



**Universität
Zürich**^{UZH}

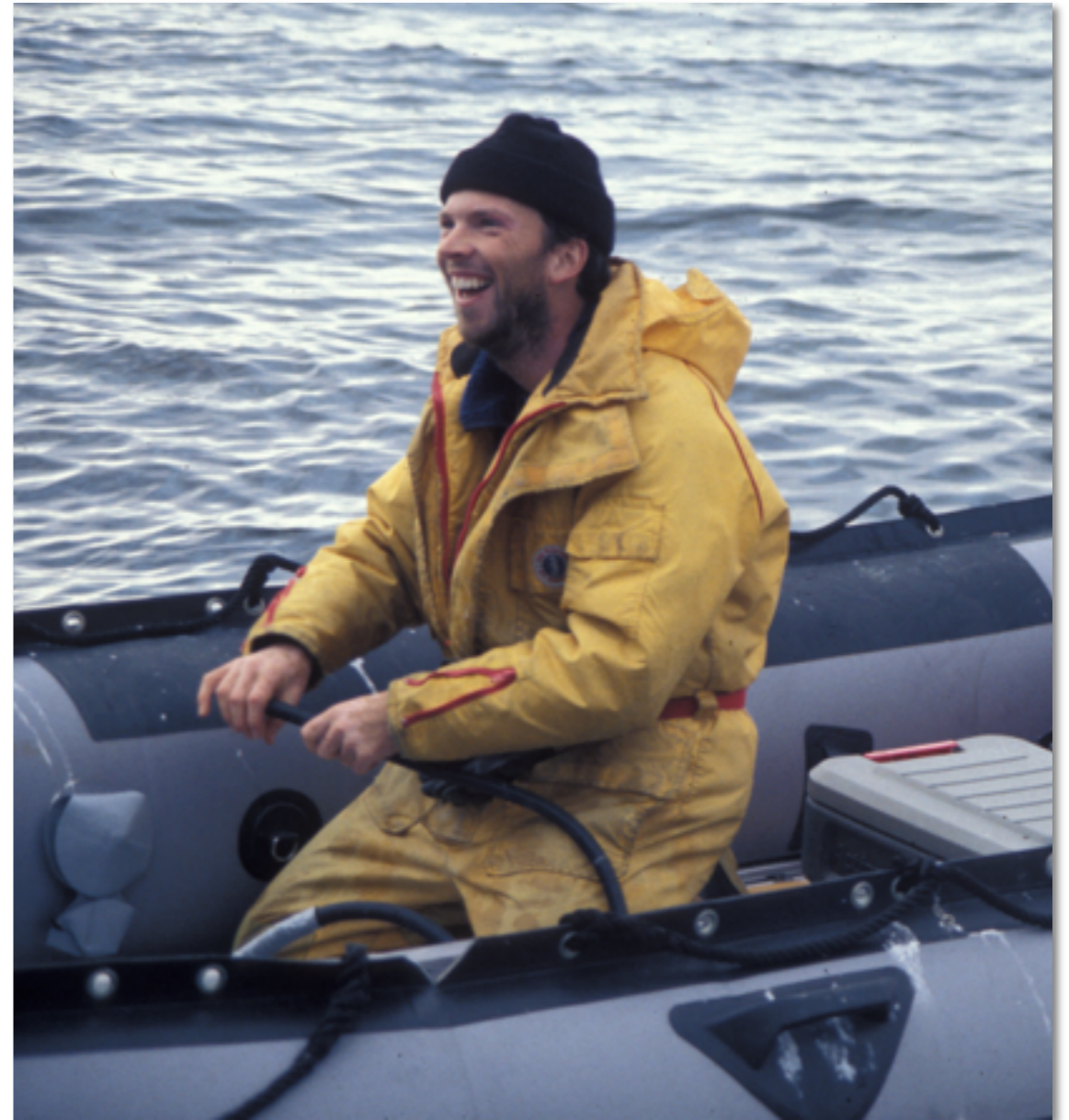
Institut für Evolutionsbiologie und Umweltwissenschaften

The genetic footprint of Alpine ibex reintroductions and implications for population management

