

# The Valdostana Red Pied

An example of a directional and adaptive selection program in an autochthonous double purpose cattle breed of the Alps

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# Valdostana Red Pied

- Double purpose cattle breed
- Valdostana Herd Book
- In Aosta Valley about 10,000 milking cows



Parity	Milk kg	Fat %	Prot %
1	3,417	3.52	3.30
2	3,805	3.52	3.34
3	4,175	3.49	3.25





## Mountain summer pasture practice





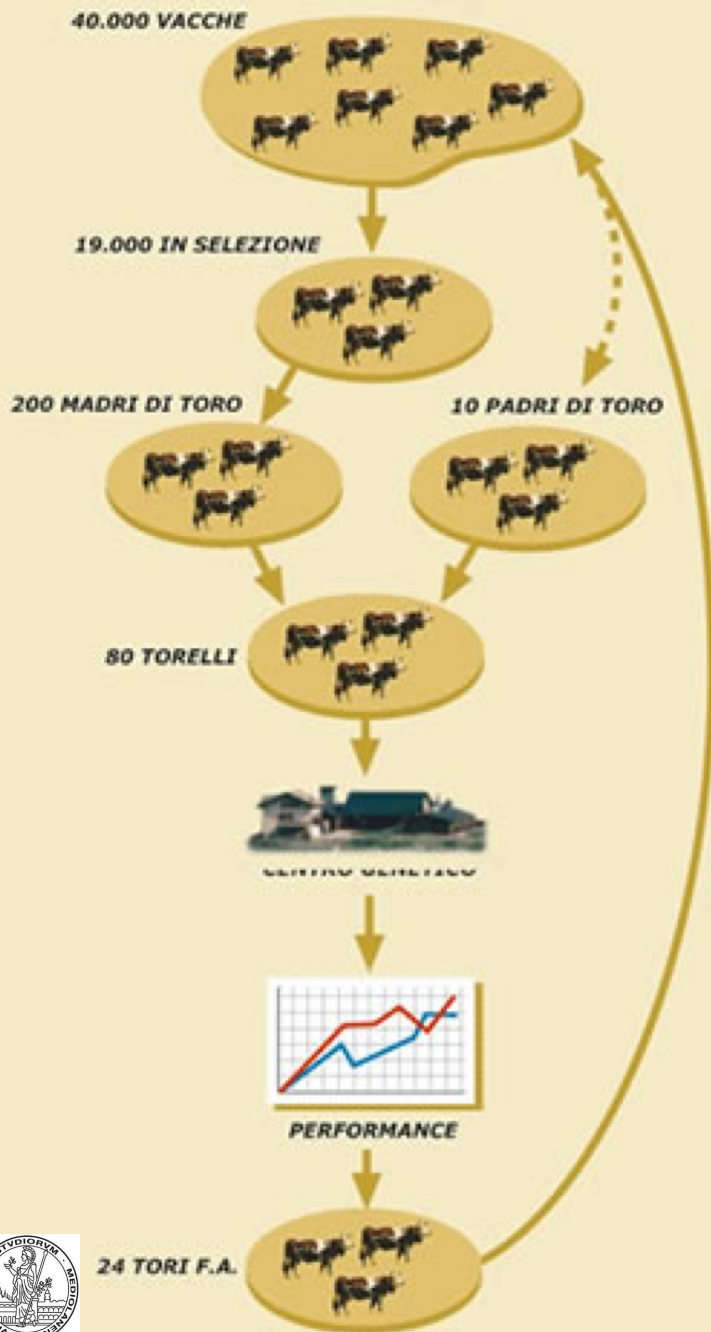


# FONTINA CHEESE

D.O.P. linked to the breed







## Selection scheme

- Milk production traits
  - including contents
  - to maximize cheese production
  - **Unproven sire of dams**
  - **10 proven sires of bulls**
- Meat production and quality of carcass
  - Performance test ➔ 24 / 80
- Maintain the genetic variability



