the major trends impacting on cattle breeding, I have come to the following general conclusions.

- **Openness & Collaboration.** The approach of Interbull and its members to openly share and collaborate in the development of genetic evaluations must be protected. Moves by individual countries or cattle breeding organisations to protect their own knowledge and gain competitive advantage create the possible risk that the rate of progress for the world's cattle farmers will be reduced.
- **Advancement in Technology and Innovation.** Interbull and its members must be continuously looking for opportunities to exploit new technologies to deliver better services to the cattle breeding industry.
- **Exploration of Options for Sharing Overheads.** Genetic evaluation units and Interbull need to explore all available options for reducing costs and sharing overheads.

Reference: \\ICBF-SERVER1\Data\Shared\Company\IBP\Brian Wickham INTERBULL 2005 Paper 26 05 2005 ver 2.doc



IRISH CATTLE BREEDING FEDERATION

Interbull and 10 years of cattle breeding progress - what's next?

Brian Wickham

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Contents

- *Past*
- *Present - developments*
- *Future*

Past – “pre 1995”

- *Animal model implementation*
- *Within country evaluations with some use of conversion equations for HF milk production traits.*
- *Within breed evaluations.*
- *Combined indexes – only in Nordic countries – most of rest focused on protein & type.*
- *Holstein domination of international semen trade.*
- *BSE not an issue*

Ireland - Background (1998)

- historical databases

9 milk recording

Dairygold
Progressive Genetics
South Western Services
Kerry Co-operative
Goldenvale Co-operative
etc

8 artificial insemin.

Dairygold
Progressive Genetics (Inc. Sligo & NECBS)
South Western Services
Kerry Co-operative
Goldenvale Co-operative
Dovea
etc

18 herd book

Holstein
Charolais
Limousin
Hereford
Irish Angus
Simmental
Blonde Aquitaine
Shorthorn
Jersey
etc

DAF

Genetic evaluation

- dairy
- beef
- performance test

Calf registration

International Evaluations – Holstein for Milk Production

Three beef evaluation systems - Performance Test, Progeny Test, Beef Herd Books

Present

- *International evaluations – MACE – for six dairy breeds -30 countries – milk, linear conformation, longevity, calving traits.*
- *Integrated shared databases.*
- *Test-day model & intellectual property*
- *Major fertility problem in HF breed.*
- *Widespread and growing usage of combined indexes in dairy and beef breeding.*
- *Across breed evaluations increasingly common within country for dairy & beef.*
- *BSE declining in Europe but is now issue in North America*
- *Molecular genetics consuming large amounts of research funds.*