WISO 2012, Christine Grossen

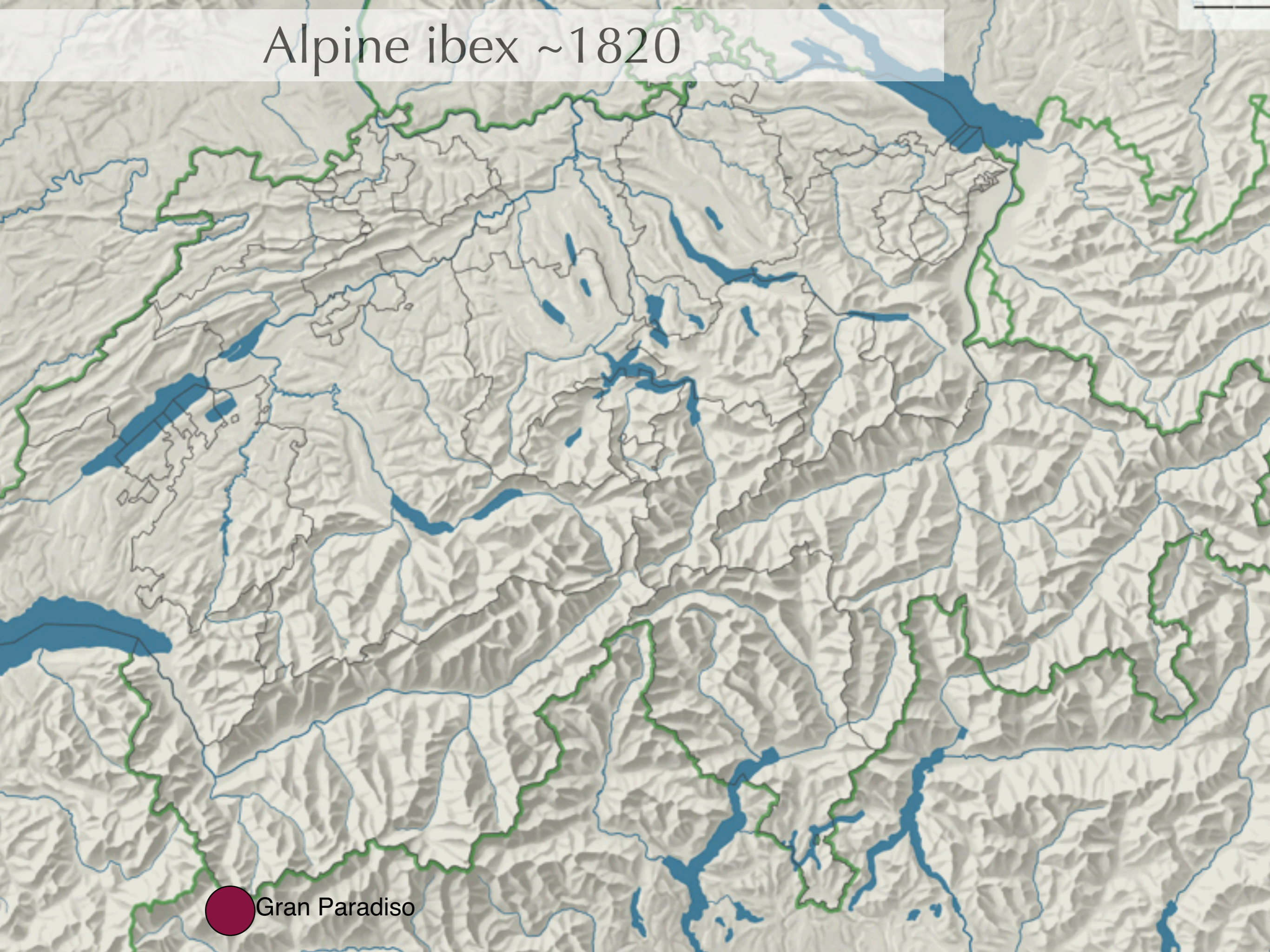


Iris Biebach



Lukas Keller

Alpine ibex ~1820



Gran Paradiso

1906



Wildpark PP

Wildpark IH

Gran Paradiso

reintroductions after 1911



Wildpark PP

Brienzer
Rothorn

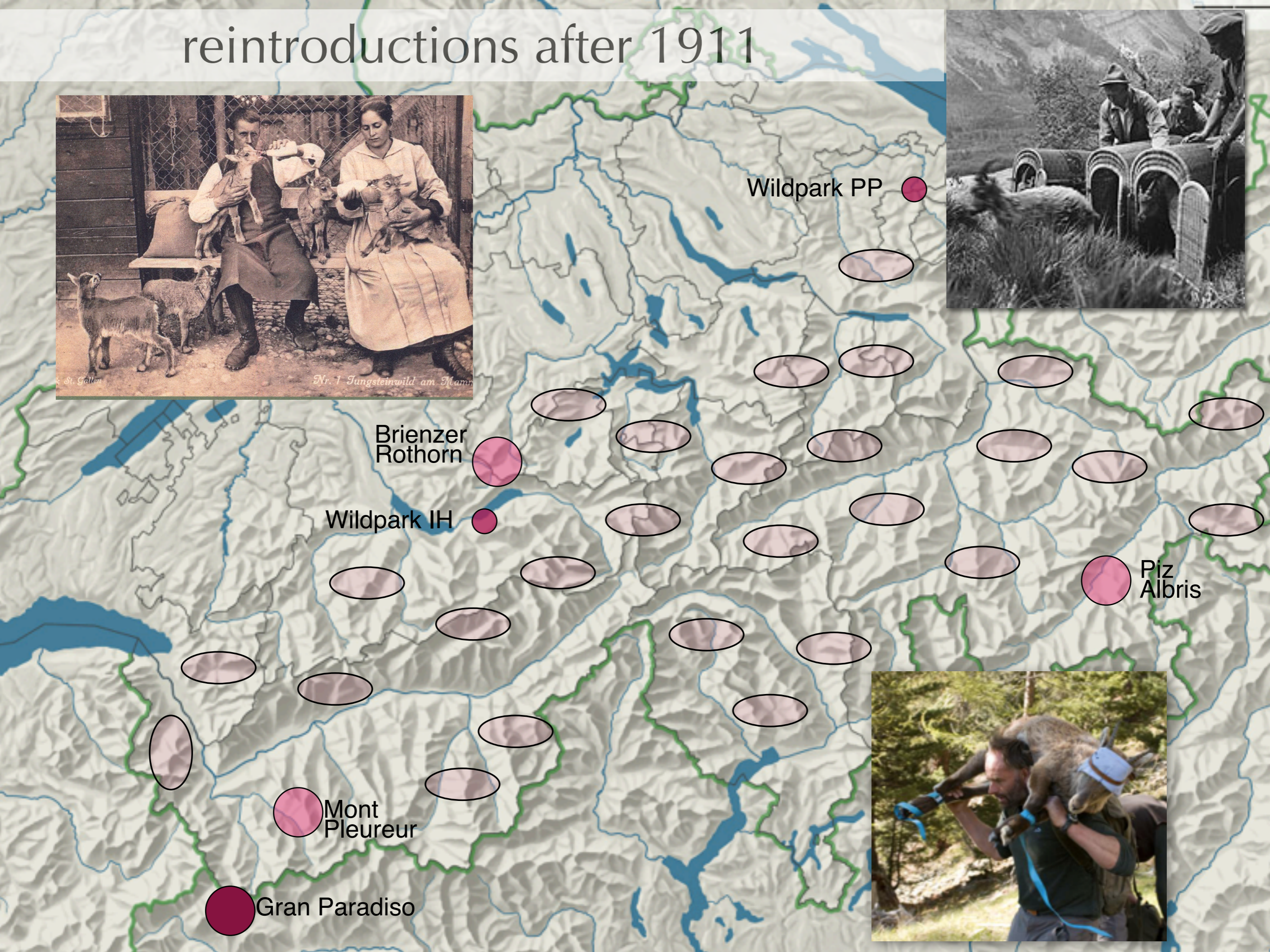
Wildpark IH

Piz
Albris

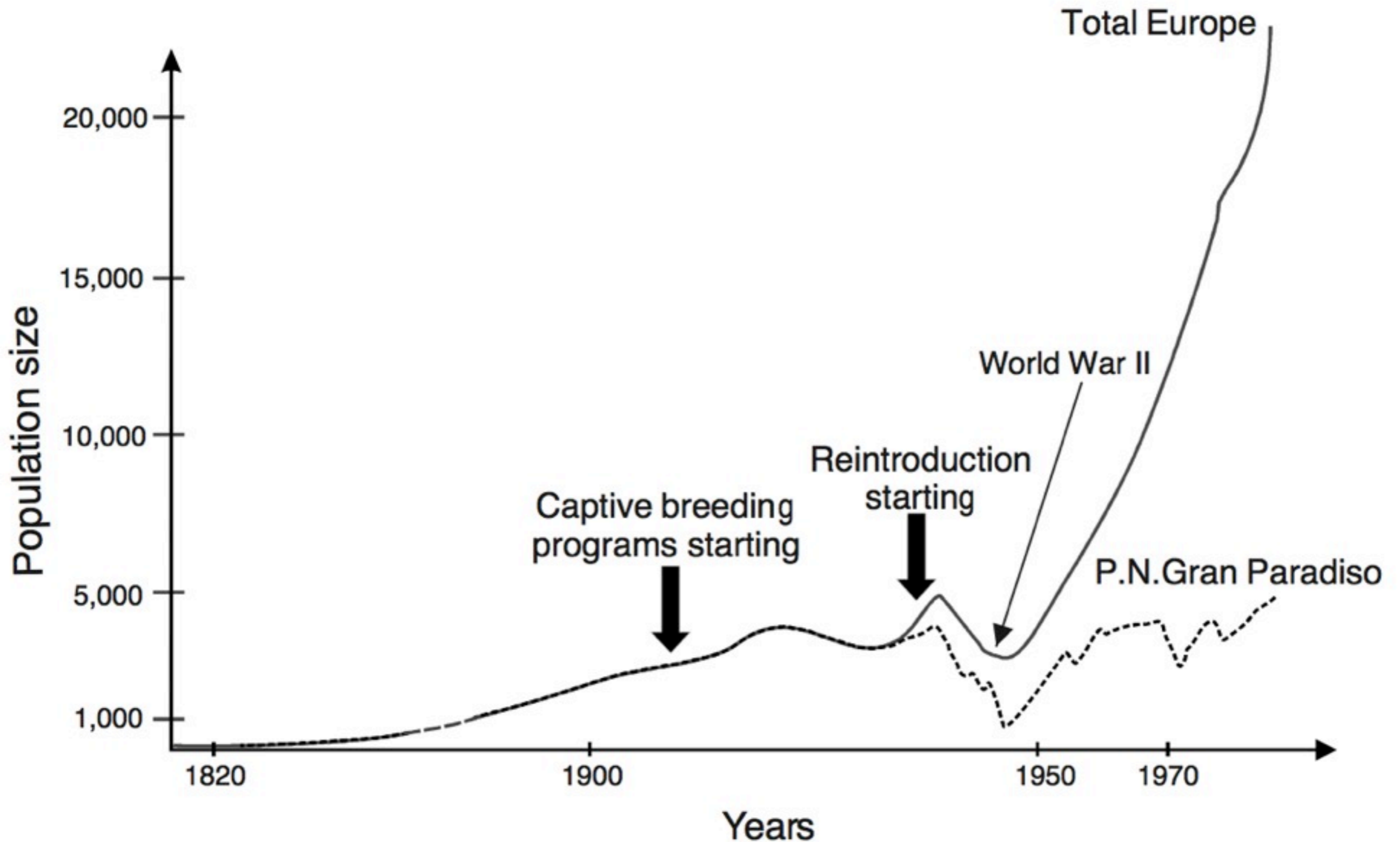
Mont
Pleureur

Gran Paradiso

reintroductions after 1911



Fast recovery of Alpine ibex populations

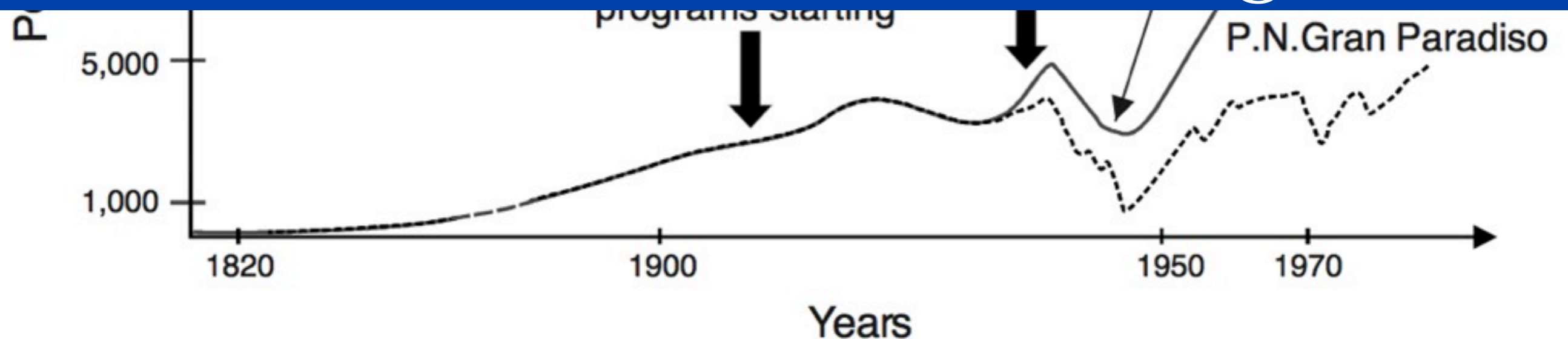


(Maudet et al. 2002, Molecular Ecology)

Fast recovery of Alpine ibex populations



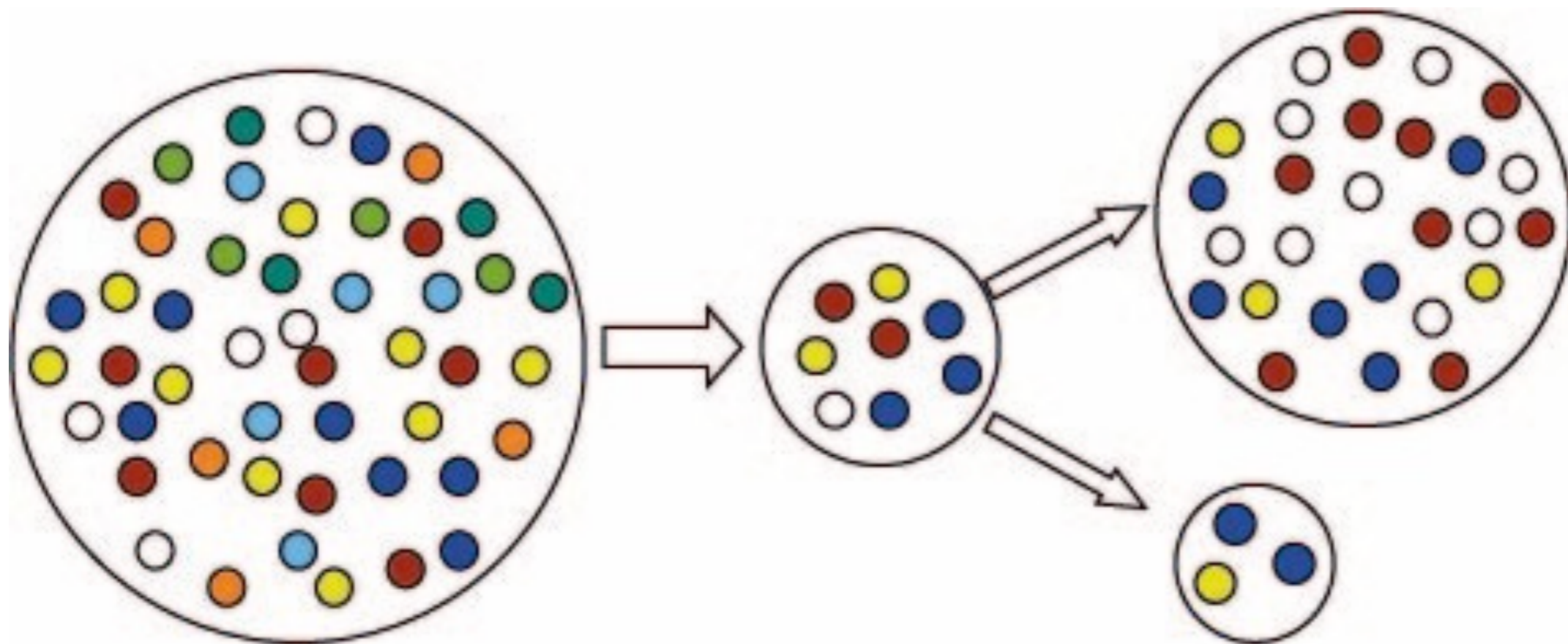
Small populations:
Decrease of genetic diversity
Increase of inbreeding



(Maudet et al. 2002, Molecular Ecology)

Genetic drift: decrease of genetic diversity

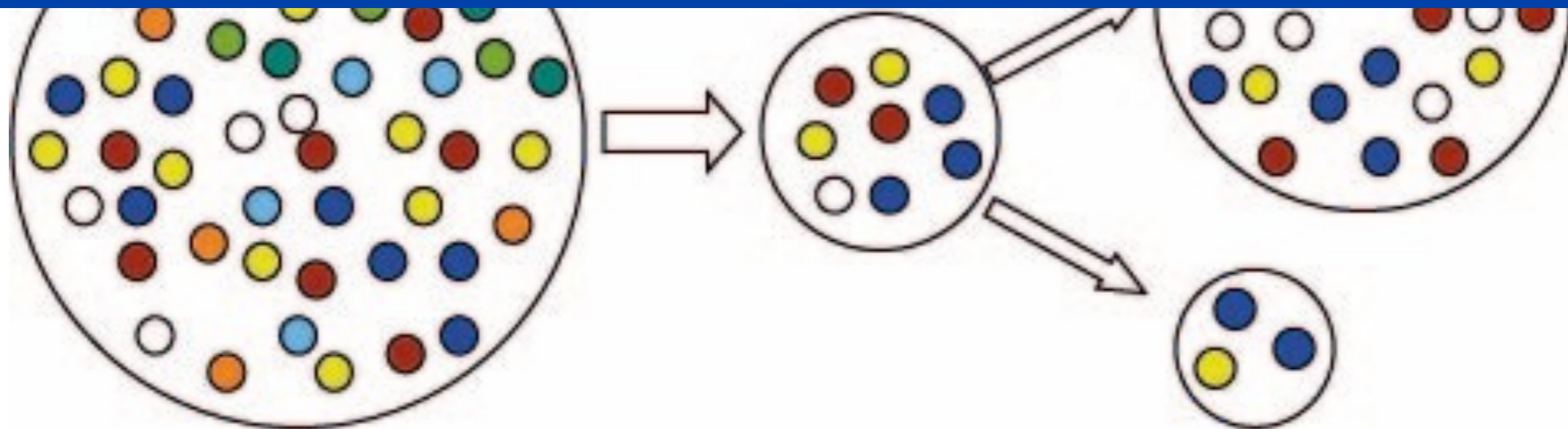
Random change in frequency of gene variants (alleles) over generations



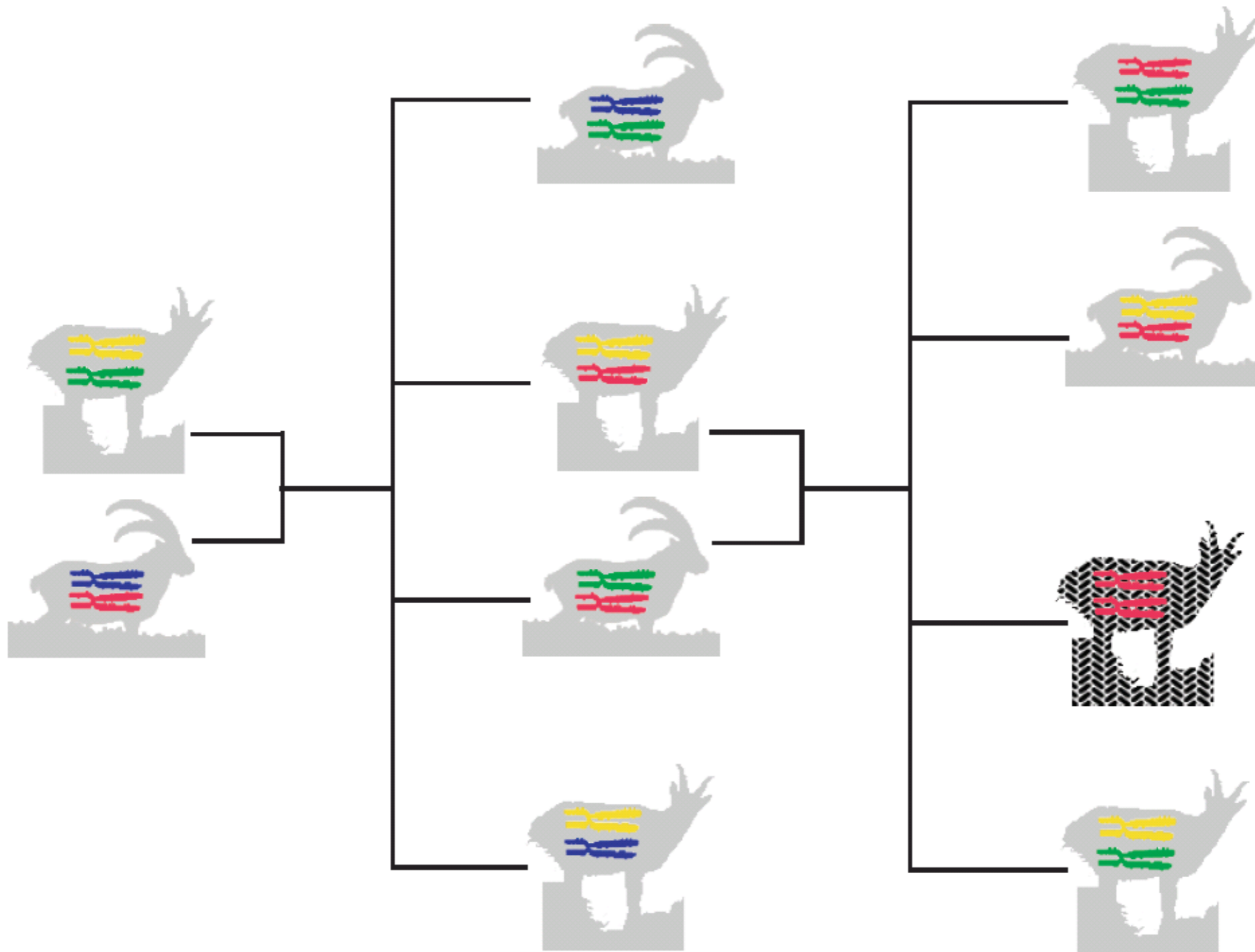
Genetic drift: decrease of genetic diversity

