

Recent Advances in Genetic Evaluation of Italian Holstein: Results from Latteco Project

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Italian Holstein and Jersey National Breeders Association (ANAFIJ)

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Science
Days
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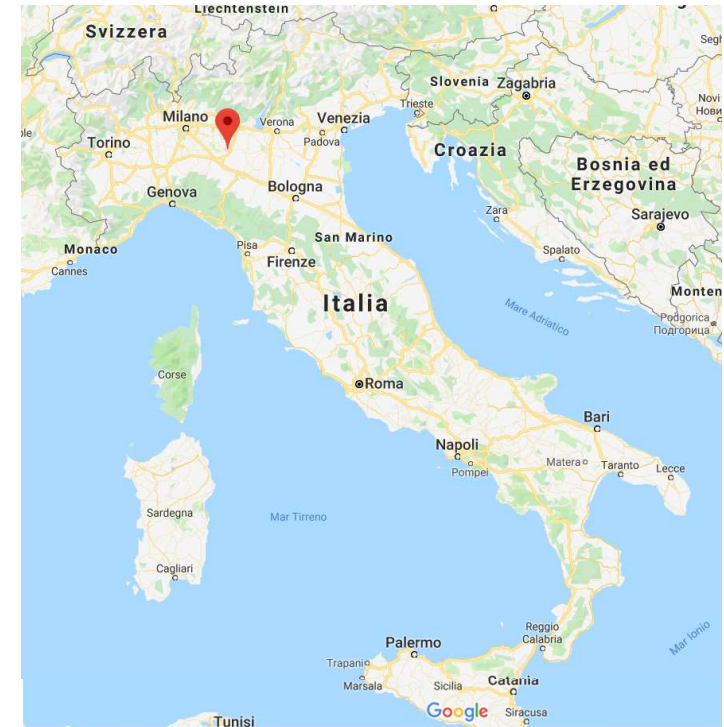
Overview

- **ANAFIJ** and the Italian dairy sector
- **LATteco** project
 - ✓ Development of a selection index for **mastitis resistance**
 - ✓ Revision of the aggregate **fertility** index
 - ✓ Development of a **cheese merit** breeding objective
 - ✓ Future work



ANAFIJ

- **Genetic selection, promotion, and valorization** of Italian Holstein and Jersey
- Herbook, genetic evaluation, linear type scoring, dairy show, bull quarantine, services for farmers and AI centers and importers



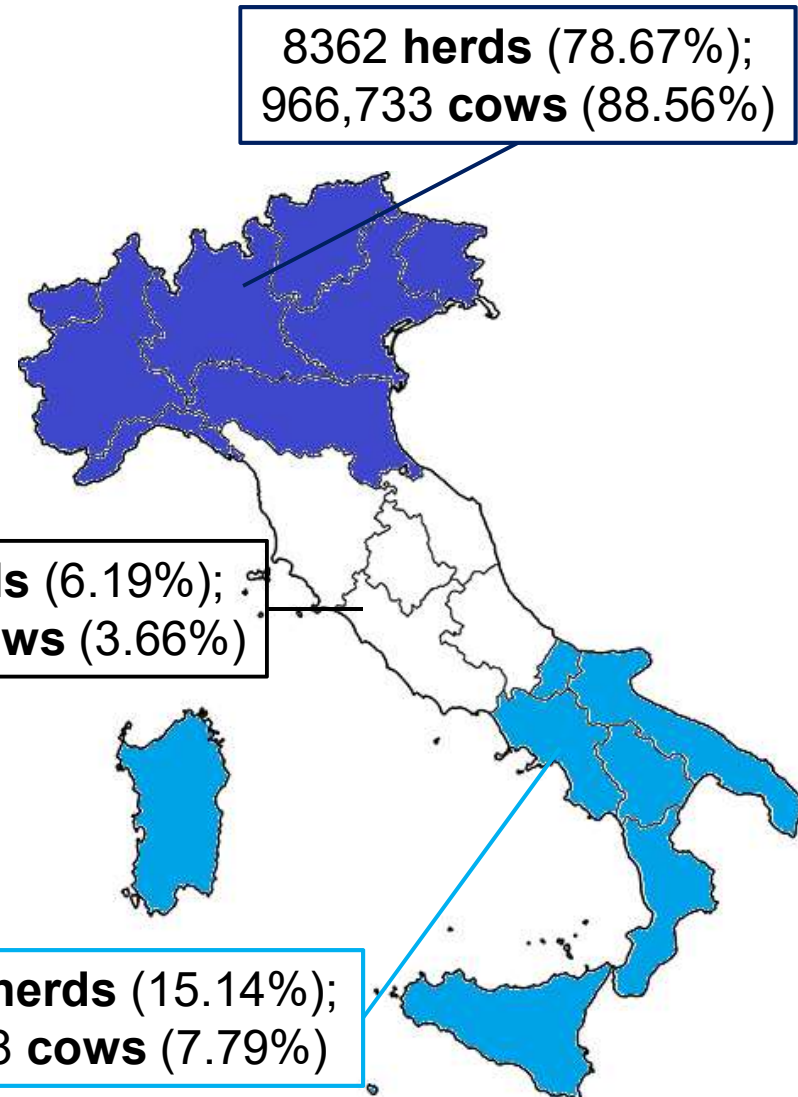
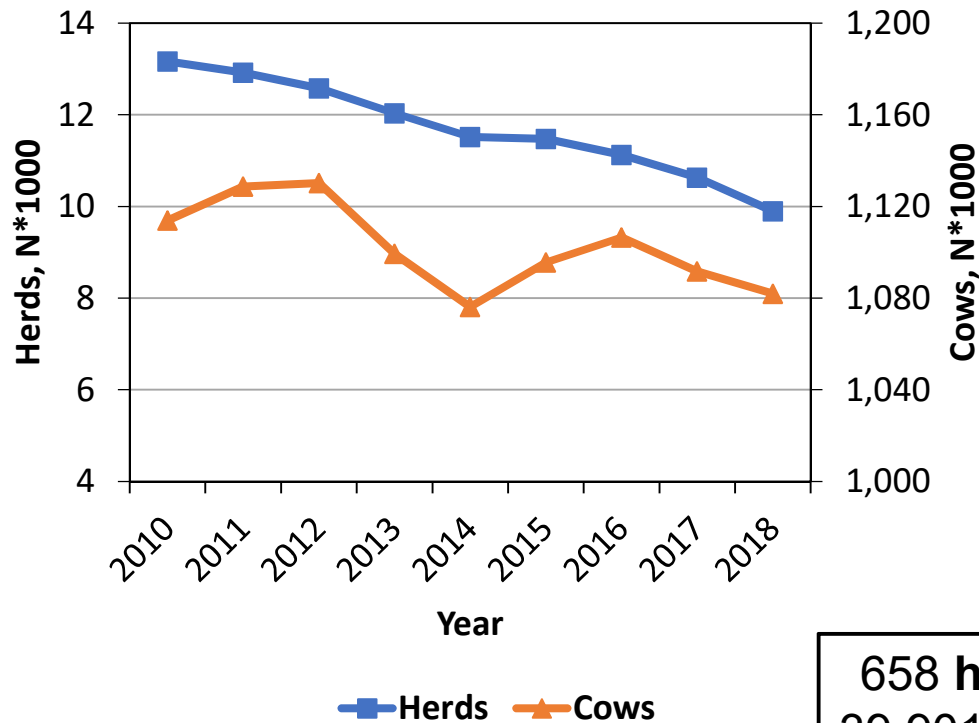


Holstein in Italy ... in pictures!

