IRISH CATTLE BREEDING FEDERATION

Utilizing millions of genotypes, phenotypes, and pedigree records, along with a few thousand WGS, to identify the best cattle breeding strategy in Ireland

Matthew McClure, PhD

Illumina UK UGM, London 10/10/2015

Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara

Grand Overall Outline

ICBF.com +  +  + 

=

Outline

1) Overview
   A. Cattle Domestication
   B. ICBF
   C. Cattle Industry

2) Genetic Use in Livestock- Typical
   A. Genetic Improvement: Selecting the Best
   B. Genetic Disease Management
   C. Genetic Use

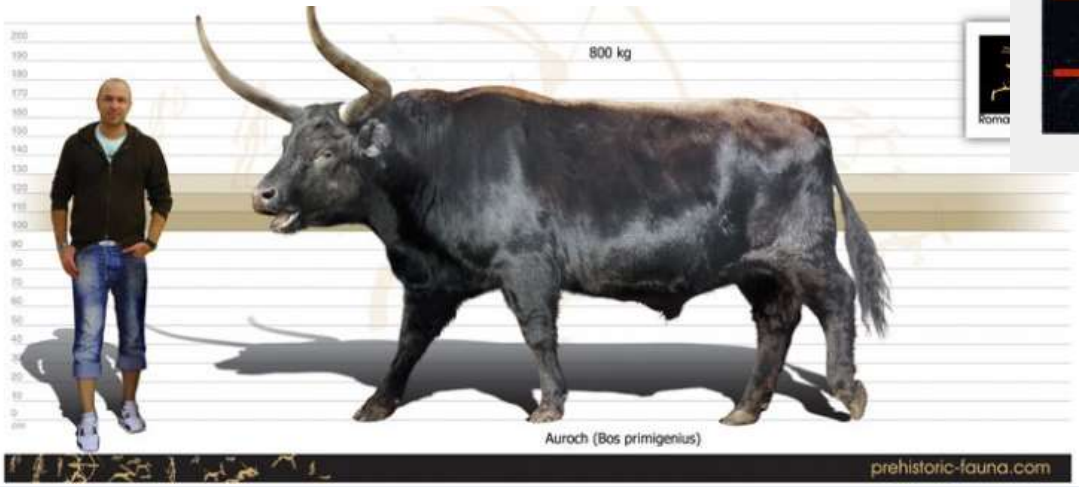
3) Irish Beef Cattle Genomics
   A. Issues
   B. ICBF Solution
   C. Irish Beef Application

4) Additional Projects
   A. New Genetic Diseases
   B. Selection for Disease Resistance

Cattle Domestication

Bos taurus >10,000 years ago

Bos indicus >7,000 years ago











Skelett av uroxe, funnet i en torvmosse i Hammarslövs s:n, Skåne.
Det bäst bevarade av de svenska torvmossefynden. Tillhör Univ. Zoolog. Museum, Lund.

GNM2965_1

Samlingarna, Göteborgs Naturhistoriska Museum

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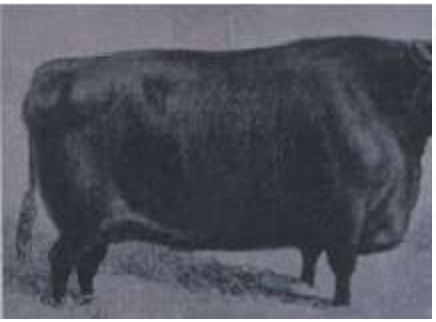
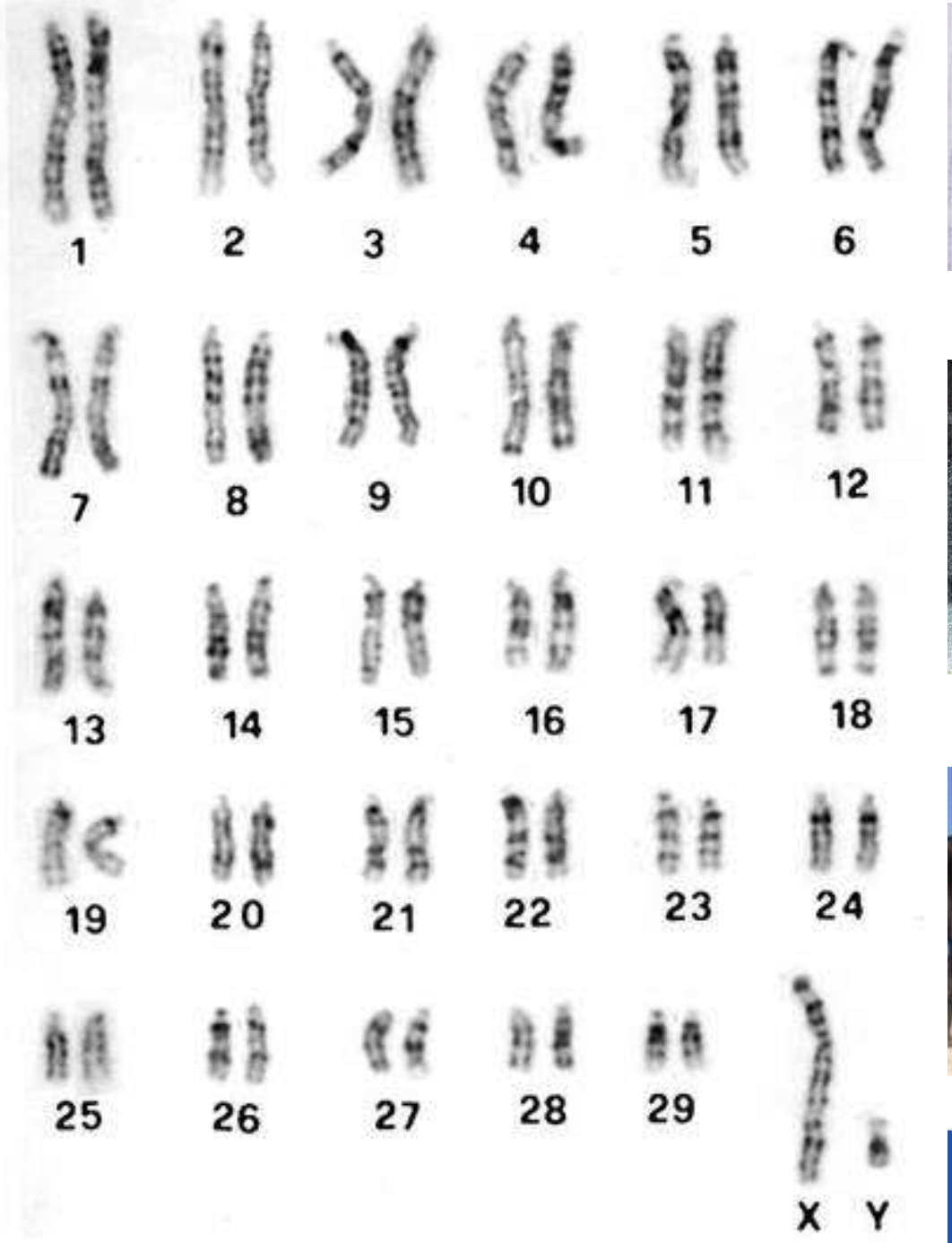


1867

1938

1972



1916

1964

2006

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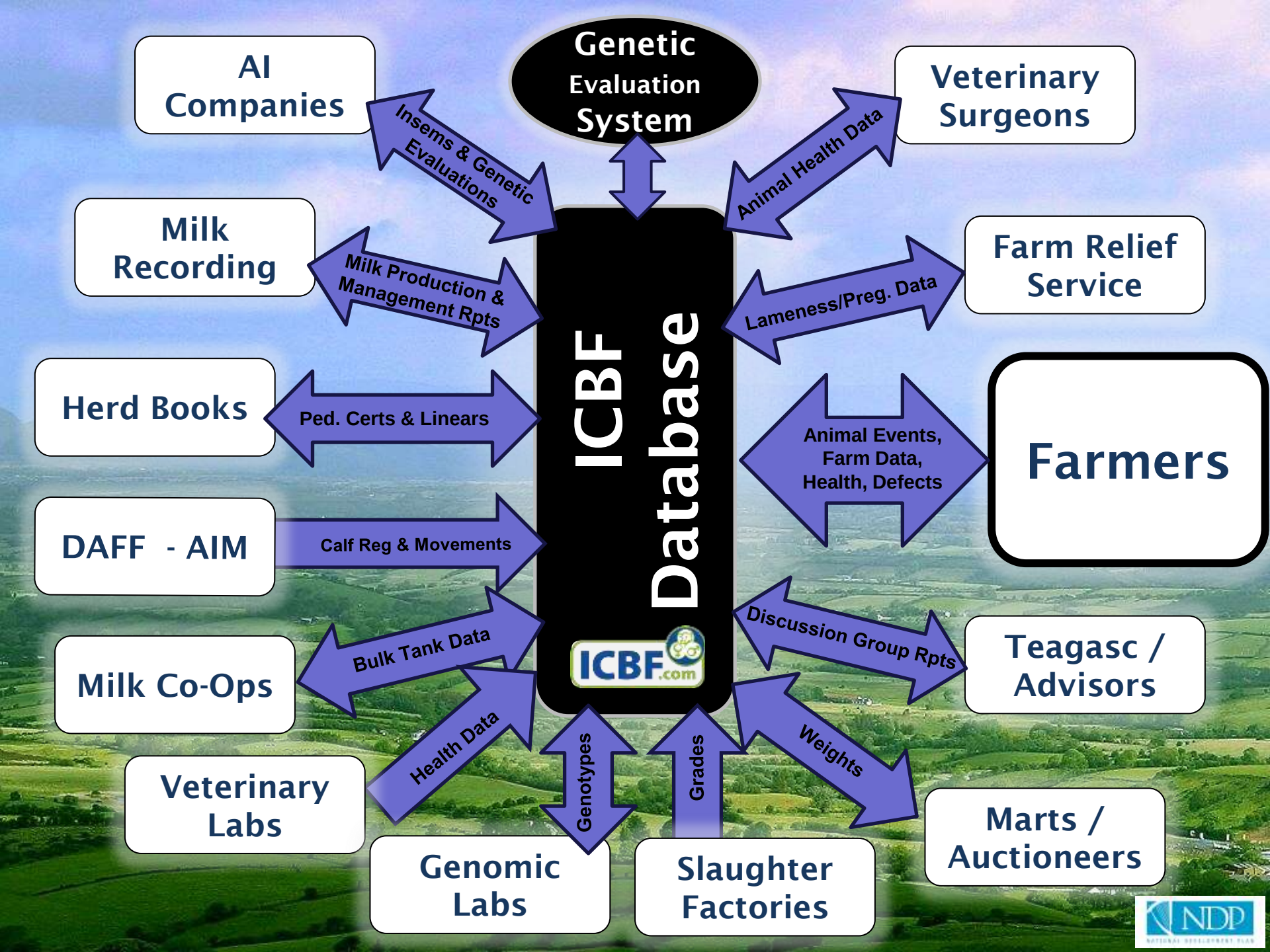
ICBF: Irish Cattle Breeding Federation

Database for all things cattle related

Tully-research feedlot

Bandon-Main office


Genetic Evaluation System
AI Companies
Insems & Genetic Evaluations
Veterinary Surgeons
Animal Health Data
Milk Recording
Milk Production & Management Rpts
Farm Relief Service
Lameness/Preg. Data
ICBF Database
Herd Books
Ped. Certs & Linears
Animal Events, Farm Data, Health, Defects
Farmers
DAFF - AIM
Calf Reg & Movements
Discussion Group Rpts
Bulk Tank Data
Milk Co-Ops
Teagasc / Advisors
ICBF.com
Health Data
Genotypes
Grades
Weights
Veterinary Labs
Genomic Labs
Slaughter Factories
Marts / Auctioneers
NDP

ICBF Outputs

- Range of reports
  - Milk recording
  - Genetic Merit
  - Health and Fertility
  - National trends

ICBF exists to benefit our farmers, agri-food industry, and wider communities through genetic gain and the application of science and technology.

- Parentage verification/prediction
- Genetic disease/trait status
- Mating advice

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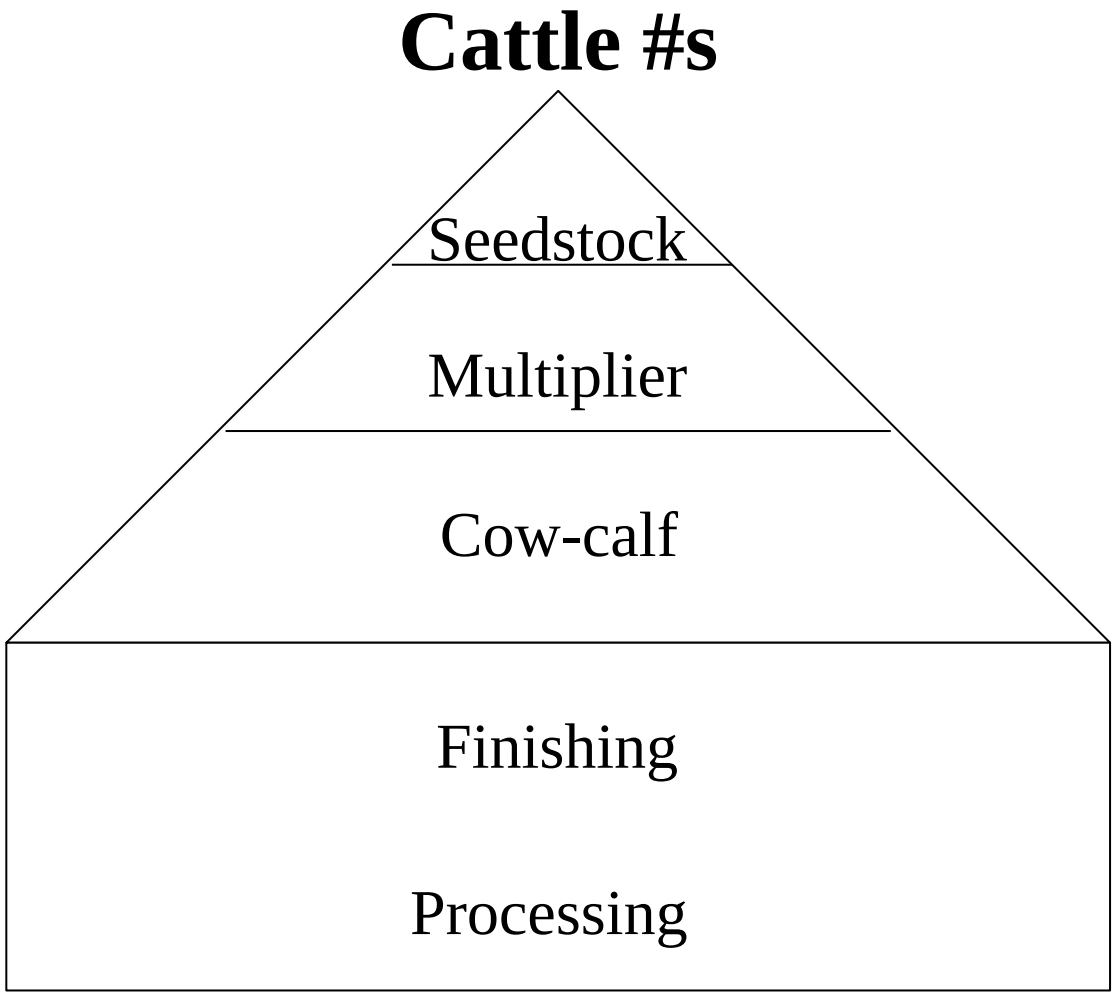
4) Additional Projects

Cattle Industry Segments

1) Seedstock
    a. Multiplier
2) Cow-calf
3) Finishing
4) Processing

Cattle Industry Segments



1) Seedstock: Pedigree Cattle

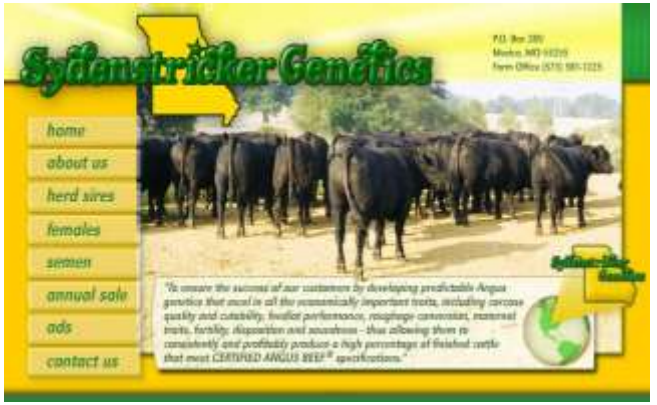
Generates High Genomic Animals, AI bulls