Random change in frequency of gene variants (alleles) over generations

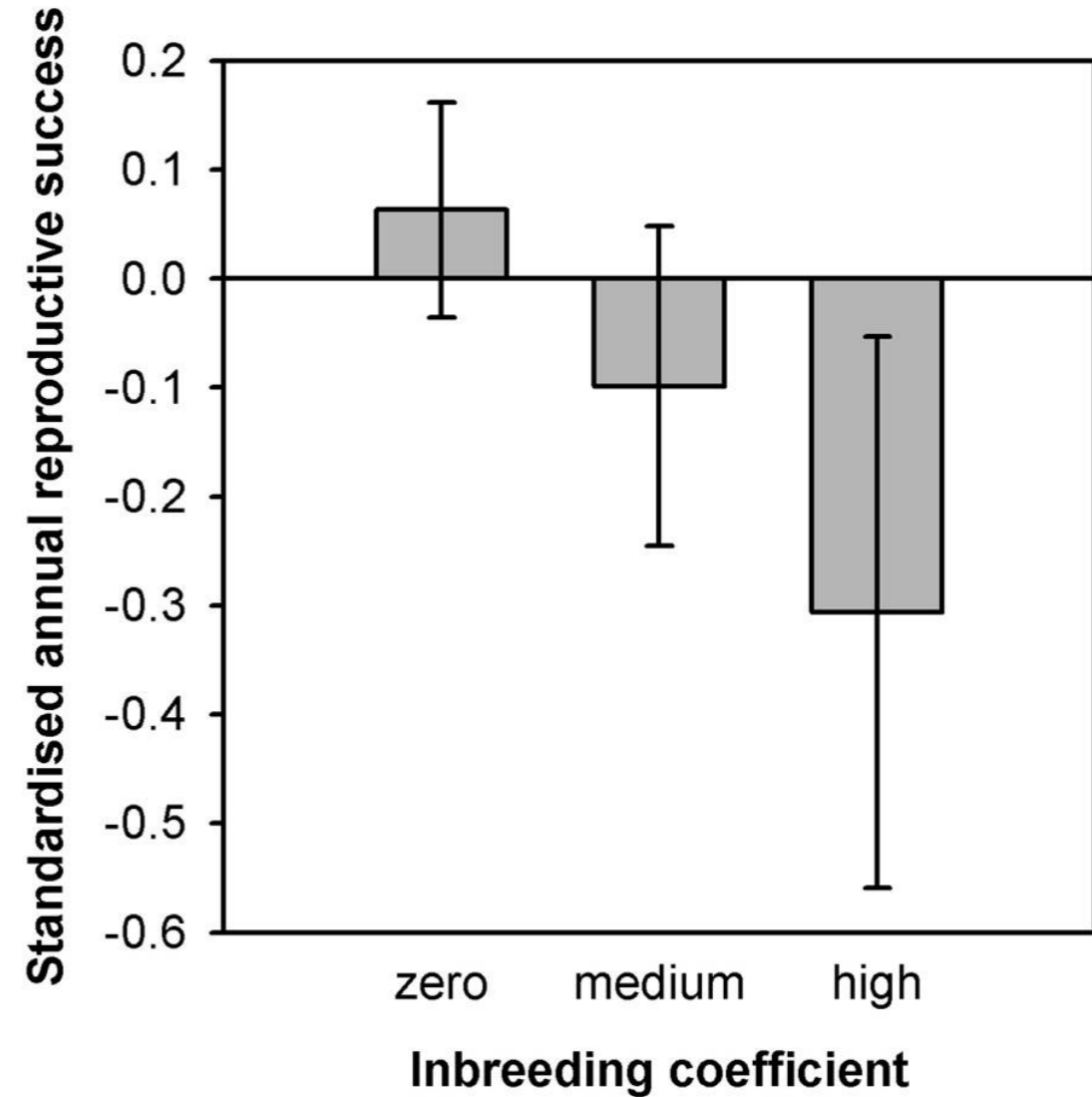
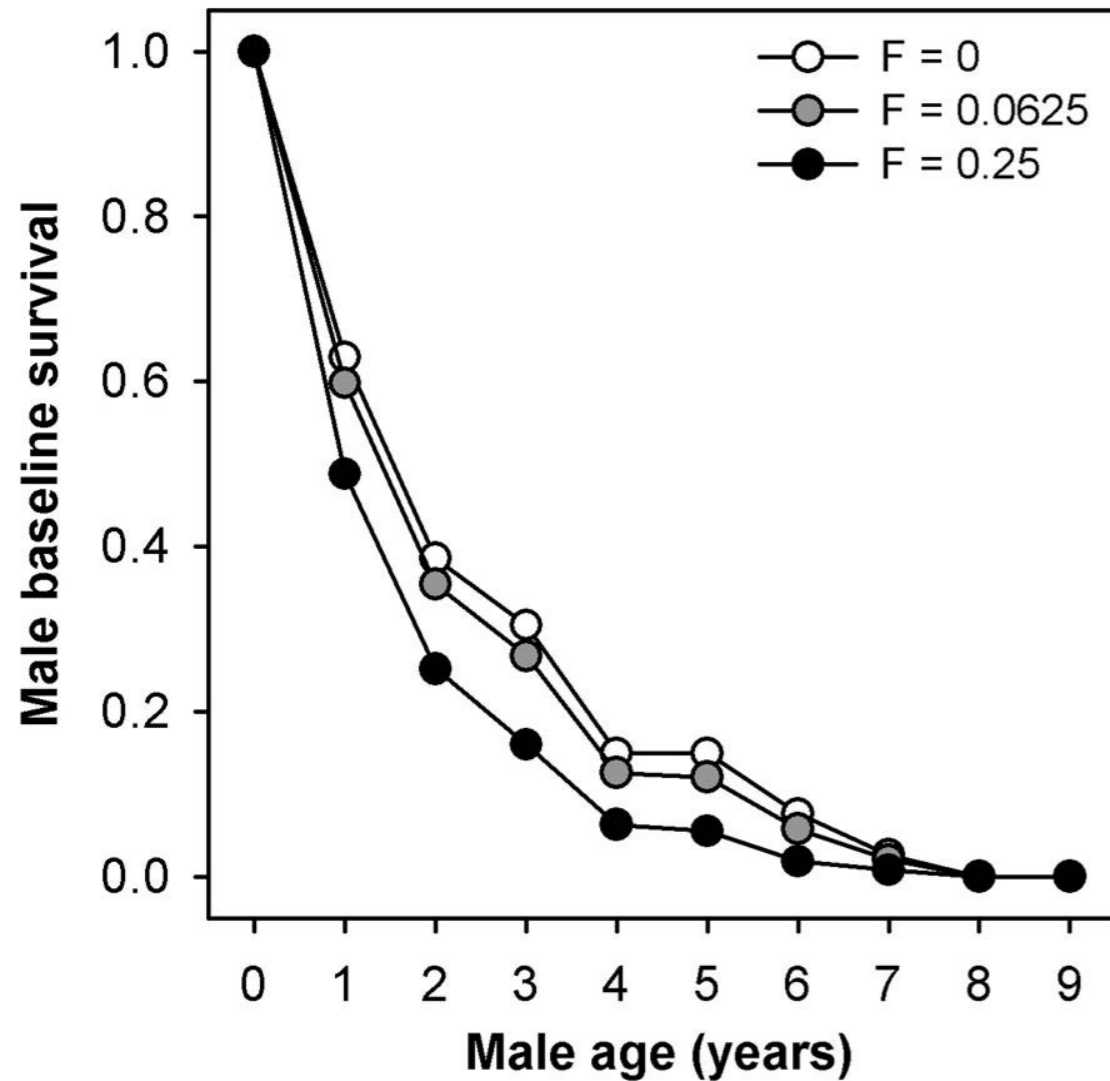
Genetic drift is strongest
in small populations



Inbreeding = breeding between related individuals

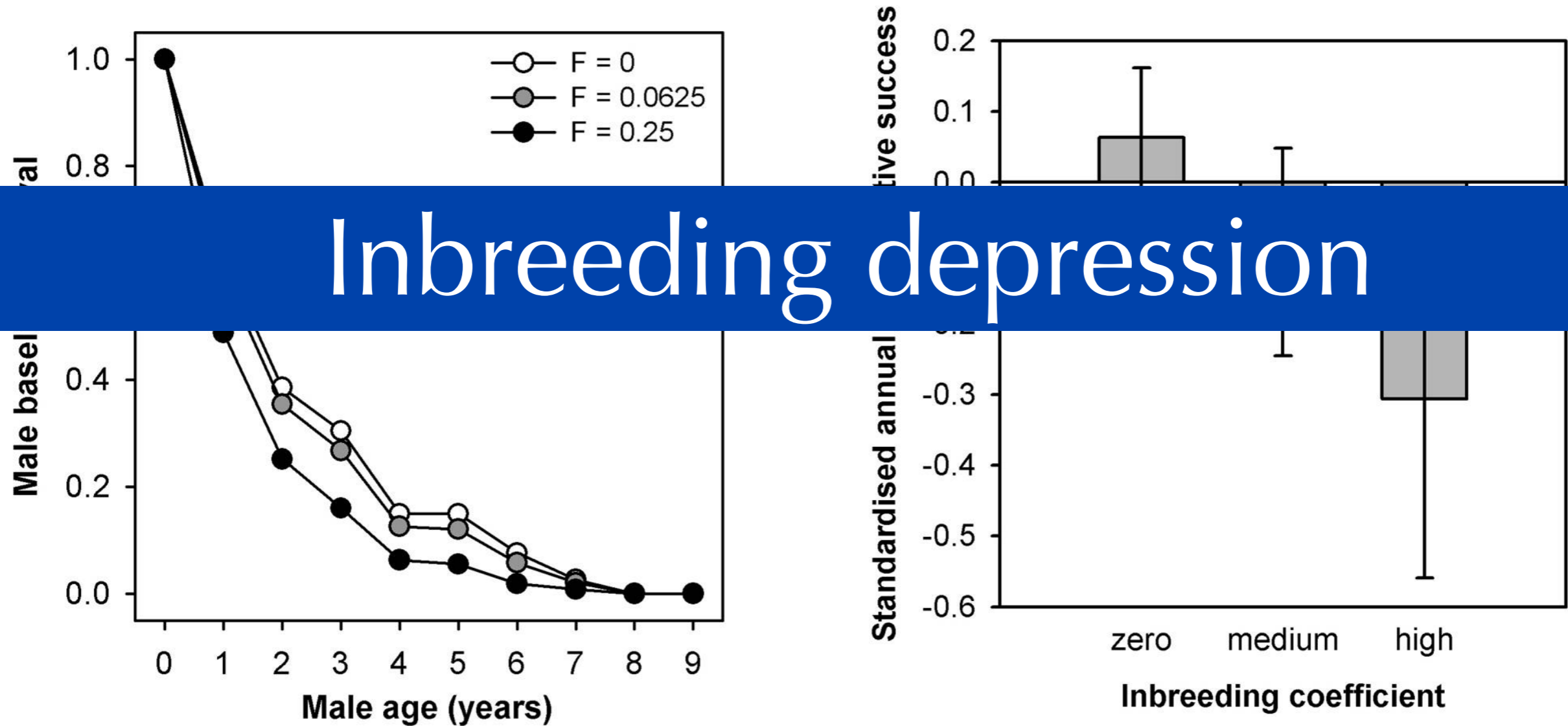


Inbreeding: reduced survival and reproduction



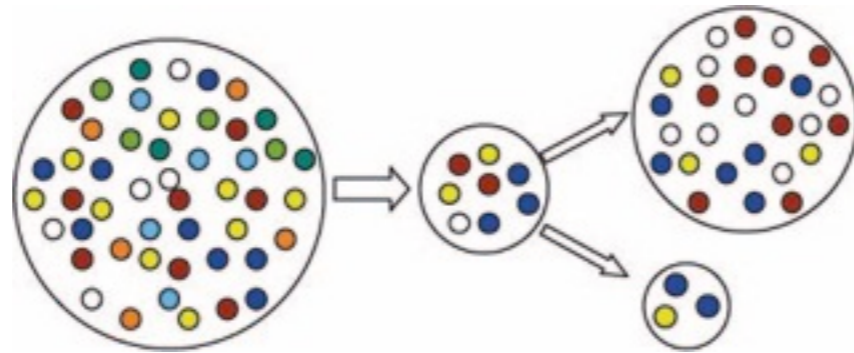
Inbreeding: reduced survival and reproduction

Inbreeding depression

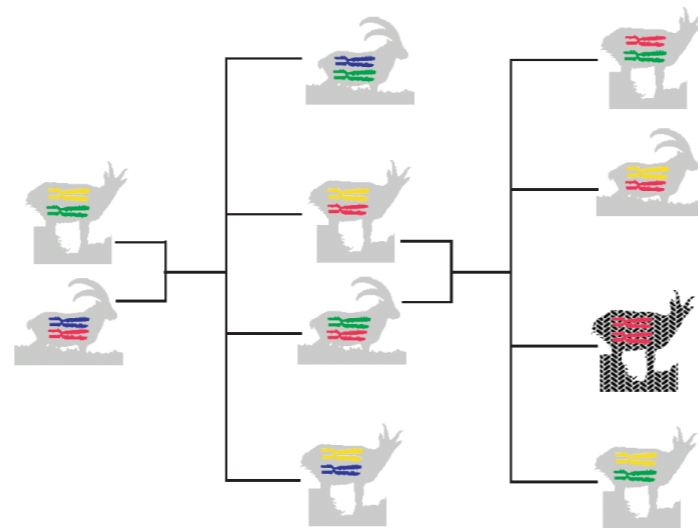


Effects of reintroductions on genetic variability of Alpine ibex

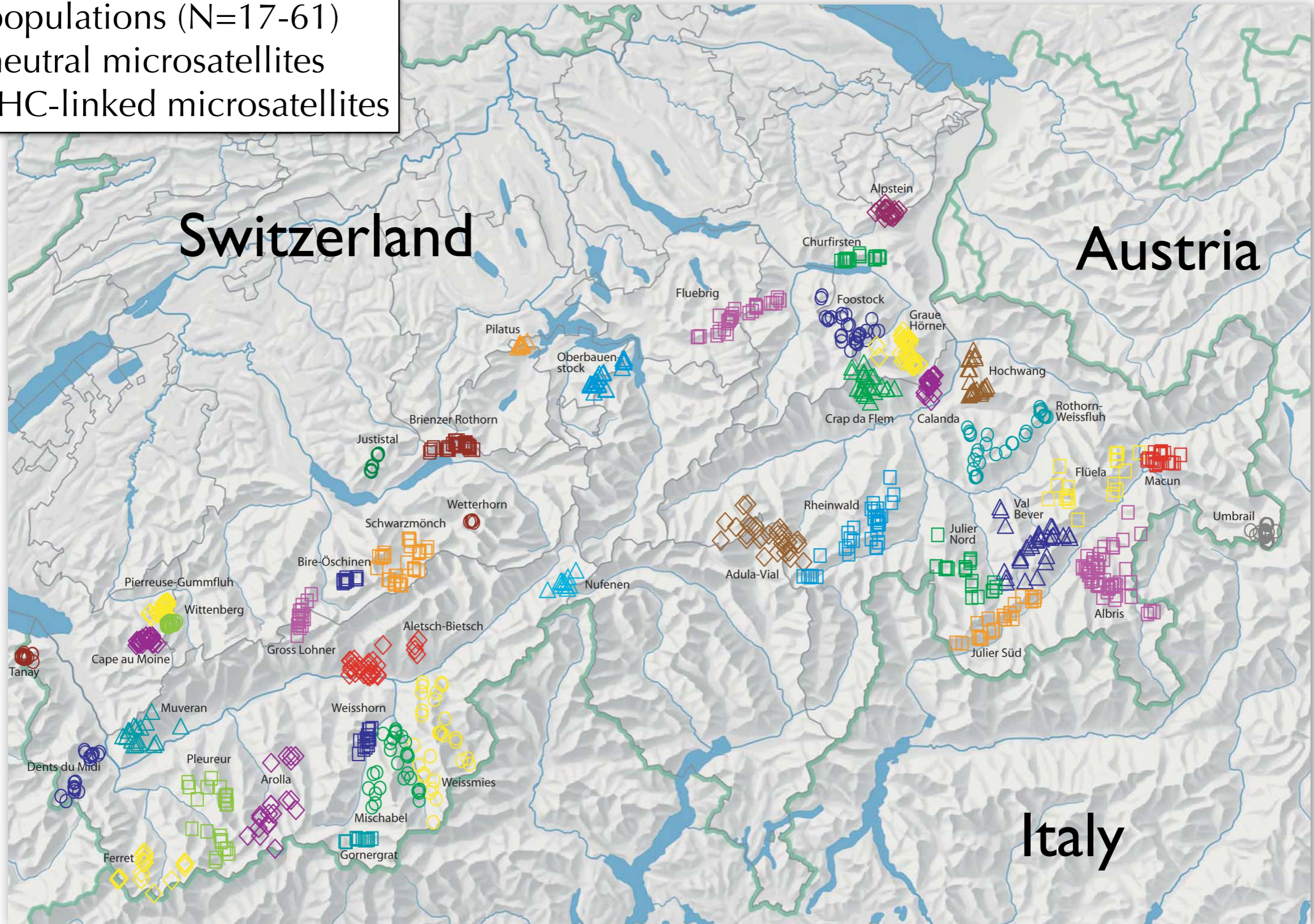
Do we see genetic drift?