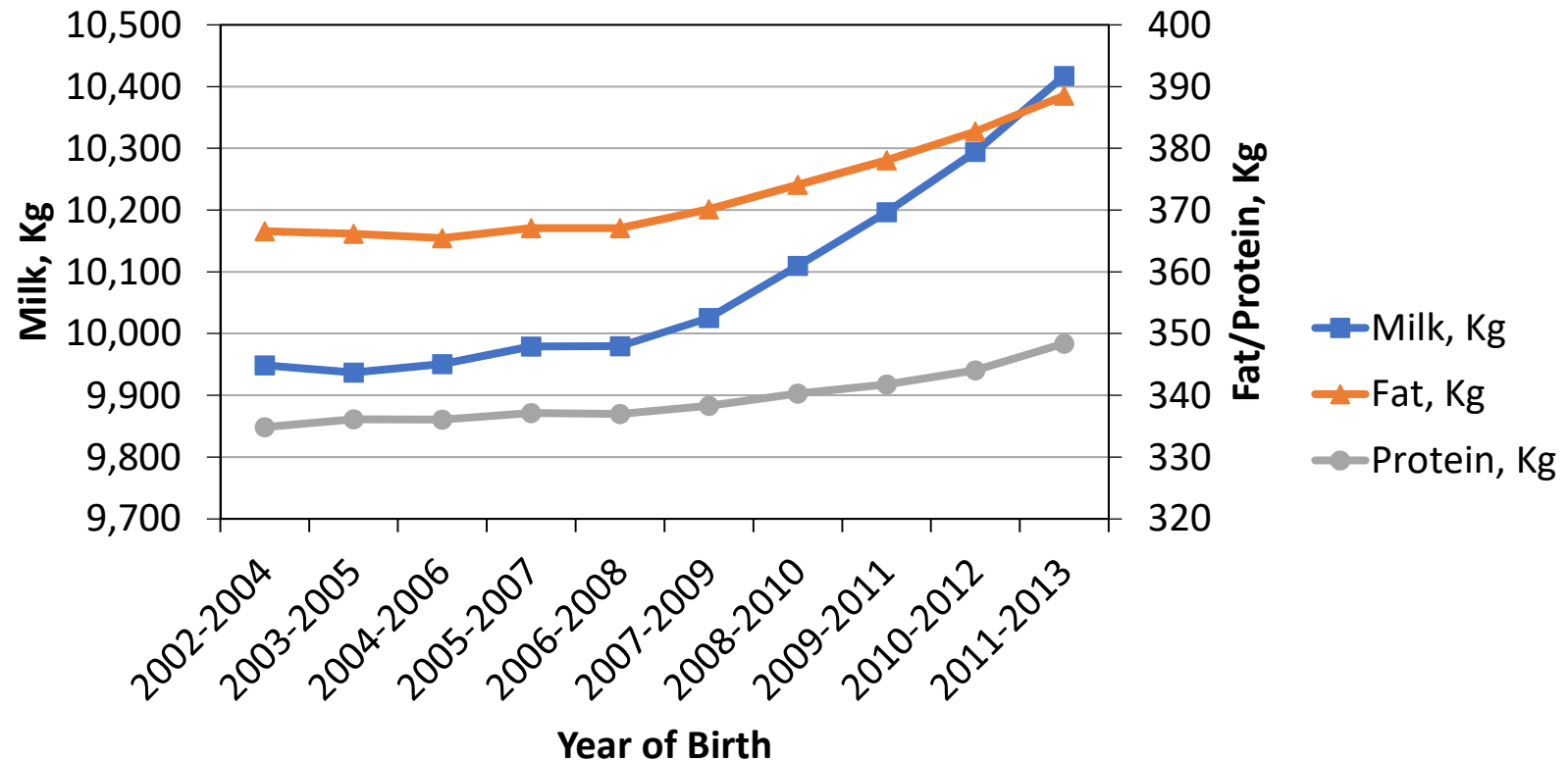




Holstein in Italy ... in numbers!



Genetic Base Trend



- **Rolling base**, cows born between YYYY-8 and YYYY-6
- +5% Milk Yield, +6% Fat Yield, +4% Protein Yield in 10 years

LATeco

- Project financed by Italian Minister of Agriculture, Food, and Forestry with N-RDP for 2014-2020
- 3 main **Objectives**:
 - ✓ **Biodiversity** (\approx 30,000 female genotyped 54K)
 - ✓ **Health and Welfare** (new selection indexes)
 - ✓ **Environmental Impact** (new equipments for FI and GHG emission for all AI bulls; indirect FE index)
- Collaboration with different universities (UNIPD, UNICATT), research centers and dairy industries

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SCS vs MST

- **SCS**: Published since 2000 (repeatability AM), updated in 2004 (random regression AM)



Reduce concentration of SCS (good for milk payment!)

!=

- **MST**: Published since 2018



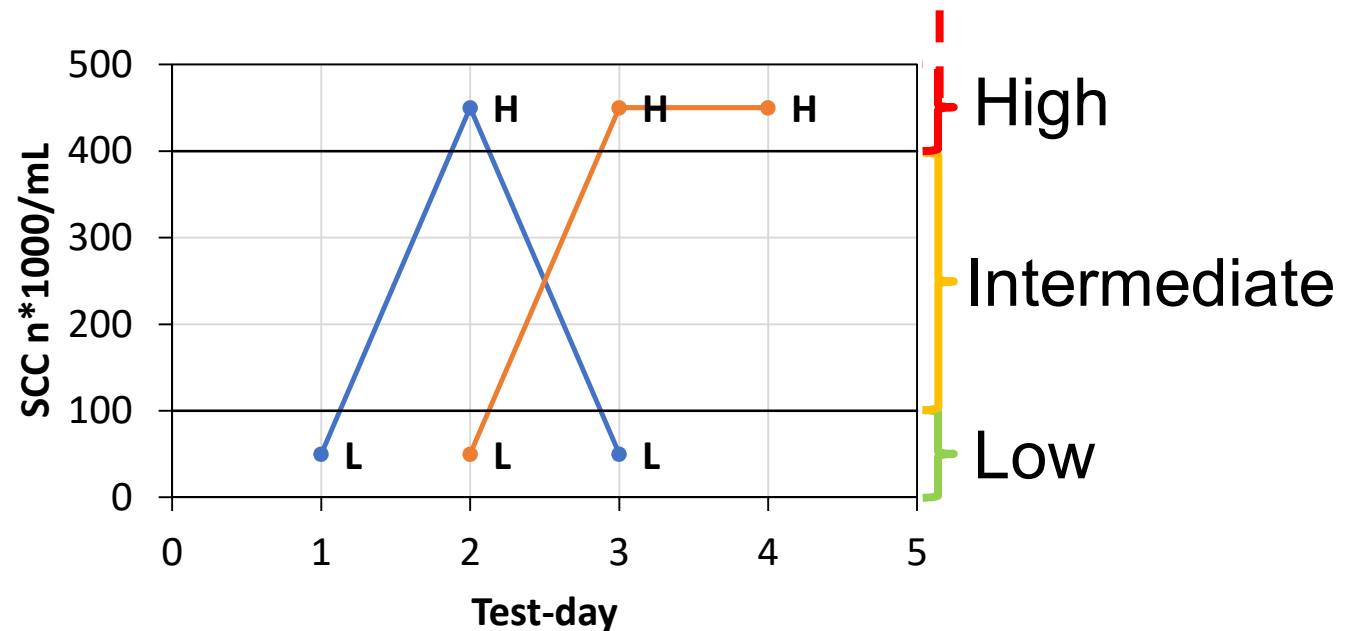
Increase mastitis resistance (still good for pocket (and animal welfare)!)

MST: which data?

- Published by Canada, DFS, France, Germany, UK, The Netherland, Norway, Switzerland, US, and Italy (Interbull, 2019)
- Data on **clinical mastitis** (presence/absence) recorded by vets/DHI technicians ...
- ... OR data on **alternative traits derived from SCS** and **genetically correlated** with clinical mastitis
 - ✓ Effective in countries where clinical mastitis is NOT recorded routinely

MST: which alternative traits?

