

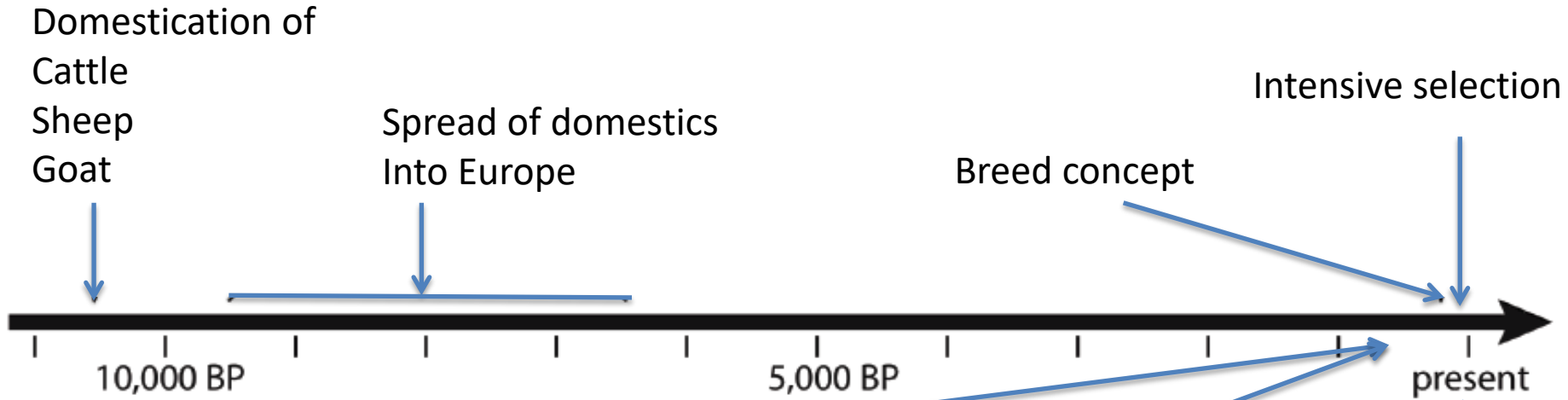
# ***The domestication history of sheep and goat***

Pablo Orozco-terWengel, F. Alberto, I. Streeter, M. Bruford  
& NextGen Consortium

August 2016

Belfast

# The timeline of domestication



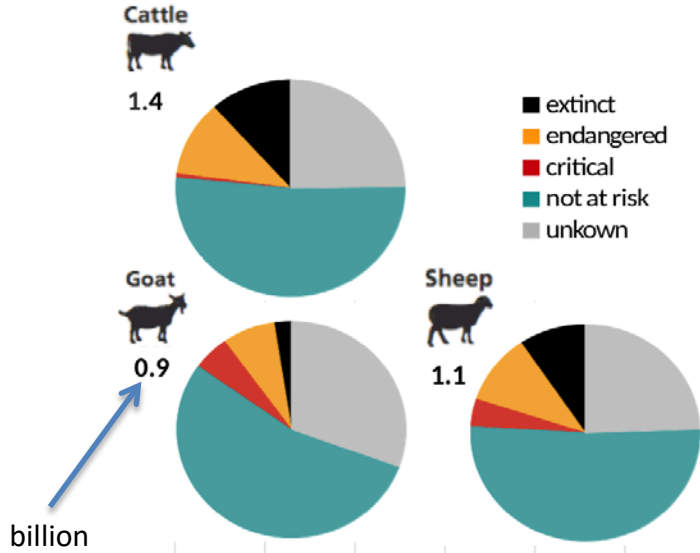
Paulus Potter (1625-1624)



Anthonie van Borssum (1630-1677)