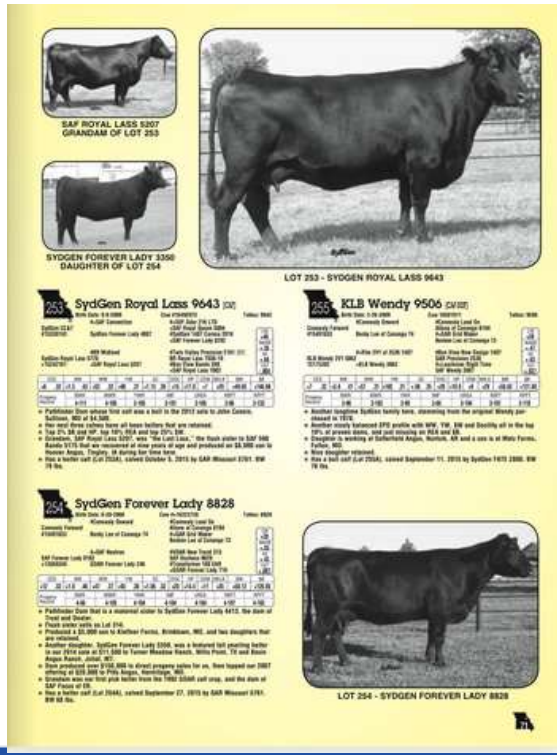
1a) Multiplier—generate more breeding stock

Creates 2nd generation of high genomic animals

Pedigree and Non-pedigree animals

Main Business: sell lots of breeding stock





2) Cow-calf

Main business is raising calves and selling them to

1) Yearlings to feedlot

and/or

2) Mature animals to processor

Need animals with good Maternal and Terminal traits

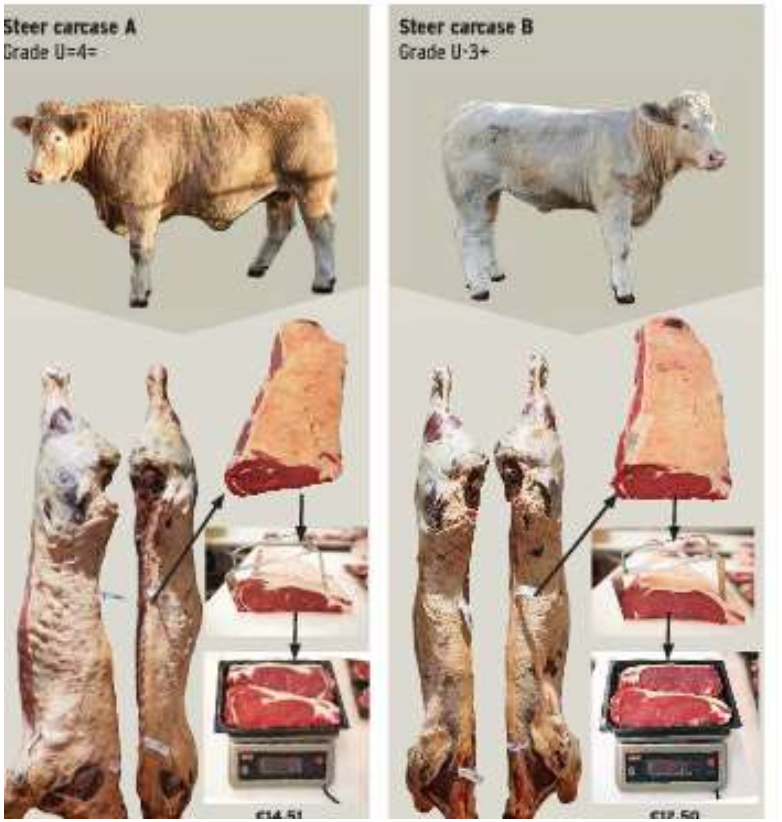
'End User' of high genomic animals

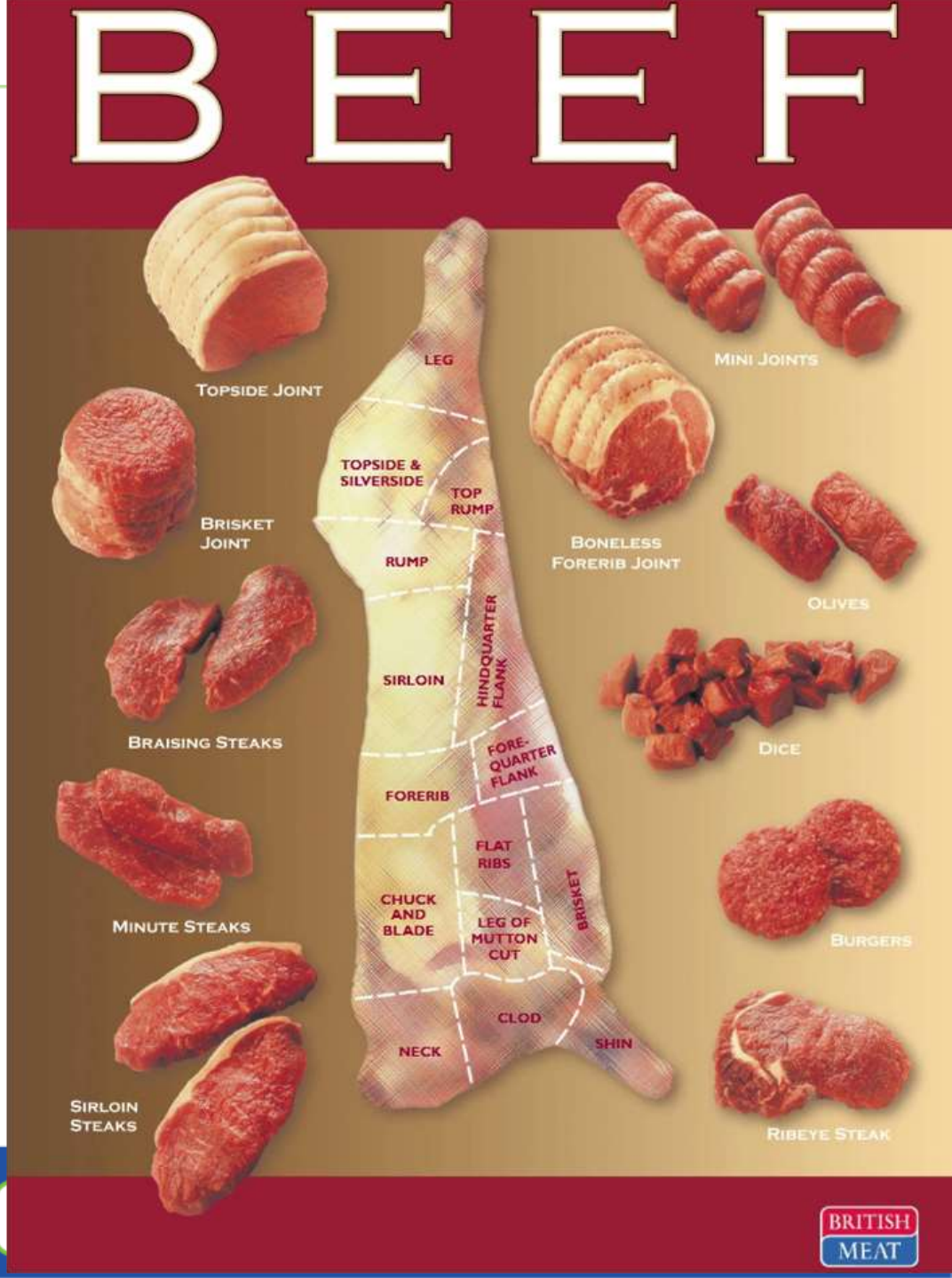
3) Feedlot

Feed cattle to put on muscle and fat till the optimal weight

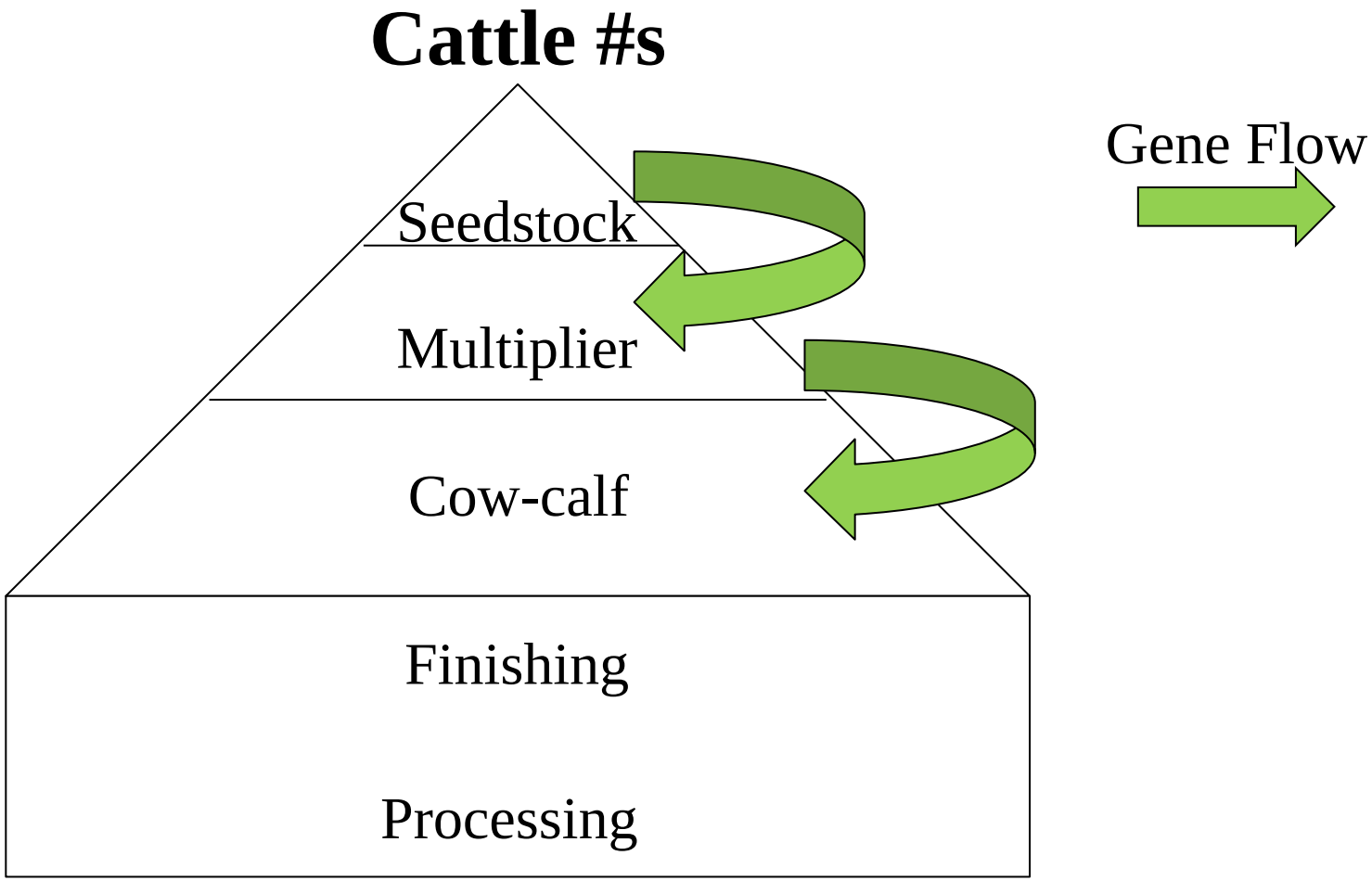
4) Processor

Turn muscle into meat





Cattle Industry Segments



Outline

1) Overview

2) **Genetic Use in Livestock- Typical**
   A. Genetic Improvement: Selecting the Best
   B. Genetic Disease Management
   C. Genetic Use

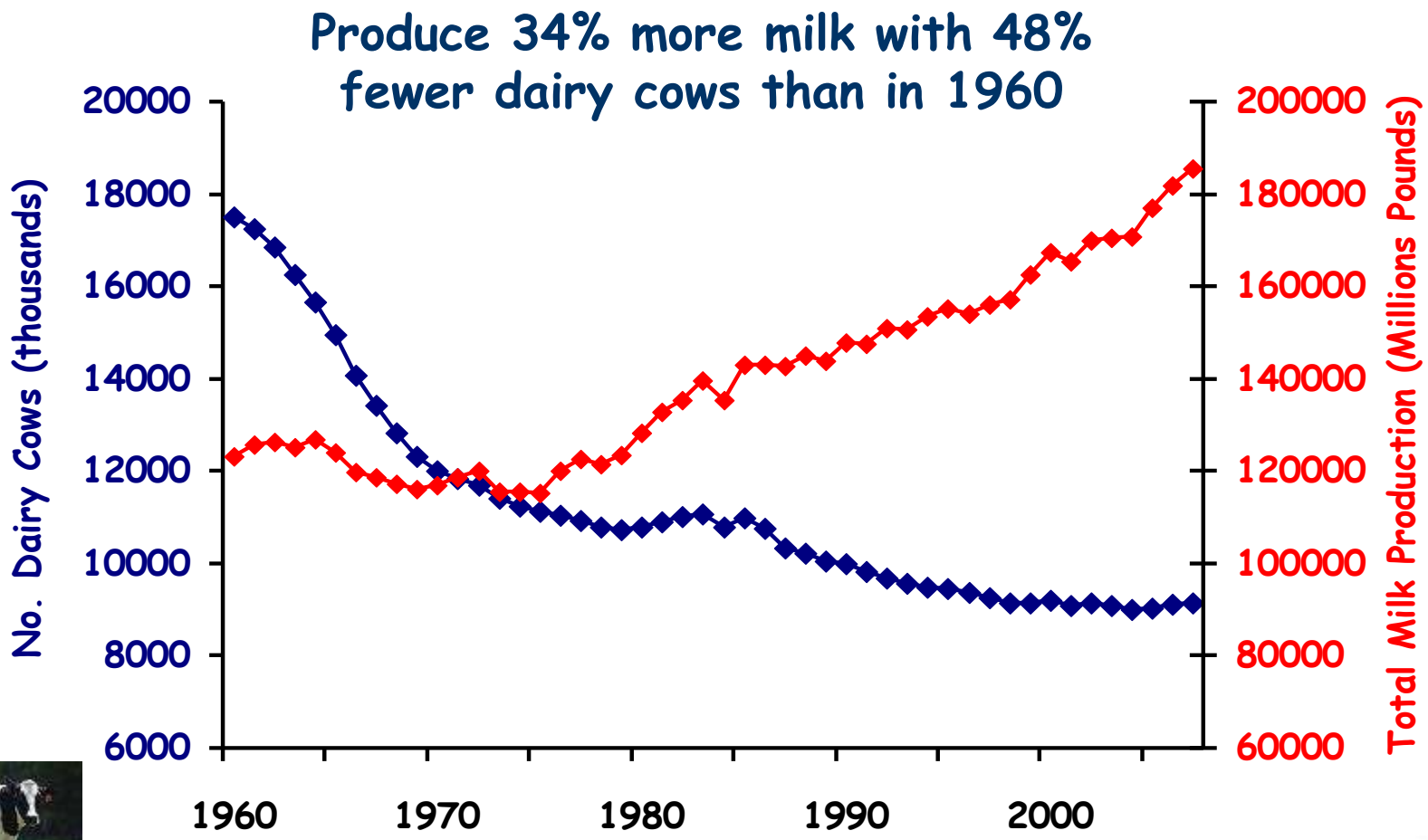
3) Irish Beef Cattle Genomics

4) Additional Projects

Genetic Improvement -the short version

- Breed animals with the best 'genes' for traits of economic importance
- Better animals should = more profit
- Next generation should be better than the previous generation and so on….