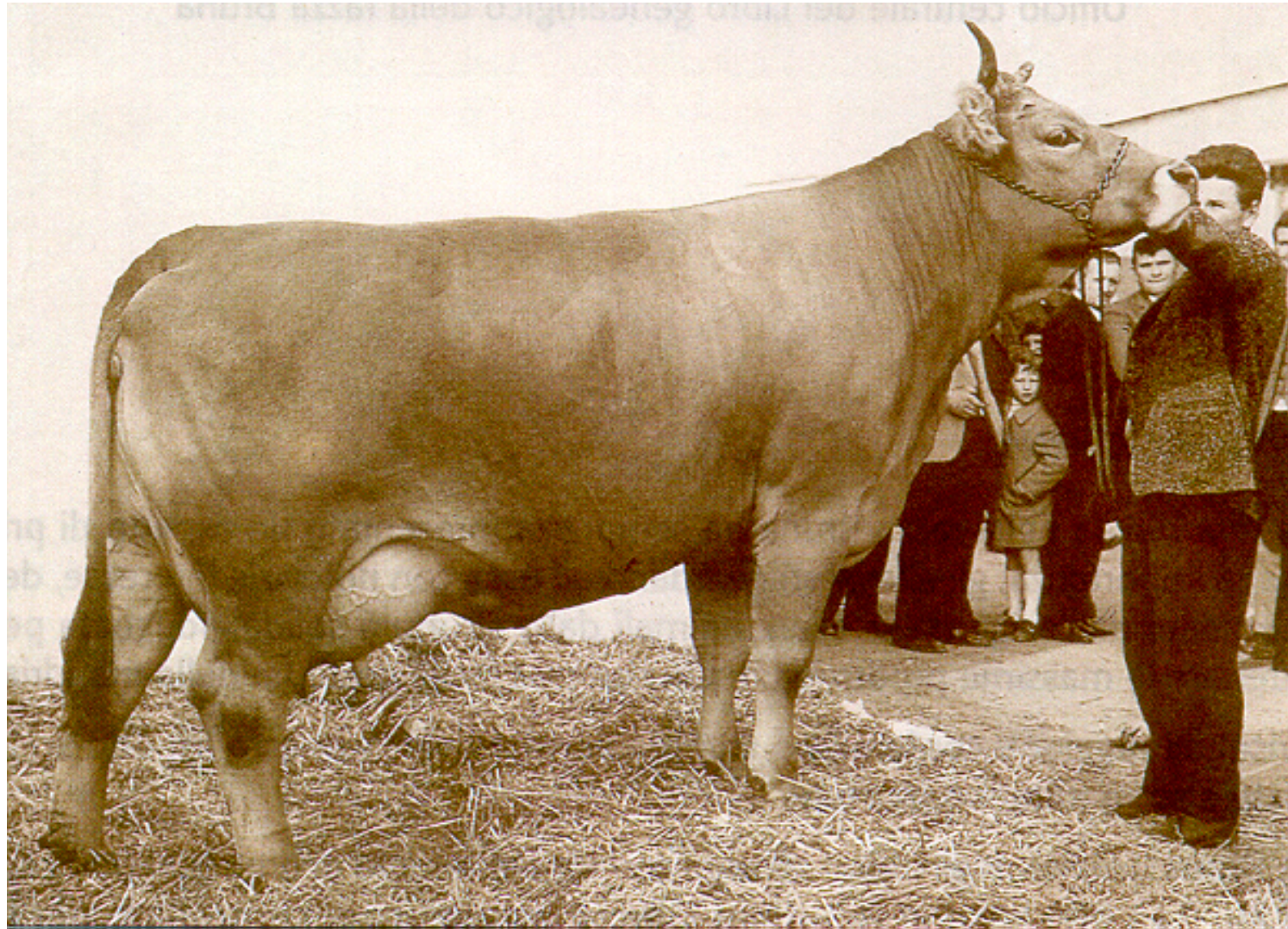


# Selection scheme

- Aosta 1980's – Mountain farming conference
  - Unbreakable link between local livestock farming and mountain maintenance
- **Maintain the ability of the breed to cope with harsh mountain environment**
  - Long-living, frugal, able to live on coarse forage
  - Adapted to harsh climate
  - Resistance and resilience to pathologies



# Selection changes animals...





# Selection changes animals...







Double purpose - dairy / beef  
Adaptive selection → environment  
Weak directional selection → meat and milk

Specialized - dairy  
Strong directional selection → milk



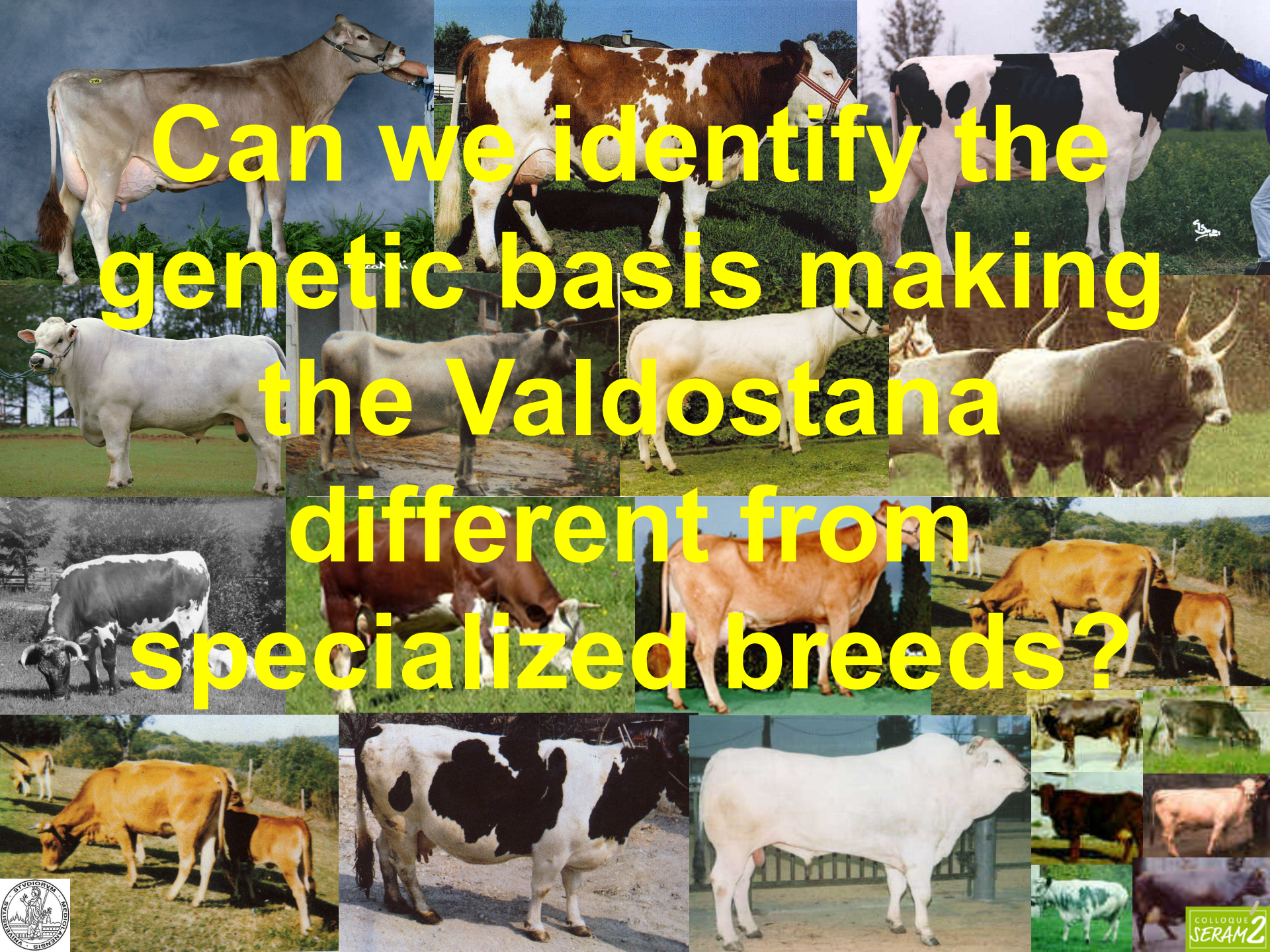
Double purpose - dairy / beef  
Adaptive selection → environment  
Directional selection → meat and milk