Trait	Description
SCS150	Mean SCS 5-150 DIM
SCS_SD	Standard deviation SCS
SEVERITY	n TD 'High'/total TD
PEAK	SCC L-H-L or L-H-H (0=no peak; 1 otherwise)



MST: published index

Trait	Mean	SD	h^2	r_g
SCS150	2.58	1.37	0.06	0.39
SCS_SD	1.20	0.62	0.02	0.44
SEVERITY	0.11	0.19	0.07	0.41
PEAK	0.10	0.31	0.02	0.51
CM	0.09	0.28	0.03	-

- **MST functional index**, therefore standardized with mean 100 and SD 5, **higher value** desired
- Correlation with SCS \approx 0.80, bulls **re-ranking**
- Both index published, weights of alternative traits are NOT

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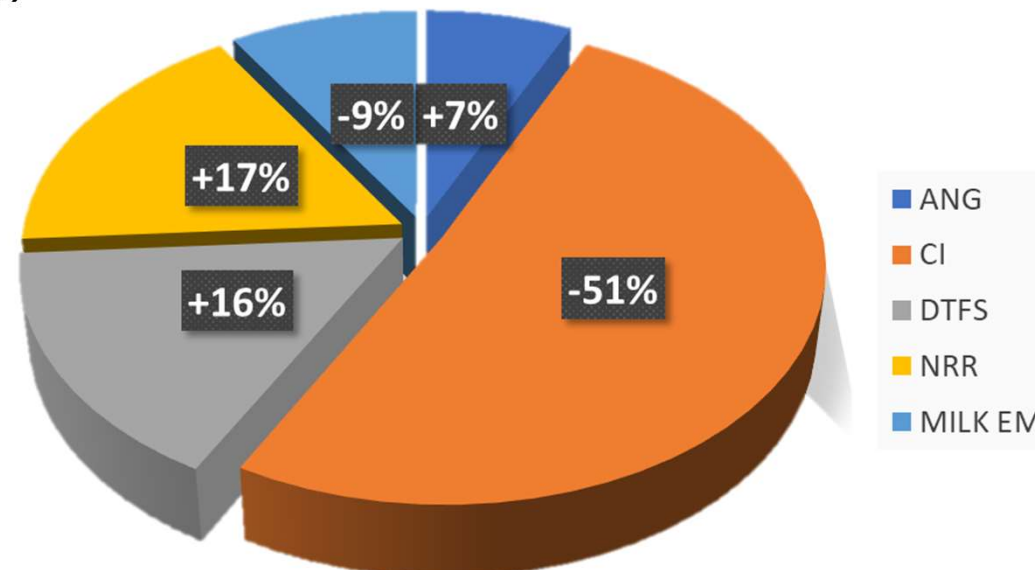


FRT: that's how it started

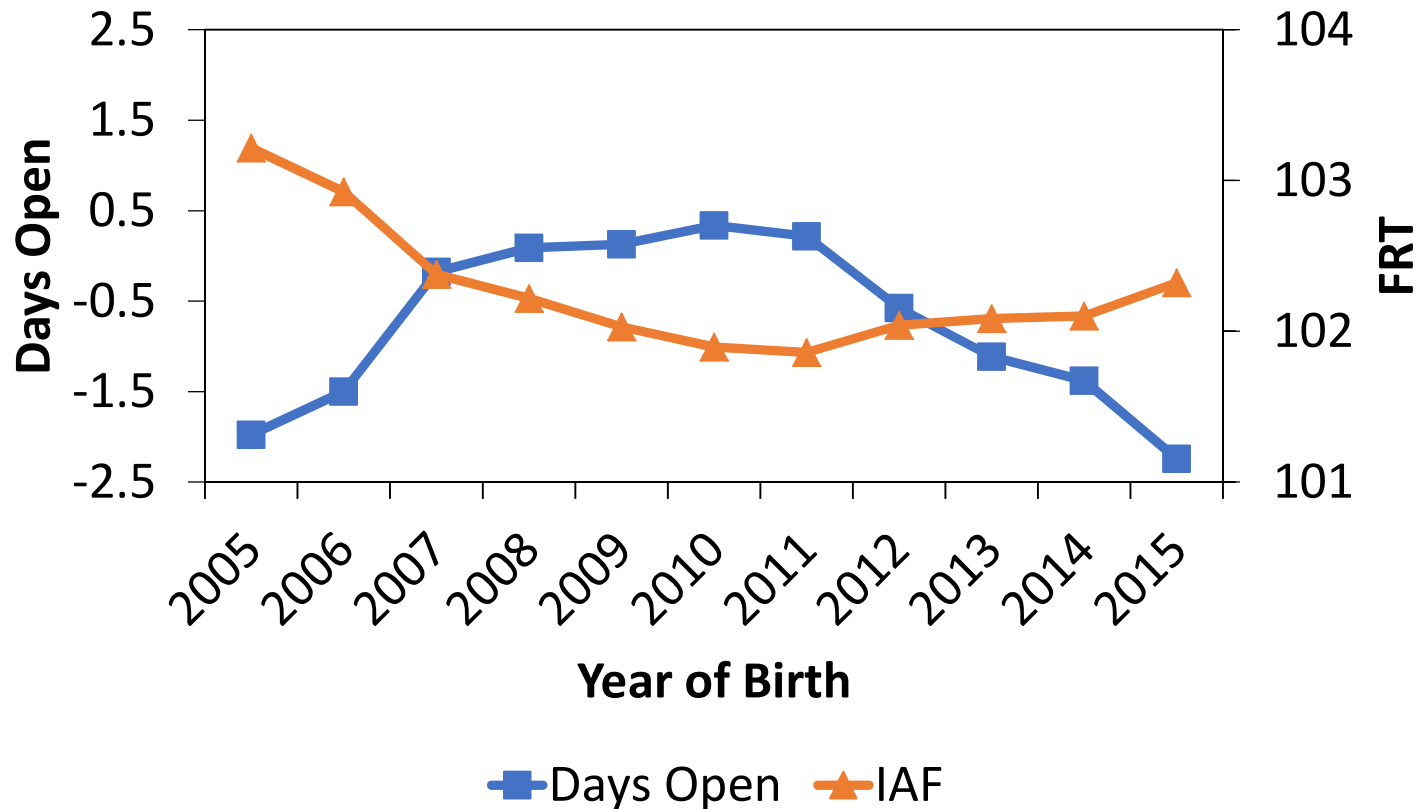
- **FRT** index: since 2005 for AI bulls, since 2009 into the national breeding index PFT (production, functionality and type) with 10% emphasis



Increase conception rate at first service (Italy all year round calving)



FRT v1.0 has done a nice job



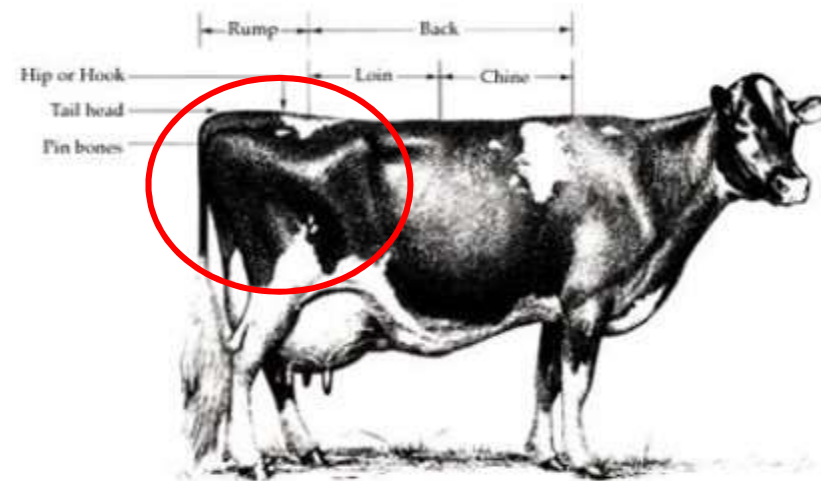
- Approx. 250 000 cows/year
- Since 2010 ΔG -0.60 d/year days open, +0.13 IAF/year

FRT: Why a revision?

