المعهد الوطني للبحث الزراعي
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Institut National de la Recherche Agronomique

Genomic bases of local adaptation in sheep and goats

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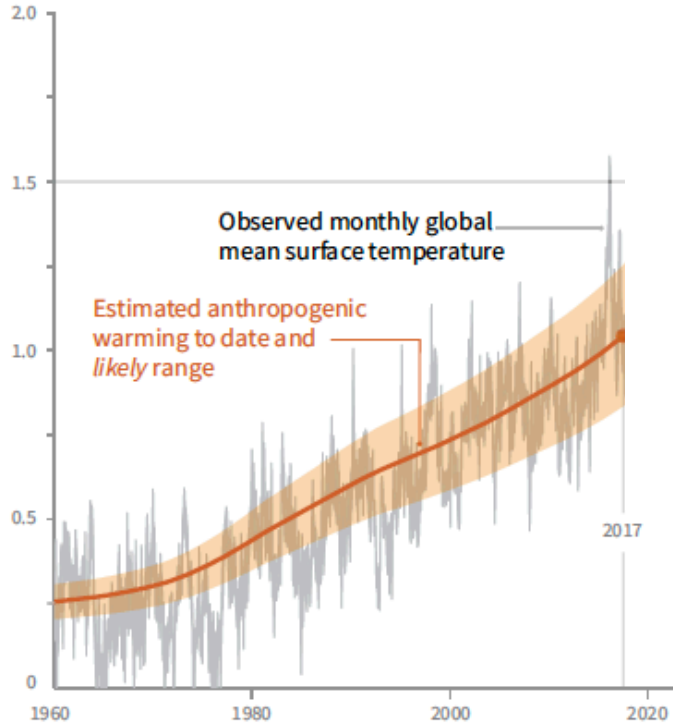
On behalf of the NextGen Consortium

INRA Morocco
CNRS-UGA France

Joint Meeting of the FAO-CIHEAM Network on Sheep and Goats. October 23, 2019

nextgen
SEVENTH FRAMEWORK PROGRAMME
EU-funded project
IMAGE
Innovative Management of Animal Genetic Resources
HORIZON 2020