Are Alpine ibex populations inbred?



1262 samples
42 populations (N=17-61)
37 neutral microsatellites
5 MHC-linked microsatellites



Sampling

Tissue from hunted animals



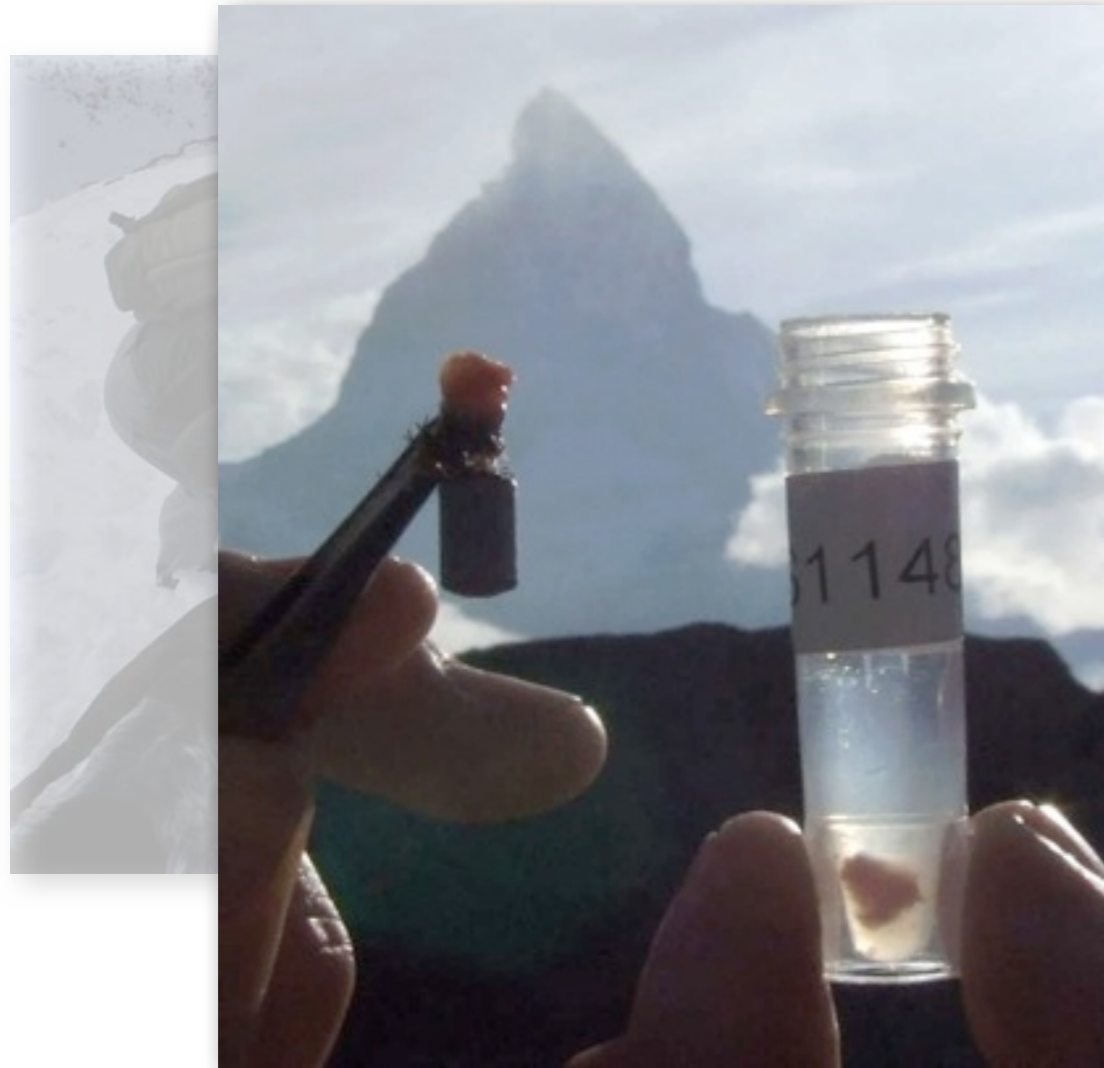
Blood from anesthetized animals



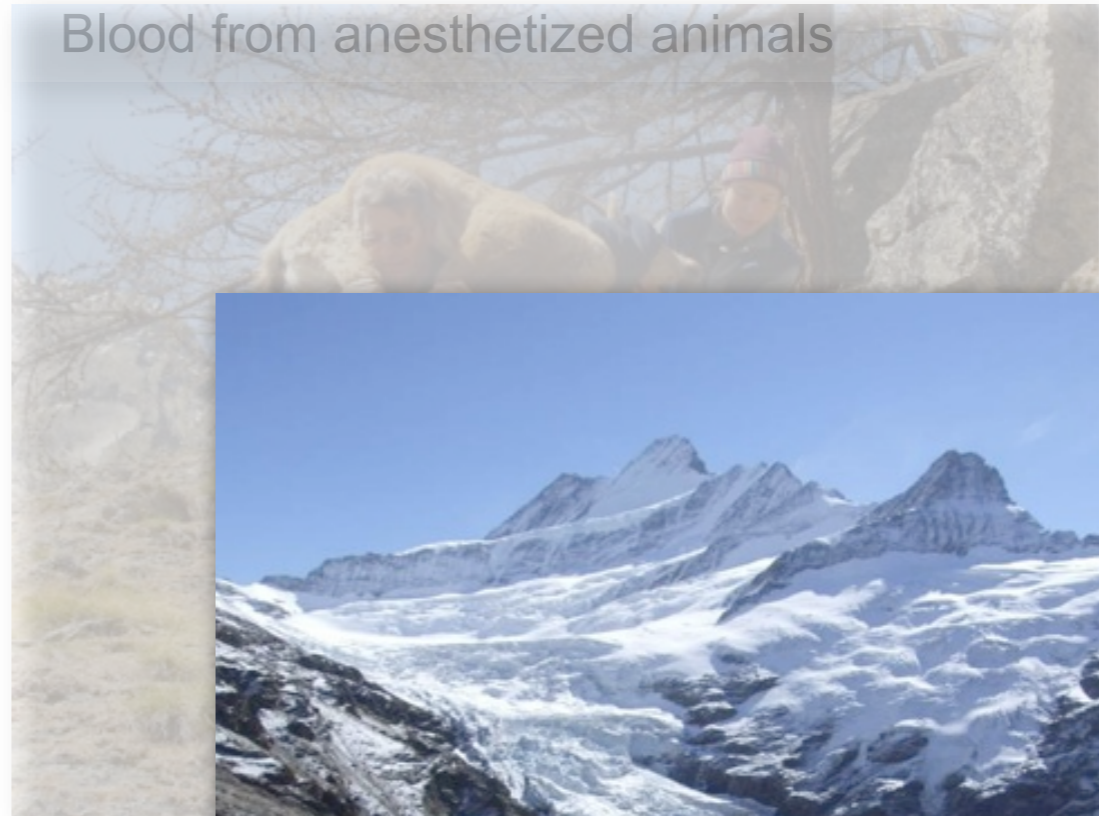
Biopsy samples (darts) from colonies with no or low hunting pressure