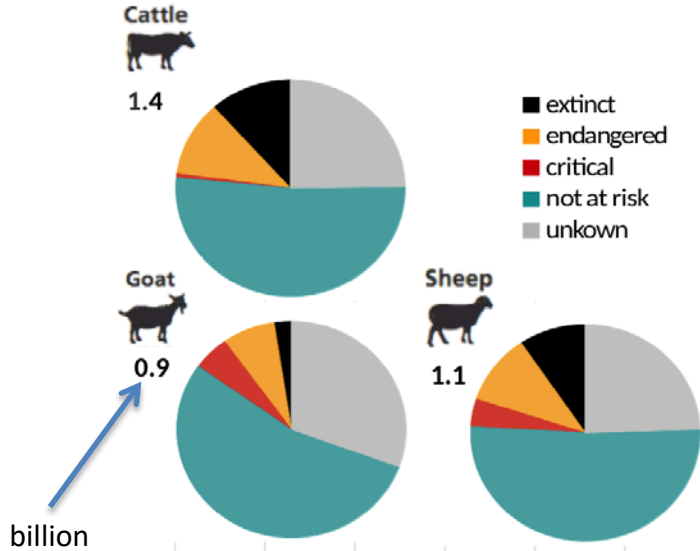


# Are cattle, goats and sheep endangered species.....?



Threatened  
+  
Extinct

# Are cattle, goats and sheep endangered species.....?



Threatened  
+  
Extinct

Ne Holstein (Denmark) ~ 49 (N~3.7m)

Ne Jersey (USA) ~ 30 (N ~0.55m)

Ne Japanese Black (Japan) ~ 17 (N~ 0.53m)

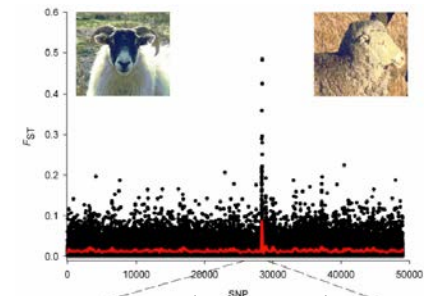


Ne ~ 627 (~N 3000)



nextgen

: Develop optimized methodologies for preserving farm-animal biodiversity in the context of whole genome data availability



# Genetic variation in Wild ancestors and Domestics

Species	Origin	Code	Sample size
<i>O. orientalis</i>	Iran	IROO	16
<i>O. aries</i>	Iran	IROA	20
	Morocco	MOOA	20
	Industrial breeds	indusOA	20
<i>C. aegagrus</i>	Iran	IRCA	19
<i>C. hircus</i>	Iran	IRCH	20
	Morocco	MOCH	20
	Industrial breeds	indusCH	10

~36M SNPs *Ovis*

~24M SNPs *Capra*

## Divergence between groups ( $F_{ST}$ )

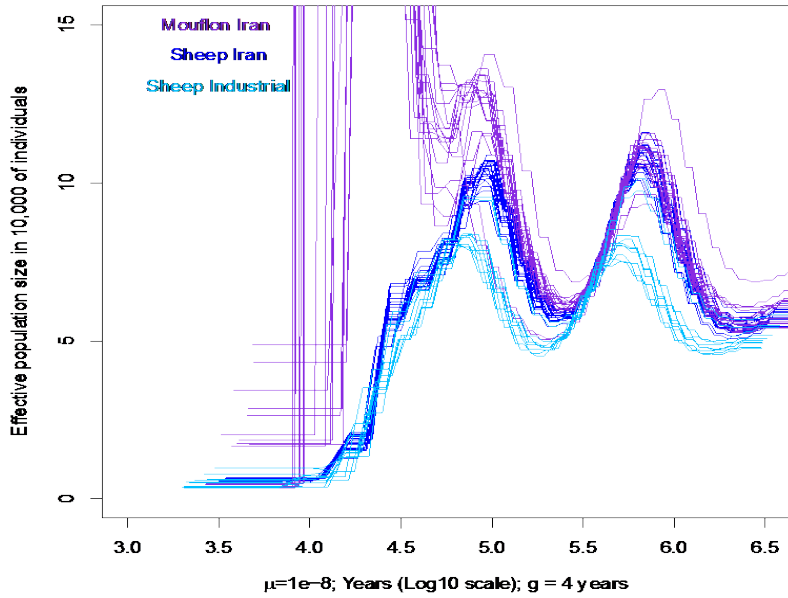
	IROA	indusOA	IROO
<b>MOOA</b>	0.017	0.007	0.087
<b>IROA</b>	-	0.011	0.088
<b>indusOA</b>	-	-	0.080

Overall 0.053

	IRCH	indusCH	IRCA
<b>MOCH</b>	0.031	0.031	0.063
<b>IRCH</b>	-	0.021	0.045
<b>indusCH</b>	-	-	0.058

