# Genomic selection for a multi-breed sheep population

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The Irish Agriculture and Food Development Authority

# Irish sheep breeding programme

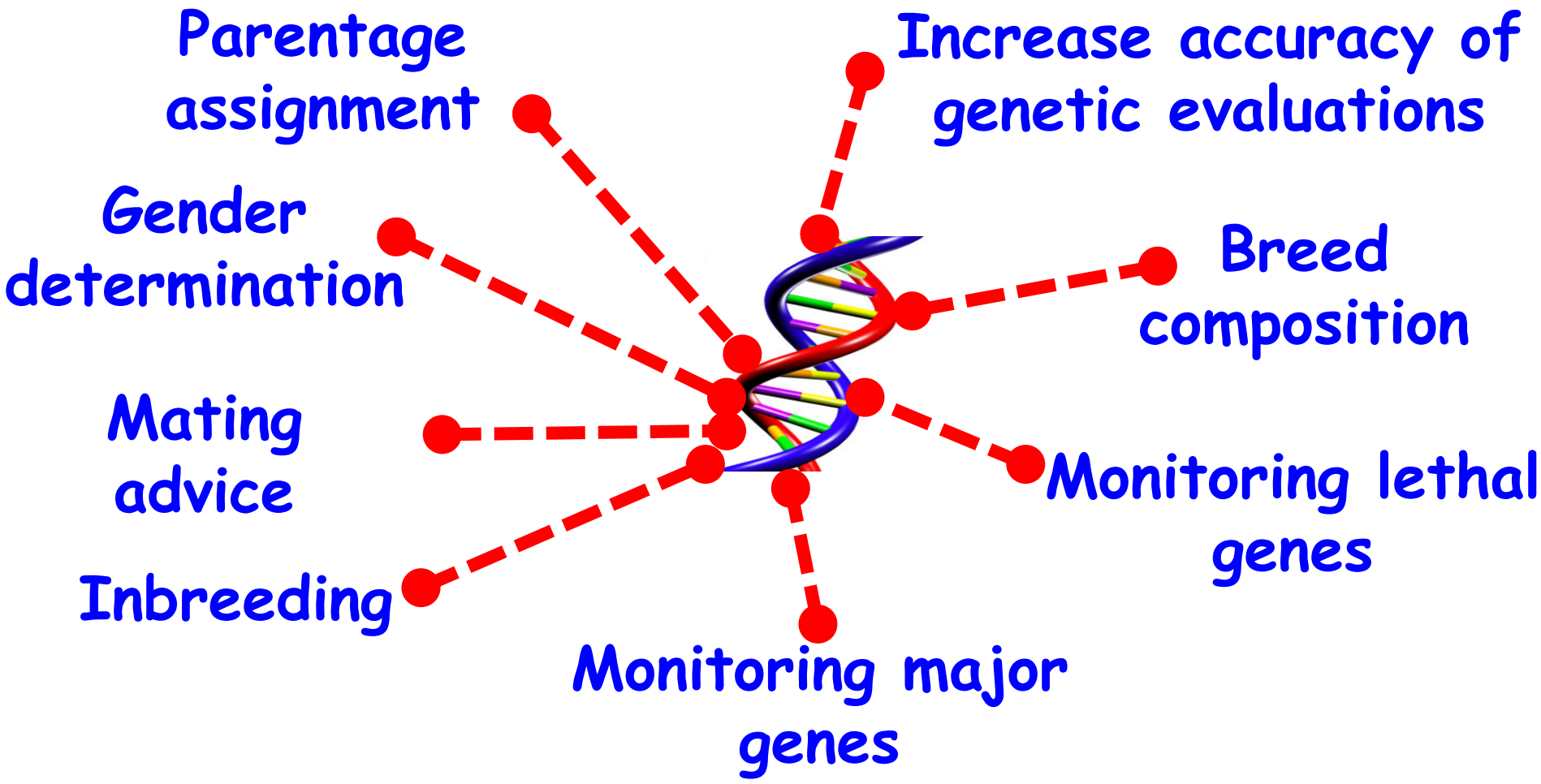
# Irish sheep breeding programme

## Data Sources

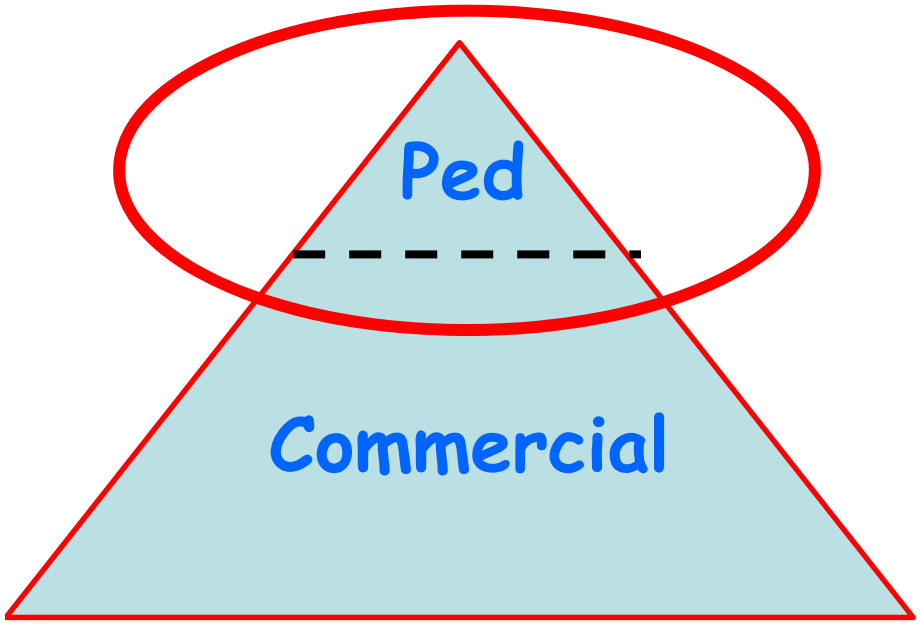
- Genetic gain levels remo
  - Farmer confidence →
- Accuracy (and genetic g oved by:
  - Genomic selection

## Extension farms

**Commercial data**


Parentage assignment
Increase accuracy of genetic evaluations
Gender determination
Breed composition
Mating advice
Monitoring lethal genes
Inbreeding
Monitoring major genes

# Genotyping




- Why pedigree??
- Lasting legacy
- Pedigree society buy in
- Drives of genetic gain
- Within breed genomic
- Which breeds???