One Database, Many Partners

less duplication and cost for farmers

AI

Munster AI

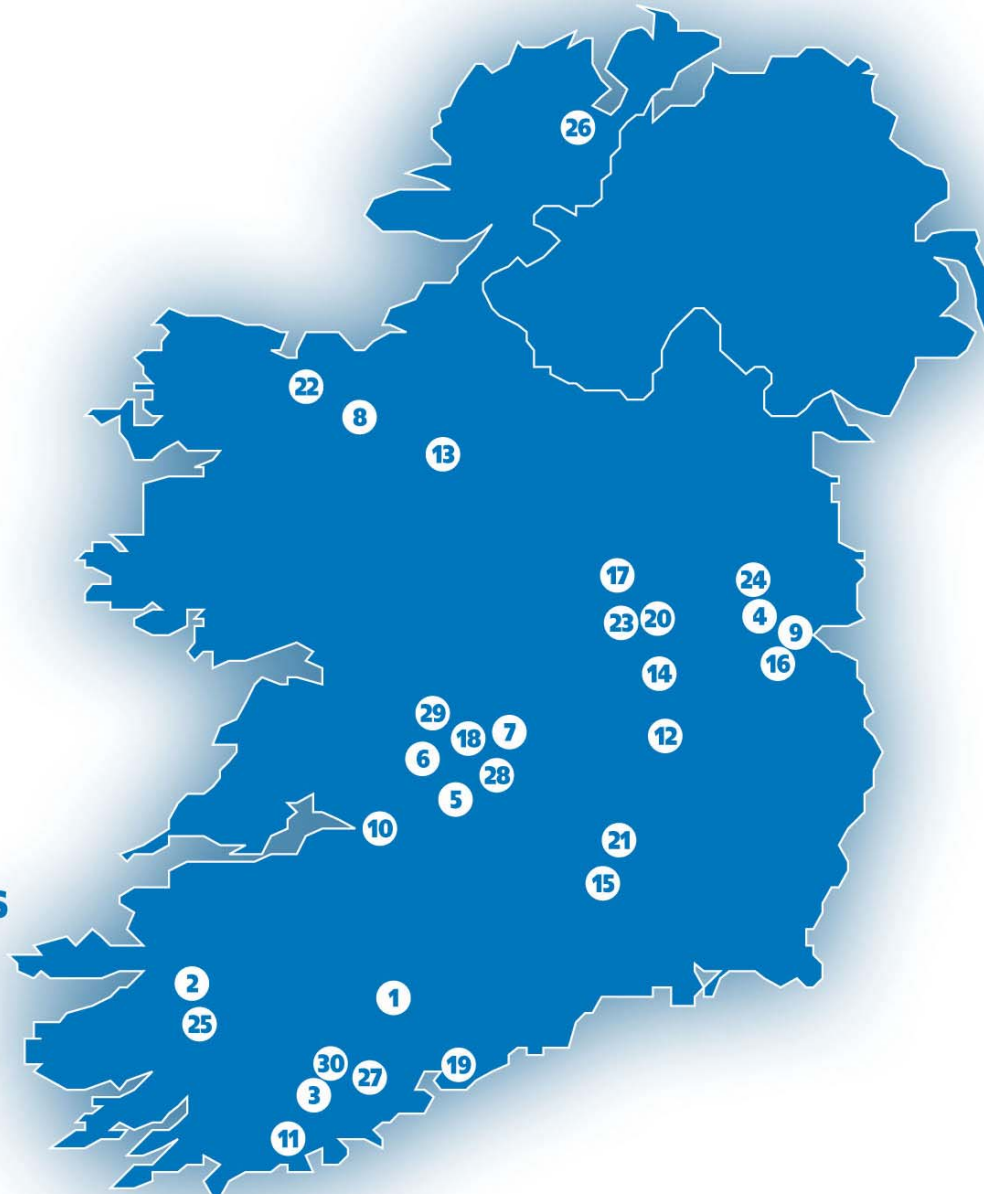
- 1** - Dairygold
- 2** - Kerry
- 3** - SWS
- 4** Progressive Genetics
- 5** Dovea AI

Milk Recording

- 1** Dairygold
- 2** Kerry
- 3** SWS
- 4** Progressive Genetics
- 6** Arrabawn
- 7** Tipperary
- 8** Connacht Gold