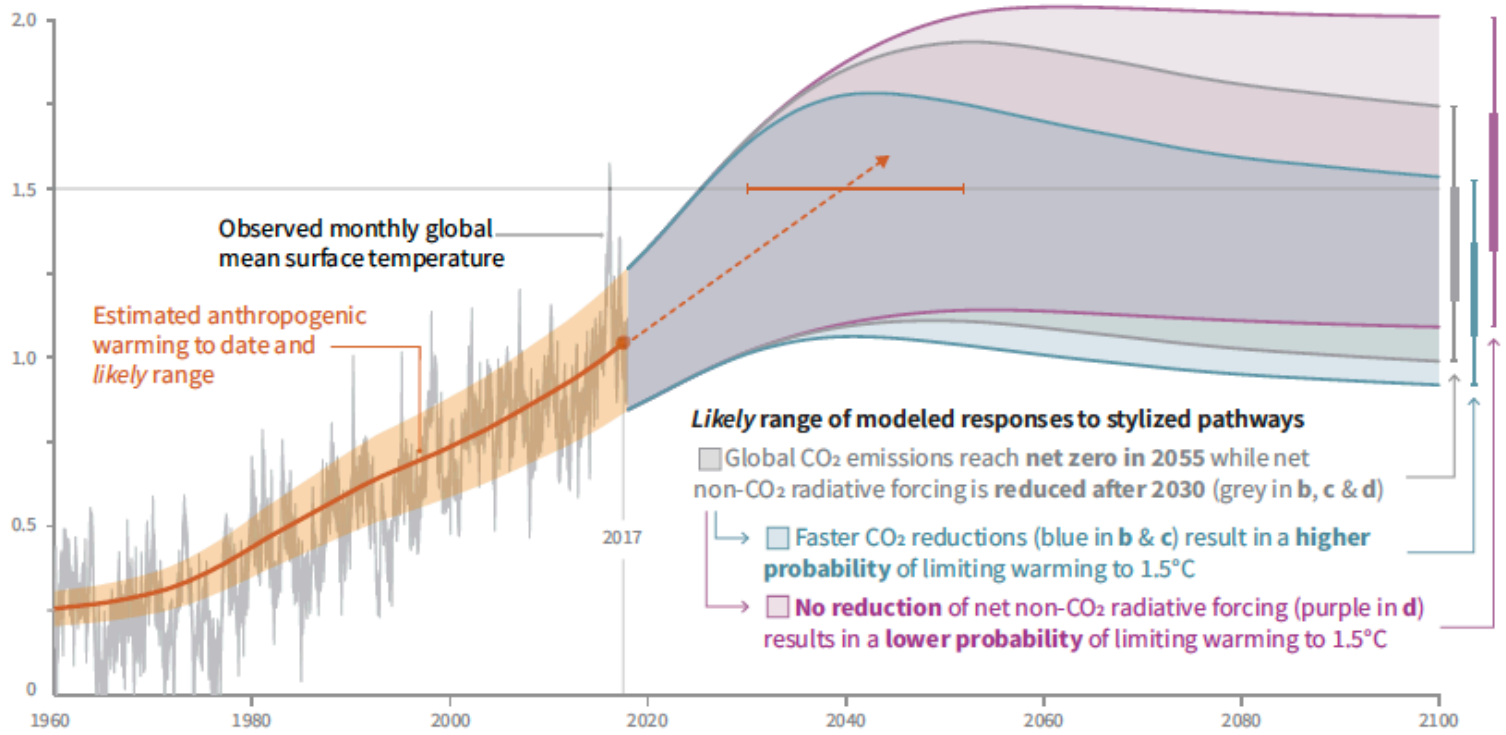
Environmental changes



Source: GW 1.5°C, IPCC, 2018

Context

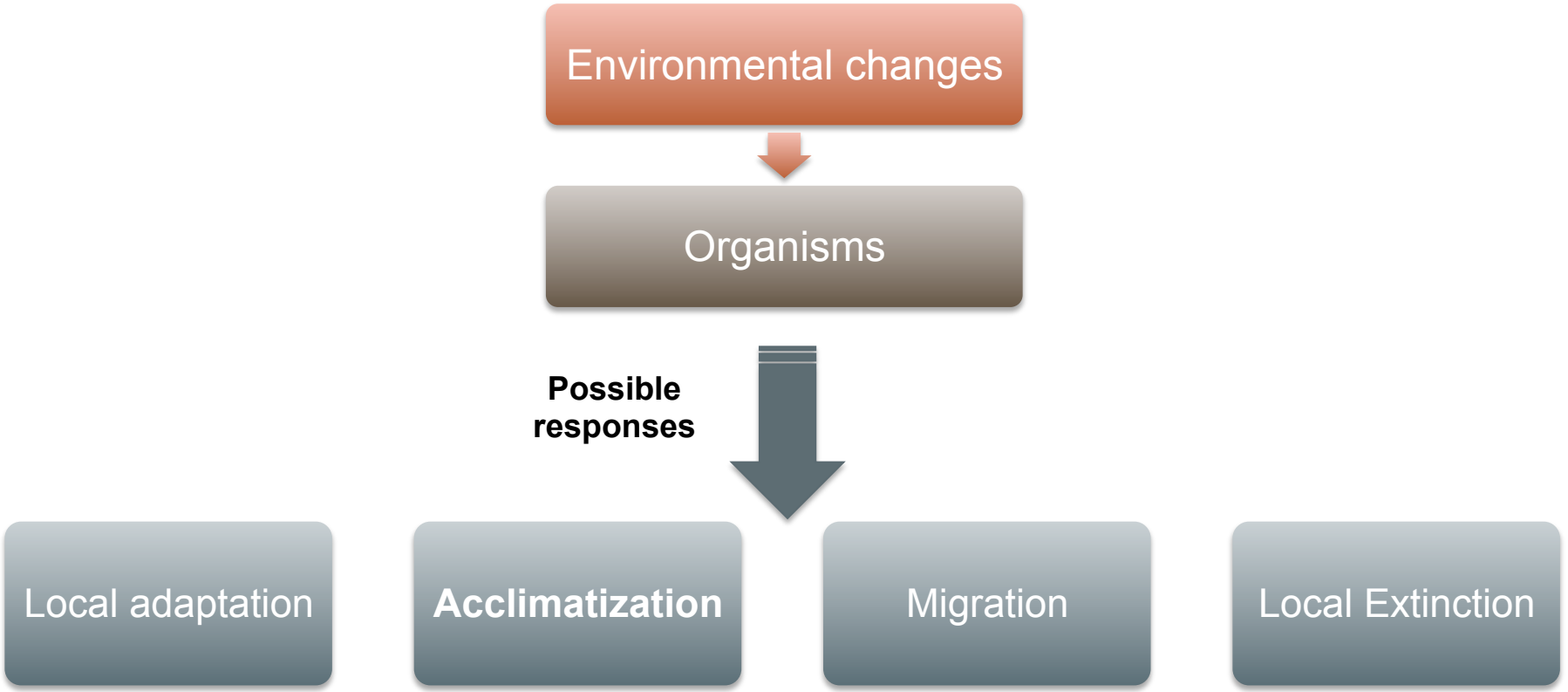
Environmental changes



Source: GW 1.5°C, IPCC, 2018

Context

Local adaptation

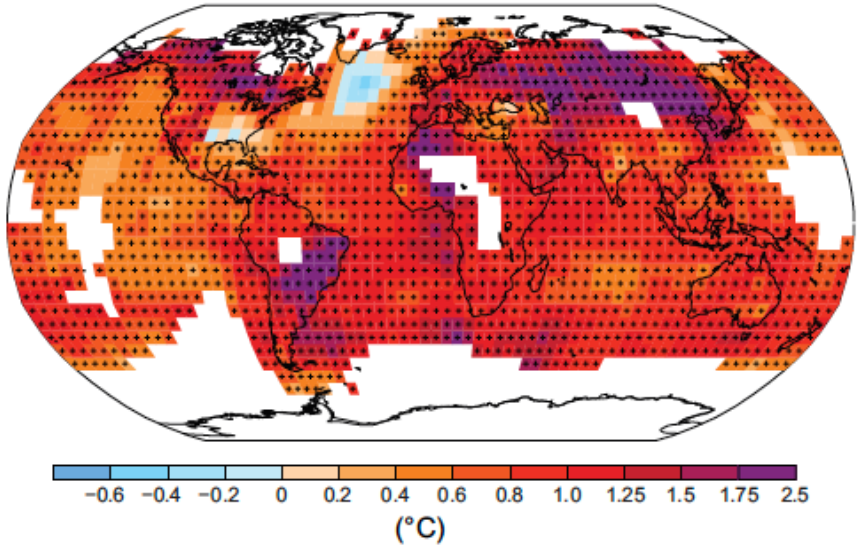


Context

Local adaptation… Genetic bases