# Genotyping

- Largest 5 breeds in the national breeding programme

Belclare 

Charollais 

Texel 

Suffolk 

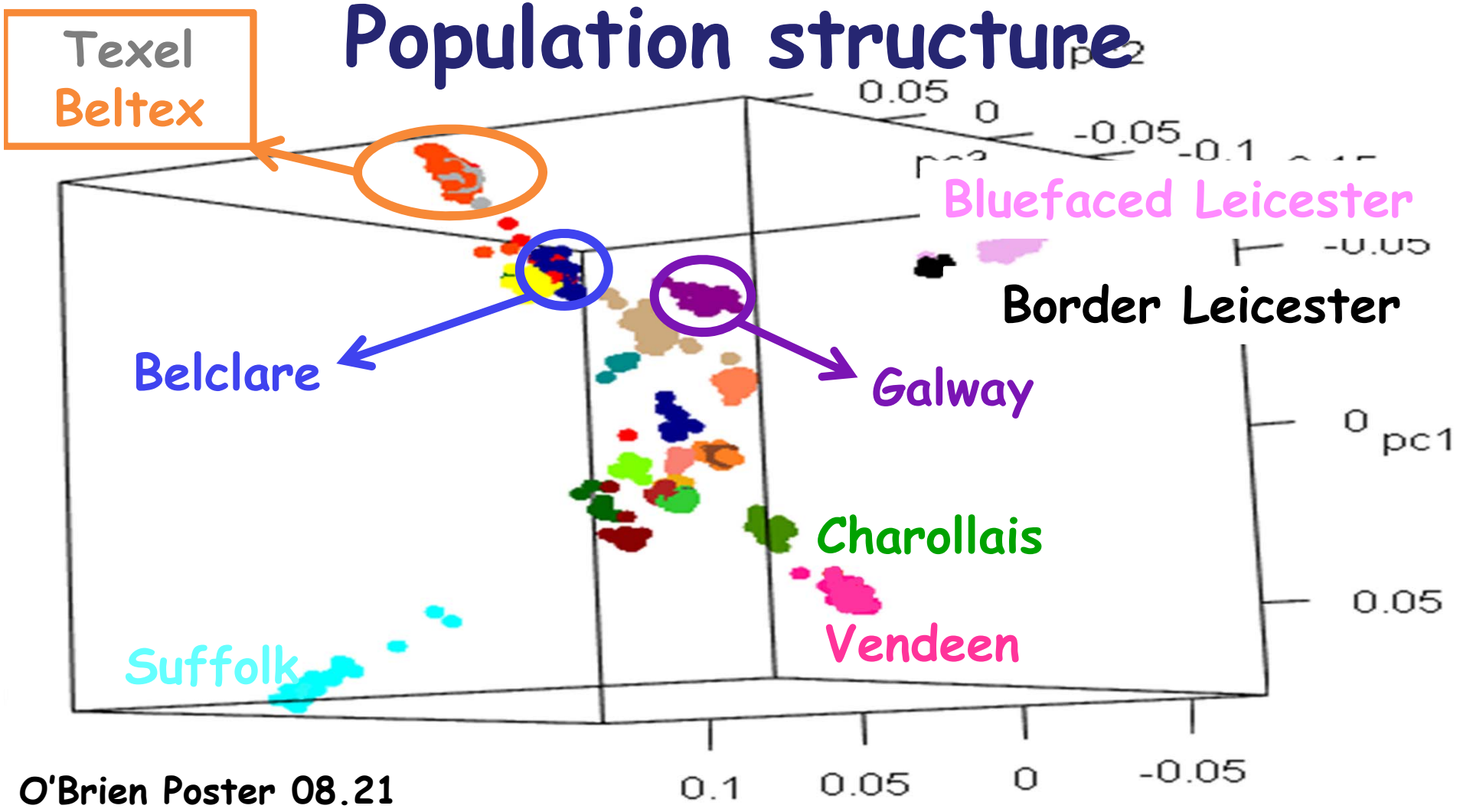
Vendeen 

**~12,000 animals**

- **All collected by technicians in 2015**

- Population structure

# Population structure




O'Brien Poster 08.21

# Genotyping Options

| Chip | Cost (€) |
|---|---|
| High-Density | 118 |
| 50K | 80 |
| Low-Density | 30 |
| Parentage | 12 |

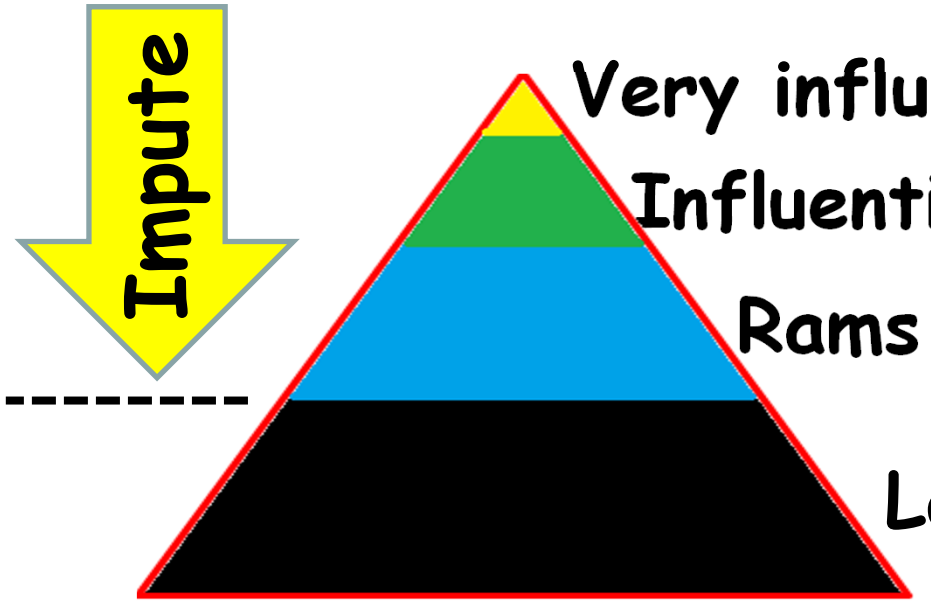
High Density

50,000 SNPs

~6,000 SNPs

100 SNPs

# Genotyping density strategy



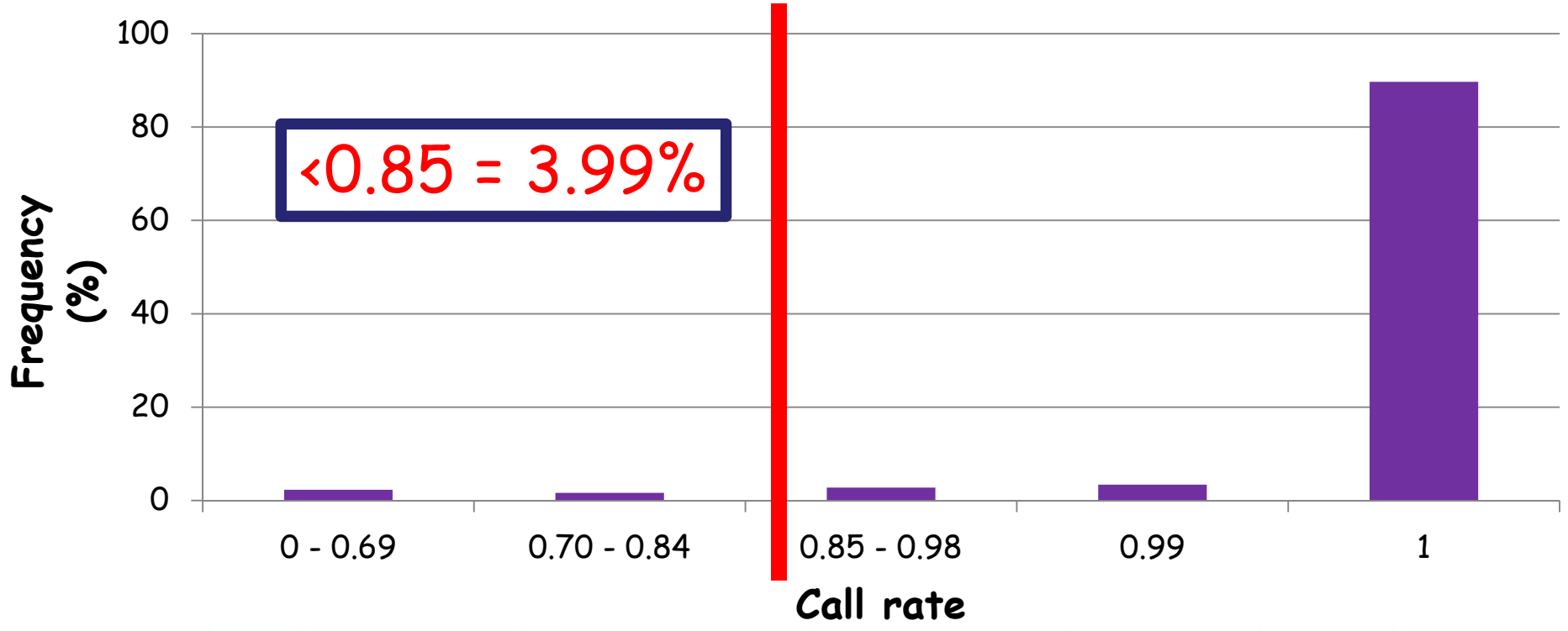

Very influential rams (HD)

Influential rams + ewes (50K)