1980's



Specialized: dairy  
Strong directional selection → milk





Can we identify the  
genetic basis making  
the Valdostana  
different from  
specialized breeds?



# A copy number variant scan in the autochthonous Valdostana Red Pied cattle breed and comparison with specialized dairy populations

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In Press



# DNA variation

- A small change in DNA sequence

GGGGGACCTAGA



GGGGGA<sup>A</sup>CTAGA

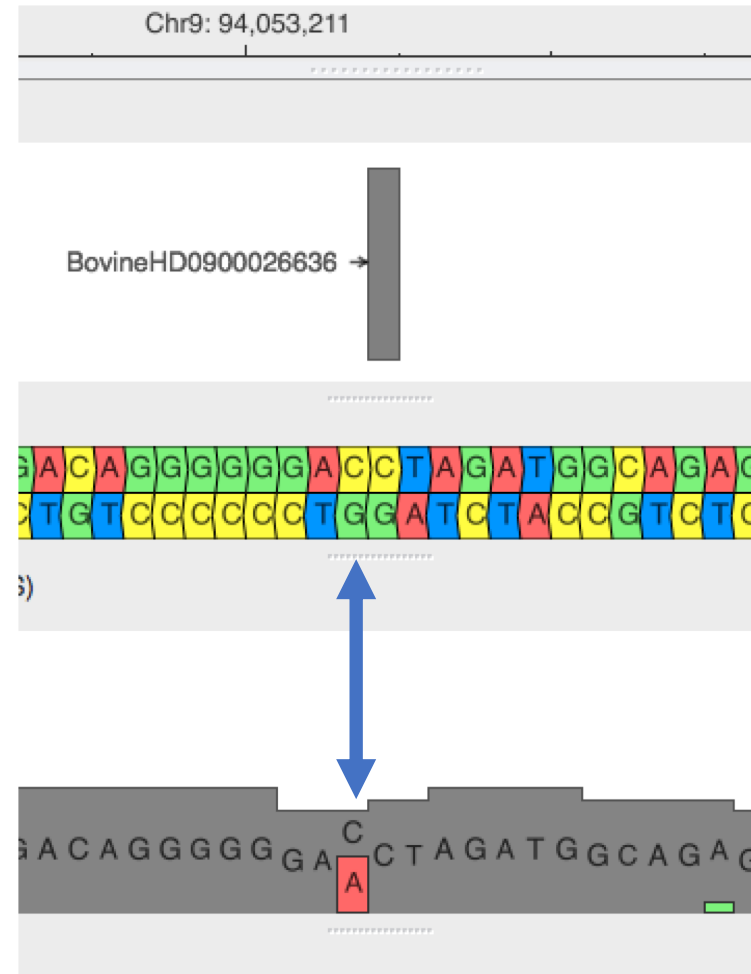
- Single Nucleotide Polymorphism (SNP)

GGATGT-GGTCG

GGATGT<sup>A</sup>GGTCG

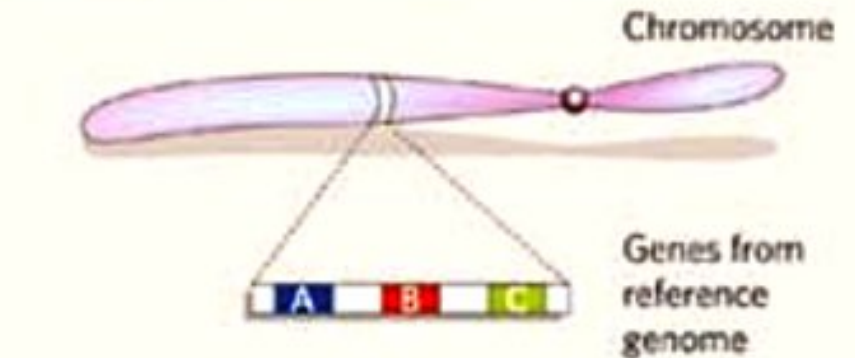
- An insertion or a deletion (indel)