U.S.A. Milk Production



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Outline

1) Overview

2) Genetic Use in Livestock- Typical
   - **A. Genetic Improvement: Selecting the Best**
     - **I. Visual**
     - II. Breeding Value
     - III. Genomic Breeding Value
   - B. Genetic Disease Management
   - C. Genetic Use

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4) Additional Projects

Visual Selection

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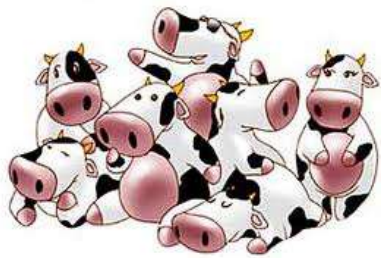
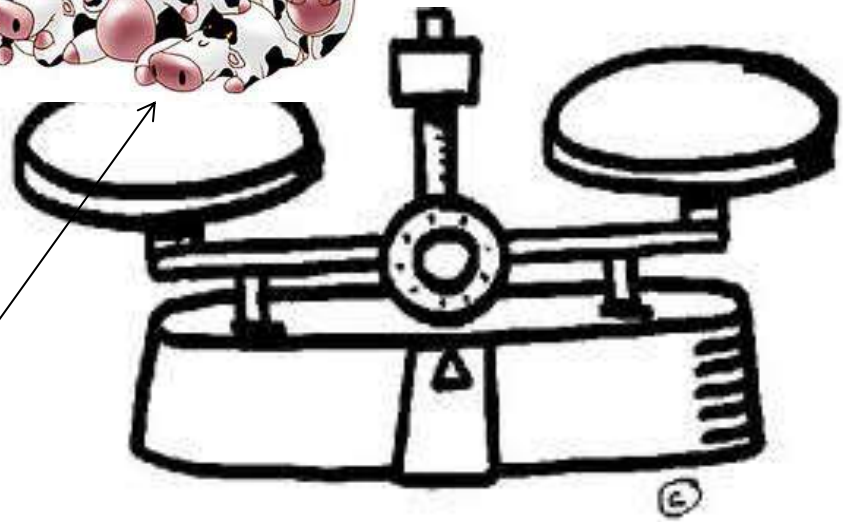
4) Use of Sequencing

Traditional Breeding Value

$$\begin{bmatrix} \hat{\mu} \\ \hat{\alpha} \end{bmatrix} = \begin{bmatrix} \iota^t\iota & \iota^tX \\ X^t\iota & X^tX+I\phi \end{bmatrix}^{-1} \begin{bmatrix} \iota^ty \\ X^ty \end{bmatrix}$$



Breed Average



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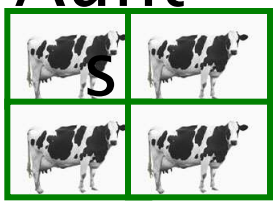
Traditional way a bull gets EBI: Proof over Time

Aunt

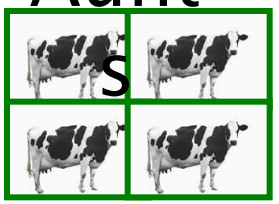


Sire

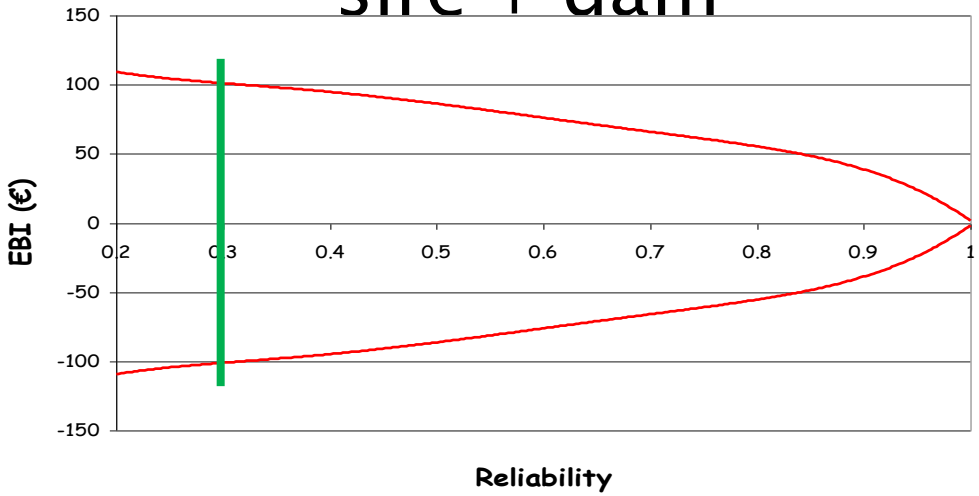
RUU

Dam

Aunt



Selection for Progeny test based on average EBI of sire + dam



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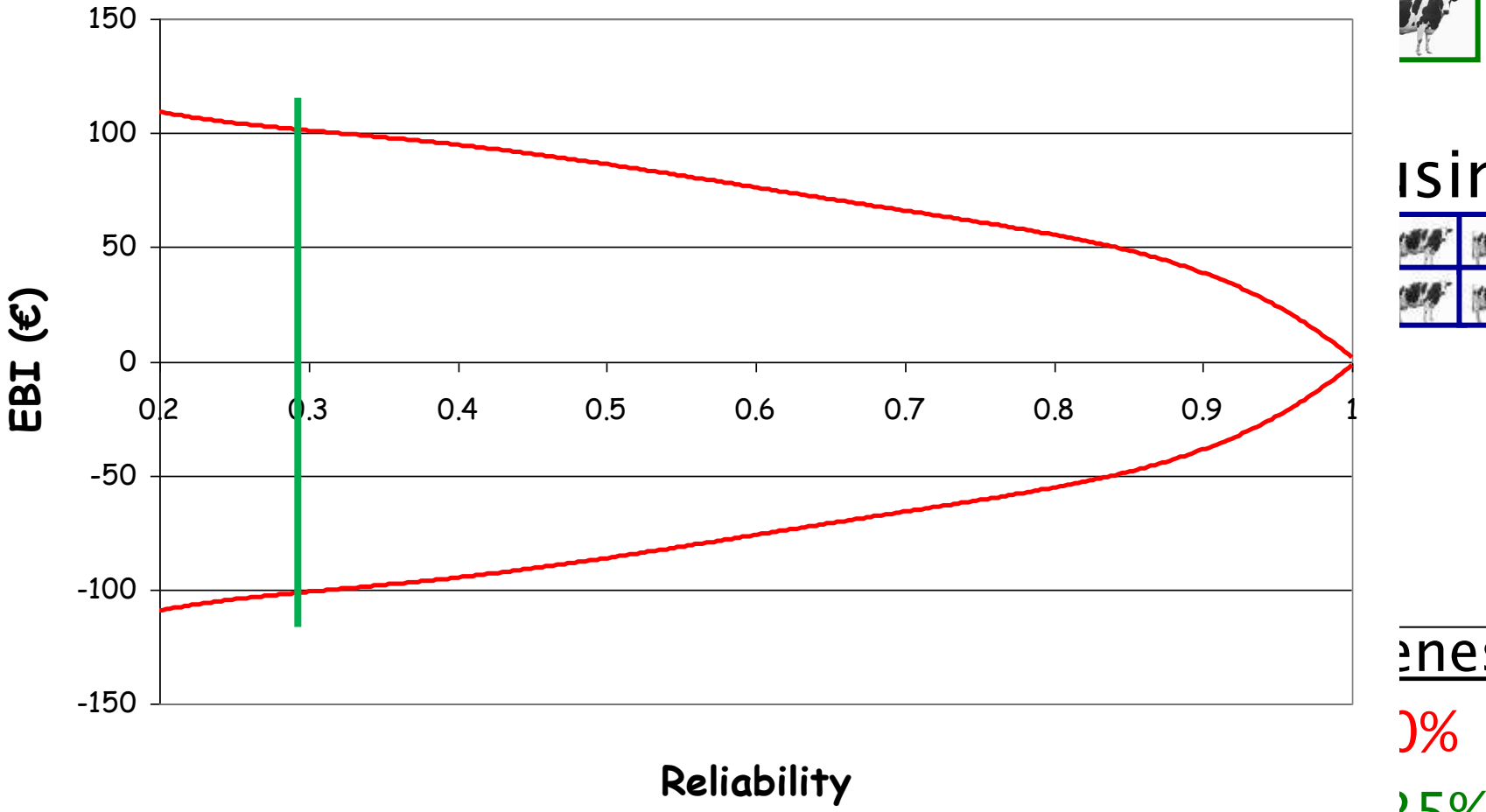
Traditional way a bull gets EBI: Proof over Time

Aunts

Sire

Dam

Aunts



isins

enes

0%

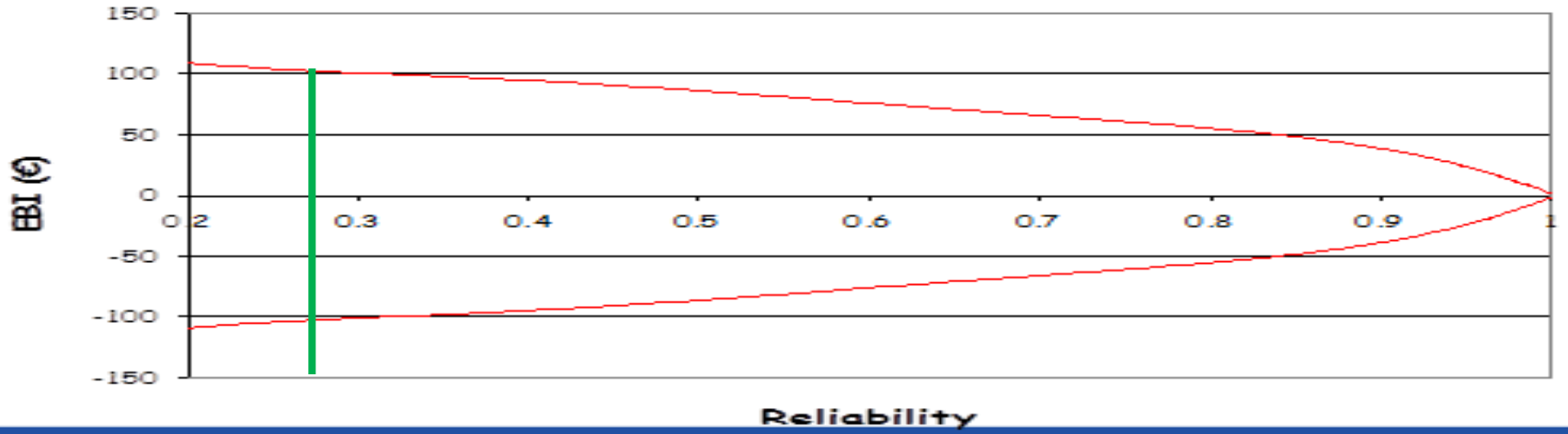
2.5%

Blue = 12.5%

Traditional Breeding Value Timeline

Year -1	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Cows mated	Bull calves born/ bought	Bulls enter AI company	Daughters born	Daughters mated	Daughter calves/milk recorded ~100	Bulls for widespread AI use

>€50,000



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Traditional Breeding Values


LOT 4KY


LOT 6034


LOT 070


LOT 62Y


LOT 060


LOT 45Y


LOT 6Y

ID	BIRTH DATE	SIRE	BW	WW/RATIO	YW/RATIO	ADG	CE
4KY	3/11/2010	Sakic	75	604/110	1206/105	3.47	4
6Y	4/5/2010	2025	86	641/112	1294/115	3.79	1
11SY	3/29/2010	2025	68	547/95	1129/100	3.35	6
13SY	5/5/2010	5542	85	719/125	1178/114	2.57	-1
20UY	3/22/2010	736	76	601/104	1198/102	3.44	6
21Y	4/22/2010	2025	74	590/103	1142/101	3.15	6
25Y	2/24/2010	Red Knight 640F	87	558/107	1109/98	3.15	2
29TY	3/26/2010	Fully Loaded	78	597/104	1088/106	2.78	-1
29Y	3/10/2010	Sakic	88	587/102	1131/100	3.11	0


LOT 39Y


LOT 11SY


LOT 35Y


LOT 20UY


LOT 25Y


LOT 29TY


LOT 29Y


LOT 34Y

Red Angus EPD Averages for Non Parents under 2 years old.

CED	BW	WW	YW	M
5	-0.1	32	60	17

TM	S	MARB	REA	BF
33	9	0.08	0.09	0

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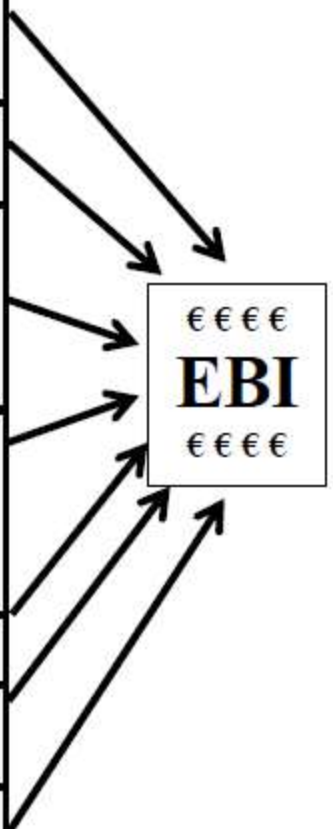
2) Genetic Use in Livestock- Typical
   A. Genetic Improvement: Selecting the Best
      I. Visual
      II. Breeding Value
         a) Index=Economic Sum of gBVs
      III. Genomic Breeding Value
   B. Genetic Disease Management
   C. Genetic Use

3) Irish Beef Cattle Genomics

4) Use of Sequencing

EBI=Sum of Economicly Weighted BV

2014 Economic values and % emphasis for traits in the EBI				
Sub-Index	Trait	Economic Weight	Trait Emphasis	Overall Emphasis
Production	Milk	-€0.09	10.6%	33%
	Fat	€1.04	3.4%	
	Protein	€6.64	18.9%	
Fertility	Calving Interval	-€12.43	24.0%	35%
	Survival	€12.01	10.9%	
Calving	Direct Calving Difficulty	-€3.52	2.8%	9%
	Maternal Calving Difficulty	-€1.73	1.3%	
	Gestation Length	-€7.49	4.1%	
	Calf Mortality	-€2.58	1.0%	
Beef	Cull Cow Weight	€0.15	0.7%	9%
	Carcass Weight	€1.38	5.1%	
	Carcass Conformation	€10.32	1.7%	
	Carcase Fat	-€11.71	1.1%	
Maintenance	Cull Cow Weight	-€1.65	7.2%	7%
Management	Milking Time	-€0.25	2.1%	4%
	Milking Temperament	€33.69	1.9%	
Health	Lameness	-€54.26	0.6%	3%
	SCC	-€43.49	1.8%	
	Mastitis	-€77.10	0.8%	



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Euro-Stars

AI Code:	AFF	**Breed:**	BB (100%)	**Pedigree Statu**	
Animal Name:	ATTRIBUT DU FOND DE BOIS	**Owner:**	NATIONAL CATTLE BREEDING CNTR	**Sire:**	
National ID:	00727363707	**Date of Birth:**	14-OCT-2010	**Dam:**	
International ID:	BBLBELM000727363707	**Date of Evaluation:**	Aug 2015	**MGS:**	

€uro-star Index | Replacement Graphics | Terminal Graphics | Linear Type | Pedigree | Prev Eval

Replacement Index Contributions

Within breed star rating	Trait	Index €	Rel %	Across breed star rating
★★★★★	**Replacement index €**	70	21	★★★☆☆
	(a) Calving difficulty	-17	68	
★★☆☆☆	(b) Gestation	-3	69	★★★★☆
★★★★★	(c) Mortality	0	43	★★☆☆☆
★★★☆☆	(e) Docility	2	52	★★★★★
★★★☆☆	(f) Feed intake	12	13	★★★★★
★☆☆☆☆	(g) Carcass weight	44	35	★★★★★
★☆☆☆☆	(h) Conformation	20	20	★★★★★
★★★☆☆	(i) Carcass fat	3	13	★★★★★
	(j) Meat Quality	0		

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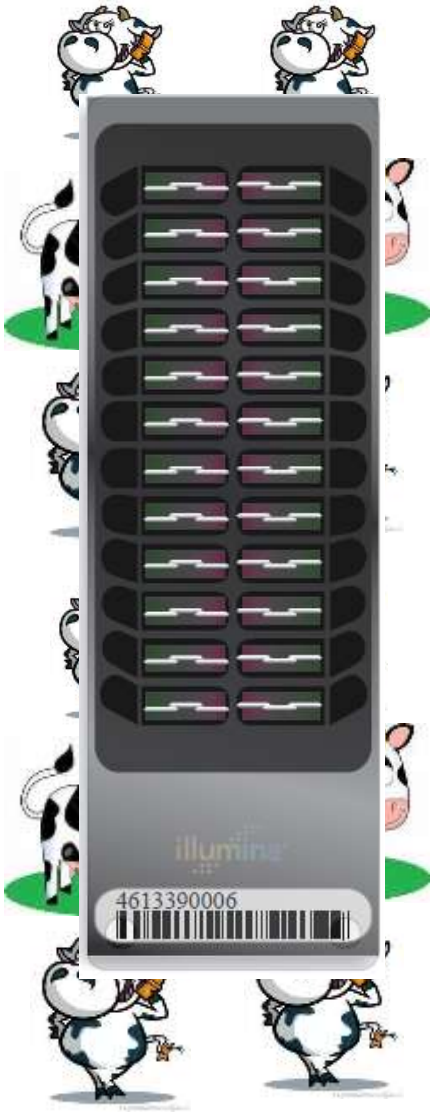
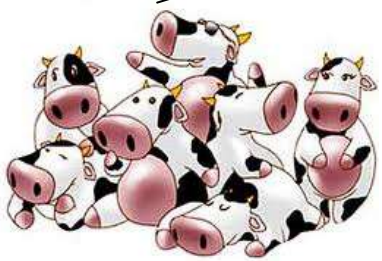
Genomic Breeding Values