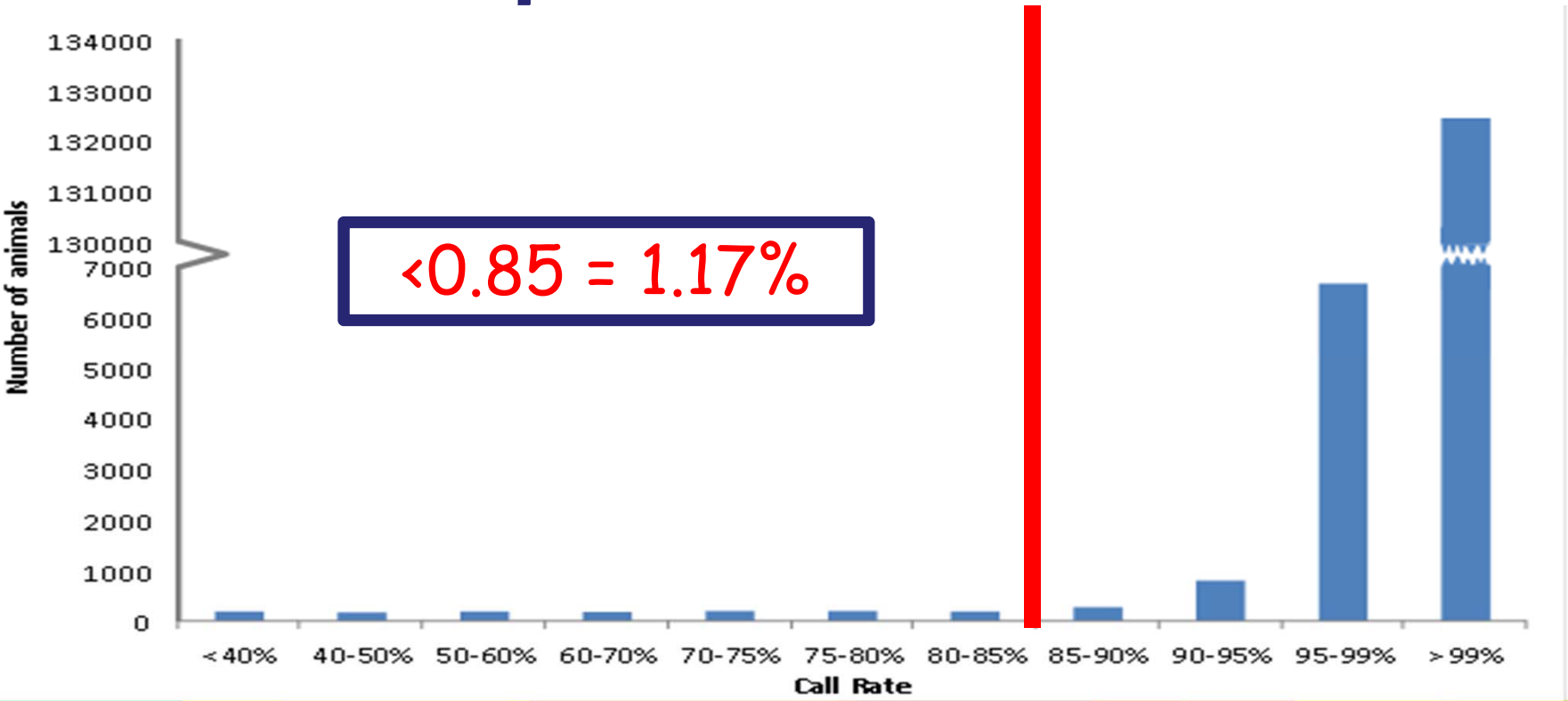
Rams + ewes (LD)

Lambs (parentage)

# Call rates


100
80
60
40
20
0
Frequency (%)
<0.85 = 3.99%
0 - 0.69
0.70 - 0.84
0.85 - 0.98
0.99
1
Call rate

# Compared to cattle

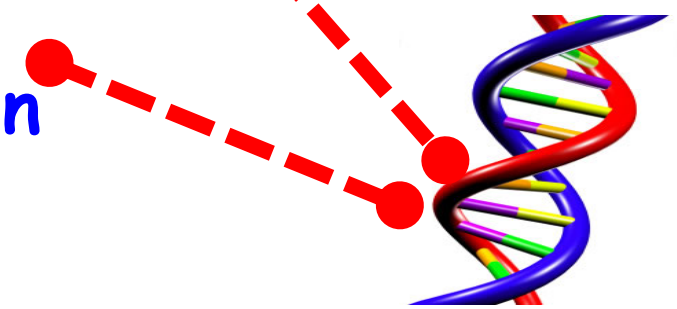


# Improving call rates over time

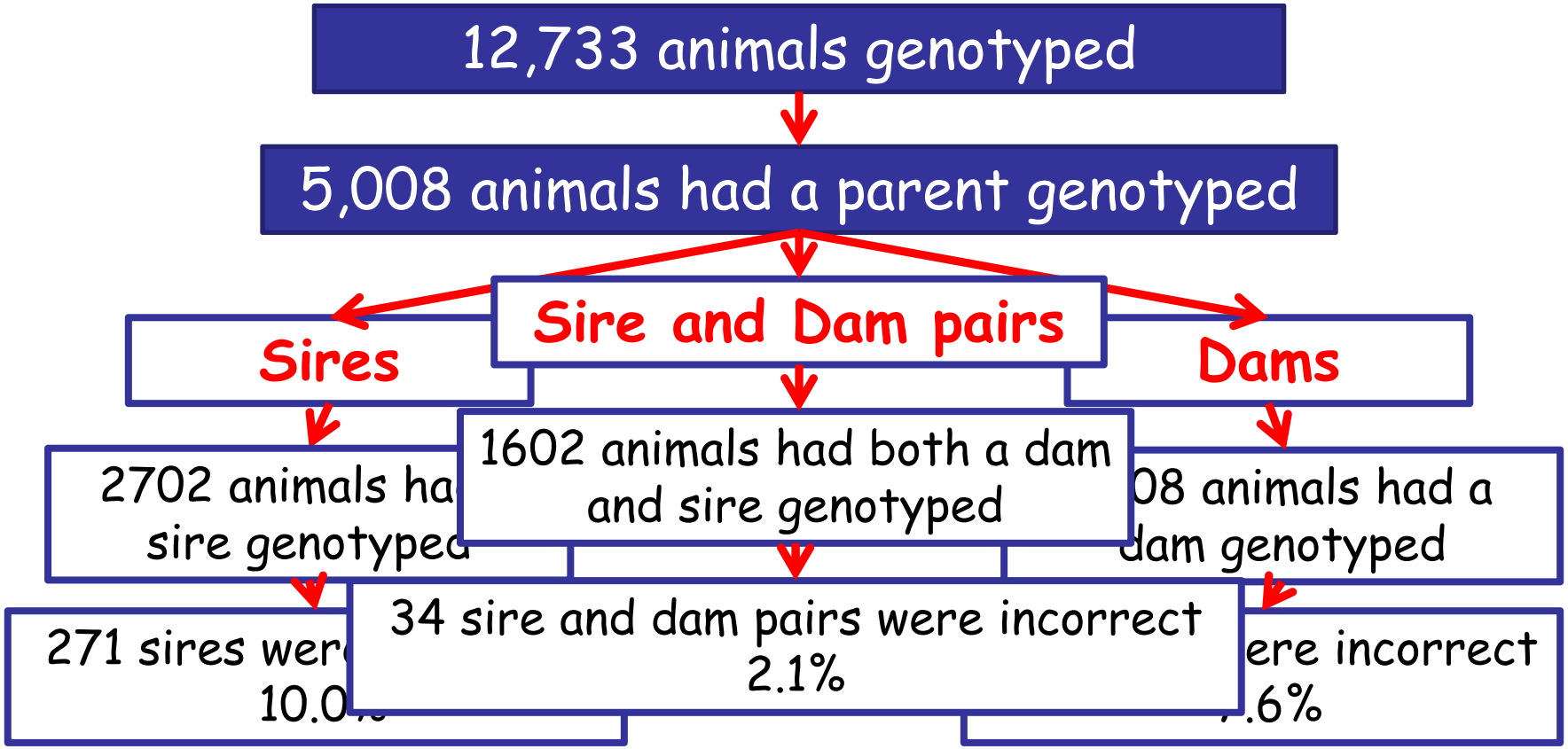

- Initial call rates – very poor
- Tag identified as main issue
  - Preservative
- Type of tag changed
  - Double the volume of preservative
- Notable improvement in call rate