- Larger structural changes





## VARIATIONS IN OUR GENOMES



Deletion



Insertion



Inversion



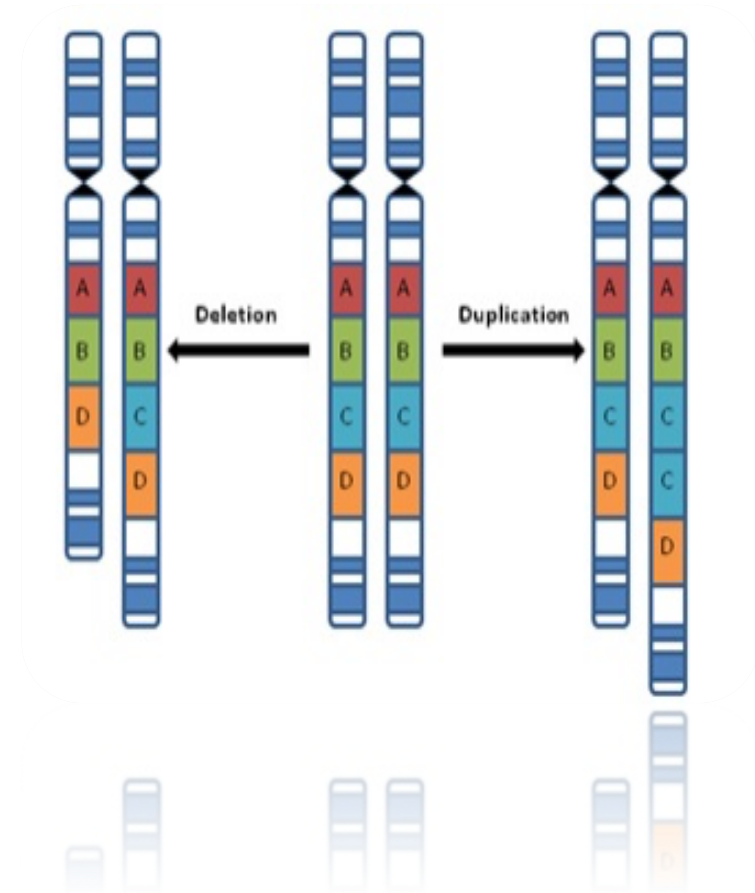
Copy-number variant



Segmental duplication



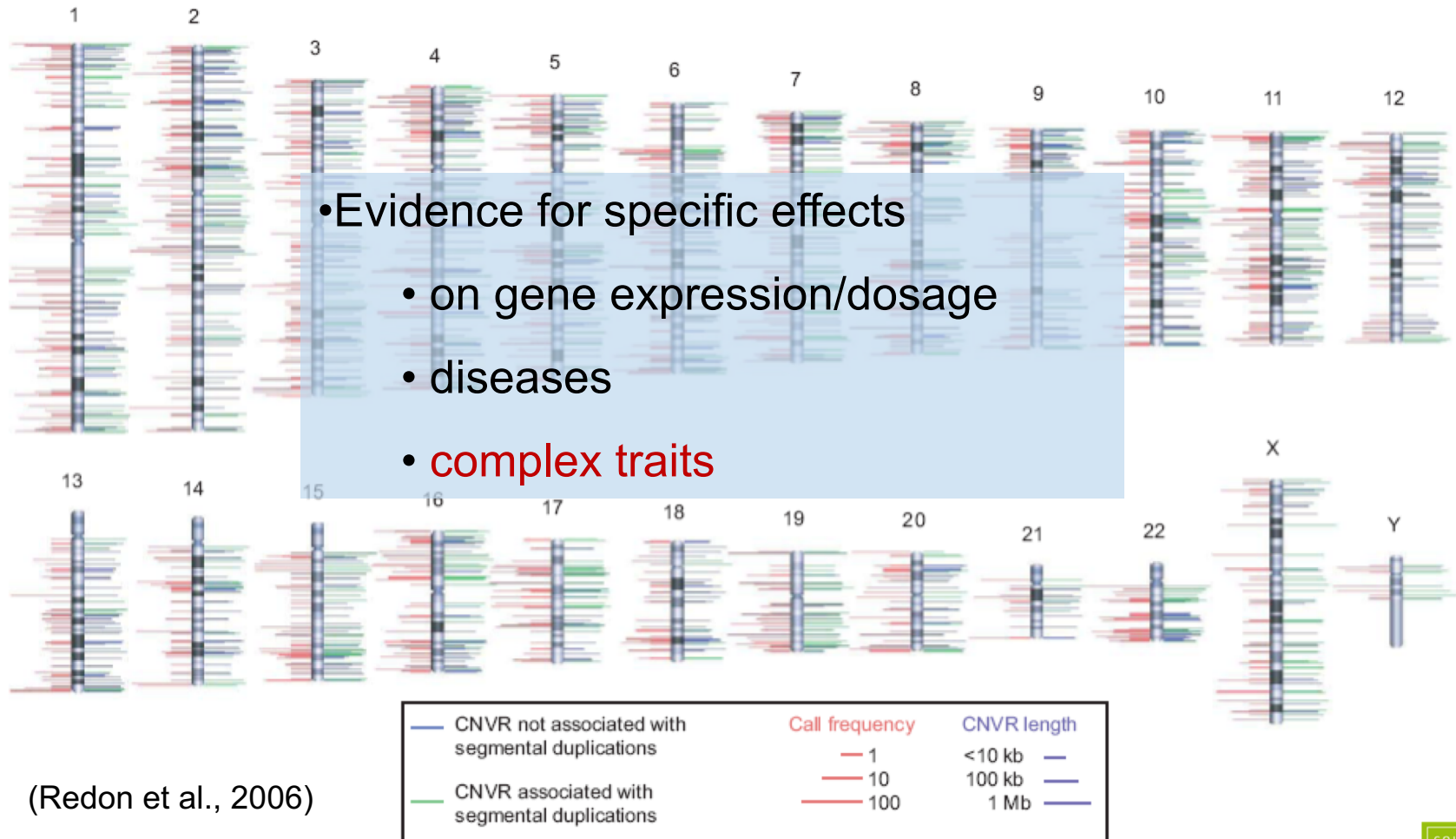
## Structural variation



Copy number variation (CNV)