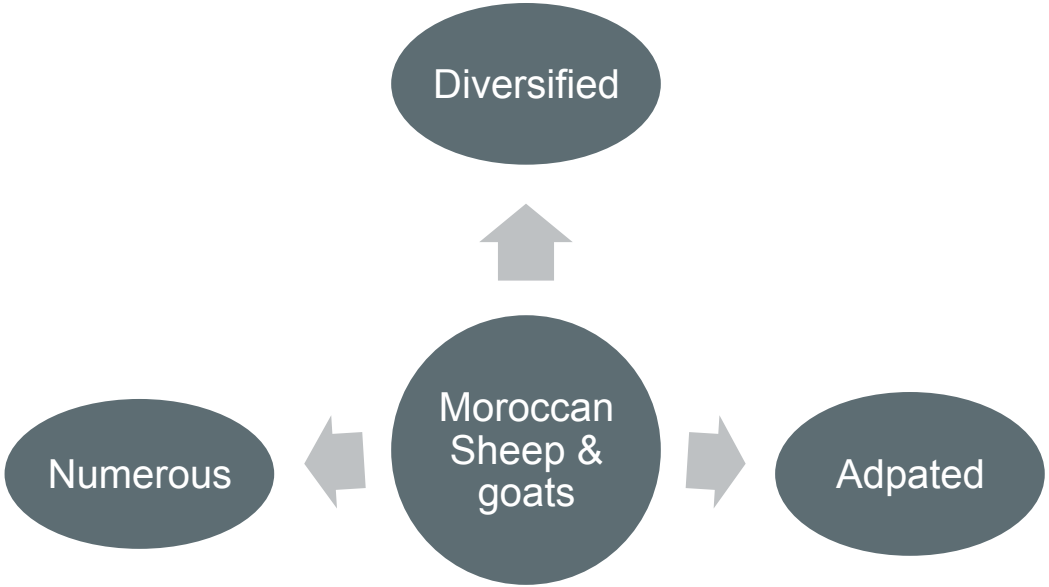
Genetic bases of adaptive mechanisms

Sustainable management of livestock genetic resources under climate changes



Context

Sheep and goats



Selection signatures linked to environmental variation in sheep and goats?

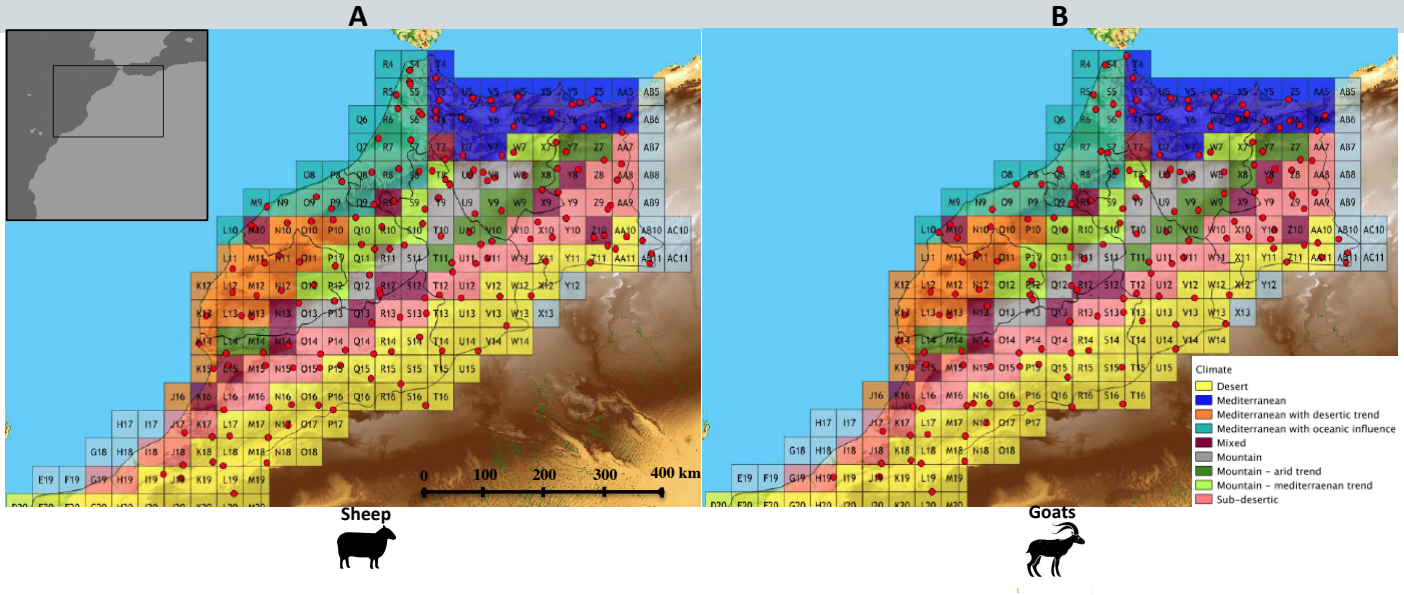
Congruence of selection signatures in both species?

Approach

Landscape genomics framework

1412 sheep and 1283 goats sampled in the Northern part of Morocco (≈ 450,000 km^2)

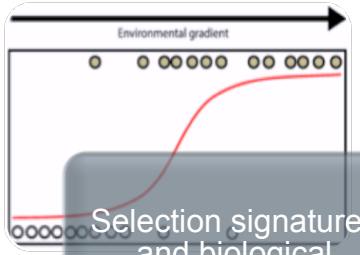
164 sheep and 164 goats selected to maximise coverage of environmental gradients