Parentage assignment

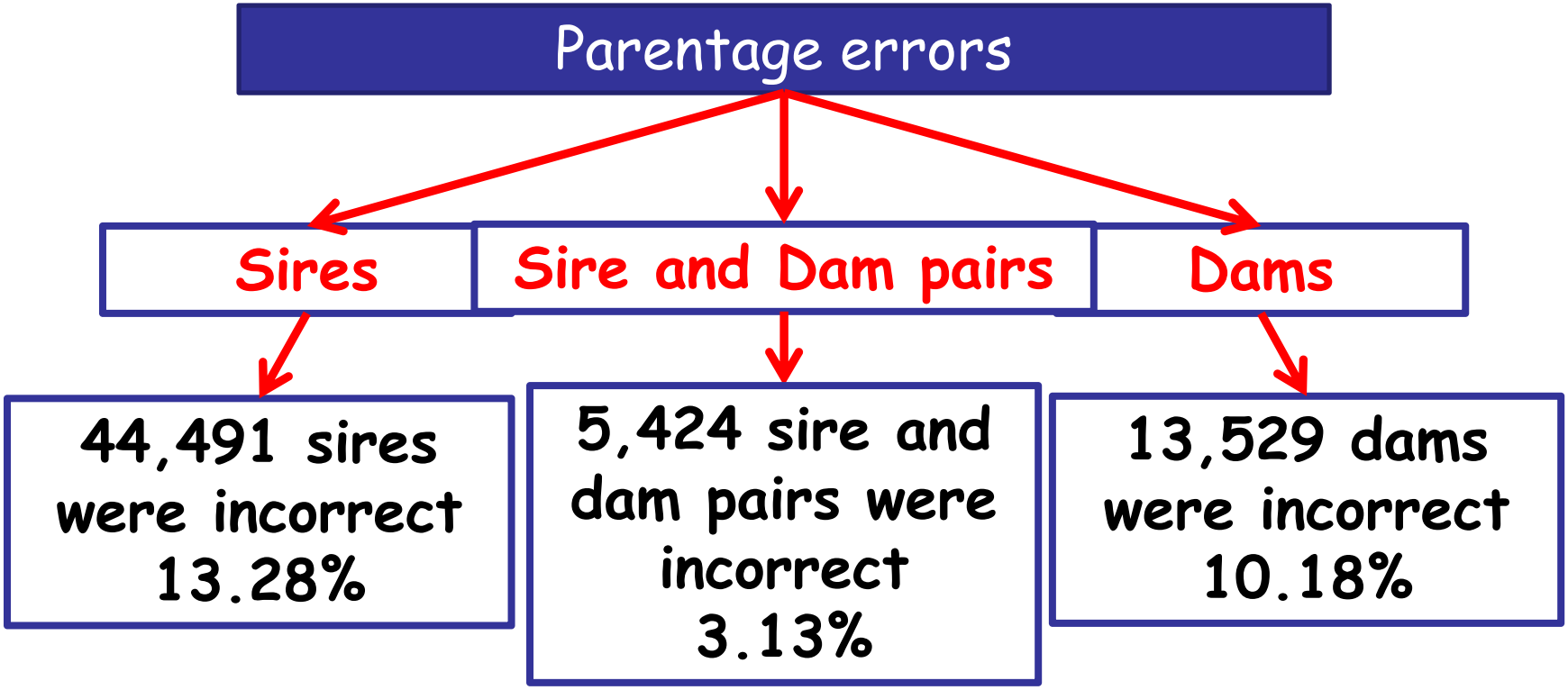
Gender determination



# Parentage

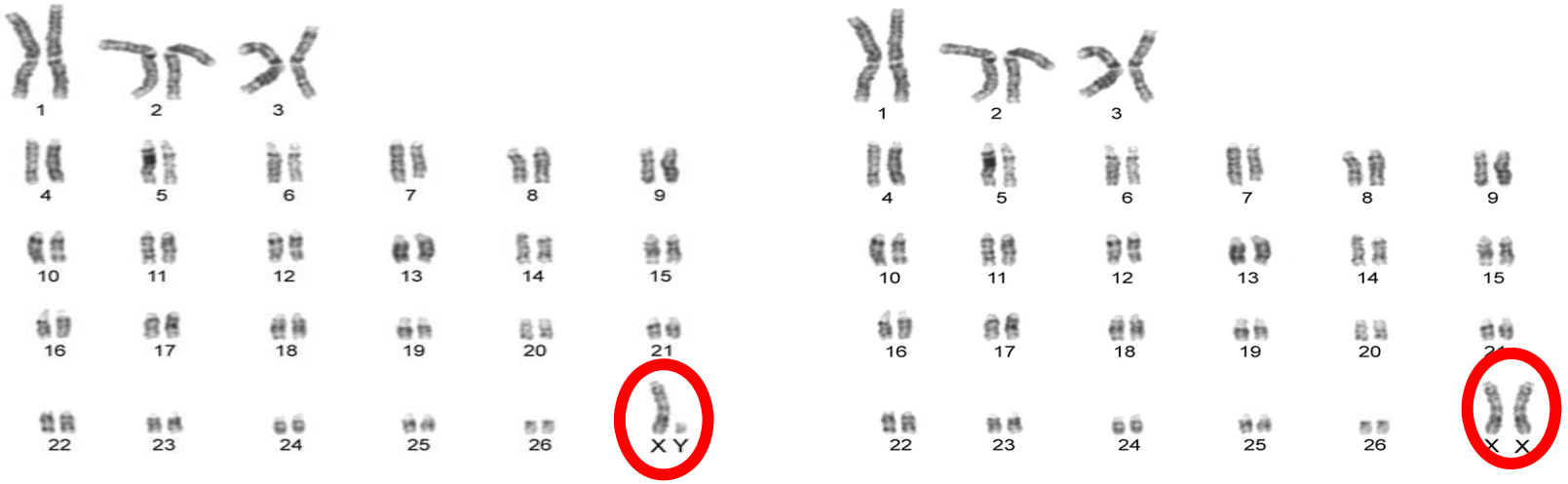

12,733 animals genotyped
5,008 animals had a parent genotyped
Sire and Dam pairs
Sires
Dams
1602 animals had both a dam and sire genotyped
34 sire and dam pairs were incorrect
2.1%