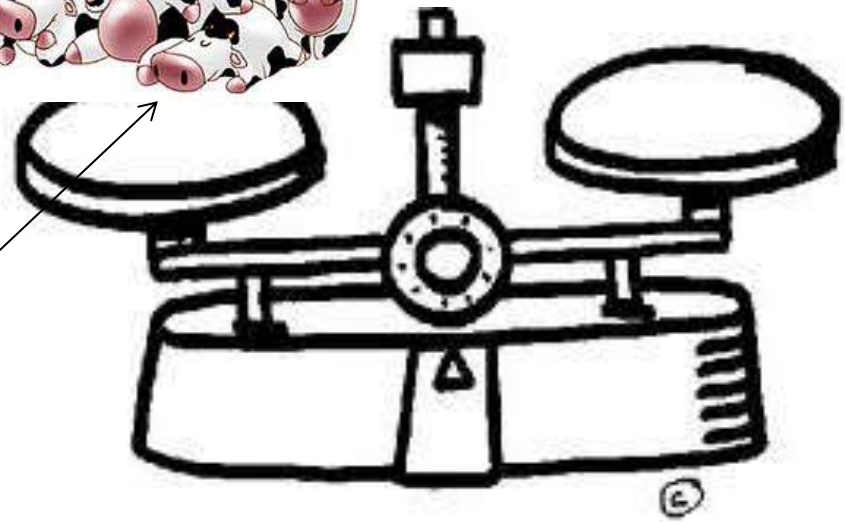
$$\begin{bmatrix} \hat{\mu} \\ \hat{\alpha} \end{bmatrix} = \begin{bmatrix} \iota^t\iota & \iota^t X \\ X^t\iota & X^tX+I\phi \end{bmatrix}^{-1} \begin{bmatrix} \iota^t y \\ X^t y \end{bmatrix}$$

$$f(\beta|y,\sigma_e^2) \propto \exp\left\{-\frac{1}{2}\frac{(\beta-\hat{\beta})'(X'X)(\beta-\hat{\beta})}{\sigma_e^2}\right\}$$

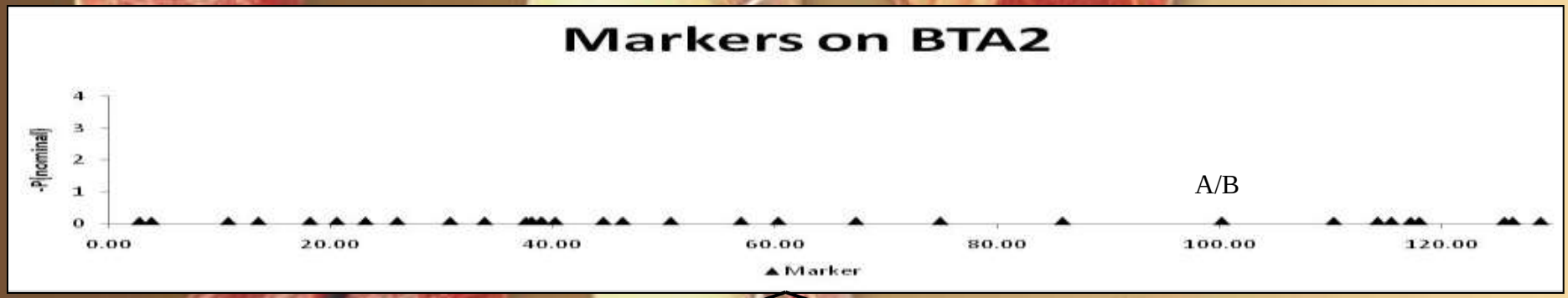


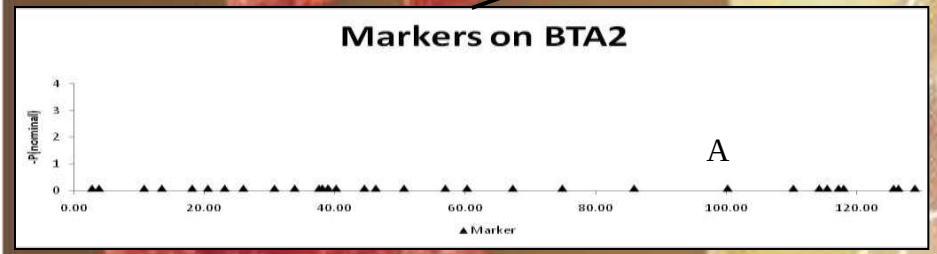


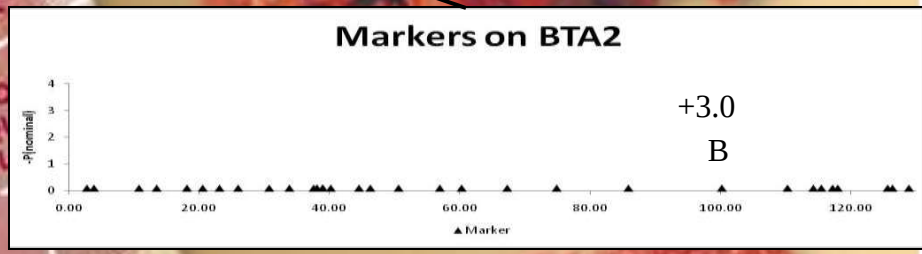
Breed Average



SNP Effect on Phenotype

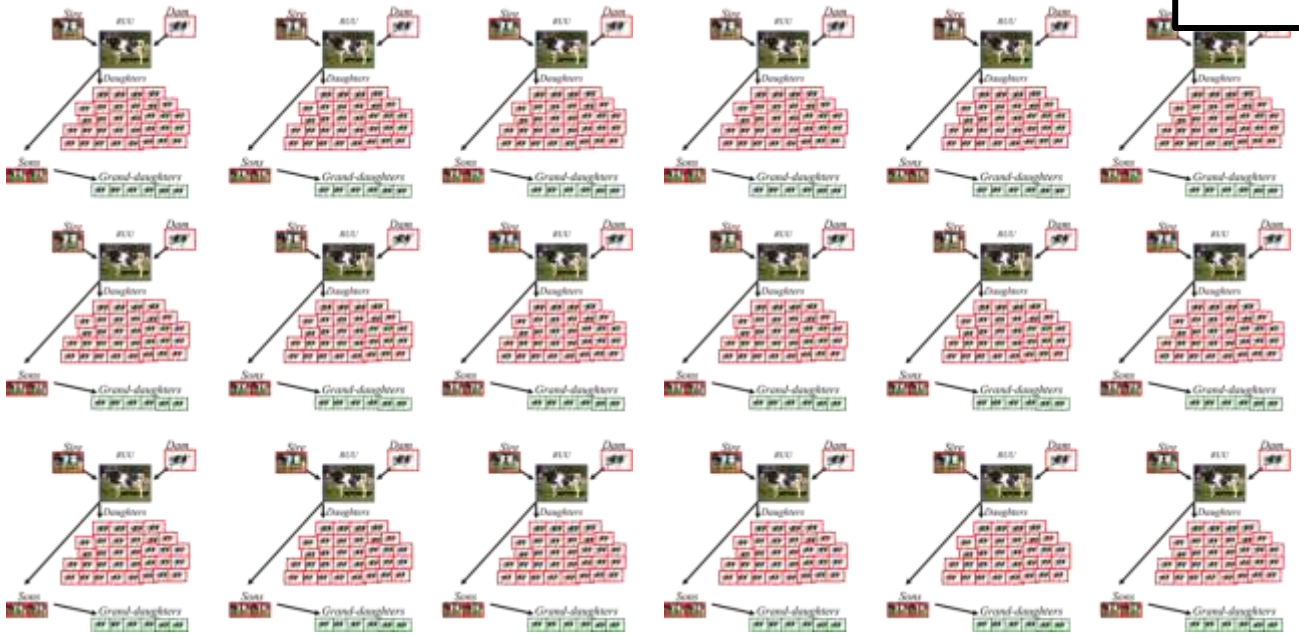


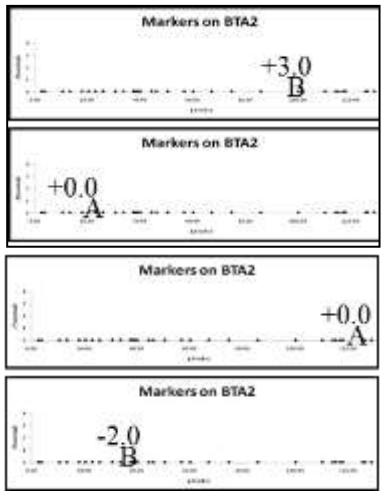




Reference Population

>1,000 per breed Needed for accurate gBV





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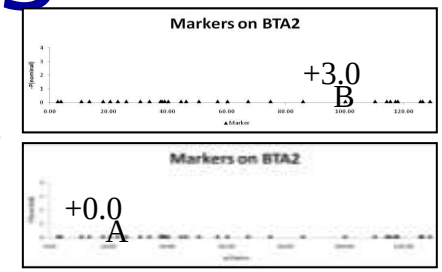
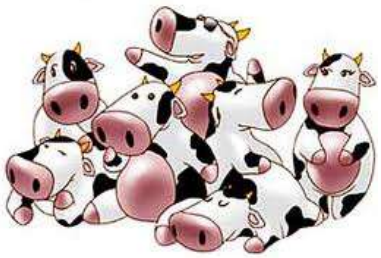
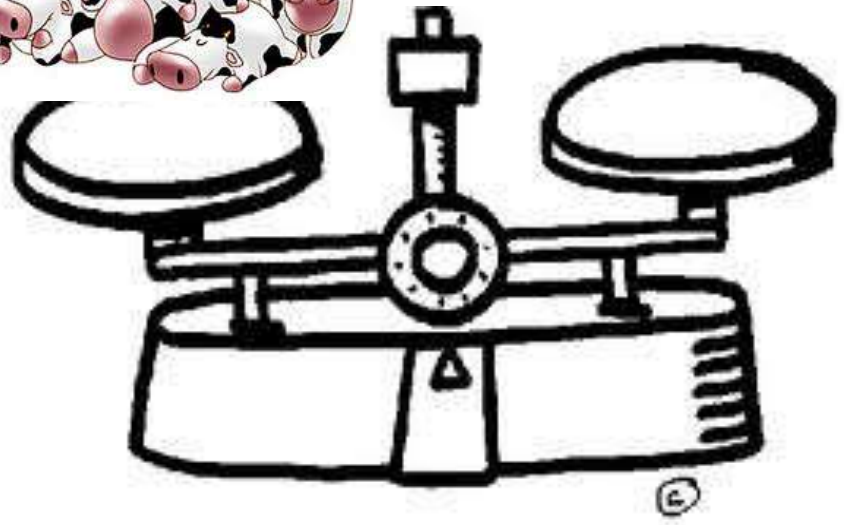
Genomic Breeding Value





Breed Average



Non-Genomic vs Genomic Breeding Value

Parents Selected

Bull Born

Parent Avg BV
~30% Reliable

Genomic Test

Genomic BV
~60% Reliability
<€100

Daughters Born (2yr)

Semen Collected (1yr)

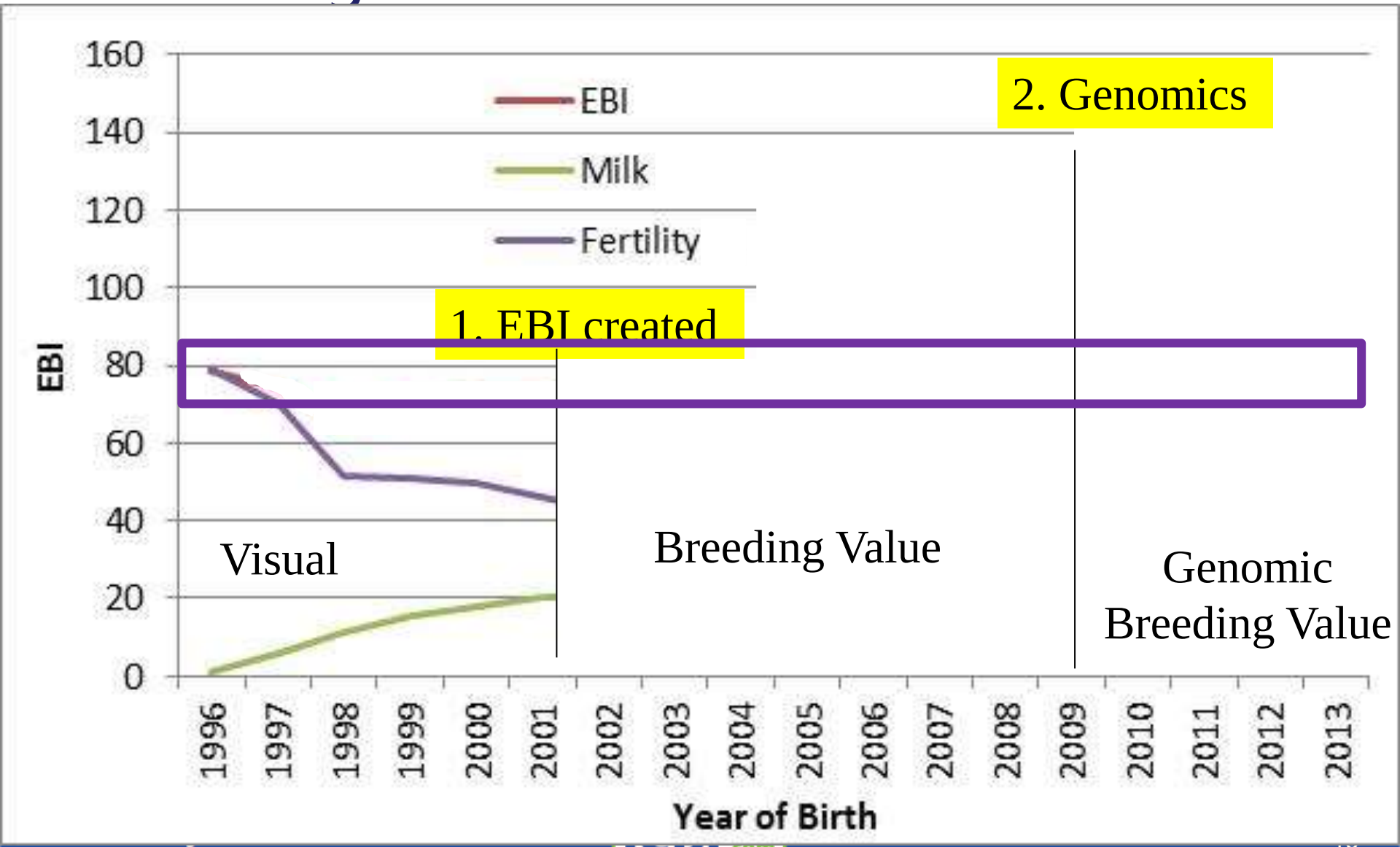
Daughters Have Calves (4yr)

Bull Receives
Progeny Proven BV
~80% Reliable
(5 yr) ~€50,000

ICBF.com

Ireland Dairy

Using Genomics to Fix Problems



Select the Best

Visual - ???

dex

Code	Name of Bull	Breed	Replacement index	Replacement index (across breed stars)
AA2064	CARRIGROE KIAN	AA	€186	★★★★★
CH2159	BONDI JACOB	CH	€94	★★★★
HE2147	ALLOWDALE RAMBO 415	HE	€111	★★★★★
HE2148	BALLYAVILLE HAMLET	HE	€121	★★★★★
LM2150	CASTLEVIEW IMMAGINABLE	LM	€137	★★★★★
LM2151	BALLYGARVAN STUD IKE	LM	€115	★★★★★
LM2156	CLONARK JUMBO	LM	€123	★★★★★
PI2157	KILREE LEO	PI	€101	★★★★★
SI2158	SEEPA FIONN	SI	€131	★★★★★

2

€147

€190

€98

€80

€166

Genetic Disease Carrier??