Approach

Whole genome sequences: 160 sheep and 160 goats

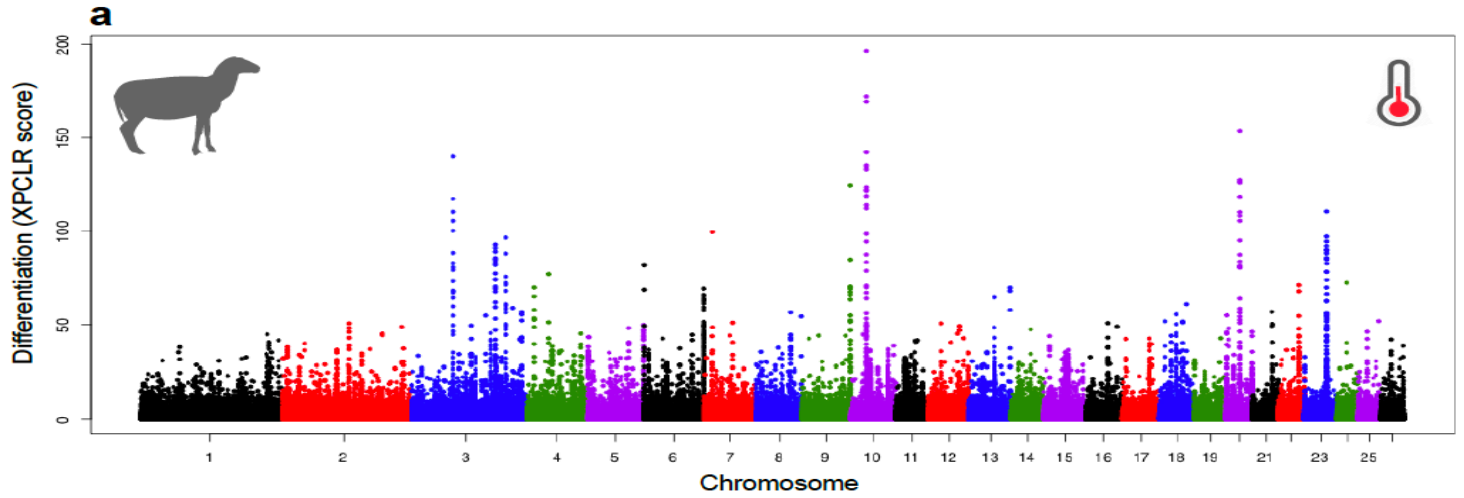
14 environmental variables: Altitude, Slope, Solar radiation, Temperature, Rainfall



Selection signatures and biological processes involved in local adaptation

Results

Genomic regions under selection



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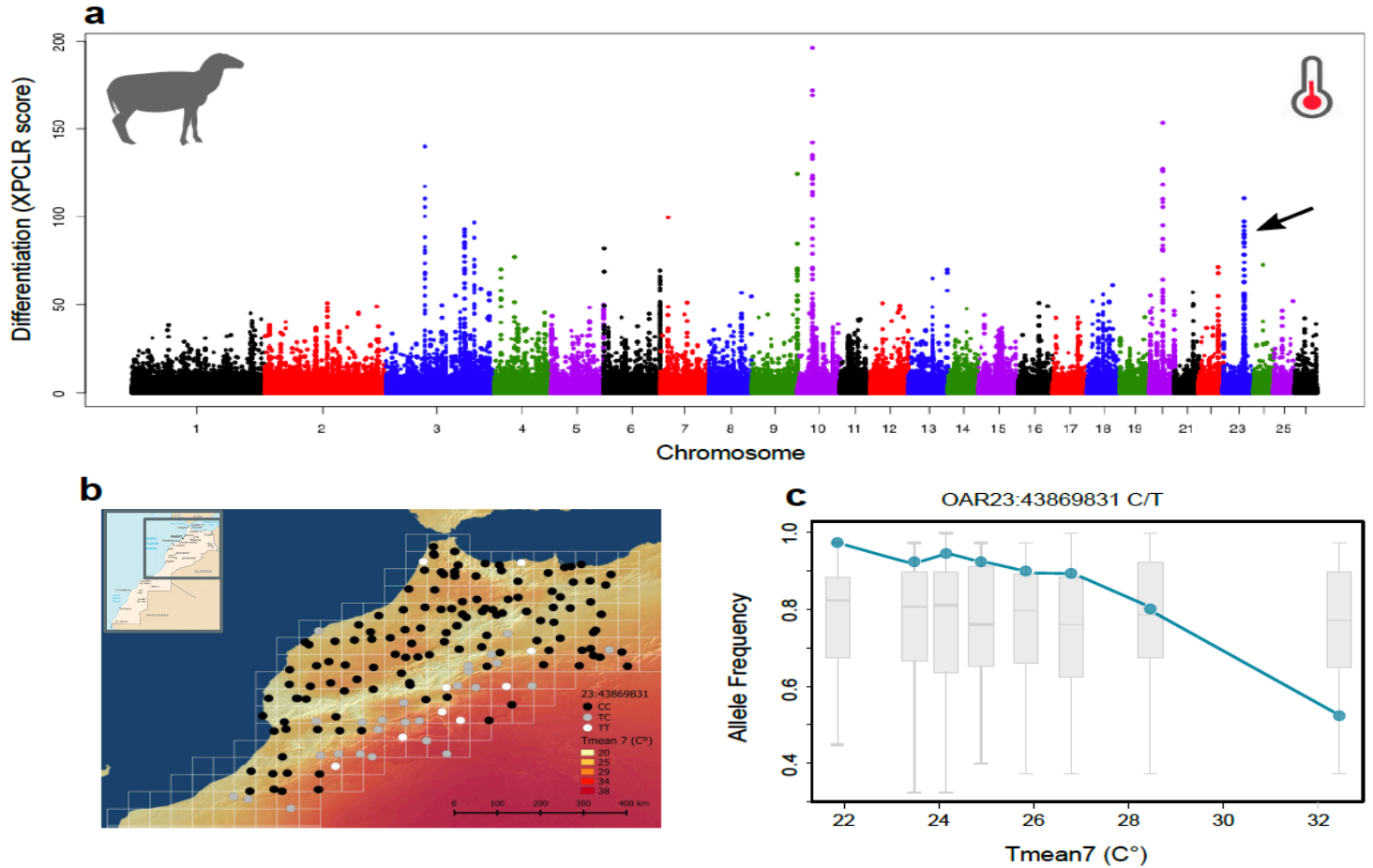
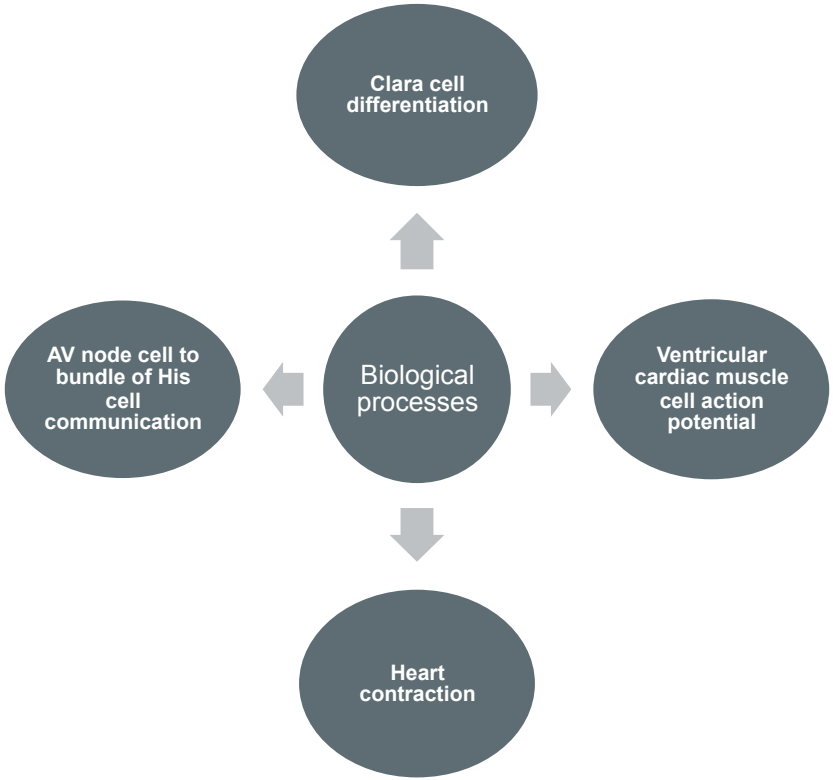