Farm Organisations

- 9** IFA
- 10** ICMSA

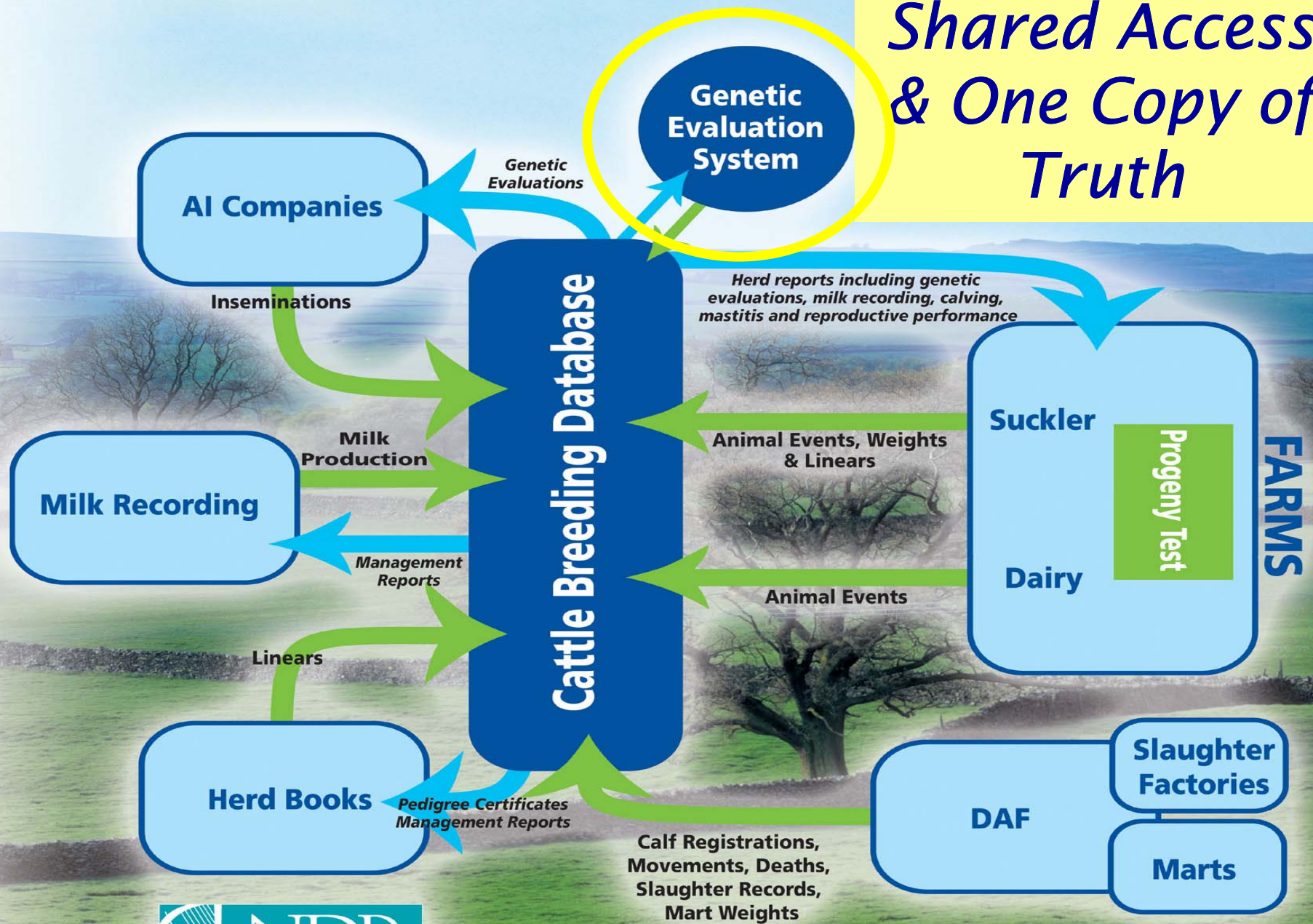


Herdbooks

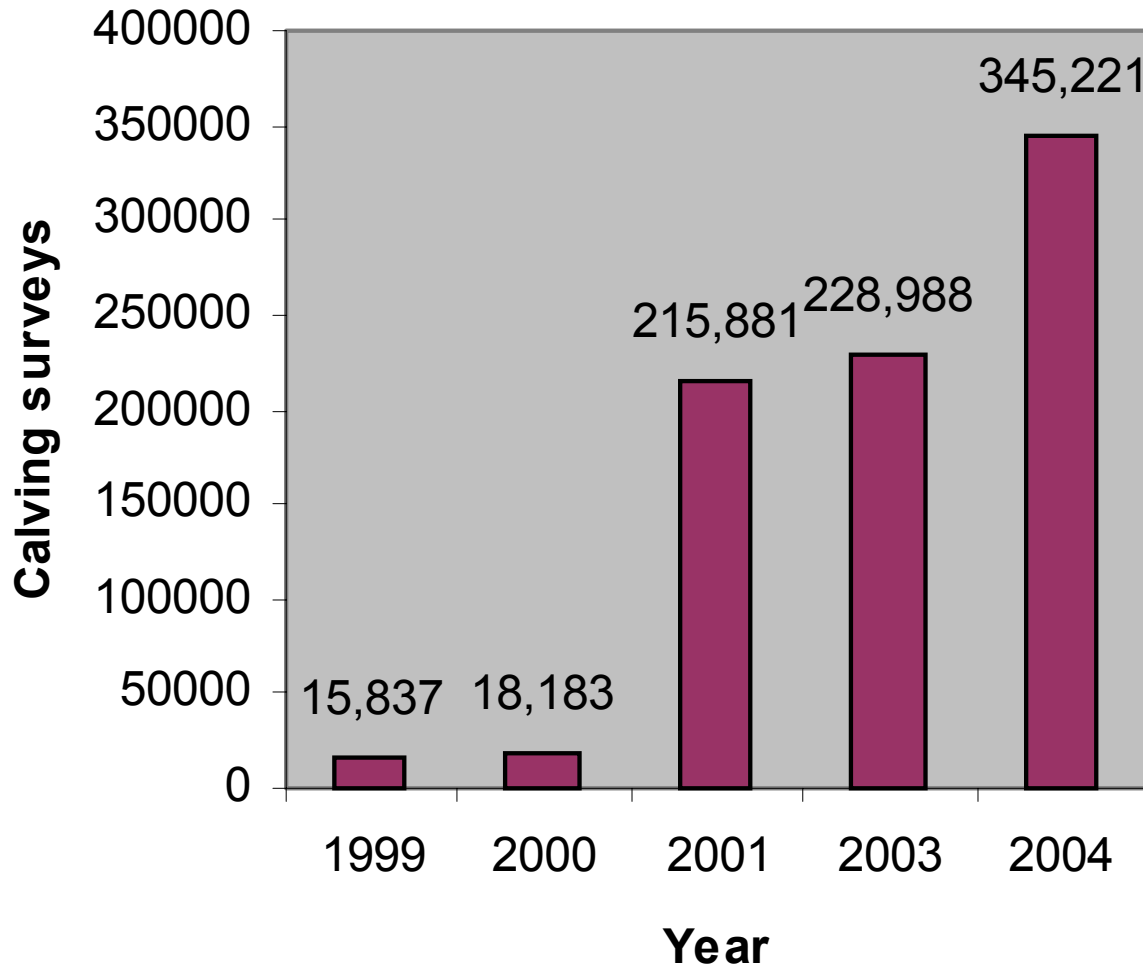
- Holstein Friesian **11**
- Belgian Blue **12**
- Angus **13**
- Aubrac **14**
- Blonde d'Aquataine **15**
- Charolais **16**
- Hereford **17**
- Limousin **18**
- Normande **19**
- Parthenais **20**
- Piedmontese **21**
- Shorthorn **22**
- Simmental **23**
- Jersey **24**
- Kerry **25**
- MRI **26**
- Montbeliarde **27**
- Rotbunt **28**
- Salers **29**