Sampling



Blood from anesthetized animals



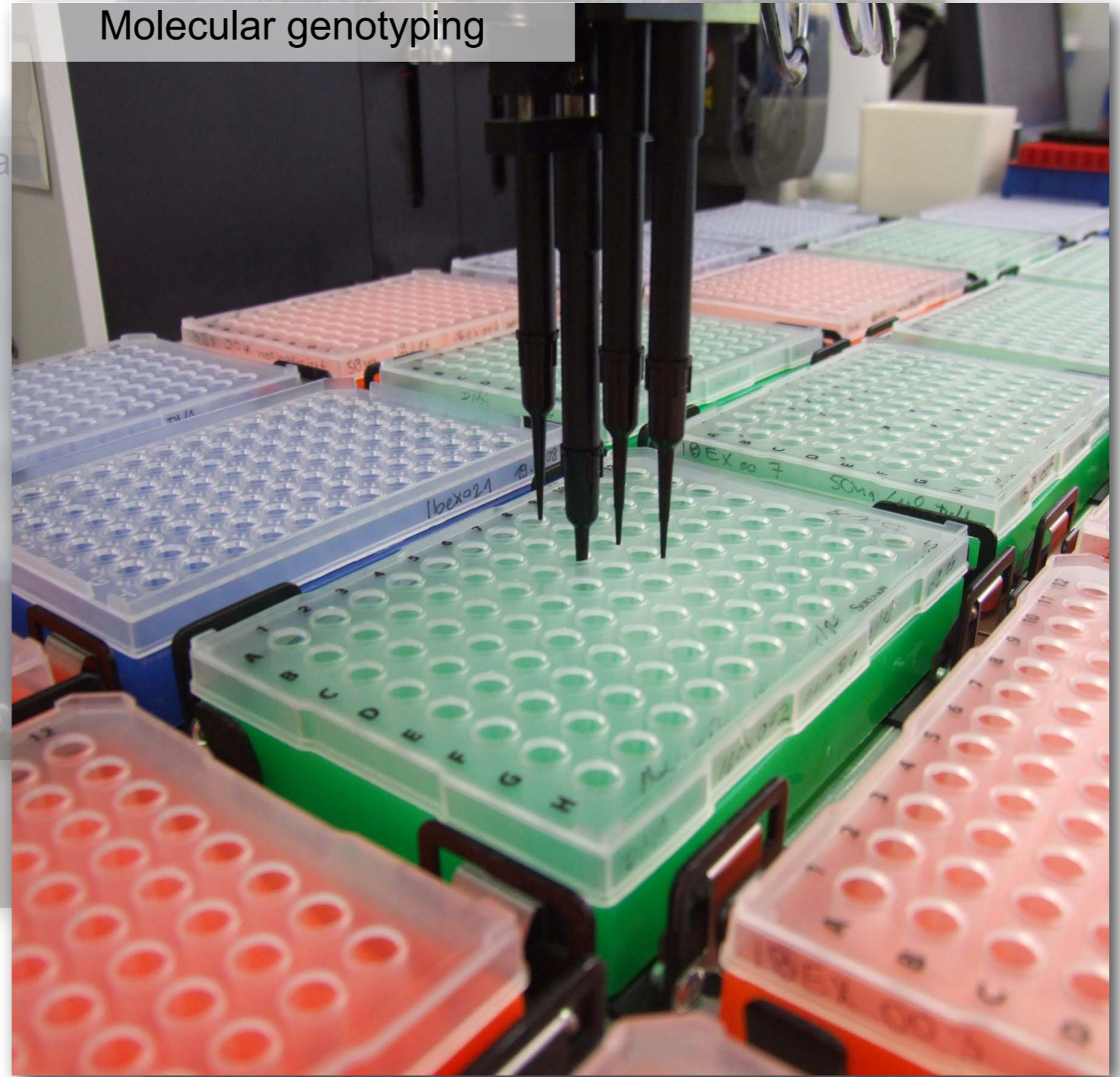
Biopsy
colonie



Sampling

Blood from anesthetized animals

Molecular genotyping

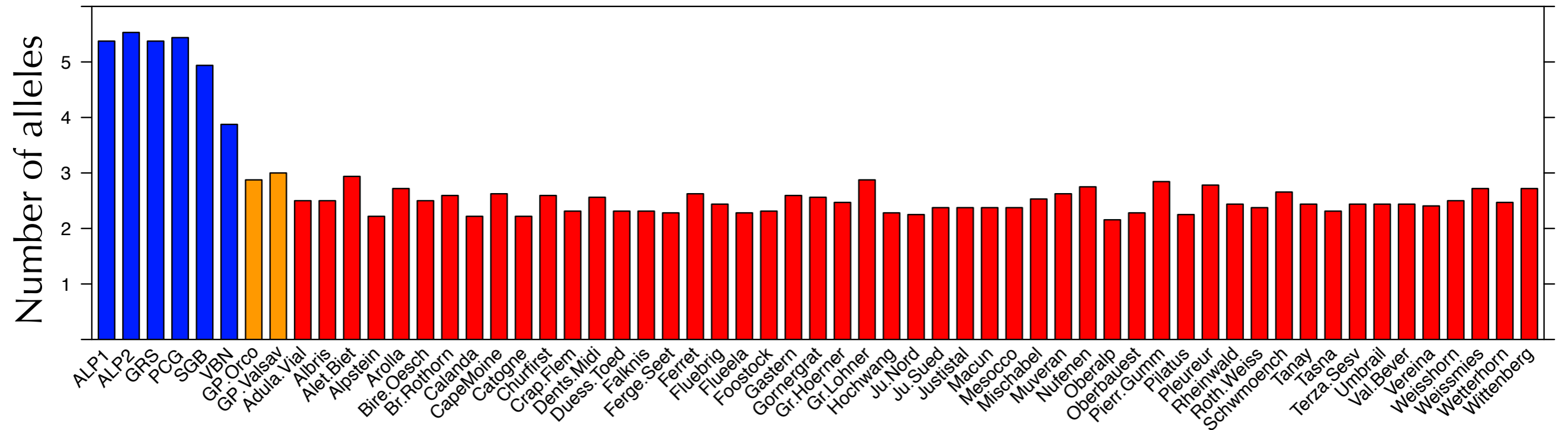


Genetic diversity in Alpine ibex is low

Low potential to adapt to changing environments

Domestic goat

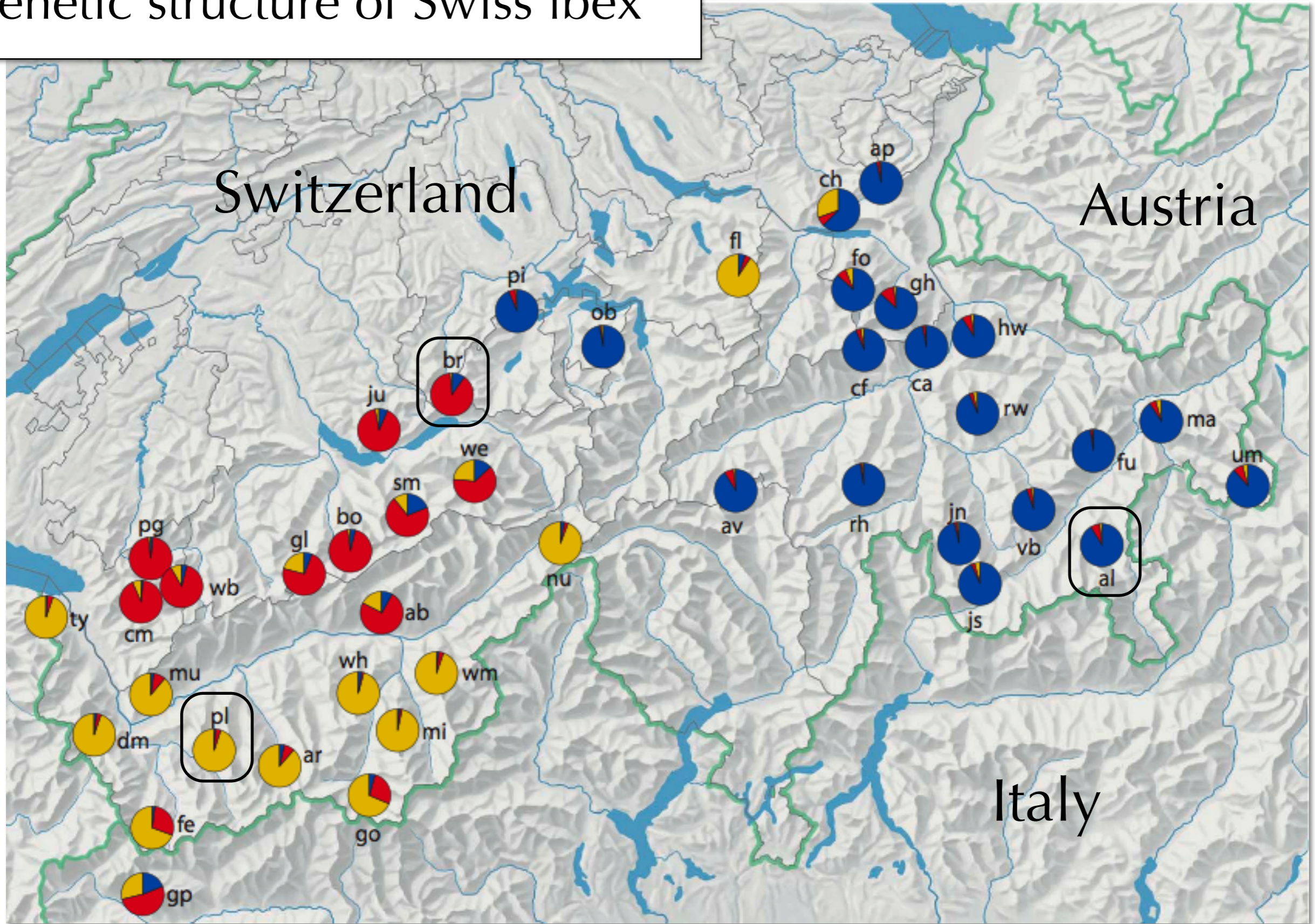
breeds



Alpine ibex
Gran Paradiso

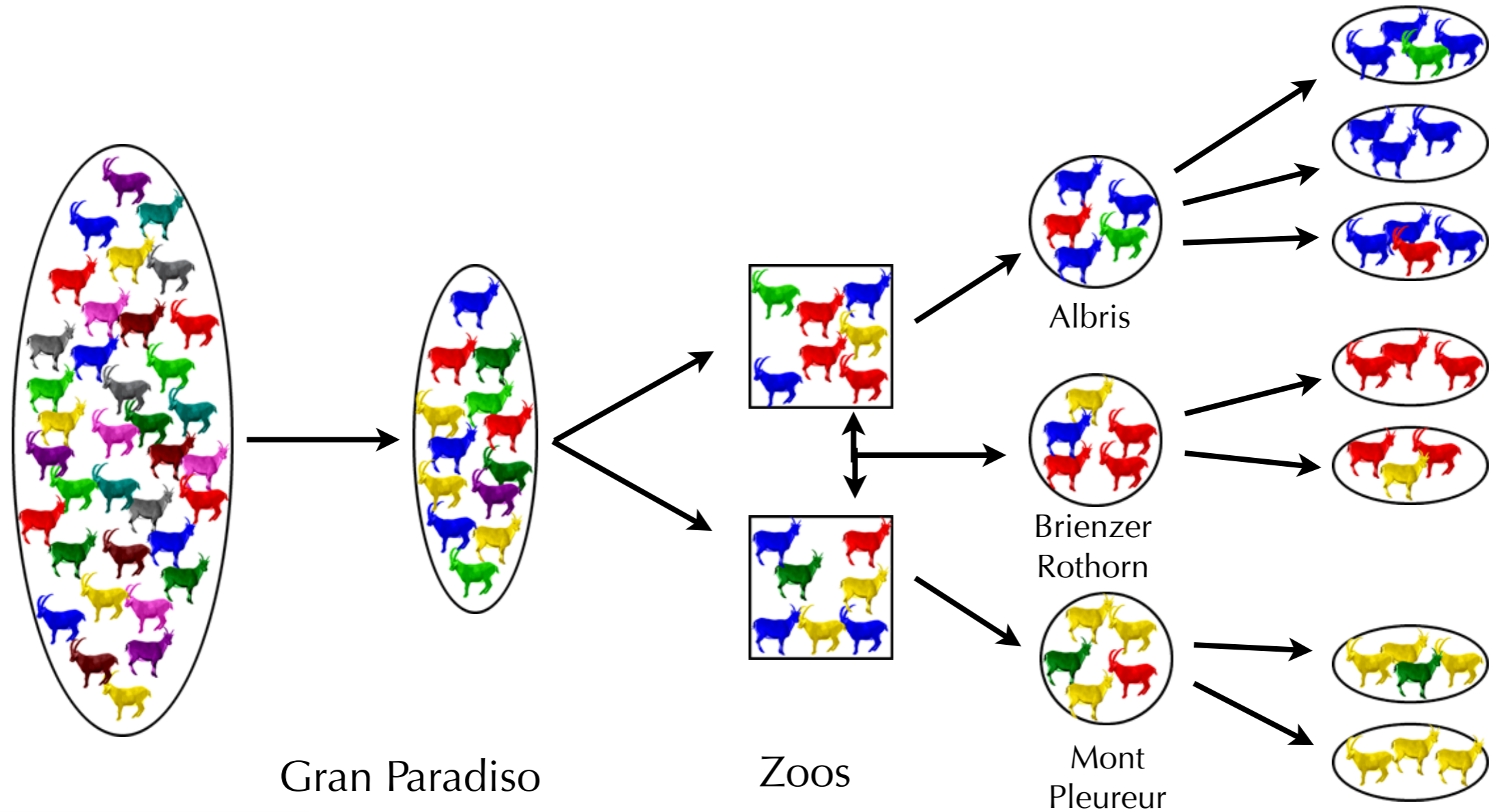
Alpine ibex
Switzerland

Genetic structure of Swiss ibex



(Biebach and Keller 2009, Molecular Ecology)

Reintroductions shaped the genetic diversity



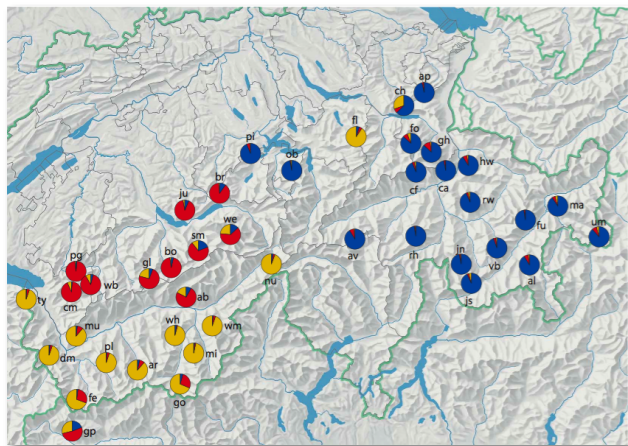
Gran Paradiso

Zoos

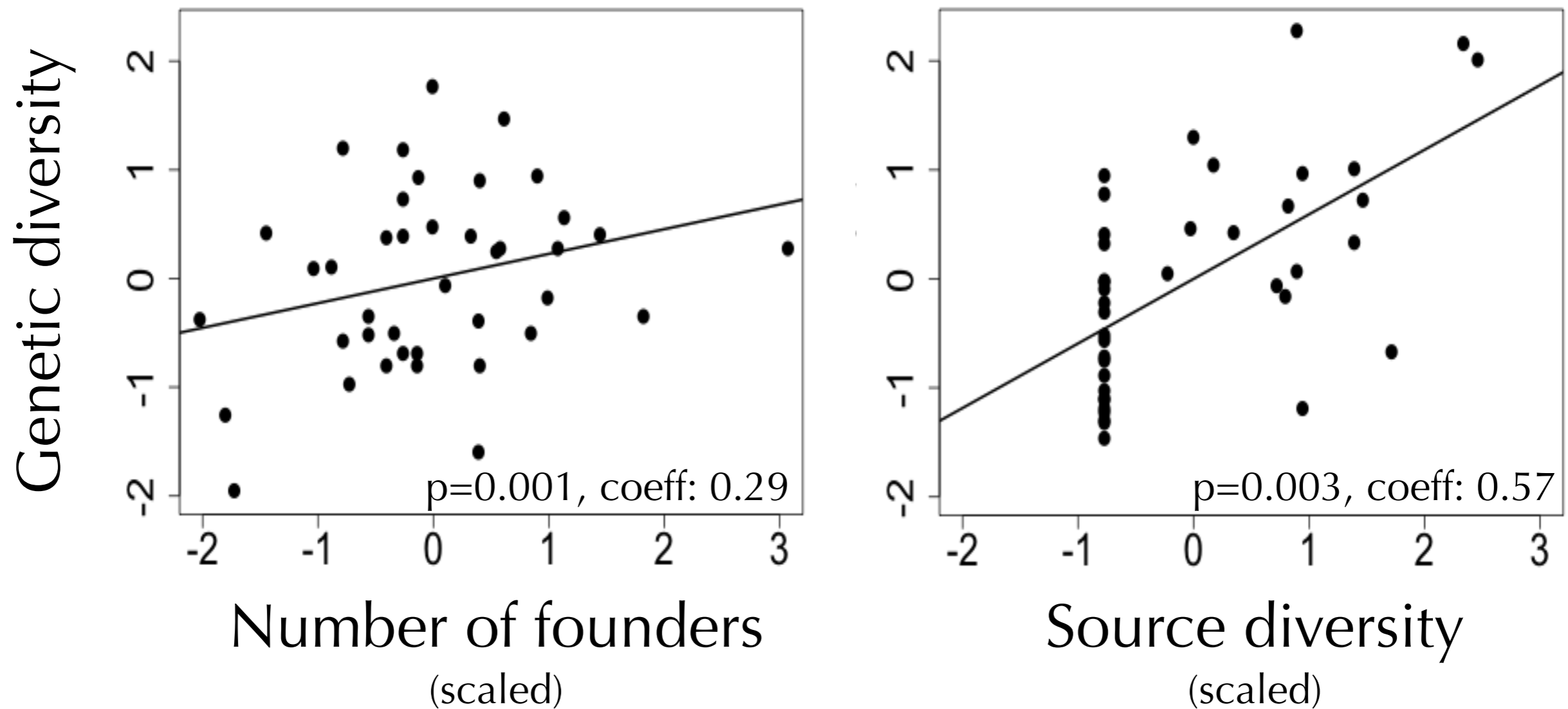
Albris

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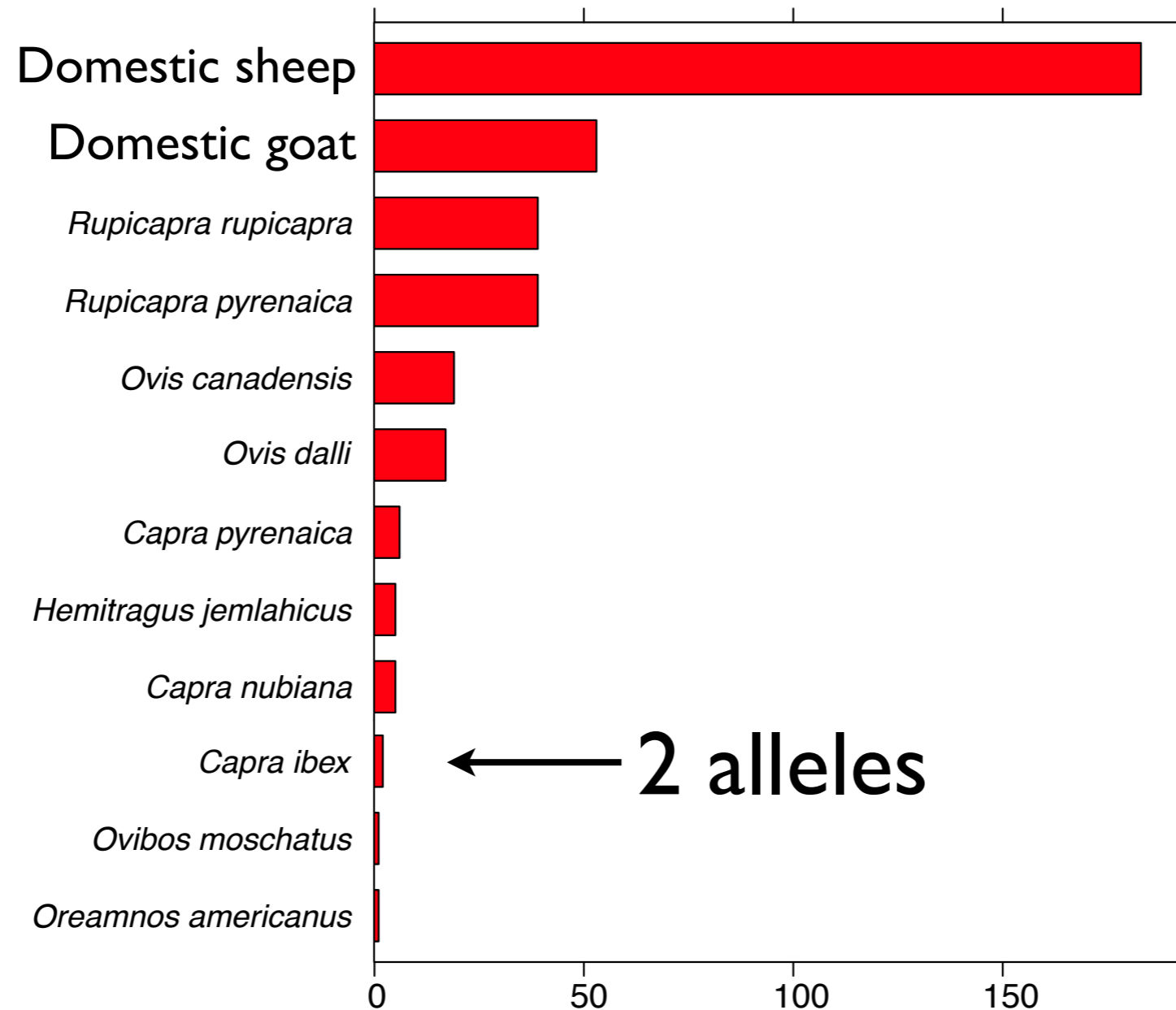
Reintroductions shaped the genetic diversity