Results

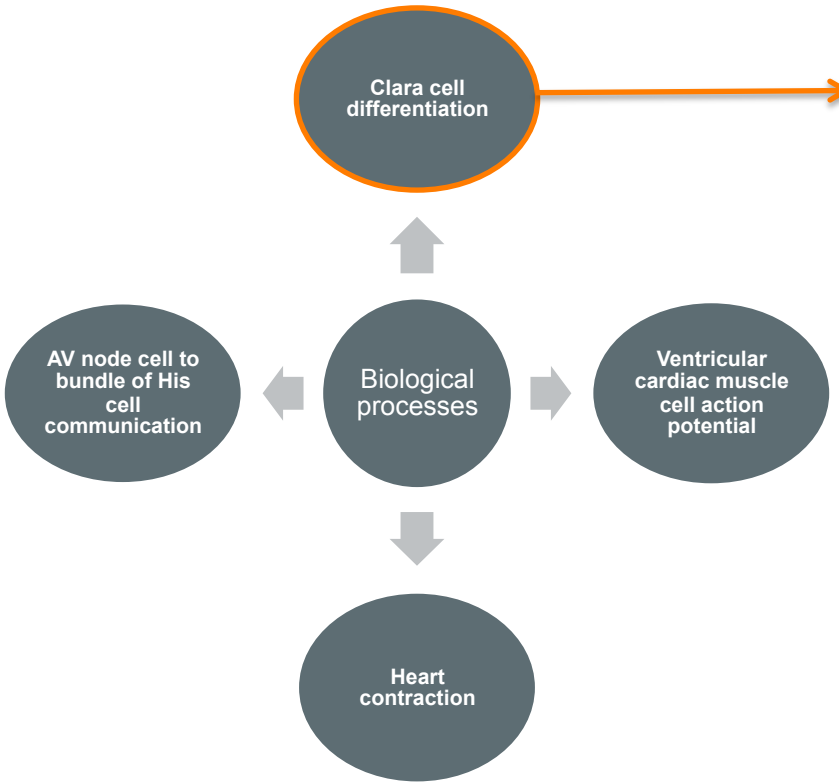
Biological processes



Goats

Results

Biological processes

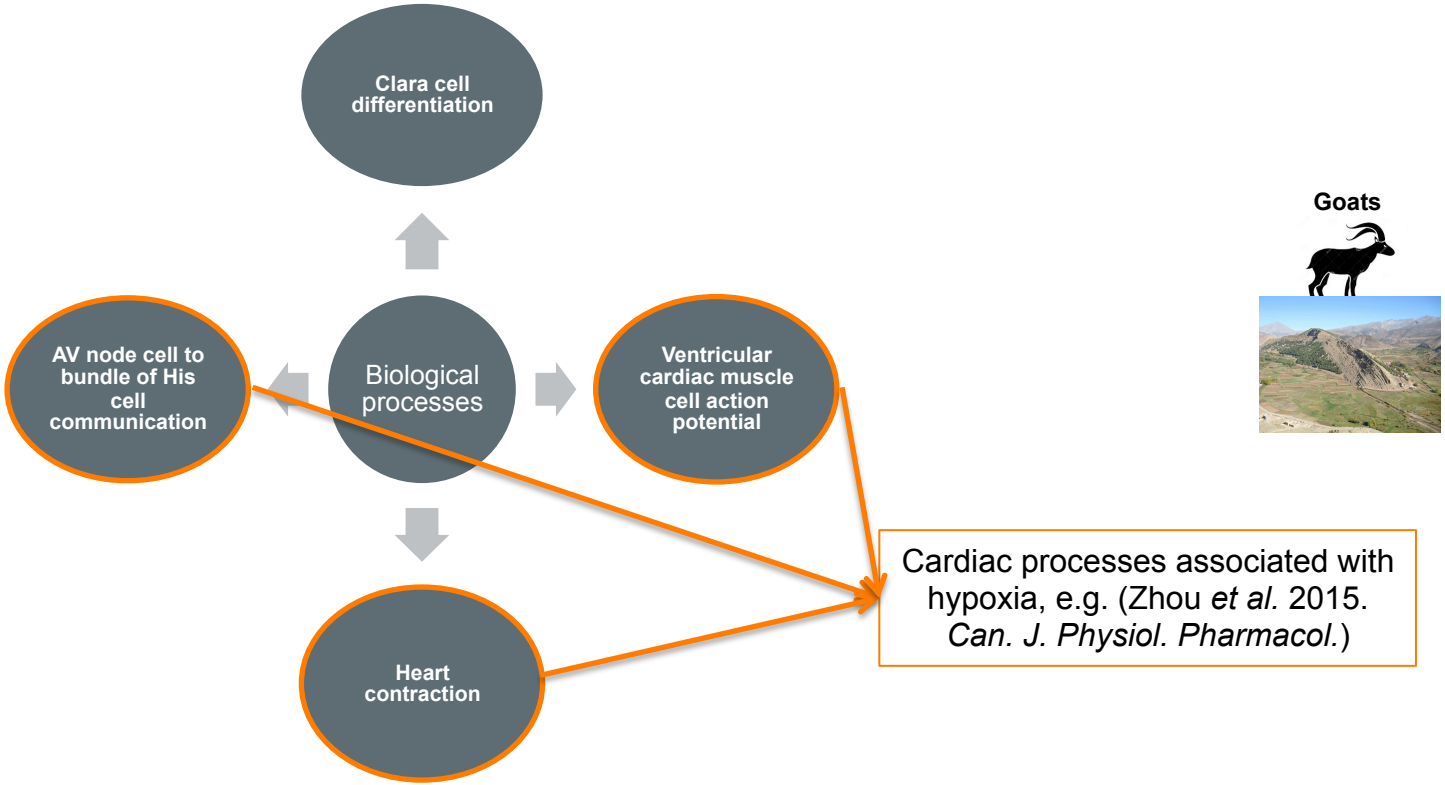


Association with high altitude in lama (Heath *et al.* 1976. *Exp. Cell. Biol.*) and with hypoxia in rabbits (Uhlik *et al.* 2005. *Vet. Med.*)