ICBF 30

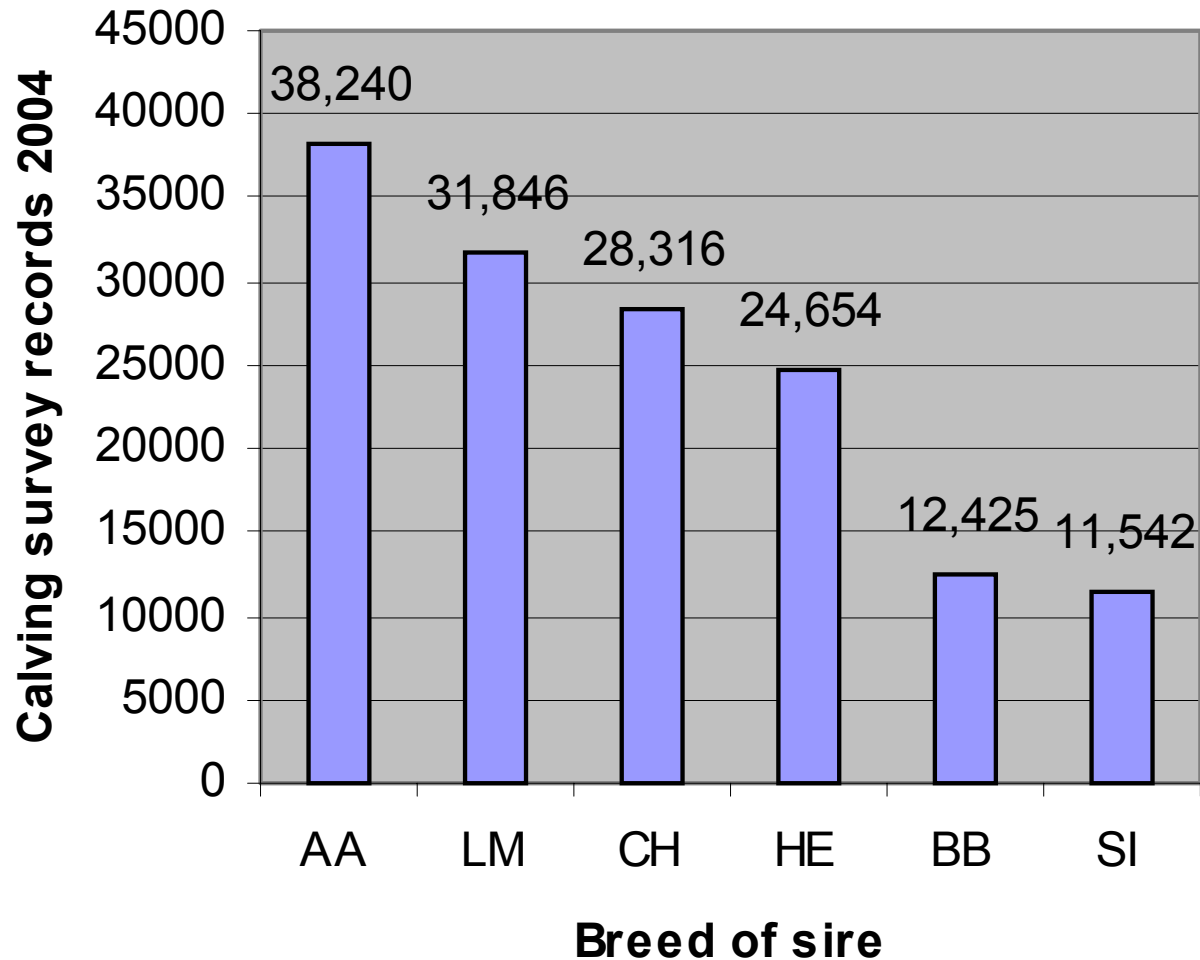
Shared Access & One Copy of Truth



Streamlined data collection resulting in more & better data



Integrated database gives data on beef from dairy herds



Genetic Trends – Irish Holstein Friesian Females

Fertility

Protein + Fat

Year

1987

1989

1991

1993

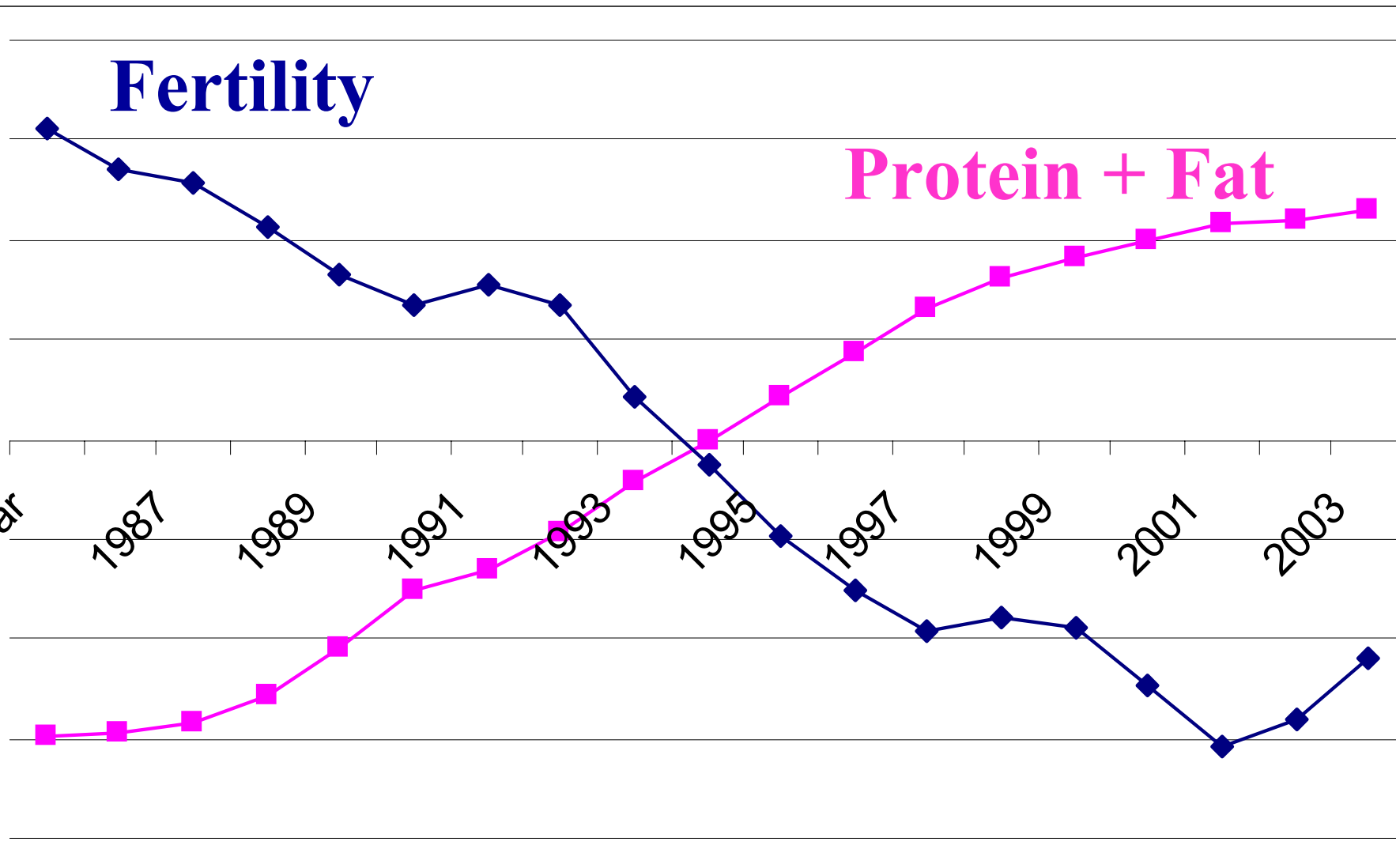
1995

1997

1999

2001

2003



ICBF Active Bull List 2005 – Combined Index

SIRE DETAILS				EBI DETAILS							Production					Fertility		Calving			Beef		Type																	
RK	Code	Name	% Ho	EBI	Rel	Dau	Hrds	Milk	Fertility	Calving	Beef	M kg	F kg	P kg	F%	P%	CI	SURV	Recs	% CD	GL	Recs	C Wt	O FL	O MA	O TYP														
4	UNG	COLLINS ROYAL HUGO	50	€123	88	975	167	€74	€49	€7	-€7	62	17.5	10.0	0.26	0.14	-3.6	2.2	3023	-0.8	-1.4	299	-5.9	-1.5	-1.7	-2.3														
EBI DETAILS											€21	€6	257	23.4	13.2	0.25	0.09	-0.3	0.8	229	-2.5	-2.6	0	5.4		0.2	0.1													