# Compared to Irish beef cattle




D Purfield

# Gender differentiation



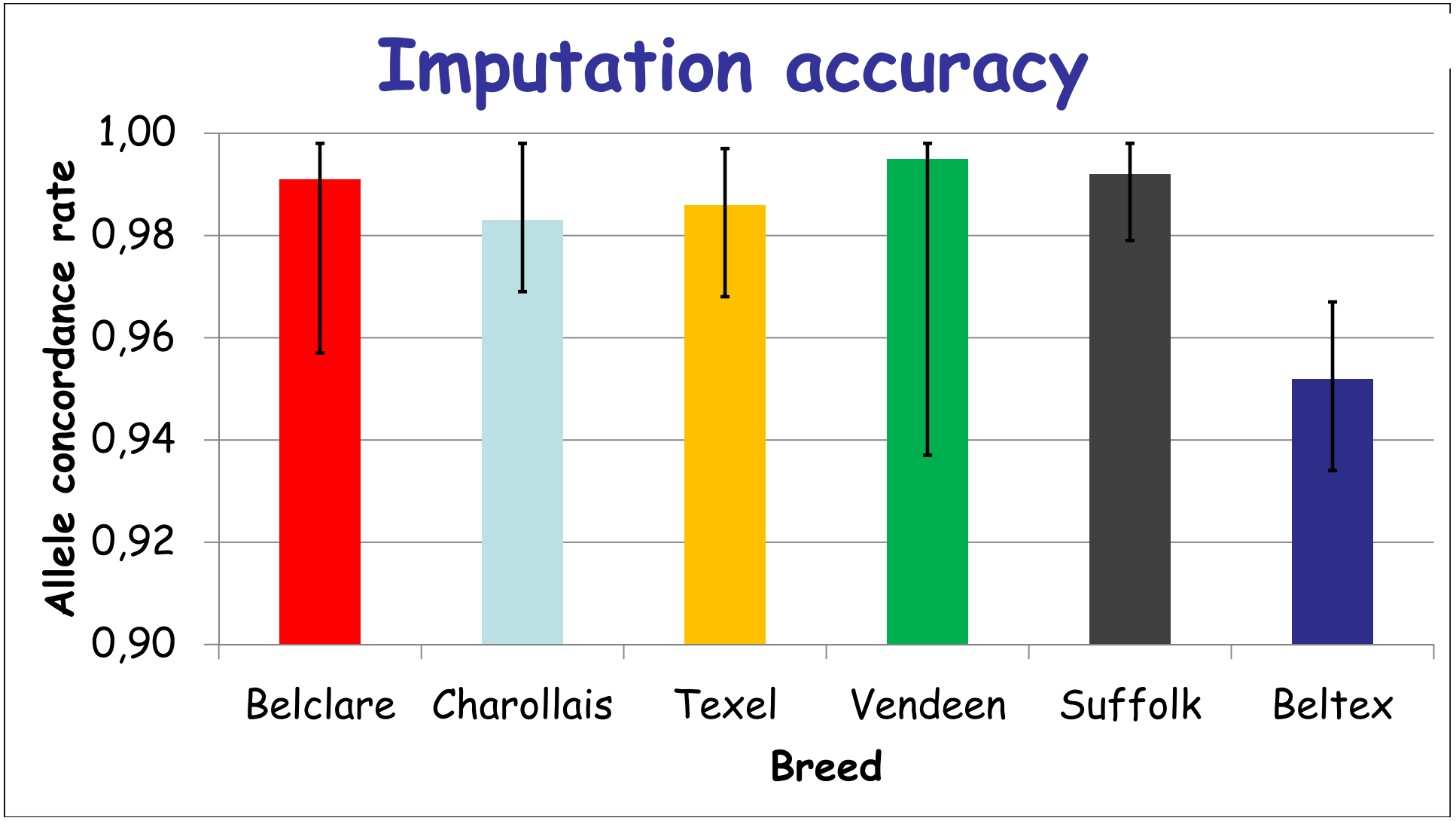

**1938 males & 9076 females**

**All correct**

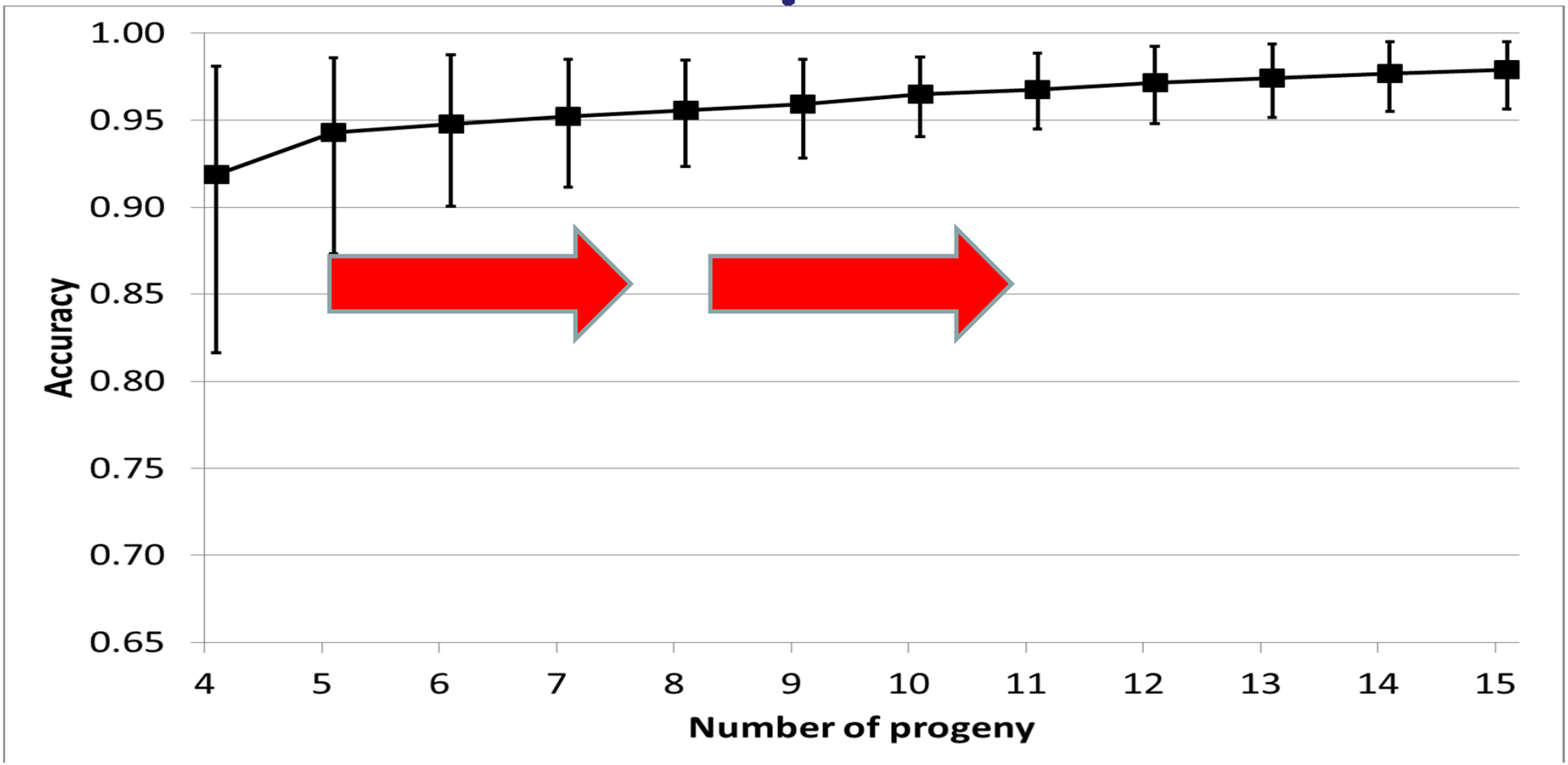
Parentage assignment

Gender determination

**Imputation (up and down)**


Imputation accuracy
Allele concordance rate
1,00
0,98
0,96
0,94
0,92
0,90
Belclare
Charollais
Texel
Vendeen
Suffolk
Beltex
Breed

# Back imputation



Parentage assignment

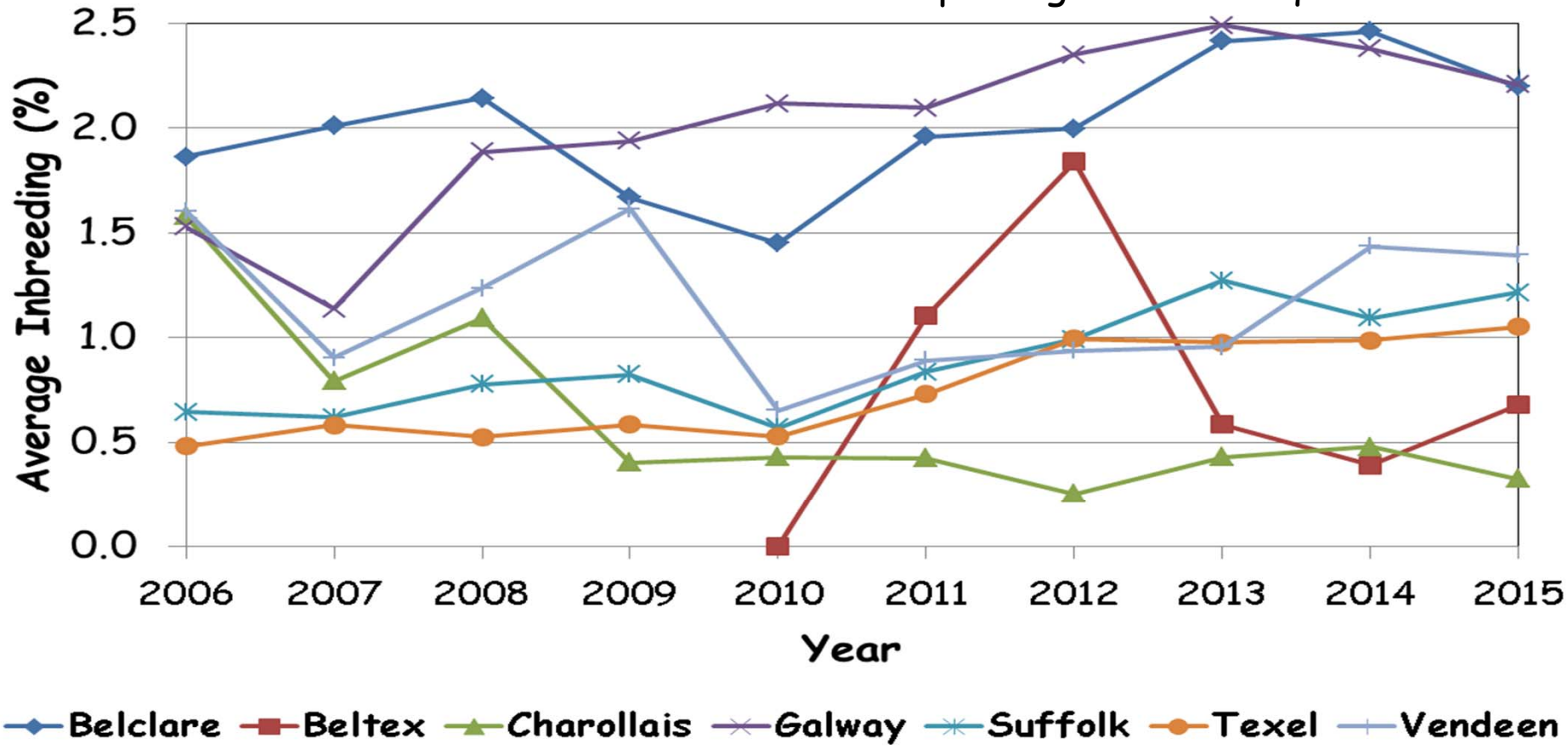
Gender determination

Imputation (up and down)