# Distribution of 1447 Human CNVs

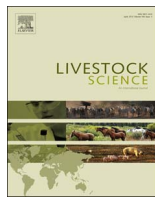
From 150 apparently healthy individuals in the human HapMap project



(Redon et al., 2006)



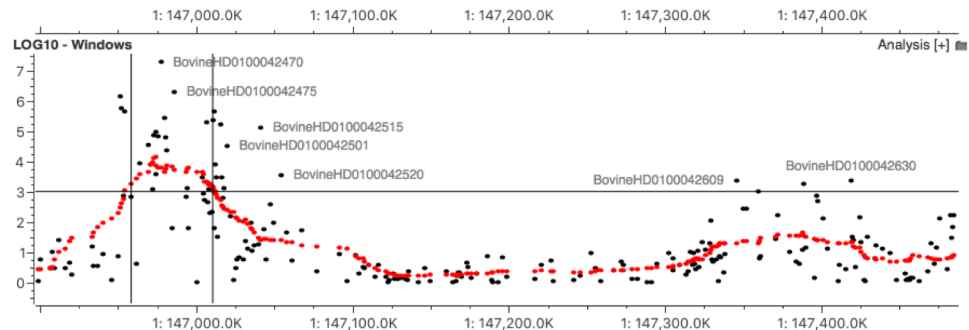
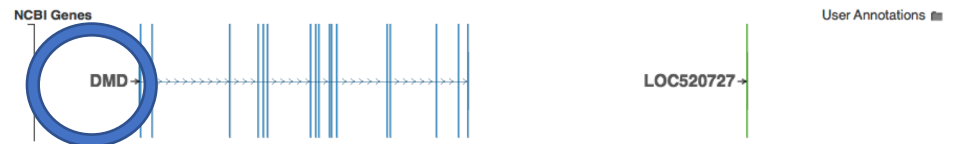
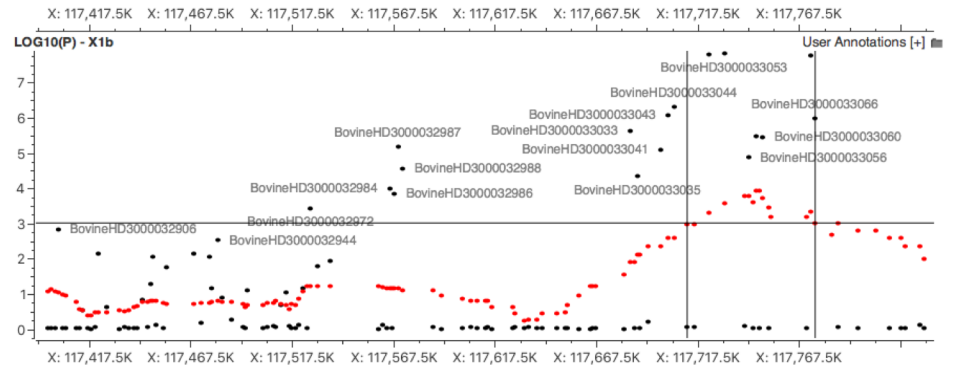
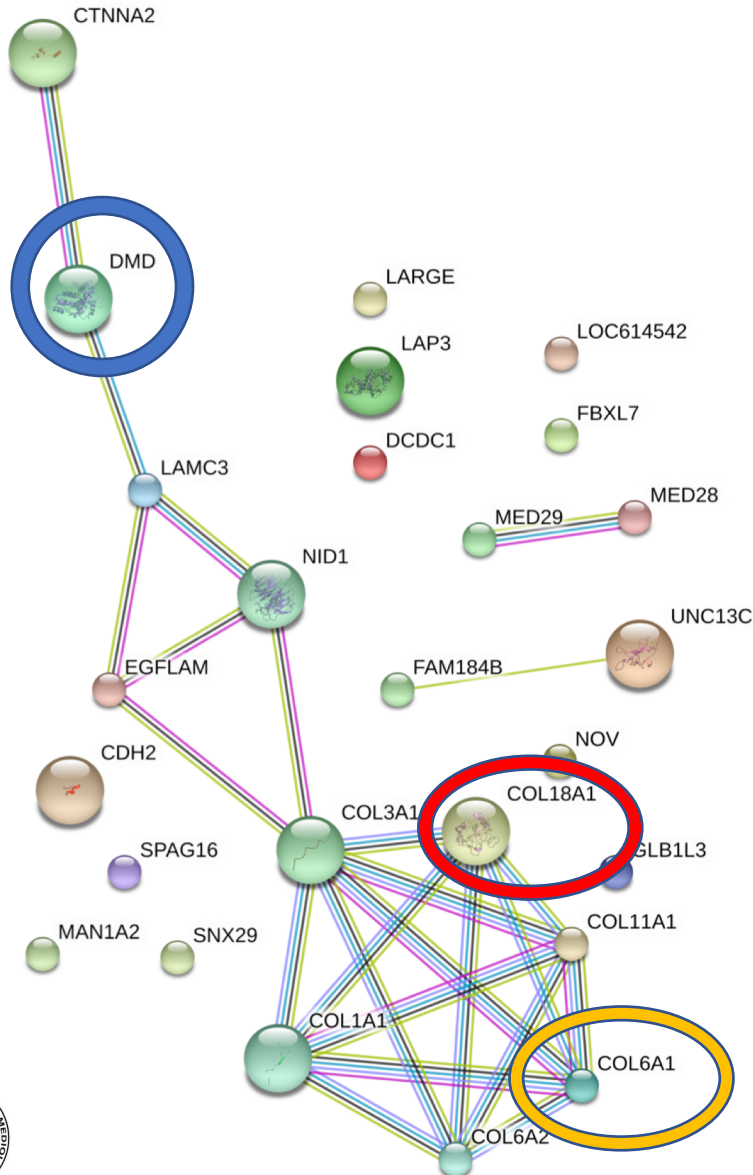