- **New information** not available in 2005



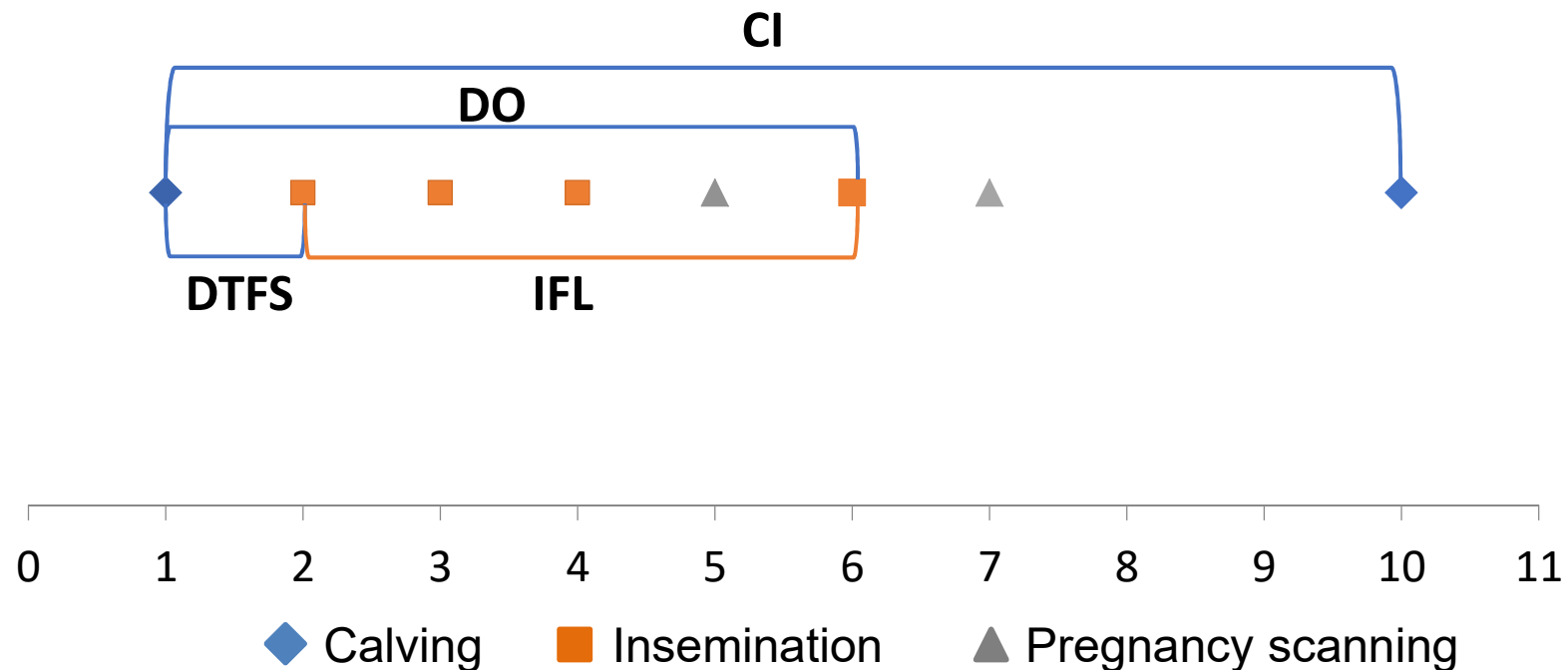
Pregnancy scanning



Body condition score

- General improvement of **data recording** with info on **heifer fertility**

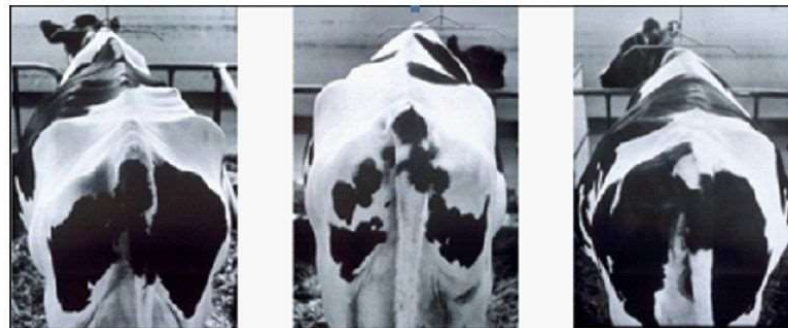
New Information: Pregnancy scanning



- **DTFS**: days to first service
- **IFL**: interval first to last insemination → More info, earlier
- **CI**: calving interval
- **DO**: Days open (DTFS+IFL)

New information: BCS

- Indicator of **energy status**
- Correlation BCS-CR **stronger** than ANG-CR (0.21 vs 0.15)
- In 2007 phenotypic correlation BCS-ANG -0.75, now ≈ 0.00 (definition of ANG has **changed over time**)
- Now BCS and ANG are two different traits

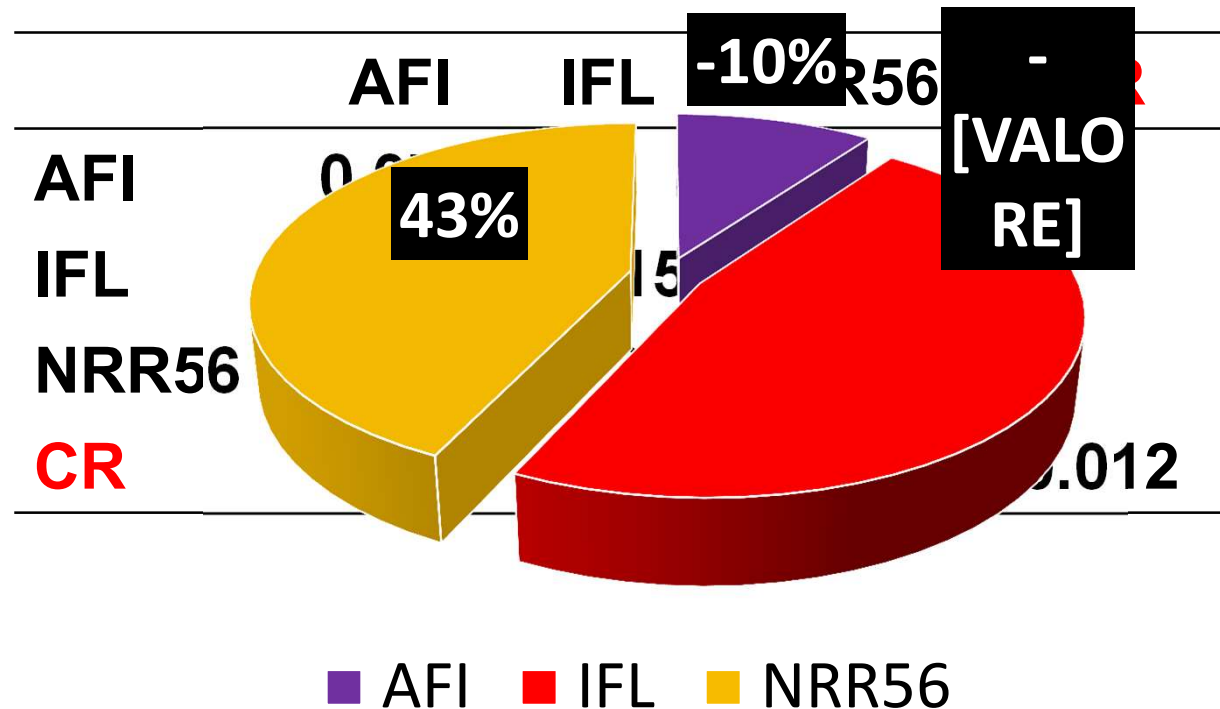


1.5 (A)

3 (B)

4 (C)