**Inbreeding**

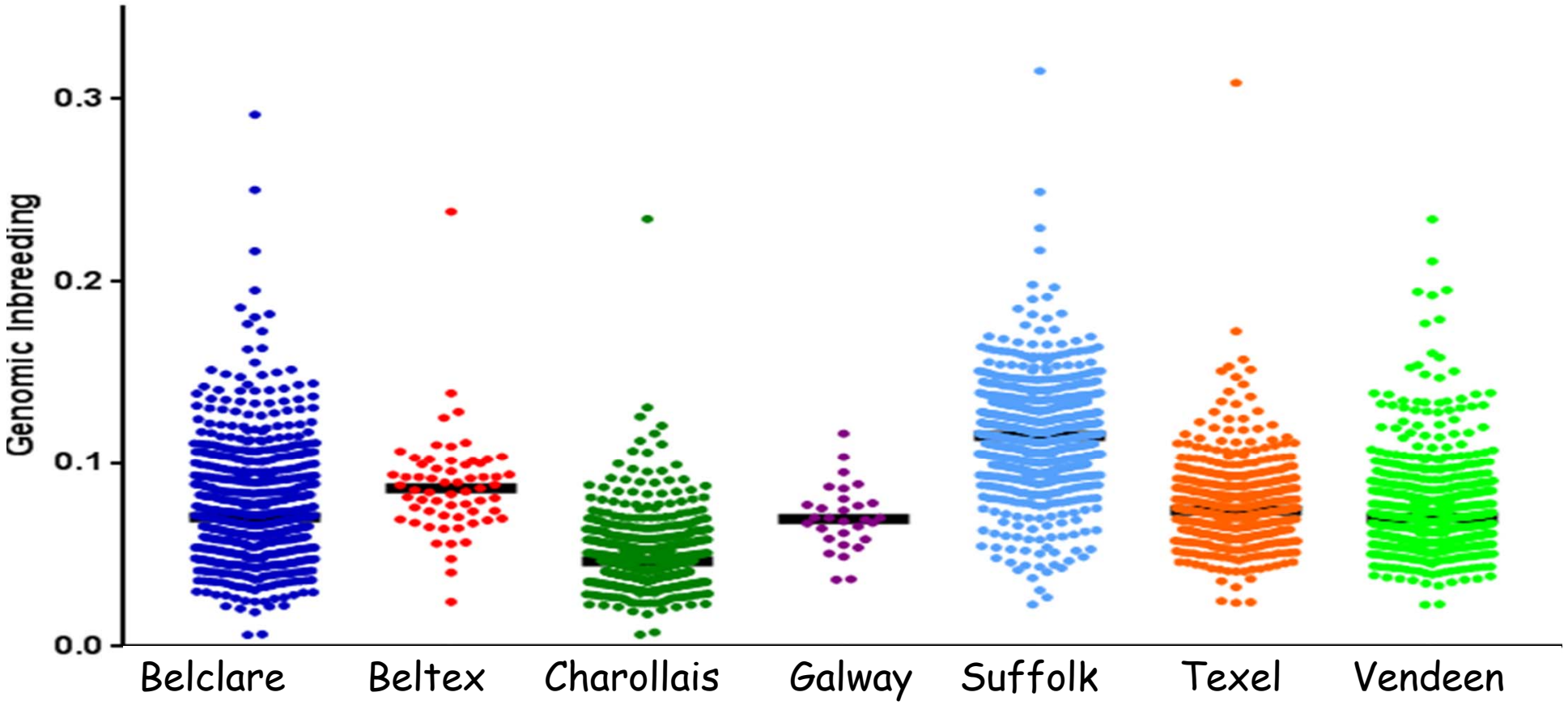
# Pedigree Inbreeding Trends

Complete generation equivalents >=3

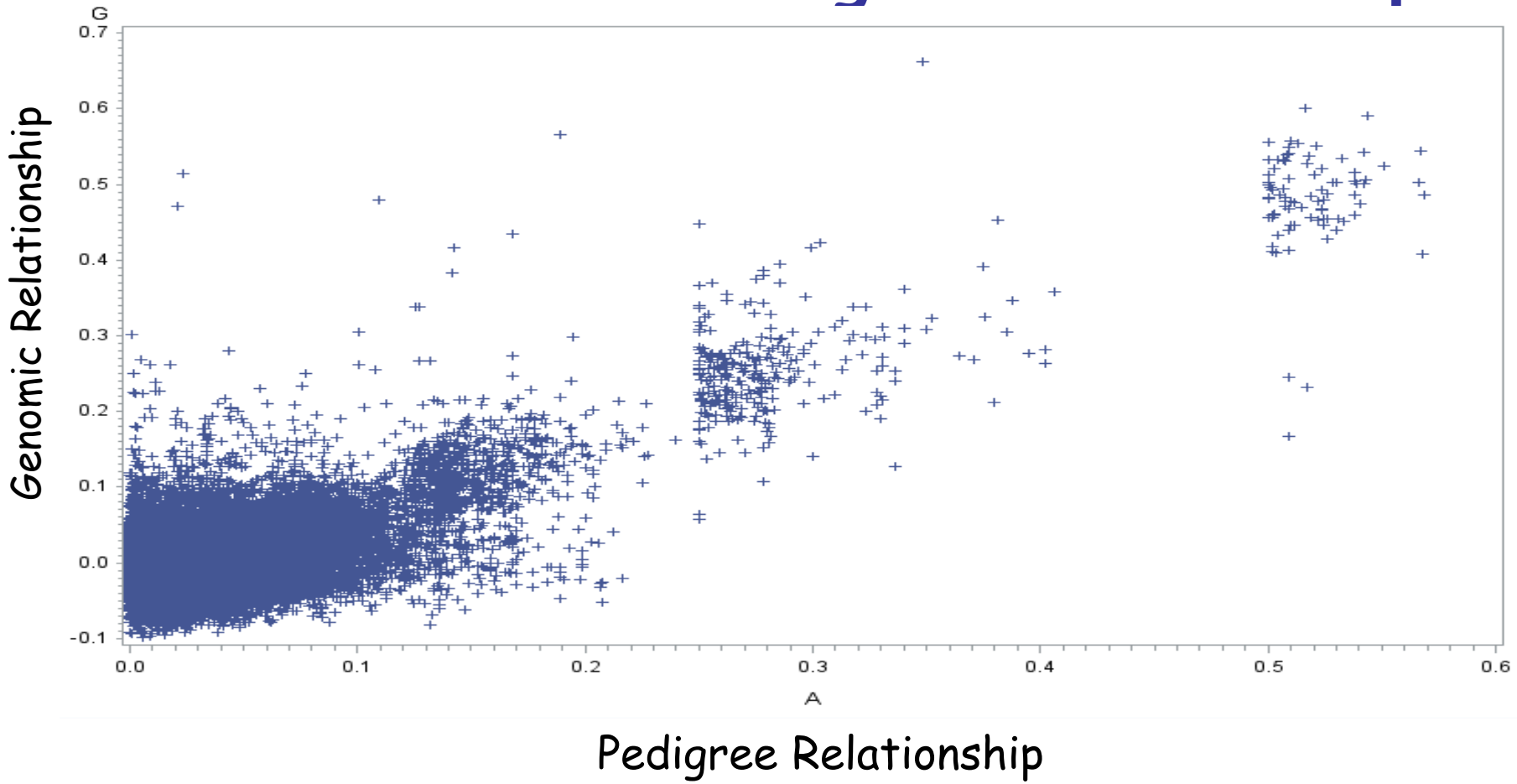


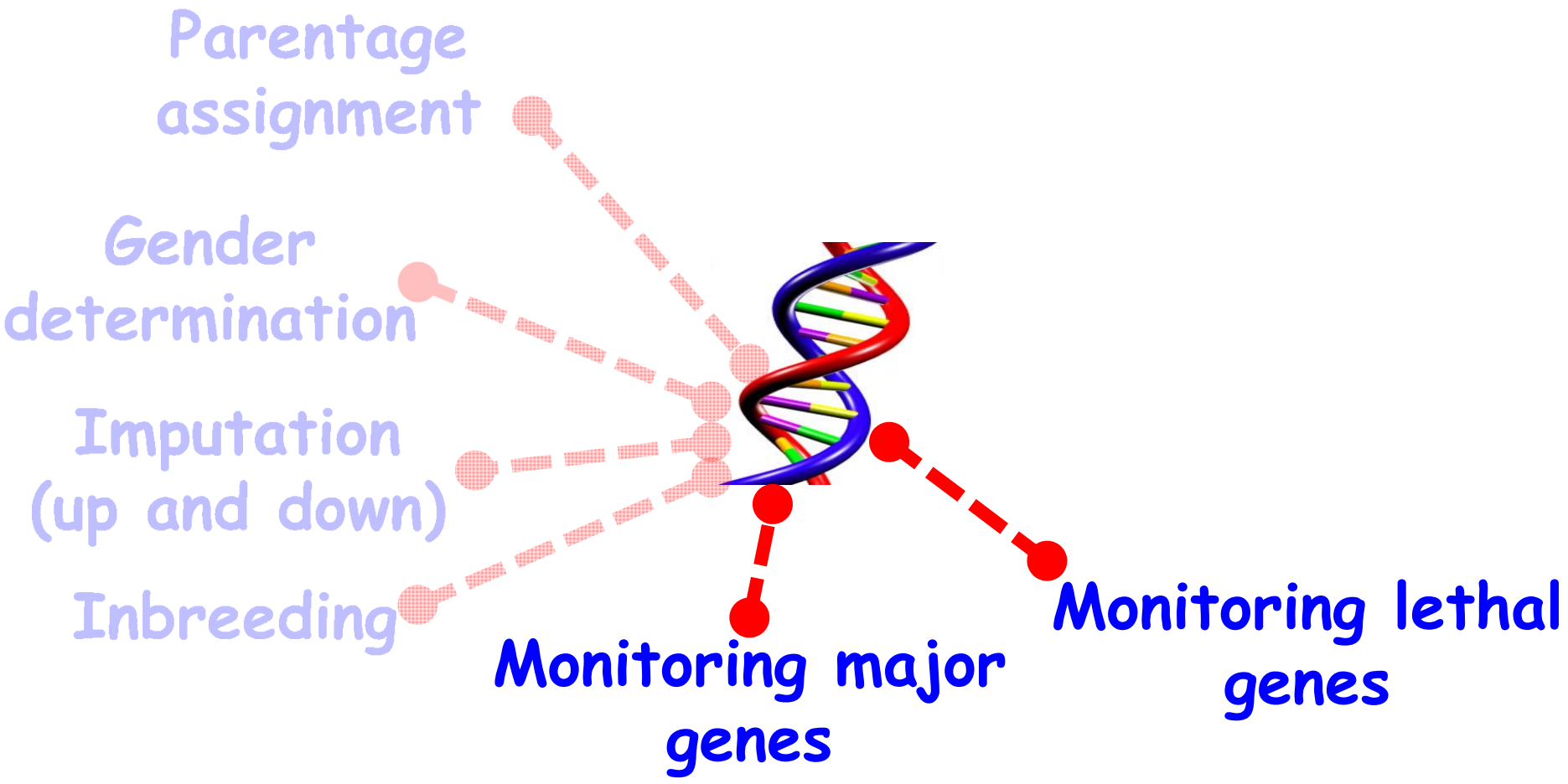
# Genomic Inbreeding

Purfield Poster 08.14



# Genomic versus Pedigree Relationship

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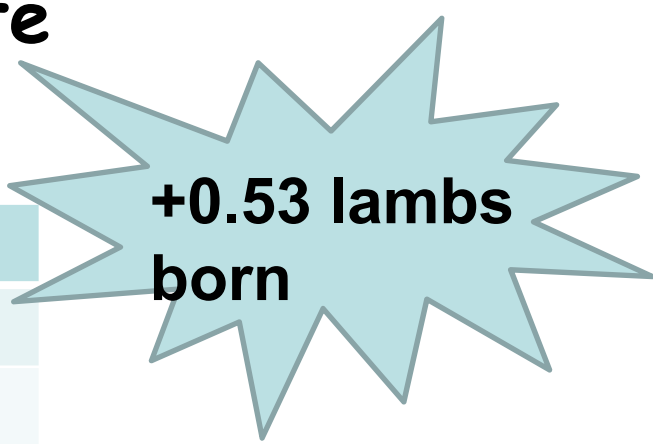
Inbreeding
Monitoring major genes
Monitoring lethal genes