# Genetic basis of Lipomatous Myopathy in Piedmontese beef cattle

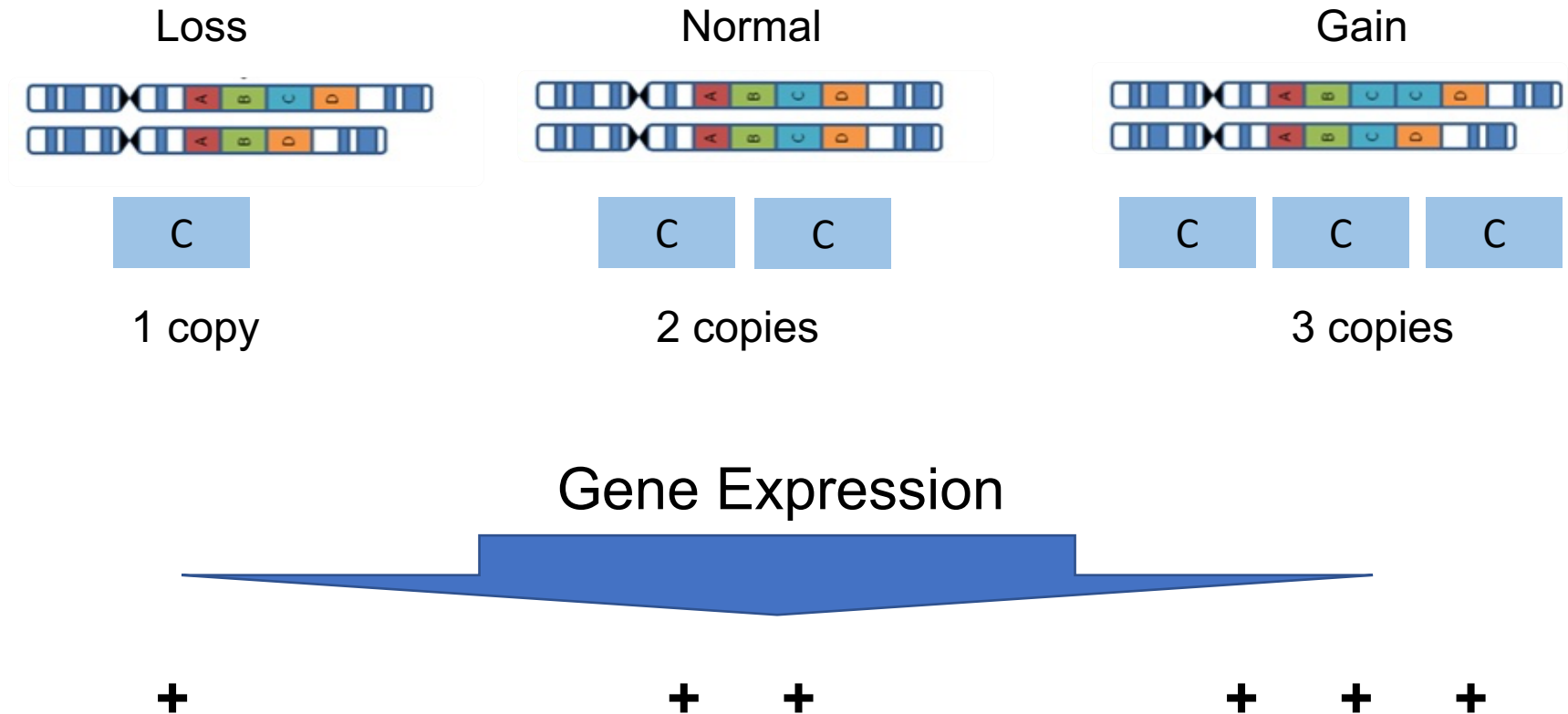
S. Peletto<sup>a</sup>, M.G. Strillacci<sup>b</sup>, M.T. Capucchio<sup>c</sup>, E. Biasibetti<sup>c</sup>, P. Modesto<sup>a</sup>, P.L. Acutis<sup>a</sup>, A. Bagnato<sup>b,\*</sup>