Genomic Breeding Value Index

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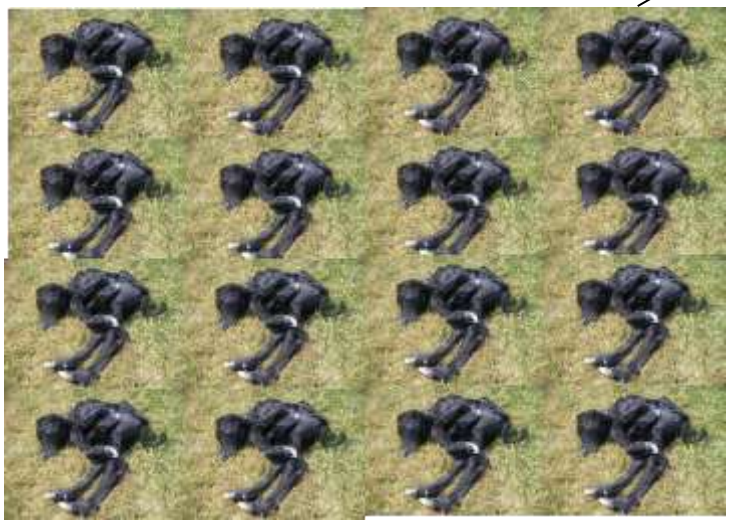
Shhhh….We're Hunting Cow Diseases

Curly Calf

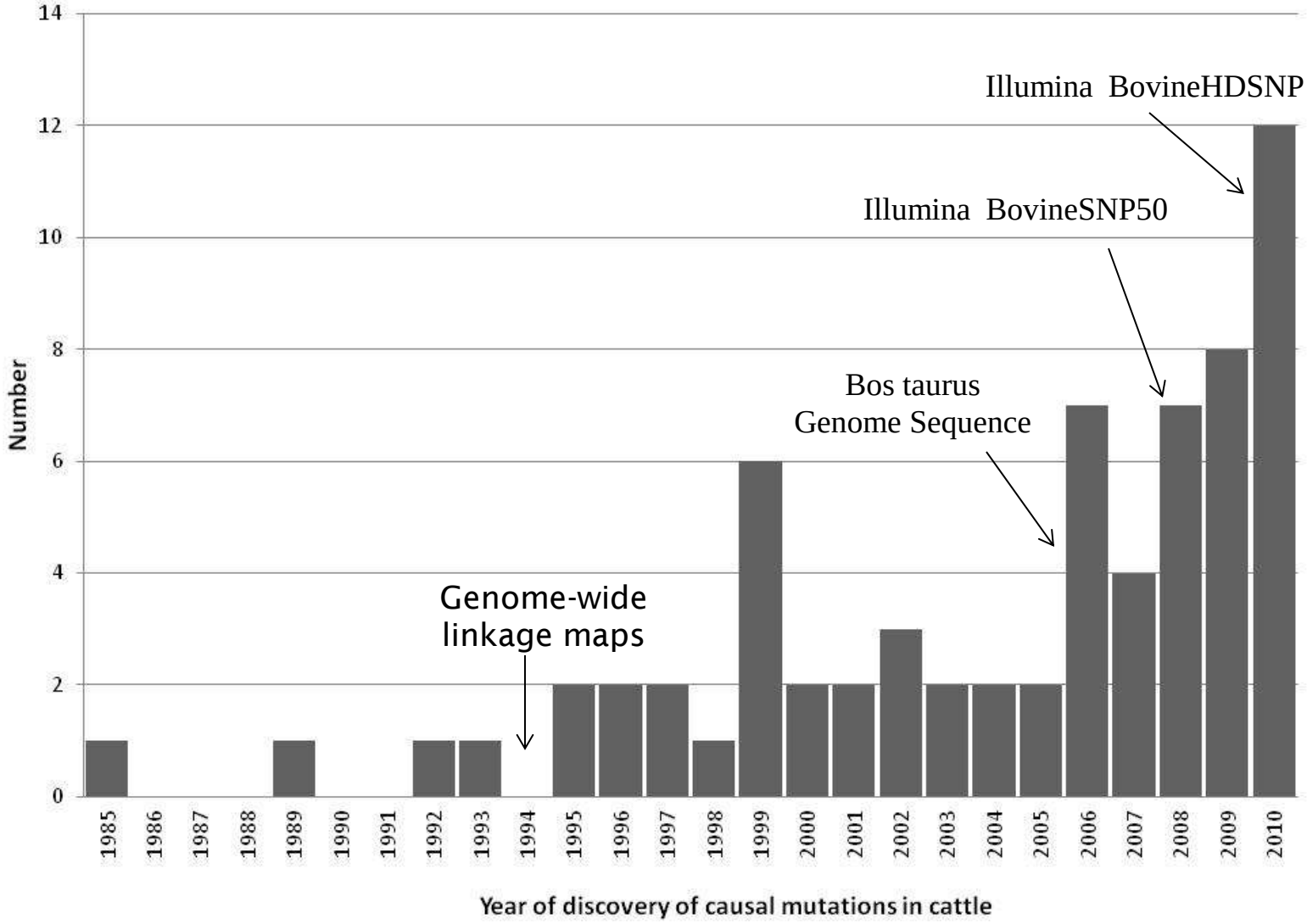
Shhhh….We're Hunting Cow Diseases

Dr. Jon Beever
Uni. Illinois



GAR Precision 1680
Born 1990
>10,000 registered offspring
>300,000 descendants registered
Low BW, high WW, YW

Cattle Genetic Diseases: Causal Mutation Discovered



From Nicholas (2012) in *Bovine Genomics* (ed. J.E. Womack). Wiley-Blackwell, Ames, Iowa (in press)

Outline

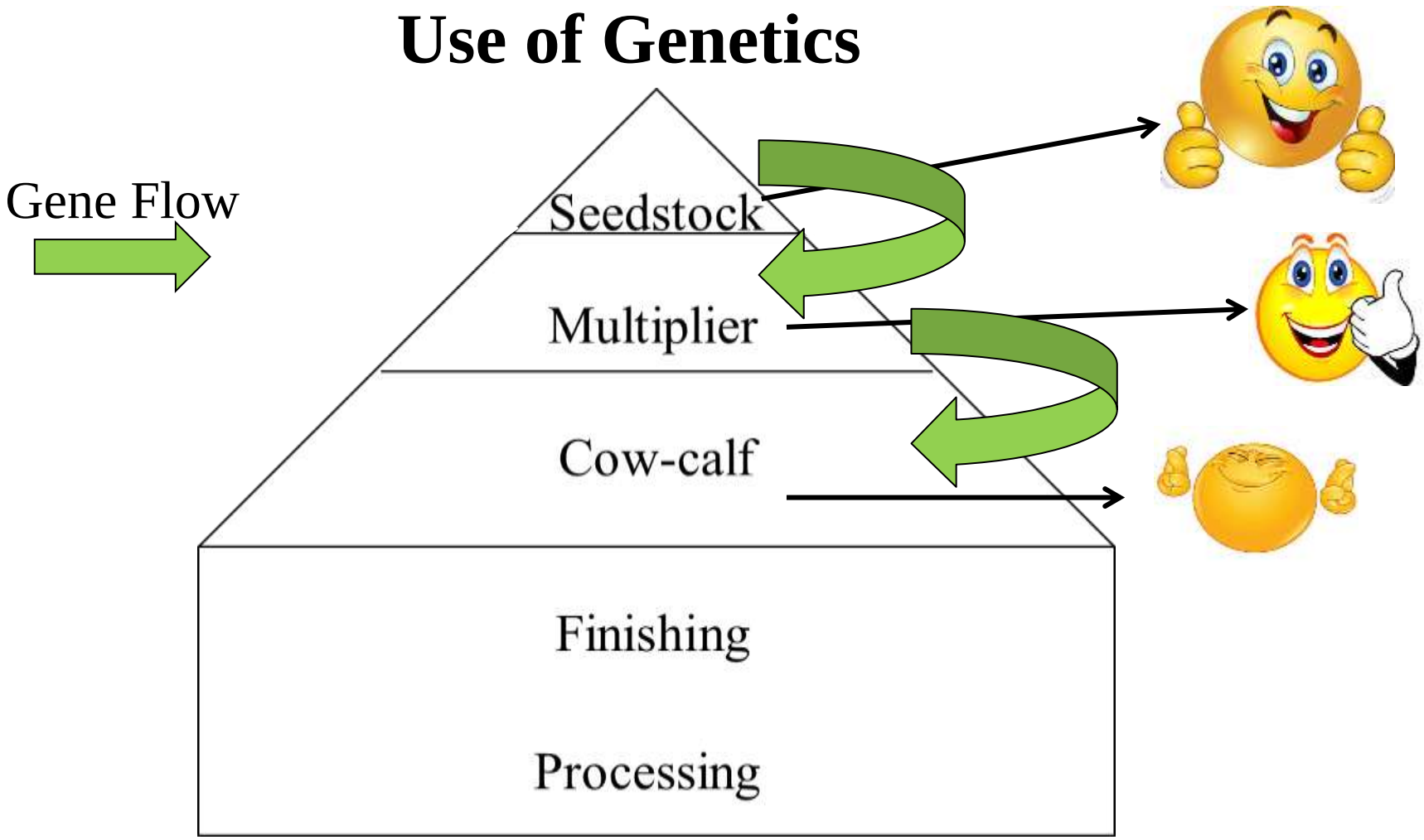
1) Overview

2) Genetic Use in Livestock- Typical
   A. Genetic Improvement: Selecting the Best
   B. Genetic Disease Management
   C. Genetic Use

3) Irish Beef Cattle Genomics

4) Additional Projects

Cattle Industry Segments



Outline

1) Overview

2) Genetic Use in Livestock- Typical

3) Irish Beef Cattle Genomics

A. Issue

B. ICBF Solution

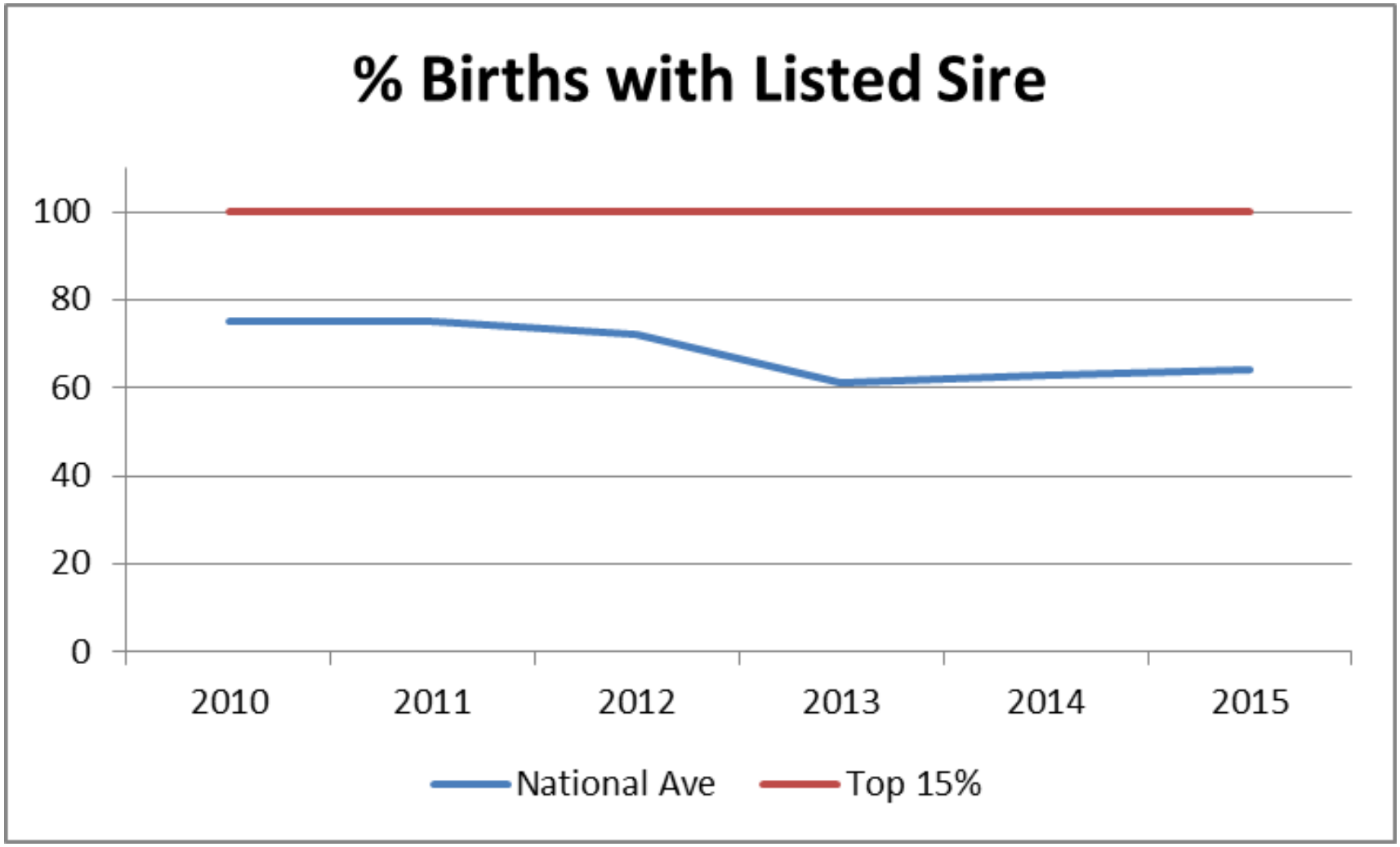
C. Irish Beef Application

4) Additional Projects

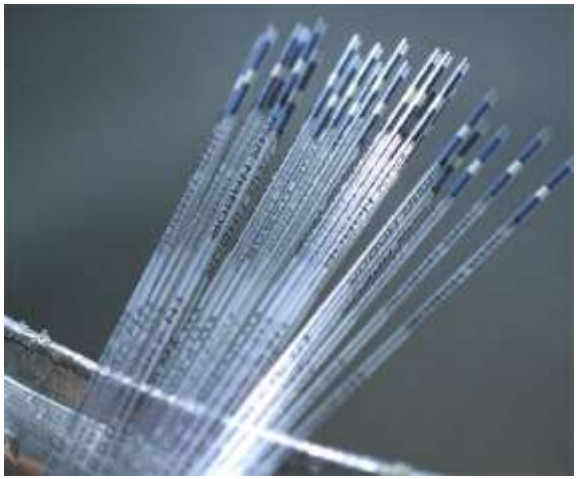
Problems in Irish Beef

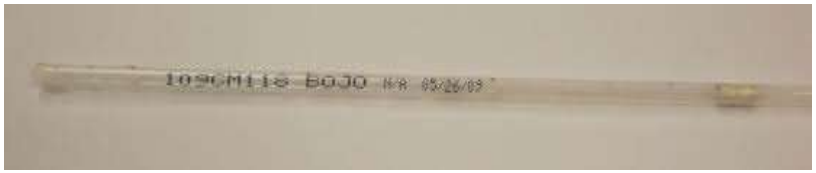
- Fertility
- Lack of Maternal Traits
- Inefficient Growth
- Genetic Diseases
- Infectious Diseases

Who's the Father??