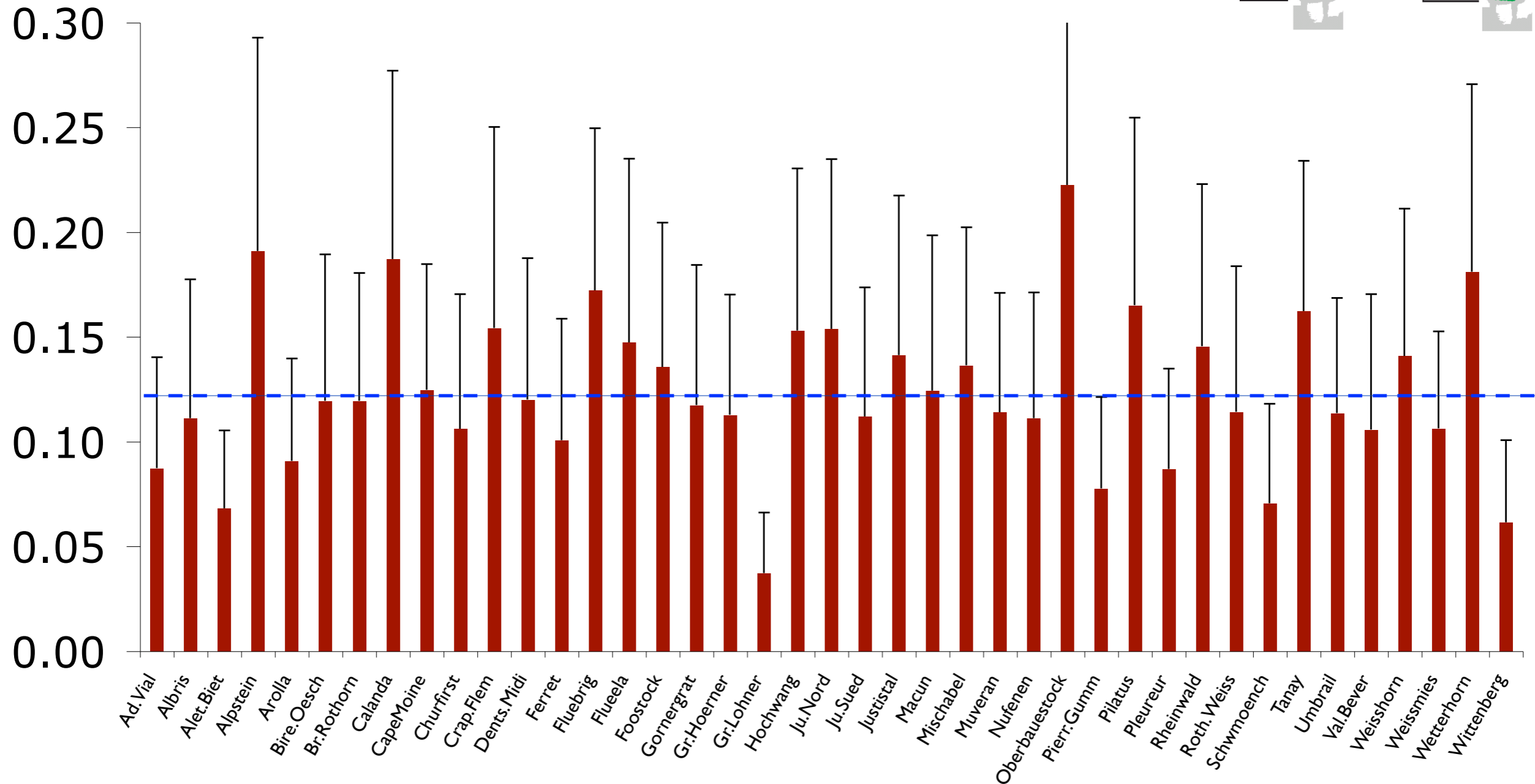
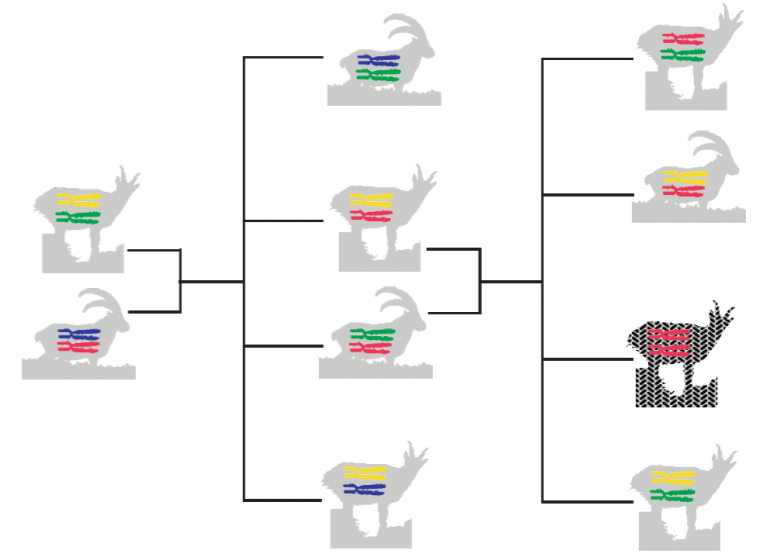
Both number of founders and number of source populations positively affected genetic diversity

Relationship between neutral and
selected diversity?

Low diversity at the MHC (important for immune response)

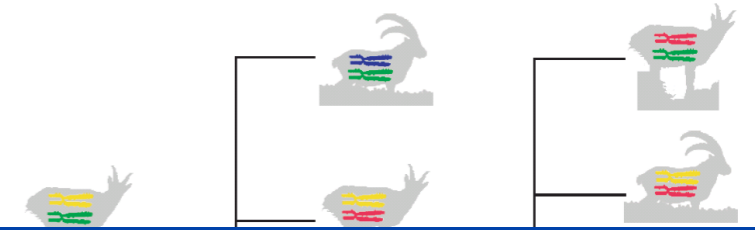


High extent of inbreeding

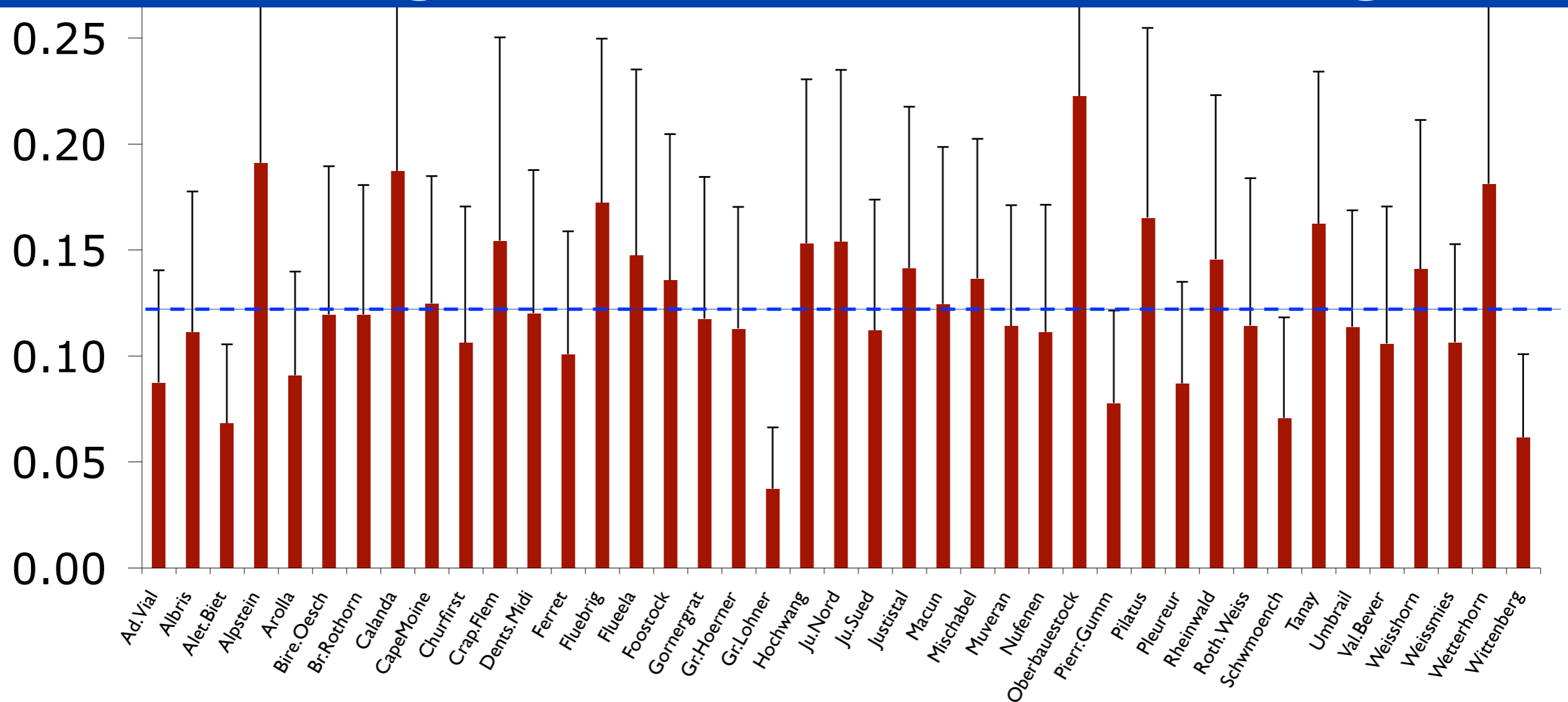


(Biebach and Keller 2010, Conservation Genetics)

High extent of inbreeding

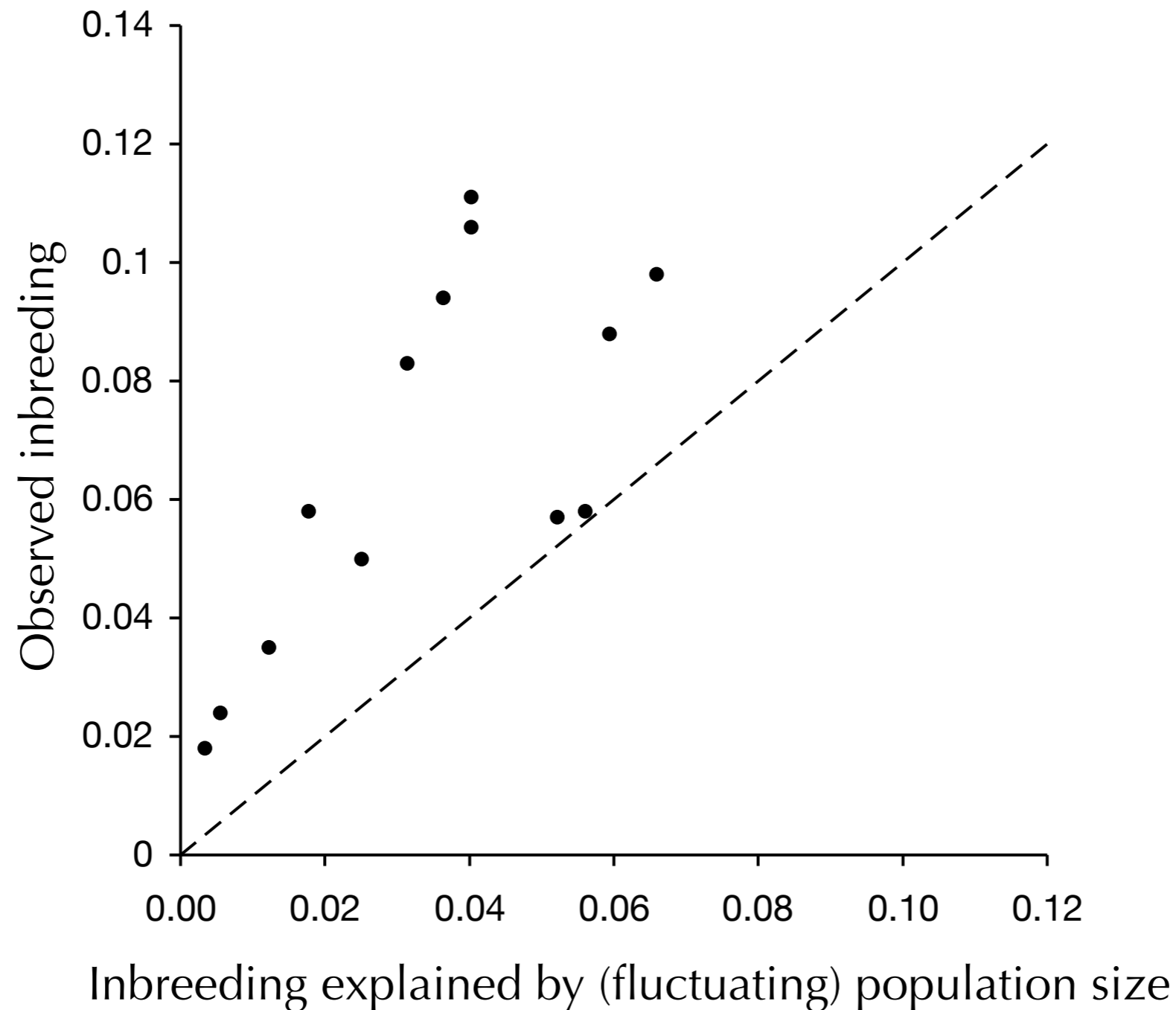


Average total inbreeding = 0.125
(mating between half siblings!)