Goats

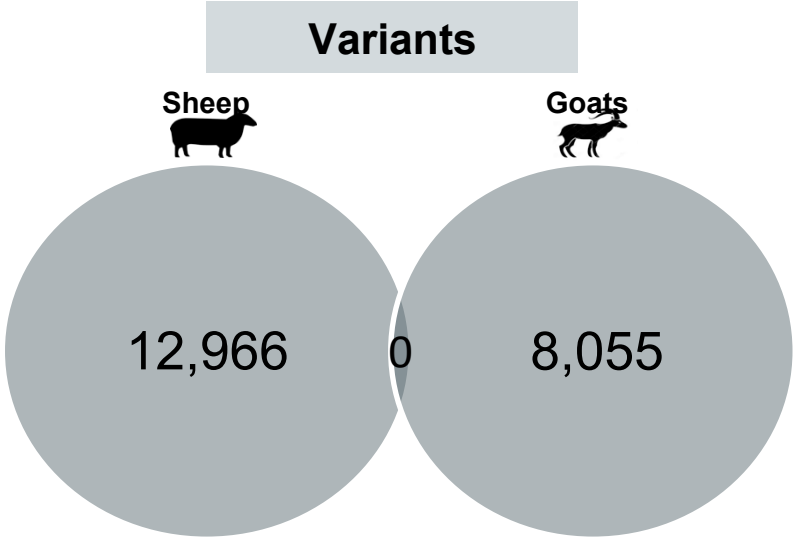
Results

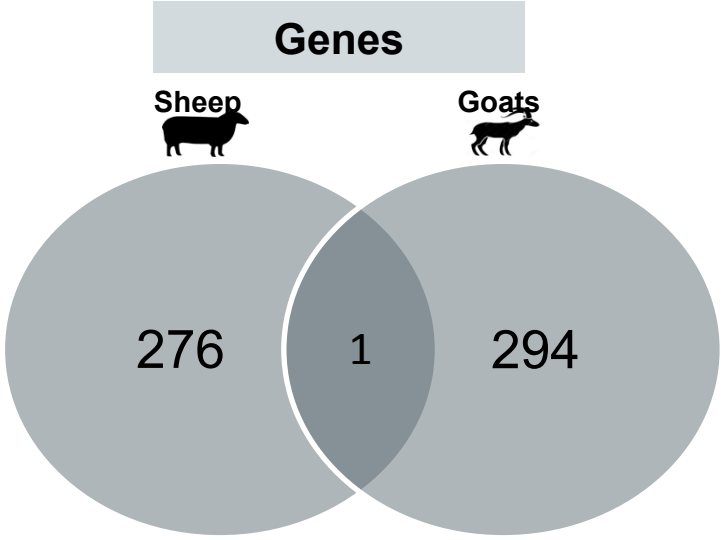
Biological processes



Results

Congruence of selection signatures





One common genomic region

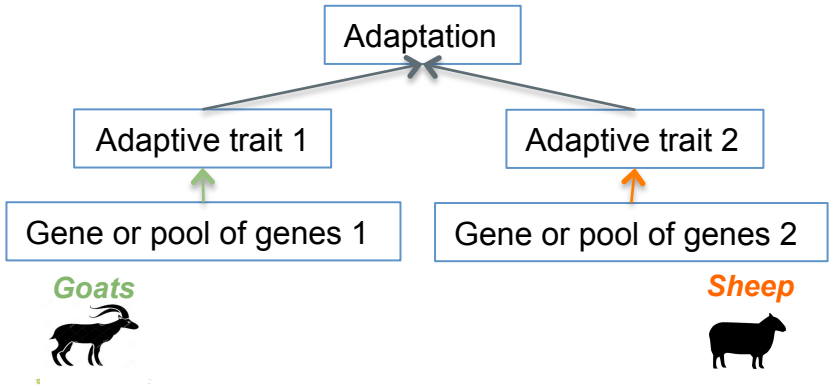
One common gene associated to sunshine duration (*CA2*)

No similar biological processes

Highlights …

Adaptive convergence

Divergent adaptation?



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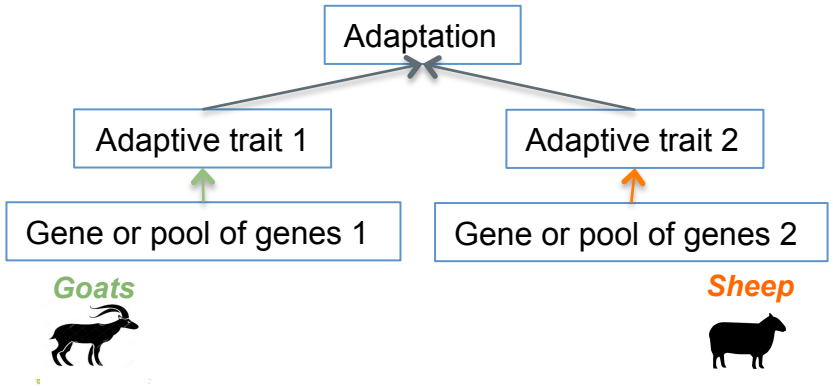
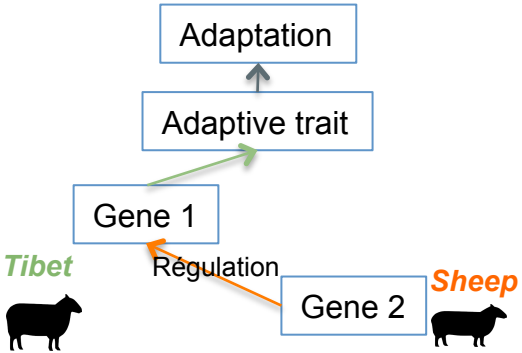


***MCM3, EPAS1* (hemoglobin)**



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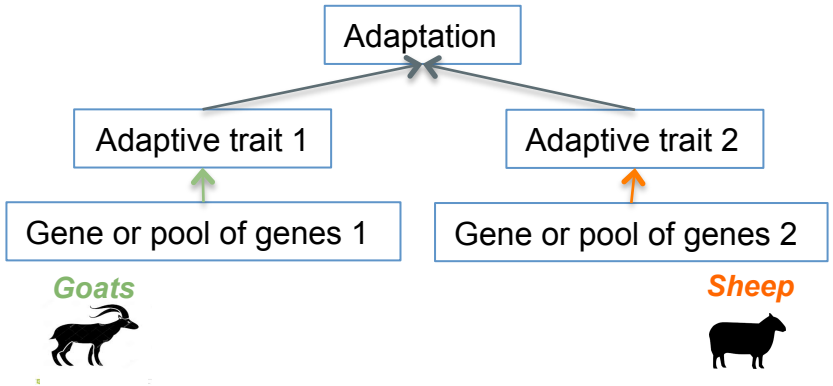