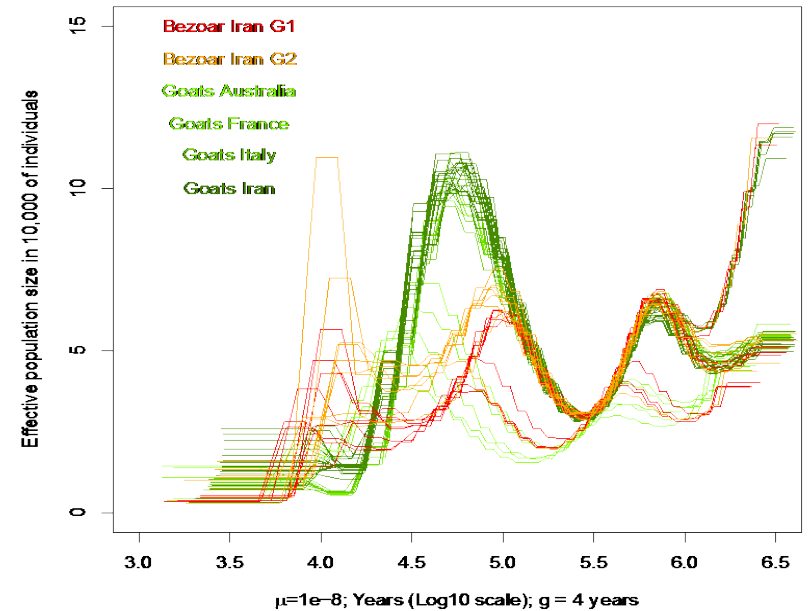
Overall 0.05

# Pairwise Sequentially Markovian Coalescent

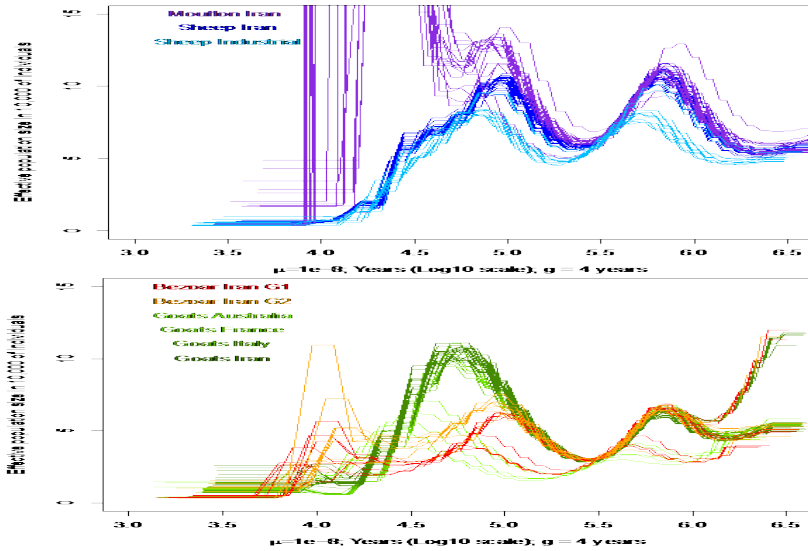


Iranian mouflon  
and  
sheep

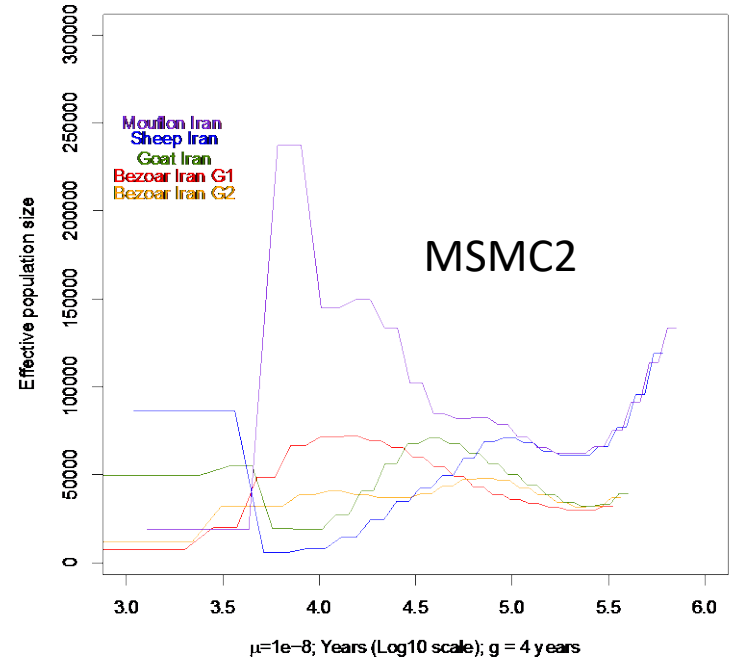
Iranian bezoar  
and  
goats



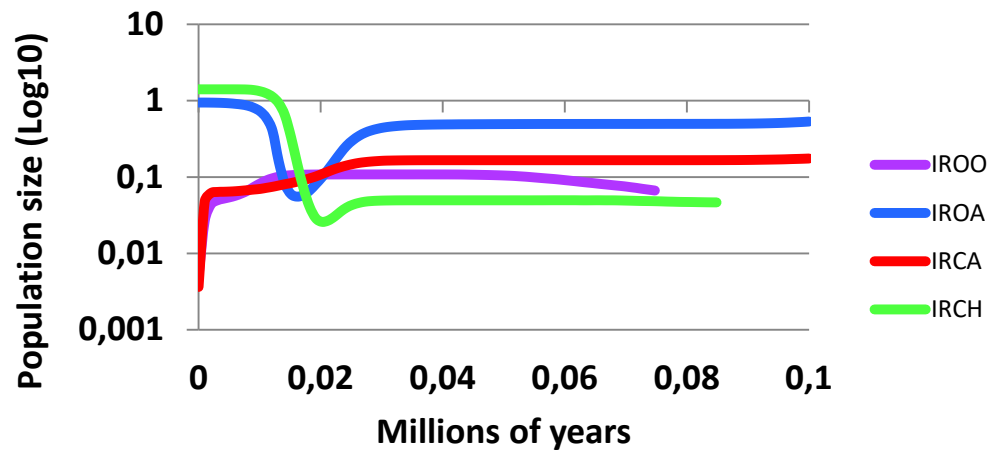
# Recent Demography



PSMC ->



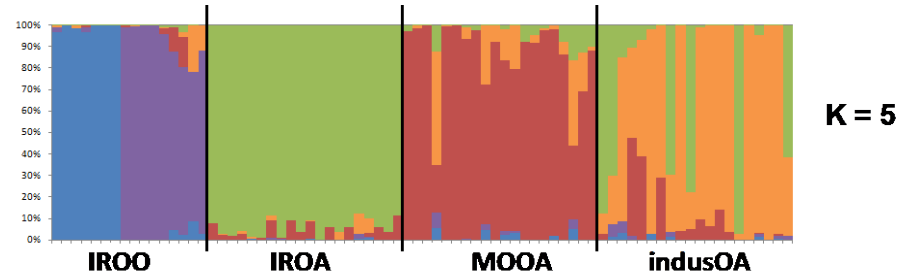
## Bayesian Skyline Plot whole mtDNA



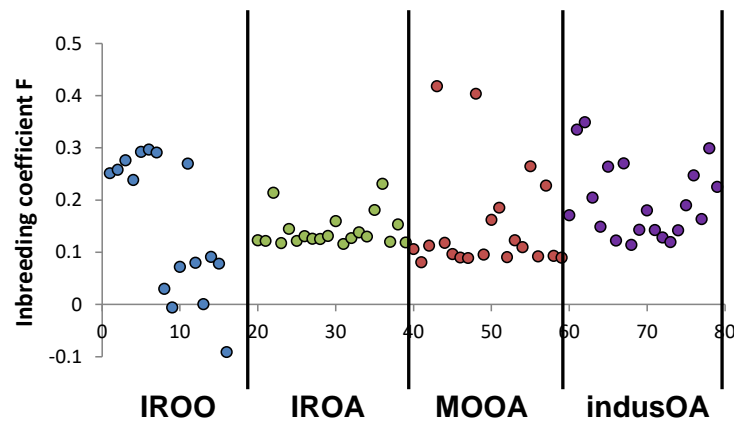


# Genetic variation in Ovis

mouflon = IROO  
Iranian = IROA  
Moroccan = MOOA  