EBI	Rel	Dau	Hrds	Milk	Fertility	Calving	Beef	€12	€5	166	14.5	8.0	0.14	0.04	-4.7	1.8	33	-0.6	-1.7	0	4.5	-0.4	0.1	0.2																
€123	88	975	167	€74	€49	€7	-€7	-€11	€9	180	19.5	12.0	0.21	0.10	-2.2	0.9	255	1.4	1.1	70	8.7	-1.1	-2.6	0.1																
€120	60	-	-	€83	€11	€21	€6	€5	€4	555	21.0	17.3	0.00	-0.02	0.5	1.6	29	-1.5	-0.4	0	4.4	1.1	0.5	0.7																
€120	73	77	52	€50	€53	€12	€5	€7	€0	104	12.7	4.8	0.16	0.03	-5.2	1.8	58	-3.1	0.0	0	0.0		-1.9	-2.8																
€101	79	225	81	€77	€25	-€11	€9	€9	-€2	200	14.5	10.5	0.08	0.04	-2.6	1.5	14	-2.1	-0.8	0	-1.9	0.5	-2.7	-1.5																
€100	52	-	-	€77	€14	€5	€4	Beef RecsC Wt																																

Production				
M kg	F kg	P kg	F%	P%
62	17.5	10.0	0.26	0.14
257	23.4	13.2	0.25	0.09
166	14.5	8.0	0.14	0.04
180	19.5	12.0	0.21	0.10
555	21.0	17.3	0.00	-0.02

Fertility	
CI	SURV
-3.6	2.2
-0.3	0.8
-4.7	1.8
-2.2	0.9
0.5	1.6

Calving		
Recs	% CD	GL
3023	-0.8	-1.4
229	-2.5	-2.6
33	-0.6	-1.7
255	1.4	1.1
29	-1.5	-0.4