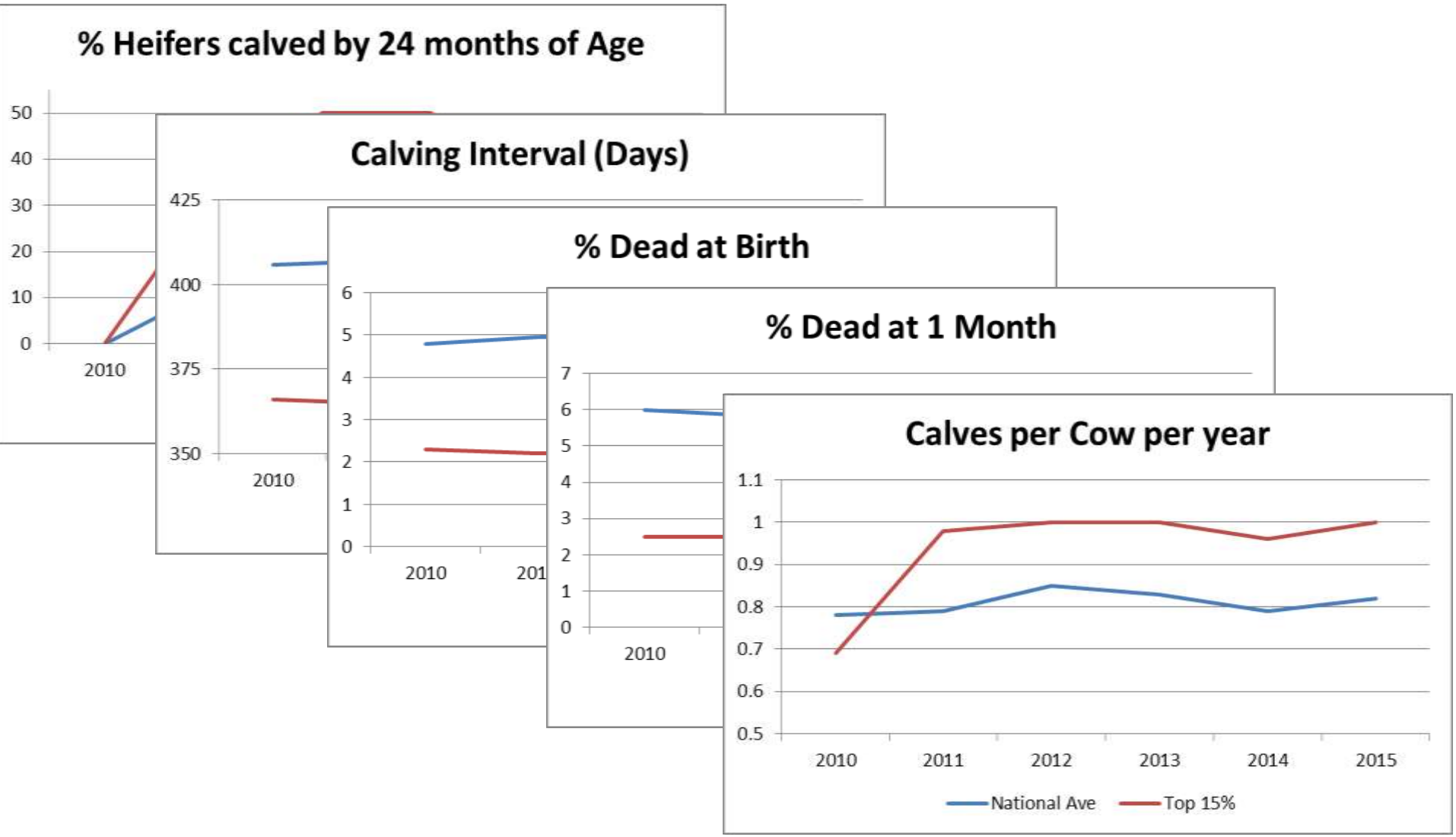


Parentage Correct?
~10-15% Wrong



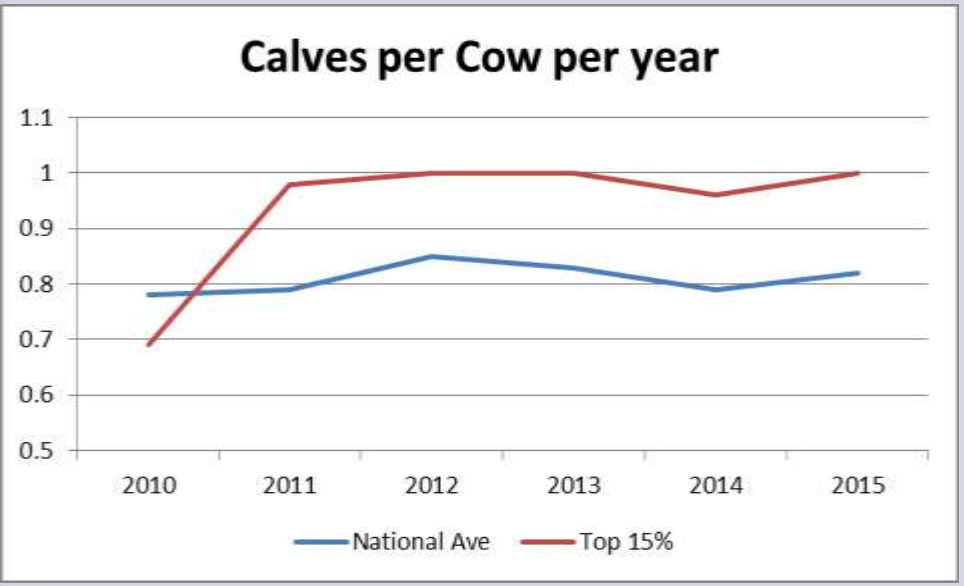


Problems in Irish Beef



HUMAN POPULATION GROWTH CHART

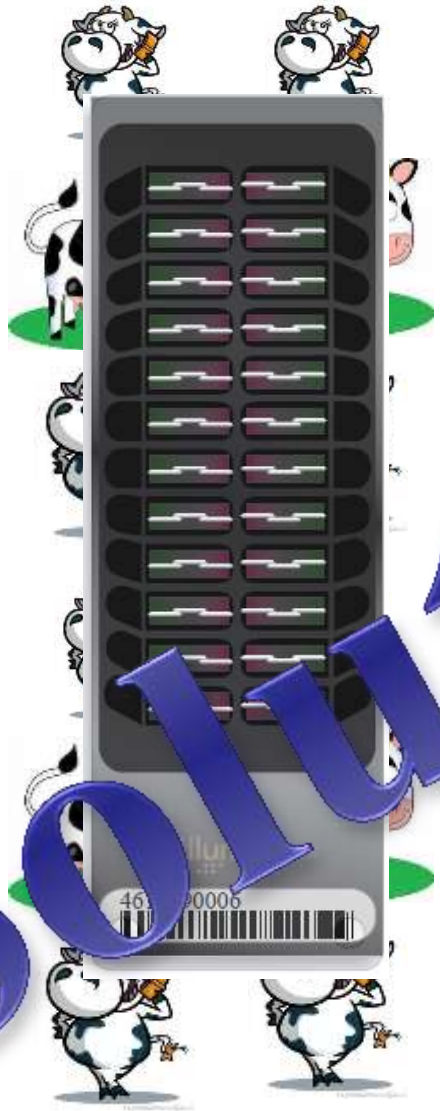
(including projections)



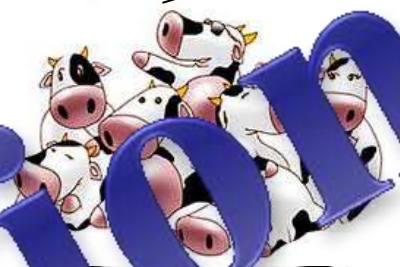
Beef Genomic Breeding Values???

$$\begin{bmatrix} \hat{\mu} \\ \hat{\alpha} \end{bmatrix} = \begin{bmatrix} \iota^t\iota & \iota^t X \\ X^t\iota & X^tX+I\phi \end{bmatrix}^{-1} \begin{bmatrix} \iota^t y \\ X^t y \end{bmatrix}$$

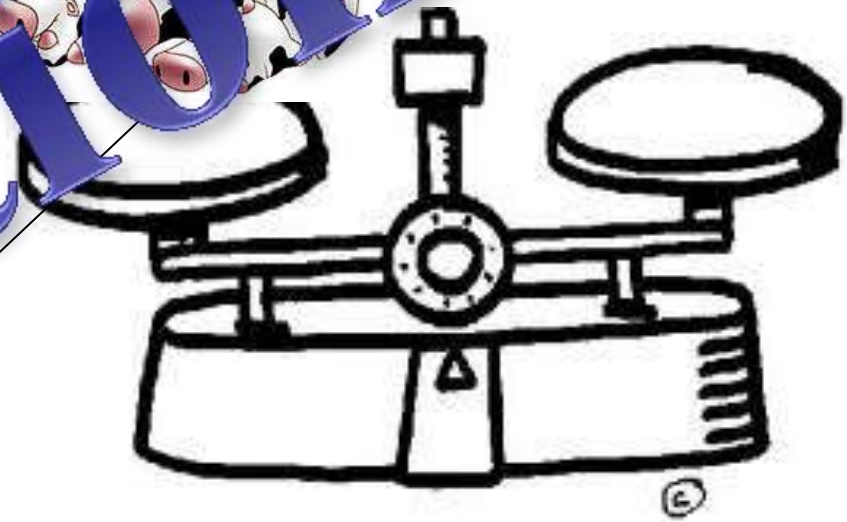
$$f(\beta|y,\sigma_e^2) \propto \exp\left\{-\frac{1}{2}\frac{(\beta-\hat{\beta})'(X'X)(\beta-\hat{\beta})}{\sigma_e^2}\right\}$$



Solution?



Breed Average



How Irish Beef Cows are Selected

>

How Irish Beef Bulls are Selected

ICBF.com Irish Cattle Breeding Federation

Animal Details

AI Code:	AFF	**Breed:**	BB (100%)	**Pedigree Status:**	PED
Animal Name:	ATTRIBUT DU FOND DE BOIS	**Owner:**	NATIONAL CATTLE BREEDING CNTR	**Sire:**	IMPERIAL DE L'ECLUSE / S905
National ID:	00727363707	**Date of Birth:**	14-OCT-2010	**Dam:**	OR… …DU FOND DE BOIS /
International ID:	BBLBELM000727363707	**Date of Evaluation:**	Aug 2015	**MGS:**	…MERO ET 6551 /

€uro-star Index | Replacement Graphics | Terminal Graphics | Linear Type | Pedigree | Prev Eval

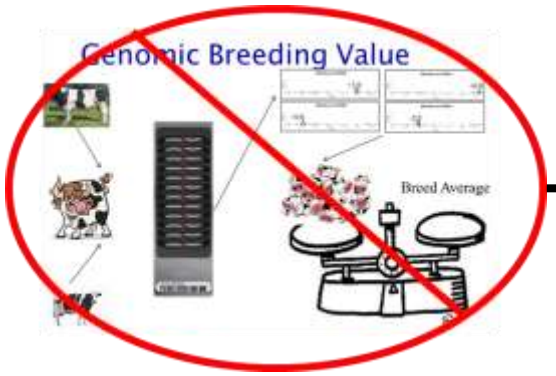
Star Rating (within Belgian Blue breed)	Economic Indexes	€uro value	Index reliability	Star Rating (across all beef breeds)
★★★★★	Replacement (per daughter lactation) Maternal Cow Traits Maternal Progeny Traits	€70 €8 €62	21% (L… 13%	
★☆☆☆☆	Terminal (per progeny)	€101		★★☆☆☆
☆☆☆☆☆	Dairy Beef			☆☆☆☆☆

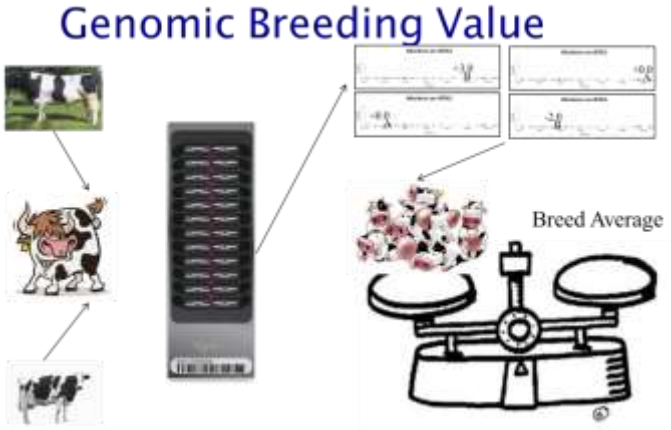
Star Rating (within Belgian Blue breed)	Key profit traits		Trait reliability	Star Rating (across all beef breeds)
	…ormance			
	Cal…	9.30%	68% (High)	
★★★☆☆	…us ave: 0.00	0.16 scale	46% (Average)	★★★★★
★☆☆☆☆	C… …ght (kg) Bree… …32.50kg, All breeds ave: 13.98kg	21kg	35% (Low)	★★★★★
★☆☆☆☆	Carcass conformation (1-15 scale) Breed ave: 2.70, All breeds ave: 1.23	2 scale	20% (Low)	★★★★★

Expected daughter breeding performance

>1.5 million bull searches in 2015

Information Needed for Beef gBV





- Phenotype Data
- Accurate Pedigree

- Genotyped Reference Population

  - >1,000 per breed. Ireland has >20 breeds
  - >1million beef cattle

Outline

1) Overview

2) Genetic Use in Livestock- Typical

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   A. Issue
   B. ICBF Solution
   C. Irish Beef Application

4) Additional Projects

ICBF plan-Grand outline

Genotype Them All

Let ICBF Sort Them Out

Illumina custom chip (IDB)

- IDBv1 2013: 16,000 SNP
  - Genotyped 26,000 animals

- IDBv2 2014: 18,000 SNP
  - Genotype ~150,000 cattle
  - BGP scheme –
    - Beef AI, stock bulls, and 15% of cows

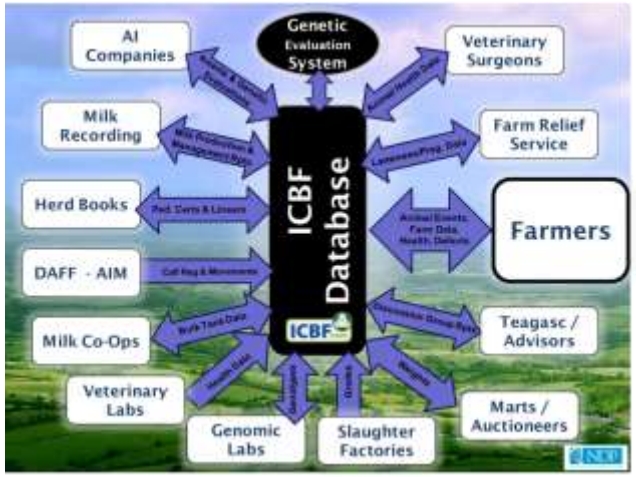

BUDGET 2014

Beef scheme the minister's flagship

In an exclusive interview, Minister for Agriculture Simon Coveney outlined the key measures affecting Agriculture in Budget 2014 to **Pat O'Keeffe**

ICBF.com

Information Needed for Beef gBV



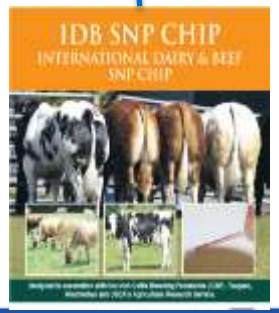
- Phenotype data 
- **Accurate Pedigree** 
- Genotyped Reference Population

Irish Parent Verification Process (N >200,000)

Calf

Tissue Sample

Weatherbys



ICBF Database

SNP based

Validate 50%

Predict 7%

Fail 4%

Microsatellite Imputed

Validate 8%

Fail 0.5%

Limbo 20%

ICBF.com

gBV needs

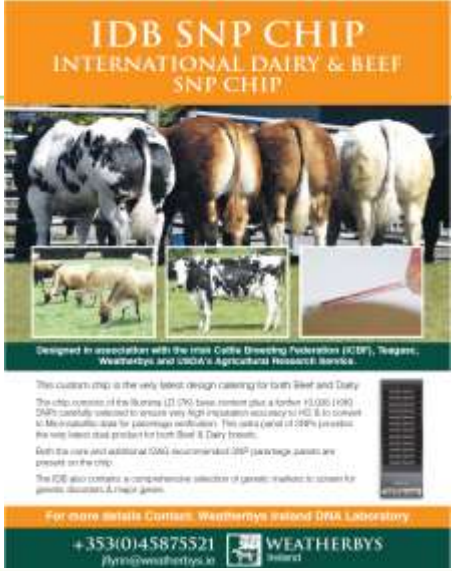
- Phenotype Data 
- Accurate Pedigree 
- **Genotyped Reference Population** 
  - **20 breeds**
  - **>1000 animals needed per breed**

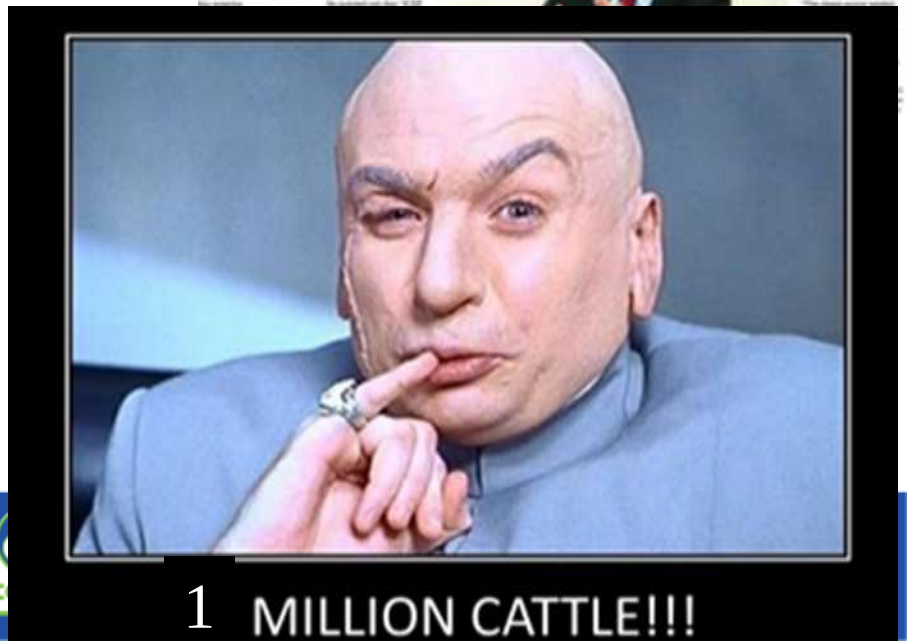
Developed custom chip (IDB)

- IDBv1 2013: 16,000 SNP
  - Genotyped 26,000 animals

- IDBv2 2014: 18,000 SNP
  - Genotype ~150,000 cattle
  - BGP scheme –
    - Beef AI, stock bulls, and 15% of cows
    - Start of beef reference population

- IDBv3 2015: 55,000 SNP
  - Genotype—lots…
  - 30K herds signed up
    (~60% of national herd)
  - 350K animals genotyped yearly





BDGP Scheme Applied

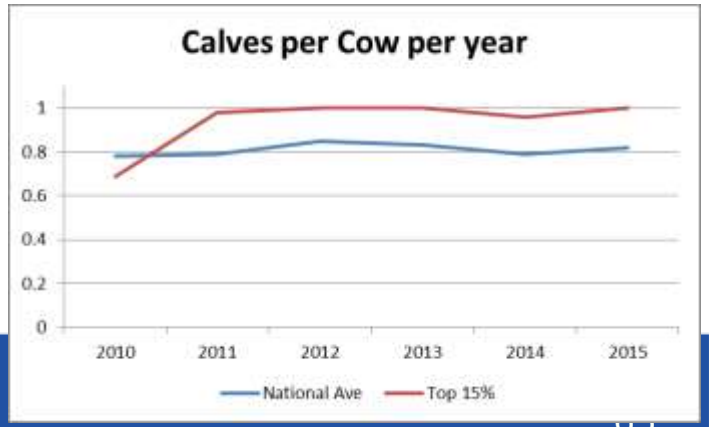
6 year scheme

Farmers in scheme have to

- Have a top genomic bull
- 20% of cows are top genomic by 2018
- 50% of cows are top genomic by 2020
- Replacement cows/bulls must be genotyped

Goal is

1) Increase efficacy though increased fertility and production
2) Minimize Genetic Disease Risk