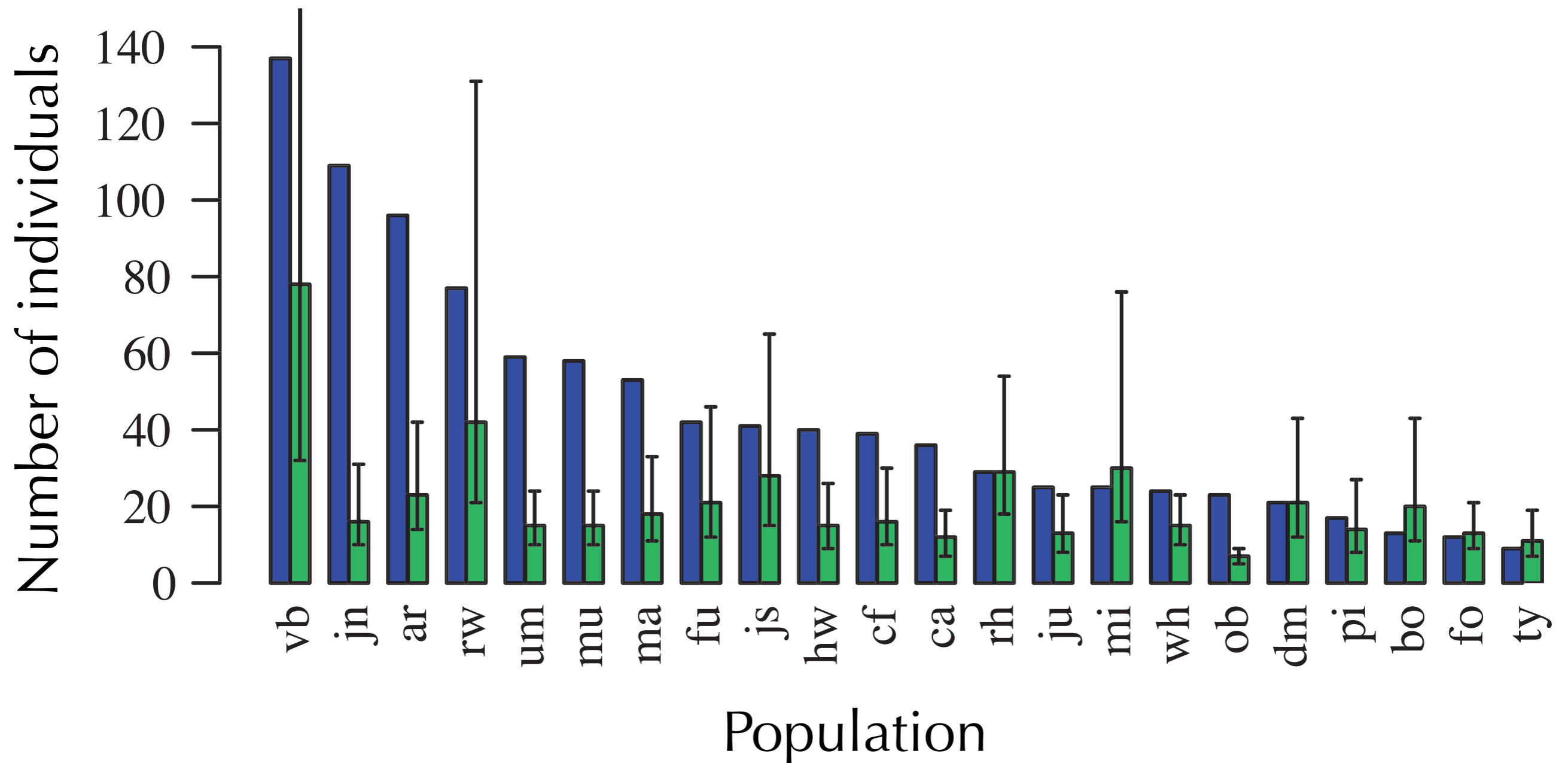


(Biebach and Keller 2010, Conservation Genetics)

Population size alone does not explain observed level of inbreeding

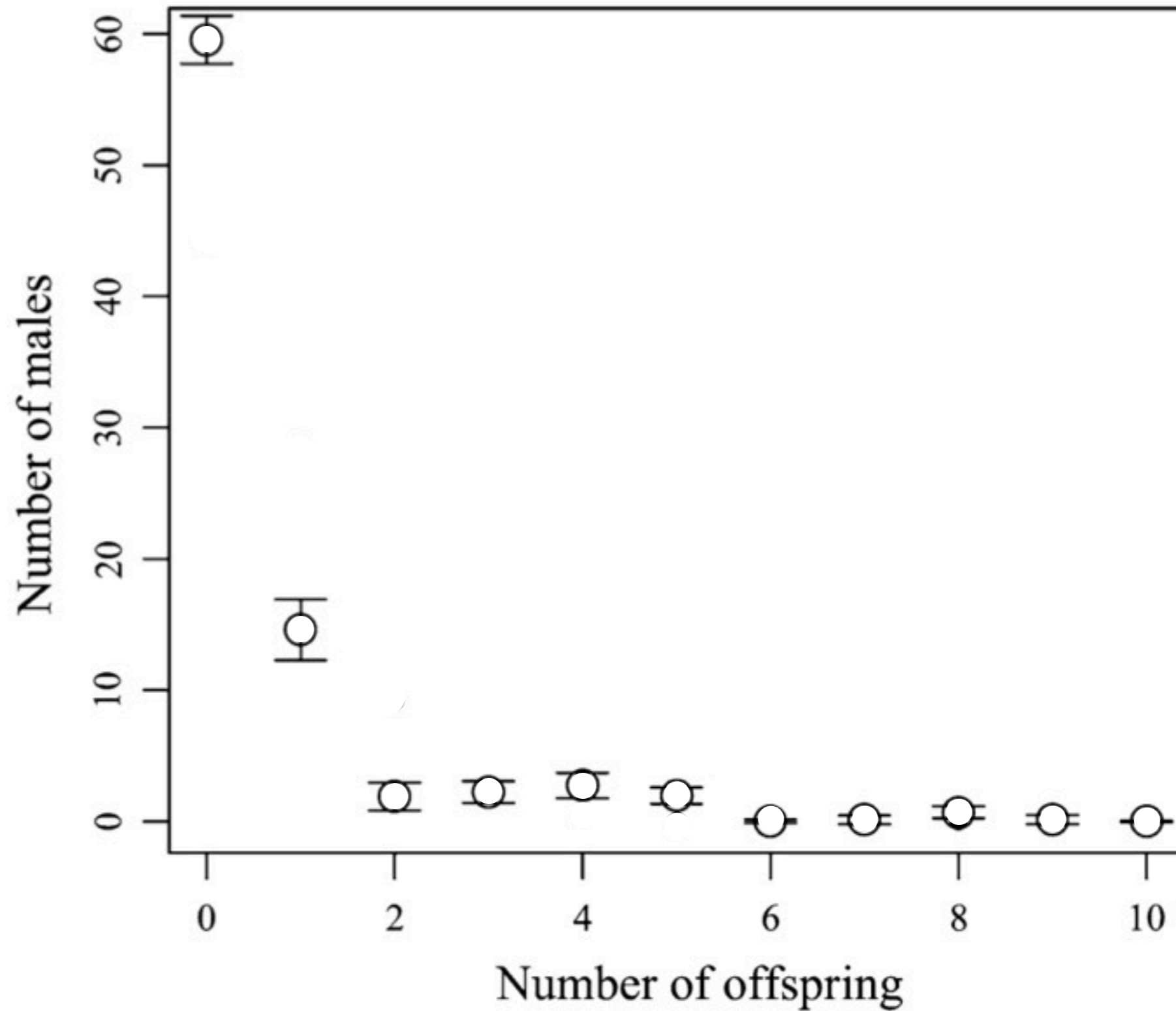


Not every released individual is a founder

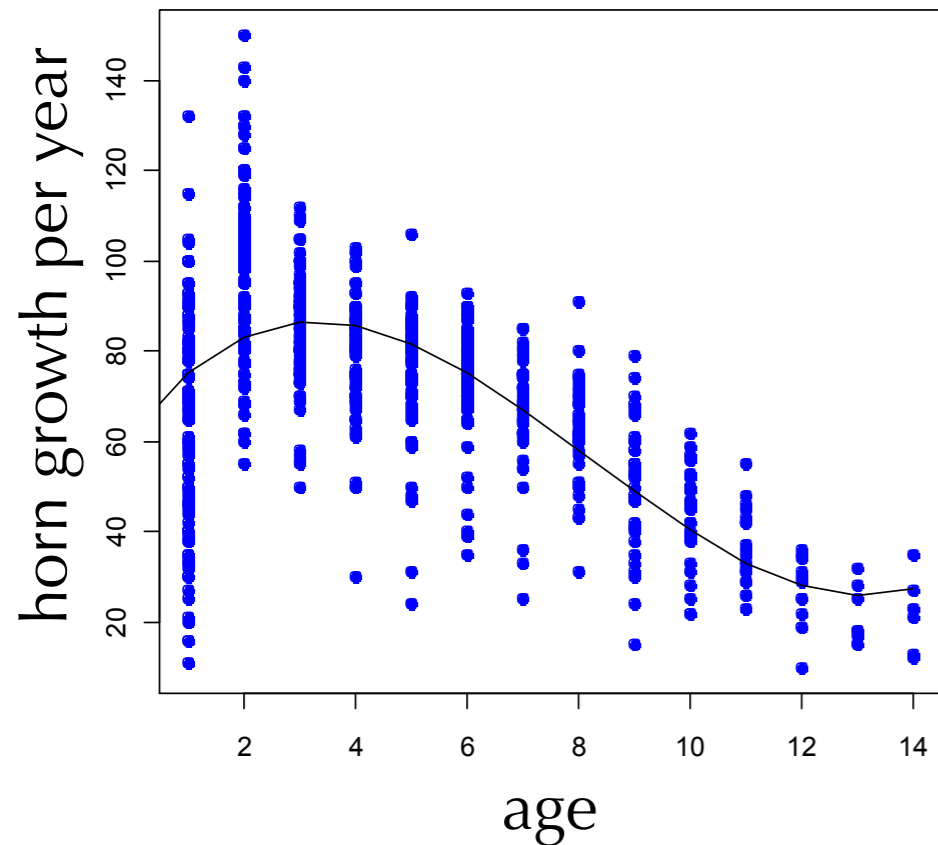


individuals released
genetic founders

Only a few males reproduce



Genetic effects on horn growth?