Industrial = indusOA

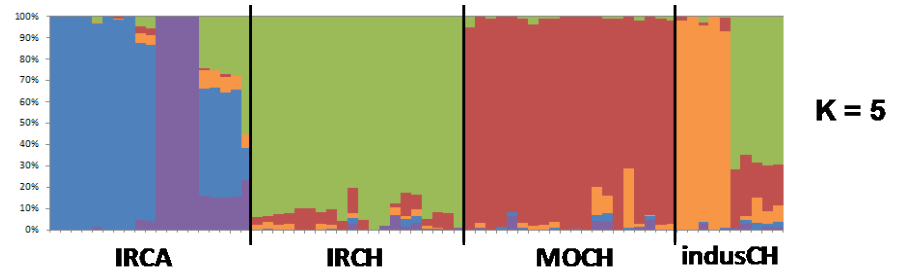


	IROA	MOOA	indusOA	IROO	IROO-1	IROO-2
<b>Sample size</b>	20	20	20	16	9	7
<b>Nb. SNPs</b>	25.6 M	27.2 M	25.1 M	30.1 M	28.5 M	14.3 M
<b>mean pi</b>	<b>0.139</b>	<b>0.145</b>	<b>0.141</b>	<b>0.210</b>	<b>0.171</b>	<b>0.114</b>
<b>mean F</b>	<b>0.15</b>	<b>0.16</b>	<b>0.20</b>	<b>0.20</b>	<b>0.06</b>	<b>0.27</b>

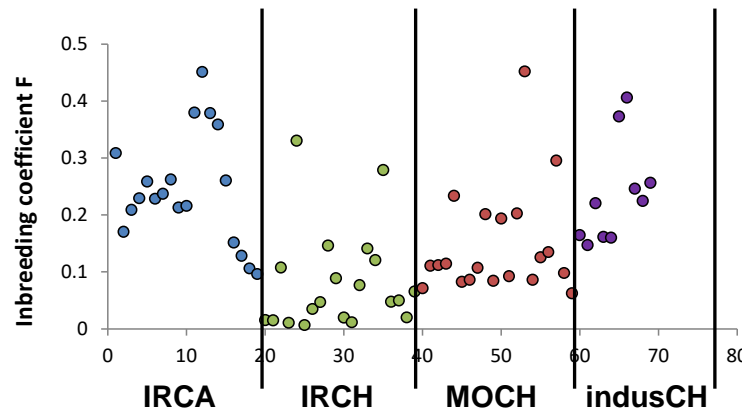


# Genetic variation in Capra

Bezoar = IRCA  
 Iranian = IRCH  
 Moroccan = MOCH  