# Major genes

- Prolificacy genes
- BMP15 Xb → associated with Belclare breed
- 1 copy increased ovulation rate
- 2 copies sterile

| Genotyped | 1 copy |
|---|---|
| All population | 0.07% |
| Belclare | 9.78% |



# Major genes – GDF8

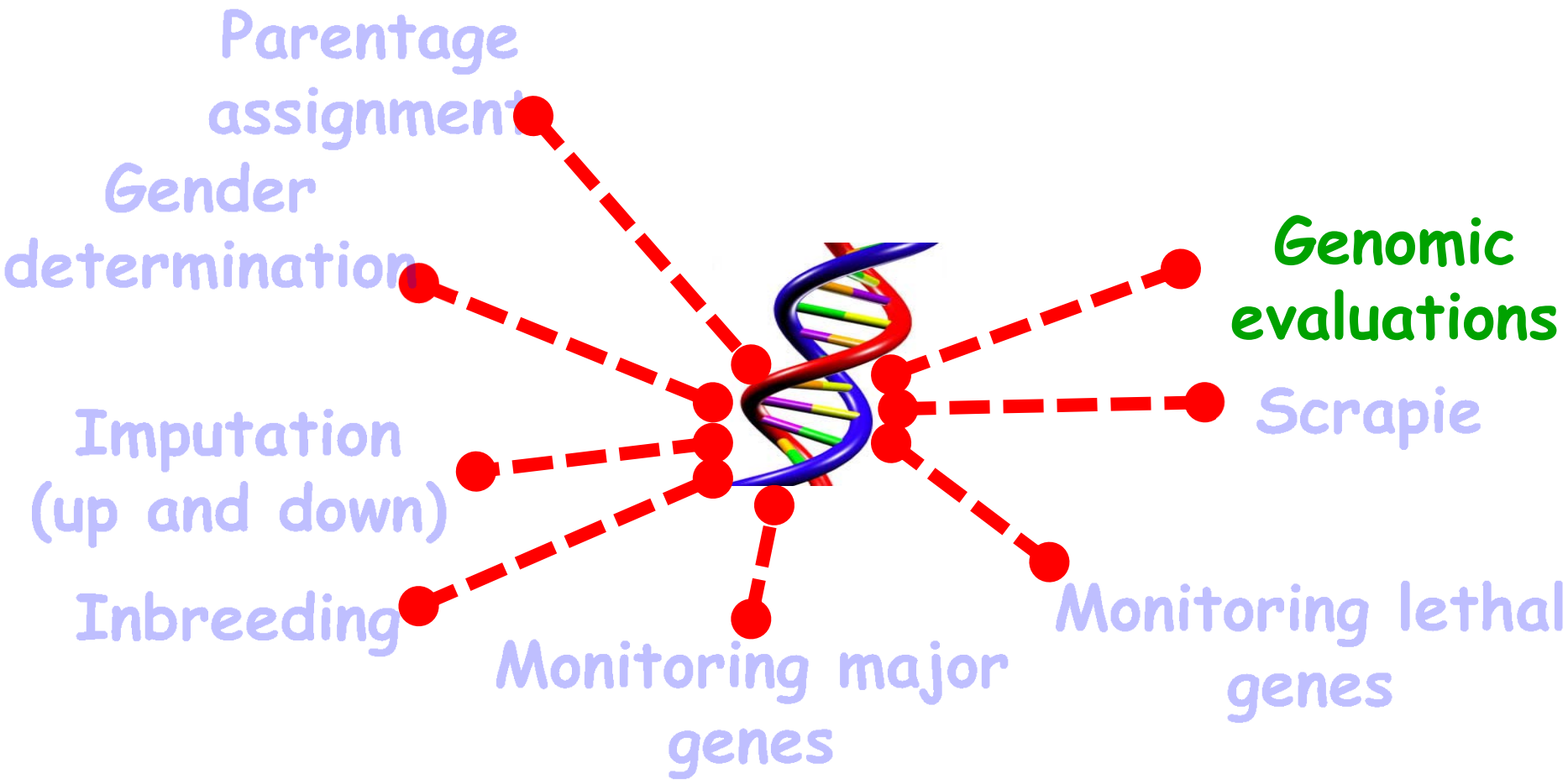


| Population | 2 copy | 1 copy | 0 copy |
|---|---|---|---|
| All breeds | 43% | 12% | 45% |
| Beltex | 0% | 2% | 98% |
| Vendeen | 100% | 0% | 0% |