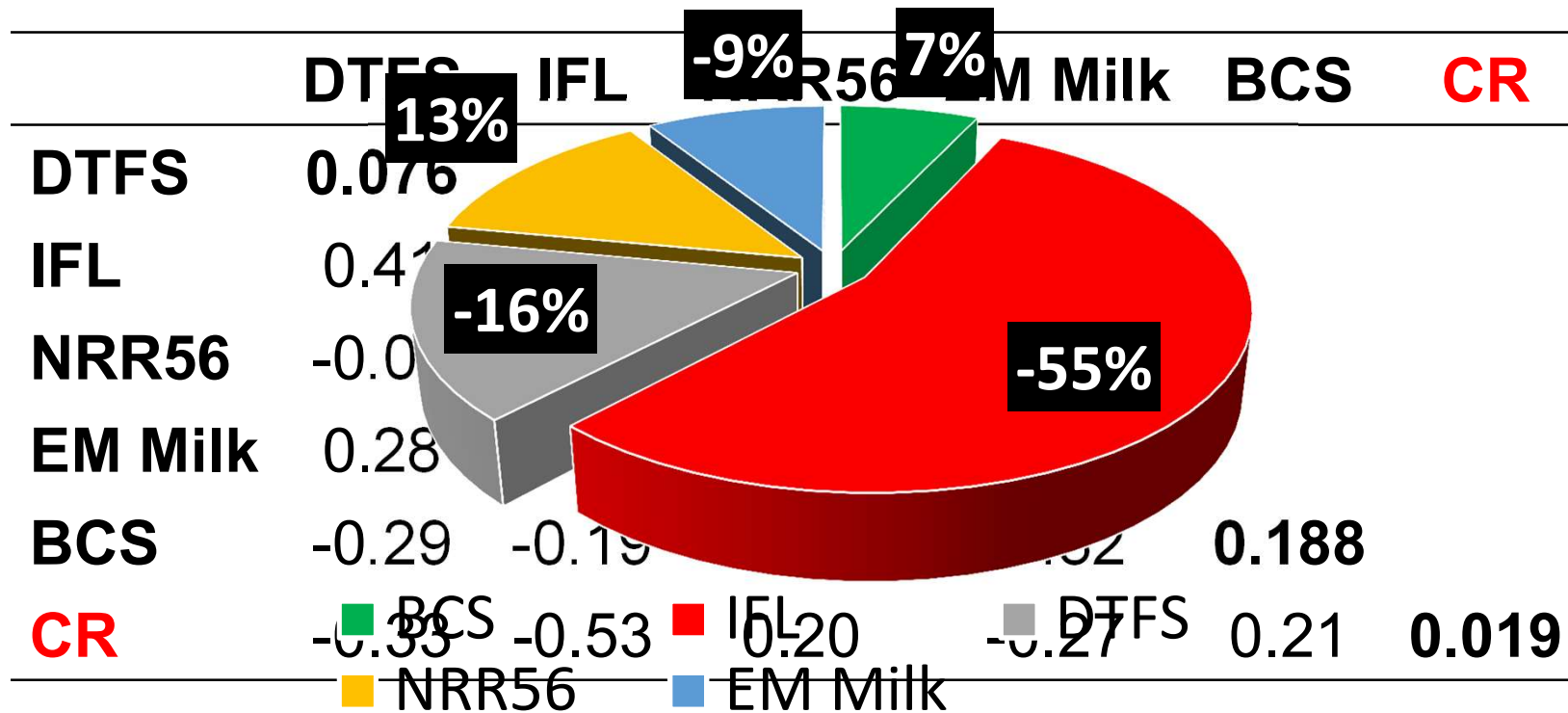
Genetic Parameters - Heifers



$$Emphasis_i = \frac{\beta_i \sigma_i}{\sum_{j=1}^n |\beta_j \sigma_j|}; \quad \beta = G_I^{-1} G_{IT} v$$

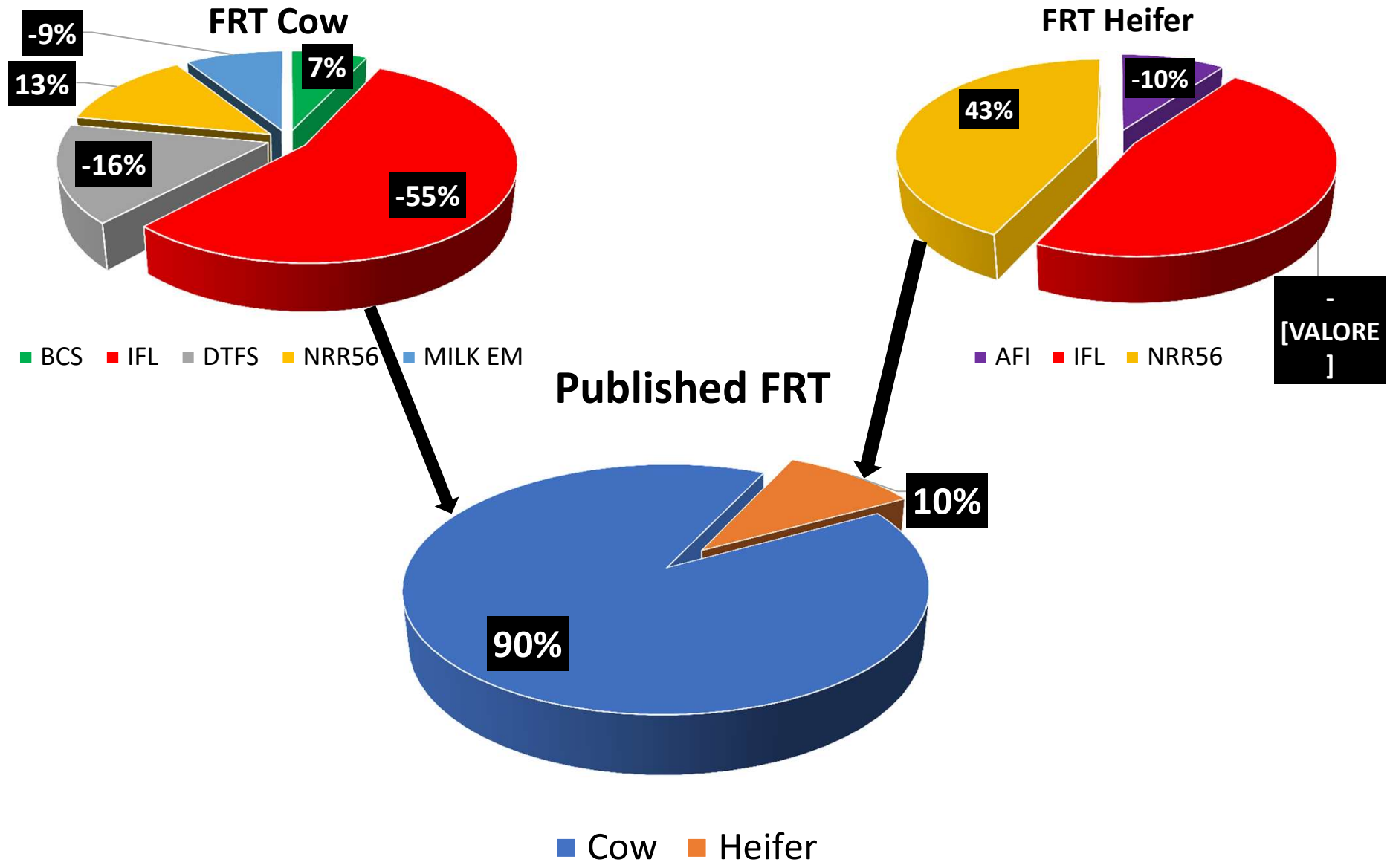


Genetic Parameters - Cows



$$Emphasis_i = \frac{\beta_i \sigma_i}{\sum_{j=1}^n |\beta_j \sigma_j|}; \beta = G_I^{-1} G_{IT} v$$

Published Fertility Index



Published Fertility Index

Cows

FRT	BCS	IFL	DTFS	NRR56	CR
> 105	3.03	62.05	84.72	0.60	0.38
95-105	2.99	73.14	87.27	0.57	0.33
< 95	2.96	86.81	89.24	0.54	0.28

BCS: body condition score; **IFL**: interval first to last insemination; **DTFS**: days to first service; **NRR56**: non return rate at 56 d; **CR**: conception rate at first insemination (**breeding goal**)