Livestock Science 206 (2017) 9–16



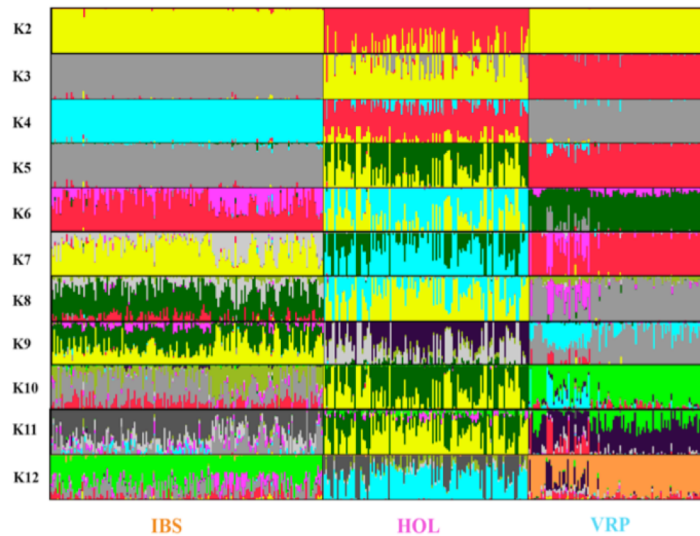
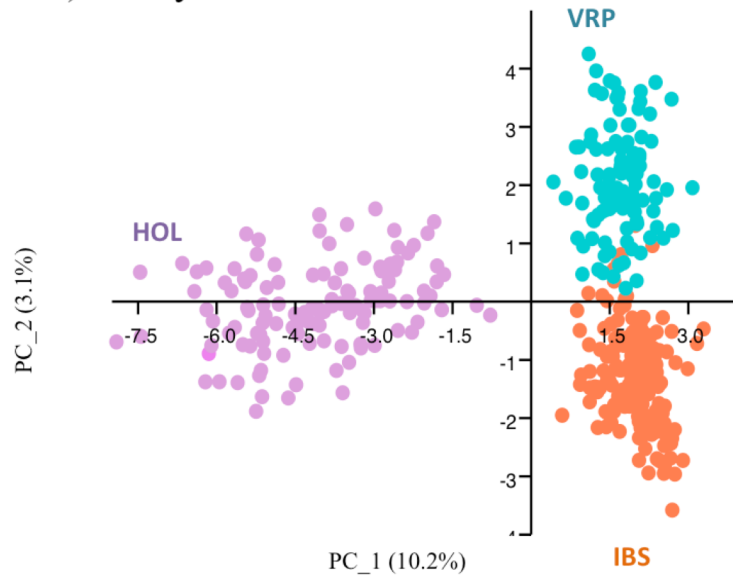
# CNV and genes

- 70 to 80% of CNVs contain genes

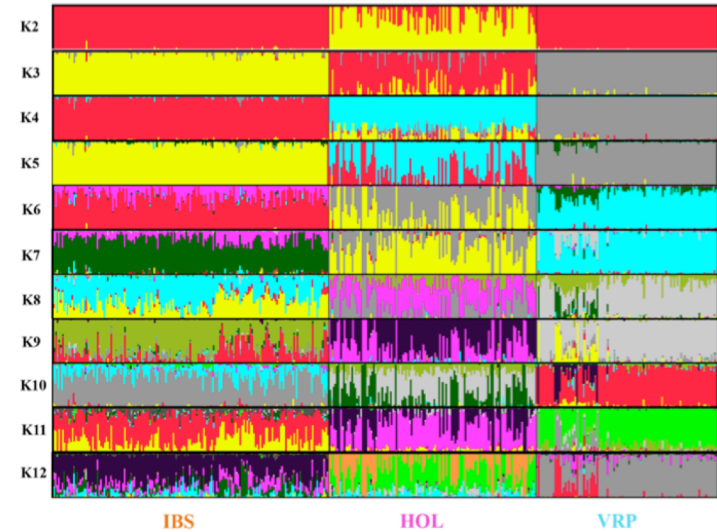
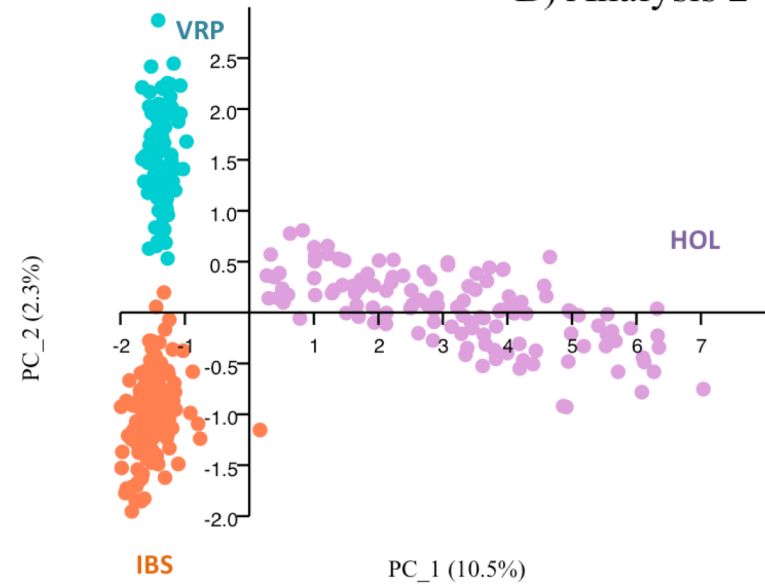