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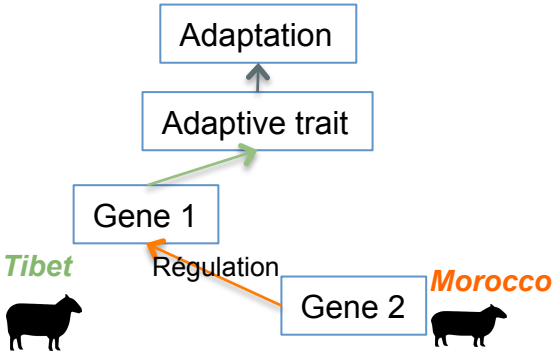
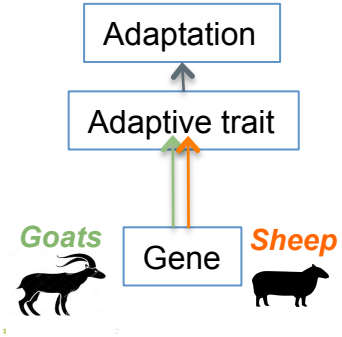
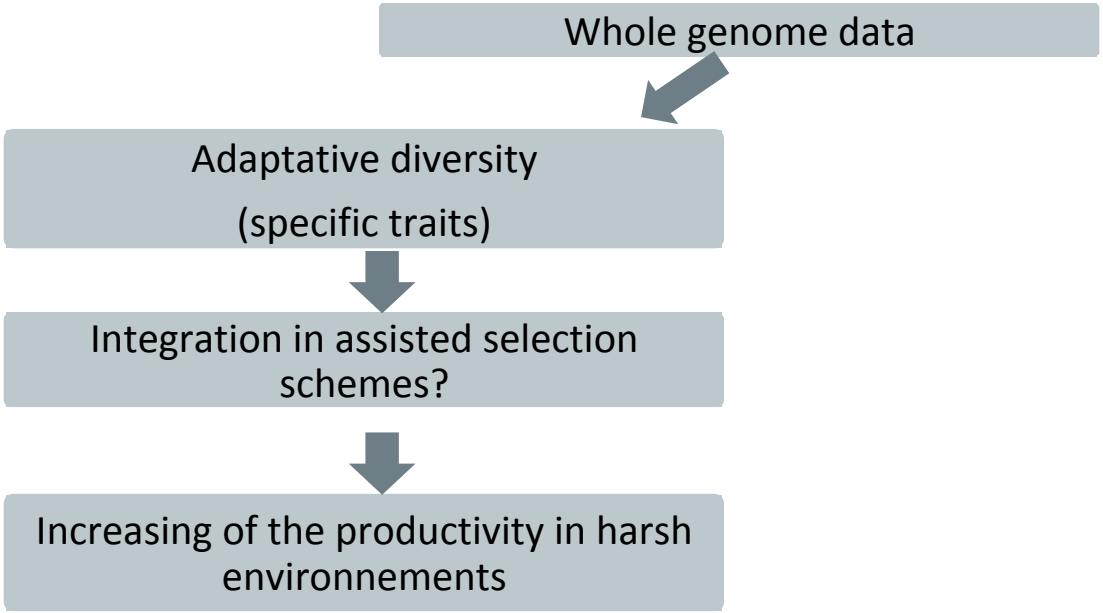


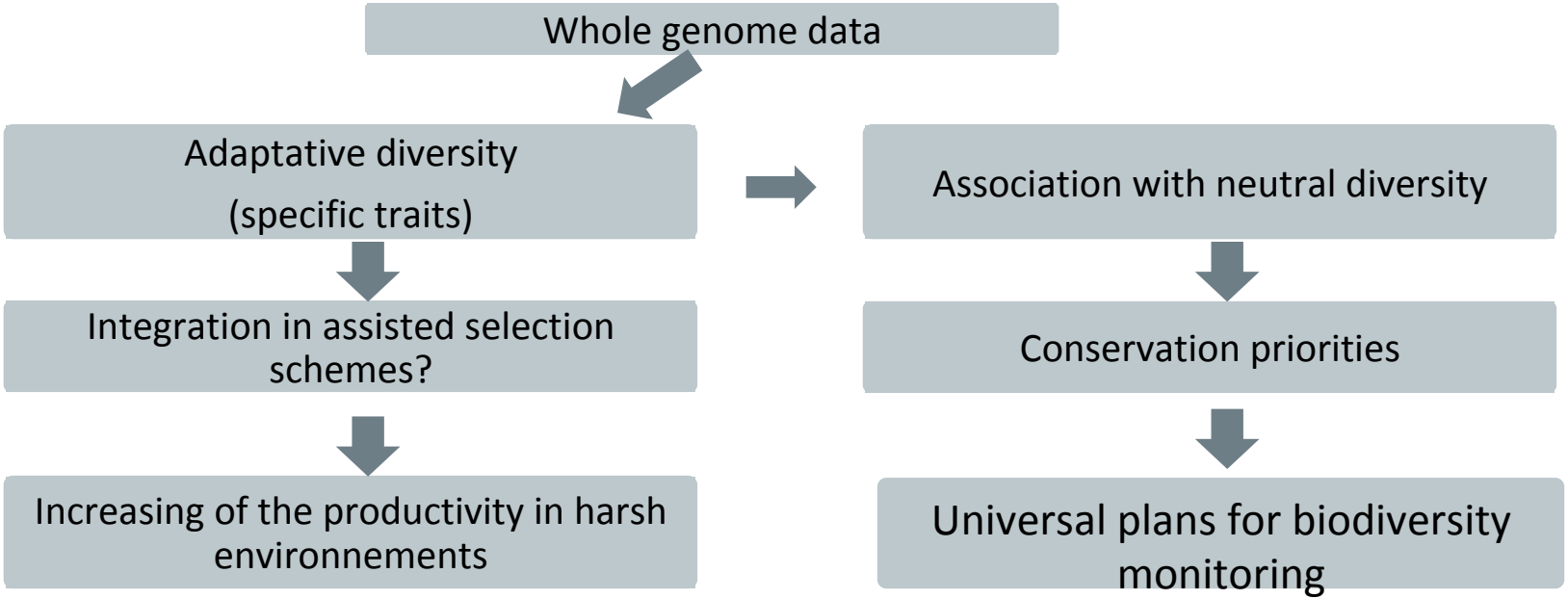
***CA2* (Sunshine)**



Discussion


Whole genome data
Adaptative diversity
(specific traits)
Integration in assisted selection schemes?
Increasing of the productivity in harsh environnements

Discussion


Whole genome data
Adaptative diversity
(specific traits)
Integration in assisted selection schemes?
Increasing of the productivity in harsh environnements
Association with neutral diversity
Conservation priorities
Universal plans for biodiversity monitoring

Aknowledgements

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Consortium EU H2020 IMAGE http://www.imageh2020.eu

Consortium VarGoats http://www.goatgenome.org

Aknowledgements

Thanks !!!

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Sheep and goats in Imilchil region, Morocco (Altitude~2300m)