Heifers

FRT	AFI	IFL	NRR56	CR
> 105	17.3	25.87	0.79	0.62
95-105	17.2	27.32	0.77	0.60
< 95	17.1	29.80	0.75	0.58

AFI: age at first insemination; **IFL**: interval first to last insemination; **NRR56**: non return rate at 56 d; **CR**: conception rate at first insemination (**breeding goal**)

Published Fertility Index

- Actual Fertility index calculated on **more daughters** and on **more information** (preciser tool for breeding decision)
- 1 published index...made up of 8!
- Information on heifer fertility delivered to ITB (T1) opens **new perspective for exporting Italian Holstein genetics**



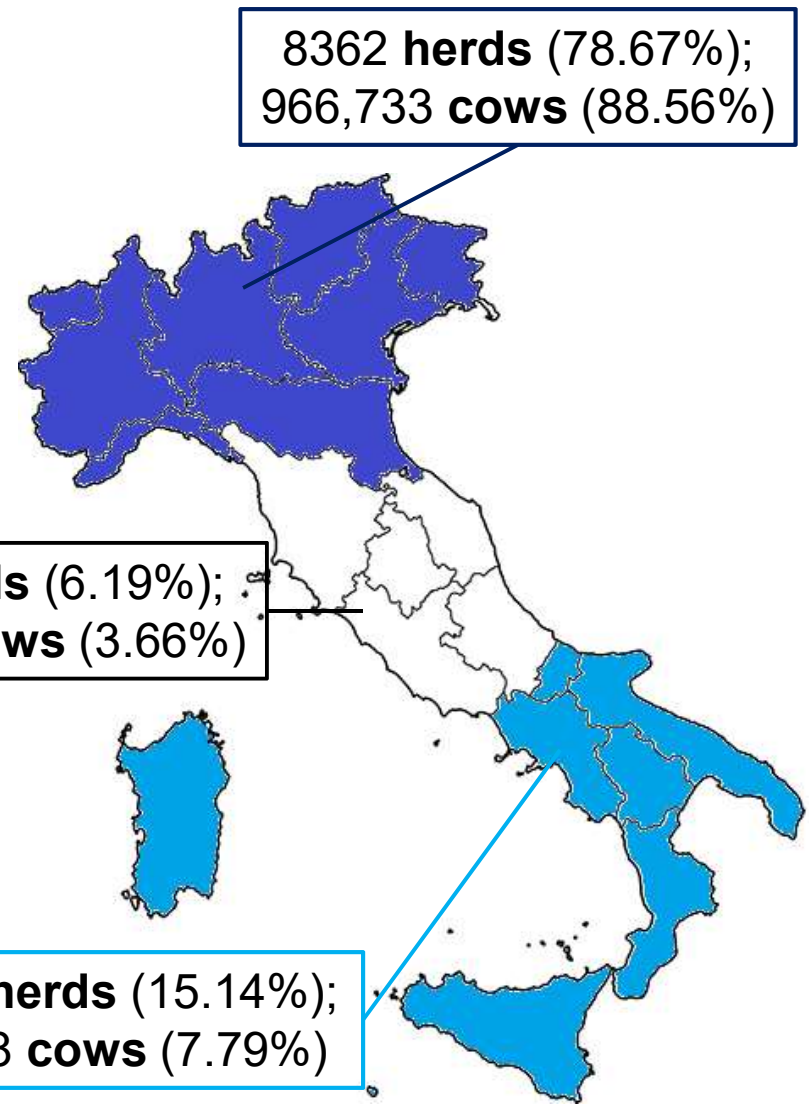
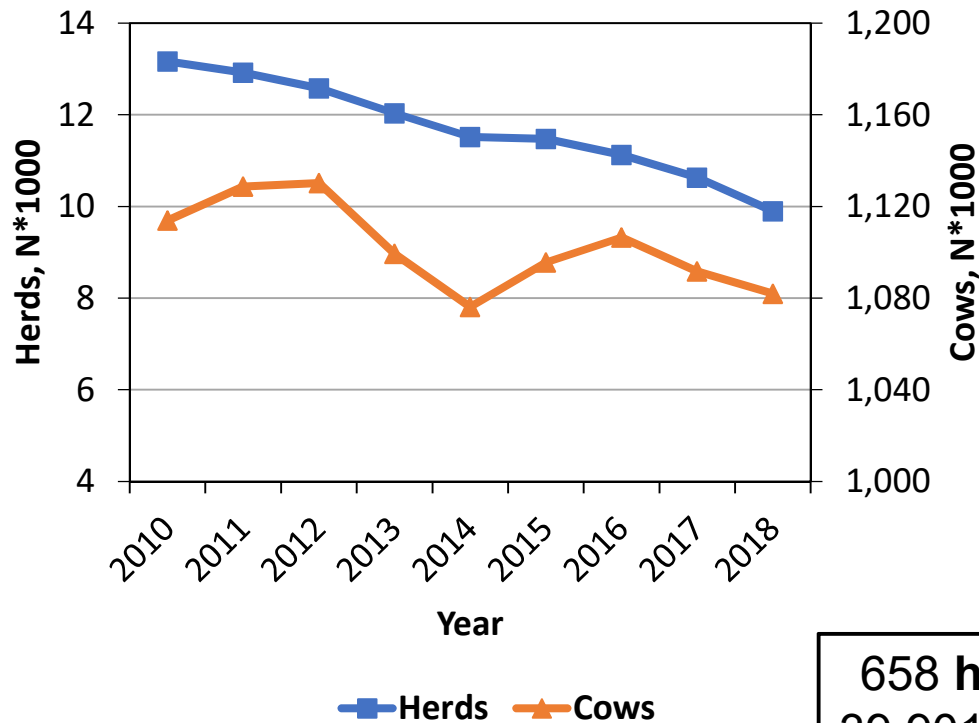
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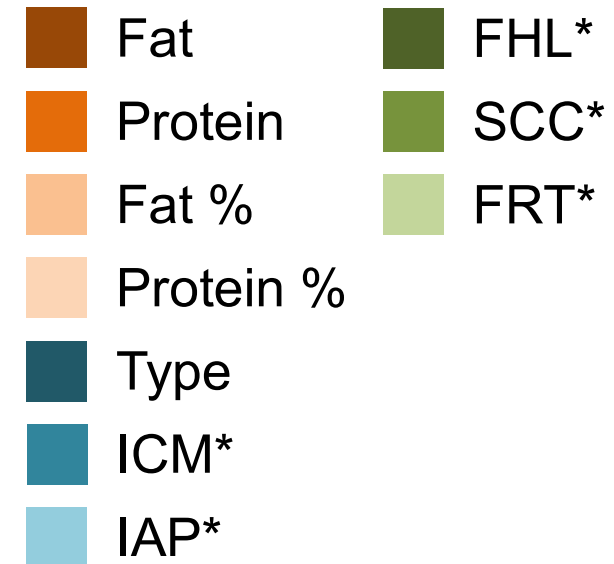
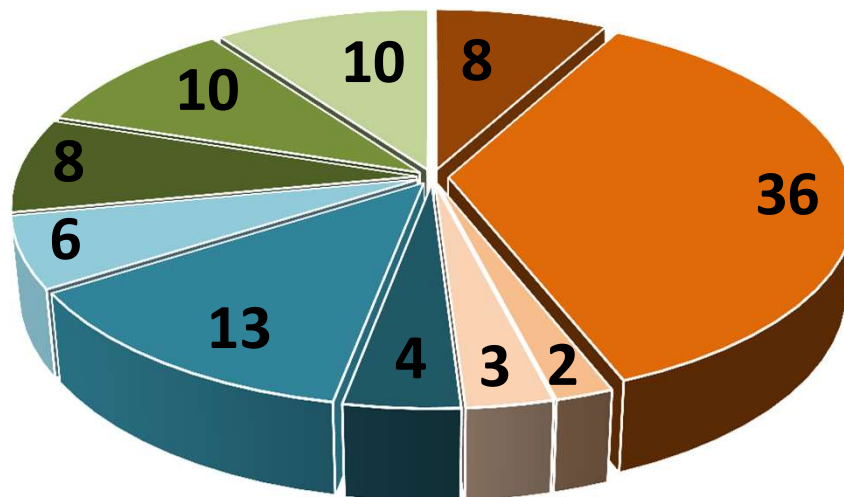


Holstein in Italy ... in numbers!