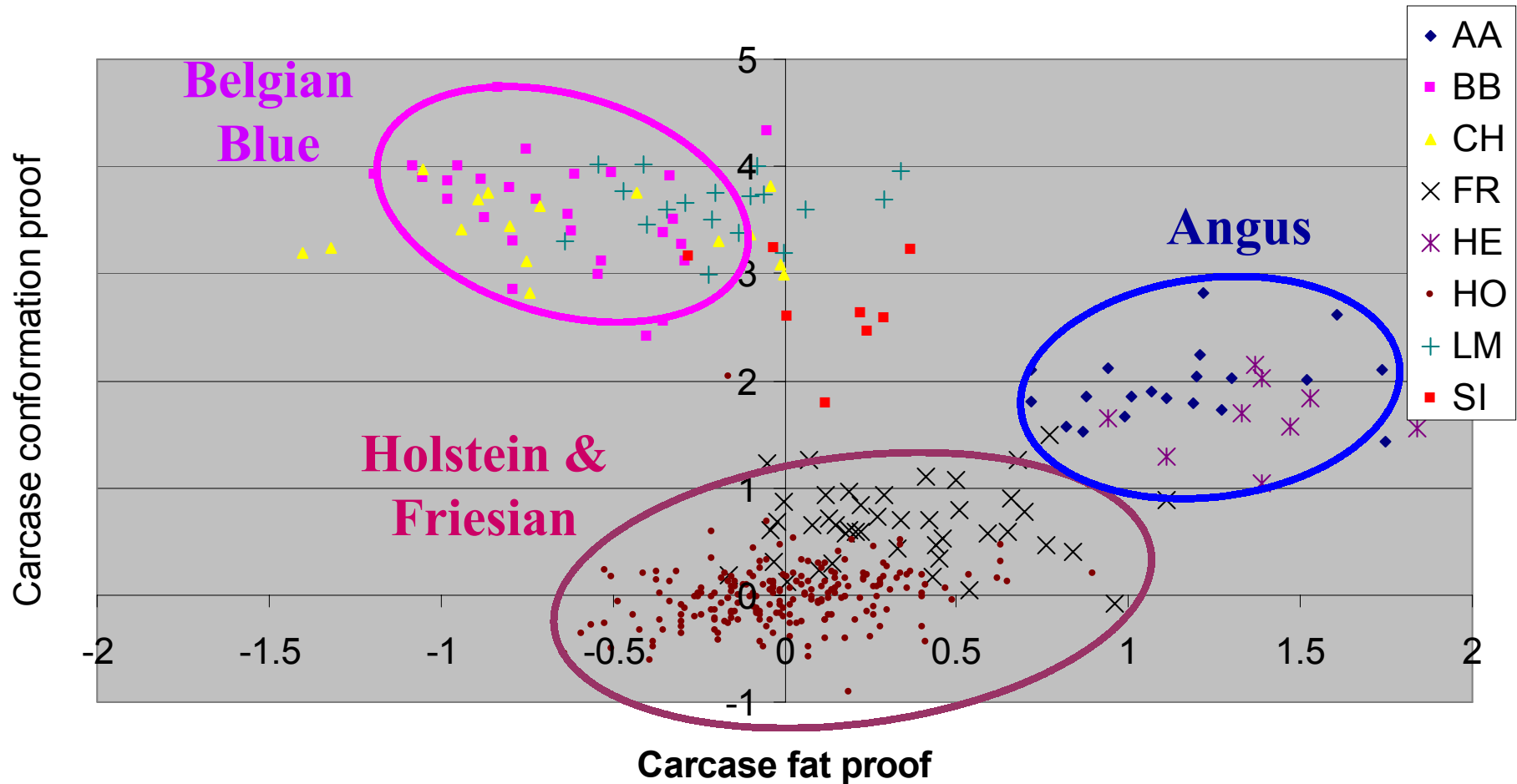
Beef	
Recs	C Wt
299	-5.9
0	5.4
0	4.5
70	8.7
0	4.4

- EBI = 68% Milk, 26% Fertility, 5% Calving, 1% Beef**

New Traits

- *Imported semen*
- *Home country evaluations suffice*
- *Conversions for several years before international evaluations*
- *Service needed – clearing house for evaluations for all traits*
- *Help identify traits for international evaluations*