## A) Analysis 1



## B) Analysis 2



From Strillacci et al., 2018. PlosONE in press





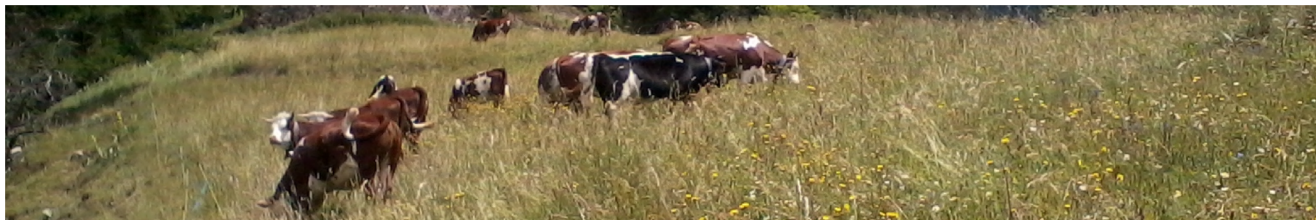




# Discussion



- Valdostana
  - Clearly differentiates from Holstein
  - In a less extent, from the Italian Brown Swiss
- Valdostana and Italian Brown Swiss
  - Share a common genetic background
- Italian Brown Swiss
  - Originally double purpose - now a dairy breed
  - In late 1980s introgression of US genetics → milk production





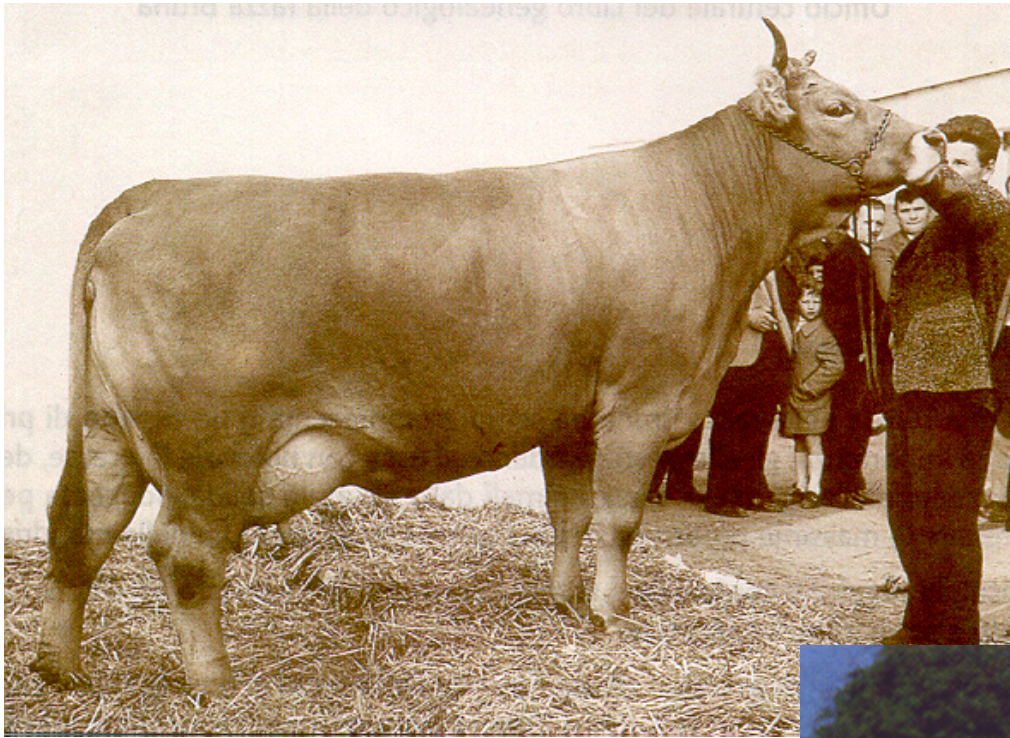
# Discussion



- Holstein
  - CNVR gain → genes mainly related to milk production
- Valdostana
  - CNVR gain → genes mainly related to functional and health traits
- Brown Swiss
  - Intermediate between HOL and VRP
  - Directional selection modified the structure, the physiology and the related genome of the population in the recent past







Directional  
Selection

For milk  
production





# Take home messages

- **Link between animal farming and mountain**
  - Fundamental for the maintenance of the pastoral system and related activities including tourism
- **Genomic information**
  - Permits to disclose the peculiar genomic characteristics of a breed and manage its breeding
- **Each population**
  - A unique livestock resource, adapted to a specific environment
- **Each breed needs a specific management**
  - for its breeding plans
  - for its farming practices



Semaine Européenne des Races locales des Massifs

Oloron-Sainte-Marie

« PASTORALISME & RACES LOCALES »

16-17-18 septembre 2018