| Muscle Scan (mm) | 0.00 | 0.71 | 1.18 |
|---|---|---|---|

# Scrapie genotypes

| Genotype result | Type | Degree of resistance/ | All breeds |
|---|---|---|---|
| ARR/ARR | 1 | Sheep that are genet to scrapie. | 73% |
| ARR/AHQ<br>ARR/ARH<br>ARR/ARQ | 2 | Sheep that are genet scrapie, but will need when used for furthe | 25% |
| AHQ/AHQ<br>AHQ/ARH<br>AHQ/ARQ<br>ARH/ARH<br>ARH/ARQ<br>ARQ/ARQ | 3 | Sheep that geneticall resistance to scrapie selection when used | 1.7% |
| ARR/VRQ | 4 | Sheep that are genet scrapie and should n breeding unless in th controlled breeding approved by NSPAC. | 0% |
| AHQ/VRQ<br>ARH/VRQ<br>ARQ/VRQ<br>VRQ/VRQ | 5 | Sheep that are highl scrapie and should n breeding. | 0.3% |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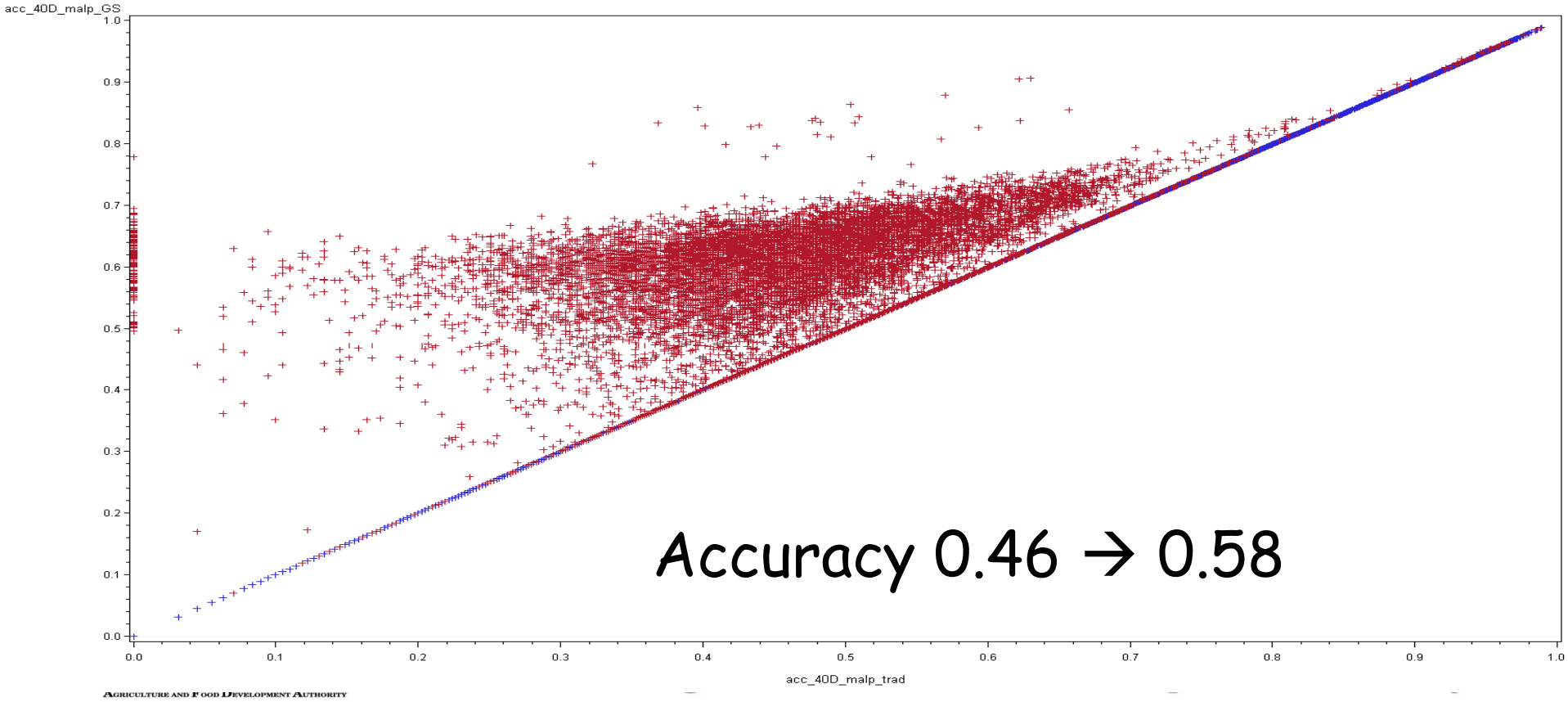
Genomic evaluations
Scrapie

# Genomic evaluations

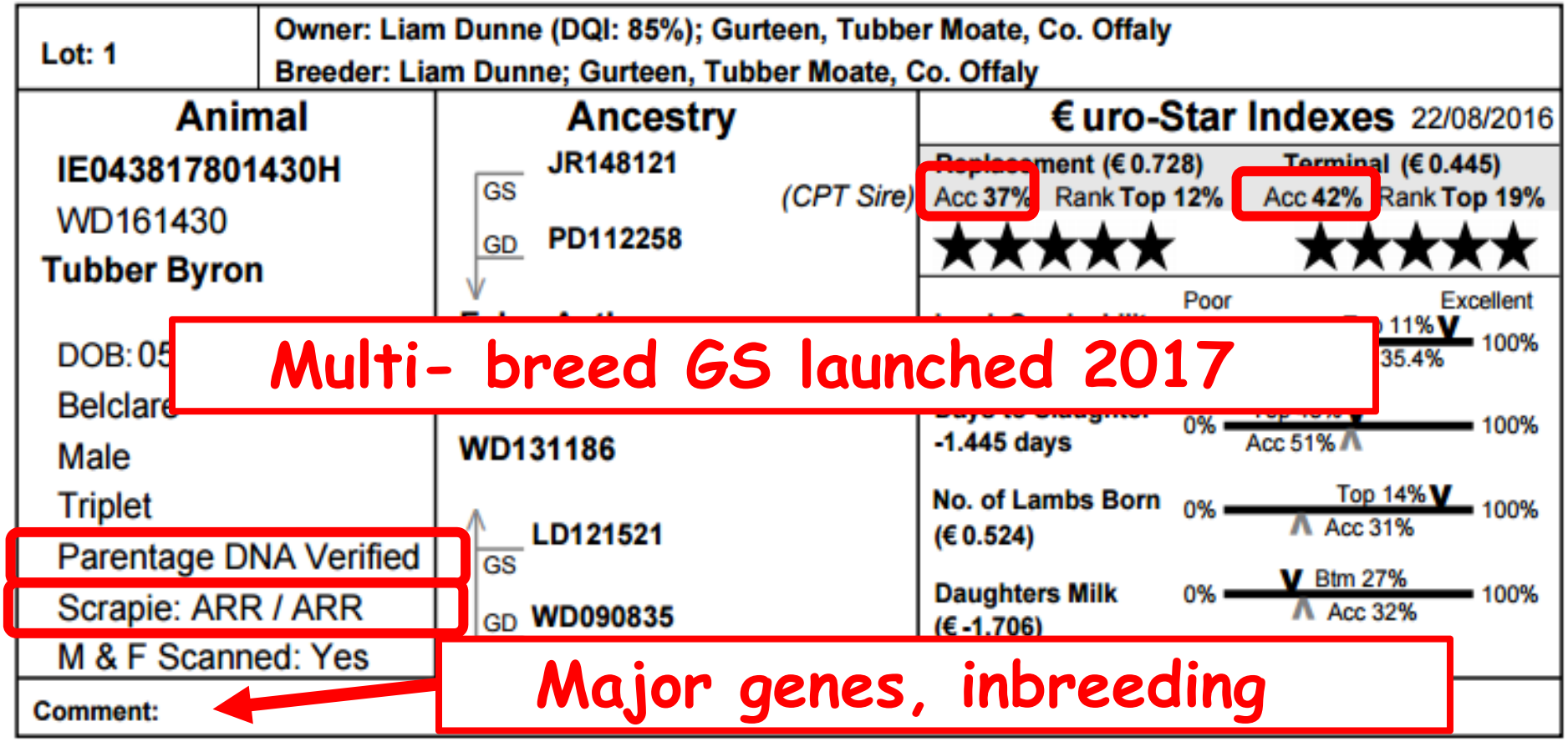


# Future…

## Genotyping

| Animal Number | Animal Name | Replacement Index € | DOB | Sex | Breed | Sire | Dam | Age Range | Genotype Possible? | Cost € | Select |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IE321185340025 | | 127 | 18-APR-10 | F | SI (63%), LM (22%) | HTY | IE181844230041 | 2+ yrs | | | Genotyped |
| IE271676520036 | | 124 | 30-APR-08 | F | CH (50%), SI (41%) | PTE | IE321522160222 | 2+ yrs | | | Genotyped |
| IE271676570040 | | 69 | 01-JUN-08 | F | SI (50%), CH (50%) | PTE | IE272020250059 | 2+ yrs | YES | 22 | Select |
| IE271676580041 | | 68 | 01-JUN-08 | F | LM (50%), SI (47%) | NIN | IE321558050308 | 2+ yrs | YES | 22 | Select |
| IE272299150108 | | 8 | 10-MAR-07 | F | SI (50%), LM (50%) | ION | IE301350880317 | 2+ yrs | YES | 22 | Select |
| IE251231350130 | | 36 | 02-MAR-10 | F | SI (50%), CH (50%) | IE281080450232 | IE231244620246 | 2+ yrs | YES | 22 | Select |
| IE231354990131 | | -2 | 31-MAR-07 | F | CH (63%), LM (38%) | CF42 | IE231354920091 | 2+ yrs | YES | 22 | Select |
| IE241648760133 | | 87 | 02-FEB-13 | F | LM (63%), HO (16%) | HCA | IE241536480458 | 2+ yrs | | | Genotyped |

# Benefits


Lot: 1
Owner: Liam Dunne (DQI: 85%); Gurteen, Tubber Moate, Co. Offaly
Breeder: Liam Dunne; Gurteen, Tubber Moate, Co. Offaly
Animal
IE043817801430H
WD161430
Tubber Byron
DOB: 05
Belclare
Male
Triplet
Parentage DNA Verified
Scrapie: ARR / ARR
M & F Scanned: Yes
Comment:
Ancestry
JR148121
GS
(CPT Sire)
GD
PD112258
WD131186
LD121521
GS
GD
WD090835
€uro-Star Indexes 22/08/2016
Acc 37%
Rank Top 12%
Acc 42%
Rank Top 19%
Poor
Excellent
11%
100%
35.4%
0%
100%
Acc 51%
-1.445 days
No. of Lambs Born
(€ 0.524)
0%
Top 14%
100%
Acc 31%
Daughters Milk
(€ -1.706)
0%
Btm 27%
100%
Acc 32%
Multi- breed GS launched 2017
Major genes, inbreeding

# Acknowledgements


- Irish department of agriculture, food and the marine Stimulus Funding grant

OviGen