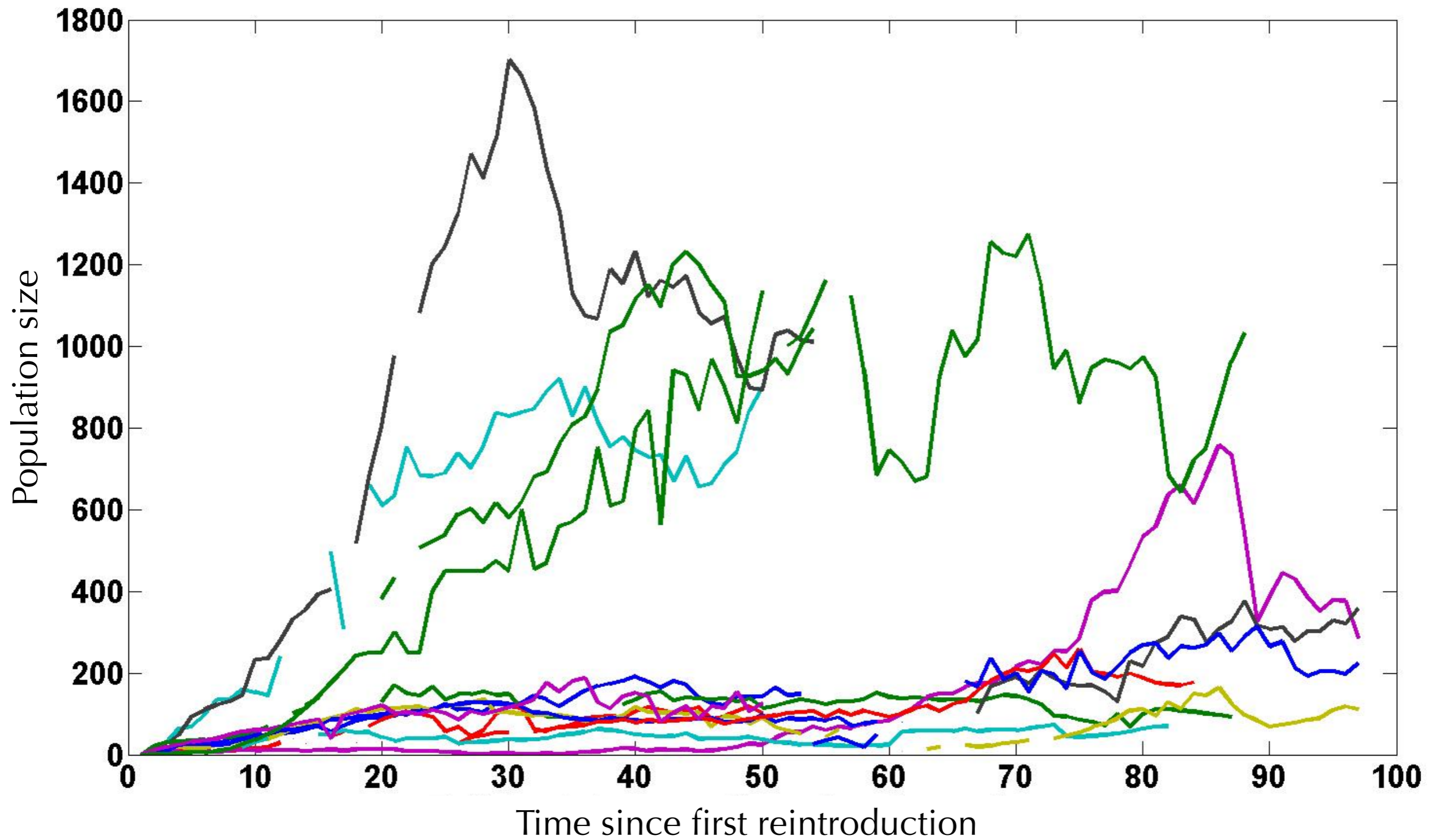


No effect of inbreeding on horn growth

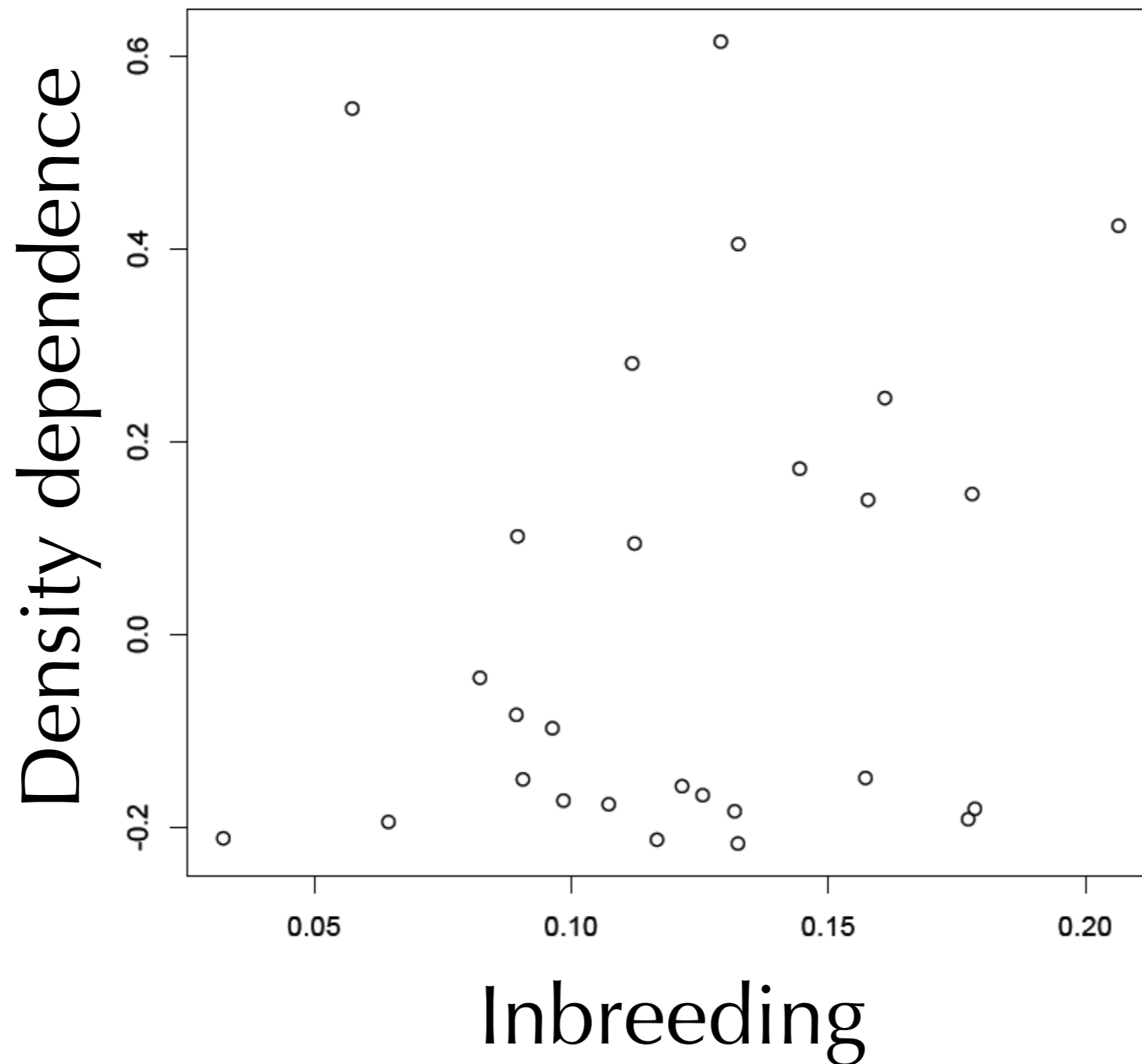
Significant effect of genotype at MHC (immune gene) on horn growth of male ibex older than ~6 years.

(Anina Knauer)

Population size over time



Inbred populations react stronger to changes in density

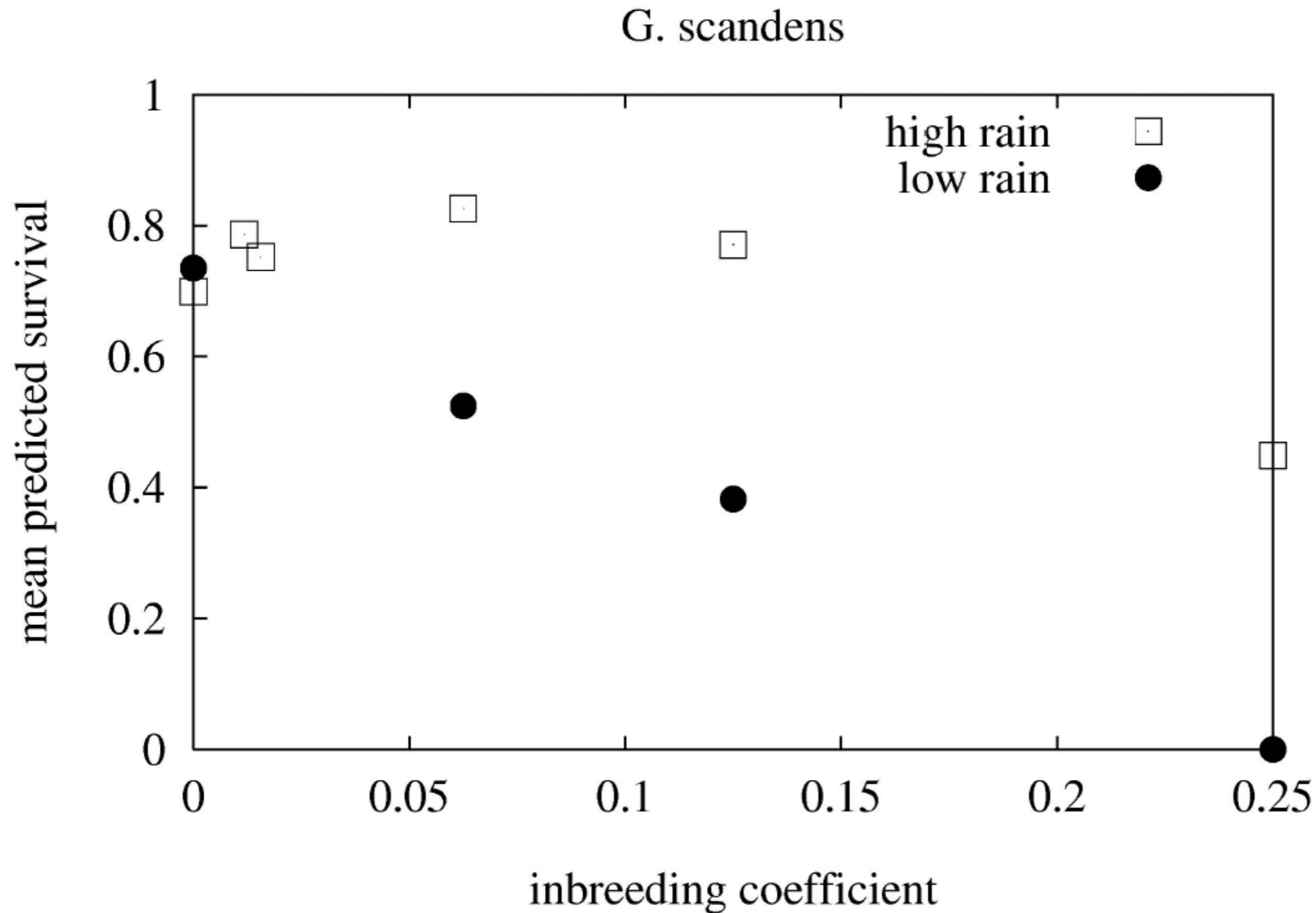


(Claudio Bozzuto)

Inbreeding in variable environments

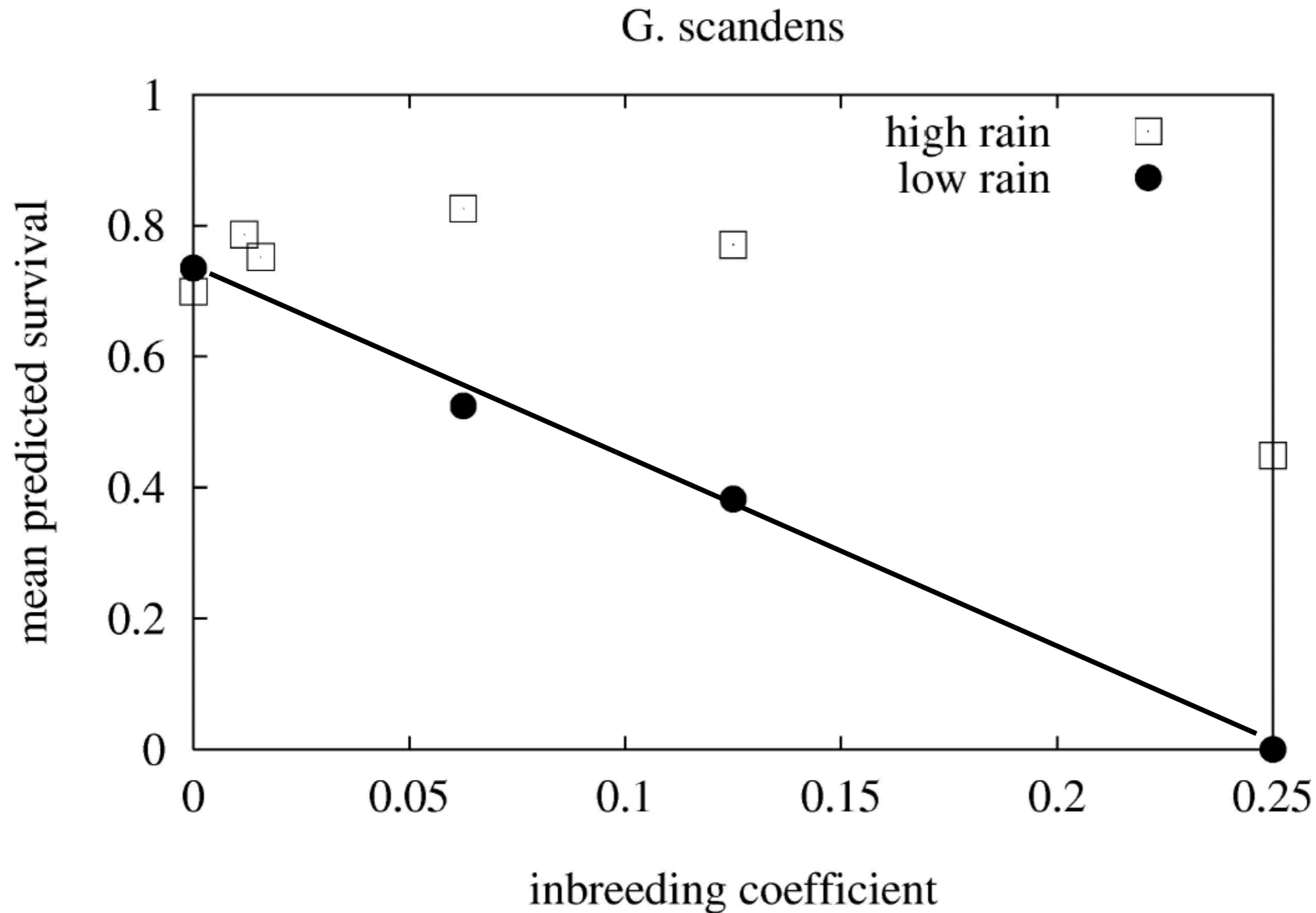


Inbreeding in variable environments



(Keller et al. 2002,
Evolution)

Inbreeding in variable environments

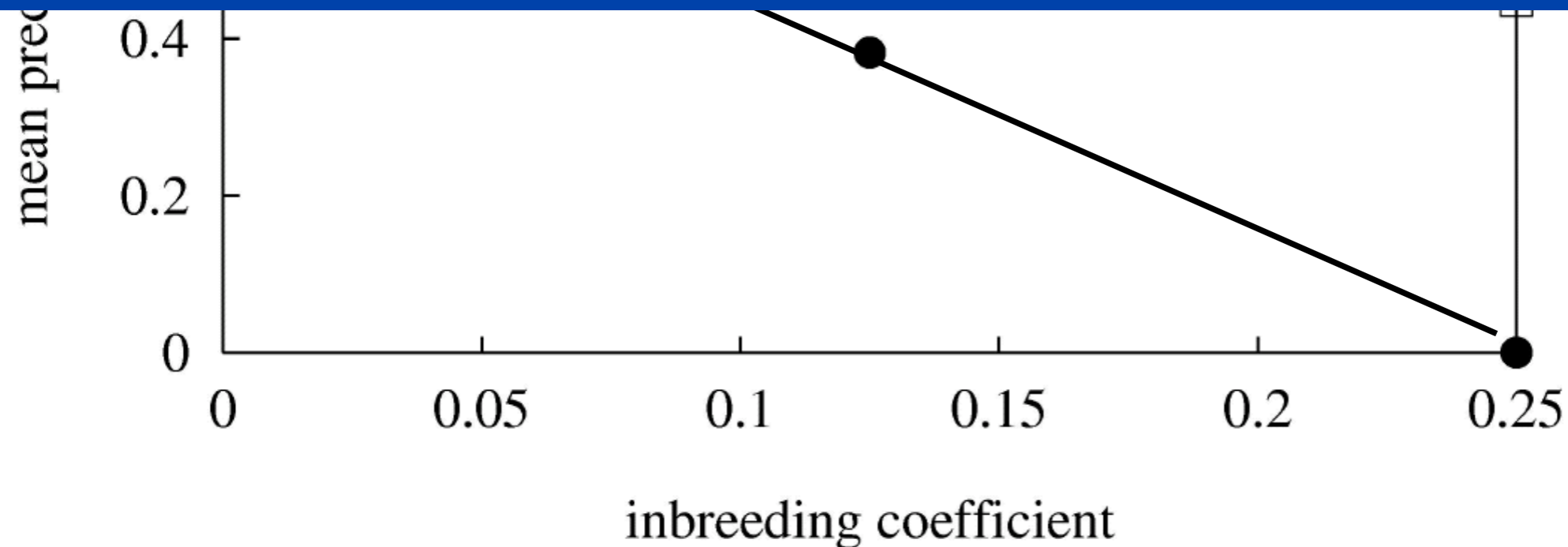


(Keller et al. 2002,
Evolution)

Inbreeding in variable environments

G. scandens

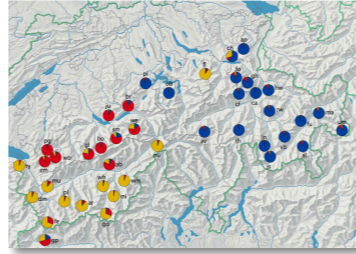
Extent of inbreeding depression depends on environmental conditions



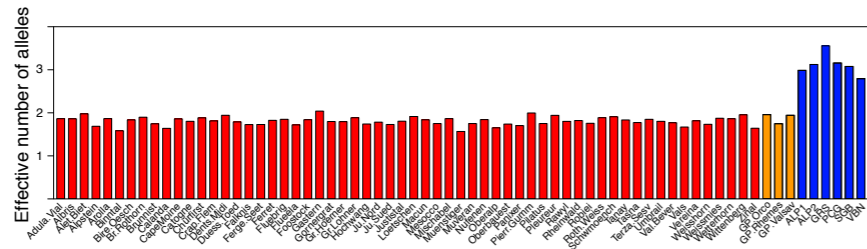
(Keller et al. 2002,
Evolution)

Summary

Strong genetic footprint of the reintroduction history in Swiss Alpine ibex populations



Genetic variation (also at the MHC) is low and inbreeding is high



No effect of inbreeding but significant effect of genotype at MHC on horn growth



Populations with particularly high inbreeding show stronger density dependence

What do we learn for future translocations?

Many individuals should be released (better 100 than 10)

Translocate individuals from several different source populations

Take into account genetic relatedness among founder populations



Thank you!

Lukas Keller
Iris Biebach

Christian Willisch
Anina Knauer
Claudio Bozzuto

Game keepers and
Jagdinspektorate

Achaz von Hardenberg
Flurin Filli

Heinz Maag



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
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