ICBF.com

Outline

1) Overview

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3) Irish Beef Cattle Genomics

A. Issue
B. ICBF Solution
C. Irish Beef Application

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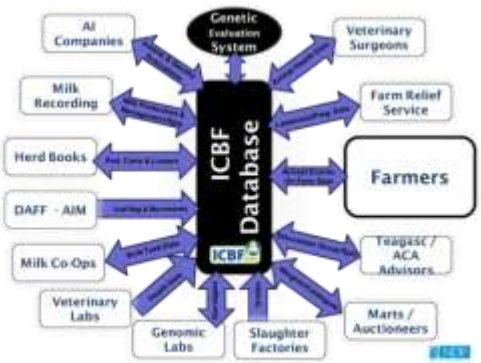
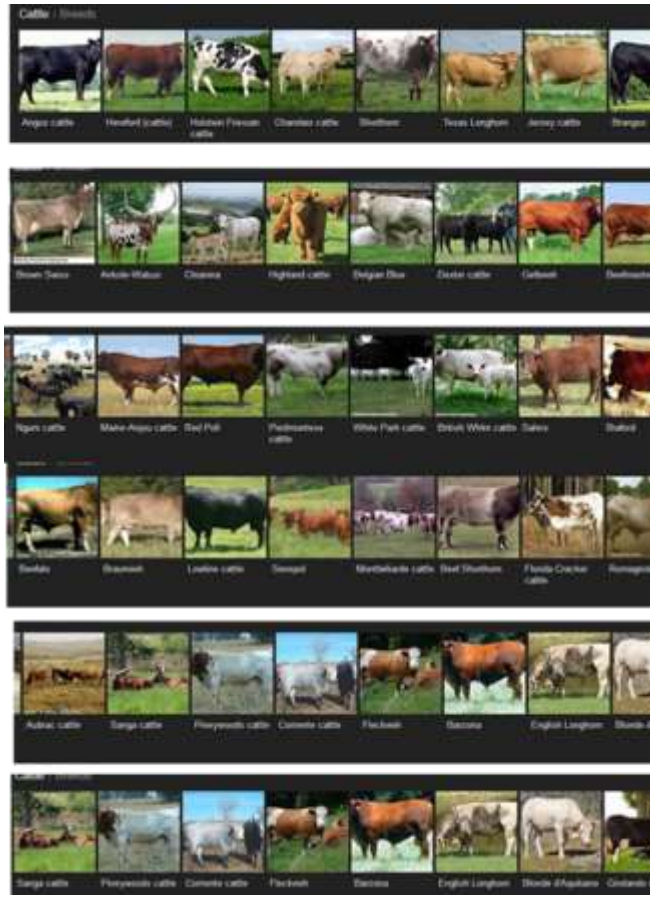
IDBv3 and BDGP scheme





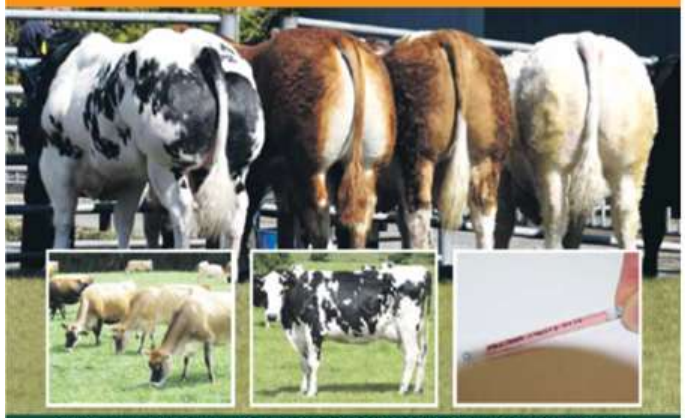
gBV for all Genotyped Purebred and Commercial Beef Animals

ICBF.com

How Irish Beef Cows are Bought >2015

>150 Disease/Trait Probes

IDB SNP CHIP
INTERNATIONAL DAIRY & BEEF SNP CHIP



Designed in association with the Irish Cattle Breeding Federation (ICBF), Teagasc, Weatherbys and USDA's Agricultural Research Service.

This custom chip is the very latest design catering for both Beef and Dairy.

The chip consists of the Illumina LD (7K) base content plus a further 10,000 (10K) SNPs carefully selected to ensure very high imputation accuracy to HD & to convert to Microsatellite data for parentage verification. This extra panel of SNPs provides the very latest dual product for both Beef & Dairy breeds.

Both the core and additional ISAG recommended SNP parentage panels are present on the chip.

The IDB also contains a comprehensive selection of genetic markers to screen for genetic disorders & major genes.

For more details Contact: Weatherbys Ireland DNA Laboratory

+353(0)45875521
jflynn@weatherbys.ie
WEATHERBYS Ireland

CHIP CONTENTS FOR DISEASES & TRAITS

Lethal recessives
1 CVM*-Complex Vertebral malformation
2 DUMPS
3 Brachyspina*
4 BLAD

Congenital disorders
1 Arthrogryposis (Curly Calf)*
2 Fawn Calf Syndrome or Contractural Arachnodactyly*
3 Hypotrichosis, PMaH7
4 Hypotrichosis in Belted Galloway, HEPHL1 SNP
5 Hypotrichosis, KRT71*
6 Spidership- MOCS1 gene- Simmental
7 Spidership- SOUX gene- Brown Swiss
8 Polledness
9 Mule Foot
10 Tibial Hemimelia (TH)*
11 Black/Red Coat Color/Red Factor
12 Red Recessive coat colour (Different to red factor)
13 Silver Color Dilutor
14 Dun Color
15 RNF11 (affects growth and stature)
16 Osteopetrosis (Marble Bone Disease)
17 Pink Eye (Infectious Bovine Keratoconjunctivitis)
18 Protoporphyria Ferrochelatase Gene (Photosensitization)
19 SMA- Spinal muscular atrophy
20 Beta Lactoglobulin
21 Beta Mannosidosis
22 Alpha Mannosidosis
23 Citrullinemia
24 CMDI: Congenital muscular dystonia I
25 CMDII: Congenital muscular dystonia II
26 Crooked Tail Syndrome*
27 Factor XI
28 Heterochromia Irides (White Eye)
29 SDM- Spinal dysmyelination-SPAST Gene
30 Idiopathic Epilepsy*
31 Pulmonary Hypoplasia*
32 Weaver
33 Neuropathic hydrocephalus* (water head syndrome)

Major genes
1 DGAT1
2 MSTN (GDF8) Double Muscling*
3 A1/A2 beta casein + *
4 Fertility Haplotypes (HH1, HH2, HH3, JH1)
5 Kappa Casein I
6 Kappa Casein II
7 ABCG2
8 GH2141 and GH2291 (Marbling,growth rate)*
9 IGF1-AF017143
10 STAT1*
11 STAT3*
12 STAT5*
13 Calpain (Tenderness) loci

* Royalty fees may apply

illumina CSPro CERTIFIED SERVICE PROVIDER ICBF.com Teagasc ISAG

Brachyspina
Agerholm et al., 2006

Mulefoot
Duchesne et al., 2006

RNF11 affected (front) and normal (back) calf of the same age.
Sartelet et al., 2012

ICBF.com

National Herd Genetic Disease Surveillance:

Carrier Frequency in National and Pedigree Herds

	Beef	Dairy
AM_662	**0.002%**	-
BLAD	**0.133%**	**0.398%**
BM	**0.020%**	-
BD1	**0.002%**	-
BY	**0.194%**	**1.706%**
CMD1	**0.234%**	**0.005%**
CMD2	**0.092%**	**0.002%**
CT	**0.063%**	**0.083%**
CTS_AG	**0.575%**	**0.037%**
CVM	**0.407%**	**2.283%**
DUMPS	**0.001%**	**0.002%**
DUN	**0.012%**	-
HH1	**0.171%**	**1.625%**
HH3	**0.070%**	**4.923%**
HH4	**0.007%**	**0.251%**
HY_KRT71	**0.432%**	**0.009%**
JH1	**0.001%**	**0.085%**
MF_NG1621KC	**0.009%**	**0.129%**
MH2	**0.035%**	**0.076%**
NH	**0.006%**	-
OS	**0.007%**	-
PCS	**0.006%**	-
PROTO	**0.845%**	**0.002%**
PMT_211	**0.005%**	-
PMT_284	**0.005%**	**0.002%**
RNF11	**0.306%**	-
SMA	**0.005%**	**0.021%**

ICBF Genetic Disease Reports

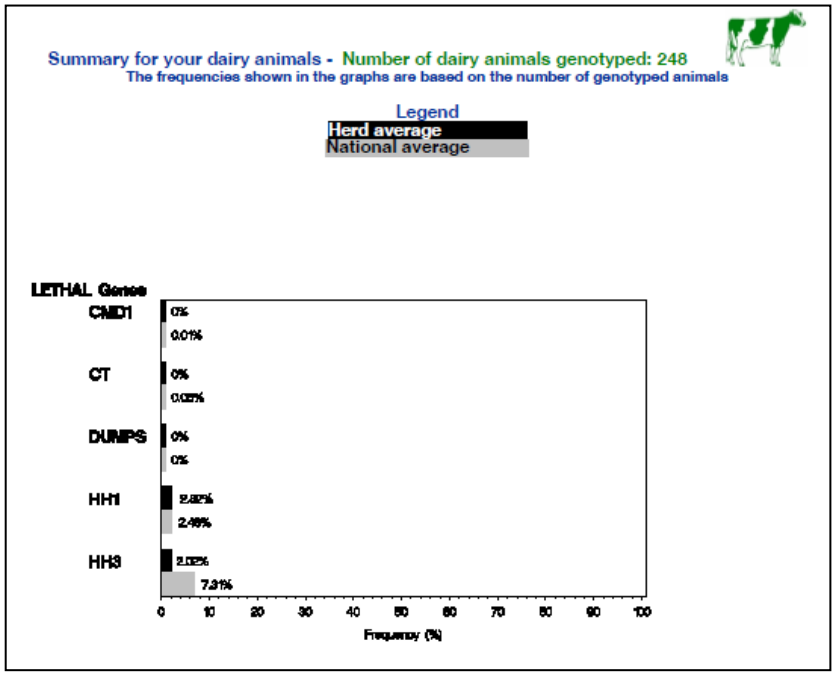


Table 3. Summary for DAIRY animals						
Jumbo	Animal tag	Beneficial	Colour	Milk	Unwanted	Lethal
1	IE141949011102	STAT1	BLACK_E		PMT_284	
10025	IE241355510025	STAT1 STAT3_19069 STAT3_25402	BLACK_E			
1033	IE141949071033	STAT1 STAT3_19069 STAT3_25402	BLACK_E			
1039	IE141949041039	STAT1 STAT3_19069 STAT3_25402	BLACK_E			
1070	IE141949031070	STAT1 STAT3_19069 STAT3_25402	BLACK_E		SMA	
115	IE141949061115	STAT1 STAT3_19069 STAT3_25402			PMT_284 SMA	
1178	IE141949031178	STAT1 STAT3_19069 STAT3_25402	BLACK_E		SMA	
1268	IE141949021268		BLACK_E			
1271	IE141949061271	STAT1 STAT3_19069 STAT3_25402	BLACK_E			
1272	IE141949071272	STAT1 STAT3_19069 STAT3_25402	BLACK_E	ABCG2		
1274	IE141949091274	STAT1 STAT3_19069 STAT3_25402	BLACK_E		SMA	
1275	IE141949011275	STAT1 STAT3_19069 STAT3_25402	BLACK_E			
1276	IE141949021276	STAT1 STAT3_19069 STAT3_25402	BLACK_E			
1290	IE141949091290	STAT1 STAT3_19069 STAT3_25402	BLACK_E			
1293	IE141949031293	STAT1 STAT3_19069 STAT3_25402	BLACK_E		SMA	
1310	IE141949031310	STAT1 STAT3_19069 STAT3_25402	BLACK_E		SMA	
1313	IE141949061313	STAT1 STAT3_19069	BLACK_E		SMA	
1314	IE141949071314		BLACK_E			
1318	IE141949021318	STAT1 STAT3_19069 STAT3_25402			SMA	
1322	IE141949071322	STAT1 STAT3_19069 STAT3_25402	BLACK_E			
1328	IE141949041328	STAT1 STAT3_19069 STAT3_25402	BLACK_E			
1330	IE141949071330		BLACK_E		SMA	HH1
1339	IE141949071339		BLACK_E			

Select the Best

Mulefoot carrier

Code	Name of Bull	Breed	Replacement index	Replacement index (across breed stars)
AA2064	CARRIGROE KIAN	AA	€186	★★★★★
CH2159	BONDI JACOB	CH	€94	★★★★
HE2147	ALLOWDALE RAMBO 415	HE	€111	★★★★★
HE2148	BALLYAVILLE HAMLET	HE	€121	★★★★★
LM2150	CASTLEVIEW IMMAGINABLE	LM	€137	★★★★★
LM2151	BALLYGARVAN STUD IKE	LM	€115	★★★★★
LM2156	CLONARK JUMBO	LM	€123	★★★★★
PI2157	KILREE LEO	PI	€101	★★★★★
SI2158	SEEPA FIONN	SI	€131	★★★★★

Mulefoot carrier

€190

Genomic Breeding Value Index

What Does ICBF do With a Genotype?

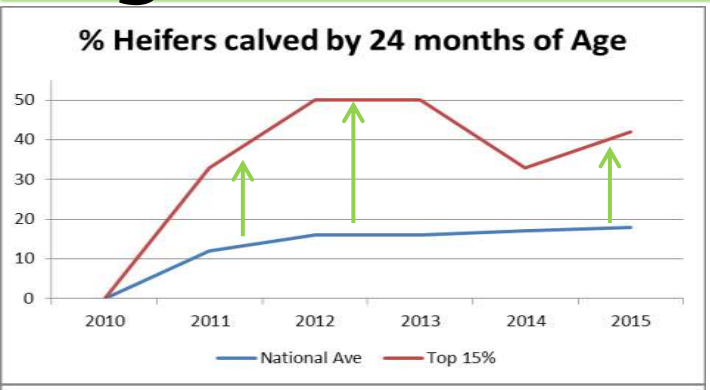
Male? Or Female?

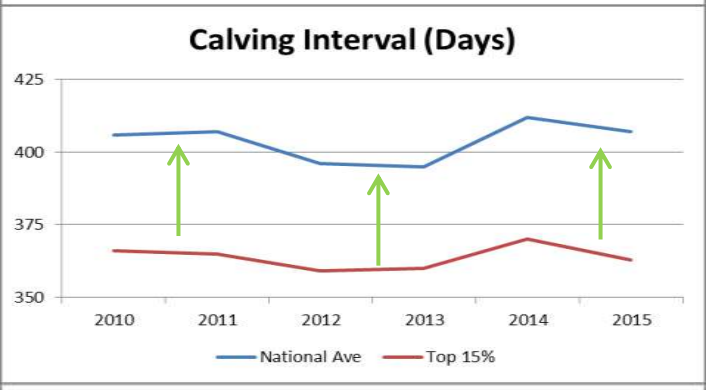
Who's IE123xxxxx

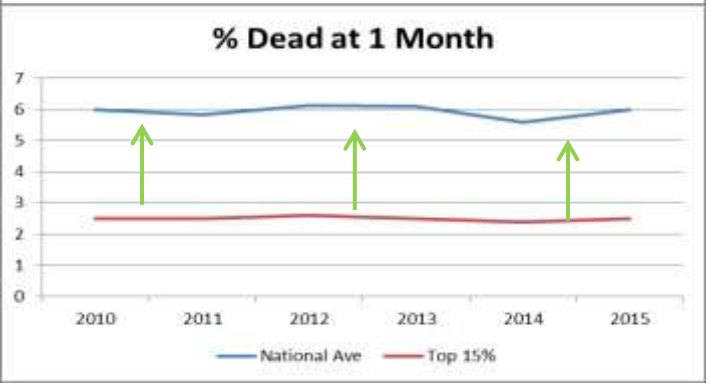
Genetic Disease Status

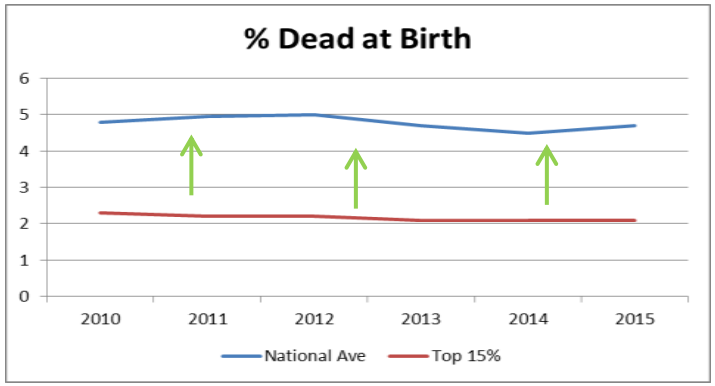
Identify High Genomic Animals
1 star vs 5 star