Italian Holstein Selection

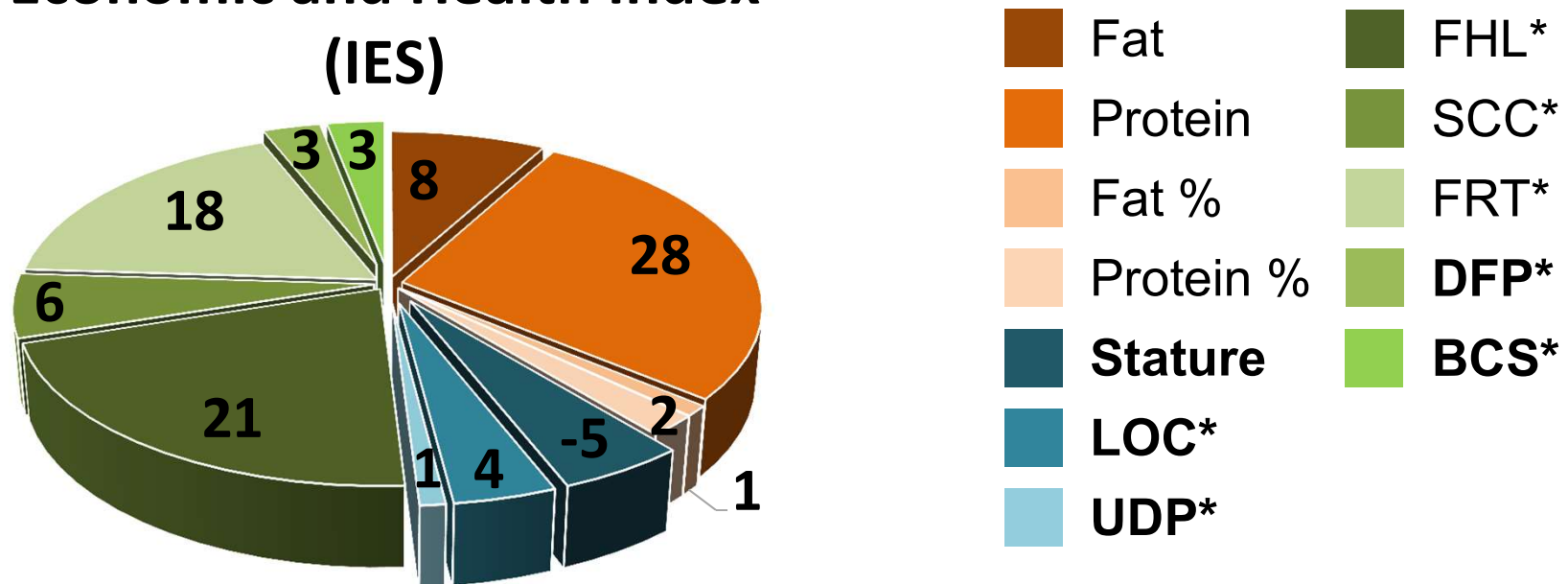
**Production, Functionality, Type
(PFT)**



***ICM** = Udder Composite Index; **IAP** = Feet and Leg; **FHL** = Longevity;
SCC = Somatic cell; **FRT** = Fertility

Italian Holstein Selection

Economic and Health Index (IES)



***LOC** = Locomotion; **UDP** = Udder Depth; **FHL** = Longevity; **SCC** = Somatic cell; **FRT** = Fertility; **DFP** = Calving Ease; **BCS** = Body Condition Score

Italian Holstein Selection

- **No breeding indexes** (in any Italian dairy and dual purposes breed) for farmers operating in market in which milk is transformed into **high added-value products, until 2018!**
- **Cheesemaking and Sustainability Index – Parmigiano Reggiano** is an **economic index** tailored for them, aiming at **maximizing net profit/day**
- Collaboration with **UNIPD, UNIPR, UNIBO, PR consortium**



INDICE CASEIFICAZIONE
..... SOSTENIBILITÀ
PARMIGIANO REGGIANO

Which Costs?

- Costs **estimable** from production, linear and functional **breeding values**



- **Heifer** rearing



- **Feeding** maintenance / production (DMI)

- Milk kg, fat%, prt%, MLW (from linear traits)
- UNIBO using data from PR ration

Which Costs?

- Costs **estimable** from production, linear and functional **breeding values**



- **Heifer** rearing



- **Feeding** maintenance / production (DMI)
- **Health** status (fertility, mastitis, calving difficulty)

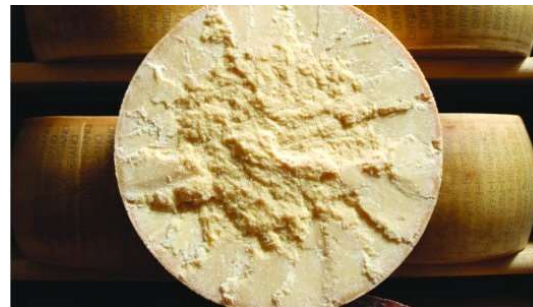


- **Milk Delivery** (kg, fat%, prt%, MW) (from linear traits)
- **UNIBO** using data from PR ration

Which Revenues?



- **Revenues** estimable in all **cow's productive life**

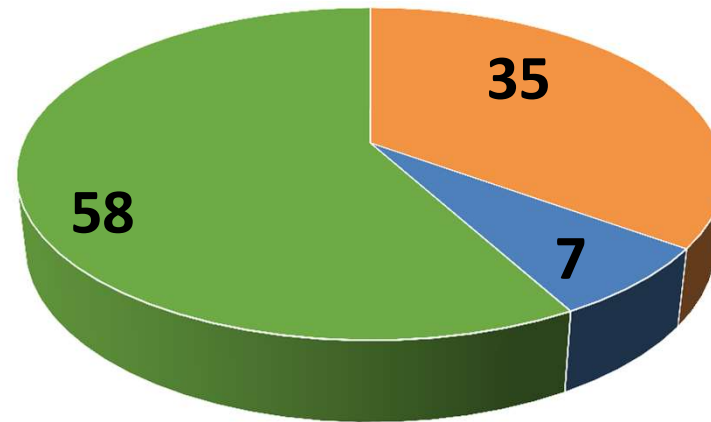


- Predictors in cheese yield **prediction formulae**:
Production indexes (% grs, % prt, SCC) + κ -casein AA/AB/BB
- Developed by UNIPR using data collected in PR dairies

Index Weights Derivation

- € Revenues - € costs = **PROFIT**/day (**Breeding goal**)
- **Stepwise multiple linear regression** between **profit** and bulls' **EBV** routinely estimated (R^2 bulls > 0.50, rank > 59)
- Index weight_x = $\frac{|\beta_x * \sigma_x|}{\sum_{j=1}^n |\beta_j * \sigma_j|}$; **Stakeholders** involvement
- **10-year genetic gain** estimated from **P** and **G** routinely used for BLUP (Calo's Correlation (Calo et al., 1973) if no covariances available)