 Industrial = indusCH



	IRCH	MOCH	indusCH	IRCA	IRCA-1	IRCA-2	IRCA-3
Sample size	20	20	10	19	10	4	5
Nb. SNPs	21.7	19.2	11.2	17.4	11.4	6.5	12.9
mean pi	<b>0.125</b>	<b>0.118</b>	<b>0.092</b>	<b>0.109</b>	<b>0.099</b>	<b>0.077</b>	<b>0.121</b>
mean F	<b>0.08</b>	<b>0.15</b>	<b>0.24</b>	<b>0.24</b>	<b>0.23</b>	<b>0.39</b>	<b>0.15</b>

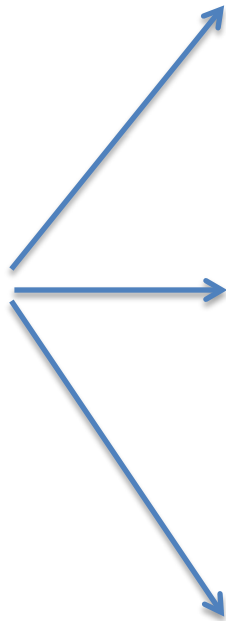


# Consistent signatures of selection

Wild vs. Domesticated



mouflon



Iran



Morocco



industrial

***XP-EHH***

Consistent Selection Signature:

SNP1      SNP9

YES      YES

YES      YES

NO      Yes

NO      Yes

# Consistent signatures of selection

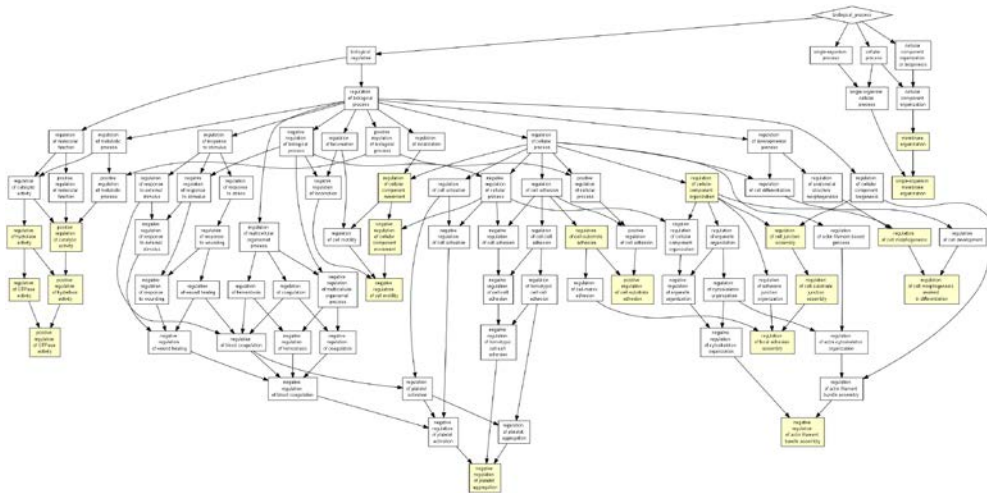


## Consistent 1 % extreme

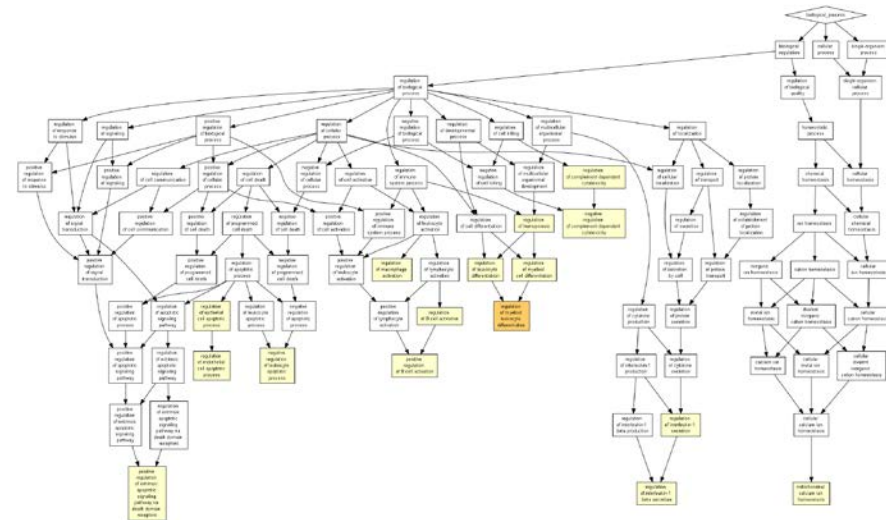
Comparison	Wild	Domestic
Mouflon Domestic	10927	15007
Bezoar Domestic	1245	805



### GO enriched in Mouflon



### GO enriched in Sheep



# Consistent signatures of selection



Consistent 1 % extreme

Comparison	Wild	Domestic
Mouflon Domestic	10927	15007
Bezoar Domestic	1245	805



GO enriched in Mouflon

GO enriched in Sheep

20 categories

e.g. morphogenesis,  
hydrolyzation, and  
organization

15 categories

e.g. differentiation,  
hematopoiesis and 6 GO on  
immunity

*Work in progress.....*

- GO analysis on *Capra*
- Comparative analysis of the signatures of selection in both genera (domestication syndrome?)

# Acknowledgements



Padano, Italy



Teramo, Italy



Brisbane, Australia



Errachidia, Morocco



Piacenza, Italy



Grenoble, France



Lausanne, Switzerland



Cardiff, UK



Cambridge, UK



Gorgan, Iran



Makerere University  
Kampala, Uganda



Paris, France

¥€\$:



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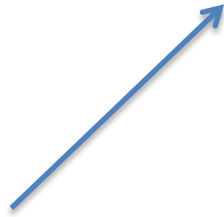
# The Adaptive landscape

## Consistent signatures of selection II:

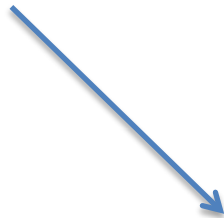
Comparison Domesticats Iran vs. Rest



Iran



Morocco



industrial

SNP1

SNP9

YES

YES

NO

Yes

Consistent Selection Signature:

NO

Yes

## Consistent 1 % extreme

		Wild	Domestic
	Comparison		
Wild vs Domestic	Mouflon Domestic	10927	15007
	Bezoar Domestic	1245	805
		Iran	Rest
Domestication Centre vs Rest	Iran Sheep vs Rest	23230	15940
	Iran Goat vs Rest	3565	1049