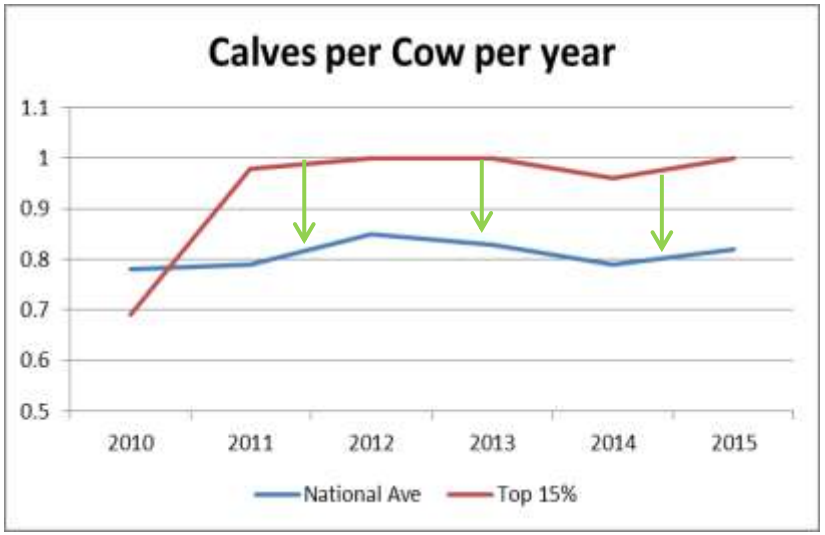
High Genomic Animals Will Help Farmers











High Genomic Animals Will Help Farmers

5 Star v 1 Star Cows

BDGP Cows			Fertility				Milk		Carcass	
ICBF €uro - Stars	Replacement Index	Number of cows	Number of Calvings	Age at 1st Calving	Calving Interval	% Alive after 7 years	Growth of Calves	Farmer Milk Score	Carcass Weight of progeny	Age at slaughter of progeny
★★★★★	**€124**	**25,311**	**4.33**	**971 days**	**399 days**	**72%**	**1.17**	**4.11**	**363 kgs**	**752 days**
★★★★	€85	19,776	4.03	988 days	405 days	66%	1.12	3.86	359 kgs	772 days
★★★	€64	16,020	3.82	1000 days	409 days	62%	1.09	3.75	358 kgs	784 days
★★	€44	16,823	3.71	1007 days	413 days	59%	1.09	3.69	358 kgs	783 days
★	**€8**	**19,793**	**3.46**	**1022 days**	**420 days**	**52%**	**1.06**	**3.48**	**359 kgs**	**791 days**
Difference			**+0.87**	**-51 days**	**-21 days**	**+20%**	**+10%**	**+15%**	**+4kgs**	**-39 days**

Above analysis was performed on the 97,723 suckler cows that were born in 2008, in herds that joined the BDGP in 2015.

5 Star Cows:

1. Produce more calves, go back in calf quicker and survive longer.
2. Have more milk & rear calves with better growth rates.
3. Produce cattle which finish earlier with heavier carcasses.

High Genomic Parents = Higher Value Carcass

Sire Stars		Dam Stars 1	2	3	4	5	Average
1	Slaug. age (month)	25.7	26.4	25.9	27.6	25.4	26.2
	Carcass weight (kg)	303	288	296	294	311	298
	Yield price (€)	1694	1628	1677	1637	1748	1677
2	Slaug. age (month)	28.4	25.4	24.2	23.4	24.7	25.3
	Carcass weight (kg)	325	323	341	330	344	333
	Yield price (€)	1860	1787	1912	1897	1947	1881
3	Slaug. age (month)	23.6	24.5	24.2	24.6	24.0	24.2
	Carcass weight (kg)	320	336	331	331	335	331
	Yield price (€)	1838	1862	1932	1868	1942	1888
4	Slaug. age (month)	25.3	23.8	25.5	23.3	24.2	24.4
	Carcass weight (kg)	340	349	359	335	345	346
	Yield price (€)	1959	1997	2066	1963	1969	1991
5	Slaug. age (month)	22.7	22.9	25.5	24.4	23.3	23.8
	Carcass weight (kg)	341	348	350	358	361	352
	Yield price (€)	1920	2003	2002	1977	2073	1995
Average	Slaug. age (month)	25.2	24.6	25.1	24.7	24.3	
	Carcass weight (kg)	326	329	335	330	339	
	QPS price (€)	1240	1256	1283	1259	1301	
	Yield price (€)	1854	1855	1918	1868	1936	

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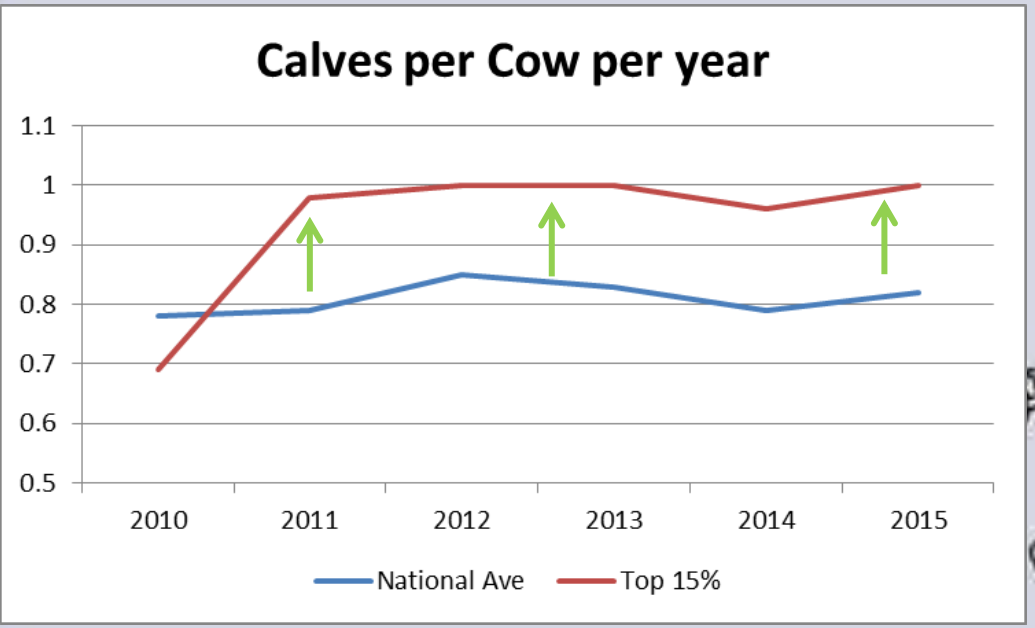
Grand Overall Outline

=

HUMAN POPULATION GROWTH CHART

(including projections)



I THINK I CAN...
I THINK I CAN...
I HOPE I CAN...
I REALLY HOPE I CAN...
MAN, HOPE I CAN...

FOOD Systems

WORLD Delivery

POP. IN BILLIONS
12.5
10
7.5
5
2.5
0

YEAR
1 AD 200 400 600 800 1000 1200 1400 1600 1700 1800 1900 2000 2050

GREENBERG steve@greenberg-art.com

Outline

1) Overview

2) Genetic Use in Livestock- Typical

3) Irish Beef Cattle Genomics

4) **Additional Projects**
   1) **New Genetic Diseases**
   2) Selection for Disease Resistance

illumina

Typical Genetic Disease Reporting

Pawnee Farm Arlinda Chief, 1962

- >16,000 daughters
- >500,000 granddaughters
- >2 million great-granddaughters
- HH1 carrier

CHIEF

040HO02025
Pawnee Farm Arlinda Chief
Admiral x x
Born: 05/09/1962
Reg No: HOUSA000001427381
100% RHA EX-94 aAa: DMS: HH1
Breeder:
Beta-casein: Kappa-casein:

Controller: 0040 Not Available

Commercial Farmer Reporting to ICBF

Commercial Farmer Reporting to ICBF

Congenital defect recording

Congenital defect reporting questionnaire

Thank you for participating in this programme. We hope that through data collection such as this we will be able to identify animals that carry various congenital defects and eradicate the defects that reduce farmer profitability. After the 8 mandatory questions (denoted by a *) in the beginning and 3 at the end, feel free skip any questions that do not apply to the animal you're reporting. If you have any questions about this survey please e-mail Health@ICBF.com Thank you again for your participation!

*** 1. Are you the animal's owner?**

- ○ Yes
- ○ No

If no, what is your role with the calf (Veterinarian, farm worker, knackery, etc)?

*** 2. What is your herd number?**

*** 3. What is the dam's tag number?**

Genetic Disease Discovery- Farmer and Vet Reported Diseases

- Atresia Ani
- Atresia Jejuni
- Atresia Coli
- Progressive Ataxia
- Ventricular Septal Defect
- Schistosomus Reflexus
- Cleft Palate
- Tail-lessness
- Photosensitisation

Outline

1) Overview

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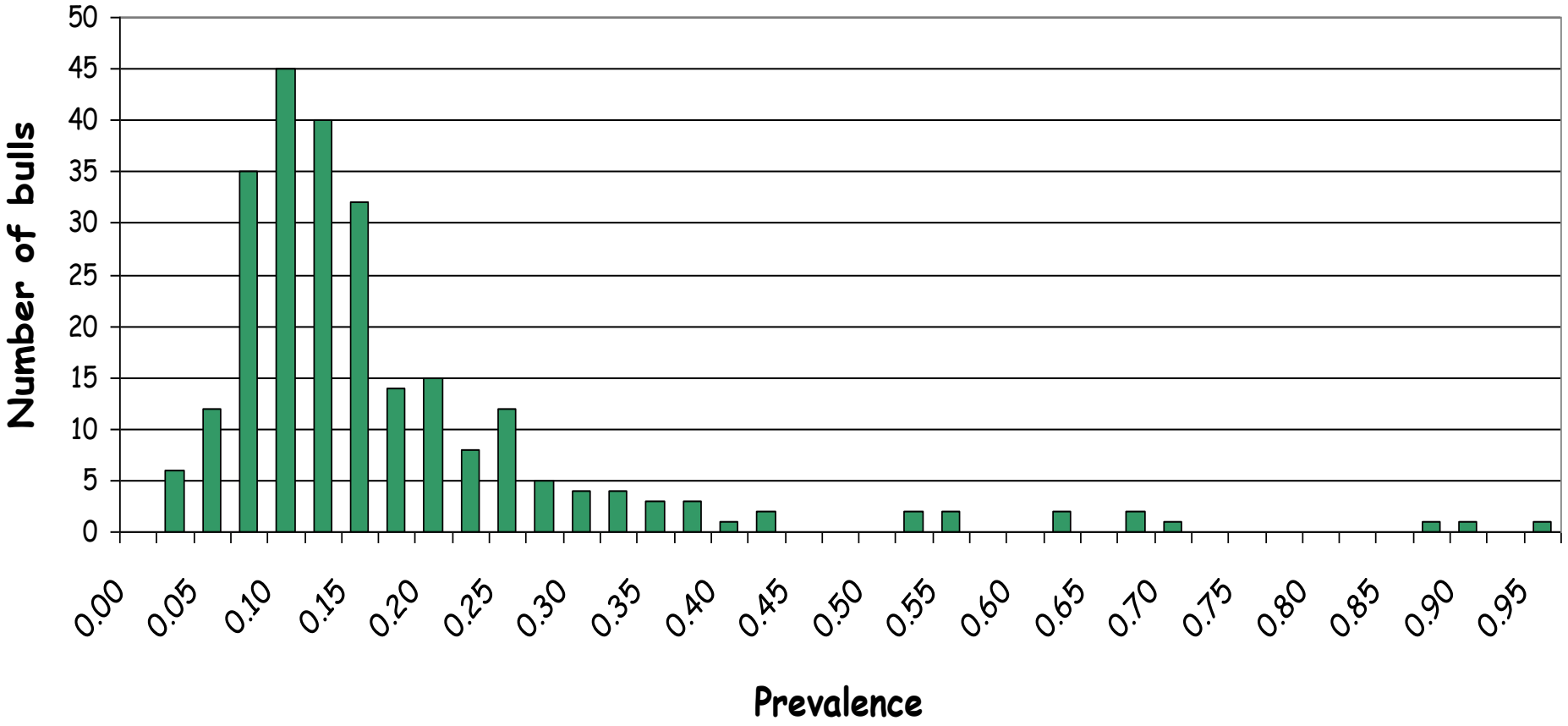
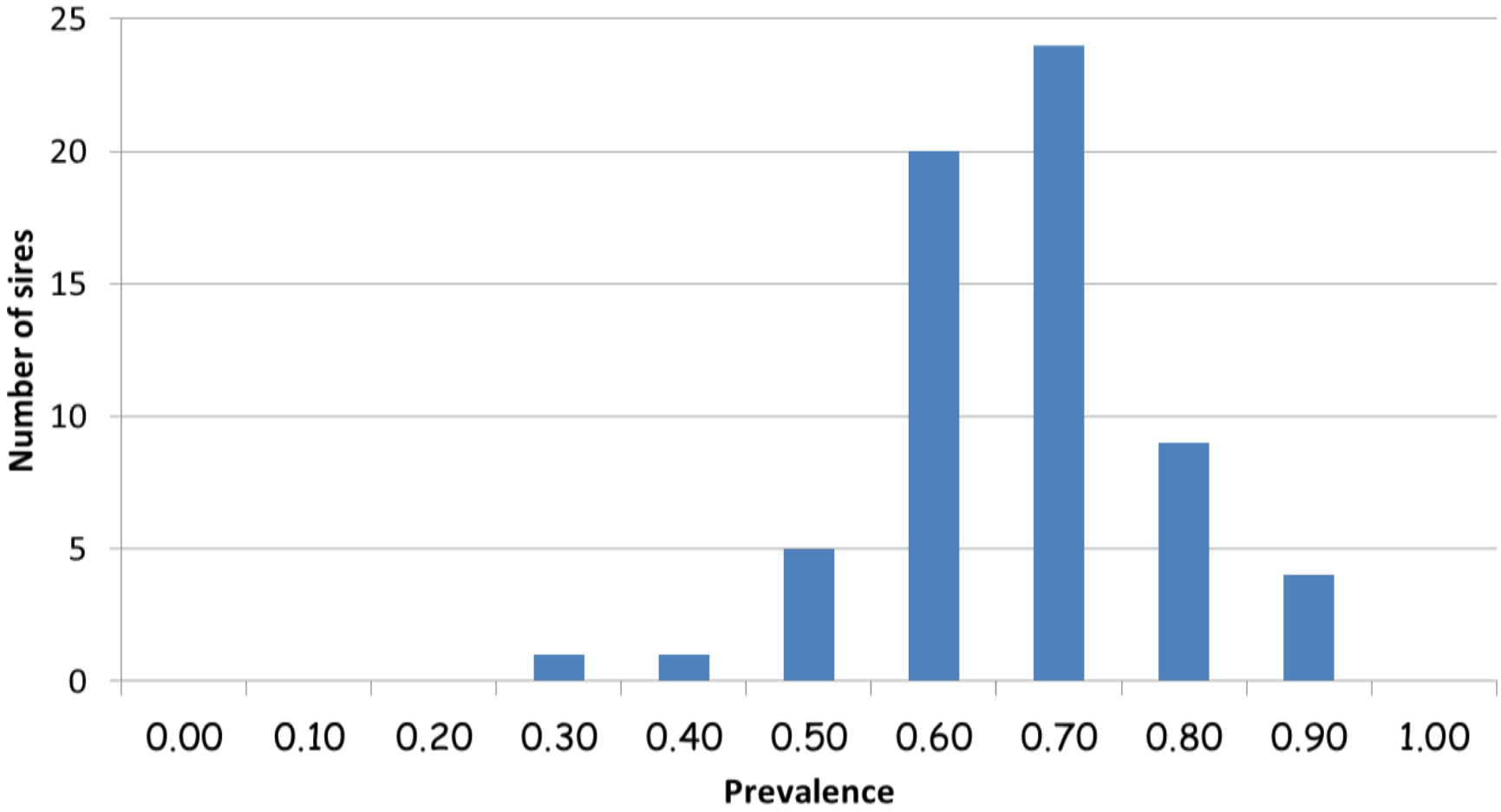
Tuberculosis-Sire offspring prevalence



Liver Fluke-Sire offspring prevalence



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Robustness Index in Development

Robustness index

- Metritis h^2= 0.04
- TB h^2=0.15
- Ketosis h^2=0.04
- Neospora h^2=0.08
- BVD h^2=0.16
- Hoof Ailments h^2=0.06
- Displaced Abomasum h^2=0.08
- Cystic Ovaries h^2=0.05
- BoHV-1 h^2=0.28
- Milk Fever h^2=0.07
- Johne's h^2=0.07
- Nematode Burden h^2=0.21
- Ticks h^2=0.10
- Lameness h^2 = 0.06
- Liver Fluke h^2=0.05
- Mastitis h^2=0.04

All heritability estimates are derived from Ireland and international sources from the literature

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  - Romy O'Donnell
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- Data Suppliers
  - Farmers
  - Processors
  - Vets
  - Milk Recording
  - Coops
  - AI companies
  - Marts

Thank you