Across Breed Evaluations – Beef & Dairy for Carcase Traits



Combined indexes across breeds – beef breeding

Sire Details					Economic Sub Indexes								Calving Performance Data					Beef Performance Data									
Brd	Code	AI Station	Price	Avail	Name	Beef Production	Rel	Weaned Calf	Rel	Beef Calving	Rel	Dairy Calving	Rel	Recs	CD%	GL Days	Mort %	CD Mat	Recs	W wt	C wt	C Conf	C Fat	Cull Cow	L Wt	Calf Quality	Feed Intake
AA	BEH	NCBC	8	H	BOHEY LEO	€37.4	65	€49.6	68	-€4.5	71	-€8.5	80	156	-0.9	1.0	1.6	-0.9	33	-4.2	14.5	1.7	1.0	1.6	26.9	42.3	-34
AA	BJP	NCBC	8	H	BOHEY JASPER	€33.1	77	€55.4	81	-€3.5	79	-€9.8	88	400	-0.7	1.2	1.2	-1.1	83	-1.7	13.5	1.8	1.2	-4.1	32.2	44.3	3

Economic Sub Indexes							
Beef Production	Rel	Weaned Calf	Rel	Beef Calving	Rel	Dairy Calving	Rel
€37.4	65	€49.6	68	-€4.5	71	-€8.5	80
€33.1	77	€55.4	81	-€3.5	79	-€9.8	88
€55.2	81	€59.4	85	-€4.2	73	-€19.2	84
€25.3	90	€64.5	93	€1.7	96	€7.1	98
€40.2	74	€70.7	74	€2.3	76	€5.4	88

84	326	0.7	2.1	0.5	-1.5	105	-6.0	20.6	2.1	0.9	7.1	26.7	51.7	-76
98	8707	-2.6	-0.1	0.8	-0.8	947	2.8	9.6	1.8	0.9	-4.2	37.8	46.7	26
88	412	-1.1	-0.2	-0.1	-1.2	70	-1.3	15.0	2.2	1.2	-6.4	30.0	55.7	-27

Calving Performance Data				
Recs	CD%	GL Days	Mort %	CD Mat
156	-0.9	1.0	1.6	-0.9
400	-0.7	1.2	1.2	-1.1
326	0.7	2.1	0.5	-1.5
8707	-2.6	-0.1	0.8	-0.8
412	-1.1	-0.2	-0.1	-1.2

Beef Performance Data								
Recs	W wt	C wt	C Conf	C Fat	Cull Cow	L Wt	Calf Quality	Feed Intake
33	-4.2	14.5	1.7	1.0	1.6	26.9	42.3	-34
83	-1.7	13.5	1.8	1.2	-4.1	32.2	44.3	3
105	-6.0	20.6	2.1	0.9	7.1	26.7	51.7	-76
947	2.8	9.6	1.8	0.9	-4.2	37.8	46.7	26
70	-1.3	15.0	2.2	1.2	-6.4	30.0	55.7	-27

International Beef Evaluations

- *Desirable – big & small populations*
- *Practical – connected populations, use phenotypes, fit complete models*
- *Organisation now needed – Steering Committee, ICAR Board & genetic evaluation units.*

Information Technology

Microprocessor	Year of Introduction	Transistors
4004	1971	2,300
8008	1972	2,500
8080	1974	4,500
8086	1978	29,000
Intel286	1982	134,000
Intel386™ processor	1985	275,000
Intel486™ processor	1989	1,200,000
Intel® Pentium® processor	1993	3,100,000
Intel® Pentium® II processor	1997	7,500,000
Intel® Pentium® III processor	1999	9,500,000
Intel® Pentium® 4 processor	2000	42,000,000
Intel® Itanium® processor	2001	25,000,000
Intel® Itanium® 2 processor	2003	220,000,000
Intel® Itanium® 2 processor (9MB cache)	2004	592,000,000

Information Technology

- *More and better phenotypes (inc DNA)*
- *Fit ever more complex models*
- *Quickly transfer large quantities of data internationally*
- *Provide breeders with better information quickly at low cost*

Molecular Biology

- *Use data in genetic evaluations*
- *Access to DNA phenotypes*
- *Breeders well informed on how to use the new knowledge*

Economics

- *Reducing returns for cattle products*
- *Reduced funding for genetic evaluation activities*
- *Reduced funding for University based research*
- *Reduced supply of suitably skilled scientists*

Implications for INTERBULL

- *The approach of INTERBULL and its members to openly share and collaborate in the development of genetic evaluations must be protected.*
- *INTERBULL and its members must be continuously looking for opportunities to exploit new technologies to deliver better services to the cattle breeding industry.*
- *Genetic evaluation units and INTERBULL need to explore all available options for reducing costs and sharing overheads.*