ICS-PR: Index weights



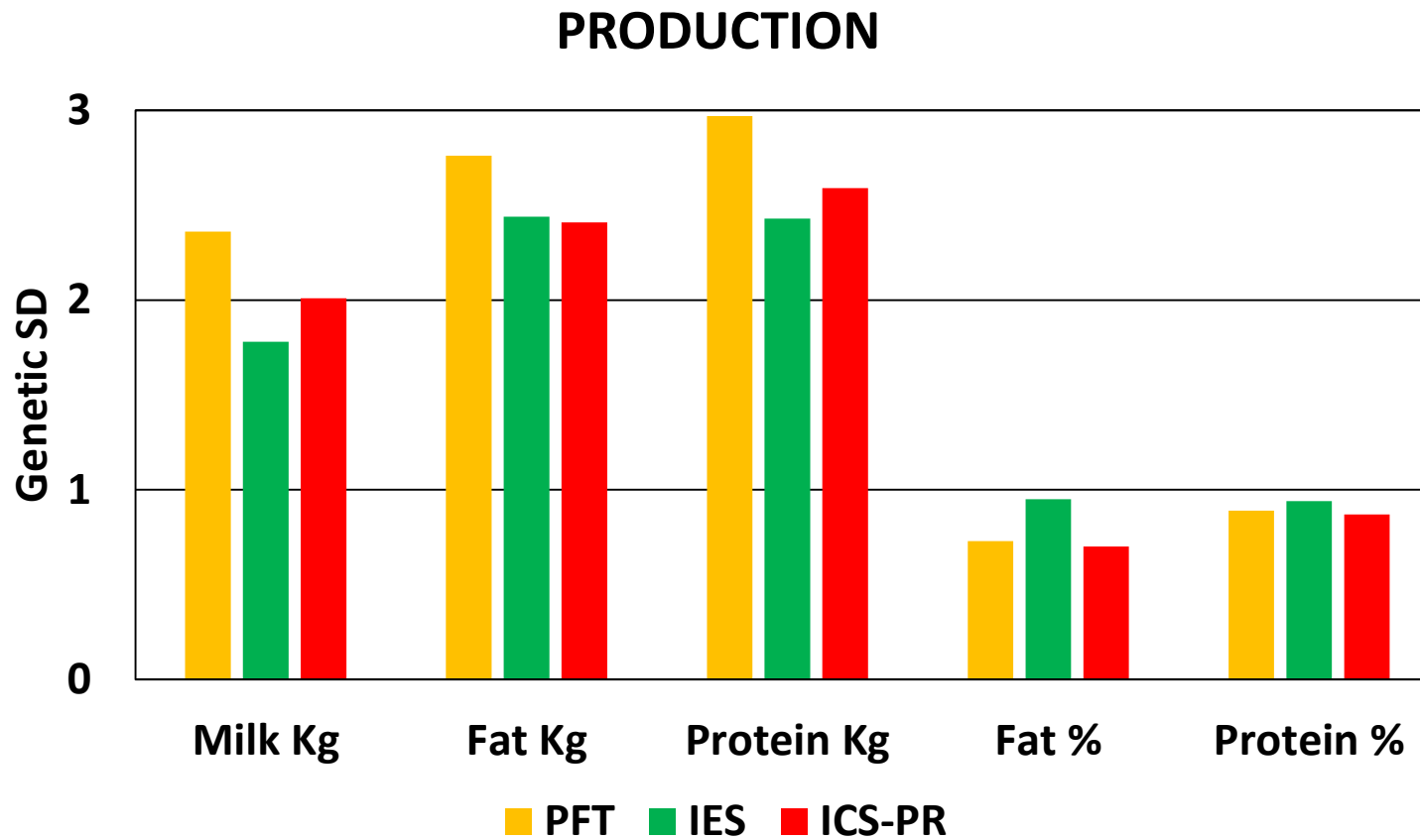
■ Production
 ■ Morphology
 ■ Functionality

Production	
Fat Kg	5
Protein Kg	30

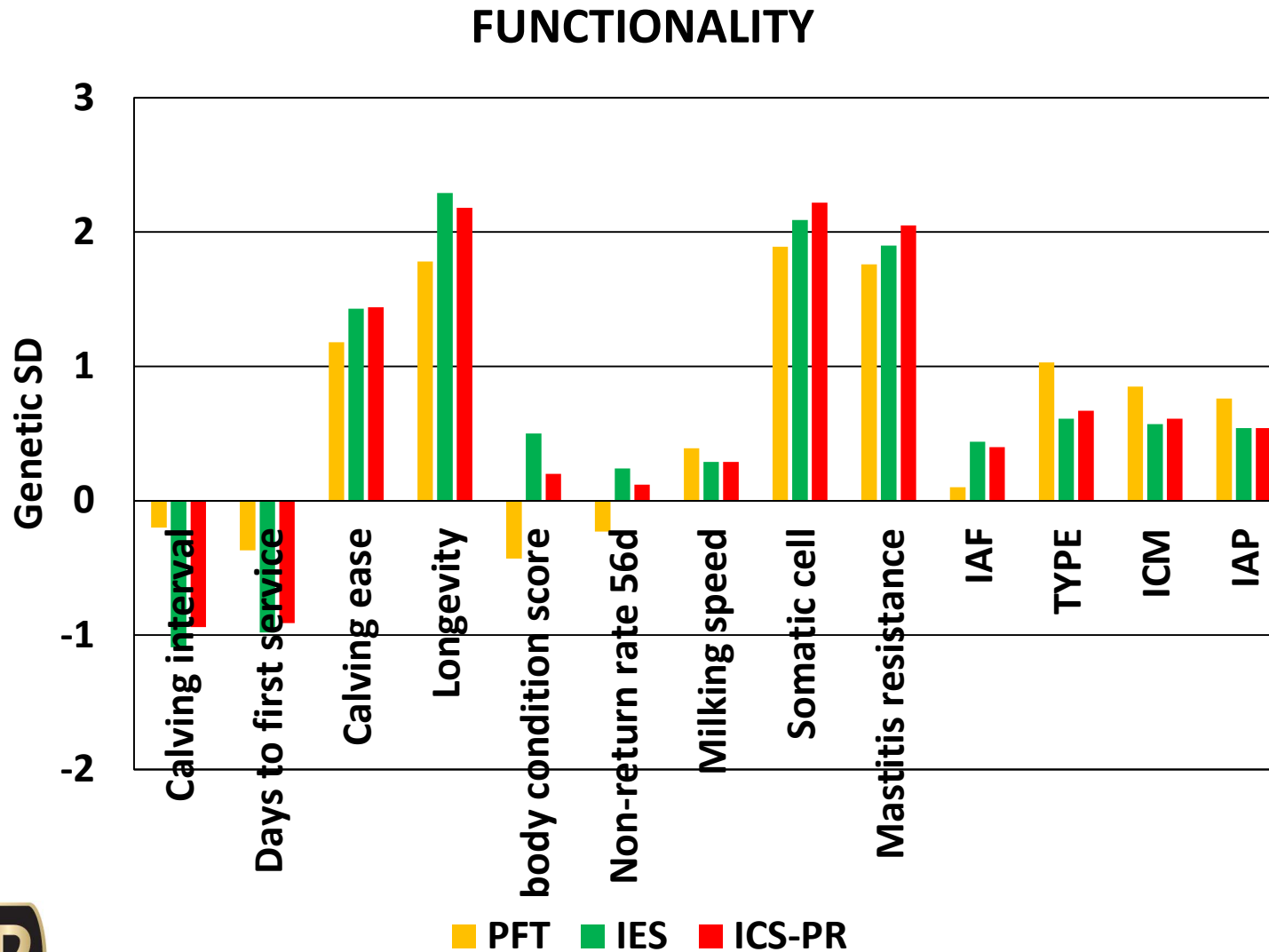
Morphology	
Stature	-2
Locomotion	3
Udder Depth	2

Functionality	
SCC	14
Calving Ease	9
Longevity	10
Mastitis	5
Fertility	20

10-year Genetic Gain



10-year Genetic Gain



Three Things Regarding ICS-PR

- ICS-PR is the **3rd selection index** of Italian Holstein-Friesian ... more options for the **best breeding decision!**
- 2000 € ICS-PR: *The daughters of Bull X are expected to yield an extra 2000 € compared to the average profit*
- Will be updated with **new health** and **tecnological traits EBV** as available



But LATteco is also more...

- Implementation of **BHB** selection index
- **Revision of PFT** index (more emphasis on fertility)
- Direct measurement of **methane emission** and **feed intake** on young bulls in our genetic centre



THANK YOU!

DĚKUJI!

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